

Computers & Electronics

JANUARY 1984

\$1.75

A SCANNING MONITOR FOR PERSONAL COMPUTERS

HEATH'S 16-BIT COMPUTER TRAINER

LEARNING ASSEMBLY LANGUAGE FOR THE IBM-PC

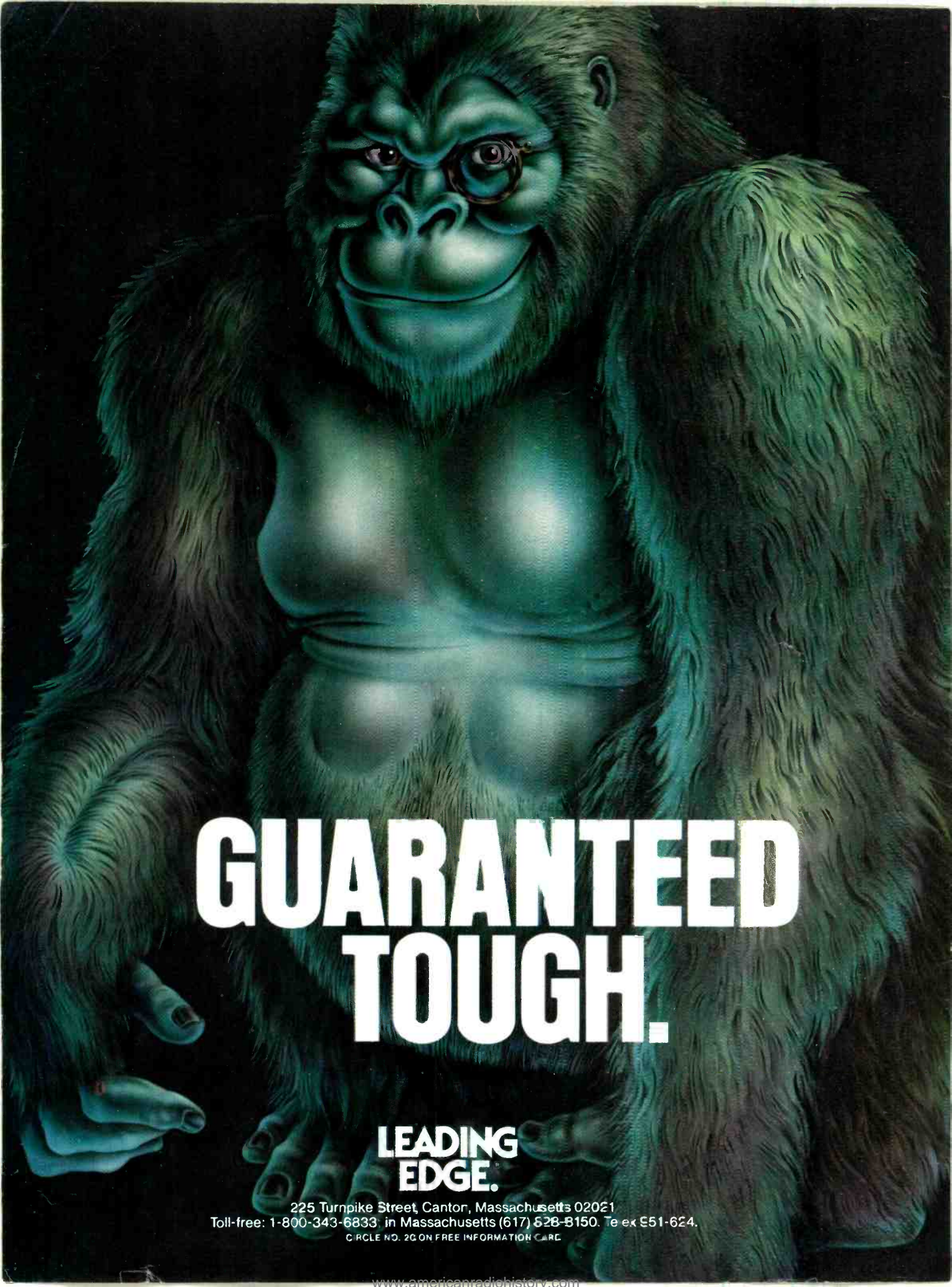
WHAT'S NEW IN CP/M?

Meet jr.

**IBM'S
NEW
BABY**



*****5-DIGIT 60506
390736 DHM 09976093 PAID SEP84
MRS EDNA DAHM
997 GRAND AV
AURORA IL 60506
01*RK



GUARANTEED TOUGH.

**LEADING
EDGE.**

225 Turnpike Street, Canton, Massachusetts 02021
Toll-free: 1-800-343-6833 in Massachusetts (617) 528-8150. Telex 551-624.
CIRCLE NO. 26 ON FREE INFORMATION CARD

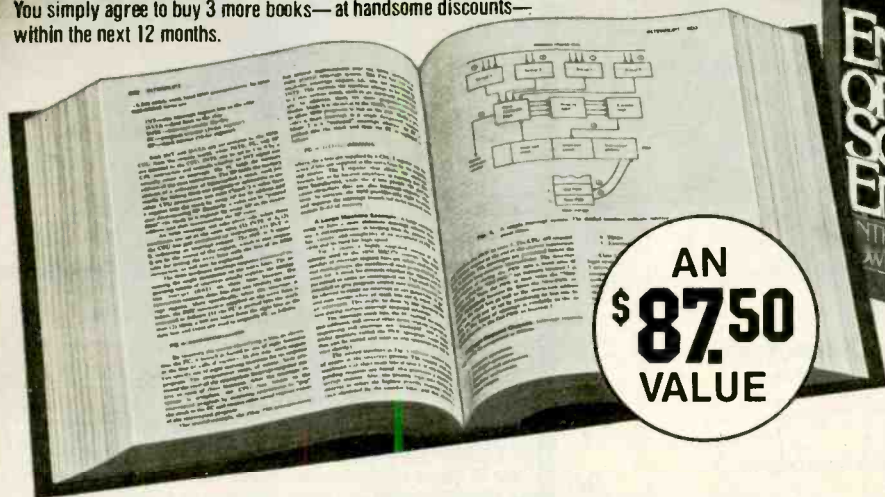
THE MOST COMPLETE COMPUTER INFORMATION RESOURCE

THE NEW ENCYCLOPEDIA OF COMPUTER SCIENCE AND ENGINEERING

IS YOURS FOR ONLY \$2.95!

WHEN YOU JOIN THE LIBRARY OF COMPUTER AND INFORMATION SCIENCES

You simply agree to buy 3 more books—at handsome discounts—within the next 12 months.



Thoroughly revised, updated and reorganized.

AN \$87.50 VALUE

This up-to-date Second Edition contains:

- Over 1,670 pages of revised, expanded, and updated text
- 550 articles on virtually every aspect of the computer sciences
- Written by 301 distinguished authorities
- Profusely illustrated with over 500 photos, and over 250 diagrams, graphs and charts

Indispensable to consultants, business people, data processing professionals, and enthusiasts, the ENCYCLOPEDIA OF COMPUTER SCIENCE AND ENGINEERING is a veritable data base of information on:

- Hardware
- Software
- Programming languages
- Artificial intelligence
- Computer applications
- Personal computing and much more!

The Encyclopedia is organized to make finding and using its wealth of information an ease. Articles are alphabetically arranged and are cross-referenced to related articles and to specific subject matter. The clear and expanded appendices include abbreviations, acronyms, special notation and terminology, as well as numerical tables, the mainstay of applied technologies. A complete 5,000-term index contains

references to sub-categories, doubles as a computer science dictionary, and is an invaluable tool for locating specific information.

Praise For the First Edition:

Called "Impressive... comprehensive... well done" by *Datamation*, and "...a real treasure cache" by *Business Management*, the new Second Edition promises to eclipse *Computer Management's* statement on the original of "There isn't another book like it." Send for your free 10-day trial.

The Library of Computer and Information Sciences is the oldest and largest book club especially designed for the computer professional. In the incredibly fast-moving world of data processing, where up-to-date knowledge is essential, we make it easy for you to keep totally informed on all areas of the information sciences. In addition, books are offered at discounts up to 30% off publishers' prices. Begin enjoying the club's benefits today!

MEMBERSHIP BENEFITS: In addition to getting the Encyclopedia of Computer Science and Engineering for only \$2.95, when you join, you keep saving substantially on the books you buy. Also, you will immediately become eligible to participate in our Bonus Book Plan, with savings up to 70% off the publishers' prices. At 3-4 week intervals (16 times per year) you will receive the Book Club News, describing the coming Main Selection and Alternate Selections, together with a dated reply card. If you want the Main Selection, do nothing and it will be sent to you automatically. If you prefer another selection, or no book at all, simply indicate your choice on the card, and return it by the date specified. You will have at least 10 days to decide. If, because of late mail delivery of the News, you should receive a book you do not want, we guarantee return postage.

The Library of Computer and Information Sciences

(the oldest and most respected computer book club in the world) 7-CG3
Riverside, New Jersey 08075

Please accept my application for trial membership and send me the Encyclopedia of Computer Science and Engineering (44904) for \$2.95. I agree to purchase at least three additional Selections or Alternates over the next 12 months. Savings range up to 30% and occasionally even more. My membership is cancelable any time after I buy these three books. A shipping and handling charge is added to all shipments.

No-Risk Guarantee: If you are not satisfied—for any reason—you may return the Encyclopedia within 10 days and your membership will be canceled and you will owe nothing.

Name _____

Name of Firm _____
(If you want subscription sent to your office)

Address _____ Apt. _____

City _____

State _____ Zip _____
(Offer good in Continental U.S. and Canada only. Prices slightly higher in Canada.) Computer & Electronics 1/84

Computers & Electronics

JANUARY 1984

VOLUME 22, NUMBER 1

FEATURE ARTICLES

38 IBM'S PEANUT: A PC IN A JUNIOR-SIZE PACKAGE
George Mitchell/Compatibility with PC Senior and some innovations.

48 BEARCAT COMPUSCAN/2100 SCANNING RECEIVER
Joe Desposito/Interfacing a microcomputer with a radio.

56 WHAT'S NEW IN THE CP/M WORLD?
Josef Bernard/An up-to-date look at microcomputing's most widespread DOS.

59 C & E INTERVIEWS DIGITAL RESEARCH

62 NEW HEATHKIT/ZENITH 16-BIT LEARNING COMPUTER
Joe Desposito/A powerful combination for "hands-on" self instruction.

67 GETTING STARTED IN PERSONAL COMPUTING
Al Burawa/How they work and choosing what you need.

77 AN ATARI TAPE INTERFACE
Randy Carlstrom/Offers reliable and inexpensive program loading on standard cassette recorders.

82 ASSEMBLY LANGUAGE PRIMER FOR IBM PC: FEATURING THE 8088 MICROPROCESSOR
Robert Lafore

92 CONVERTING PROGRAMS FOR VIC-20, PET, AND C-64 COMPUTERS
Ron Gunn/Tricks and knowledge to make your programs transportable.

COLUMNS

24 BITS & BYTES/Sol Libes

26 LES SOLOMON ON COMPUTER HARDWARE
How Computers Create Color.



34 COMPUTER VIDEO GAMES

THE ELECTRONICS SCIENTIST
96 *Forrest M. Mims, III/Rediscovering the Transistor, Low-Cost Radio Control/Adding an Output Interface to a Digital Timer/ A New Fiber-Optic Breakthrough.*

DEPARTMENTS

6 EDITORIAL
Art Salsberg/And The [Computer] Beat Goes On

7 LETTERS

12 NEW PRODUCTS

111 COMPUTER MART/ELECTRONICS CLASSIFIED

120 ADVERTISER'S INDEX

COVER PHOTOGRAPH BY GARRY HEERY

COPYRIGHT © 1983 BY ZIFF-DAVIS PUBLISHING COMPANY. All rights reserved. Computers & Electronics (ISSN 0032-4485) January 1984, Volume 22, Number 1. Published monthly by Ziff-Davis Publishing Co., at One Park Ave., New York, NY 10016. Richard P. Friese, President; Selwyn Taubman, Treasurer; Bertram A. Abrams, Secretary. One year subscription rate for U.S. and Possessions, \$15.97; Canada, \$20.97; all other countries, \$23.97 (cash orders only, payable in U.S. currency). Second Class Postage Paid at Los Angeles, CA 90052 and at additional mailing offices. Authorized as second class mail by the Post Office Dept., Ottawa, Canada, and for payment of postage in cash. POPULAR ELECTRONICS including ELECTRONICS WORLD trademark registered. Indexed in the Reader's Guide to Periodical Literature. Ziff-Davis also publishes Boating, Car and Driver, Cycle, Flying, Popular Photography, Skiing, Stereo Review, Electronic Experimenter's Handbook, and Tape Recording & Buying Guide. **POSTMASTER:** Send address changes to COMPUTERS & ELECTRONICS, Circulation Dept. P.O. Box 2774, Boulder, CO 80302. Please allow at least eight weeks for change of address, enclosing, if possible, an address label from a recent issue. **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.



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

Only one disk guarantees safe passage through the torrid zone of drive heat. Maxell.

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

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

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

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

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

maxell®
IT'S WORTH IT.



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

Circle No. 30 on Free Information Card

www.americanradiohistory.com

Hello, information.

Or, how the IBM Personal Computer can bring you the world.



Modem shown not supplied by IBM.

There's a world of information just waiting for you. But to use it, study it, enjoy it and profit from it, you first have to get at it.

Yet the facts can literally be right at your fingertips — with your own telephone, a modem and the IBM Personal Computer.

Plug into the network.

The modem that plugs into your phone takes the codes your IBM Personal Computer understands and turns them into signals that can be transmitted over the phone lines.

On the other end of the phone lines are independent information services* ready for you to access from your home, school, lab or office. So, in minutes, you can tap the resources of over a thousand data bases — and plug into a world of possibilities.

Something for everyone.

At home, for example, you can shop through an electronic catalog. Access mortgage amortization and tax depreciation schedules. Study the wines of France, the foods of Italy. Find property to sell, rent, swap or share. And play hundreds of games.

At school, you can bring news into the classroom — as it happens. You can teach and learn with facts about everything from

phrase origins to plane geometry. You can also tap instructional courses and learn how to program the very IBM Personal Computer you're using.

In the lab, you can call up a wealth of mathematical and statistical programs or retrieve scientific and technological data.

In the office, you can plug into the commodities market. Read abstracts of leading publications. Even get census figures to see who's in your major market. And when you're planning a business trip, your IBM Personal Computer can provide airline schedules and car rental information, as well as tell you what the weather is and where the best restaurants are.

Calling all computers.

And these outside data bases aren't your only information link, either.

With assigned passwords, you can also have access to data that's stored in your company's IBM minicomputer or mainframe via your IBM Personal Computer.

You can even exchange a sales forecast with a manager two floors down or two thousand miles away — one IBM Personal Computer to another.

So the IBM Personal Computer really *can* let you call the world. But there's one call to make first. For more information on where to buy the IBM Personal Computer, call 800-447-4700. In Alaska or Hawaii, 800-447-0890.

IBM[®]

The IBM Personal Computer

A tool for modern times

*Information services are available by subscription at additional cost, and are not supplied by IBM.

WILLIAM S. DAVID *Publisher*

ARTHUR P. SALSBERG *Editorial Director*

LESLIE SOLOMON *Technical Director*

JOHN R. RIGGS *Managing Editor*

JAMES KIEHLE *Art Director*

A. W. BURAWA *Senior Editor*

JOSEPH DESPOSITO *Technical Editor*

JOSEF BERNARD *Technical Editor*

ANDRE DUZANT *Technical Illustrator*

ROBERT LASCARO *Assistant Art Director*

CARMEN VELAZQUÉZ *Production Editor*

JEFF NEWMAN *Editorial Assistant*

Contributing Editors: Walter Buchsbaum, Len Feldman, Julian Hirsch, Sol Libes, Forrest M. Mims, III

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

Advertising Sales Offices

New York
Tom Ballou 212 725-3578
Ken Lipka 212 725-3580

Midwestern

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

Western

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

Representation in Japan

J.S. Yagi, Iwai Trading Co., Ltd. 603 Ginza Sky Heights Bldg., 18-13, Ginza 7-Chome, Tokyo, Japan 104

Consumer Computers & Electronics Magazine Division

Larry Sporn *President*
Jeff Hammond *Vice President, Marketing*
Carole Mandel *Vice President, Circulation*
Eileen G. Markowitz *Vice President, General Manager*
Seth Alpert *Editorial Director*
Peter J. Blank *Creative Director*

Ziff-Davis Publishing

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

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

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.



And the [Computer] Beat Goes on

HERE it is fully two months before the New Year, though our production lead time forces me to write for our initial 1984 issue. As you all know by now, IBM's "Peanut" was unshelled as the "PCjr." A telephone call by an IBM representative alerted us to its public unveiling a day before it was to happen.

The happening was smoothly professional. A bevy of working PCjr's were on hand, manned (womanned?) by IBM'ers who demonstrated how the machine performed with a handful of software packages developed outside the company. The color graphics were vivid and sharp; the wireless keyboard worked beautifully; and IBM should be pleased as punch by the attendant publicity, which it rightly earned.

Other computer makers should count their blessings, too. Firstly, the PCjr is not a low-cost machine. Thus, it is certainly not a mass-market system. Accordingly, you won't see this machine on the discount shelves of Toys 'R Us and other such mass merchandisers. IBM doesn't like to lose control, you know. So this leaves plenty of room for the Commodores, Apples, Radio Shacks, and others to compete. It also settles the stomachs of computer aftermarket makers who will, doubtlessly, introduce a host of devices to make the machine better, such as a substitute keyboard with better keypads.

The year 1983 might go down now as the year in which Christmas buying habits were ignored since PCjr's won't be available until the first quarter of '84, and then not enough to satisfy demands. Coleco, too, appears to be looking toward the New Year for its biggest sales. As a result, one wonders how other personal computer sales will fare around the biggest traditional selling season?

Will there be a really big freeze as buyers take a wait-and-see attitude?

None of the biggies in the home computer market have been knocked off, in my opinion, by the introduction of the Junior. Texas Instruments' 99/4A fell by the wayside before its debut. In fact, the machine was really terminal for a long, long time. Not because it is not a good computer. It's terrific! But it started life on the wrong side of the tracks.—an \$1100 price tag for the basic machine, ultra-costly peripherals, an arrogant "we don't have to advertise, our name is Texas Instruments" attitude, and shutting out third-party hardware and software makers by not making an open bus available. It recognized its mistakes too late. Right now, the 99/4A is probably the buy of the decade.

So new microcomputer makers are entering the field, dropping by the wayside, and modifying their wares. The goal: a good slice of a projected \$92-billion market in 1992.

Where does this leave you in making a personal-computer buying decision? Right in the middle, I'm afraid! This is a maturing market with all the attendant fluctuations. Innovative new products will constantly be introduced to tantalize you. This aside, you'll really have to decide which part of the market you should be in: office use, home use, travel use, school use. Reaching this conclusion is the easiest of all, of course. Beyond this point, there are numerous avenues to explore, which we will cover editorially as the months go by.

The entry of the PCjr in 1984, however, adds an important element into the mix—another standard operating system. But a major one that will drive other computer makers to adopt it, just as the IBM PC small business computer forced others to follow suit in this field. And with the Junior's degree of upward compatibility with the more powerful, larger IBM PC, this could well lead the microcomputer industry closer to the single major operating system standard that's always been considered to be wishful thinking. Given this, I would guess that Japan would start moving in less costly home computers that are compatible with PCjr, abandoning the MSX standard they fostered.

LETTERS

COMPUPHOBIA

Your editorial on the fear of computers in the September issue was really to the point as far as I was concerned. It expressed most of the reasons I did not buy the computer system for which I went shopping last month.

There's no way I can spend that much money unless I know what I am buying. However, none of the employees of the four dealers I visited could speak about computers without throwing out meaningless (to me) jargon; none could tell me if Texas Instruments' computer could be used with the Com-Star printer; and none could tell me just what a specific item of software was about.—*Jim Hyde, Waycross, GA.*

PERFECT WRITER MEMORY

In your review of the Kaypro II computer in the June 1983 issue, it was stated that Perfect Writer's "virtual memory" feature enables the computer to handle word-processing files larger than its 64K memory. This is not true. Kaypro's version of Perfect Writer is capable of editing files no larger than

about 50K or 50 pages (depending on your definition of a "page"). The practical limit—that is, the size that permits rapid editing, saving, etc.—is only 20 pages.—*A. S. Pfeffer, Kunming, Yunnan, People's Republic of China.*

MAIL-ORDER 2068

In the article on the Timex Sinclair 2068 computer (November, p. 69), it was stated that one mail-order house planned to offer the computer for \$148.32. Whom did he have in mind? Sears Roebuck quotes me \$179.99.—*S. S. Whiting, Pittsburgh, PA.*

Best Products, PO Box 25031, Richmond, VA 23260, Catalog page 386, #150002RDM.

PETER NERO

I enjoyed your article about Peter Nero and his use of a personal computer in his artistic and business life. You (and he) might be interested to know that there is, indeed, a Music Printing Option, which can be attached to the Synclavier II Digital Music System to produce printed scores from music played into the system's digital recorder through a real-time keyboard. The Synclavier II (New England Digital Corp., White

River Junction, VT 05001) also includes a 16-bit, 128-Kb computer and a 640 × 480 video terminal.—*Frank Benoit, Boston, MA.*

H/Z AND IBM COMPATIBILITY

I was happy to see the review of the Heath-Zenith-100 in your October issue. This is an excellent machine that has been too long neglected in the press.

It should be noted that it is not true that the Zenith and IBM are totally software incompatible. The Zenith will read directories from all IBM disks that I have had a chance to try. It will read and can use all data files. Most programs require some modification. However, I have one program written for the IBM in compiled BASIC that the Zenith was able to run with no problems. Another IBM program written in Interpretive BASIC was run by the Zenith after first loading it into the IBM, then saving it in ASCII format.—*Erick Smith, Brooktondale, NY.*

OUT OF TUNE

In "A DC Motor Speed Controller" (October, p 57), Figs. 4 and 7 were inadvertently interchanged, as were Figs. 5 and 8.



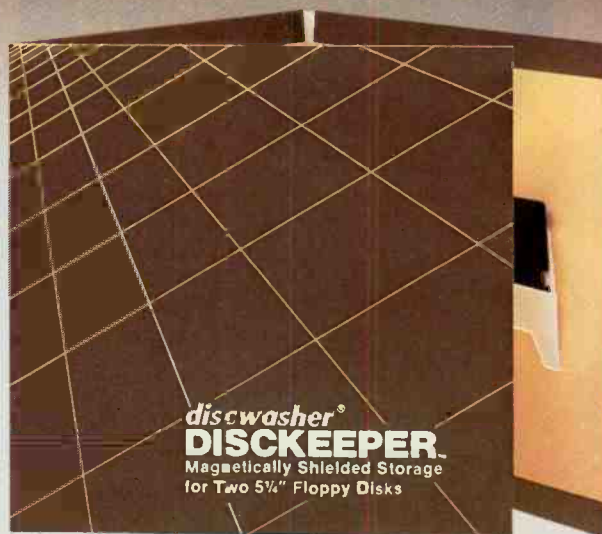
Data Lost

Magnetism is a most destructive force to any magnetic media. Even something as simple as a magnetic paper clip holder is capable of erasing valuable data stored on a floppy disk.

The Discwasher® Disckeeper™ is a magnetically shielded storage system for floppy disks. Disckeeper protects disks against stray magnetic fields from printers, peripheral motors, CRT's, telephone ringers, airport security systems...and even paper clip holders.

Discwasher Disckeeper...for the transportation and storage safety of your important disks.

Disckeeper is no larger than conventional folder packs and is available in three sizes: storage for two-5 1/4" disks, four-5 1/4" disks or two-8" disks.



Data Protected

discwasher 1407 North Providence Road, P.O. Box 6021, Dept. CE, Columbia, MO 65205 USA A DIVISION OF JENSEN an ESMARK Company

Everybody's making money selling microcomputers. Somebody's going to make money servicing them.

Now NRI Trains You At Home To Make Money Servicing, Repairing,
and Programming Personal and Small Business Computers



Learn At Home to Service Any Computer

NRI can train you for this exciting, rewarding field. Train you at home to service not only microcomputers, but word processors and data terminals, too. Train you at your convenience, with clearly written "bite-size" lessons that you do evenings or weekends, without going to classes or quitting your present job.

Your training is built around the latest model of the world's most popular computer. It's the amazing TRS-80™ Model 4, now with disk drive and the capabilities and features to perform a host of personal and business functions. No other small computer has so much software available for it, no other is used and relied on by so many people. And it's yours to keep for personal and business use.

You get plenty of practical experience. Under NRI's carefully planned training, you even install a *disk drive*

as an alternative to the Model 4. The same technique for getting inside is enhanced by using the new NRI-developed Computer Access Card. Only NRI offers you a choice to fit your specific training needs.

Become the Complete Computer Person

In addition to training in BASIC and advanced machine language, you gain hands-on experience in the operation and application of the latest computers for both business and personal jobs. You're trained to become the fully rounded, new breed of technician who can interface with the operational, programming, and service facets of all of today's computers. You're ready to take your place in the new electronic age.

Other Opportunities

NRI has been giving ambitious people new electronic skills since 1914. Today's offerings also include TV/Audio/Video Systems servicing with training on our exclusive Heath/Zenith computer-programmable 25" diagonal color TV... Industrial Electronics, Design Technology... and other state-of-the-art courses.

Training now includes either the TRS-80 Model 4 Microcomputer with *Disk Drive* or the TRS-80 Color Computer with Computer Access Card; professional LCD multimeter; the NRI Discovery Lab; and hundreds of demonstrations and experiments.

Seems like every time you turn around, somebody comes along with a new computer for home or business use. And what's made it all possible is the amazing microprocessor, the tiny little chip that's a computer in itself.

Using this new technology, the industry is offering compact, affordable computers that handle things like payrolls, billing, inventory, and other jobs for business of every size... perform household functions including budgeting, environmental systems control, indexing recipes. And thousands of hobbyists are already owners, experimenting and developing their own programs.

Growing Demand for Computer Technicians

This is only one of the growth factors influencing the increasing opportunities for qualified computer technicians. The U.S. Department of Labor projects over a 600% increase in job openings for the decade; most of them *new* jobs created by the expanding world of the computer.



verifying its operation at each step. Using the NRI Discovery Lab® that also comes as part of your course, you build and study circuits ranging from the simplest to the most advanced. You analyze and troubleshoot using the professional 4-function LCD digital multimeter you keep to use later in your work. Then you use the lab and meter to actually access the interior of your computer... build special circuits and write programs to control them. You "see" your computer at work and demonstrate its power.

Same Training Available With Color Computer

NRI offers you the opportunity to train with the TRS-80 Color Computer

The Catalog is Free. The Training is Priceless.

Send the postage-paid card for our 104-page catalog showing all courses with equipment and complete lesson plans. There's no obligation other than to yourself. See how NRI can help you take advantage of the exciting job and earnings opportunities in the exploding field of microcomputers. If card has been removed, please write to us.



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

We'll give you tomorrow.

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

January 1984

11

NEW

PRODUCTS



HARD-DISK PORTABLE COMPUTER

Eagle's new Spirit XL combines a 10M hard-disk system with a portable computer that features IBM PC and XT compatibility. It incorporates extensive graphics, color monitor, enhanced standard IBM PC keyboard, 9" green video display screen, two serial and one parallel ports, 360K 5 $\frac{1}{4}$ " floppy-disk drive, monochrome/color graphics display card with composite-video and RGB outputs, and four IBM PC-compatible hardware slots. The computer is built around the 16-bit 8088 processor and has a socket for an 8087 coprocessor option. It comes with 128K (expandable to 640K) of RAM. Display resolution is 640 \times 200 pixels, and up to eight colors can be displayed on an optional monitor or eight levels of intensity on the built-in monitor. Also supplied with the less-than-33-lb portable are MS-DOS and CP/M-86. \$4795.

Circle No. 83 on Free Information Card

DAISY-WHEEL PRINTER

Data Terminals & Communications' DTC Style Writer daisy-wheel printer features a 35K (expandable to 67K) buffer and a multicopy mode that repeats printing of selected documents without having to reload the buffer from the computer. Features include: bidirectional printing; automatic proportional spacing; Centronics parallel interface; graphics plotting; two-color printing; momentary pause for paper, printwheel and ribbon changing; self-test diagnostic routine; and LED indicators for all error conditions. Options include a forms tractor, bidirectional cut-sheet feeder, 17 type fonts, buffer memory add-in, and a variety of interconnecting cables for most popular computers. \$899. Address: Data Terminals & Communications, 590 Division St., Campbell, CA 95008.



HARD-DISK DESKTOP COMPUTER



Morrow's new Model MD11 desktop computer offers 11M of hard-disk and 400K of floppy-disk storage, full-size terminal, and eight software packages for just \$2795. Hardware features of the single-board computer include: Z80 processor running at 4 MHz; 128K of RAM; 8K of ROM; 12" video screen

(80 × 24 characters); parallel Centronics port; and three serial ports. Two of the serial ports are standard RS-232C configurations; the third can be either RS-232C or any of a number of special modes, including high-speed RS-432, or mainframe-compatible modes like HDLC, SDLC, or bisyn-

chronous. Software packages supplied with the MD11 include: CP/M Plus; BASIC 80; BaZic (North Star compatible BASIC), New Word word processor; LogiCalc spreadsheet; Correct-It spelling checker; and Personal Pearl database manager.

Circle No. 85 on Free Information Card



INTELLIGENT INTERFACE FOR COMMODORES

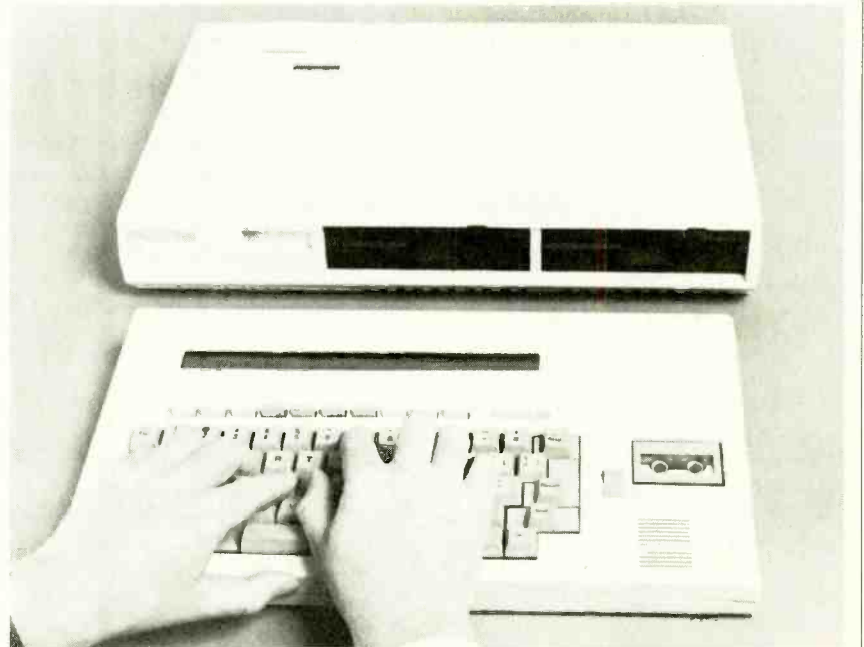
Limbic Systems' "Interpod" is an intelligent 6502-based transparent multiple interface that gives serial and parallel capabilities to VIC-20 and Commodore 64 computers. It allows the computer to communicate with all Commodore serial IEEE and IEEE-488, as well as RS-232, devices. It uses no computer memory, and use of the various I/O ports, including the cartridge slot, is not restricted. The device allows the computer to access from 1/8M to 10M mass storage on floppy disks and hard-disk systems. Plugging Interpod into the serial port also allows users to compile BASIC programs on the Commodore 4040 and 8050 drives, using PET-SPEED, and gives the VIC-20 and C-64 the capability to communicate with IEEE-based voltmeters, plotters, and other A/D peripherals. \$180. Address: Limbic Systems, Inc., 1056 Elwell Ct., Palo Alto, CA 94303.

BRIEFCASE-SIZE COMPUTER

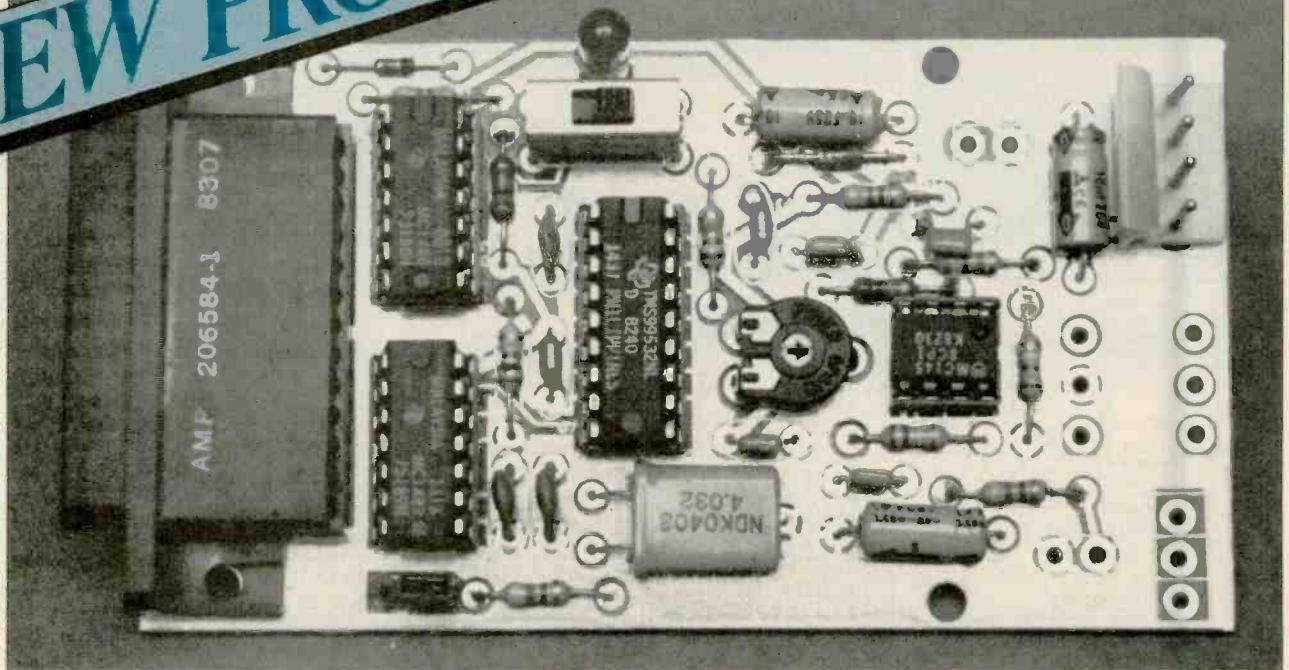
The Xerox 1810 portable computer comes with 64K of RAM, 80 × 3-character LED display, 200K microcassette recorder, direct-connect modem, serial and parallel ports, output for video monitor, TV adapter, and slot for plug-in ROM cartridges. Software includes appointment calendar, clock with alarm, four-function calculator, text editor, electronic mail, and BASIC. The 8-bit computer is CP/M compatible and, with addition of an optional Xerox 1850 flat pack can be 16-bit CP/M-86

and MS-DOS compatible. Addition of the 1850 offers dual 500K IBM PC-compatible 5 1/4" floppy-disk drives, built-in modem, parallel and serial ports for a monitor, printer/plotter, data and power links, and a facility for using an optional four-color printer/plotter. The 1850 is supplied with 128K of RAM and is expandable to 512K. Options include the Xerox 1845 dual 5 1/4" disk drive expansion unit and a briefcase designed to accommodate the 1810 computer. \$2195 for 1810, \$2495 for 1850, \$1195 for 1845, \$325 for briefcase.

Circle No. 86 on Free Information Card



NEW PRODUCTS



ORIGINATE/ANSWER MODEM

Micromint's build-it-yourself Model ECM-103 is a 300-bps modem kit based on the Texas Instruments TMS99532 FKS modem chip, which provides all

the necessary modulation, demodulation, and filtering circuitry to implement a full-duplex serial asynchronous communications link. It requires no calibration or adjustments and uses no external filtering or frequency setpoint

components. It lends itself to acoustic and direct telephone-line connection through an FCC-registered DAA. Connection to the DTE is via an RS-232C. \$60. Address: Micromint Inc., 561 Willow Ave., Cedarhurst, NY 11516.

SOFTWARE SOURCES

Low-Cost Word Processor. Commodore Software's Easy Script 64 is a full-featured word-processing software package for the Commodore 64 and SX-64 portable color computers. Easy Script 64 has the ability to interface with Commodore's Easy Spell 64 spelling checker and to transfer words, phrases, and blocks of text from one location in a document to another. It can change display colors; do global/local hunt-and-find and search-and-replace; go directly to a specified line number; insert/delete characters, words, lines, and blocks; provide sound-effects prompts; print up to 240 characters per line; edit using a special function key; do superscripting and subscripting; and transfer words and phrases. \$49.95.

Circle No. 90 on Free Information Card

Apple-IBM Connection. Alpha Software has introduced a new version of its Apple-IBM Connection program that supports the Apple IIe and additional communications cards for the Apple II family. The program enables easy transfer of data files between the Apple II

family and the IBM PC or PC-XT and is now compatible with the Apple Super Serial Card and the California Computer Systems CCS 7710 card. \$250. Address: Alpha Software Corp., 12 New England Executive Park, Burlington, MA 01803.

Equation-Solving Software. Calcu-Plot is a new software package of mathematical utilities from Human Systems Dynamics that transforms complex equations into easy-to-read graphics for Apple II and IIe computers. The program accepts data from the keyboard, disk files, and even print format VisiCalc files. Solved equations can be plotted one at a time or in sets of two or three, all on the same graph. The program can create sequential disk files that can be used with all other software products offered by the company. To be able to use Calcu-Plot, the computer must have 48K of RAM, Applesoft in ROM, and one or two disk drives. \$150. Address: Human Systems Dynamics, 9010 Reseda Blvd., Suite 222, Northridge, CA 91324.

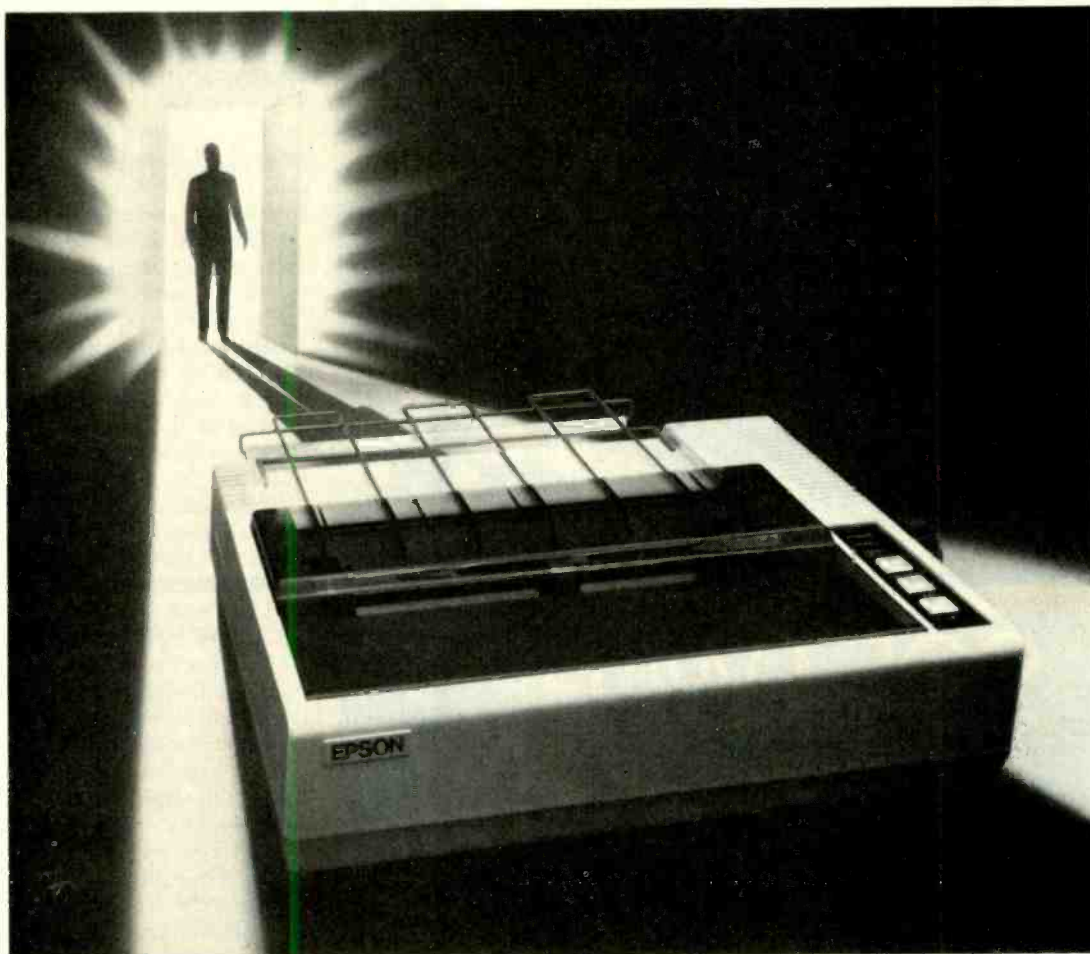


CP/M- AND APPLE-COMPATIBLE PORTABLE

The Abacus portable computer from CompuSource comes standard with Apple and CP/M compatibility and can optionally be made IBM PC compatible. Hardware features include: full-size keyboard with auto repeat, 64K of dynamic and 16K of static RAM, either one or two 5 1/4" floppy-disk drives, five Apple-compatible I/O slots (expandable to seven slots), game paddle port, composite-video and r-f outputs, and high- and low-resolution graphics. \$1645 for single-drive unit, \$1995 for dual-drive unit, \$400 for IBM option.

Circle No. 87 on Free Information Card

Introducing the new RX-80.



A printer this good
could only come from one company.

Epson.

Take a look at the new Epson RX-80 with a critical eye and you'll know what we mean. Epson printers are put together with manufacturing tolerances in the micron range. And meticulously checked for quality — one at a time.

Our reliability rate is approaching perfection. Which means you'll probably never — ever — have a problem with your RX-80.

A real Epson for only \$299.

For a limited time, you can get the RX-80 for only \$299. But just because we made it affordable doesn't mean we've left off the goodies. You get 128 different typestyles with a resolution so sharp you have to look twice to make sure it's dot matrix. You get bidirectional printing, logic seeking, and a speed of

100 characters per second. And you even get programmable forms control, graphics, and a special Quiet Mode to keep the noise down.

This is your printer.

No matter what computer you own — or will own — do yourself a favor and make sure your printer is an Epson RX-80.

We build them to be the finest printers on earth. No matter how small the price.

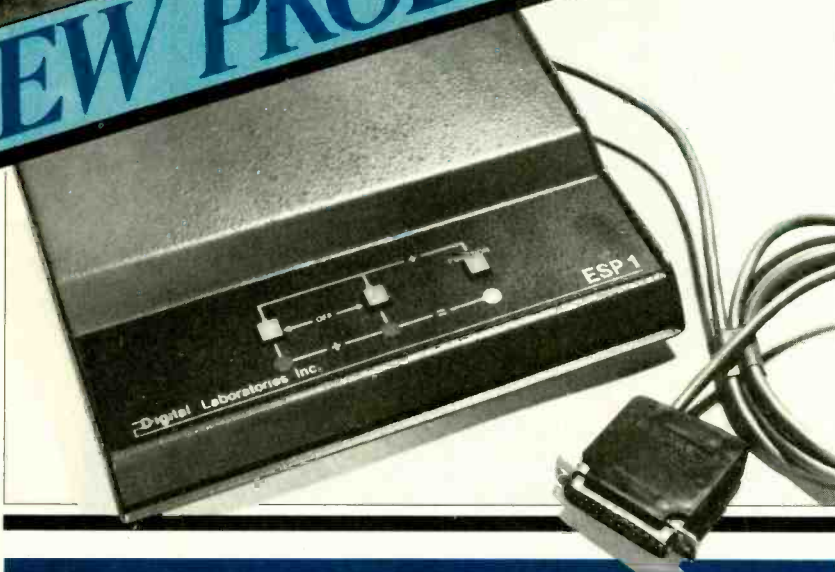
Number one. **EPSON**
And built like it. EPSON AMERICA, INC.

3415 Kashiwa Street, Torrance, CA 90505

Please call (800) 421-5426 for the dealer nearest you. In California (213) 539-9140

Circle No. 25 on Free Information Card

NEW PRODUCTS



PROGRAMMABLE PORT EXPANDER

A low-cost RS-232C A-B-C-D switch that operates under software control or via manual override has been introduced by Digital Laboratories. The Model ESP-1 port expander creates four RS-232C serial ports from one and permits instant switching to different serial peripherals, using two-character instructions (prefix followed by a port designator). It switches four lines per port and can be cascaded to operate unlimited ports. The 8" x 6" x 1.8" device consumes 5 watts. It comes with a 4-ft RS-232C DTE cable equipped with 25-pin connector. \$395. Address: Digital Laboratories, Inc., 148 Linden St., Suite 105, Wellesley, MA 02181.

SOFTWARE SOURCES

Telecommunications Software.

Source Telecomputing Corp. is marketing a new telecommunications software product called Sourcelink that simplifies use of its electronic service, The Source. The Sourcelink disk provides automatic dial-up and sign-on procedures; direct access to the various services on The Source, through the software or by programming the IBM PC's function keys; simultaneous capture of data from The Source into the IBM PC's memory or onto a disk; ability to turn on/off a printer while using The Source; and simplified transfer of data from IBM PC disks to files on The Source or from The Source files to the computer's memory or disks. Additional features include an editor; ability to automatically dial up as many as five other on-line services; and optional use of color graphics for IBM PCs equipped with 128K of RAM and 4- or 16-color graphics board. \$149.95, includes membership to The Source.

Circle No. 91 on Free Information Card

Precompiler for BASIC. Software 128's MetaBASIC is a comprehensive precompiler for interpreter BASIC. It permits large BASIC programs to be developed in modular fashion with "real" subroutine calls (not GOSUBs) to other BASIC program modules. Full argument passing is supported, and subrou-

tines can be nested to any level. MetaBASIC also supports Named Global Common, Data Declaration, Structured Conditional Program Control, and Simplified File I/O using Record Data Constructs. Its Program Compression feature allows interpreter BASIC programs to be written in a structured fashion with liberal use of descriptive remarks without slowing program execution or making file sizes excessive. MetaBASIC is available for the IBM PC for both interpreter and compiler BASIC. \$59. Address: Software 128, 363 Walden St., Concord, MA 01742.

English Tutor. T.H.E.S.I.S. has announced a new English grammar program for grades 2 through adult. A two-disk program can create students' disks for use in a variety of educational settings. The student disk can be used as a drill for any combination or all parts of speech and can be set to use a specified number of sentences in each session. Sentences can be modified by teacher or parent to match the reading level of the student. Students' results are stored on disk for viewing by teacher or parent. The program is written to work on Apple II+ and IIe computers. \$45.00 plus \$3.00 S/H. Address: T.H.E.S.I.S., PO Box 147, Garden City, MI 48135.

(More on page 22)

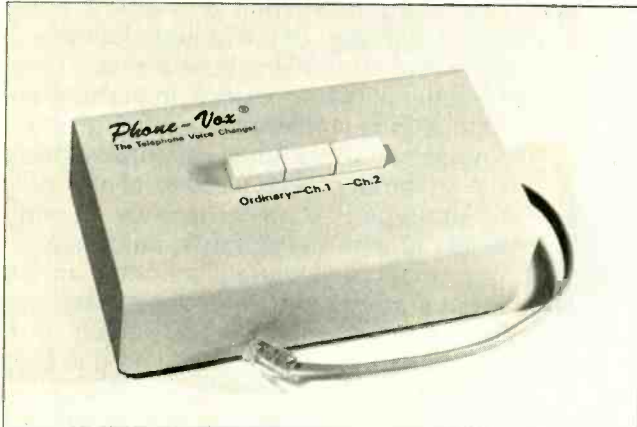
VOLTAGE SPIKE PROTECTOR

General Electric's new Voltage Spike Protector is designed to protect sensitive electrical devices from the effects of high-voltage surges. Rated at 15 amperes, the single-outlet protector plugs between the device to be protected and any three-wire 117-volt ac power outlet. Protection is provided by a GE MOV varistor, which clamps the potential being delivered from the ac line to the device being protected to a safe level below 600 volts. Power from excessive voltage is harmlessly dissipated as heat. Address: General Electric Co., 316 E. 9 St., Owensboro, KY 42301.



Two New Products—

Turn Your Phone into James Bond



The Telephone Voice Changer

The telephone voice changer gives you a new voice even you yourself wouldn't recognize.

Push a button then call your mother.

Not an "electronic hankerchief" that muffles or filters your voice, the VOICE CHANGER completely restructures the tone and timber. It literally changes the quality of sound.

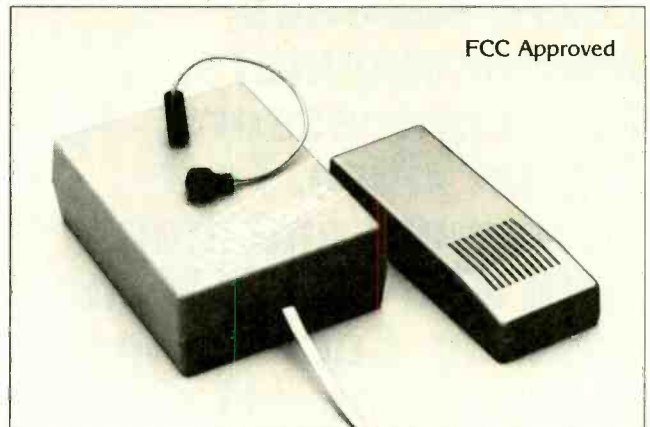
This is the new, improved model that completely eliminates distortion as it changes your voice. Your own mother would swear it's a stranger calling.

Choose from two separate, distinct Changer Channels. Pushing "Channel 1" changes timber and texture. Pushing "Channel 2" creates a second. 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 for just plain fun. Anytime you like, during a conversation, push the "ordinary" button and the other person will hear your normal voice.

Compare our unit with others selling for hundreds of dollars more. Low introductory price:

\$129.95. Two for only **\$109.95** each.



What's Going On at Home or the Office When You Aren't There?

The Informer

Turns your phone into an open ear.

You're away from home when a premonition grabs you. Is the baby asleep, or is he squalling?

From any phone in the world, call home. Use the special "beeper". The Informer opens its super-sensitive microphone and transmits to you, wherever you are, every sound in the room, up to 100 feet away from the phone.

The Informer is **not** a gadget. It's an FCC-approved electronic instrument, small (3" x 4") but incredibly powerful. Connect it in a few seconds with its standard modular phone plug. No one will see it, but it will pick up every sound in the room, even whispers.

Get one for—

- an elderly relative, so you can check during the night, to be sure all is well.
- your office, so you can investigate strange lights and noises without having to go inside.
- your second home, in-town apartment, or mountain cabin, so you can make occasional "Is all well?" calls.

See for yourself this incredible device. Order now at our special low price:

\$149.95. Two for only **\$129.95** each.

TRY IT AT OUR RISK

Order now the Telephone Voice Changer or the Informer. Try it for 30 days. If you decide you don't want it, send it back for complete refund. We'll bet, though that after 30 days you'll want several more.

NEW HORIZONS

Dept. C1

5-31 Fiftieth Avenue
Long Island City, NY 11101
TELEX: 4993183 HORIZONS

© 1983 New Horizons

For fast service on credit card orders call **NOW** toll-free:

1-800-453-9600

IN UTAH CALL 1-800-662-2500

For information call: (201) 370-1234 or use coupon below:

- Telephone Voice Changer \$129.95 / Two only \$109.95 ea.
 The Informer \$149.95 / Two only \$129.95 ea.
+2.75 per total order for shipping

VISA MASTERCARD # _____ Exp. Date _____

Name _____

Address _____

City _____ State _____ Zip _____

Circle No. 17 on Free Information Card

NTS Electronics

Learn Robotics, Microcomputers, Microprocessors, Digital Video, Test Equipment and more with NTS INTRONIC™ home training. Courses include state-of-the-art equipment, lessons and texts to make your hands-on programs exciting and down-to-earth practical.

HERO 1 is included in two courses, one basic and one advanced. You'll cover principles of industrial electronics, microprocessor troubleshooting, fundamentals of mechanics, and robotic applications in industry. You'll learn analog and digital skills, radio control, fluidic, pneumatic and servo-mechanisms, as well as computer interfacing and robotic programming. HERO 1, complete with arm, gripper and speech synthesis board, is a fully self-contained electro-mechanical robot—the featured unit in the most exciting training programs ever offered in home study.

NTS Intrinsic Training is a carefully developed and tested learning system providing a thorough intergration of advanced electronic hardware with modern lesson texts. The relationship between theory and practical applications is made clear through the hands-on experience of building and assembling kits of state-of-the-art equipment. Courses include a wide variety of test instruments, both digital and analog, as well as other units not shown here. And, depending on the NTS program you select, you can earn up to 30 CEU credits for successful completion. Our full-color catalog has complete details. NTS has taught industrial skills for over 78 years—a record that has no equal.



Training.....

FIRST WITH TOMORROW'S TECHNOLOGY

1. **Advanced "Z Chassis" NTS/HEATH "Smart Set"** with computer space command remote control and space phone. Originate or receive telephone calls through this set and the number appears on the screen-store your police and other emergency numbers into memory which may be recalled and auto-dialed at any time. Traditional and incomparable picture quality. Unit has Quartz Controlled Tuning, 178 channel capacity, remote antenna switch accessory for reception of VCR, VDR, Broadcast, Cable, Video Games, and Personal Computer Input (no cable change) plus computer-controlled color. Featured in all-new Video Technology Course.

2. **NTS/HEATH HN89A Microcomputer** is included in two programs. This famous and reliable unit features Floppy Disc Drive, 48K Memory on Board, CRT Terminal with its own Z-80 Processor, and standard keyboard as well as Numerical Input Keyboard. The growing importance of computer knowledge and skills have made these programs increasingly significant. The experience gained in assembling these kits is invaluable in the understanding of computer troubleshooting skills.

3. **NTS Microprocessor Trainer** is included in our Industrial and Microprocessor Technology Course. It is a portable unit, contained in a convenient high-impact carrying case. Hardware/Firmware includes Monitor Operating System-Expandable User Memory-User Experimental On-Board Section-Breakpoint Editor-Single Step Trace-Cassette I/O.



NO OBLIGATION NO SALESMAN WILL CALL



TECHNICAL TRADE TRAINING SINCE 1905
Resident and Home-Study Schools
4000 So. Figueroa St., Los Angeles, CA 90037

Use the mail-in card or fill out and mail the coupon. Indicate the field of your choice. (One, only please.) FREE full color catalog will be sent to you by return mail.

NATIONAL TECHNICAL SCHOOLS Dept 205-014
4000 South Figueroa Street, Los Angeles, CA 90037

Please send FREE color catalog on course checked below:

- | | |
|---|---|
| <input type="checkbox"/> Robotics | <input type="checkbox"/> Computer Electronics |
| <input type="checkbox"/> Digital Electronics | <input type="checkbox"/> Video Technology |
| <input type="checkbox"/> Auto Mechanics | <input type="checkbox"/> Home Appliances |
| <input type="checkbox"/> Air Conditioning/Solar Heating | |

Name _____ Age _____
Address _____
Apt. _____ City _____
State _____ Zip _____

- Check if interested in G.I. information.
 Check if interested ONLY in classroom training in Los Angeles

NEW PRODUCTS



DESKTOP PERSONAL COMPUTER

The Model 1050 personal computer system from Visual Technology comes bundled with Multiplan, WordStar 3.3, MailMerge 3.3, DR-Graph graphics, GSX-80 graphics device driver, C BASIC, DEC VT-100 terminal emulator, and CP/M Plus software. It uses a Z80A system and 6502 display processors and comes with 96K (expandable

to 160K) of RAM, 64K (expandable to 128K) of PROM, and 32K of display memory. Hardware includes: dual 400K 5 $\frac{1}{4}$ " disk drives; hi-res (640 \times 300) bit-mapped graphics and 25 \times 80-character monochrome display monitor; printer port; modem port; hard-disk expansion port; and detached typewriter-style keyboard. Options include a plug-in dual-port serial card and hard-disk system. \$2695.

Circle No. 88 on Free Information Card

Executive Information Service.

Compuserve, Inc. has introduced a package designed to offer the business executive total access to practical business information. The Executive Information Service features a comprehensive package of financial data, current news, decision-support research, and communications options. Among the features it offers are: updated price quotations on over 9000 security issues, information from Standard & Poor's on more than 3000 companies, access to the Official Airlines Guide Electronic Edition, access to the Associated Press Wire Service, electronic communications through Compuserve's InfoPlex Electronic Mail Service and the U.S. Postal Service's E-COM system, and Electronic Conferencing and Professional Forums, including a forum exclusively for IBM PC users. While the Executive Information Service can be accessed by most computer terminals and communicating word processors, Compuserve's Professional Connection software, for the IBM PC, provides a number of easy-to-use, menu-driven functions valuable to the first-time user. \$150.

Circle No. 92 on Free Information Card

PROGRAMMABLE REMOTE CONTROLLER



The "Autocrat" from Bi-Comm Systems is a microprocessor-based unit that can be used to remotely control electrical devices through existing ac wiring. It is said to be compatible with almost any computing system and energy-management controllers equipped with RS-232C ports. Autocrat plugs directly into an ac outlet to transmit and receive signals over the power line. It can control up to 256 Leviton/BSR devices and is compatible with all BSR X-10 and Leviton CCS accessories. Included in the Autocrat is a battery-backed CMOS clock/calendar, firmware operating system in EPROM, and self-diagnostic routine. The device can operate as a stand-alone processor or a computer-controlled interface, or under telephone modem control. \$485. Address: Bi-Comm Systems, 10 Yorkton Industrial Blvd., St. Paul, MN 55117.



TRANSPORTABLE COMPUTER

Radio Shack's new TRS-80 Model 4P is a compact portable version of the company's Model 4 desktop. It is totally compatible with all Model 4 programs and can run all Model III TRSDOS and LDOS disk programs (in

Model III mode). It is also compatible with the CP/M Plus operating system offered by Radio Shack. The Model 4P comes with 64K of RAM (expandable to 128K), two built-in 184K double-density 5 $\frac{1}{4}$ " disk drives, 9" hi-res 80 \times 24 display. \$1799.

Circle No. 89 on Free Information Card


WORD PROCESSING SYSTEM \$995

(Everything you need for word processing)

PLUS! THE  **Olympia** OPTION!!




 **Olympia**

You can add the  **Olympia** Electronic Typewriter/Computer Printer for **Superb Letter Quality** correspondence and documents! Now you can have the best **Electronic Typewriter** made and used by the world's largest corporations (better than IBM Selectric) plus — a **Professional Computer Printer** (two machines in one) for only \$395.00 additional cost!! List Price \$799.00. (Competitive word processing systems sell for \$3000 to \$5000 without the electronic typewriter feature!!!)

LOOK AT WHAT YOU GET FOR ONLY \$995.00

- The powerful 84K Commodore 64 Computer! (More features than Apple II)
- 170K Commodore 64 Disk Drive!
- Box of 10 "Loran" Disks!
- Gemini 10X Starmicronics 10" Carriage Deluxe 120CPS, Dot Bit Addressable Tractor-Friction Printer!
- Deluxe Cardco Printer Interface!
- Box of Printer Paper!
- Your choice of 12" Green Screen or Amber Screen Monitor!
- Monitor Interface Cable!
- Executive Word Processor, 80 Columns in Color, 20,000 Word Customizable Dictionary, Data Base, Powerful Mail Merge!
- Special Software Coupon that allows \$100 to \$300 Savings Off of Catalog Sale Prices!



PLUS THE  **Olympia** OPTION!! You can substitute the 20" Carriage OLYMPIA typewriter/prINTER for the GEMINI 10X printer for only \$395.00 additional cost!! LIST PRICE \$799.00.

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

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

Add \$50.00 for shipping and handling!!

• LOWEST PRICES • 15 DAY FREE TRIAL • 90 DAY FREE REPLACEMENT WARRANTY
• BEST SERVICE IN U.S.A. • ONE DAY EXPRESS MAIL • OVER 500 PROGRAMS • FREE CATALOGS

WE DO NOT EXPORT TO OTHER COUNTRIES EXCEPT CANADA.

Enclose Cashiers Check, Money Order or Personal Check. Allow 14 days for delivery, 2 to 7 days for phone orders, 1 day express mail! Canada orders must be in U.S. dollars. We accept Visa and MasterCard. We ship C.O.D.

Circle No. 40 on Free Information Card

PROTECTO
ENTERPRIZES (WE LOVE OUR CUSTOMERS)

BOX 550, BARRINGTON, ILLINOIS 60010
Phone 312/382-5244 to order

Bits & Bytes

NEWS, VIEWS & GOSSIP/BY SOL LIBES

RUMORS & GOSSIP

► Expect Apple to introduce its long-awaited Macintosh computer at its annual stockholder's meeting scheduled for this month. That is what they did last year when they announced the Lisa. . . . Hewlett-Packard is rumored to have dropped development of a 68000-based low-end microcomputer since introducing a unit that runs MS-DOS. . . . It is probable that IBM will produce 500,000 home computers this year. . . . IBM has reportedly ordered about a thousand 16032 chips from National Semiconductor for evaluation. The 16032 is National's new 32-bit microprocessor, which it expects to start sampling January 1. That means that IBM is wide open on which 32-bit micro to use. Intel 80386 samples are not expected for another 6 months yet. National claims the 16032 has the power of a VAX. . . . Sources report that Microsoft is developing a networking version of MS-DOS, to be called, you guessed it, "MS-Net". . . . The IBM XT is doing much better than expected and industry pundits estimate that IBM will need 1.8 million 10-Mb drives this year with most going to the XT. If true, it means that Seagate Technology, MiniScribe, and IMI are going to make a mint. . . . According to *Business Week* magazine, "IBM has already ordered enough components to build 2-million computers" this year. . . . According to Daniel H. Wilke, IBM PC manufacturing engineer, "a computer is made every 45 seconds."

APPLE DOINGS

► Among problems that Apple must address is that of Lisa compatibility and communications. The first part, Apple plans to handle by introducing a plug-in 8088 processor that will allow users to run MS-DOS and most PC-compatible software. This package is being developed by Apple for Microsoft. The second problem will be dealt with by the introduction, hopefully in the first quarter, of networking and communications controllers that will allow Lisas to talk to other micros and to mainframes. In another attempt at industry compatibility, Apple shut down its disk drive manufacturing and had decided to buy its drives outside.

Apple has also announced that it will increase the number of Lisa dealers from 130 to over 200. It is also expected that Apple will introduce a hard disk for the IIe and a plug-in board that will provide the unit with enhanced display features, such as windowing.

BATTLE OF THE OPERATING SYSTEMS

► According to John Rowley, President of Digital Research Inc., DRI currently has about 900 contracts with OEMs for CP/M (including both 8-bit and 16-bit systems), and industry estimates are that Microsoft has about 200 OEM contracts for MS-DOS. Further, Digital Research boasts that CP/M is now running on over 1.5-million computers worldwide. Similar estimates of systems running MS-DOS are less than half this number.

Digital Research is also known to be developing a new version of Concurrent CP/M-86, upgrading it to have many of the features of CP/M-80+, windowing, and the ability to run MS-DOS software. In the meantime, version 3.0 of MS-DOS, which Microsoft had promised to start shipping last fall, has

been delayed. The new version of MS-DOS is expected to be compatible with Microsoft's Xenix multi-user system and concurrency (a la Concurrent CP/M-86).

In the meantime, Digital Research has introduced CP/M-80, which has the operating system and processor integrated on one chip. This is expected to be used by manufacturers of low-cost home computers.

QUOTATION OF THE MONTH

► "The shakeout of 1985 is happening now."

—Steve Jobs, Chairman,
Apple Computer Corp.



IBM DROPS 4" DISK DRIVE

► After nearly a year of trying to find OEM purchasers, IBM has given up on its 4" floppy-disk drive. The problem appears to be that the device did not use any of the current disk interface standards; and it was more expensive than the 5.25" drives.

IBM BOOSTS STAKE IN INTEL

► IBM bought another 1.71-million shares of Intel stock, bringing its interest in Intel up to 15.2%. It started with 12.5%, then boosted it to 13.7% before the latest purchase. Most of the shares were bought in blocks of 40,000 to 60,000. Under an agreement between the two companies, IBM can purchase no more than a 30% interest in Intel.

While on the subject of stakes, it should be noted that IBM also boosted its equity position in Rolm Corp. from 15% to 17.7%. Rolm makes sophisticated PBX systems. This apparently indicates IBM's intention to start actively competing with AT&T in this lucrative market. Why not? Isn't AT&T planning to jump into the computer business?

Along these lines there are rumors that, in the light of IBM's decision to drop the 4" floppy, it intends to buy into a disk maker such as either Seagate or Tandon. One question that comes to mind is why hasn't IBM bought into Microsoft?

PREDICTIONS

► Egil Juliusen of Future Computing, a market research firm, predicts that, by the end of the year, IBM will have 18% of the \$2.9-billion home computer market, and by 1988 it will have 45% of the \$5.9-billion home market. He said that distribution through mass merchandisers is required and over 10,000 locations are needed to be a leader in the home market.

CAN AT&T COMPETE WITH IBM?

► AT&T is expected to introduce a personal computer soon to compete head-on with IBM. It is expected to employ a 32-bit micro and run Unix with an emulator that will allow users to run MS-DOS software. According to International Resource Development, Norwalk, CT, a market research outfit, the software is being developed by Microsoft. The system is expected to be significantly more powerful than the XT. IBM will probably respond with price reductions on the XT and, later, with the introduction of a more powerful desktop based on a new 32-bitter.

ROBOT STANDARDS FOR LANGUAGE & SAFETY

► The Industrial Automation Planning Panel of the American National Standards Institute (ANSI) is pursuing the development of standards for robot programming languages and safety. The lack of language standards is currently making it difficult, if not impossible, to transport software and interface different robots in automated factories.

The National Bureau of Standards (NBS), which previously developed programming standards for CAD/CAM (Computer Assisted Design/Computer Assisted Manufacturing), is also working on a language standard for robotics.

In the area of robotic safety the Robot Institute of America (RIA) and the Underwriters Laboratories (UL) are both working on standards. Areas of concern include installation, programming/teaching, and maintenance.

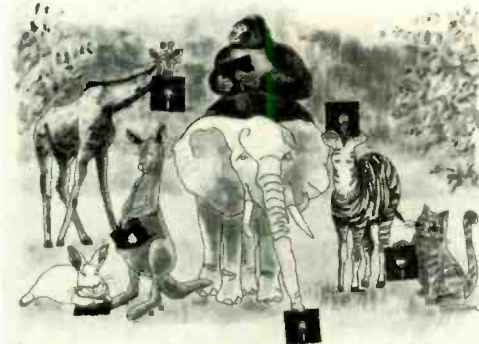
NBS, RIA and UL are all members of ANSI's panel.

RANDOM NEWS BITS

► Move over Gucci and Gloria Vanderbilt! Make way for the "Apple Collection" of clothes and gifts bearing the Apple insignia. Items range from low-cost bumper stickers and cocktail napkins all the way up to a \$900 windsurfer bearing the Apple logo. . . . Atari has reportedly laid off another 380 staffers in a continuing shift of manufacturing to offshore. . . . Binary Star Inc., Bellevue, WA, claims to have developed a high-brightness flat color display panel with almost unlimited area and pixel density using straightforward digital raster scanning. Initial use is expected to be in a three-dimensional display for the military and CAD applications, with possible later use in TV. . . . IBM has begun letting software-only stores sell IBM brand software. The first such chain (32 stores) is Software Centres International of Los Angeles. . . . There are now over 800 PC dealers in 26 countries outside North America. . . . Judging by companies exhibiting at trade shows, training of end users is becoming a big business, with close to a dozen companies already getting into the action.

Diskette Users...

When you've heard from all the animals in the diskette zoo, to which you need fast delivery and high quality diskettes...



Call Communications Electronics

Diskette order desk
800-521-4414
In Canada 800-265-4828

CE... your best source for diskettes

For you the diskette buyer, it's a jungle out there. There are so many different brands to choose from, you need to go on a safari to find a good brand at a reasonable cost. Fortunately, CE has already hunted for the best diskettes and offers you an excellent choice at a CE price. To save you even more, CE also offers bulk product where 100 diskettes are packed in the same box without envelopes or labels. Since we save packaging costs, these savings are passed on to you. Diskette envelopes are also available from CE.

Other Useful Computer Accessories

When the computer needs your computer, we give you a lot of great new CE Head Cleaning Diskettes, you can clean the read/write heads on the floppy drive for 30 seconds. Each in a convenient two-head, reusable design and enough solution for 30 cleanings. Order # D-CLE for \$9.95 and order a D-CLE for \$8.95. Also available from CE is a 3M data cartridge. The DC100A data cartridge is a small version of the DC300A data cartridge. The DC100A comes in a "top" in a package marking # 21 1/2 x 3 1/2 inches. Cost is \$14.00 each. The DC300A is a pre-loaded tape cartridge containing 300 feet of one mil thick Mylar computer tape. The DC300A costs \$11.00 each. The DC500 is an extra length data cartridge with 450 feet of tape. It is the same size and interchangeable with the DC300A. The DC500 provides a full average capacity of 3.6 million bits at 1000 BPS. The cost of the DC500 is \$22.00 each. If you need some mini-diskette envelopes, CE has a huge supply and has "reusable" envelopes for \$12.00 per 100 pack. Use only #15 for a 100 pack of 5 1/4" diskette envelopes. Another CE "letter quality" printer are available in a series of optional versions for only \$279.00 each.

Quantity Discounts Available

Our diskettes are packed 10 to a carton and 6 or 10 cartons to a case. The economy bulk pack is packaged 100 disks to a case without envelopes or labels. Please order only in increments of 100 units for quantity 100 pricing. With the exception of bulk pack, we are also willing to accommodate your smaller orders. Quantities less than 100 units are available in increments of 10 units at 20% less charge above our 100 unit price. Quantity discounts are also available. Order 1,000 or more disks at the same time and deduct 1% 500 or more save you 2% 1,000 or more save you 3% 2,000 or more save you 4% 5,000 or more save you 5% 10,000 or more save you 6% 50,000 or more save you 7% 100,000 or more save you 8% 500,000 or more save you 9% and 1,000,000 or more save you 10%. For the quality products you need, low quantity 100 packs. Almost all our diskettes are immediately available from CE. Our efficient warehouse facilities are equipped to ship you the quality products you need. If you need more information, assistance to find the floppy diskette that's right for you, call the appropriate manufacturer compatibility hotline numbers listed at the bottom of this ad. Dealer inquiries invited.

Buy your diskettes from CE with confidence

To get the fastest delivery from CE of your computer products, we recommend you phone your order directly to our Computer Products Division and charge it to your credit card. Be sure to calculate your price using the CE prices in this ad. Written purchase orders are accepted from approved government agencies and most well rated firms at a 30% surcharge for 30 day billing. For maximum savings, your order should be prepaid. All sales are subject to availability, acceptance and verification. All sales are final. All prices are in U.S. dollars. Prices, terms and specifications are subject to change without notice. Out of stock items will be placed on backorder automatically unless CE is instructed otherwise. Minimum prepaid order is \$50.00. Minimum purchase order \$200.00. All shipments are F.O.B. CE warehouse. No COD's. Non-certified and foreign checks require bank clearance.

For shipping charges add \$8.00 per 100 diskettes and/or any fraction of 100 5 1/4 inch diskettes, or \$6.00 per 100 diskettes and/or any fraction of 100 8 inch mini-diskettes. For cleaning kits, add \$3.00 per kit. For tape data cartridges, add \$1.00 per cartridge. For envelopes, add \$3.00 per pack of 100 envelopes. For printers add \$20.00 each for U.S. ground shipping and handling in the continental U.S. For Canada, Puerto Rico, Hawaii, Alaska, or APO/FPO delivery, shipping charges are three times continental U.S. rates. Mail orders to: Communications Electronics, Box 1002, Ann Arbor, Michigan 48106 U.S.A. If you have a Visa or MasterCard, you may call and place a credit card order. Order toll-free in the U.S. dial 800-521-4414. In Canada, order toll-free by calling 800-265-4828. If you are outside the U.S. or in Michigan dial 313-973-8888. Telex anytime 810-223-2422. Order today. Copyright © 1983 Communications Electronics. Ad #102763

COMMUNICATIONS ELECTRONICS
Computer Products Division
818 Phoenix Dr. Box 1002, Ann Arbor, Michigan 48106 U.S.A.
Call Toll-Free 800-521-4414 or outside U.S.A. 313-973-8888

Choose your brand Choose your price

Product Description	Wabash Part #	CE Quant. 100 prices per disk (\$)
8" SSDD IBM Compatible (128B) 5, 26 Sector	F111	1.89
8" SSDD Shugart Compatible 32 Hard Sector	F31A	1.89
8" SSDD IBM Compatible (128B) 5, 26 Sector	F131	2.39
8" DSDD Soft Sector (Unformatted)	F14A	2.99
8" DSDD Soft Sector (248 B) 5, 26 Sector	F16A	2.99
8" DSDD Soft Sector (512 B) 5, 16 Sector	F145	2.99
8" DSDD Soft Sector (1024 B) 5, 8 Sector	F147	2.99
5 1/4" SSDD Soft Sector w/Hub Ring	M11A	1.49
5 1/4" SSDD Same as above but bulk product	M11AB	1.29
5 1/4" SSDD 10 Hard Sector w/Hub Ring	M41A	1.49
5 1/4" DSDD 15 Hard Sector w/Hub Ring	M01A	1.49
5 1/4" SSDD Soft Sector w/Hub Ring	M13A	1.79
5 1/4" DSDD Same as above, but bulk product	M13AB	1.59
5 1/4" DSDD Soft Sector (Fixed) Extra Hole Side	M18A	2.99
5 1/4" SSDD 10 Hard Sector w/Hub Ring	M43A	1.79
5 1/4" DSDD Soft Sector w/Hub Ring	M53A	1.79
5 1/4" DSDD Same as above, but bulk product	M11A	2.69
5 1/4" DSDD 10 Hard Sector w/Hub Ring	M14AB	2.49
5 1/4" DSDD 15 Hard Sector w/Hub Ring	M44A	2.89
5 1/4" DSDD 15 Hard Sector w/Hub Ring	M04A	2.69
5 1/4" SSDD Soft Sector w/Hub Ring (96 TPI)	M15A	2.59
5 1/4" DSDD Soft Sector w/Hub Ring (96 TPI)	M16A	3.89



Wabash diskettes for... \$1.29 each

Wabash Part #	CE Quant. 100 prices per disk (\$)
F111	1.89
F31A	1.89
F131	2.39
F14A	2.99
F16A	2.99
F145	2.99
F147	2.99
M11A	1.49
M11AB	1.29
M41A	1.49
M01A	1.49
M13A	1.79
M13AB	1.59
M18A	2.99
M43A	1.79
M53A	1.79
M11A	2.69
M14AB	2.49
M44A	2.89
M04A	2.69
M15A	2.59
M16A	3.89



Ultra diskettes for... \$1.39 each

Ultra Part #	CE Quant. 100 prices per disk (\$)
81728	1.99
81701	2.49
82701	3.19
82708	3.19
90001	1.79
90053	1.39
90010	1.79
90018	1.79
51401	1.89
00096	1.59
51410	1.89
51416	1.89
52401	2.79
00140	2.49
52410	2.79
82418	2.79
51801	2.59
52801	3.69



3M diskettes for... \$1.94 each

3M Part #	CE Quant. 100 prices per disk (\$)
88820	1.94
88820-32	1.94
88820	2.49
88820	3.14
88820-1024	3.14
88820 RH	1.94
88820-10RH	1.94
88820-18RH	1.94
88820 RH	2.59
88820-10RH	2.89
88820-18RH	2.89
88820-96RH	2.79
88820-96RH	3.74



Memorex diskettes for... \$1.94 each

Memorex Part #	CE Quant. 100 prices per disk (\$)
3082	1.94
3015	1.94
3080	2.49
3102	3.14
3104	3.14
3481	1.94
3481	2.59
3501	3.74



Burroughs diskettes for... \$2.09 each

Burroughs Part #	CE Quant. 100 prices per disk (\$)
FD-101	2.09
FD-105	2.09
FD-108	2.64
FD-106	3.19
FD-110	3.19
FD-111	3.19
FD-112	3.19
MFD-11	2.09
MFD-12	2.09
MFD-13	2.09
MFD-14	2.84
MFD-18	2.84
MFD-19	2.84
MFD-20	2.94
MFD-23	3.69



Dysan diskettes for... \$2.99 each

Dysan Part #	CE Quant. 100 prices per disk (\$)
800501	2.99
800618	2.99
800605	3.89
800606	3.89
800830	4.59
801184	2.99
801186	2.99
801185	2.99
801187	3.19
801014	3.19
801188	3.19
802080	3.89
802082	3.89
802081	3.89
800438	3.89
802087	4.89

For more information about this brand call: **800-323-9868** In Illinois 312-583-6363

3 year warranty For more info on Wabash call **800-323-9868** In Illinois 312-583-6363

Lifetime warranty unless bulk For more info on Ultra call **408-728-7777** Monday-Friday 9 am-4 pm PT

Lifetime warranty For more info on 3M call **800-328-9438** In Minnesota 800-672-9524

8 year warranty For more info on Memorex call **800-538-8080** In California 800-672-3525

1 year warranty For more info on Burroughs call **800-448-4422** Monday-Friday 9am-4pm ET

1 year warranty For more info on Dysan call **800-552-2211** In California 408-970-8080

LES SOLOMON ON COMPUTER HARDWARE



How Computers Create Color

THE NTSC (National Television Systems Committee) method of transmitting and receiving color TV has been around for a few decades and has proved to be reasonably good in reproducing color TV images.

Until the introduction of video games and personal computers, all using digital techniques, color TV and color video monitors operated only with analog signals. Since analog and digital techniques are different, circuit designers had to develop new concepts to provide interfaces between the digital circuit and the analog color system to "fool" the latter into thinking that it was receiving an analog color signal instead of a stream of digital pulses.

Different techniques are used by vari-

ous manufacturers. This piece will cover color circuits used within the popular Apple II computer, as an example. The technique is contained in U.S. Patent 4,278,972, "Digitally Controlled Color Signal Generation Means For Use With Display" by Stephen G. Wozniac, assigned to Apple Computer Co.

The Apple II has two color modes—HIRES (high resolution) and LORES (low resolution). Each will be covered in turn.

High Resolution. A pixel is a picture element that appears on the screen as a small dot. HIRES specifications call for a picture that is 192 pixels high by 280 pixels wide. However, the latter number is not quite correct.

As shown in Fig. 1, a single horizontal line can be divided into 280 "cells," each occupied by a single pixel. However, the pixel, being slightly smaller than the cell, can be either centered completely within its cell or it can overlap the adjacent pixel cell. Thus, it is possible to have up to 560 pixel positions on a single horizontal line. In fact, in the monochrome mode, that is exactly how many pixels there are.

In the HIRES color mode, the circuit is designed so that any one data byte poked by BASIC or machine language into the pertinent screen location contains the binary signals to form either of two sets of colors. One set consists of violet, green, black or white, while the

other set can be selected from blue, orange, black or white. However, you cannot use colors from both sets in the same byte.

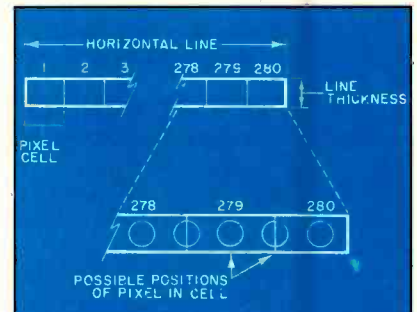


Fig. 1. A pixel can be centered in its cell or can overlap the adjacent pixel cell.

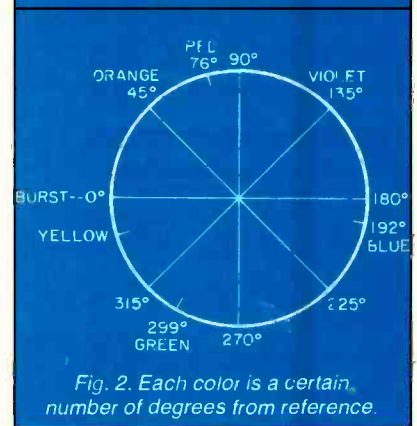


Fig. 2. Each color is a certain number of degrees from reference.

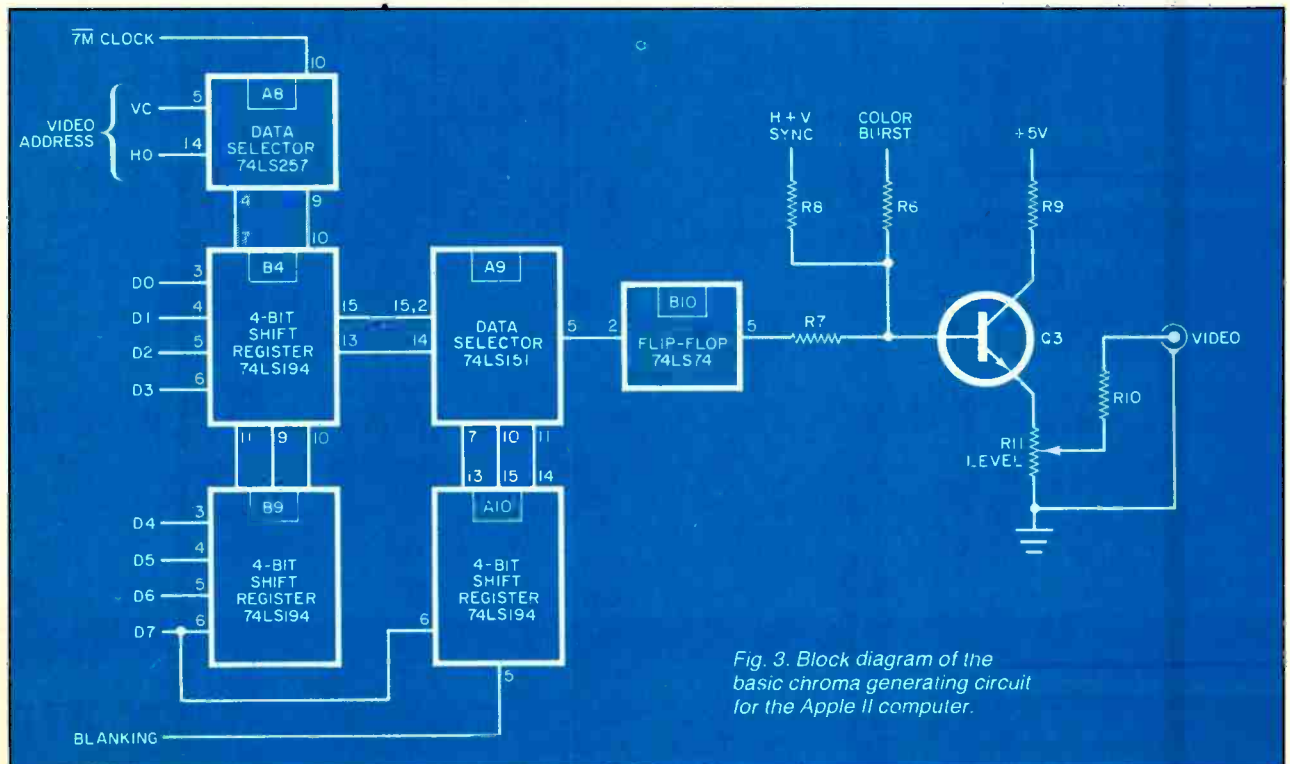
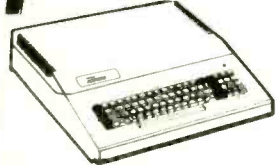


Fig. 3. Block diagram of the basic chroma generating circuit for the Apple II computer.

COMPUTER MAIL ORDER



APPLE/FRANKLIN DISK DRIVES MICRO-8CI

A2	\$219.00
A40	\$299.00
A70	\$319.00
C2 Controller	\$79.00
C47 Controller	\$89.00

RANA	
Elite 1	\$279.00
Elite 2	\$389.00
Elite 3	\$569.00

ACE 1000 Color Computer CALL
ACE Family Pack System CALL
ACE PRO PLUS System CALL
ACE 1200 Office Mgmt. System CALL
"NOT IIE EXPENSIVE"

APPLE IIe STARTER PACK
64K Apple IIe. Disk Drive & Controller.
80 Column Card. Monitor II & DOS 3.3
COMPLETE \$1499.00



HOME COMPUTERS



600XL.....\$189 1200XL CALL
800XL.....\$299 1400XL CALL



CBM 8032 \$599



B128-80	\$789.00
CBM 64K Memory Board	\$269.00
8032 to 9000 Upgrade	\$269.00
2031 LP Disk Drive	\$299.00
8050 Disk Drive	\$949.00
8250 Disk Drive	\$1199.00
4023 Printer	\$379.00
8023 Printer	\$589.00
6400 Printer	\$1399.00
Z-RAM	\$499.00
Silicon Office	\$699.00
The Manager	\$199.00
Soft ROM	\$125.00
VisiCalc	\$159.00

CBM 64 \$199

VIC 20 CALL	
C1541 Disk Drive	\$249.00
C1530 Datasette	\$69.00
C1520 Color Printer/Plotter	\$169.00
C1525 Dot Matrix/Parallel	\$219.00
C1526 Dot Matrix/Serial	\$279.00
C1702 Color Monitor	\$249.00
C1311 Joystick	\$4.99
C1312 Paddles	\$11.99
C1600 VIC Modem	\$89.00
C1650 Auto Modem	\$89.00
Logo 64	\$49.00
Pilot 64	\$39.00
Simon's Basic	\$19.00
Word Pro 3 Plus	\$59.00
Word Pro 4 Plus/5 Plus... each	\$279.00
Parallel Printer Interface	\$69.00
Calc Result 64	\$129.00
Codewriter 64	\$75.00
Quick Brown Fox	\$49.00
Word Pro 64 Plus	\$59.00

PROFESSIONAL SOFTWARE

Word Pro 2 Plus	\$159.00
Word Pro 3 Plus	\$189.00
Word Pro 4 Plus/5 Plus... each	\$279.00
InfoPro	\$179.00
Administrator	\$399.00
Power	\$79.00

MODEMS

ANCHOR

Mark I (RS-232)	\$79.00
Mark II (Atari)	\$79.00
Mark III (TI-99)	\$109.00
Mark IV (CBM/PET)	\$125.00
Mark V (Osborne)	\$95.00
Mark VI (IBM-PC)	\$169.00
Mark VII (Auto Ans/Auto Dial)	\$119.00
Mark XII (1200 Baud)	\$299.00
TRS-80 Color Computer	\$99.00
9 Volt Power Supply	\$9.00

HAYES

Smartmodem 300	\$219.00
Smartmodem 1200	\$509.00
Smartmodem 1200B	\$459.00
Micromodem II	\$265.00
Micromodem II Plus	\$299.00
Micromodem IIE	\$269.00
Micromodem 100	\$299.00
Smart Com II	\$89.00
Chronograph	\$199.00

NOVATION

J-Cat	\$99.99
SmartCat 103	\$179.00
SmartCat 103/212	\$399.00
AutoCat	\$219.00
212 AutoCat	\$549.00
Apple Cat II	\$249.00
212 Apple Cat	\$569.00
Apple Cat 212 Upgrade	\$309.00
Cat	\$139.99
D-Cat	\$149.00
PC-Cat	\$339.00

ZENITH

ZT-1	\$369.00
------	----------

MONITORS

AMDEK

300 Green	\$149.00
300 Amber	\$159.00
310 Amber	\$169.00
Color 1	\$279.00
Color 1 Plus	\$299.00
Color 2	\$399.00
Color 2 Plus	\$419.00
Color 3	\$349.00
Color 4	\$699.00

BMC

12" Green	\$79.99
12" Green Hi-Res	\$119.99
9191-13" Color	\$249.99

GORILLA

12" Green	\$88.99
12" Amber	\$95.99

NEC

JB 1260 Green	\$109.99
JB 1201 Green	\$149.99
JB 1205 Amber	\$159.99
JC 1215 Color	\$299.99
JC 1216 RGB	\$429.99

QUORAM

Quadchrome	\$499.99
------------	----------

TAXAN

12" Green	\$119.00
12" Amber	\$129.00
Taxan 1 RGB	\$279.00

UBI

Pi 1, 9" Green	\$99.99
Pi 2, 12" Green	\$119.99
Pi 3, 12" Amber	\$149.99
Pi 4, 9" Amber	\$139.99
1400 Color	\$269.99

ZENITH

ZVM 122 Amber	\$99.99
ZVM 123 Green	\$89.99
ZVM 135 Color/RGB	\$469.99

1010 Recorder	\$74.00
1020 Color Printer	\$249.00
1025 Dot Matrix Printer	\$449.00
1027 Letter Quality	\$299.00
1030 Direct Connect Modem	CALL
1050 Disk Drive	\$379.00
CX30 Paddle	\$12.00
CX40 Joystick	each. \$8.00
CX77 Touch Tablet	\$64.00
CX80 Trak Ball	\$48.00
CX85 Keypad	\$105.00
4003 Assorted Education	\$47.00
4011 Star Raiders	\$33.00
4012 Missile Command	\$29.00
4013 Asteroids	\$29.00
5049 VisiCalc	\$159.00
7097 Logo	\$79.00
7101 Entertainer	\$69.00
7102 Arcade Champ	\$75.00
8026 Dig Dug	\$33.00
8030 E.T. Phone Home	\$33.00
8031 Donkey Kong	\$39.00
8036 Atari Writer	\$79.00
8040 Donkey Kong, Jr.	\$39.00
8043 Ms. PacMan	\$39.00
8044 Joust	\$39.00

PRINTERS

AXIOM

AT-100 Atari Interface	\$249.00
CD-100 CBM 64/VIC 20	\$249.00
GP-100 Parallel Interface	\$199.00

BMC

401 Letter Quality	\$589.00
BX-80 Dot Matrix	\$269.00

C.I.TOH

Gorilla Banana	\$209.00
Prowriter 8510P	\$379.00
Prowriter 1550P	\$679.00
A10 (18 cps)	\$69.00
F10-40	\$99.00
F10-55	\$1499.00

EPSON

MX-80FT. MX-100. RX-80. RX-80FT.	CALL
FX-80. FX-100	CALL

OKIDATA

82.83.84.92.93.2350.2410	CALL
--------------------------	------

SMITH CORONA

TP-2	\$449.00
Tractor Feed	\$119.00

SILVER REED

500 Letter Quality	\$469.00
550 Letter Quality	\$699.00

STAR

Gemini 10X	\$299.00
Gemini P15	\$449.00
Delta 10	\$559.00
Serial Board	\$75.00

CONTROLLERS & JOYSTICKS

WICO

Joystick	\$21.99
3-way Joystick	\$22.99
Famous Red Ball	\$23.99
Power Grip	\$21.99
BOSS Joystick	\$17.99
ATARI/VIC Trak Ball	\$34.99
Apple Trak Ball	\$54.99
Apple Adapter	\$15.99
Apple Analog	\$37.99

AT 88-S1	\$329.00
AT 88-A2	\$259.00
AT 88-S2	\$529.00
AT 88-S1PD	\$429.00
AT 88-DDA	\$119.00
RFD 40-S1	\$449.00
RFD 40-A1	\$269.00
RFD 40-S2	\$699.00
RFD 44-S1	\$539.00
RFD 44-S2	\$869.00

TEXAS INSTRUMENTS

TX 99-S1	\$279.00
----------	----------

RANA

1000	\$319.00
------	----------

TRAK

AT-D2	\$389.00
-------	----------

MEMORY BOARDS

Axlon 32K	\$59.00
Axlon 48K	\$99.00
Axlon 128K	\$299.00
Intec 32K	\$59.00
Intec 48K	\$85.00
Intec 64K	\$99.00
Intec Real Time Clock	\$29.00

SOFTWARE FOR ATARI

BRODERBUND

Bank Street Writer	\$49.99
Chopflitter	\$29.99
Track Attack	\$21.99

BIG FIVE

Miner 2049er	\$34.99
--------------	---------

DATASOFT

Canyon Climber	\$23.99
Magneto Bugs	\$11.99
Pooyan	\$19.99
Zaxxon	\$27.00
Word Wizard	\$52.99
Spell Wizard	\$38.99

ON-LINE

Crossfire	\$29.99
Frogger	\$26.99
Threshold	\$24.99

PARKER BROTHERS

Frogger	\$38.99
Popeye	\$38.99
O'Bert	\$38.99

SPINNAKER

Alphabet Zoo	\$23.99
Facemaker	\$23.99
Rhymes & Riddles	\$19.99
Snooper Troops: 1 or 2	\$29.99

SYNAPSE

Bluemax	\$24.99
Claim Jumper	\$29.99
File Manager 800 Plus	\$69.99
Slime	\$29.99
Shadow World	\$25.99
Zeppelin	\$26.99

= WEST = = CANADA = = EAST =

1-800-648-3311

1-800-268-4559

1-800-233-8950

In NV call (702)588-5654, Dept. 0107
P.O. Box 8689, Stateline, NV 89449
Order Status #: 588-5654

In Toronto call (416)828-0866, Dept. 0107
2505 Dunwin Ct., Unit 1B,
Mississauga, Ontario, Canada L5L1T1
Order Status #: 828-0866

In PA call (717)327-9575, Dept. 0107
477 E. Third St. Williamsport, PA 17701
Order Status #: 327-9576
Customer Service Number: 327-1450

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 \$5.00) shipping and handling on all C.O.D. 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. We stock manufacturer's and third party software for most all computers on the market. Call today for our new catalog.

CANADIAN ORDERS: All prices are subject to shipping, tax and currency exchange fluctuations. Call for exact pricing in Canada.

Circle No. 11 on Free Information Card

HIRES Circuit Operation. Before we discuss the basic chroma generating circuit within the Apple II, observe from the vector diagram of Fig. 2 how the various colors in the NTSC color system are defined. Note that all colors are referenced as "so many degrees" offset from the 3.579545-MHz reference burst that establishes the 0-degree point. Circuitry within the TV receiver or monitor creates the vector pattern. In reality, the various colors blend smoothly into each other and there is no sharp demarcation between colors (as in a rainbow or prism). Color saturation is a function of the pulse duty cycle, as will be explained further along.

The basic chroma generating circuit for the Apple II is shown in Fig. 3. The letter and number in each logic block indicates the IC's physical location on the Apple II motherboard in case the reader wants to use a scope to observe actual circuit operation.

Let us start with the violet color. As shown in Fig. 4, this color is generated by having 10101010 (85 decimal, 55 hex) present on the D0-D7 data lines. Note that, in this and the following discussions, the LSB (least significant bit) starts the single-file "parade" of binary bits exiting from the shift registers. Note also that, before clocking, the D0 bit is always present at the register output.

The two 4-bit shift registers (B4 and B9) are interconnected to form one 8-bit register. As the data selector (A8) clocks

the composite 8-bit shift register, the alternating pattern of 1s and 0s is shifted out—LSB first—to be applied to data selector (A9). Figure 4 shows that this particular square-wave pattern is delayed by 135 degrees from the reference burst. According to the chroma phase diagram of Fig. 2, 135 degrees is the required angle for violet.

For blue, the 8-bit shift register is provided with 10101011 (213 decimal or D5 hex) on the D0 through D7 data lines as shown in Fig. 5. Note that the low-order seven bits for blue are the same as the low-order seven bits for violet (10101010 vs. 10101011). The difference is in the bit on the D7 line. For violet, it is a 0; and for blue, it is a 1.

As shown in Fig. 3, data selector A9 is driven from register B10 when bit D7 appears as a logic 1. This causes the data selector to switch its input from the 8-bit shift register to the output of flip-flop A11, as in Fig. 5. Observe that the 8-bit shift register data is also coupled to flip-flop A11, which when clocked at a 14-MHz rate produces a delay equivalent to 90 degrees of phase shift.

Thus, the violet waveform at 135 degrees is delayed a further 90 degrees, producing 225 degrees (blue). Therefore, the difference between violet and blue is the extra 90 degrees of phase shift produced by the action of the logic-1 bit on the D7 line.

A little study will show how the other colors can be produced by changing the data byte on the D0 through D7 lines,

and noting the action when flip-flop A11 is turned on when bit 7 is a 1.

If the D0 through D7 lines contain all zeros, black will be produced since the 8-bit shift register output is always low (with A11 activated, the output is still low). If the D0-D7 lines contain all ones, output of the 8-bit shift register remains high—even with A11 turned on by the high at D7—thus producing white.

Low Resolution. The LORES mode uses the same hardware as HIRES but it is software switched into the arrangement shown in Fig. 6. The major change is that shift registers B4 and B9 now form two 4-bit registers instead of a single 8-bit device as used in HIRES. Each is selected by data selector A8.

Unlike the single dot pixels used in the HIRES mode, each LORES pixel is actually a block that is four scanning lines high and seven dots long, with each pixel stored as 4 bits. Data lines D0 through D3 feed shift register B4 to determine one pixel, while data lines D4 through D7 feed shift register B9 to create the other pixel. Thus, the 8-bit data bus generates two pixels.

The two shift registers actually generate four pixels (on even and odd bytes) with each addressed via the four combinations of the H0 and VC signals applied to register A10 (Fig. 6). The VC signal changes every four scanned lines, while the H0 signal changes every 978 nanoseconds. These signals, along with the blanking signal applied to register A10,

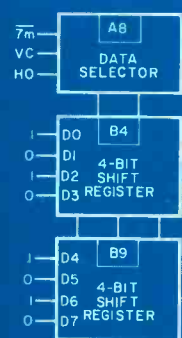


Fig. 4. The color violet is generated by having 10101010 on the D0-D7 lines.

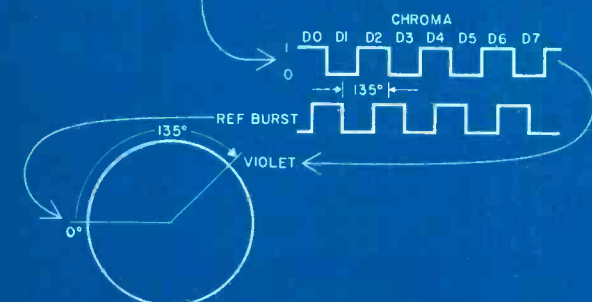
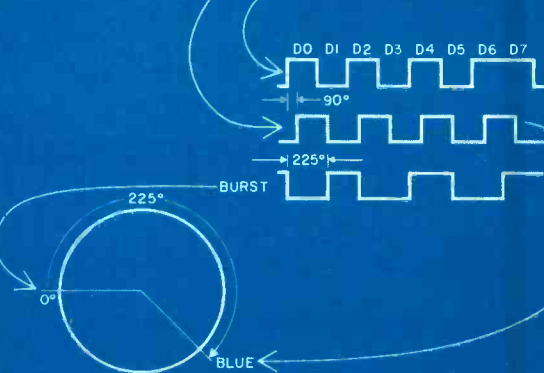
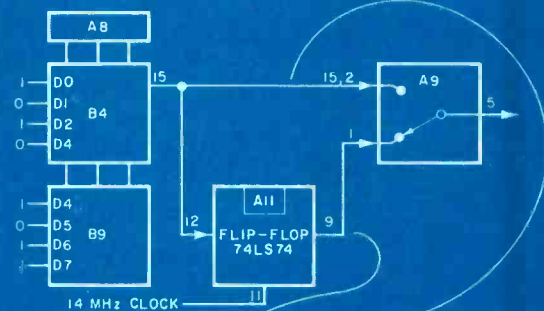


Fig. 5. The binary bits for blue are the same as violet except for a 1 on the D7 line.



from the publishers of PC



For IBM Personal Computers in Education, Home and Business Use



THE NEW FOUNDATION FOR IBM PERSONAL COMPUTERS

Fulfill all of your expectations for your IBM personal computer with PCjr, the applications magazine written for you and your household! Whether you're completing your banking from home, cataloging your book, record or recipe collections, teaching your pre-schooler math or the alphabet, preparing your taxes or term papers, or just playing games, PCjr. will enable you to get the most out of all IBM PC's or compatible computers!

PCjr. is written for all members of your household as a tool to utilize your computer to its fullest extent.

SUBSCRIBE TODAY AND SAVE UP TO 35%!



For IBM Personal Computers in Education, Home and Business Use

P.O. BOX 2450, Boulder, Colorado 80322

YES, please enroll me as an Introductory Subscriber to PC JR. for:

- | | | |
|---|--|--|
| <input type="checkbox"/> One year (12 issues)
\$14.97 and SAVE 25% | <input type="checkbox"/> Two years
\$27.97 and SAVE 30% | <input type="checkbox"/> Three years
\$38.97 and SAVE 35% |
|---|--|--|

Mr./Mrs./Ms. _____ please print name in full

Address _____

City _____ State _____ Zip _____

CHECK ONE: Payment enclosed Bill me later
Charge My American Express Visa MasterCard

Card No. _____ Exp. Date _____

Savings based on full one-year subscription price of \$19.97
Please allow 30 to 60 days for delivery of first issue.

8H138

determine which pixel passes through data selector *A9* at any particular time.

Now, let us see how LORES color is created using the partial logic arrangement shown in Fig. 7. The output of the selected 4-bit shift register (*B4* and *B9*) is passed to two circuits—data selector *A9* (Fig. 6) and the video output circuit, and then back to the bottom of the 4-bit shift register (Fig. 7). Thus, as the shift register is clocked, the data present on data lines D0(D4) through D3(D7) circulates through the register. While this is going on, the H0 and VC lines are selecting the desired "pixel."

As shown in the waveforms of Fig. 7, for "plain" green, the waveform is displaced 315 degrees from the reference. The waveform that generates dark green is not a square wave, but has a 25% duty cycle (it spends $\frac{3}{4}$ of its time at logic 0, which is essentially black). The fact that the waveform is at 270 degrees still makes it green, but a little darker since, besides the 25% duty cycle, it is also closer to blue on the phase diagram of Fig. 2.

On the other hand, note that the waveform for light green spends $\frac{3}{4}$ of its time at the logic 1 level. Since logic 1 is white, the greenish color is diluted. Thus, you can see how a change in duty cycle changes the saturation (density) of a color.

Obviously, all 0s on the data lines produces black, and conversely, all 1s generates white. This means that a double-frequency square wave (1010 on the

data lines) produces grey.

If you now go back to either Fig. 3 or Fig. 6, you will note that, after leaving flip-flop *B10*, the chroma information is matrixed into emitter follower *Q3* along with the horizontal and vertical sync signals and the 3.579545-MHz reference burst.

Due to the limited bandwidth of the *Q3* circuit, the interconnecting cable, the r-f modulator if used, and when coupled with the restricted bandwidth of

the TV receiver, the higher frequencies that form the sharp corners of the square wave are lost. This makes the edges of the square waves round off, making them look somewhat "sine-ish," and thus acceptable for the NTSC system. Note also that, although the horizontal and vertical sync signals generated by the Apple are not exactly as specified by NTSC, they are close enough so that the bulk of TV receivers and video monitors will lock to them. ◊

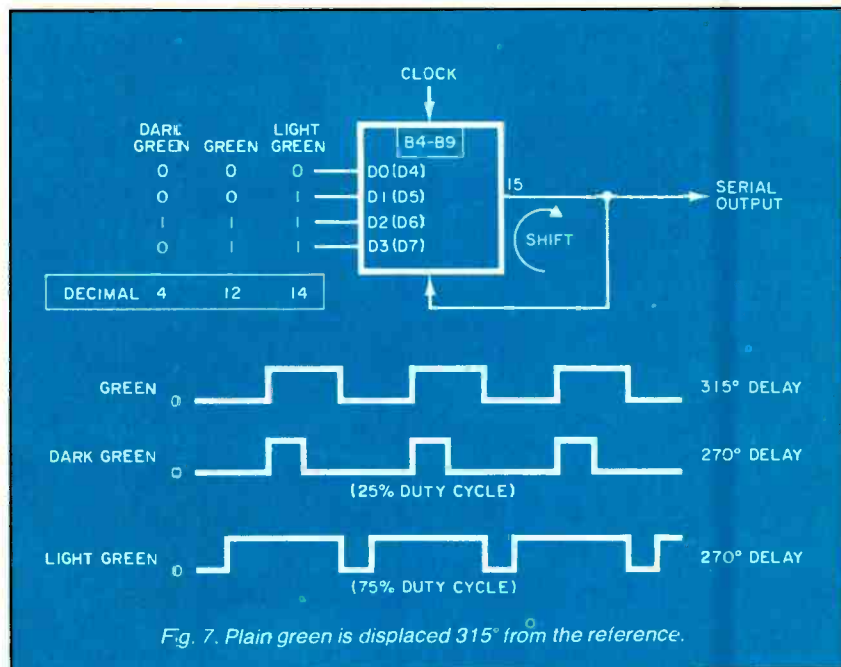


Fig. 7. Plain green is displaced 315° from the reference.

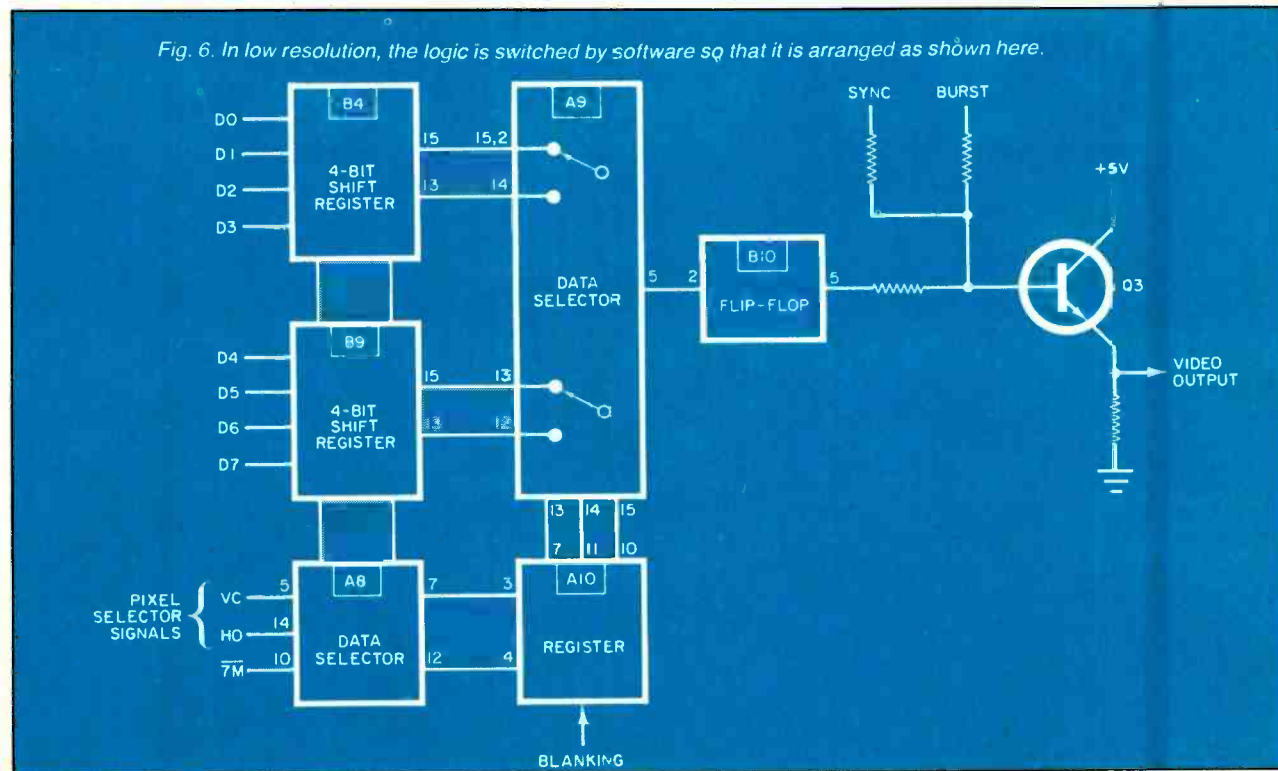


Fig. 6. In low resolution, the logic is switched by software so that it is arranged as shown here.

"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.

H-100 SERIES COMPUTER SPECIFICATIONS:

USER MEMORY:
128K-768K bytes*

MICROPROCESSORS:
16-bit: 8088
8-bit: 8085

DISK STORAGE:
Built-in standard
5.25" disk drive,
320K bytes/disk

KEYBOARD:
Typewriter-style,
95 keys, 13
function keys,
18-key numeric pad

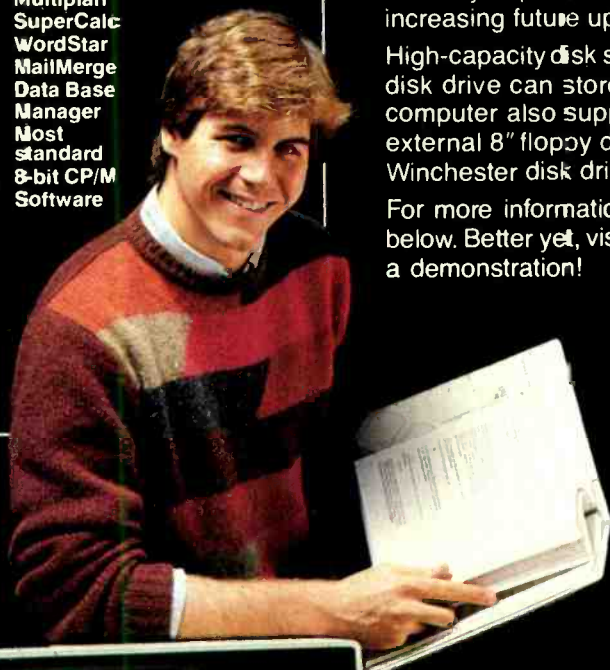
GRAPHICS:
Always in graphics mode.
640h/225v resolution;
up to eight colors
are available**

COMMUNICATIONS:
Two RS-232C Serial
Interface Ports and
one parallel port

* 128K bytes standard.
** Optional.

DIAGNOSTICS:
Memory self-test
on power-up

AVAILABLE SOFTWARE:
Z-DOS (MS-DOS)
CP/M-85 #
Z-BASIC Language
Microsoft BASIC
Multiplan
SuperCalc
WordStar
MailMerge
Data Base
Manager
Most standard
8-bit CP/M
Software



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 upgradability 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!

Heathkit
Heath
Company

Heathkit Electronic Centers are units of Veritechnology Electronics Corporation. Heath Company and Veritechnology Electronics Corporation are subsidiaries of Zenith Radio Corporation. CP/M is a registered trademark of Digital Research Corporation.

Circle No. 28 on Free Information Card

dealers get a little nervous when someone signs for half their inventory. You understand.

programs again.
What kinds of programs will work with ProFile and Catalyst?



Apple Computer Inc., 20525 Mariani Ave., Cupertino, CA 95014. For the authorized Apple dealer nearest you, call (800) 538-9696. In Canada, call (800) 268-7796 or (800) 268-7637. © 1983 Apple Computer Inc.

VisiCalc is a trademark of VisiCorp, Inc. Catalyst is a trademark of Quark, Inc. Apple, the Apple logo, Quick File and ProFile are trademarks of Apple Computer Inc.

www.americanradiohistory.com

COMPUTER VIDEO GAMES

Hands-On Reviews of Recently Released Game Software

GATEWAY TO APSHAI

ROM Cartridge for Atari 400/800
Epyx Computer Software, 1043 Kiel Ct.,
Sunnyvale, CA 94089; 408-745-0700.

Graphics ****

Gameplay ****

Sustained Interest ****

Type: Joystick action/maze/adventure
game

Memory Required: Resident ROM

encountered. Otherwise, the monster can get a couple of hits on you while you take your hand off the joystick to press the "Start" key. These monsters include such unlikely creatures as the Mamba Snake, the Ghouls and the Slime Mold (called "Fungus" on the screen).

By hitting the "Select" key, you can retrieve a set of keys from your bag to open locked dungeon doors that bar your progress with annoying frequency. That means getting out of the fight

MURDER BY THE DOZEN

Diskette for Apple, Commodore 64 and
IBM PC

CBS Software, One Fawcett Pl.,
Greenwich, CT 06836; 203-622-2500.

Graphics ****

Gameplay ****

Sustained Interest ****

Type: Keyboard mystery game

Memory Required: 48K

Mystery lovers rejoice! This latest entry in the convoluted pathways of computerized sleuthing is a combination text game with some throwaway graphics that help give you proper perspective. Some of the graphics are just window dressing; others, like the three-dimensional city map, are a pleasure and joy for computer nuts like me.

There are 12 possible cases; you pick the one you want to work on. They're all murders, and some are rather improbable.

CBS has supplied a mountain of documentation: a detective (instruction) manual, a book of clues that tells you the meaning of clue numbers that appear on the screen, a special printed pad to keep track of the case, and a confidential book of solutions.

The game is really designed more as a parlor exercise with up to four players matching wits with one another. It's exceptionally well done, intriguing, and one of the better text-style mystery computer games we've seen.

B.C.'S QUEST FOR TIRES

Diskette or ROM cartridge for Atari
400/800

Sierra On-Line, Inc., Sierra On-Line
Bldg., Coarsegold, CA 93614;
209-683-6858.

Graphics ****

Gameplay ***

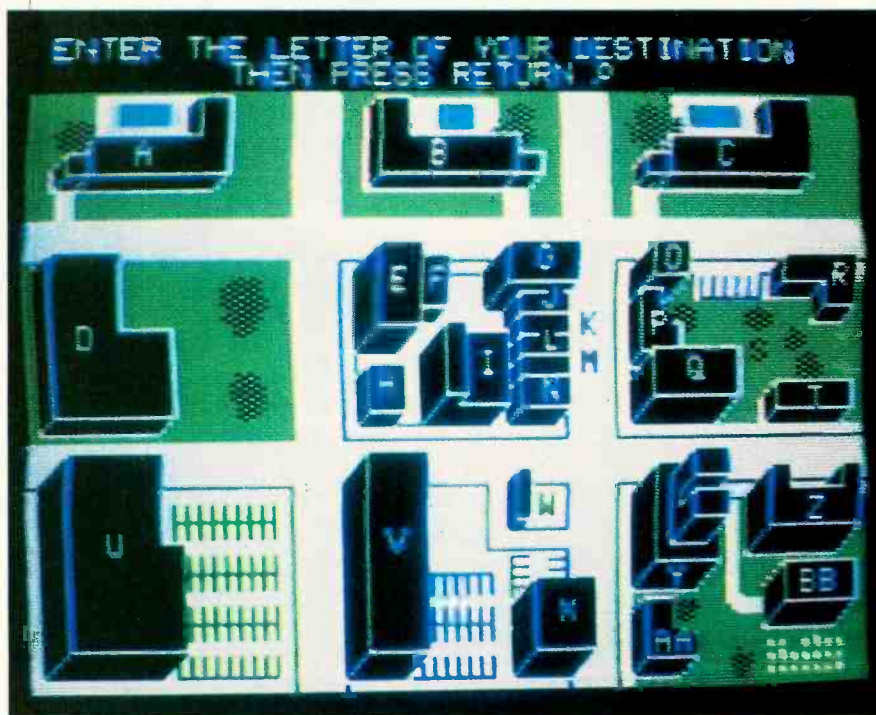
Sustained Interest ***

Type: Joystick action game

Memory Required: 32K

If you follow the comic strips, you're familiar with B.C. and star character Thor who is always riding on his uni-wheel. The graphics and animation of this game—actually designed by the comic strip's creator, Johnny Hart, are true to the sense and feel of the newspaper version.

Thor is at once comical and semi-tragic as he rides his wheel across the



Some of the graphics for "Murder by the Dozen" are fascinating.

Once again, we're presented with an adventure game-maze combination from Epyx, this time on a plug-in ROM cartridge. The object of the game is to complete all eight levels, scoring as many points as possible along the way. You complete a level by moving your hero through a maze of dungeons, fighting off monsters and avoiding traps, while picking up treasures to score points.

This is also a time-oriented game; if you haven't finished in 6.5 minutes, your hero is automatically transported to the start of the next deeper level. If that sounds like you're getting a freebee, forget it. Your five lives won't last long enough to run the clock out unless you decide to pace the floor in just one dungeon.

I found that keeping the game in the "fight" mode (selected with the "Start" key) helps to save a little time in doing battle with the several types of monsters

mode, which inevitably lays your hero open to danger.

During the game, when you use the Select key, you can check on such things as your status: strength, agility, luck, health, etc. You will also be able to see a full inventory of the treasures, spells, and useful objects that you're carrying.

Gateway has eight levels, 16 dungeons on a level, and about 60 rooms in each dungeon. That's a whopping 7500 different rooms for you to explore, which is a tall order no matter how much time you have.

The automatic screen scrolling is effortless and smooth, which means that the Epyx programmers have fine-tuned this particular aspect of the maze. This is an especially good game for adventure and maze game lovers. It has so many convolutions and twists and turns that it should be good for many an evening of enjoyment.

country to try to rescue Cute Chick, who's being held a prisoner by a dinosaur. The trip is loaded with hazards: boulders and craters to be jumped over, tree limbs to duck under, a river to cross by hopping stepping-stone fashion across turtle's backs. And on the other side awaits arch enemy Fat Broad with her club ready to do Thor in.

Then comes the lava pit, which our hero can cross by grabbing onto Dooky Bird's legs. Then there are a rushing, dangerous downhill sprint, crossing a ravine, ducking a volcanic eruption, and finally one more river to cross just before the dinosaur cave. Can Thor finally save Cute Chick from her fate? It all depends on your skill.

HARD HAT MACK

Diskette for Apple II
Electronic Arts, 2755 Campus Dr., San Mateo, CA 94403; 415-571-7171

Graphics ★★★★★+

Gameplay ★★★★★

Sustained Interest ★★★★★

Type: Two-button joystick or keyboard strategy/action game

Memory Required: 48K

When we see a game with the Electronic Arts logo, we expect excellence, and Hard Hat is no exception. This is a multilevel, get-through-the-task-and-avoid-being-killed kind of game. If you have an analog joystick with two firing buttons, it goes a bit easier and faster.

Mack is trying to work on his construction job—putting steel girders into place and then riveting them. But he has



In Level 2, Hard Hat Mack rides a girder to the top to collect tool boxes.

two enemies and several on-the-job hazards. The first enemy is called OSHA (that Federal safety agency that finds danger in every job situation) and the second is a vandal. If Mack runs afoul of either one, he loses a life.

He can also get hit by runaway hot rivets that fall and bounce down the screen, and he can fall off a girder. He has an elevator to help him get between construction levels on the screen. So much for the dangers in the first level.

The second level gets harder. Mack has to jump on conveyers and ride a girder up into the stratosphere to collect tool boxes. He has to avoid his usual en-

emies plus added dangers.

In the very difficult third level, Mack has to collect all the steel blocks and drop them through holes in the girders to the rivet machine. There's an elevator in this level that Mack can use, and he has to watch for the port-a-potti. There are three more levels, but we aren't good enough to see them yet.

OIL'S WELL

Diskette for Atari 400/800
Sierra On-Line, Inc., Sierra On-Line Bldg., Coarsegold, CA 93614.
209-683-6858.

Graphics ★★★★★

Gameplay ★★★★★

Sustained Interest ★★★★★

Type: Joystick action game

Memory Required: 32K

This is another one of those games inspired by Pac-Man, but in our opinion, it's much more original and interesting than most of the copycats. You have to go after the oil field with a drill bit that looks very much like old Pac-Man himself, but he's attached to a pipeline that snakes around mazelike shafts and passageways gobbling up oil "pellets", oozies and goblets.

There are land mines which can destroy the bit but not the pipe. The oozies—of which there are plenty, will destroy your extended pipe if you let them get near it. The only defense is to retract to the wellhead in a hurry with the firing button on the joystick.

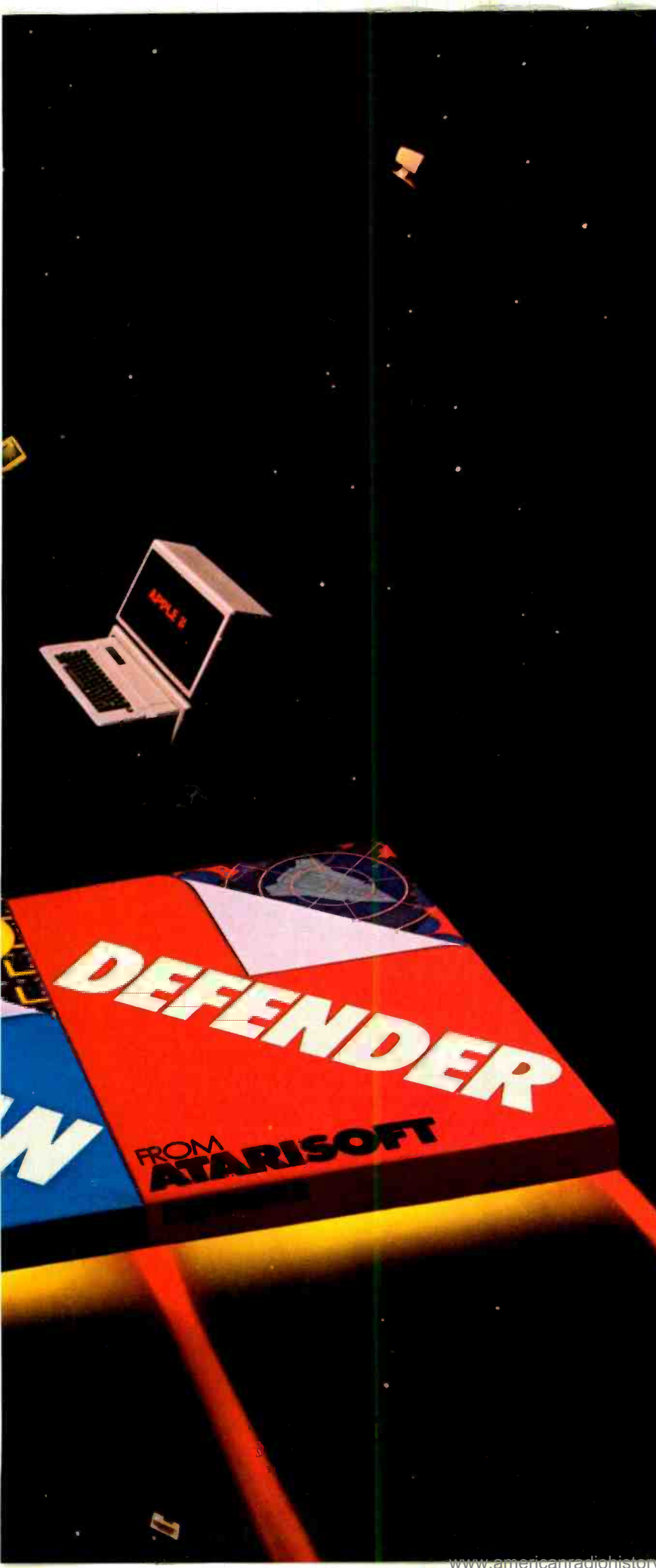
This is a high-speed, high-skill game, and certainly one of the better of the twitch variety that we've seen recently.

Thor has to cross a river by hopping from one turtle's back to another.



NOW YOUR COMPUTER FITS THE ORIGINAL ARCADE HITS.





Now the excitement of original arcade graphics and sound effects comes home to your computer.

Introducing ATARISOFT.™ A new source for computer software.

If you own a Commodore VIC 20 or 64, a Texas Instruments 99/4A, an IBM or an Apple II, you can play the original arcade hits.

DONKEY KONG by Nintendo, CENTIPEDE,™ PAC-MAN, DEFENDER, ROBOTRON: 2084, STARGATE and DIG DUG. (On the TI 99/4A you can also play Protector II, Shamus, Picnic Paranoia and Super Storm.)

So, start playing the original hits on your computer.

Only from ATARISOFT.

Some games also available on ColecoVision and Intellivision.

ATARISOFT™

Now your computer fits the arcade hits.

DONKEY KONG, Mario and NINTENDO are trademarks and © Nintendo 1981, 1983. PAC-MAN and characters are trademarks of Bally Midway Mfg. Co. sublicensed to Atari, Inc. by Namco-America, Inc. DEFENDER is a trademark of Williams Electronics, Inc., manufactured under license from Williams Electronics, Inc. ROBOTRON: 2084 is a trademark and © of Williams 1982, manufactured under license from Williams Electronics, Inc. STARGATE is a trademark and © of Williams 1981, manufactured under license from Williams Electronics, Inc. DIG DUG is created and designed by Namco Ltd. manufactured under license by Atari, Inc. Trademarks and © Namco 1982. PROTECTOR II is a trademark of Synapse Software Corporation, manufactured under license by Atari, Inc. SHAMUS is a trademark of Synapse Software Corporation, manufactured under license by Atari, Inc. PICNIC PARANOIA is a trademark of Synapse Software Corporation, manufactured by Atari, Inc. SUPER STORM is engineered and designed by Synapse Software Corporation, manufactured under license by Atari, Inc. ATARISOFT™ products are manufactured by Atari, Inc. for use on the above referenced machines and are not made, licensed or approved by the manufacturers of these machines. COMMODORE 64, VIC 20, TEXAS INSTRUMENTS 99/4A, IBM, APPLE, COLECOVISION and INTELLIVISION are respectively trademarks of Commodore Electronics Limited, Texas Instruments, International Business Machines Corp., Apple Computer, Inc., Coleco Industries, Inc. and Mattel, Inc. A Warner Communications Company. © 1983 Atari, Inc. All rights reserved.

Complete this coupon and we'll keep you up to date on the newest hits from ATARISOFT.™

Name _____

Address _____

City _____

State _____

Zip _____

Telephone _____

PRODUCT OWNED: (Check one)

1 TI-99/4A

5 Commodore Vic 20

2 IBM PC

6 Intellivision

3 Commodore 64

7 Apple II

4 ColecoVision

8 _____

Mail to:

Atari, Inc., P.O. Box 2943,
So. San Francisco, CA 94080.

ASM 4

Circle No. 9 on Free Information Card



INSIDE STORY

IBM's Peanut: A PC in a Junior-size Package

Offering upward compatibility with the PC, jr reveals some surprises, including a cordless keyboard

By George Mitchell

THE long-awaited IBM home system is here and it sports some interesting surprises.

Although the new system was long-ago dubbed the Peanut, supposedly the internal IBM code name for the project, the name being used is the PCjr. And, not so surprisingly, the name pretty much tells the tale—though it is certainly not a precise chip off the old block.

For example, the PCjr still uses the IBM PC's Intel 8088 microprocessor operating at 4.77 MHz and the DOS 2.1 in the disk-oriented version, which is a new generation of PC-DOS utilized on the larger machines.

Even with the similarities in processor and operating system, however, there are a number of differences between the IBM PC and PCjr. Specifically, the latter is designed to work with a standard home television set, has a cordless keyboard, and uses a desktop transformer for power, much like an Atari 800 does. Other features of the system include:

- 64K bytes of dynamic RAM, expandable to a maximum of 128K. Of this, 16K is dedicated to the video buffer.
- 64K bytes of ROM, containing power-on diagnostics, cassette BASIC interpreter, cassette operating system, I/O drivers, dot patterns for 256 characters in graphics mode, and a diskette bootstrap loader.

- Two ROM cartridge program slots.
- A cassette interface.
- Interfaces for adding joysticks, modem, light pen, and I/O expansion.

In addition, the system console, which measures 13.9" × 11.4" × 3.8" and tips the scale at less than 6 lb without disk drive (9 lb with a single drive), includes individually keyed connectors on the rear panel for attaching a variety of I/O devices.

The "entry" unit, without disk drives but with 64K of memory, cordless keyboard, transformer, and two cartridge slots, is expected to carry a price tag of \$669. To attach the unit to your color television set, add another \$30 for the connector cable. What you then have is a cassette-based BASIC system that is capable of displaying 40 characters on the screen and up to 16 colors.

Adding additional functions costs more, of course. For example, expect to pay in the neighborhood of \$1269 for the "enhanced" system that includes 128K of main memory and a 360-Kb disk drive. Cost will be higher, though, to make it all happen for this option-laden machine. So add \$30 for a TV set connector, \$175 for a thermal printer, etc., etc. You can add other items such as a joystick, internal modem, carrying case, adapter cable for an IBM color display, and a keyboard cord. Generally speaking, you will have more than



Using infrared communication, the keyboard is said to be able to be used 20 ft away from the base unit.

\$1900 invested in the machine if you purchase everything, excluding software, firmware, and color display.

The Keyboard's Cordless. One of the exciting features of the PCjr is its keyboard. Measuring approximately 13½" × 6½" × 1" and weighing 25 oz with 4 AA batteries, the keyboard features a typewriter-style 62-key layout, cursor-key control cluster, and a single function key.

Although the keyboard looks standard enough, it communicates with the system through two infrared-emitting diodes. The keystrokes are encoded with pulse-modulation techniques, which are then detected by the base unit.

IBM claims that the keyboard can be used 20 feet away from the base unit and that it has a wide 60-degree arc of operation. Physical obstacles will block the signal of course.

You don't have to rely on the IR link, however. IBM provides, at additional cost, a cable connection. This cable not only provides power to the keyboard but establishes a serial link for the encoded data by disengaging the battery power and IR link. IBM says that this option must be used when more than one unit is used in the immediate area to avoid interference.

Because the PCjr keyboard differs greatly from the standard PC keyboard, aside from its much smaller size and slightly-sculpted, Chiclet-like keys, IBM allows emulation via SHIFT CONTROL keys. It's claimed a user can then do everything on the PCjr that he does on the larger PC keyboard. To facilitate this, cardboard overlays are offered for

the PCjr keyboard. These are designed to be written or typed on so that specific application overlays can be created. Basically, this seems to be a cheap solution to what will probably be a very complex problem for serious users. Letters and numbers aren't marked directly on keys, by the way.

Apparently, the reason for the cordless keyboard is that positioning of the control section can be more flexible when used in the home and for playing games. However, some observers think that this foreshadows the IBM office communication system. The keys are supposedly full-travel types with membrane contacts.

Memory and Display Can Be Expanded. The very basic PCjr comes with 64K of built-in dynamic memory

and the ability to display 40 characters. Expanding both is handled via the memory and display expansion option, which you can expect to pay around \$140 for.

This module enables you to have a 625 x 480 resolution, 80 columns, and up to six pages of display memory. Moreover, an additional 64K of 150-nanosecond dynamic RAM is added. The board plugs into a 44-pin connector on the system board. This connector is the only I/O expansion on the system board.

You can probably expect a variety of manufacturers to offer multifunction boards to fit this connector by the first quarter of this year. But be aware that the electrical power to the PCjr is minimal. A single 60-VA transformer supplies the power, and extending the memory beyond 128K would severely drain its capabilities. Additionally, little space is available inside the system unit, and stacked boards won't fit.

Interestingly, the PCjr doesn't provide you with as much usable memory as you may wish, as you can see in Table I. Notice that only 112K bytes maximum is available, due to the 16K required for the video buffer. And when using the new DOS 2.1 only 82K bytes is available. As a result, many programs that work on a full-sized PC won't fit. However, IBM has modified some (EasyWriter 1.15 and most of the PFS software) to work in the limited memory.

Although there is little space inside the system cabinet, IBM has designed an internal 300-bps auto/answer auto/dial modem. This plugs into a special connector on the system board, and the telephone jack extends from the rear. Since the modem does employ serial signals and uses the interrupt structure of the PCjr, the connector may offer add-

APPLE'S MACINTOSH OFFERS MORE FOR LESS

If you're not an IBM fan and like the Apple world, the Macintosh personal computer is just a month away.

According to sources close to the company, Apple's latest entry is expected to be unveiled at the annual stock holders' meeting in early January.

The machine, which features Lisa-like functions such as the mouse cursor controller, uses a 68000 processor, has dual 5¼" standard disk drives rather than the unreliable Twiggy drives, includes a 7" (diagonal measurement) monochrome integrated CRT, and provides composite video output for use with a color monitor or television.

The full-size typewriter keyboard, although not cordless, may be easier to use than any other machine offered in its price class. (You can probably expect to pay

less than \$3000 for the Macintosh when it finally appears on the market.)

As enticing as Macintosh sounds, it, too, may have some shortcomings. Specifically, it may be lacking in software. To date, not enough has been developed for Lisa, so why should Macintosh have great early software support? It seems that most programming shops are tuned in to creating products for the 8088 CPU rather than the 68000.

However, it is believed that Macintosh may have a heads-up chance at getting software by offering more than just an Apple operating system. You might expect to see Digital Research's CP/M-68K and VisiCorp's Visi-On on the machine. In addition, it appears that Microsoft is preparing to offer its popular Multitool series on the machine.

Radio Shack Presents the Transportable TRS-80[®]

The New Model 4P Computer—From the World's Largest Computer Retailer



The Computer for Today's Upwardly Mobile Society

If you're headed for success, our newest TRS-80 can help you get there in record time. The Model 4P is a compact, disk-based desktop computer with a big difference: it has a handle. So wherever your work may take you, you can get a handle on scheduling problems, ever-changing sales projections, and last minute reports. It's like having your office with you on trips, at home—anywhere!

A Completely Portable, Self-Contained System

We don't sacrifice features for portability, either. The Model 4P comes standard with two 184,000-character disk drives and 64K internal memory. You also get a full 80-character by 24-line 9" display, an electric typewriter-quality keyboard with numeric keypad, and printer and communications interfaces. And you can add an extra 64K of memory, an internal modem or even external hard disk drives!

"Off the Shelf" Software

In addition to running the entire selection of TRS-80 Model III/4 disk software, you can add the optional CP/M Plus™ operating system to use thousands of additional ready-to-run programs.

Easy to Use, Easy to Tote

The Model 4P works anywhere there's AC. And when you're ready to move on, slip the keyboard into the hi-impact case, snap on the protective cover and go. It weighs just 26 pounds.

Like Every TRS-80, We Stand Behind the "4P" 100%

Tandy Corporation is a two-and-one-half billion dollar company with over 6,600 stores nationwide. That means software, service, leasing plans and friendly faces are always just around the corner.

Available Nationwide

Stop by your nearest Radio Shack Computer Center, participating store or dealer today and find out where Model 4P will take you.



Radio Shack[®]

The biggest name in little computers[®]
A DIVISION OF TANDY CORPORATION



TRS-80 Model 4P Computer

179900

26-1080

Commercial Lease Available
For Only \$65 Per Month
(Plus Applicable Use/Sales Tax)

Prices apply at participating Radio Shack stores and dealers.
CP/M Plus is a trademark of Digital Research.

Send me your free TRS-80 Computer Catalog today!
Mail To: Radio Shack, Dept. 84-A-680
300 One Tandy Center, Fort Worth, Texas 76102

NAME _____
ADDRESS _____
CITY _____ STATE _____ ZIP _____
TELEPHONE _____

on makers a solution as to where to plug things in.

Cartridges Add Programs. Following an Atari- and TI-like concept, the PCjr also comes equipped with two 28-pin ROM cartridge slots.

The cartridges include a number of games, educational software, and, apparently, an IBM logo. You can look for: Monster Math, Animation Creation, Bumble Games, Juggles' Butterfly, Turtle Power, Personal Communications Manager, and Casino Games, to name a few. Cartridge BASIC is also available as an option for \$75.

There are expected to be about 50 cartridges available by the time you read this, and an equal number of disk-based software packages.

DOS 2.1, a Better O/S. Once you tire of using the PCjr as a cassette-based system (1500-baud transfer is used on the cassette) or cartridge system, you will more than likely upgrade to a disk-based system.

You can choose to use one single drive in concert with cartridge BASIC and the cassette O/S to maximize system operation and minimize cost. (IBM does not presently offer an outboard second drive, though the system is said to be able to support it with the proper controller electronics to go with it.) You can upgrade the entire system by adding serial and parallel adapters, a thermal printer, and a host of other options.

Once you've added everything, you have a fairly complete system, though only a one-drive system. And DOS 2.1 completes the picture. The \$65 O/S comes with a user's guide and a DOS reference manual.

Like previous versions, DOS 2.1 operates on all prior PC models, but earlier versions of DOS don't work on the PCjr. The new version works with either single- or double-density disk drives, can support a hard disk (an option that may come for the PCjr).

One aspect of DOS 2.1 to be considered is that it has higher memory requirements than previous versions (about 12K bytes more than 1.1). In addition, it supports graphics screen dump to the printer, global file name searches,

TABLE I—MEMORY USAGE

	Memory Used	Total System Memory	
		Approx. Remaining User Memory	128K
Video buffer	16K	64K	128K
Cassette BASIC (ROM)	4K	44K	108K
DOS	24K	24K	88K
Cartridge BASIC (w/o DOS)	6K	42K	106K
Cartridge BASIC (with DOS)	30K	18K	82K

and supports multiple-disk I/O memory buffers to speed disk performance.

You can also have job stream command sequences, and support current date and time in directory entries. Further background operations such as file print are included, and you can divert parallel printer output to serial.

The basic commands of DOS 2.1 are similar to previous versions, with some added functions and commands to ease its use, as shown in Table II.

Generally speaking, the use of DOS 2.1 and the cordless keyboard may be the real hallmarks of the system. The rest is almost pedestrian.

Setting Up. Setting up the PCjr is fairly simple. You can use the keyboard cable or operate in a cordless mode. You can then connect the system console to either your color TV, a standard composite video monitor, or, through a \$20 adapter cable, the IBM color display via a plug on the rear of the system console. If you plan anything serious, you should probably consider getting the higher-class display. The popular BMC color monitor will work nicely, I believe. Be aware, however, that, if you plan to have sound effects, you do need the television receiver since the system uses the speaker in the TV set. If you want the better display *and* sound, you'd have to kludge up a speaker on the system console.

The 2-lb, 13-oz desktop stepdown transformer is plugged into a connector at the rear and supplies power to the entire system.

Once you have everything plugged in and turned on, you're greeted with the IBM logo and 16 color bars. While this screen is being displayed, the system is self-checking, and a single beep and change to BASIC 1.1 signifies that everything is operating correctly.

You can choose to run Keyboard Adventure, which is built into the system ROM. This is entered by tapping the escape key during the system start-up sequence. This program uses a cartoon character to take you through the use of the keyboard.

Early Conclusions. The PCjr, finally emerging out of the swell of rumors under the guise of "Peanut," is a classy home personal computer. Sure there's a list of wish-it-hads that could be made; but, price aside, it's an impressive package—for the home, that is, not for heavy small-business use. After all, it would be unfair to compare, say, a student's home electric typewriter with a heavy-duty office typewriter.

Nonetheless, the keypads, though operating smoothly, are not a touch-typist's delight owing to their size and

TABLE II—DOS COMMANDS

Function	DOS Command or Utility
Configuration File (CONFIG.SYS)	BREAK = ON/OFF BUFFERS = DEVICE = FILES = ASSIGN
Substitute diskette drive assignments	
Batch file support	.BAT
Check for Ctrl/Break interrupt	BREAK
Check diskette or fixed disk	CHKDSK
Clear screen	CLS
Compare files	COMP
Copy files	COPY
Set date	DATE
Set time	TIME
Delete files	DEL. ERASE
List directory	DIR
Compare diskettes	DISKCOMP
Copy diskette	DISKCOPY
Format diskette or fixed disk	FORMAT
Graphics screen dump	GRAPHICS
Set display or printer options	MODE
Remark within batch file, then wait	PAUSE
Print files in "Background"	PRINT
Change DOS prompt	PROMPT
Recover file	RECOVER
Remark from batch file	REM
Rename a file	RENAME, REN
Transfer DOS to another diskette or fixed disk	SYS
Set time of day	TIME
Display file contents	TYPE
Display DOS version	VER
Write-verify data to diskette	VERIFY
Display disk(ette) label	VOL
Line editor	EDLIN
Load, alter, display/execute files	DEBUG
Link-edit a compiled program	LINK
Change directory	CHDIR
Substitute screen & keyboard	CTTY
Convert .EXE files to .COM format	EXE2BIN
Search for string in file	FIND
Create a sub-directory	MKDIR
Pause after displaying screenful	MORE
Specify directory paths	PATH
Remove directory	RMDIR
Set environment	SET
Sort data	SORT
Display directory paths	TREE
Initialize a fixed disk	FDISK
Backup fixed disk files to diskette	BACKUP
Restore files from diskette to fixed disk	RESTORE

shape. The same could be said for keys of some very fine electric typewriters, too. Further, people who aren't proficient typists might find the absence of markings directly on the keys disconcerting. Instead, they're marked on the keyboard's base. Apparently, the anticipated use of a variety of keyboard overlays led IBM to make this decision (each key can be programmed for special applications). Furthermore, it would have been nice to have a numeric keypad.

Color video quality of a model demonstrated was excellent, with 16 individual colors in medium-resolution and four colors in high-resolution.

When we get our hands on a jr for a reasonable period of time, we'll get more details on it for you. Meanwhile, I'd liken this machine to Cadillac's "Cimarron" small automobile. It will compete at the top of the nonbusiness personal computer area. Other less prestigious machines will get you there also, of course. ◇



LAST NIGHT, 39 MUSICIANS HAD A COMPU SERVE CONFERENCE, SO DID 31 M.D.S, 49 SPORTS FANS AND 640 APPLE POLISHERS, AND NO ONE HAD TO LEAVE HOME.

The Electronic Forum, Cheaper than Long Distance and Much More Rewarding.

Every night on the CompuServe Information Service, professional and social groups discuss a wide range of subjects. From what's new in medical technology to what's nouvelle in continental cuisine.

And every day more computer owners who share a common interest are discovering this exciting new way to exchange ideas and even transfer hard copy data.

And besides electronic forums, they leave messages for each other on our national bulletin board, "talk" informally on our CB simulator, and communicate via CompuServe's electronic mail.

But best of all, in most cases, CompuServe subscribers get all of these state of the art communications options, plus a world of on-line information and entertainment for the cost of a local phone call plus connect time.

To become part of this flexible communications network, all you

need is a computer, a modem and CompuServe. CompuServe connects with almost any personal computer, terminal, or communicating word processor.

To receive an illustrated guide to CompuServe and learn how you can subscribe, contact or call:

CompuServe

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

800-848-8199

In Ohio call 614-457-0802

Circle No. 60 on Free Information Card

An H&R Block Company

At CIE, you get electronics career training from specialists.



If you're interested in learning how to fix air conditioning, service cars or install heating systems— talk to some other school. But if you're serious about electronics... even earning an Associate Degree... come to CIE —The Electronics Specialists.

Why trust your education and career future to anything less than a specialist?

You shouldn't. And you certainly don't have to.

If you talked to some of our graduates, chances are you'd find a lot of them shopped around for their training. They pretty much knew what was available. And they picked CIE as number one.

Be sure to shop around. Because, frankly, CIE isn't for everyone.

There are other options for the hobbyist. If you're the ambitious type—with serious career goals in electronics—take a close look at what we've planned for you at CIE.

What you should look for first.

Part of what makes electronics so interesting is it's based on scientific discoveries—on ideas! So the first thing to look for is a program that starts with ideas and builds on them!

That's what happens with CIE's Auto-Programmed® Lessons. Each lesson takes one or two principles and helps you master them—before you start using them!

How practical is the training?

This is the next big important question. After all, your career will be built on what you can do—and on how well you do it.

Here are ways some of CIE's career courses help you get your "hands-on" training...

With CIE's Personal Training Laboratory...

you learn and review the basics—perform dozens of experiments. Plus, you use a 3-in-1 precision Multimeter to learn testing, checking, analyzing!

When you get your own 5MHz, solid-state

oscilloscope, you take some real professional steps. You use it as a doctor uses an X-ray machine—to "read" waveform patterns...lock them in...study, understand and interpret them!

When you get your Digital Learning Laboratory, you'll

be into digital theory—essential training today for anyone who wants to keep pace with the state of the art of electronics. With CIE's Digital Lab, you'll be applying in dozens of fascinating ways the theory you've learned. For example, you'll compare analog and digital devices. You'll learn to make binary to decimal conversions and to work with semiconductor devices and circuits. You'll see how digital equipment is vital to today's exciting, growing fields such as security... where digital theory provides the brains for space-age alarm and protective devices.

You'll build your Microprocessor Training Laboratory, a working microcomputer—from "scratch." You'll also learn how to program and interface it with displays, memories, switches, and more.

Earn An Associate Degree from CIE.

One of the best credentials you can have in electronics—or any other career field—is a college degree. That's why CIE gives you the opportunity to earn an Associate in Applied Science

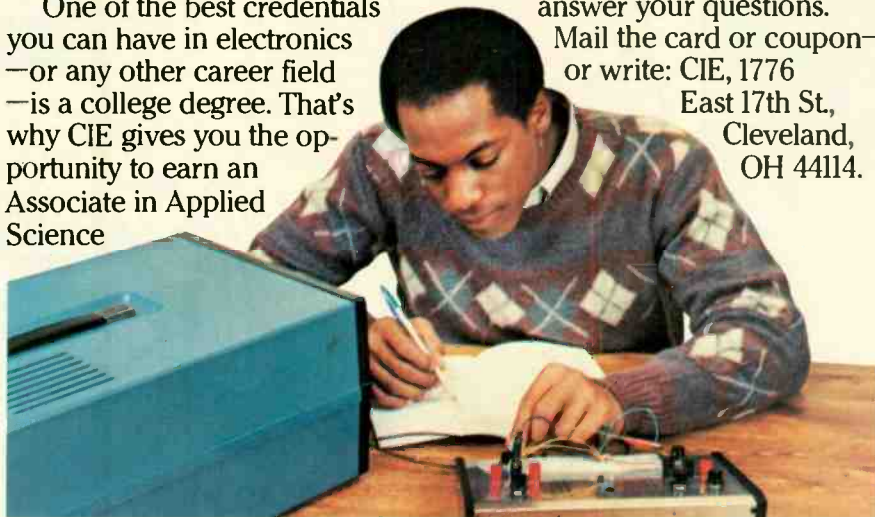
in Electronics Engineering Technology. Any CIE career course can offer you credit toward the degree...more than half of the number needed in some cases.

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

Shop around...but send for CIE's free school catalog first!

Mail the card. If it's gone, cut out and mail the coupon. If you prefer to write, mention the name and date of this magazine. We'll send you a copy of CIE's FREE school catalog—plus a complete package of independent home study information! For your convenience, we'll try to have a representative contact you to answer your questions.

Mail the card or coupon—
or write: CIE, 1776
East 17th St.,
Cleveland,
OH 44114.



CIE Cleveland Institute of Electronics, Inc.

1776 East 17th Street, Cleveland, Ohio 44114

Accredited Member National Home Study Council

YES... I'm shopping around for the right kind of career training in electronics—and CIE sounds well worth looking into. Please send me my FREE CIE school catalog—including details about the Associate Degree program—plus my FREE package of home study information!

Print Name _____

Address _____ Apt. _____

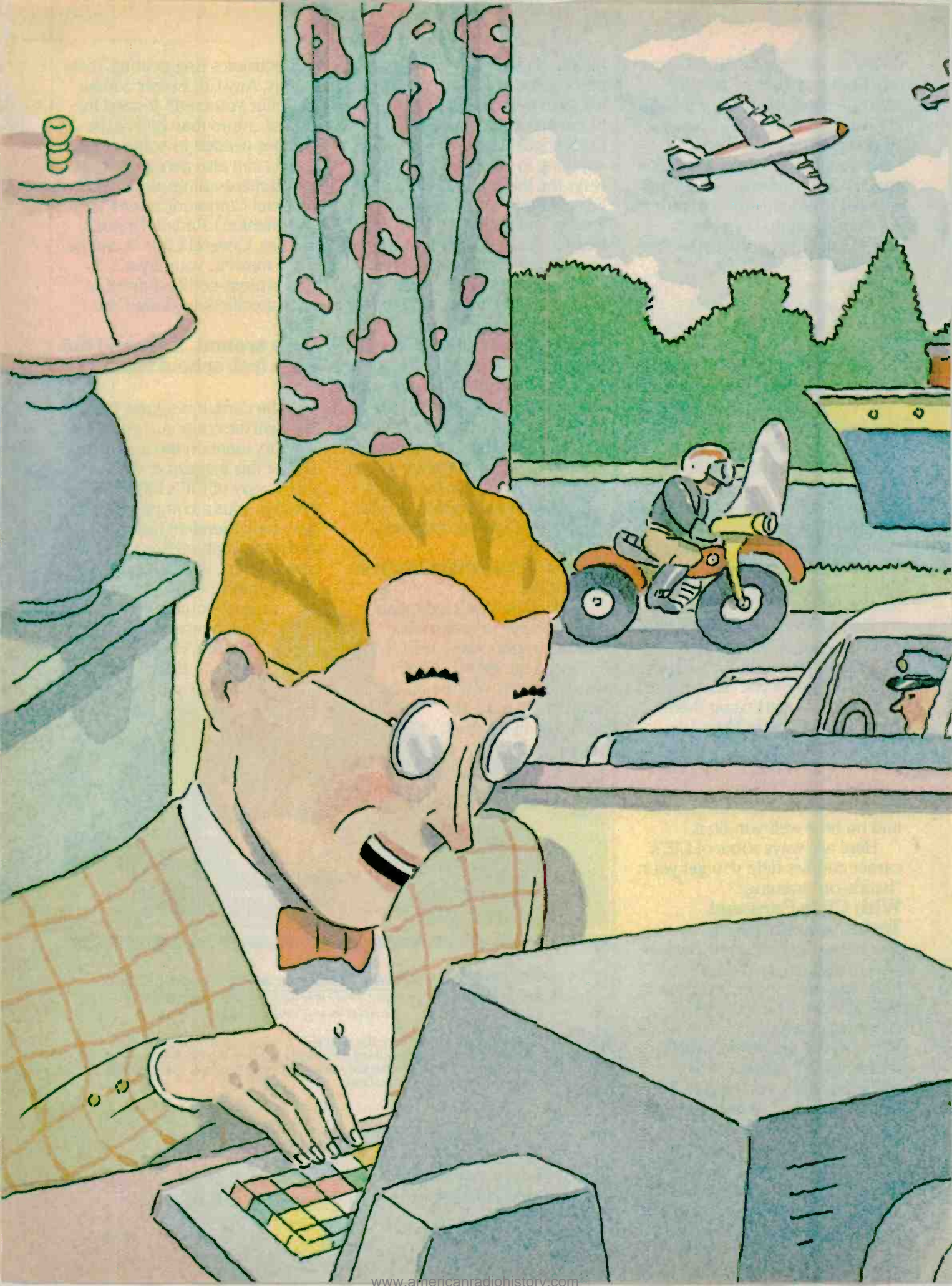
City _____ State _____ Zip _____

Age _____ Area Code/Phone No. _____ / _____

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

MAIL TODAY!

PE-03





CompuScan/2100

BEARCAT SCANNING RECEIVER

INTERFACING microcomputers to external equipment is commonplace. Every so often, though, an exciting new application comes along. This is the case with the Bearcat CompuScan/2100 scanning receiver system from the Electra Company. Electra, which produced the first scanning receiver radio in 1968, has interfaced a high-quality scanner to a Commodore-64 personal computer (and plans to do the same with other popular micros). The result is a scanning receiver system with capabilities well beyond those available on current top-of-the-line scanners.

For those not familiar with scanners, this type of receiver can tune in the Public Service bands such as local Police and fire calls, mobile telephone conversations, weather broadcasts, marine radiotelephone, and many other kinds of transmissions. Scanning usually consists of establishing frequencies that are monitored in sequence by the receiver. If a signal is picked up, the receiver broadcasts it until it is over; then it continues on, jumping from one frequency to the next until it finds another active transmission. The cycle then repeats itself.

*Combining a microcomputer
with a scanner*

By Joe Desposito



The 10¼" x 9½" enclosure houses receiver and CPU.

The number of frequencies that can be monitored at one time with a scanner is typically less than ten, although some top-of-the-line models scan as many as 50. In contrast, the CompuScan system can monitor 200 frequencies at a time. Additionally, it displays pertinent information about the frequency (such as its source of transmission), and maintains a log of selected frequencies.

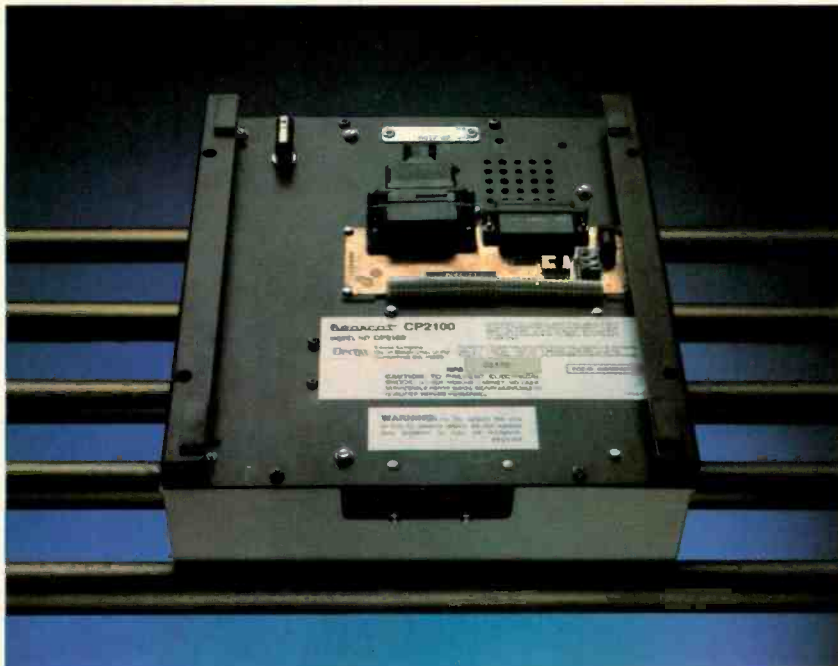
CompuScan can receive frequencies in the following ranges:

30- 50 MHz Low-Band VHF (FM)

118-136 MHz Aircraft (AM)
 144-148 MHz 2-M Amateur (FM)
 148-174 MHz High-Band VHF (FM)
 421-450 MHz 70-cm Amateur (FM)
 450-470 MHz UHF Band (FM)
 470-512 MHz UUHF-T Band (FM)

The CompuScan scanning receiver system includes the receiver, a whip antenna and cable, interface cable, software on 5¼" disk, and power supply. To run the system reviewed here, you need a Commodore-64 microcomputer, whose keyboard is used as the front-end

On the bottom are the RS-232 port and accessory connector.



tuning selector, and one disk drive. Suggested retail price of the system is \$499.95.

Hardware. The Bearcat CompuScan/2100 system includes a state-of-the-art scanning receiver that operates under microprocessor control. Patented features such as track tuning, enhance scanner sensitivity. A block diagram of the microprocessor control section is shown in Fig. 1.

A modest 10¼" x 9½" x 2¼" enclosure houses both receiver and microprocessor circuitry. The microprocessor is a Z-8 with an on-board UART. The unit interfaces to the host computer through an RS-232 port that provides TTL compatible signals as well as true RS-232. An RS-232 interface cable that plugs into the user port of the Commodore 64 is included with the package. Also included is a system disk, and an adapter.

Four auxiliary outputs on the receiver permit the user to connect accessories such as an audio tape recorder to the receiver. One of the outputs connects to a normally open relay that closes when a signal is present. The other three outputs each provide 200 mA current sink capacity (to ground) under various control conditions.

Supplied with the receiver is a telescoping whip antenna (with base) and 20' of RG-58 cable. The antenna can be easily maneuvered in a room for maximum reception. The receiver has an internal speaker, and volume and squelch controls. If desired, the speaker and controls can be disabled and replaced by comparable external devices.

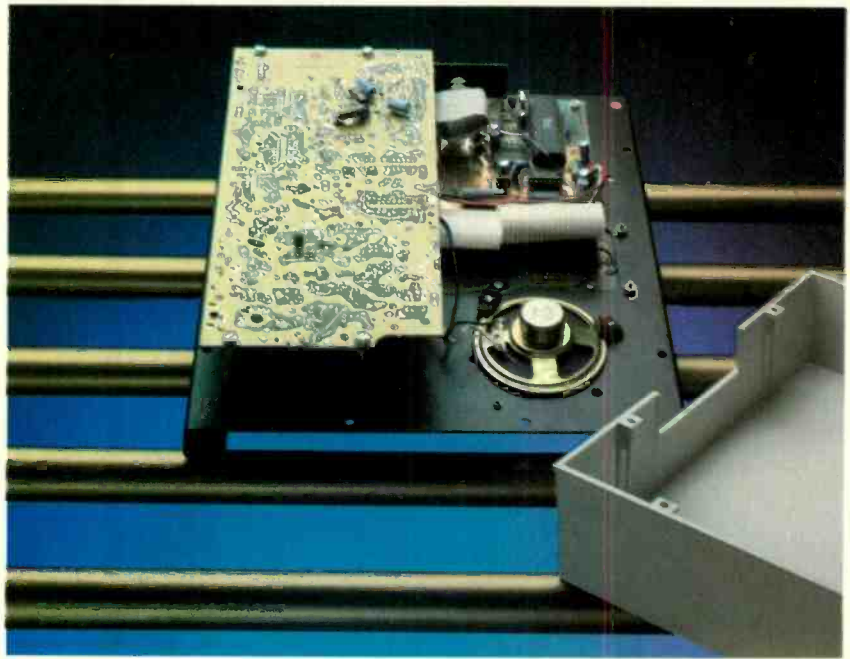
Software. CompuScan software is completely menu driven. The system comes up in "Standby" mode, which presents five options to the user: Manual, Scan, Search, Quit, and Zero.

Manual mode is selected by pressing M on the keyboard. This brings up a display of "Bank 1" that contains channels 1 to 20, plus additional information for each channel (Fig. 2). The information indicates whether or not a channel is locked out, a delay is set, or the auxiliary bits are set. To select a channel from bank 1 (or any other bank), you just enter the channel number. To change to a different bank, press C, and then enter the appropriate bank number.

When you select a channel, the receiver automatically tunes to the frequency and broadcasts a signal if it is present. A screen appears, too, showing corresponding channel data (Fig. 3). If you are entering information for the first time, you must input the frequency first. Once the frequency is entered, you may then input additional information

that pertains to it. LOCK OUT causes the scanner to pass over the frequency when in the scan mode. DELAY causes the receiver to remain tuned to a given channel in scan mode about two seconds following the loss of signal on that channel. This feature is useful for transmissions that are followed by a response on the same frequency. COUNT keeps track of the number of times a frequency is found to have a signal present during a scan sequence. Selecting this option zeroes the count.

Choices 5 through 8 of the channel data menu allow you to set the auxiliary bits. These bits refer to special control signals present at the accessory jack on the bottom of the receiver. AUX 1 activates built-in relay contacts when set and a signal is present. This is useful for connecting a cassette tape recorder to the scanner. When AUX 2 is set and a signal is present, it sinks 250 mA (max) for controlling external devices such as alarms. AUX 3 and AUX 4, when set, sink 200 mA whenever a channel is sampled



Interior of the scanner shows the main and CPU boards.

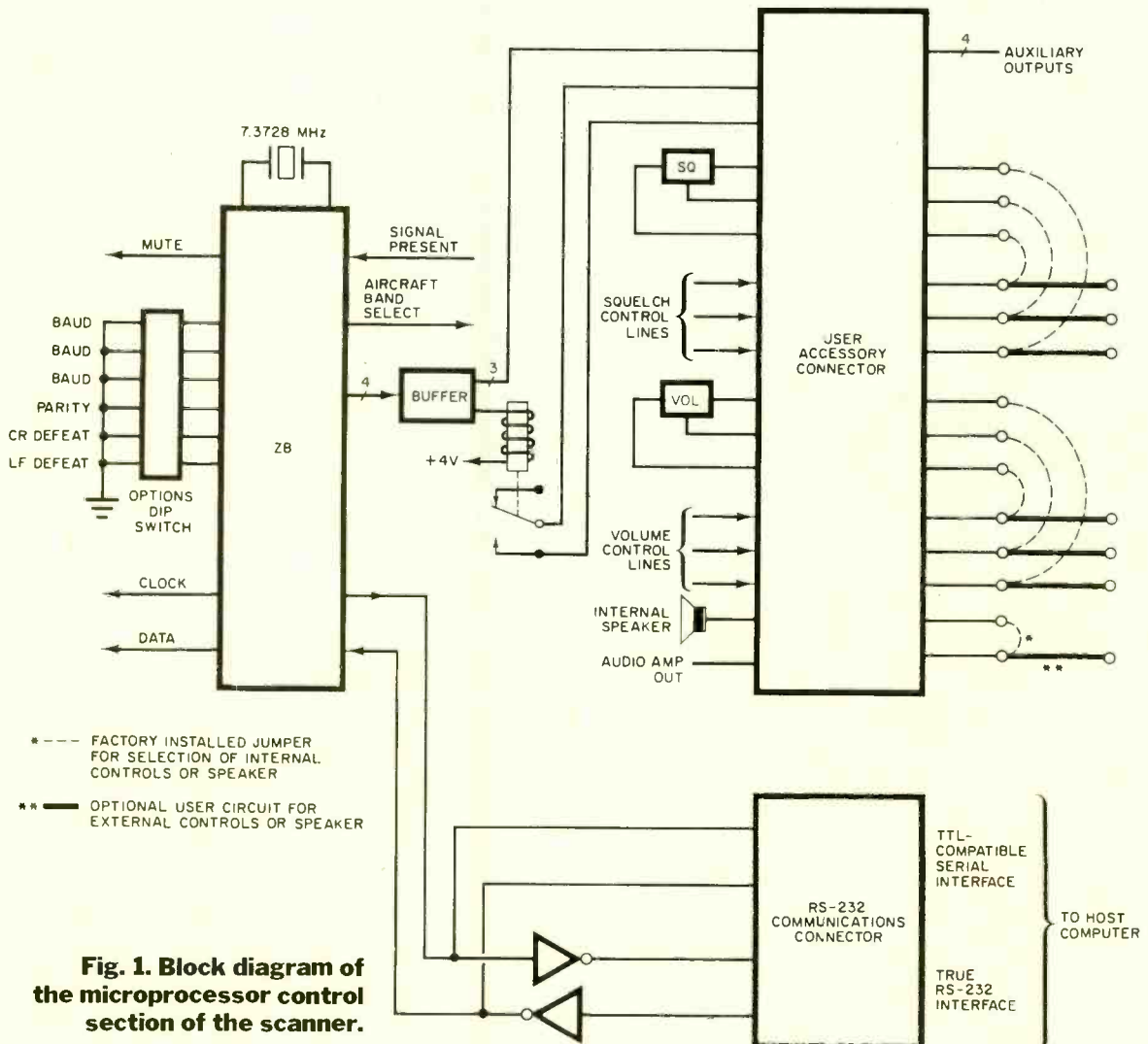


Fig. 1. Block diagram of the microprocessor control section of the scanner.

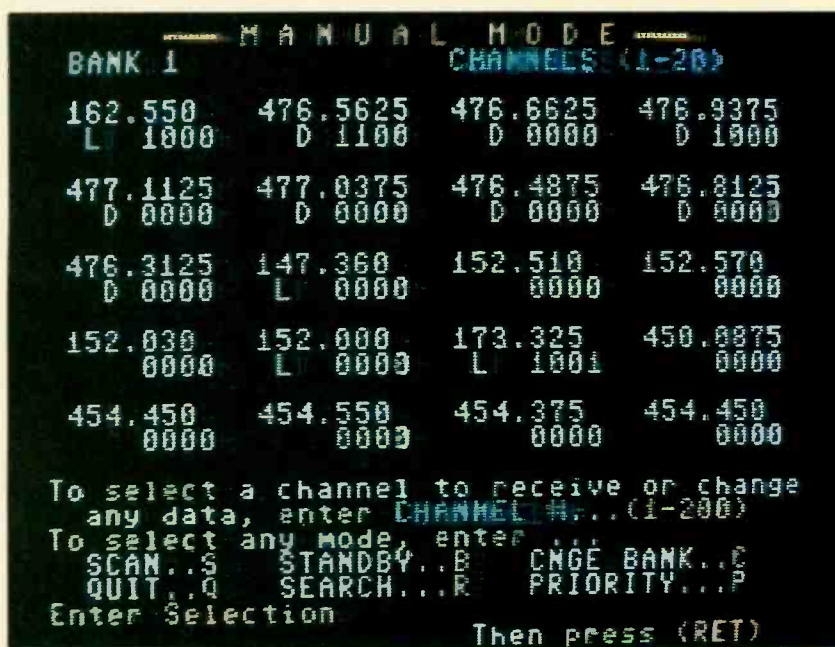


Fig. 2. Display of Bank 1 shows channels 1 to 20.

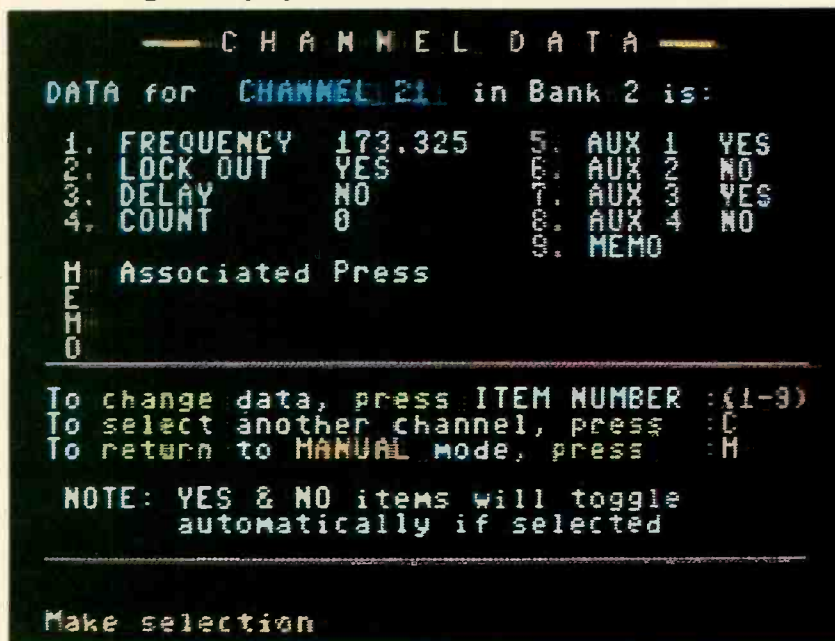


Fig. 3. When a channel is selected, its data appears.

(a signal need not be present). These bits are useful for antenna switching.

With the MEMO feature, you can insert up to four lines of information about a channel. Information might include the source of the broadcast, names, telephone numbers, codes, required procedures, etc.

From Manual mode, you may select up to three "Priority" channels. Priority operation causes CompuScan to monitor the channels regardless of what the user may be doing otherwise. If CompuScan picks up a signal while scanning or searching, it will also sample the priority channels at approximately 2-second intervals. If a signal ap-

pears on a priority channel, CompuScan switches the broadcast to that signal.

Scan mode is the "business" mode of CompuScan and can be entered from either standby or manual modes. You may choose the number of banks you wish to scan (10 banks of 20 channels each are available). Channels within each bank can be skipped over during the scanning process by choosing the lockout feature while in manual mode.

Once you start scanning, a graphic appears on the screen that shows you the channels being scanned. For example, when the receiver scans channels 1 through 20, the screen looks like the one shown in Fig. 4A. An L beneath a chan-

nel number means that the channel is locked out; an asterisk means that the channel has been sampled, and no signal was found. If a signal is present on a channel, the screen changes to that shown in Fig. 4B. It shows the channel, its frequency, and any information about the channel that was included when first stored. If the channel loses its signal, the receiver automatically begins scanning again. If you want to interrupt the process, you may do so with one of the five options shown at the bottom of the screen (Fig. 4B).

Search mode allows you to search for active frequencies between upper and lower limits that you enter. The frequencies that you enter must be valid ones, which means that they must lie within the band limits of the receiver (Fig. 5).

There is one other search feature that I didn't review, but which will be included in the final product. It's called the Search/Store/Count feature. In effect, the system in this mode does not stop and transmit a signal. Instead, it pauses momentarily and stores the frequency. When through with the search, the system displays the number of frequencies stored. Also, you can step through the frequencies to get a count of how often each was encountered during the search. If the frequency is of interest to you, you can automatically store it in a data bank.

The final two options of the Standby Menu are Zero and Quit. CompuScan automatically counts how many times a signal is present on a frequency during scan mode and displays a running total on the channel-data screen. Zero allows you to zero these counts for all channels stored in the system. When you are through operating the scanner, Quit closes all the files.

There are a few other noteworthy features of the software. Whenever you make an improper entry, the screen blinks in red. This gives you a quick visual feedback that an error has been made. If you load the software and forget to turn the receiver on, NO RESPONSE comes up on the display. This is a reminder to turn the receiver on.

All the data you enter is stored on the system disk. Thus, there is no need for a separate data disk. The program itself is written in BASIC. A spokesman for Electra indicated that the program could have been written in machine code to achieve optimum performance. However, it was decided instead to allow users access to the code if they wanted to modify it in any way. The complete program listing in BASIC is available from Electra. The listing is well commented and contains a cross-reference table.

Here's How You Can Learn 16-Bit Technology. And Graduate To One Of Today's Most Powerful And Advanced Microcomputers.

Now you can master 16-bit technology with an all-new Advanced Microprocessor course. And build hands-on experience with the only 16-bit microcomputer specifically designed for the hobbyist, working engineer and student.

Advanced Microprocessor Course

This all-new self-study course (#EE-8088) provides in-depth coverage of 16-bit, state-of-the-art technology.

You will gain a thorough understanding of microprocessors from this 1200 page course. In 10 easy-to-understand units, starting with microcomputer basics, you'll cover all phases of 16-bit micro-processing. Assembly language. Program writing. Addressing modes. Dynamic and static RAM. And hardware interfacing.



And by using your 16-bit Trainer/Learning Computer for hands-on experiments (over 60 included), you'll gain actual circuit interface and software programming experience with an

8088 microprocessor system.

Trainer/Learning Computer

A unique combination of design features makes this versatile microprocessor system much more than a "teaching machine." Use it as a trainer with the Advanced Microprocessor course. Use it as an experimental design computer. And use it to run a wide variety of 16-bit software—including Z-Dos, Multiplan, Z-Basic, Condor File Manager, and much more.



In its most basic form, the Trainer/Learning Computer is a 16-bit,

cassette-based microcomputer.

Its unique design features access ports and solderless breadboards to allow you to build interfaces, design and modify circuits, or simply experiment with the inner workings of the microprocessor system.

The basic system has an 8088 processor, 32K ROM (including assembler, editor and debugger) and 16K RAM.

The unit also features a serial I/O printer port, cassette interface and a detached 95-key keyboard (including 16 function keys and a numeric keypad) which generates a full ASCII character set. It's available either in kit form or factory assembled.

And you can take advantage of the system's H/Z-100 computer design heritage by easily upgrading it to a disk-based, 16-bit microcomputer that will run H/Z-100

series software and many other forthcoming programs.

Fully Upgradeable

The powerful upgrade package and variety of accessories allow you to make the basic 16-bit system more powerful and versatile. You can add 128K or 192K bytes

of RAM. Floppy disk controller. 48TPI double-sided, double-density, single or dual floppy disk drive. Bit-mapped video graphics or full-color graphics. Two RS-232 ports. Programmable timer. And a Centronics-compatible printer port.

Learn on it. Design with it. Use it as a 16-bit computer.

It's the only 16-bit microprocessor system specifically designed to integrate theory with a hands-on understanding of how 16-bit computers work. And it's from Heathkit/Zenith Educational Systems, the world-leader in problem-solving courses, trainers and accessories to help you learn state-of-the-art technology.



Heathkit[®]
Heath
Company

A subsidiary of Zenith Radio Corporation

Circle No. 24 on Free Information Card



Get more information in the
**FREE
HEATHKIT CATALOG**

Mail to: Heath Company, Dept. 010-134
Benton Harbor, MI 49022

Name _____

Address _____

City _____

State _____ Zip _____

ED-200

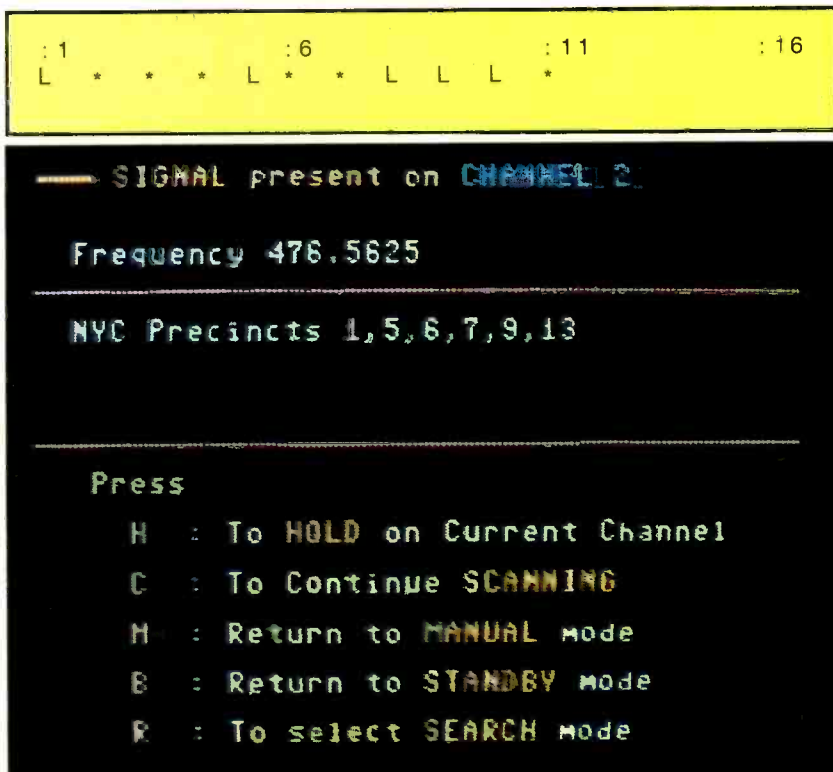


Fig. 4. At top (A) is scan of 1 to 20. Screen changes to (B) below if a signal is present on a channel.



Fig. 5. This screen shows band limits of frequencies.

Using CompuScan. Initial setup of the CompuScan receiver is fairly simple. A cable must be connected between an RS-232 connector on the underside of the receiver and the user port of the Commodore-64. The receiver also connects to a telescoping whip antenna with a 20' length of RG-58 cable. Then all you have to do is plug the ac adapter into a wall socket and plug its jack into

the receiver. This procedure has to be done only once and it can be left as is thereafter.

Loading the program takes a little over a minute. When you run it, data on the disk is loaded into RAM. This takes another 1½ minutes or so. The software comes up in standby mode, which is a menu that allows you to enter any of the other modes of the system. When you

first use the system, you must enter manual mode and load frequencies into the data banks. If you're not familiar with the frequencies to tune to in your area, there are publications available to find out what they are. Electra publishes a pamphlet that lists local frequencies and who is transmitting on them. They also publish the "Betty Bearcat" frequency directory for different regions of the U.S. Your local dealer can help you find this information.

Once you've loaded the frequencies into the data banks, you can switch into scan mode. You can scan all or some of the data banks by listing the appropriate bank numbers, which the program queries you for. Any channels within the banks that you don't want scanned must be locked out while in manual mode. A typical frequency that you would want to lock out is the weather broadcast. Since this is a continuous broadcast, the scanner would never leave the station once it tuned it in. After you've determined the banks you want to scan, you press G and the scanner begins operation.

The procedure just outlined is the basic scanner operation; but there are other options, too. Suppose you wanted to listen to the weather channel. You can call the station up by inputting its channel number while in manual mode. You might also be interested in searching for active frequencies in your listening area. If you were interested in the aircraft band, you would enter frequencies between 118 and 136 MHz while in search mode. The scanner would then search between the frequency boundaries you entered, and broadcast whatever it found.

User Comments. I used the CompuScan scanning receiver with a Commodore-64. Setting up the hardware was straightforward and easily done. Loading the software, however, presented a problem. It appears that Commodore is having compatibility problems with its disk drives. For example, a disk that runs on one 64 drive might not run on another. After trying a few different disks, however, the programs did run. One other small problem appears to have its roots in the architecture of the Commodore-64.

When data is being loaded from the disk into RAM there are sometimes delays of a few seconds or more right in the middle of an operation. For example, if the frequencies of bank 1 are being listed on the screen, the computer sometimes stops in midstream. After a few seconds, it resumes the listing. This is because the Commodore-64 has no provision for dimensioning strings. Thus, RAM is allocated for storage and

then must be re-allocated once the area is filled.

Loading frequencies into the data banks is a little time consuming, but it's done only once. Besides loading the frequencies, it's wise to insert a memo so that you can later recall who transmits the frequency. You'll have to experiment with the frequencies in your area to find those that will provide the information that you're interested in.

Once into the scan mode, I found reception to be quite good. Sometimes the receiver gets stuck on a station that's not transmitting anything intelligible. But the software allows you to press C to continue scanning. If this happens during every scan cycle, you can omit the frequency entirely or just lock it out by switching back to manual mode and making the adjustments.

Conclusions. The marriage of a scanner receiver and a personal computer adds a great deal of utility to the receiver. I was able to enter any frequencies I wanted, limited only by the frequency range of the receiver. The receiver scans up to 200 frequencies at a time, and can store them to disk with any relevant information. This is certainly a quality improvement over any scanning receiver

TECHNICAL SPECIFICATIONS BEARCAT COMPUSCAN/2100 SCANNING RECEIVER

R-f sensitivity:	30-50 MHz: 0.6 μ V 118-136 MHz: (AM): 1.0 μ V 144-148 MHz: 0.6 μ V 148-174 MHz: 0.6 μ V 421-450 MHz: 1.0 μ V 450-470 MHz: 1.0 μ V 470-512 MHz: 1.0 μ V
Squelch sensitivity:	Equal or better than specified under r-f sensitivity
I-f selectivity:	-60 dB @ \pm 25 kHz
Audio output:	1 W rms, 10% THD (max.) into internal speaker. 2 W rms, 10% THD (max.) total (internal and 8-ohm external speakers or 8-ohm external only)
Scan speed:	15 channels/second nominal during any bank. 100 ms to change banks. 60 ms additional to bank change when priority is programmed.
Channel capacity:	200 (10 banks, 20 channels each)
Memo capacity:	4 lines, 30 characters each available for each of the 200 channels.

er on the market today. Additional search features and access to control signals make the combination of computer and scanner even more attractive.

But as with all marriages, sometimes there are problems. The problem with the Commodore-64 disk loading is something to watch out for.

Some obvious software utility is missing, too. For example, there is no provision to output stored frequencies to a

printer. Though a user has access to the code and might indeed insert this feature, it really should be provided.

Overall, I think that the Bearcat CompuScan receiver is a fine product. For the scanner enthusiast it offers features that have been unavailable up to now. For the computer enthusiast it offers an exciting new add-on product that could develop into a lifetime interest. \diamond

Digital Capacitance Meter

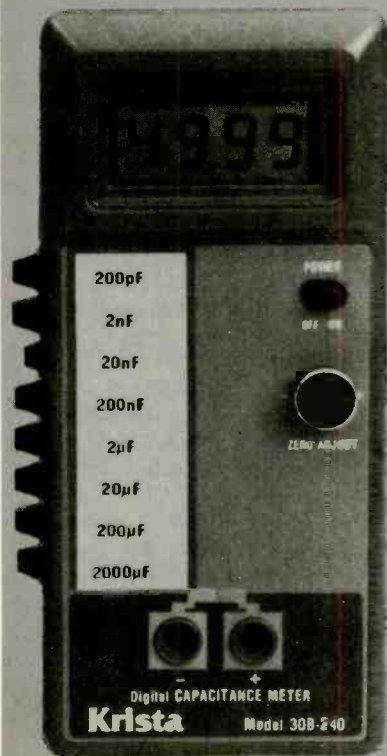
Only **\$49.99**

SPECIAL

BOTH FOR \$85.00

Digital Multimeter

Only **\$39.99**



Digital Capacitance Meter

Stock No. 99-240

- 3 1/2" Digit LCD
- Push-button selection
- 0.1 pF to 1999 μ F
- Direct lead insertion jack
- Immediate direct reading
- Fuse protected
- 200 hour battery life

SIZE: 7 1/8" x 3 3/8" x 1 1/2"
WEIGHT: 10 Ounces

Digital Multimeter

Stock No. 99-140

- 3 1/2" Digit LCD
- Push-button selection
- Large 0.5" LCD
- AC/DC to 1000 V, DC to 10A
- Resistance to 2 M ohms
- Auto polarity
- Full overload protection

SIZE: 7" x 3 3/4" x 1 1/2"
WEIGHT: 16 Ounces

1 Year Warranty

Distributed By

FUJI-SVEA

P.O. Box 3375, Torrance, CA 90510

Toll Free: **1-800-421-2841**

California/Local: **1-213-533-1221**

Shipping/Handling \$4.50 additional. COD Fee \$2.00
California Residents add 6 1/2% Sales Tax



WHAT'S NEW IN THE CP/M WORLD?

The state of CP/M: an up-to-date look at microcomputing's most widely used disk operating system

THE most prevalent disk operating system in use today is the one known as CP/M. If you are using a computer other than the IBM PC or one of its work-alikes, you are almost certainly using CP/M. If you own an Osborne, a Kaypro, a Morrow, or any one of a number of medium- to high-end 8-bit systems designed for serious use, you are using CP/M.

Even if you own an Apple or a TRS-80, or another computer that originally came with a different operating system, you may very well now be using CP/M. Why is it that this "antique" of an operating system—it's been available for microcomputers for over eight years—is still so much in use... and why is it that even many brand new systems use it in preference to another?

Certainly there are operating systems that are more manageable than CP/M, that offer more features, and that are easier to understand. How does CP/M manage to hold on and, perhaps more important, why is it likely to be with us for a long time to come despite MS-DOS and its derivatives?

A Little Background. CP/M, which stands for Control Program for Microcomputers, was created as a programmer's tool. It was never intended to be "user friendly." Evidence of this is found in the utilities, like ED, ASM, and DDT that are included as part of the standard CP/M package. These utilities are intended for the creation and debugging of assembly-language programs—certainly not the purpose for which you bought *your* computer. It's probably fair to say that most present-day owners of CP/M systems never even bother to run these utilities. Still, they are supplied with every CP/M disk and we may be able to understand why a little later.

CP/M was created in the early 1970s by Gary Kildall to fill a need he had for a disk operating system to assist him in his work. At the time he was with Intel Corporation, the company that produced the first microprocessors. There

By Josef Bernard

were other disk operating systems around (after all, it was IBM that had developed the floppy disk), but they were tailored to much larger and more complex computers than Gary was using. What he needed was a simple tool to allow him to work with his little 8-bit microprocessor, not some 32-bit giant. Thus came about CP/M. Kildall later left Intel and formed his own company, Digital Research, Inc., to distribute

CP/M as well as develop and market new CP/M products.

When the first disk drives for microcomputers arrived on the market, most of them came with their own proprietary operating systems. Notable among these were the NorthStar DOS (which still has a small but ardent following today) and PTDOS from the now-defunct Processor Technology, a pioneer in microcomputers. Some of these disk operating systems were good and some were awful. All, though, shared a common flaw. They could be used only with the specific systems they came with and, worse, programs written to run using one operating system were totally incompatible with computers using another.

All disk drives require a piece of hardware called a controller, which is an interface between the computer and the drive. Before the days of all-in-one computers, the controller was supplied as a plug-in board, and was usually sold together with the disk drive and operating system. This was probably the first example of bundled software for microcomputers. (The word-processing and spreadsheet packages included in the price of many computers now are current-day bundled software.)

As the microcomputer industry grew, some companies began selling controller boards that were not associated with a specific computer or disk drive. The majority of these were intended for computers using the S-100 bus. These computers consisted generally of a cabinet, a power supply, and a motherboard carrying a hundred control, data, and address lines into which could be plugged an assortment of CPU (microprocessor) boards, memory boards, input/output boards, etc. Among the etceteras were disk-controller boards.

Given the general nature of the S-100 systems, it was only natural that the disk operating systems provided for S-100 controller boards also be as nonspecific as possible. Under these circumstances, CP/M was the ideal candidate. The rest is history.



Digital Research markets much more than CP/M.

A Universal DOS. Virtually all of the early—and most of the current—disk operating systems were intimately tied into the computer system for which they were intended. For example, PTDOS, mentioned earlier, could be used only on Processor Technology computers, and only with the disk drives offered by that company. It was an excellent operating system, but could be used by relatively few. Similarly, the NorthStar DOS was intimately linked to the NorthStar controller board, and would work with no other. Not so CP/M.

In designing CP/M, Gary Kildall made it independent of any particular computer or controller board. Of course, certain parts of CP/M has to be compatible with the computer system it was being used with, but these parts were supplied in a form that could be altered by a manufacturer or knowledgeable computer user to conform to his own equipment. That is probably one strong reason for the assembly-language utilities that are still provided with the operating system. Not only did you get the DOS, but you also get the tools you needed to tailor it to your requirements.

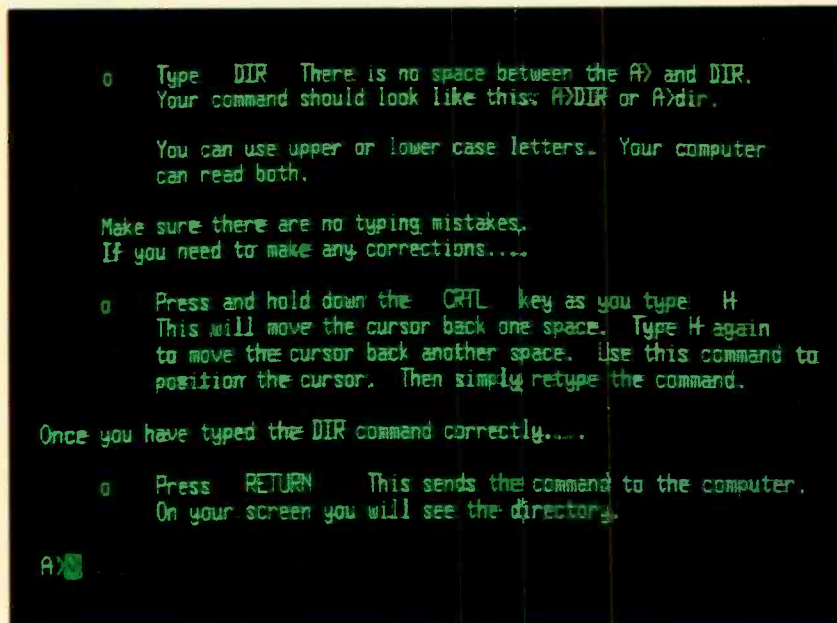
CP/M's universality is due largely to the fact that it is formed of modules. The most important of these is the BIOS, or Basic Input/Output System. It is the portion of the CP/M that controls the disk drive, and that allows the computer to communicate with the outside world through terminals, printers, and other peripheral devices.

The portion of the BIOS that controls the disk drive must be tailored specifically to the disk controller and to the physical drive itself. Once that is done, though, little more work need be performed on it. This is because CP/M uses a number of what are termed *function calls*.

Each function call performs a specific task, like reading the directory of files (programs or assemblages of data) that are contained on the disk, opening or closing files (very important to keep various programs and data files from intermingling and turning into valueless garbage), and controlling the flow of information between the computer and various peripherals.

Every function call is assigned a number, and, to use one, all that is necessary is to refer to its number. So, a programmer does not have to write a series of routines to get data into or out of the computer, or to read it from or write it to the disk. All he has to do is use the appropriate function call. This may seem unimportant, but the effect it ultimately has on the programs you use is significant.

The other concept that makes CP/M



ATI's CP/M course builds confidence in using the DOS.

so convenient, and its use so widespread, is the one of *logical devices*. As opposed to a physical device, like a specific printer or console device (usually a terminal), a logical device is more a generalization of a device type. The most frequently encountered logical device in CP/M is the LIST device, which is generally a printer. The particulars of the various physical devices are described in the BIOS for a particular system, and they are then referred to by their logical names.



An intimidating message from CP/M.

Instead of writing a program that instructs the computer to send its output to a Diablo Model 1650 serial-interfaced using XON/XOFF protocol and connected to the port designated "2F," all the programmer has to do is instruct the program to output the data to the LIST device. The BIOS takes care of all the detail work.

That's all well and good for the programmer, but how does it benefit you?

Transportability. The significance of CP/M's BDOS (Basic Disk Operating System) and BIOS is that, once they are configured for a particular computer system, virtually *any* program written to run under CP/M can make use of them to run on any CP/M system with-

out modification! This ability to go from one system to another without having to customize a program for each one is called *transportability*.

For the programmer, this means that he does not have to write a separate version of his program for each computer he intends it to run on. The use of function calls and logical devices makes a single version almost universal.

For you, it means that almost any CP/M-compatible program you choose is guaranteed to run on your system. Furthermore, because CP/M is so convenient for programmers to use (and because the greater the number of systems their programs can run on, the more they will sell) there are well over 2000 pieces of CP/M-compatible software for you to choose from!

(Compare this to the fact that many programs written to run on IBM's Personal Computer under PC-DOS—IBM's version of MS-DOS—will not run on other MS-DOS-based computers. When you look at the ads for PC-like computers, read the fine print; you'll see what we mean.)

Fear of CP/M. If CP/M is so wonderful, why is there so much trepidation about using it? Most people who purchase CP/M-based systems seem afraid even to concede its existence, and are content to run the 'Stars, 'Calcs, and other applications programs it supports.

Part of the desire to avoid contact with CP/M is probably due to its history. In its early days, CP/M frequently was supplied unconfigured, in skeletal form, and required someone with extensive assembly-language-programming experience and an intimate knowledge

of how the hardware of a system should be organized to get it running. Coupled with that was a thick and nearly incomprehensible set of manuals that even experienced programmers puzzled or wept over at times. Furthermore, when a CP/M system was successfully configured, the novice computer user still had to refer to those impossible manuals if he wanted to get anything done, even if it was only copying a file from one disk to another.

Another factor stems from one of man's earliest instincts: fear of computers. Even though they may have been persuaded to purchase, and even use, them fairly regularly, many people are

if special printers or other peripherals have to be added, there are usually utilities supplied by the computer manufacturer that make their installation about as easy as selecting items from a menu.

Additionally, the latest manuals from Digital Research are easier to understand. Finally, a number of book and software publishers have hopped on the CP/M bandwagon with titles intended to help you fathom the intricacies of what may be the world's most popular but least-understood disk operating system.

Almost every major publisher has at least one book on the shelves with a title like "The Complete CP/M User's

happens is that the program (metaphorically) slaps your hand and makes you do it again until you get it right. By the time you've finished the course, you may not be an expert on CP/M, but you'll be comfortable with it and able to learn more about it on your own.

8 Bits/16 Bits. It is interesting to look at what 16-bit computers offer that 8-bit ones don't. It is generally assumed that more bits make a better computer, but that is not necessarily the case.

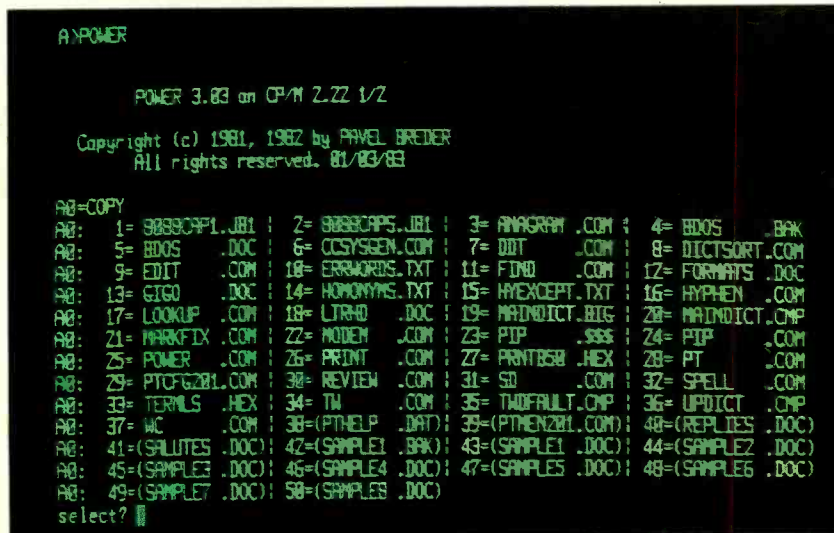
What are the advantages of a 16-bit computer over an 8-bit one? The answer usually given is speed and the ability to address larger amounts of memory (needed for large programs and for manipulating large amounts of data). Some might also mention the color and graphics capabilities of most of the 16-bit machines.

To tackle the last point first, many 8-bit computers—even the lowly VIC 20—have color and graphics capability. The resolution of some 8-bit systems even approaches that of the 16-biters. And, if high-resolution, full-palette color is required, there are add-on boards and systems for 8-bit computers that make machines like the IBM PC's abilities look insignificant.

As for memory size, the 8088 microprocessors used in almost all 16-bit computers can address about 1 megabyte (one million bytes) directly. While that figure may make the Z80's 64 thousand bytes of addressable memory look paltry in comparison, it should be noted that several schemes are routinely used in 8-bit systems to extend their capacity that far and beyond.

Finally, there is speed. For most purposes, 8-bit systems already operate as fast as necessary, and may even have some speed in reserve. After all, how many people can type faster than their computers? The advantage of 16-bit CPUs is their ability to cope with larger chunks of data, primarily numbers. However, although the 8088 is a 16-bit CPU internally, it is essentially an 8-bit device as far as the rest of the computer system is concerned. All its 16-bit data transfers to and from memory, for example, have to be broken up into two 8-bit operations. That slows it down considerably. Actually, in running a given program, many 8-bit systems, running theoretically more slowly than the 16-bit systems they were being compared to, have been demonstrated to run that same program more quickly than their 16-bit competitors!

State of CP/M. If CP/M is so wonderful, what's all the to-do about the MS-DOS family? Why doesn't CP/M dominate the 16-bit computer world, as it



Power! is utility for CP/M that makes it easy to use.

scared to get more involved with computers than they have to. Perhaps it's the idea of irretrievably losing data, or maybe it's just the thought that "If I touch the wrong key, the thing'll blow up!"

In truth, it's very hard to break a computer. If you hit the wrong key you may cause the computer to do something you don't expect it to, but it's not going to blow up. And if you are working with a disk you've set aside for practice purposes, you're not going to lose any irreplaceable data or programs.

Finally, there's the "who-needs-it" syndrome. You've learned how to use your word processor, so what else do you have to know? Though computers and operating systems are becoming more and more "transparent," letting you concentrate on the work you bought the computer for, one day you may find out what you have to know... the hard way.

Fortunately, using and learning about CP/M is a lot easier than it used to be. First, almost every CP/M computer sold today comes with the operating system already installed. Moreover,

Guide" or "Three Weeks to Better CP/M." There are books written for experienced programmers and books written for complete neophytes. A trip to a nearby computer or book store will give you a chance to examine a variety of works on the subject, and you can select the one(s) that you feel most comfortable with.

An interesting entry at the software level is a training course on disk from ATI (American Training International, Inc., 3800 Highland Avenue, Suite 300, Manhattan Beach, CA 90266). The disk comes with a rather skimpy manual and, in fact, does not go into many aspects of CP/M itself. Despite those shortcomings, though, it is an amazingly powerful learning tool, especially for those who suffer from a "what-if-I-break-the-computer" complex.

The disk simulates the CP/M environment. As you progress through the lessons, it looks and feels as though you are using CP/M; but it is all really an illusion created by the program. You get nowhere near the *real* CP/M your system is running.

If you make a mistake, the worst that

does the 8-bit computer world?

Part of the answer lies, unfortunately, in intercorporate politics, and that's a subject we'll leave for another time. Actually, there is a 16-bit version of CP/M called CP/M-86 that competes with MS-DOS; but, largely because of its originally high price, it has found little acceptance.

At the CP/M 83 East show held in Boston last fall, not much new in the way of CP/M hardware and software was shown. There were a few new computer systems, but nothing out of the ordinary. Most of the new CP/M software shown was of interest to people who wished to upgrade at the system, rather than the application, level.

Embarrassingly, in fact, two of the most interesting new pieces of (application) software, OZ, a business management system from Fox & Geller, and an improved spreadsheet program, SuperCalc3 from Sorcim, were shown running on 16-bit IBM PCs! The CP/M versions, we were told, would be available early in 1984.

Does this mean that 8-bit CP/M is dead? Not by a long shot! First, there exists a large established base of 8-bit computers. It would be unrealistic to assume that the owners of all those systems would discard them overnight in favor

CP/M is not dead—by a long shot.

of 16-bit machines. CP/M applications software will still be written for them.

Second, many of the new computers being introduced, as well as some of the current best sellers, use 8-bit microprocessors. Even some of the 16-bit systems include a second, 8-bit Z80 CPU and the CP/M operating system. This would seem to indicate recognition that CP/M is still a strong force in the software industry.

Nor has Digital Research dropped out of the 16-bit arena. Although its CP/M-86 seems to have missed the boat, with MS-DOS in its various versions dominating the market, there also exists a 16-bit version of CP/M called Concurrent CP/M. It allows a 16-bit computer to run several programs simultaneously, and there were numerous programs being run under Concurrent CP/M at the Boston show.

The ideal computer has often been conceived of as being able to supply any kind of information at any time. If, for example, you were writing a letter on your word processor and needed to look up a name and address to include in it, you would like to be able to find that information without having to leave the word-processing program.

With most operating systems in use today, you would have to save the portion of the letter you had already written on disk, exit the word-processing program, run your database program, make a note of the name and address, then restart the word processor and insert that information.

With an operating system like Concurrent CP/M, you could have both programs running at the same time (together, perhaps, with a communications program that could automatically download the closing stock-market prices for your later perusal) and simply "glance" from one to the other.

Most popular applications programs can now run under Concurrent CP/M, and the list is growing almost daily.

In answer to the question; "What is the state of CP/M?" the answer is that, despite rumors to the contrary, it's still in very good health and continuing to flourish. ◇

C&E Interviews Digital Research

At the CP/M83 East show held in Boston last fall, COMPUTERS & ELECTRONICS had the opportunity to interview Gary Kildall, the developer of CP/M and founder (and now Chairman of the Board and Chief Executive Officer) of Digital Research, Inc., and John Rowley, President and Chief Operating Officer of the company. Following are some excerpts from that interview. The two are not identified individually in their remarks.

C&E: Here you are with CP/M and CP/M-86, and there's Microsoft with MS-DOS. What do you think is going to happen?

DRI: That's a question I get asked a lot. At any point in time in the evolution of CP/M there's been a competitor of some sort. It could be Unix. . . . In the early days it was Oasis. There's always somebody out there competing with you. I think it's pretty clear that PC-DOS is the competition, incidentally, not MS-DOS.

C&E: What's the difference between the two?

DRI: I don't think most people understand that those are two different areas

of competition. PC-DOS is sold in quite large quantities because of IBM. MS-DOS is not anywhere near as much a competitor for us. In terms of volume it's less than half of what CP/M-86 is. So we don't view MS-DOS as major competition. PC-DOS is the major competition.

C&E: What about CP/M versus PC-DOS? That's the real issue.

DRI: We started out originally with the idea that CP/M-86 was an entry-level operating system for 16-bit microcomputers because where our marketing has always been is the office-oriented systems. We've sold mainly to Fortune 5000 or Fortune 1000 companies. The orientation we've had from the beginning was to go toward Concurrent CP/M. That was the original design for 16-bit machines, because that's the operating system that more closely matches the capabilities of 16-bit machines. Once you've used a system like Concurrent CP/M, an operating system like CP/M-86 or PC-DOS is pretty primitive. Concurrent CP/M is really the focus of the 16-bit processors and there is no competition for that at all. We see a very strong growth now through

CP/M-86 to Concurrent CP/M and to the networking systems. That's what the strategy's been all along.

C&E: So CP/M-86 is more or less an interim operating system.

DRI: Well, in fact, it is. It's a starter system. The idea is if you have a small memory system and you want to be able to get as much functionality as you can in it, then you can use CP/M-86. It is a starter system in that, as you add more memory and more peripherals and so forth, then the growth is into Concurrent.

That's always been the strategy, and it's paying off quite nicely out there right now because, to get some product differentiation and to do some of the things that are necessary in systems like data communications, manufacturers are realizing they have to have something like Concurrent.

C&E: What's the software base like currently?

DRI: Anything that runs under CP/M-86 will run under Concurrent. There are quite a large number of packages [that run] under CP/M-86. We have our own CP/M Library, with 20 of the most popular titles, and we're going to be increas-

ing that significantly. The independent software vendors are lining up something on the order of 500 packages to run under CP/M-86. There could easily be well over 1000 applications right now.

C&E: Will they all run concurrently?

DRI: Sure. Concurrent CP/M has all the file protection needed to keep those programs from interfering or working with one-another's data files. That's a major feature of Concurrent. It also has significant compatibility.

Incidentally, there's a difference between running concurrently and using Concurrent CP/M, just like there is in local area networks. (You can use them for file transfer and as a distributed operating system, which are two different things.) What we're seeing now is vendors using Concurrent to do multiprocessing in one environment. That is, data communications linked up, say, with word processing.

C&E: Getting back to our original question—what about CP/M versus MS-DOS?

DRI: The question is really much larger. If you take a look at those two—CP/M-86 and MS-DOS—where our competition likes to focus, there's a heated battle there. But if you take it to Concurrent, there's no battle at all. We'll be retailing four different versions of Concurrent. When manufacturers start bundling CP/M-86 and/or MS-DOS, it will be just like having a button on the machine—an ON button. Turn it on and you're in CP/M or MS-DOS. Now they're looking for product differentiation, and Concurrent is really the only significant product differentiator right now for personal computing.

C&E: You're getting more into retailing products now, aren't you.

DRI: Yes, there's a whole retail program and, talking about the CP/M Library, we have a whole manufacturing facility that I don't think any of the other microcomputer manufacturers have.

C&E: At several of the press conferences we've attended here, we've noticed that a lot of the new software is running under MS-DOS or PC-DOS, though this is a CP/M show. It almost looks as though CP/M is being ignored.

DRI: Well, that's clearly not the case. Certainly by far the majority of the packages running down at the show are CP/M based.

You shouldn't be surprised by that, though, if you think about it. The thing that's confusing is that, when you said PC-DOS, that should not be surprising because the IBM PC is absolutely the number-one seller; it drags the most software. So if we were not Digital Research—if we didn't have operating systems and were just coming out with

applications—the first market we would probably go to would be IBM. We'd program some unique application and put it on PC-DOS.

Back in the 8-bit heyday, people would go to Apple DOS. But there was no confusion. They'd go to Apple DOS and then they'd come to CP/M. They found that all the popular Apple applications were on CP/M. And, there were many popular CP/M applications that might not have gotten to Apple DOS. That's why 1 out of 5 Apples gets sold with CP/M.

C&E: What about the 8-bit versus 16-bit situation? Where do you see things going?

DRI: There's sort of a stratification of computer systems. There are the \$500-\$1000 machines, there are the portables and the nonportable 8-bit machines that have been around for some time; there's a variety of 16-bit machines, and there's also the 16-bit IBM generic-type ma-

**“If we were not
Digital
Research . . .
we would
probably try the
IBM market
first.”**

chine. Then you get into the high-performance 16-bit machines and the minis.

What has happened is that the 8-bit market is essentially CP/M. The low-end machines are either CP/M or emulations of CP/M machines of some sort (basically because CP/M is a good design for that type of machine). The portables are a mixture of 8- and 16-bit machines, typically, again because all the 8-bit machines are CP/M machines. The 16-bit machines are mixtures using CP/M-86 or MS-DOS. The IBM generic types are often MS-DOS because what they're trying to do is emulate PC-DOS . . . as best they can. But the others tend to be Concurrent CP/M to get the product differentiation and to get the growth back because they're not interested in the IBM. Their idea is to get some other product that's different and better than what's around. The future systems that are being designed are all basically (designed for) Concurrent, because they have no choice. The new OEMs [Original Equipment Manufac-

urers] are looking at Concurrent, not strictly MS-DOS or CP/M.

C&E: Do you see a future for 8-bit machines?

DRI: Oh yes, definitely!

C&E: We mean not only at the low end, but at higher levels.

DRI: Yes, you see, 8-bit machines are very inexpensive to build; and, as a result, they're probably going to be less expensive as an overall computer system. For most people's requirements, they do a fine job. If you take a look at most of the programs running on 16-bit machines, they're running in a 64K area anyway; most compilers don't even generate code for outside of a 64K region. And if you're talking about assembly language, with 64K you can rule the world!

That, together with the fact that in a 16-bit machine the code is not nearly as dense as 8-bit code. There's probably a 20 to 100% difference in the size of the assembly-language code, which means that there's basically no reason for them [8-bit machines] to go away.

A number of new 8-bit machines are just starting to really build up their sales. Finally, some programs which are among the classics on a Z80, 6-MHz device, run faster there than on an IBM PC. Literally, if you push the buttons at the same time, you'll end up faster on your 8-bit machine. A lot of the 16-bit mystique is related to the marketing field . . . 16 is bigger than 8. That's not to say that there's anything wrong with the 16-bit direction. There are lots of applications, for example, like DR Logo, that wouldn't have been developed for an 8-bit processor because they require large memory areas. But that's a different kind of function.

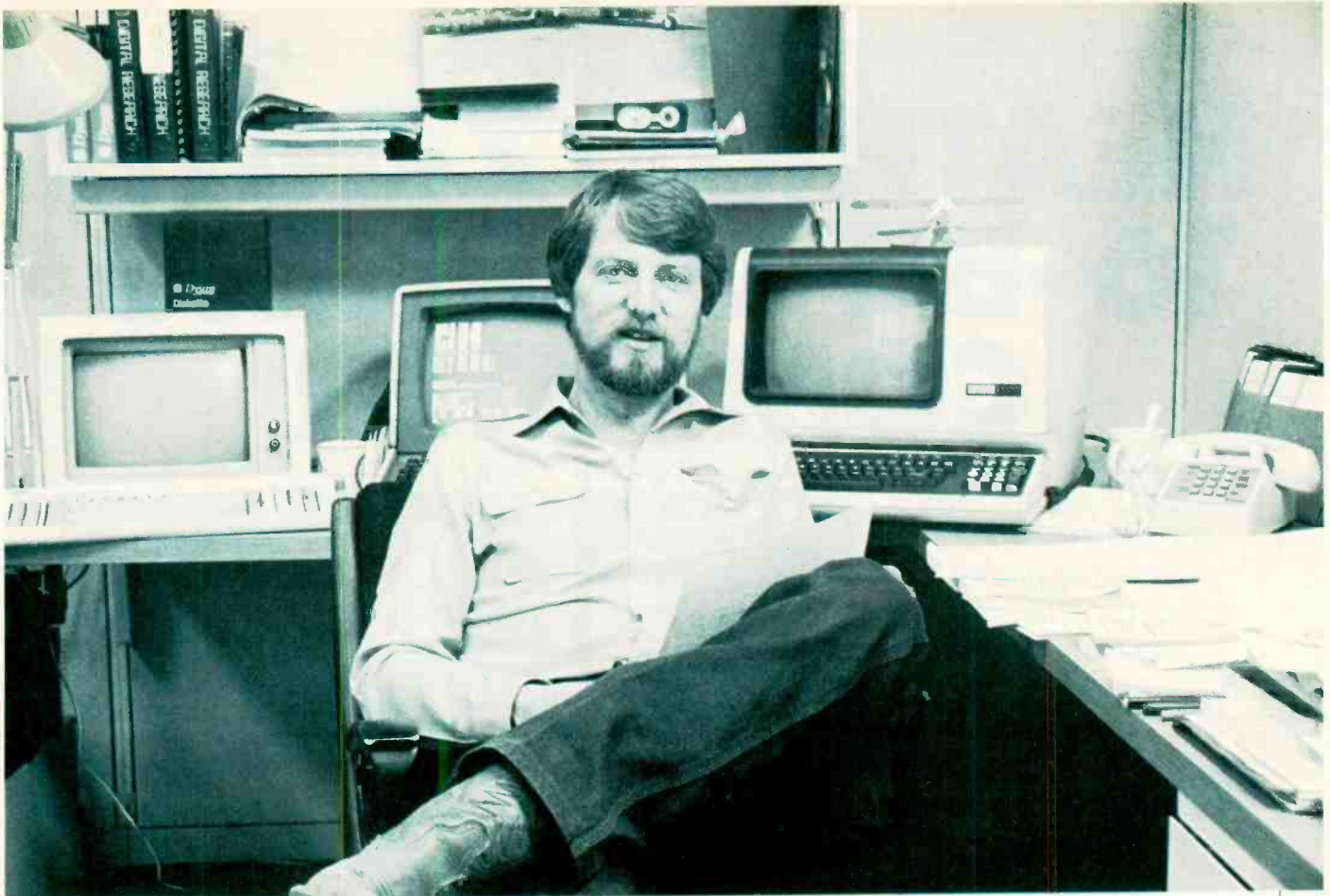
C&E: Do you have any opinions about the MSX “standard” for BASIC?

DRI: Well, the Japanese do believe in standards because they have a manufacturing country. So if they can get into high-volume production (that's why they're so intrigued with CP/M), they endorse the standards. But if you ask the manufacturers, they do not endorse MSX. In fact, the JEDA, which Microsoft tried to have endorse MSX, has said formally that it does not endorse it. However, they do endorse the concept of standardization. It started out with a bang; but in general, the large companies are not endorsing it as a standard.

The reason is that it isn't a viable alternative for standardization in home computing. You really need an operating system [rather than a language].

C&E: Where does DRI stand on this matter?

DRI: We've introduced, in Europe and Japan, a derivative of CP/M called per-



Gary Kildall, creator of CP/M and founder of Digital Research

sonal CP/M, which is not available in the States yet, but will be later this fall. So we have that, and some other technologies related to providing, first of all, an environment that is friendly and very usable in the home.

Obviously CP/M itself was written much more for programmers . . . not for my 11-year-old son. Personal CP/M is a derivative of CP/M which has a much more user-friendly interface and is just very much more consumer-oriented. But it still carries the compatibility at the BDOS level—at the system-call level—of CP/M so that, if you did want to run some CP/M-based software, that's fine—there's no problem. You could run CP/M-based software or you could write new applications and you'd have a different user interface.

C&E: This is not available in this country yet.

DRI: No, but we're working with other companies and . . . you'll hear about it later this fall. But in discussing MSX you almost have to discuss this particular alternative because, in reality, in Japan, the three largest manufacturers have already gotten involved . . . at the low end . . . and here in the US, I think you'll see the same thing. You'll see a variety of the home computer manufacturers in the US take that derivative of

CP/M as an operating system.

C&E: What else do you have in the works?

DRI: We are working with Zilog and some of the silicon manufacturers to move CP/M right into the Z80 architecture so if you buy a Z80, you'll get CP/M because it'll be on a single chip. The whole thing has become an integral part of how you construct a home computer. There's also some associated technology that allows us to bring home computer applications . . . but we can't talk about that yet.

C&E: Do you think you'll find a big market down at the level of machines like the Spectravideo, Adam, and the Commodore computers?

DRI: I think the whole idea of our Consumer Division is to get into those markets where we haven't really been before. The Consumer Division's first product—DR Logo—is already out and, as things open up—like the Adam and the Commodore 64—we intend to have products that will facilitate each one of these. We will have products that consumers can buy through mass-merchandising channels.

C&E: For example?

DRI: DR Logo is a product where sales volumes are going to be extremely high. If we look at the DR Logo Learning

Library—that is an associated learning library of Logo-based software—we would say that 80% of the revenues of Digital Research will come through it and will be brought back either to the consumer or the educational/institutional segment. We've got some things going that you'll be hearing about in the next three to six months. They'll just keep rolling out.

C&E: Digital Research products have not previously been noted known as particularly user-friendly. Is DR Logo going to be different?

DRI: We had an on-line help facility in DR Logo to begin with; it was using abbreviated help commands. Now we basically have the entire reference manual available as an on-line help facility. If you hit HELP, you don't even have to go into the manual any more.

C&E: Do you have any final comments?

DRI: The main thing for COMPUTERS & ELECTRONICS is probably that you're going to find that computers in the home are going to be a lot more environmental-sensitive. Home computers are going to be operating controllers and be out into the homes a little bit more than just as a keyboard and display. That's definitely going to be exciting over the next two years . . . and we're definitely going to be in the middle of it. ♦

NEW HEATHKIT/ZENITH 16-BIT LEARNING COMPUTER

*Powerful, expandable
semi-kit combines
with educational
course for "hands-on"
self instruction*

By Joe Desposito

BUILD-it-yourself microcomputers, so prevalent in the mid-to-late 1970's, have now almost vanished from the scene. But the big daddy of the electronic kit business, the Heath Company, continues to support such products. Its latest kit computer, the ET-100 Learning Computer, is a 16-bit trainer that can be expanded into a full-blown system.

The Learning Computer consists of a cassette-based 16-bit computer with detached keyboard, and a top-mounted experimental breadboard. The computer trainer is fully functional in its basic configuration and needs only a video monitor for display and standard cassette tape recorder for data storage. (Alternatively a TV set and optional modulator can be used for the display.) Suggested retail price of the ET-100 Learning Computer kit is \$999.95 (\$1499.95 factory assembled).

With the ET-100, you can learn the fundamentals of 16-bit microprocessors (specifically Intel's 8088 CPU) and assembly-language programming. The breadboard atop the main unit gives you access to the 8088 for interfacing the computer to the outside world.

Unlike some kit computers, this one doesn't really have to be built from scratch—the main logic board and keyboard come pre-assembled and tested. Though this might offend some purists, it should encourage those who are somewhat gun-shy (solder, that is).

Here then, is an over-the-shoulder view of what it takes to build a 16-bit microcomputer (circa 1983) accompanied by a review of the product as trainer.



The ET-100 breadboard can be used to perform experiments.

Electronic Assembly. A computer kit usually conjures up visions of microprocessor, RAM, and support chips by the truckload. Not so with the ET-100. There are three printed-circuit boards to assemble: the breadboard, keyboard logic, and power supply, but notably missing is the main logic board.

The main logic board for the ET-100 is so complex that it is assembled and tested at Heath. This may steal away some kit-building glamour, but it most certainly avoids major problems in getting the computer to work. The keyboard, too, comes wired, though the keyboard logic board does not.

Building a Heathkit is an exercise in organization. You're expected to set aside a workplace for the project and to have the proper tools needed for the job. Since correct soldering techniques are

so important to success, the assembly manual reviews them for you. I used three soldering devices during the project: a 25-W pencil iron for IC and other semiconductor soldering, a 40-W pencil iron for general-purpose soldering, and a 140-W gun for heavy duty work. Confident but realistic, I also kept a de-soldering bulb close at hand.

Soldering components to the breadboard, keyboard logic, and power supply pc boards is straightforward. Assembly instructions have you soldering components to the board one section at a time. When each section is finished, there is a checklist of commonly made errors. These include unsoldered connections, poor solder connections, and solder bridges, plus correct installation of ICs, tantalum capacitors, diodes, and resistor packs. I'm usually very careful

when I build a kit, so I considered skipping these checks. But after finding two capacitors soldered in place in the wrong direction, I was glad I didn't. Skipping checks might save time initially, but could prove to be disastrous at the end.

Most of the cables are constructed from scratch. This means cutting wires to size, stripping the ends, soldering them to spring connectors, and then inserting them in socket shells. I found this to be the most tedious part of the kit construction.

Mechanical Assembly. There is as much, if not more, time spent on mechanical assembly of the ET-100 as there is on electronic assembly. Even the solderless breadboards come disassembled! You have to push many, many metal connectors into plastic holes to complete the assembly.

A piece of advice on mechanical assembly is in order here. If you intend to build the ET-100, purchase a few ice cube trays. Then when you have to sort the myriad screws and hex nuts included with the kit, you'll be well prepared. This will help you immensely when a 6-32 x 5/8" black screw (rather than 8-32 x 3/8") is called for, or when it's necessary to distinguish between a #6 fiber flat washer and a #6 shoulder washer.

If you're not familiar with press-in nuts, you'll get ample opportunity to learn about them. These nuts must be placed over holes in the plastic enclosure, heated with a soldering gun, and pressed into the holes once the plastic begins to melt.

Final Checkout. After what Heath figures to be about nine hours of construction, you'll be ready to test the final product. (Why did it seem more like 18 hours to me?) The initial tests are resistance checks and voltage measurements. If you successfully build the power supply, you'll find ±5 V and ±12 V in the appropriate places. Then it's

;	LABEL/ NAME	OPCODE/ DIRECT.	OPERANDS/ ARGUMENT
		ORG	00FFH
NUMBER	EQU		0FF00H
	MOV	AX, NUMBER	
	MOV	CX, VAR	
	ADD	AX, CX	
	MOV	STORE, AX	
	HLT		
VAR	DW	00FFH	
STORE	RW	1	
END			Fig. 1

just a matter of whether the keyboard and main logic board will function properly. Since the main logic board is preassembled and checked, there's a good chance the system will work. Mine did the first time, and that's a good feeling.

The Working Unit (Hardware). When you hear the term "microcomputer trainer," you usually think of a unit with a hex keypad for program and data entry. The ET-100 is very different in this respect—it uses a full-size keyboard. The keyboard is detachable and

an 8041 Universal Peripheral Interface (UPI) on the main board through the coiled cord. The 8041 is also a dedicated 8-bit microprocessor with internal RAM and ROM. When a key is pressed, the 8021 sends the code to the 8041. The 8041 then generates an interrupt to tell the CPU that a key has been pressed. The CPU accesses the 8041 and the ASCII code is put on the data bus.

The computer contains the main logic board, power supply, fan, interface connectors, and breadboard. On the main logic board is Intel's 8088 microprocessor, 16K RAM (expandable to 64K on

TECHNICAL SPECIFICATIONS HEATHKIT ET-100 16-BIT LEARNING COMPUTER

Central processor unit:	Type iAPX 88/10 (8088)
Clock rate:	5 MHz
On-board memory:	16K RAM (expandable to 64K)
User memory (incl. EA-100):	Expandable to 192K
ROM space:	One 64K page; 32K for monitor, editor, etc.; 16K reserved for MTR-100 ROM.
Video RAM:	2K
Video controller:	68A45 CRTC
Display format:	24 rows of 80 char. or 20 rows of 40 char.
Character type:	5X9 dot matrix; 8X10 dot matrix graphics
Character set:	96 ASCII characters; 32 graphics
Keyboard:	95 keys: 61 alphanumeric; 16 function and control; 18 numeric and control.
Serial I/O:	RS-232 (DCE)
Baud rate:	300, 600, 1200, 2400, 4800, 9600, default baud rate 4800
Cassette data rate:	300 baud
Primary power:	100 W
Keyboard dimensions:	18 1/4" W x 3 1/2" H x 7 1/4" D
Main unit dimensions:	18 1/4" W x 4 1/2" H x 12 1/2" D
Weight:	21 lb

connects to the computer through a coiled wire. The computing unit is distinguished by three solderless breadboards sitting on top of it that are used for microprocessor interfacing experiments.

The keyboard has 95 full-travel keys, which includes a standard (QWERTY) alphanumeric keyboard, as well as separate numeric keypad. The keyboard generates a full 96-character ASCII set that can be displayed in 24 80-character lines on a video monitor, or in 20 40-character lines on a standard TV set (using an optional modulator). There are four cursor-control keys, 13 function keys, and assorted others. Some of the special keys are delete or insert a character, delete or insert a line, line feed, and fast repeat. Line feed moves the cursor to the next line, but has no effect on the entry of a command or instruction. All keys will repeat when pressed and held down; the fast repeat key is used to increase the repeat speed.

Inside the keyboard enclosure is an 8021 keyboard encoder, which is a dedicated 8-bit microprocessor with internal RAM and ROM. It decodes the keyboard matrix and communicates with

board), 32K ROM, and 2K video RAM. Also on the main board are an 8255 programmable peripheral interface (PPI) and 68A45 cathode-ray-tube controller (CRTC), among other things. Part of the PPI's parallel ports are used by the system and part are routed to the breadboard for experiments. Video display is controlled by the CRTC. It generates the addresses needed to refresh the screen and also generates the horizontal and vertical sync pulses.

The power supply produces +5 V dc at 6 A, +12 V dc at 1 A, and -12 V dc

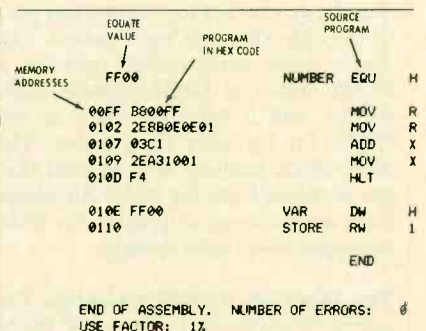


Fig. 2

at 500 mA for the system. There is also power available at the breadboard (+5 V dc at 1 A, +12 V dc at 500 mA, -12 V dc at 100 mA, and -5 V dc at 100 mA), which is independently regulated from the logic board supply for protection. Line filtering is provided by a capacitor and toroid inductance combination to remove or reduce "noise" from the power line.

At the rear of the computer are the connectors supplied with the standard ET-100: a composite video output, RS-232 port, and cassette I/O. Also on the rear panel are a 110-V ac line, cord,

0	D	I	T	S	Z	A	P	C	FFF0	01	01	01	01
0	0	0	0	0	0	0	0	0	01	01	01	01	01
									FFFS	01	01	01	01
AX=	0000								01	01	01	01	
BX=	0000								0000	→	00	00	00
CX=	0000								00	00	00	00	
DX=	0000								0008	00	00	00	00
									00	00	00	00	
SP=	0400	Break Pt.							0010	00	00	00	00
BP=	0000								0018	00	00	00	00
SI=	0000								00	00	00	00	
DI=	0000								0020	00	00	00	00
									00	00	00	00	
CS=	0280								0028	00	00	00	00
DS=	0300								00	00	00	00	
SS=	03C0								00	00	00	00	
ES=	0300								0030	00	00	00	00
IP=	0000								00	00	00	00	

Fig. 3

on/off power switch, and fuse compartment for a 1.5-A slow-blow fuse. A LOW/NOR switch permits compensation for consistently low line voltage by connecting to a tap on the power transformer in the LOW position.

The breadboard, which takes most of the top of the computer, can be used to perform experiments with the ET-100. The large center area consists of three solderless breadboards (one removable). There are several smaller breadboard blocks, which connect to specific places inside the console. The *Power* block supplies ±5 and ±12 V dc. The *Address* and *Data* blocks give you access to A0 through A19 and D0 through D7 of the 8088 CPU. The *PPI* block allows you to access the 8255A Programmable Peripheral Interface. Since some parts of the PPI are used by the system, you must be careful not to program any part of the chip that you can't access. The *System* block consists of the reset line, a 60-Hz output, a 5-MHz system clock output, and a light-pen input to the CRT controller for light-pen experiments. The *MPU* block contains several lines that are available from the 8088. All access lines are buffered to protect the 8088 microprocessor from damage.

The Working Unit (Firmware). The system firmware includes a 16K ROM that contains an assembler and a 16K ROM that contains a monitor, editor

and debugger. The monitor is in control of the system when you turn it on. Through it you can gain access to the assembler, editor and debugger. You can also run, save, load and list programs, among other things.

The ET-100 assembler is based on the CP/M-86 assembler. You can assemble a program from source code created with the monitor's editor, or from source code saved on cassette tape or downloaded from the RS-232 port.

To gain an idea of how the system works, let's suppose you wanted to enter a program into the computer. After turning on the computer, you would be greeted with a prompt that looks like a "greater than" symbol (>). To get into the editor, you simply type EDIT and press RETURN. Once in the editor, you type your program in assembly language. A typical program to add two numbers is shown in Fig. 1. After typing in the program, a CTRL Z will allow you to exit the editor.

At this point you can assemble the program by typing ASM86 and pressing RETURN. The assembled version of the program of Fig. 1 is shown on Fig. 2. Any errors in the code are noted at the bottom of the display. To correct an error, you must return to the editor and make the correction, then return to the assembler and reassemble the program.

Once assembled, the program can be loaded into the debugger. You enter this mode by typing DEBUG at the monitor prompt. The debugger allows you to



Simple, even for adults.

load a program, single step through it while watching register and memory contents, and change the program if necessary. The debugger display is shown in Fig. 3. The nine *Flag* registers are shown across the top left, the contents of each register are shown on the left side of the screen, and the contents of memory are shown on the right side of the screen. Debugger commands are entered at the bottom of the screen. When you're satisfied that your program will run correctly, you can exit the debugger by typing, Q, and then use

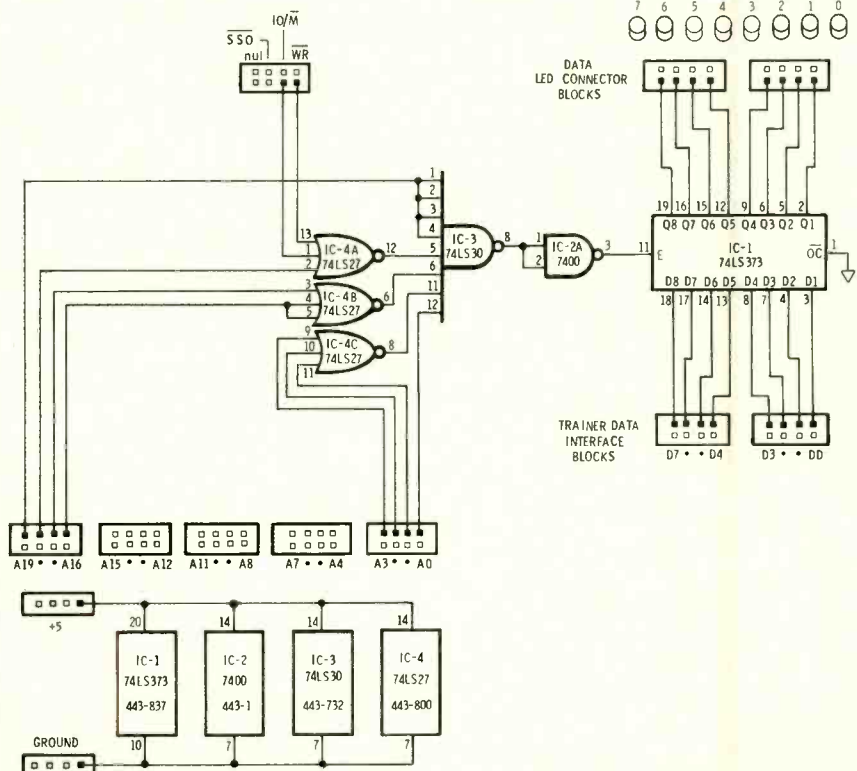


Fig. 4



Memorable.

With 3M diskettes, your computer never forgets.

3M diskettes remember everything, every time. Because at 3M, reliability is built into every diskette. We've been in the computer media business for over 30 years. And we've never settled in. We're constantly improving and perfecting our product line, from computer tape and data cartridges to floppy disks.

3M diskettes are made at 3M. That way, we have complete control over the entire manufacturing process. And you can have complete confidence in the reliability of every 3M diskette you buy.

Look in the Yellow Pages under Computer Supplies and Parts for the 3M distributor nearest you. In Canada, write 3M Canada, Inc., London, Ontario. If it's worth remembering, it's worth 3M diskettes.



3M hears you...

3M

Circle No. 48 on Free Information Card

www.americanradiohistory.com

monitor commands to run the program, save it to tape, or print it out.

Using the ET-100. The ET-100 can be used for learning to program the 8088 in assembly language (as shown above), or it can be used to learn the basics of hardware interfacing to a microprocessor. A typical experiment that uses both hardware and software techniques is interfacing the microprocessor to an external data display.

Figure 4 is a circuit diagram that shows the ET-100 breadboard connections to the address lines, data lines, and $\overline{IO}/\overline{M}$ and \overline{WR} control lines of the 8088. This circuit can be used with a program that will alternately turn all of the data LEDs on and off (Fig. 5).

In operation, bistable octal latch *IC1* is enabled whenever a decoded address is accessed. Any data appearing on the data lines at that time is latched into *IC1*. Since the output control pin (\overline{OC}) of *IC1* is tied to ground, the data LED will follow the latched data level of the output pin it is connected to.

This simple experiment shows how the 8088 can be interfaced with the outside world with the ET-100. Extending this experiment, one could envision actuating a display for an operator to read, or sending a digital control signal to an electromechanical device.

Documentation. The ET-100 comes complete with an assembly manual and user's manual. The assembly manual takes you step by step through the construction and testing of the ET-100. The user's manual provides a description of the system, and all the technical data you'll need. For the hardware, there are data sheets and schematics. For software, there are the commands for the editor, monitor, and debugger, plus a complete description of the 8088 instruction set.

The Microprocessor Course and System Expansion. There are two ways to enhance the value of your ET-100. First is with the "Advanced Microprocessors" individual learning program that sells for \$99.95. This 1200-page book is a complete training course for 16-bit microprocessors. Although Heath uses the term "advanced," the course also covers the fundamentals of microprocessors, programming and interfacing.

The other way of enhancing the ET-100 is to expand it into a disk-based 16-bit computer system. An expansion accessory kit priced at \$1299.95 (\$1999.95 factory assembled and tested) adds features that include 128K RAM, a 320K disk drive, and bit-mapped video. The system can then run all current

CP/M ASM86 1.1 SOURCE: SOURCE.A86

```

;LABEL/ OPCODE/ OPERANDS/
;NAME/ DIRECT. ARGUMENT
      LED_ADR EQU 8000H
      LED_OFF EQU 1

0000 B80000      MOV AX,LED_ADR
0003 B8DB      MOV DS,AX
0005 BB0100      START: MOV BX,LED_OFF
0008 33C0      XOR AX,AX
000A 9807      MOV [BX],AL
000C E80C00      001B CALL DELAY
000F BB0100      MOV BX,LED_OFF
0012 B0FF      MOV AL,0FFH
0014 9807      MOV [BX],AL
0016 E80200      001B CALL DELAY
0019 EBAA      0005 JMP START

001B B90400      DELAY: MOV CX,4
001E BB00CF      REPEAT: MOV BX,53000
0021 4B      AGAIN: DEC BX
0022 9B      NOP
0023 75FC      0021 JNZ AGAIN
0025 E2F7      001E LOOP REPEAT
0027 C3      RET

      END

```

END OF ASSEMBLY. NUMBER OF ERRORS: 0
USE FACTOR: 167.

Fig. 5

16-bit software under the Z-100 operating system, Z-DOS (MS-DOS), including such programs as Multiplan, WordStar, Lotus 1-2-3, and PeachText. Further system expansion is also possible to add more memory (192K), color graphics, and dual drives. Even after it is fully upgraded, however, the ET-100 can be returned to its training mode with a simple keyboard command.

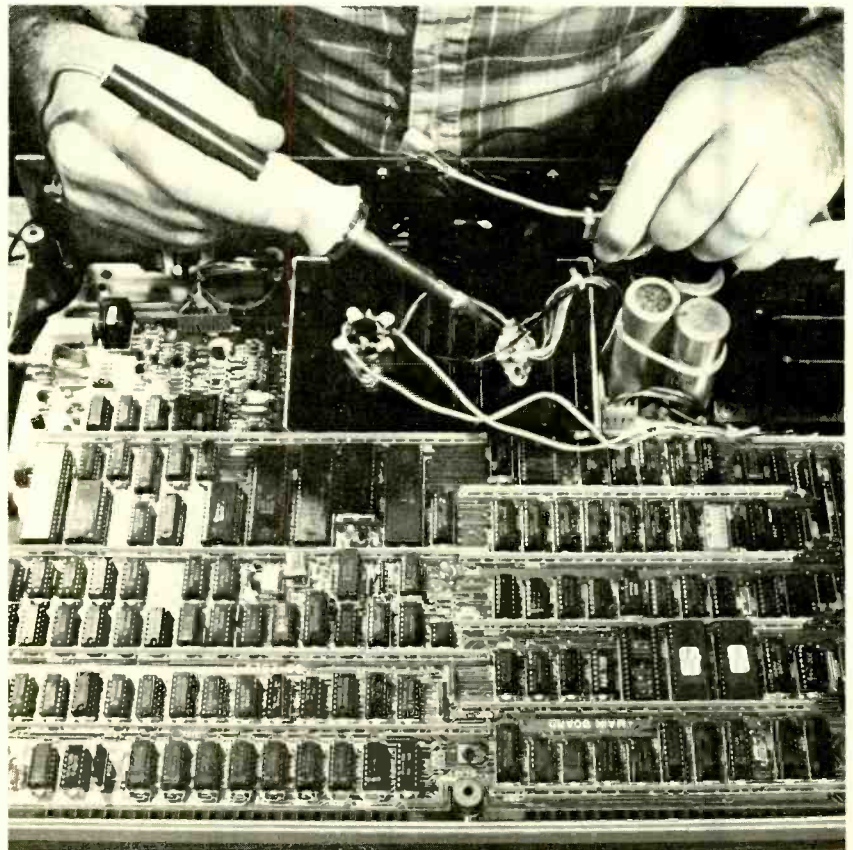
Conclusion. If you've ever built a Heathkit, you're aware of the incredible care this company takes in guiding you through the construction of a project. All you have to do is cooperate by extending some care on your own part to have a successful kit-building experience.

Kit builders might regret that so much of the kit is pre-assembled, but it's clearly a case of the technology outdistancing the skills of the kit-building enthusiast. Though much of the kit building tasks are mundane, it does give you a good understanding of the construction and interconnection techniques used.

I think the ET-100 is an excellent learning tool. With it a person can gain an in-depth understanding of the 8088 CPU, one of the most popular microprocessors available today. Though much more expensive than some 8-bit microprocessor trainers, the ET-100 gives one a handle on a microprocessor that's most often found in new business-oriented personal computers. This fact and its expandability feature make the price, in my opinion, less of a factor in the buying decision.

A good review should highlight both the positive and negative features of a product. However, I feel hard-pressed to find anything that disturbs me about the ET-100. ♦

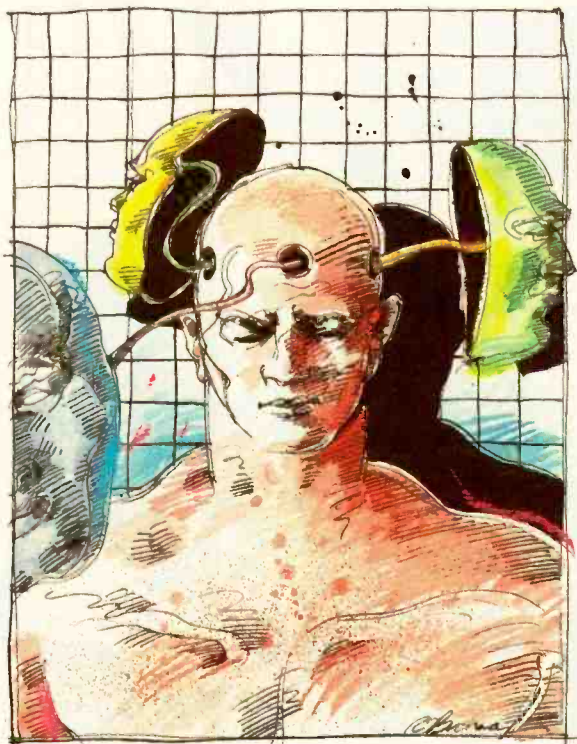
With a pre-assembled breadboard, soldering is minimal.



Getting Started in PERSONAL COMPUTING

FOR new readers who have not yet joined the computer revolution, this is your invitation to a learning adventure that will prime you for a smooth entry into home or business computing.

The personal computer has had an ever-growing influence on our everyday lives in business, in education, and in the home. It's helping businessmen to plan, forecast, and generally manage their enterprises; educators to more effectively motivate and teach students from elementary school to graduate-level school; and home users to become computer literate, keep track of family finances,



and play action games in full color with sound effects.

The most popular uses of personal computer systems are in the areas of word processing, financial spreadsheets, database management, games, education, and telephone communications with data banks and other computers.

The manner in which you perceive a personal computing system depends largely on what you know—and don't know—about computing in general. Therefore, we've geared this introductory-level article toward demystifying personal computer hardware and software terms.

By Alexander W. Burawa

How a Computer Works

All computers, regardless of how simple or complex they are, have in common three major sections: input/output (abbreviated I/O), memory, and processor. Without any one or more of these sections, no computer is complete, nor can it operate in any meaningful way. Although I/O, processor, and memory are usually combined within a computer, each has a separate and distinct function.

To help make sense of the various sections that make up a personal computer (indeed, *any* computer) and to explain their purposes and importance to the computing process, you should understand what a computer is and what it does. There is nothing really mysterious or magical about a computer, nor are you required to know every technical detail of its design or operation to be able to use its processing power.

In very basic terms, a computer is an information or data processor. It takes information fed into it from the outside world, through the input portion of the I/O sec-

tion, and does whatever it has been programmed to do with the information. Then, after processing the information according to the detailed instructions in a program, the computer sends the results back to the outside world through the output portion of the I/O section. This information is presented in the form the user can understand and may be displayed on the TV-like screen of a video display monitor or printed out on paper.

To be able to take in the desired information, the computer must have some convenient means for loading (entering) the data. This may be a typewriter-like keyboard, a disk or cassette-tape drive, or some other mechanism that can be used for entering data and instructions. Frequently, more than one entry device is used, such as a keyboard and a disk drive; new data is fed in from the keyboard, while the program that is to process it might come from a preprogrammed magnetic disk.

Once information is fed into a computer, the processor acts upon it according to the steps detailed in the program. To be able to operate efficiently, a place inside the computer is used to store the data and instructions until needed by the processor and any intermediate results of processing. This is the task of the memory section.

Finally, a video display screen or a hard-copy printer is fed the results of processing through the output portion of the computer's input/output section.

Information processing inside a computer can have any number of meanings, depending on the applications software (program) being used. In word processing, for example, the processing function executes commands that allow you to change characters, words, and even whole blocks of typed-in copy; formats letters and reports to give them a professionally finished appearance; and performs any number of editing operations available with the software package. Another program might allow you to alphabetize long lists of names or words or place in order numerical data. Yet another program might permit you to quickly and accurately perform mathematical computations in the sciences and engineering. From the foregoing, it's obvious that "processing" is a catch-all term that refers to the multitude of data and information manipulations available with a given software applications package.

All data and instructions entered into a computer are manipulated according to a precise set of instructions detailed in a computer program. As data and instructions are entered—whether by running a magnetic disk or tape with the program already on it or by keying in your own program—they're stored in memory until needed by the processor. Intermediate results of manipulations are stored in memory, too, at locations different from those used for data and instructions.

There's nothing arbitrary or random in the way in which the computer's processor assigns memory locations to the data and instructions fed to it. The processor manages its memory by assigning data and instructions to specific blocks of memory for instant recall.

Whatever form of information processing is performed, at some point in the program you want the results in a form you can use. In the case of word processing, this will usually be a document or letter printed out

on paper. It's the task of the output portion of the computer's I/O section and a hard-copy printer (a peripheral that's not part of the computer's basic system) to provide the results of word processing and many other forms of processing. In many cases, however, you may want a nonpermanent output, in which case, the results of processing may be displayed on the system's video display screen instead of being printed out on paper.

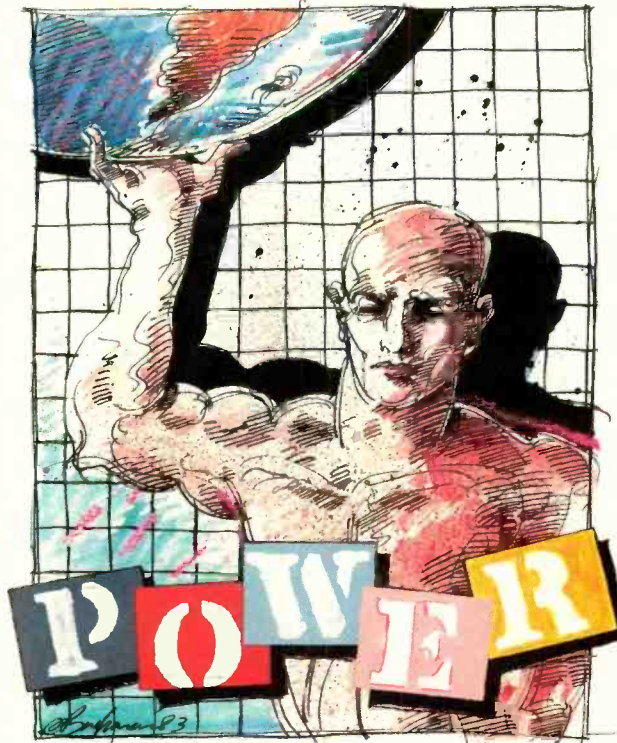
Now that we've introduced the basic sections that make up even the most elementary of computers, let's look at each section in greater detail.

Input Devices

A common data-entry (input) device for modern computers takes the form of a standard QWERTY type-

writer-like keyboard that has the usual alphabetic, numeric, and punctuation keys. To these are added the special-character and special-function keys required by and unique to computing. Though such a keyboard is the most common entry device used in computing, it's only one of many input devices available.

Computers can also obtain data from other computers over the telephone lines, using a device called a "modem" (more about this later). They can also obtain what they need from magnetic tape in any number of guises ranging from an audio cassette, to a solid-state cartridge, to disks that superficially resemble audio



In basic terms a computer takes information from the outside world and processes it.

records. Yet another input device, very popular with computers with games-playing capabilities, is the so-called "joystick," which is used for controlling the action of video games and sometimes for much more serious applications. There are also a number of other specialized input devices, such as the light pen and the barcode reader that "reads" optical coding, and analog-to-digital (A/D) converters that feed such nondigital information as temperature, pressure, weight, etc., into the computer after converting it to a form the computer can use. And information can be entered by vocalizing it—speaking to a computer equipped with an electronic "ear."

We'll discuss input (and output) devices in much greater technical detail in a later section. For now, to understand how computers do what they do, it's enough to know that the input/output section is a major and very important part of any computer system. It's this I/O section that makes it possible for us to communicate and interact with the computer.

Output devices are usually grouped with input devices, since both are managed by the same section in the computer. Output devices, such as the printer and video display unit are required only after information has been processed within the computer. The video display unit, however, is also used to display data as it's being entered from the keyboard and instructions from programs being used, as well as for display of output information.

Before we get too deep into a discussion of output devices, however, let's take a look at the processor and memory sections, which are next in the computer flow.

The Processor

In a very real sense, the processor is the "brain" of the computer, since it orchestrates the flow of data into and out of the computer's memory section and from and to the outside world, in addition to actually processing of data. This device goes by a number of names, all of which refer to the same thing. Among the names in common use are "central processing unit" (commonly abbreviated CPU) and simply "processor." In the case of the personal computer, another name commonly used is "microprocessor," which is derived from the *microscopic* size of its *processor* circuits.

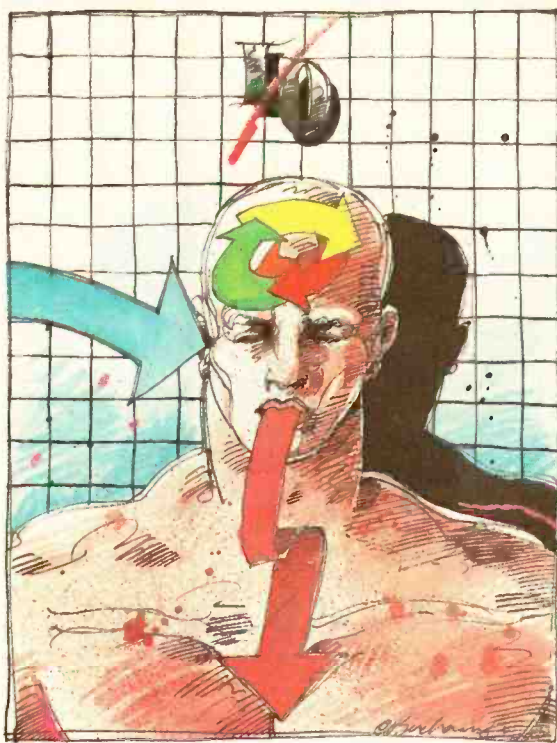
For the sake of efficiency, the processor accepts in-

structions and other information several bits at a time in parallel chunks. One could say that it takes a "bite" at a time, except that in computing the spelling is "byte." Just how many bits at a time it can handle is called the processor's word size, which has a direct influence in determining how powerful a given processor is and, thus, the power of the computer in which it's used.

The microprocessor is actually a miniature computer in its own right. It's made from a single integrated-circuit (IC) "chip" on which are thousands of basically very simple on/off circuits that act like switches. Though these circuits are very simple individually, they're combined in complex arrangements and there are so many of them that the microprocessor, in all its designs, is among the most complex devices ever created by human ingenuity. With all this complexity and power, the typical microprocessor is a very low-cost

device. In fact, the more popular microprocessors in current use average only a few dollars each to manufacture.

As we've already mentioned, the word size of a microprocessor determines just how powerful in terms of processing the device can be. The first microprocessors, introduced in the early 1970s, handled 4-bit words and, consequently, were known as 4-bit processors. By 1975, when personal computing made its debut, the word size had increased to 8 bits, with the introduction of Intel's popular 8080, followed by Motorola's MC6800 microprocessors and Mostek's 6502 devices. Today, the most popular processors used in personal computers are still 8-bit devices. However, a new generation of 16-bit microprocessors will likely surpass them in the business-orient-



The I/O section makes it possible for us to communicate with the computer

ed computer area.

There are a few different types of microprocessors in current use in personal computers. Each is more or less incompatible with all the others. Furthermore, even the same types cannot often use the same software because each design has its own special approach to processing information.

Understanding how computers work and the task of the processor requires some understanding of how programs (the processor's instructions) are stored in the computer's memory. A computer stores its instructions and data at locations in memory called "addresses."

When the processor needs the contents stored in a particular location, it sends the location's address out over its bus, along with a signal that tells the memory system that the processor wants to "read" the contents at that address. Since the processor reads several bits of data simultaneously, that's also the manner in which it's stored in the computer's memory section.

The retrieved data can be either an instruction or a number. If it's an instruction, the processor performs the required operation and then sends out a new address call to memory to retrieve the next instruction or piece of data. This process continues until the entire program stored in memory has been executed.

Sometimes, an instruction, such as a mathematical operation, requires a number to be processed. In a stored-program computer, that number is usually located in memory at a location immediately following the location of the instruction. At other times, the data immediately following the instruction is another address in memory where the number can be found, instead of the number itself. In any case, it's the processor's task to interpret each instruction, sending out new addresses to memory, which, in turn, sends back more instructions and data to be processed.

The concept of stored programs, in which all of a processor's instructions are stored in sequential addresses in memory and intermixed with numbers, is common to all modern computers. The steps performed are very similar to those in an ordinary calculator, which accepts a number and then an instruction, such as + for addition or \times for multiplication, and then another number, followed by another instruction, such as = to obtain the result.

The major difference between how a computer and a calculator perform a mathematical operation is significant. In a computer, instructions and numbers are stored in memory and are automatically "fetched" when needed. In a calculator, on the other hand, numbers and instructions are entered one at a time by hand. More advanced "programmable" calculators operate in a manner similar to a computer in performing mathematical operations, but the computer extends the concept to include handling of nonmathematical symbols as well.

A computer, "thinks" only in terms of 1s and 0s. You might wonder, then, how it's able to extend its process-

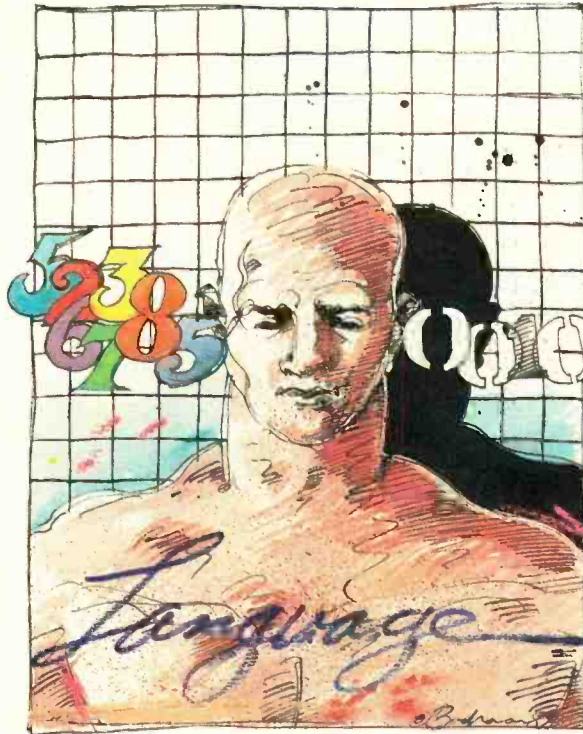
ing power to manipulate letters and numbers. To understand this process requires a closer look at a byte. To simplify this discussion, we will limit it to 8-bit processors, which handle 8-bit bytes.

Since each of the eight bits in a byte can be either a 1 or a 0, there are a total of 256 different possible bytes. This number is derived from the fact that the number of different combinations of a string of a binary number "n" bits long is 2^n . Thus, a byte has 2^8 , or 256, different possibilities.

With 256 possible variations, one byte is assigned to each upper- and lower-case letter of the alphabet and one each for the ten digits (0 through 9). The remaining 194 bytes are assigned to punctuation, graphics, and special characters. Thus, while the bit is the basic unit of information, the 8-bit byte is used to represent numbers and letters. For microcomputers, this is based on the widely accepted ASCII (American Standards Committee for Information Interchange) correspondence

between bytes and the symbols they represent. It's important to note that this correspondence, while useful for translating between bits and the more familiar symbols we commonly use in everyday language, isn't the only meaning given to a byte.

Within the processor itself, bytes often represent instructions the processor must execute and for which the ASCII code doesn't apply. The kind of instructions a processor follows gets us to the very core of the processor itself, which is made up of an *arithmetic logic unit* (abbreviated ALU), a control section, and various kinds of single- and multiple-byte storage locations called *registers*. The storage registers aren't part of the computer's user memory; rather, they're located with-



A computer "thinks" only in terms of 1s and 0s

in the processor itself.

In a typical processor instruction cycle, as mentioned above, an address is sent out to memory to retrieve an instruction stored in a specific location (address). To send out the address, the processor loads it into a one-byte memory called the *address counter*.

How does the processor know at what address to look for an instruction? When the processor is first powered up, the address counter contains all 0s. This means that the processor expects to find its very first instruction in the computer's memory at address 0000. From here, the address counter keeps incrementing, or adding one



ELECTRONICS BOOK CLUB

The Best Source for Hobbyists and Professionals
for Over 18 Years!

Time- and Money-Saving Advice . . .
Practical Troubleshooting & Repair Tips . . .
State-of-the-art Technology . . . hundreds
of Projects . . . Plus, Exceptional Savings

Select 6 Books for Only \$2⁹⁵ (Values to \$123.70)



1218
List \$17.95



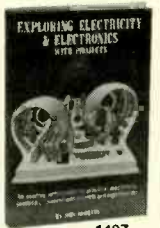
1195
List \$13.95



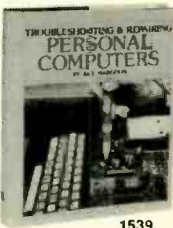
1383
List \$13.95 (paper)



1466
List \$17.95



1497
List \$15.95



1277
List \$19.95



1183
List \$15.95



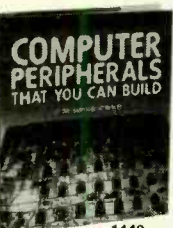
1211
List \$14.95



1332
List \$16.95



1465
List \$15.95



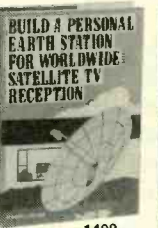
1449
List \$19.95



1537
List \$16.95



1529
List \$21.95



1409
List \$15.95



1474
List \$15.95



1396
List \$14.95



1306
List \$19.95



1276
List \$15.95



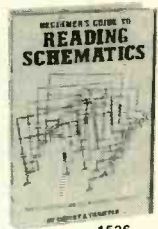
1499
List \$21.95



1428
List \$17.95



1498
List \$18.95



1536
List \$14.95



FREE guide to
mail order sources
for electronic parts
and components
A \$6.95
Value!



FREE When You Join Now

7 very good reasons to join The Electronics Book Club

- **Big Savings.** Save 20% to 75% on books sure to increase your computer know-how
- **No-Risk Guarantee.** All books returnable within 10 days without obligation at Club expense
- **Club News Bulletins.** All about current selections—mains, alternates, extras—plus bonus offers. Comes 13 times a year with hundreds 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
- **Bonus Books.** Immediately get a Dividend Certificate with every book purchased and qualify for big discounts of 60% to 80%
- **Extra Bonuses.** Take advantage of added-value promotions, plus special discounts on software, games, and more
- **Exceptional Quality.** All books are first-rate publisher's editions selected by our Editorial Board and filled with useful, up-to-the-minute information

ELECTRONICS BOOK CLUB

P.O. Box 10
Blue Ridge Summit, PA 17214

Please accept my membership in the Electronics Book Club and send the 6 volumes circled below, and my FREE copy of *The Electronics Buyer's Guide*, 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 canceled. I agree to purchase 3 or more books at reduced Club prices (plus shipping/handling) during the next 12 months, and may resign any time thereafter.

1160 1183 1195 1199 1211 1218 1276 1277 1306
1332 1383 1396 1409 1428 1449 1451 1465 1466 1474
1497 1498 1499 1529 1536 1537 1539 1543 1604

Name _____ Phone _____

Address _____

City _____

State _____ Zip _____

Valid for new members only. (Orders outside U.S. or Canada must be prepaid in International Money Orders in U.S. dollars. Canada must remit in U.S. dollars.) This order subject to acceptance by the Electronics Book Club. PE-184

or more to its own value, to locate each successive address at which it expects to find succeeding instructions. Additionally, certain instructions used to modify the address counter cause the processor to look in different areas of memory for instructions. These are called *jumps* or *branches* and are part of a programmer's strategy in writing programs.

Wherever it comes from, the instruction arriving on the data bus enters the processor's instruction register (IR), which stores it for decoding by the processor's control section. The control section is the actual "brain" of the processor. It's the responsibility of this section to interpret each instruction and to orchestrate the other parts of the processor into action at the proper time.

In some cases, an instruction might simply fetch a number or letter from memory so that the next instruction can send it out to a printer or video monitor. In other cases, the instructions use the arithmetic logic unit to perform mathematical and/or logic operations. Logic operations combine bytes of data according to certain rules to produce a desired result. Frequently, the result is redeposited in memory for later use by still another instruction that "writes" data back into the computer's memory.

The Memory

Once a computer accepts the data and instructions fed into it through the input portion of the I/O section, it either stores it for later use or processes it immediately. Storage, which is the function of the memory section of the computer, is required to hold the computer's applications program and other information.

Memory devices for computers to store data and programs are available in many different configurations. The capacity of its memory system is often used as the yardstick by which a computer's processing power is measured. The more memory a computer has, the larger the program it can accommodate. In fact, many applications programs can operate only in those computers that have at least a certain amount of user memory available. Computers with very little memory may not have enough memory capacity to run word-processing, data-base management, and other highly sophisticated software and, thus, are "underpowered" in this respect.

Computer memory is generally divided into two cate-

gories. One is *working memory* (frequently referred to as *user RAM*) and preprogrammed *ROM*. The other is so-called *mass memory*.

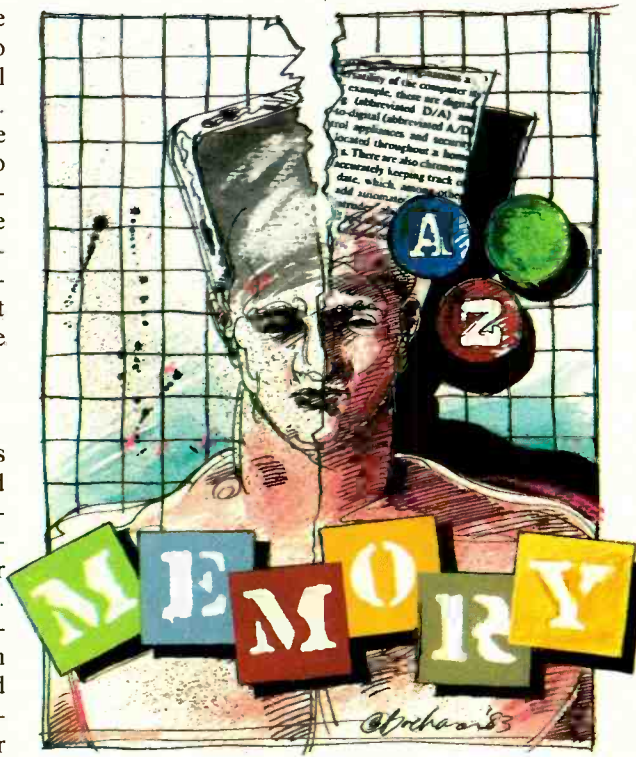
Working Memory can be thought of as an arrangement of "bins," each of which can store one and only one byte of information. Each of these bins has a unique numbered "address." The bins are subdivided into a set number of slots, the number reflecting the number of bits that make up the computer's word size. In an 8-bit computer, each memory bin has eight slots to accommodate the eight 1s and 0s that make up its word size. Each slot in the memory bin accommodates only one 1 or 0. No two locations in memory can have the same address, but two or more addresses (memory locations) can have the same character programmed into them.

When the computer's processing section requires a specific piece of information from memory, it looks up the location's address and goes directly to that location to fetch the data it needs. It doesn't have to step through each location in memory between the last location addressed and the current location to be addressed in order to arrive where it wants to be. Instead, it "jumps" directly to the location being called. This ability to jump directly to any location in memory gives the computer's processor the ability to *randomly* access any given address; for this reason, the arrangement of address locations is called *random-access memory* and is commonly abbreviated *RAM*.

In most computers, the majority of working memory is user RAM, but a portion of working memory is almost invariably set aside for a different kind of memory called *read-only memory*, which is commonly abbreviated *ROM*. As is the case with RAM, ROM locations in memory can be accessed

randomly. However, since ROM contains programming that must be executed in a specific sequence, access to its memory locations isn't usually random; thus, ROM isn't considered to be *random-access* memory.

There's one major difference between RAM and ROM—RAM is used to *temporarily* store data until needed, while ROM has data *permanently* stored in it. When a computer is through using data in RAM, the data can be erased and replaced with new data. Not so with ROM; whatever data is preprogrammed into ROM isn't ordinarily erasable by the computer user. Hence, RAM can be thought of as a blackboard that



RAM is used to temporarily store data, while ROM has data permanently stored

can be used and erased over and over, each time with different information. ROM, on the other hand, is more like a typewritten page that's nonerasable and always contains the same information.

Another important difference between RAM and ROM has to do with the data retentivity of the two different types of memory. Data stored in RAM is *volatile*, which means that it remains in memory only as long as power is applied and hasn't been interrupted. Any interruption in power to RAM will erase whatever data was stored; this data is then irretrievably lost. On power-up, the computer's RAM memory will have nothing in it. ROM, by contrast, is a *nonvolatile* memory system; anything programmed into it as it's delivered from the factory will remain in it, regardless of whether or not power is applied.

RAM and ROM are all-electronic devices. They're actually integrated-circuit (IC) chips, like the microprocessor. These solid-state devices, along with the input/output and processor sections, make up part of what is termed the computer's *hardware*. (The ROM can also be thought of as being software in the sense that it contains program data necessary to the functioning of the computer. In fact, because the programmed ROM shares many of the characteristics of both hardware and software, it's frequently called "firmware.".) Because they're totally electronic devices that directly connect to the computer's processor section via a metal-conductor data bus, they can transfer data at almost the speed of light.

Mass Memory is one step removed from the computer's processor and is available to the processor only by first passing through working memory.

Mass-memory storage is a relatively low-cost approach to meeting the large data needs of a computer. It's usually composed of a magnetic material that can have recorded on it the desired information. There are two basic magnetic-media mass-storage devices in common use in personal computing systems. These are standard cassettes and disks.

The cassette medium is the least expensive form of mass storage (\$50 to \$150). Though it can store large masses of data, it's not very practical for serious computing. Compared to disk media, cassette storage is relatively unreliable, slow in operation, and lacking in flexibility. It's mentioned here only to inform you that

it exists and offers a low-cost introduction to mass storage.

The next step up in the mass-storage medium is the so-called "floppy disk" and its drive. As its name implies, the floppy storage medium is in the form of a flexible disk of thin Mylar on both sides of which is deposited a coating of magnetic-oxide that serves as the recording medium. Depending on the type of disk drive and the type of disk being used, one or both sides are accessible for program and data storage. The floppy disk gets its name from the nature of the storage medium, which is very flexible (or, in the modern idiom, "floppy") when not housed inside its nonremovable protective plastic jacket.

Floppy disks are available in a number of sizes, ranging from the 8" diameter floppy, to the 5 $\frac{1}{4}$ " mini-floppy, to the 3" to 4" microfloppy. Each size disk is designed for a specific drive type and is incompatible with

the others. In terms of storage capacity, 8" floppy disks can store considerably more data than can 5 $\frac{1}{4}$ " minifloppies. The microfloppy has a storage capacity the equal of 5 $\frac{1}{4}$ " minifloppies, due to much tighter manufacturing and operating-control tolerances.

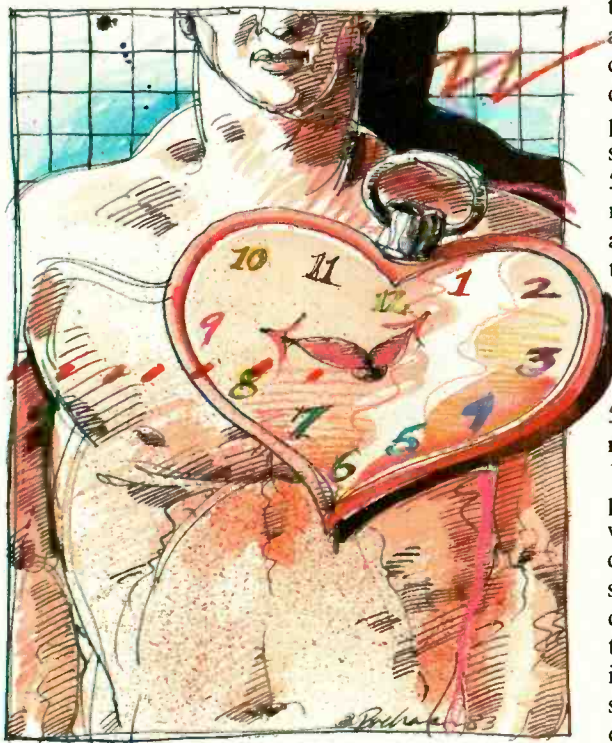
Floppy disks are capable of storing information ranging from 80,000 bytes (abbreviated 80K) in older 5 $\frac{1}{4}$ " drives to in excess of 1-million bytes (abbreviated 1M) in the newest drives, depending on media size and whether or not the disks and drives are single- or double-sided. As a rule, double-sided disks can store two or more times the program and data information than can be stored on single-sided disks of the same density.

For much greater storage capacity, it's necessary to step up to hard-disk systems, which can store anywhere

from 5-million bytes on up to and beyond 160-million bytes of program and data information.

The storage medium inside hard-disk drives (frequently called "Winchester" drives) consists of rigid, or "hard," metal disks on which is deposited the magnetic-oxide recording material. The disks themselves are sealed inside dust-proof chambers.

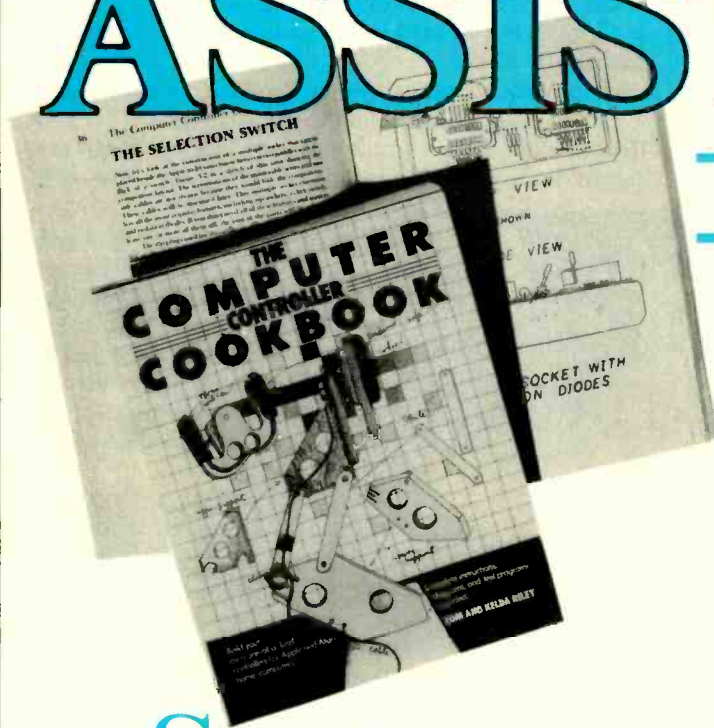
The need for mass memory is basically one of economics. Fast, immediately accessible working memory is expensive, not only in terms of the cost of the devices themselves but also in terms of the space they require inside the computer and in power consumption. ◇



If a program is stored on a thirty-minute tape, it might take 30 minutes just to locate it.

THE DO-IT-YOURSELFERS' PROJECT ASSISTANT

BY TOM & KELDA RILEY



Save up to half the usual retail price building your own game controls that will last up to twice as long as most commercially purchased models with THE COMPUTER CONTROLLER COOKBOOK...the indispensable guide for computer game enthusiasts!

Make your own game controls...repair that old joystick that's been sitting in your closet...have your own project assistant in your home, ready when you are! The **COMPUTER CONTROLLER COOKBOOK** gives you complete schematics and mechanical drawings for building and repairing joysticks, paddles and game devices for your Apple® or Atari® computer, with a special section showing you how to adapt these to most major machines. Imagine building your own Super Joystick, Annunciator, Airplane Wheel, Foot Pedals, Sketch Pad or Multiple Connector from purchased *and* scavenged parts and then using them on your own computer! Imagine saving up to half the cost of usual commercial prices and having your controls last up to twice as long! Imagine the hours of enjoyment and learning you'll get from the **COMPUTER CONTROLLER COOKBOOK!**

Order your copy today!

Apple is a registered trademark of Apple Computer Inc. Atari is a registered trademark of Atari Inc.

CREATIVE COMPUTING PRESS Dept. NJ8F, 39 East Hanover Avenue, Morris Plains, NJ 07950

Please send me _____ **COMPUTER CONTROLLER COOKBOOK(s)** at \$11.95* plus \$2.00 postage and handling each. Outside U.S.A. add \$3.00 per order. #8C.

Payment enclosed \$_____. *Residents of CA, NJ, and NY State add applicable sales tax.

Charge my:
 American Express Visa MasterCard

Card No. _____ Exp. Date _____

Signature _____

Mr./Mrs./Ms. _____
please print name in full

Address _____

City _____

State _____ Zip _____

**For faster service, PHONE TOLL FREE
1-800-631-8112**

(In NJ call 201-540-0445)

Send me a FREE Creative Computing Press Catalog.

AN ATARI TAPE INTERFACE

A simple FSK interface permits loading and storing programs on a conventional cassette recorder

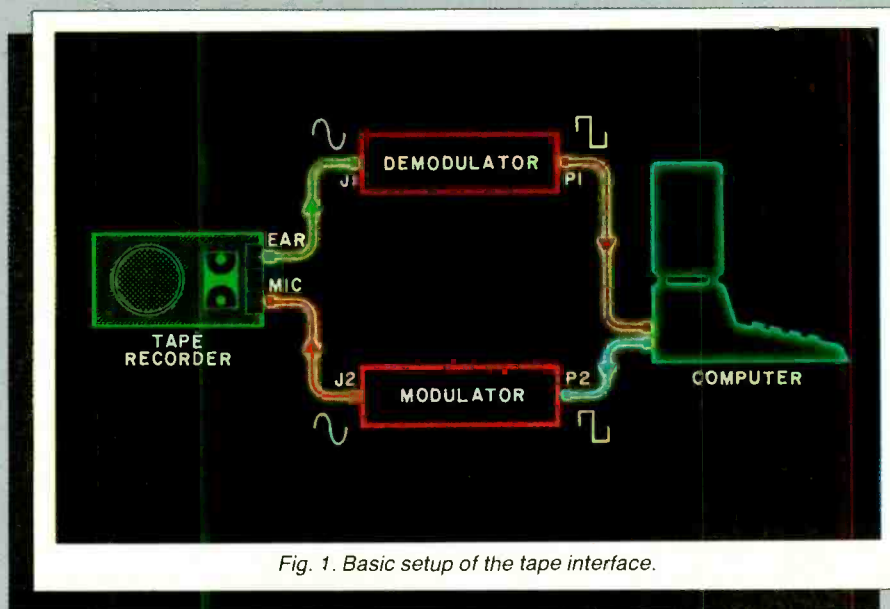


Fig. 1. Basic setup of the tape interface.

By Randy Carlstrom

ONE thing you learn quickly when you become a member of the computer revolution is that, while your computer's initial purchase price may have been dirt-cheap, the other things you need to make it useful—like a cassette recorder or disk drive, printer, and other peripheral devices—generally cost far more than you'd expect. The computer itself may turn out to be the least expensive part of your system, and it becomes a case of the tail wagging the dog.

It is difficult to justify purchasing a peripheral that costs more than the computer with which it was designed to operate. Having purchased an Atari 400 computer for less than \$80 (including an Atari rebate) from a local hobby-and-toy store, I couldn't quite bring myself to pay more for the data recorder than I had for the computer. If you belong in the same category and own a standard cassette player/recorder of decent quality, or if you already own an Atari recorder and find that it's not

quite as reliable as you'd like it to be, read on—for less than \$20 you now have access to the wealth of Atari cassette programs.

Circuit Description. The Atari data recorder differs from a conventional audio cassette recorder because the frequency-shift keyed (FSK) modulator circuit is incorporated into its design, rather than being an integral part of the computer, as is usually the case. This article describes a simple single-chip FSK interface, designed to operate with the Atari computers, based on the Exar XR-2211 integrated circuit. This interface will permit loading and storing programs using a conventional cassette tape recorder.

Basic operation of the FSK tape interface is shown in Fig. 1. The modulator section of the computer accepts digital pulses from the computer (representing the program or data in the computer that is in the process of being stored) and converts them into audio tones, which are

readily "stored" by a tape recorder. In the case of the Atari computers, a logic 1 is represented by a 5327-Hz tone and a logic 0 by a 3955-Hz tone. The demodulator section performs the reverse operation. It accepts the recorded data tones from the tape player and translates them back into their original binary format. The resulting pulses are then sent on to the computer for final processing. (If this sounds strangely similar to a modem, it's because the two are almost identical in operation. The only difference is that the tones are sent between a computer and tape deck via a cable, rather than back and forth over telephone lines.)

A block diagram of the XR-2211 integrated circuit is shown in Fig. 2. The small, numbered circles are the package pin leads. This versatile device contains an input preamplifier, a voltage-controlled oscillator (VCO), two phase detectors, two voltage comparators, and a reference voltage source. These functional blocks are internally connected to

**“Peripherals
may wind up
costing more
than the
computer
itself.”**

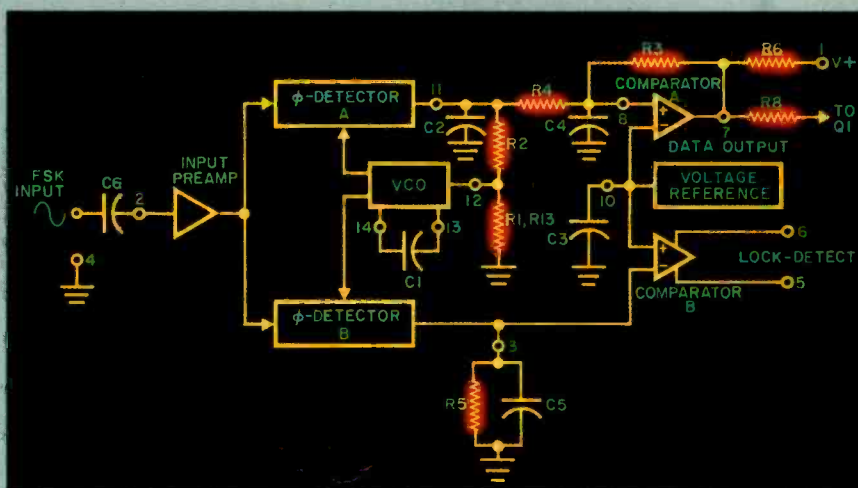


Fig. 2. Block diagram of the XR-2211 integrated circuit.

form a phase-locked loop (PLL).

When a signal of sufficient amplitude is present at the FSK input (pin 2), the loop formed by phase detector A, R2, and the VCO attempts to track the input frequency. If the input signal is within the capture range of the PLL (the range of frequencies over which the loop can lock in), the VCO will track any small changes in the input frequency. The resulting changes in the VCO control voltage at the output of the phase detector (pin 11) are filtered by C2 and the data filter, C4 and R4. This signal is a facsimile of the original data and is amplified and shaped by comparator A. Inverter Q1 provides the proper data polarity for the computer. Typical waveforms are shown in Fig. 3.

Phase detector B, filter C5 and R5, and comparator B form a lock-detection circuit. Any time the input signal falls outside the PLL's capture range (or if the input signal is lost), pin 6 of compar-

ator B is low. This pin is usually connected directly to the FSK demodulator's output (pin 7) to prevent chatter, should the PLL become unlocked.

The input preamplifier is actually a limiting amplifier that is able to accommodate a wide range of input signal levels. Ten millivolts rms is sufficient to cause limiting, but signals as large as 3 V rms can be used. This makes the PLL relatively immune to the volume (gain) setting of the tape recorder.

A schematic of the complete project is shown in Fig. 4. Resistors R9 and R11 form a 40-dB attenuator between the computer's FSK output and J2, which connects to the microphone input of the recorder. Approximately 10 mV rms is delivered to J2 during program save operations, providing the proper recording level for most recorders. The value of R9 can be changed (or it can be removed) if necessary to suit the requirements of your tape recorder.

Construction. The cassette interface can be built using any convenient construction technique and can be housed in its own enclosure or mounted inside the computer's case. If the latter method is chosen, two holes must be drilled in the case for mounting J1 and J2. The five power and I/O connections from the interface board can be soldered directly to the mounting pins of the computer's serial I/O connector. (This eliminates P1, and the serial I/O connector is left free for use with other peripherals.) However, this method is recommended only for the skilled and/or dauntless since the computer's warranty is automatically voided.

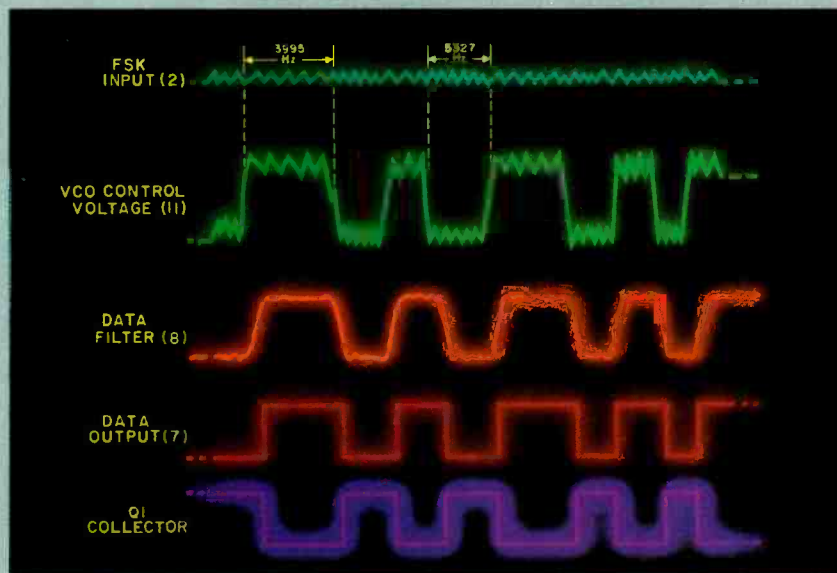
Alignment and Operation. One adjustment is necessary to ensure reliable operation of the interface. It involves setting the free-running frequency of the PLL's VCO. The following steps outline the procedure:

1. Connect an ohmmeter between pin 12 of IC1 and ground. Adjust R13 until the ohmmeter indicates approximately 21 kilohms, then disconnect the ohmmeter.

2. Connect a shielded cable from the earphone or speaker jack of a cassette recorder to J1 (EAR) of the interface. Place a program tape in the recorder and rewind it completely. If the interface wasn't installed inside the computer, make certain plug P1 is plugged into the computer's serial I/O connector at this time. Turn on the computer power.

3. Press the PLAY button on the recorder. The first 10 seconds or so of the tape should consist of a steady 5327-Hz tone, which can be verified by listening to the television speaker. During this period, adjust R13 so that pin 11 of IC1 is -2.6 V with respect to pin 10. If you don't have access to an ohmmeter or voltmeter, you can center R13 and slowly adjust it until the program loads suc-

Fig. 3. Timing diagram for the circuit shown in Fig. 4.



cessfully through the interface.

Operation of the cassette interface is similar to that of the Atari data recorder. Programs can be loaded by following the instructions that accompany the program cassette. As a program is loaded, you will hear a buzzing sound from the television speaker. This is normal and indicates that the Atari is happy with the data it is receiving from the tape recorder. When saving programs on tape, follow the instructions given with the programming language used. Remember to press the RECORD button on the recorder.

If the interface was aligned properly as outlined above, programs should load very reliably, since this interface has proven to be more reliable than the Atari 410 data recorder. If you experience any problems, adjust the recorder's volume and/or tone controls. If that doesn't help, the recorder may not be quite up to par, in which case a good tape-head cleaning may be in order.

Errors occurring at the beginning of a loading sequence can often be attributed to leaving an insufficient amount of tape leader before the actual data began on the tape. (The computer doesn't really begin accepting data from the recorder until approximately 5 to 10 seconds after the computer's RETURN key has been pressed.) A tape that refuses to load past a certain point (usually at the same point and somewhere in the middle) is a classic example of the "bargain-tape syndrome." Some cheaper tapes often contain "dead spots" where the FSK signal drops out momentarily—a phenomenon almost certain to succeed in confusing your computer.

Bit-Copying Tapes. It is a simple matter to make backup copies of any of your tapes using the cassette interface and the circuit shown in Fig. 5. This circuit simply remodulates the serial data stream from the demodulator, bit by bit, and consequently doesn't care if the program is BASIC, machine language, or even copy-protected. A second tape recorder "listens in" on J3 while the first recorder is playing the original program tape through J1 (Fig. 6).

"So," you say, "why not just patch two recorders together to duplicate tapes?" This method will work, in general, if you use a good quality recording to start with. However, it has been the author's experience that many of the commercially available cassettes tend to degrade with time, especially those that are favorites of the family and are constantly being used and abused. You can be sure that a "patched" duplicate made from such marginal tapes will be even more marginal!

It is recommended that the alignment

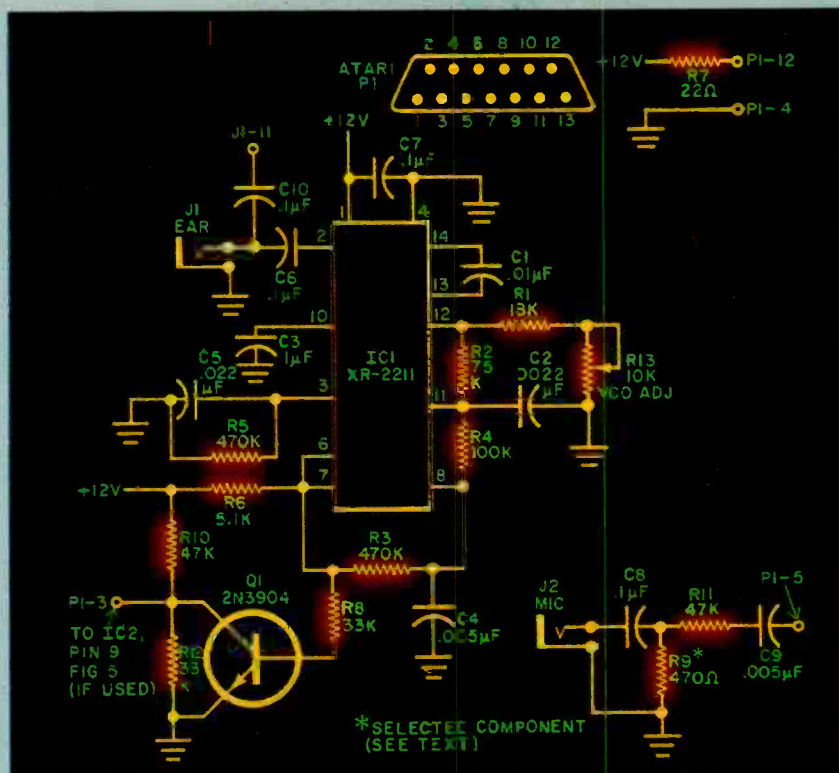


Fig. 4. Schematic of the interface. The wiring side of P1 is shown.

PARTS LIST

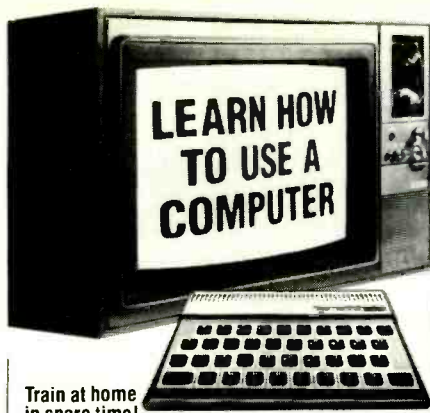
- | | |
|--|--|
| C1,C12—0.01- μ F, 5% polyester capacitor | R13,R18,R20—10-kilohm trimmer potentiometer |
| C2—0.0022- μ F ceramic capacitor | R14—200 ohms |
| C3,C6,C7,C8,C10,C14—0.1- μ F ceramic capacitor | R17—20 kilohms |
| C4,C9—0.005- μ F ceramic capacitor | R19—15 kilohms |
| C5—0.022- μ F ceramic capacitor | Misc.—Suitably etched and drilled pc board or perf board; IC sockets; 5-conductor cable; solder; enclosure; etc. |
| C11,C15—1- μ F electrolytic or tantalum capacitor | |
| C13—10- μ F electrolytic or tantalum capacitor | |
| IC1—XR-2211 FSK demodulator/tone decoder (Exar) | |
| IC2—XR-2206 function generator (Exar) | |
| J1,J2,J3—Miniature phone jack | |
| P1—13-pin Atari mating plug | |
| Q1—2N3904 npn transistor | |
| The following are 1/4-W, 5% carbon resistors unless otherwise specified: | |
| R1—18 kilohms | |
| R2—75 kilohms | |
| R3,R5—470 kilohms | |
| R4—100 kilohms | |
| R6,R21,R22—5.1 kilohms | |
| R7—22 ohms | |
| R8,R12,R15,R23—33 kilohms | |
| R9,R16—470 ohms (selected, see text) | |
| R10,R11—47 kilohms | |

Note: The following are available from RC Systems Inc., 121 W. Winesap Rd., Bothell, WA 98012: Kit of parts for cassette interface/duplicator, including etched and drilled pc board, No. AK-1, for \$29.95. Also available separately from the same source: Kit of parts for cassette interface only, No. AK-2, for \$19.95; etched and drilled pc board for interface/duplicator, No. AB-1, for \$5.00; etched and drilled pc board for cassette interface, No. AB-2, for \$4.00; XR-2211 IC for \$5.25; XR-2206 IC for \$5.00; Atari 13-pin mating plug, No. AP-1, for \$6.50. Please include \$1.75 shipping and handling on all orders. Washington state residents, add 7.8% sales tax.

of the modulator circuit in Fig. 5 be performed with a frequency counter. With the counter connected to pin 2 of IC2, short pin 9 to ground and adjust R18 for 3995 Hz. Remove the short from pin 9 and adjust R20 for 5327 Hz. (Note that the computer must be turned on to make these adjustments.) If you don't

have access to a frequency counter, you can use the following alternate procedure:

1. With a jumper wire or shielded cable, connect J3 of the modulator to J1 of the demodulator.
2. Short pin 9 of IC2 to ground and adjust R18 until pin 11 of IC1 is +2.6 V



Train at home in spare time!

Learn it all...at the office, or at home...computer operations, applications and programming!

Learn how and why a computer can help you. Learn to write your own computer programs. How to program in BASIC. How to understand and use more than 80 BASIC commands and functions. How to use pre-packaged software and change it to meet your special needs. How to make sense of the overwhelming maze of books, information and advice available at your local computer store. See how easy it is to use different programs already available. See how they fit into your home or business operations...budgeting, real estate, book-keeping, inventories, expenses, pricing, profit margins, investments, interest, taxes...hundreds more including foreign languages, and graphics. Never again be at the mercy of a so-called "computer expert."

EXPERTS SHOW YOU WHAT TO DO, HOW TO DO IT...TO MAKE YOUR LIFE EASIER

Everything is explained in easy-to-understand language with plenty of examples. Step-by-step you learn how to program in BASIC. How to understand and use more than 80 BASIC commands and functions. How to use pre-packaged software and change it to meet your special needs. How to make sense of the overwhelming maze of books, information and advice available at your local computer store. You learn everything you need to know to use the computer. You'll be able to understand computer experts and talk their language... storage, systems, terminals and much, much more. **NOW... ALL THIS IN ONE COURSE!**

- Computer Training • Computer Programming
 - Computer Applications
- Find out what you need to know about computer operations

TIMEX SINCLAIR 1500 WITH BUILT IN 16K MEMORY INCLUDED WITH YOUR TRAINING
Plugs into any TV!



SEND FOR FREE FACTS!

ICS COMPUTER TRAINING, Dept. PD0C3
SINCE 1891 Scranton, Pennsylvania 18515

Please rush me free facts and color brochure that tells how I can learn computer applications, programming and operation at home in spare time.

Name _____ Age _____

Address _____

City/State/Zip _____

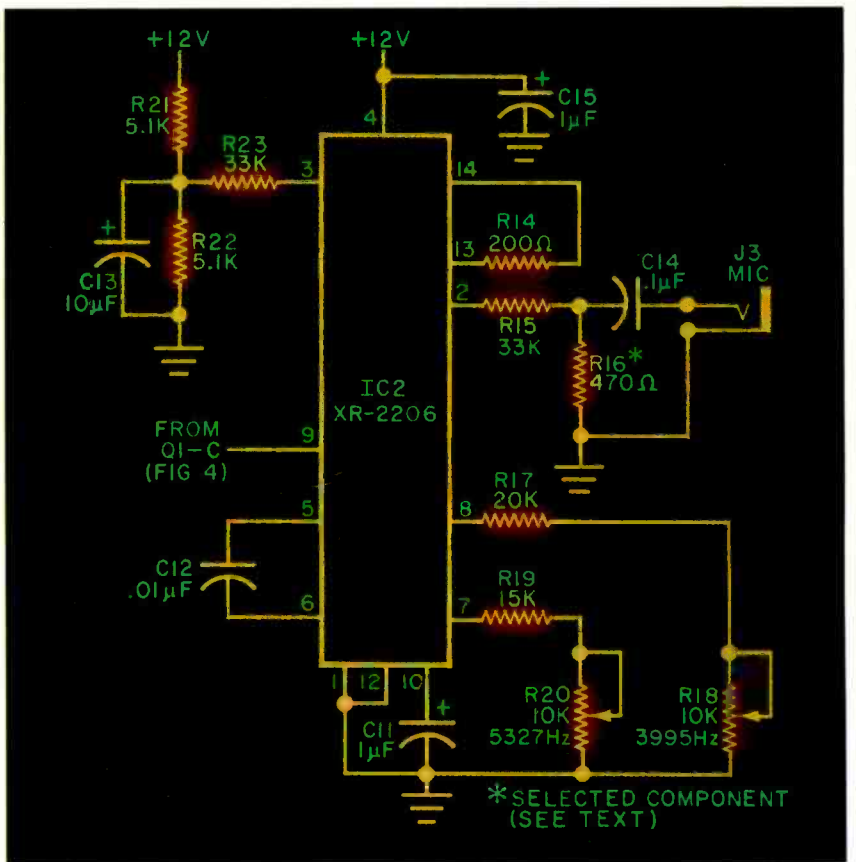


Fig. 5. Schematic of a circuit to remodulate the serial data.

with respect to pin 10.

3. Remove the short from pin 9 and short the base of Q1 (the lead that connects to R8) to ground.

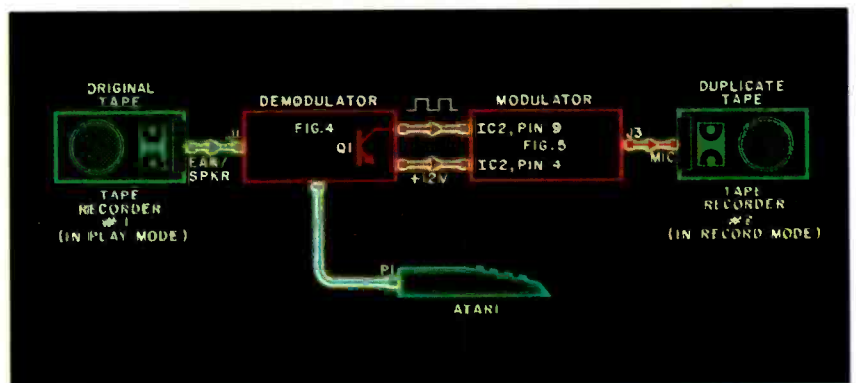
4. Adjust R20 until pin 11 of IC1 is -2.6 V with respect to pin 10. Remove the short from Q1 and the connection between J1 and J3.

Since IC1 is acting as a frequency discriminator during these adjustments, the accuracy of these adjustments will depend on how accurately R13 was set. The value of R16 sets the recording level at J3, which may need to be selected to suit the drive requirements of the second recorder.

The operation of the demodulator is not affected in any way by the modulator and can remain connected permanently. In fact, it's a good idea to have the computer load the original tape during the duplication process. If the original tape loads successfully, you can be reasonably certain the duplicate copy is accurate.

The remodulation process does a marvelous "cleanup" job of marginal tapes. In fact, I use my duplicates all the time, saving the originals for backups. Also, I don't get so upset now if my recorder gets hungry and chews up a \$40 game cassette!

Fig. 6. Modulator and demodulator interconnections.



7 Good reasons why you should subscribe to *Creative Computing*.



It's the Number One magazine of computer applications and software!

There's one place you can always be sure of learning more about microcomputer software and applications: *Creative Computing*.

Every month *Creative Computing* provides you with a continuing education on everything related to microcomputers and computer equipment. Useful articles, "how to" tutorials, exciting new applications, games and "no holds barred" reviews of the latest software and equipment make up a major part of *Creative Computing's* editorial content.

We give you probing features on programming breakthroughs and important news. Plus in-depth articles on elementary, intermediate and advanced software and applications topics—to help you develop your knowledge and skills, save hundreds (perhaps thousands) of dollars in unneeded software, discover uses for your personal computer that you might never have considered. Articles that increase your overall "computer consciousness." Here's how:

1

***Creative Computing* gives you things to actually do with a computer.**

Just owning a computer isn't enough. You've got to know what to do with it. That's why applications are our primary focus. Text editing, animation, graphics, business simulations, data base and file systems, music synthesis, control of household devices, communications, games—some of the applications and software you'll learn about in *Creative Computing*.

2

***Creative Computing* discusses business applications in simple, nontechnical language.**

If you're a business person who needs to know about the latest developments in word processing and office applications, turn to *Creative Computing*. We clarify such business applications as investment analysis, futures evaluations, data base management, mailing list, programs, text editing, word processing and simulations. And all the software available for business people.

3

***Creative Computing* helps you decide which computer equipment is best for you.**

Our tough, no-nonsense equipment profiles arm you with the facts before you walk into a computer store. You'll know the right questions to ask and how to cut through the jargon and sales hype. We give you authoritative guidance in deciding what you need, what you don't need—and what's right for you and your pocketbook.

4

***Creative Computing* covers computer education in depth.**

We started out as a computer education publication, and we're still committed to the educational community. We regularly carry articles on designing educational software, evaluating educational software, teaching concepts and terminology in computer education, text editing applications for literature and computer simulations in the classroom—plus a great deal more.

5

***Creative Computing* brings you hours of mind-expanding game entertainment.**

We've got a soft spot for the computer game addict—and computer game software. We know you want to understand more about the new computer games flooding the market: which ones are easiest to learn? Require the most skill? Offer the most surprises? Give you the best graphics? Provide the most challenge? Contain a new twist? *Creative Computing* brings you the answers.

6

***Creative Computing* features the state of the art.**

Columns on the most popular personal computers, a "software legal forum," letters to the editor. Reviews of books, games, organizations, dealers and events. Fascinating interviews with leading innovators, equipment designers, program developers and game inventors—men and women who'll give you a real glimpse of the future!

7

Our price is right.

By subscribing to *Creative Computing* now, you can save as much as 33% off the full subscription price. To learn elsewhere what you'll learn from *Creative Computing*, you might spend hundreds of dollars in course fees and books. Then you'd have to winnow out what you could use from all that you'd learned. But *Creative Computing* does that for you, so you'll have time to enjoy your own computing interests. And that saving of time makes this offer very inexpensive indeed.

SAVE UP TO 33%! ———

Creative Computing · P.O. Box 5214 · Boulder, Colorado 80322

YES! Send me *Creative Computing* for:

- One year (12 issues) for \$19.97—I save 20%!
- Two years (24 issues) for \$36.97—I save 26%!
- Three years (36 issues) for \$49.97—I save 33%!

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

Check one: Payment enclosed. Bill me later.

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

Address _____ Apt. _____

City _____

State _____ Zip _____

Offer valid in U.S. and possessions only. Please allow 30 to 60 days for delivery of first issue.

**Join over 150,000
Creative Computing readers
by subscribing today!
Just use the coupon
at right.**



Assembly Language Primer for IBM PC:

Featuring the 8088 Microprocessor

Learning and using assembly language

By Robert Lafore

INTRODUCTION

ASSEMBLY language has the reputation of being difficult to learn; especially from the pages of a magazine. We think this reputation is largely undeserved, and that assembly language can be taught as simply and easily as other languages such as BASIC and Pascal. In the following article, we present assembly language for the absolute beginner: the person who has never programmed in assembly language before.

This article is excerpted from the forthcoming *Assembly Language for the IBM PC*, a Waite Group book by Robert Lafore. (As you may recall, Mr. Lafore and Mr. Waite wrote *Soul of CP/M*, serialized in these pages in 1983.) This new book is a complete introduction to 8088 assembly language and forms part of an integrated series of **New American Library** language books on the IBM PC issued under the dual *Plume/Waite* imprint.

How is it possible to teach assembly language so simply? Mr. Lafore makes use of several innovative techniques. First, by basing his work on the IBM PC, he en-

sures that everyone will be working with exactly the same equipment. Books which attempt to teach assembly language for a particular *microprocessor chip* must be excessively vague about the actual commands used to perform a given operation, since the same chip can be used in many different machines.

Assembly Language for the IBM PC also uses the "miniassembler" built into the DEBUG program. This feature provides a greatly simplified entry into assembly language, since the reader need not start off by learning the complexities of the full-scale IBM Macro-Assembler program. Finally, by making use of the powerful *DOS functions* built into the operating system, the book can start out with programs that are very short and simple, but that nevertheless accomplish significant tasks. As you will learn, programming through DOS functions is *the* professional approach; it means your programs will work on all computers that run a version of the popular MS-DOS operating system.

For those of you who have always wanted to learn assembly language, but have not known how to begin, this is your chance!

ASSEMBLY LANGUAGE is always the fastest and most powerful language for a given computer. It is essential in programs where pure speed of operation is important, such as graphics, sorting, and sustained number-crunching. It is also the only language that can make use of *all* of a particular machine's hardware features. With higher-level languages, such as BASIC or Pascal, the programmer is always insulated from the computer by the language itself—he can only do what the writers of the language decided he should be able to do, so inevitably he cannot tap the full power of the computer.

For these reasons, many types of programs—such as operating systems, compilers, word processors, and graphics programs—are almost always written in assembly language. If you want to do this sort of programming, then you need to know assembly language.

But assembly language is not only

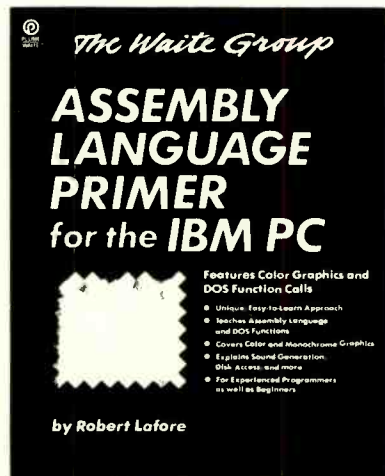
practical, it is also a fascinating and rewarding field of study. Because it is so close to the physical reality of the computer, everything you do in assembly language is the result of the way the

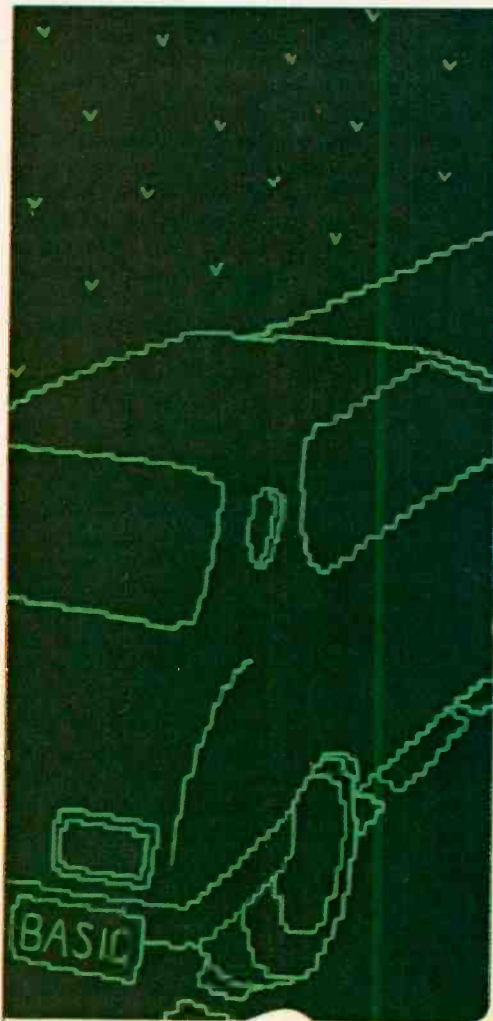
computer operates, not the way designers of a higher-level language decided to do things for the sake of ease and convenience.

We can think of higher-level languages as being like stodgy luxury sedans: they're comfortable and easy to use, but the steering is imprecise, the suspension insulates you from the feel of the road, and if you try to push them too fast they slide into the ditch.

Assembly language, on the other hand, is the sports car of computer languages. In a sports car you're close to the road, the steering, brakes and gears are light and precise, and the car is built for speed and efficiency. It may not be as comfortable as a sedan, but it's fast and, more important, it's fun to drive.

Is Assembly Language Hard to Learn? Unfortunately, assembly language has developed the reputation of being difficult to learn. Many people—





Assembly language is the sports car of computer languages. . . . It may not be as comfortable as a sedan but it's fast and it's fun to drive

even those who had no trouble learning a higher-level language such as BASIC—think that assembly language is somehow beyond them. This belief is fostered by many assembly-language books which, strange as it may seem, appear to be written with the assumption that the reader already knows about the subject. For instance, many assembly-language books start off by listing and describing all of the scores of microprocessor instructions. As a result, most readers give up before finishing the text.

We believe that assembly language, in spite of its reputation, is actually not much harder to learn than any other computer language, provided it is presented so you do not feel overwhelmed at the beginning. It's this sort of easy, step-by-step presentation that will be used in this series.

The series is intended primarily for the person who has no previous acquaintance with assembly language: the rank beginner. However, it will also

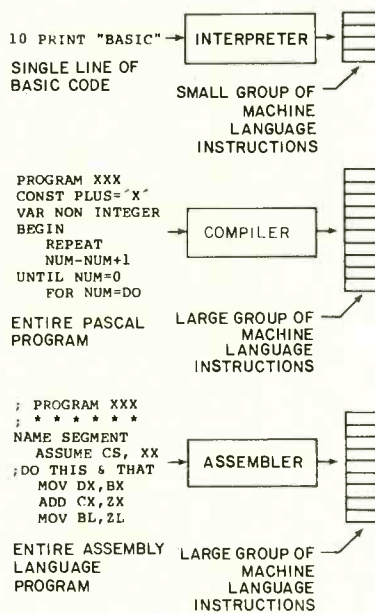


Fig. 1

package: ASM and MASM. MASM stands for "Macro ASseMbler," and is a full-scale assembler with all the bells and whistles. If you use it, you'll need a minimum of 96K of RAM.

ASM, which is sometimes called the "Small Assembler," is a more modest version of MASM. It will run in a 64K system if you are using PC-DOS Version 1.0 or 1.1. However, if you are using DOS Version 2.0, then you will need a minimum of 96K, with 128K being preferable if you get into writing long programs.

You can use any video display you like, since the concepts we'll explain here don't require the use of color. However, all the examples we'll give are based on an 80-column display. If you are using only 40 columns, you will need to do a little mental reformatting to compare the printouts here with those on your screen, but that should not pose a major problem.

It's very nice, but not absolutely necessary, to have a printer when writing assembly-language programs. A printed listing is convenient for debugging and for following the overall operation of a program, but a printer is like a house in the country: If you have one, you'll love it, but if you don't, you'll get along just fine anyway.

You'll find the Technical Reference Manual for your computer extremely useful. It's packed full of details about the computer's operation, and many of those details will become important to us as we explore the things assembly language can do. And, of course, keep

```

A>debug
-d100
04B5:0100 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00 .....
04B5:0110 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00 .....
04B5:0120 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00 .....
04B5:0130 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00 .....
04B5:0140 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00 .....
04B5:0150 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00 .....
04B5:0160 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00 .....
04B5:0170 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00 .....
  
```

Fig. 2

benefit the programmer who knows assembly language for a microprocessor other than the 8088 described here, and who wants to learn how the 8088 works.

Why the 8088? There are several reasons. First, because it's the microprocessor used in the IBM PC, a computer enjoying unprecedented sales growth, as well as work-a-like computers such as Compaq, Columbia Data Products and others. Second, if you want to learn about the new 16-bit technology, the 8088 chip in such computers is the ideal device to use.

What You'll Need. This is very much a hands-on series. Although you can gain a general understanding of assembly language by reading it without a computer at your disposal, you'll be far better off if you have a computer on your desk before you start to read. As with other languages—both human and computer—it's only through practice that real mastery is achieved.

We'll assume therefore that you have access to an IBM PC using PC-DOS or to another 8088-CPU based computer

```

-d100
04B5:0100 03 EB 42 90 75 03 EB 41-90 20 36 2C 30 38 3C 0A .kB.u.kA. 0,00<
04B5:0110 73 34 52 0B D3 9F 03 DB-03 DA 03 DB D1 DE 9E D1 s4R.S..I.Z.IQ^Q
04B5:0120 D6 0A D0 B6 00 9F 03 DA-D1 DE 9E D1 D6 5A E0 21 V.P6...Zq^QZht?
04B5:0130 00 72 0A 2C 30 72 04 3C-0A 72 D3 41 4A 0A C7 0A .r.,0r.C.rSAJ.G.
04B5:0140 C0 C3 9F 41 4A 9E F9 C3-E0 05 00 75 01 C3 EB F0 0C.AJ.yCh..u.Ckx
04B5:0150 0A C5 0A C1 75 01 C3 49-42 0B F2 AC 24 7F 0A C0 .E.Au.CIB.r,$.0
04B5:0160 F9 75 01 C3 3C 0C F9 75-01 C3 3C 0A F9 75 01 C3 yu.C<.yu.CC.yu.C
04B5:0170 3C 1A F9 75 01 C3 72 01-C3 F5 C3 A9 46 00 00 00 (<.yu.Cr.CuC)F...
  
```

Fig. 3

using MS-DOS. (Virtually everything we'll do can be done under either operating system. From now on, though, we'll speak only in terms of the PC and PC-DOS.) You'll need at least one floppy-disk drive. You won't be able to use a cassette-based computer, since the assembler program and various other pieces of software we'll make use of all require a disk operating system like PC-DOS or MS-DOS.

How much memory do you need to create assembly-language programs? That depends on which assembler you want to use. When you buy the standard IBM Macro Assembler for the PC, you actually get two assemblers in the same

handy the manuals for your assembler and for the other programs we'll be using to create our own.

You can use any of the current releases of PC-DOS: 1.0, 1.1, or 2.0. However, there are some advantages to using Version 2.0. First, PC-DOS Version 2.0 contains a very useful enhancement to the DEBUG program that is part of the disk operating system (DOS), and which we'll be using quite a bit. This is a "mini-assembler," built right into DEBUG. The first assembly-language programs we write will be created with DEBUG's mini-assembler rather than the more cumbersome ASM or MASM. You can also use older versions of DE-

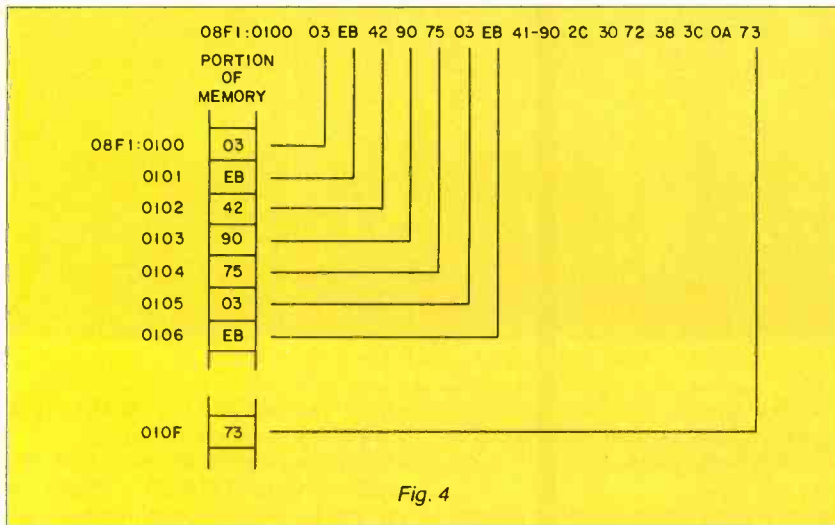


Fig. 4

BUG that do not contain the mini-assembler (we'll show you how), but it will be easier if you have it.

Three of the utility programs that come with PC-DOS are essential to following the lessons we're going to present. The first is DEBUG, which we've already mentioned. It's used to monitor, debug and edit assembly-language programs. Learning how to use it is vital to an understanding of assembly language.

The second utility is LINK, a program used to change an intermediate form of assembly language programs, call OBJ (for OBJECT) files, into an executable program called an EXE file. (We'll explain these terms as we go along.)

The last is EXE2BIN, which converts EXE (EXECutable) files to COM (COMmand) files. COM files are another, somewhat simpler, form of executable program.

Finally, once we start writing longer assembly-language programs, you'll need some sort of word processor to create what are known as the source files. These are text files, just like letters or other documents, but they contain the assembly-language instructions that will later be assembled for use by the microprocessor.

PC-DOS comes with a text editor called EDLIN (for EDit LINES). Though it's possible to use EDLIN to create assembly language source files, its limitations will become apparent as your programs become longer, and you'll probably want a good word processor anyway.

Assembly Language. Let's start by talking about assembly language in general—how it differs from higher-level languages such as BASIC—and about the operation of an assembler and how it differs from the interpreter or compiler used in higher-level languages.

If you're familiar with a higher-level language such as BASIC or Pascal, you know that there is a certain level of abstraction involved in program statements in these languages. A BASIC statement such as:

```
LET A=3
```

is operating on an abstract level. That is, we don't usually know, or need to know,



Fig. 5

where in the computer "A" is, or what changes are taking place in the computer when A is assigned the value of 3. This is because higher-level languages are oriented toward the handling of numbers with algebra-like formulas. Programmers using higher-level languages need that abstraction; they want to be insulated from what's really going on inside the computer so they can concentrate on the formulas.

In contrast, assembly language operates on a very concrete level. It deals with bits, with bytes, with words (two bytes side-by-side), with registers—which are physical places in the microprocessor where bytes and words are stored—and with memory locations, which have specific numerical addresses and specific physical locations in the memory chips inside the computer.

What Does an Assembler Do? If you've written programs in BASIC,

you're familiar with the two-step process involved: First you write a group of BASIC program statements that make up a program; then later, when you execute the program, these statements are "interpreted" or changed into machine-language instructions that are executed by the microprocessor.

This process in BASIC is made to appear "invisible" to the user. The individual program lines are interpreted one at a time, and the resulting machine-language instructions for each line are executed by the microprocessor before the next line is interpreted. (Figure 1 shows how this works.)

In compiled languages such as Pascal, things are handled a little differently. The user first creates a source file, which is a text file of the entire program. This is then changed into machine-language instructions by a compiler program. (Actually, a utility called a linker is used too, but we'll ignore it for the moment.) In a compiled language the entire program is transformed into machine language all at once.

Assembly language resembles a compiled language more than it does an interpreted language such as BASIC. An assembly-language source file consist-

ing of the text of the program is first created. This is then assembled into machine language by an assembler program. The assembler performs a process very similar to that of a compiler except that—as we'll see a little later—there is a far closer correspondence between an assembly-language instruction and a machine-language instruction than there is between a Pascal statement and the group of machine-language instructions that result from it.

What we've just described is the traditional way of transforming an assembly-language program into machine language instructions. To start with, however, we're going to use a different approach; we're going to use the mini-assembler in DEBUG. Using DEBUG, it's almost as easy to create and run short assembly-language programs as it is to create and run interpreted programs.

DEBUG vs. an Assembler. There are

several reasons why we've decided to start with DEBUG rather than with ASM or MASM. First, DEBUG is a much easier program to operate than the others. To type in and execute a program using DEBUG requires calling up only DEBUG itself, a simple process. Using an assembler, on the other hand, involves using a text editor, the assembler itself, a linker program called LINK, and often another program called EXE2BIN. Each of these programs requires a rather complex series of commands to make it work. We figured you'd have enough on your mind being introduced to a new computer language without having to learn how to operate all those other programs at the same time.

DEBUG's second advantage is that programs written with it require less "overhead" memory than those written with an assembler. This overhead comes in the form of program statements that must appear in the ASM source file, but are not necessary in DEBUG. (Don't worry if you don't understand what's meant by some of the terms we've used. Everything will be explained eventually.) The reason these additional statements are necessary in the assembler is difficult to explain at this point, so let's just say that by using DEBUG you avoid having to start your day with a lot of incomprehensible program lines.

Third, using DEBUG puts you in closer contact with what is *really* going on in your computer than using an assembler does. DEBUG has features that make it possible to get down to the most

```
A>debug
-f120 14f ff
-d100
04B5:0100  00 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00
04B5:0110  00 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00
04B5:0120  FF FF FF FF FF FF FF FF FF-FF FF FF FF FF FF FF
04B5:0130  FF FF FF FF FF FF FF FF FF-FF FF FF FF FF FF FF
04B5:0140  FF FF FF FF FF FF FF FF FF-FF FF FF FF FF FF FF
04B5:0150  00 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00
04B5:0160  00 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00
04B5:0170  00 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00
```

Fig. 6

BUG will do just fine. Table I summarizes the advantages and disadvantages of DEBUG and assemblers.

Window of the Soul. An old saying has it that "the eyes are the windows of the soul."

We might say that DEBUG is the window of the 8088's soul. Besides being useful for assembling programs, DEBUG is also used to examine and modify the contents of memory locations; to load, store, and start programs; and to examine and modify registers. In other words, DEBUG is designed to put us in touch with various physical features of the PC-DOS or MS-DOS computer.

Before we write our landmark, first-ever 8088 assembly-language program, we're going to get to know our way around DEBUG; rev it up, so to speak, find out where the controls are, and taxi it out of the hangar and around the runway. Then we'll be ready for takeoff.

on the "system disk" that contains your computer's operating system.

Following the DOS prompt, enter the program name "DEBUG". (When we tell you to "enter" something here, we mean to type the "something" and then press the ENTER key just to the left of the numeric keypad on the PC's keyboard.)

When DEBUG is loaded into the computer it will display its prompt, a single dash ("-"), which tells you that it's ready to listen to what you have to tell it.

The "D" Command. You can tell DEBUG what to do by typing in single-letter commands, usually followed immediately by one or more numbers. When we refer to these single-letter commands here we'll usually use upper-case letters, like "D," to make them stand out. However, when you type them in you can use either upper or lower case. For example, enter the letter "d" followed by the digits "1" "0" "0". You should see a display like the one shown in Fig. 2.

Wow! Look at all those numbers! What does it all mean? First of all, you may not see all zeros on your display as we show here. What the "D" command has done is to "dump" or display a portion of your computer's memory on the screen. Each pair of numbers represents one byte, or eight bits, of data stored in a particular memory location. If your

```
A>debug
-f100 117 61
-f170 17f 24
-d100
04B5:0100  61 61 61 61 61 61 61 61 61-61 61 61 61 61 61 61
04B5:0110  61 61 61 61 61 61 61 61 61-00 00 00 00 00 00 00
04B5:0120  00 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00
04B5:0130  00 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00
04B5:0140  00 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00
04B5:0150  00 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00
04B5:0160  00 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00
04B5:0170  00 00 00 00 00 00 00 00 00-24 24 24 24 24 24 24
```

Fig. 7

fundamental level of your computer's operation (short of opening up the cover and probing about with logic probes and oscilloscopes). Sooner or later, if you write programs in assembly language, you're going to have to understand this fundamental level and learn to use DEBUG; so now seems like a good time to start.

Of course, as we'll find out later, an assembler has all sorts of powerful features that make it indispensable for long programs, but for the moment, DE-

Getting DEBUG Rolling. All right, let's leap into the cockpit, get a firm grip on the keyboard, and get DEBUG rolling! We'll assume that you have a disk with DEBUG on it inserted into drive A, and that the "A>" prompt is waiting for your next move. (If you have a Winchester disk you'll have to make sure that DEBUG has been copied to it, and you'll also have to imagine a "C>" whenever you see "A>" here.) DEBUG is one of the programs provided

**TABLE I—
ADVANTAGES AND
DISADVANTAGES**

DEBUG
Easy to run
Low-overhead programs
Close to the machine
Not so versatile
Good on short programs

Assembler
Hard to run
More program overhead
Isolated from the machine
Very versatile
Good on long programs

computer's memory happened to have other data in it before you loaded DEBUG, it will appear here when you type "D", so you may well see all sorts of junky-looking numbers, like those in Fig. 3.

All the numbers there are in hexadecimal form. In fact, hexadecimal is the only numbering system DEBUG knows about, so if you aren't already acquainted with this way of representing numbers, now is the time to find out about it. A good discussion of numbering systems appeared in the December 1983 issue of COMPUTERS & ELECTRONICS.

Let's adopt this convention: Hexadecimal numbers—except for those in program listings or where the context makes clear what they are—will be followed by the small letter "h" to distinguish them from decimal numbers. Decimal numbers—again, unless the context makes it clear—will be followed by a small "d". Numbers from 0 to 9 are the same in both systems, so they don't really need a distinguishing letter, although they sometimes will have one for consistency. Of course, since DEBUG speaks *only* hexadecimal (hex for short), it doesn't use an "h" on its displays, and you should not put one after hexadecimal numbers you type in as DEBUG commands.

It requires two hexadecimal digits to represent an 8-bit byte of data. This two-digit hex number can range in value from 00h to FFh (0d to 255d). Thus, all the two-digit numbers in Fig. 3 fall into this range. There are 16 of these numbers on each line of the display. The dashes in the middle of the display are placed there for clarity, to separate the eight left-hand bytes on the line from the eight right-hand bytes.

Addresses. The numbers in the column at the left of Figs. 2 and 3 (like 08F1:0120) are the *memory addresses* of the bytes of data displayed. Each byte shown in the dumps occupies a specific address, as illustrated in Fig. 4.

The vertical column to the left represents an actual section of your computer's memory. Note how the byte in each memory location corresponds to a particular number in the DEBUG dump shown in Fig. 3.

Each address consists of two numbers separated by a colon. The number to the right of the colon (like 0100) is called the *offset address*, and for our purpose is the only portion of the address we'll be concerned with. The number to the left of the colon is called the *segment address*, and is used when addressing very high (above 64K) memory locations. Since our programs are not going to be anywhere near that large, we can safely ignore it.

Notice how each offset address (we'll just refer to them as addresses from now on, since we will not be using the segment portion) in the left-hand column of a DEBUG dump ends with a zero. If you're familiar with hexadecimal numbers you should understand why this is so. There are 16d, or 10h, bytes in each line, so when you've counted from 0h to Fh, you're ready to increase the ten's (actually sixteen's) column by one, since

10 is the number that comes after F in hex. So we display 16d (10h) bytes, and then move down one line, increment the address by 10h, and display 10h more bytes. The display would be easier to read and understand if it had the 1's column values of the address printed across the top, as shown in Fig. 5, but it doesn't.

Anyway, it should be clear that the first byte on the top row is at memory

FREE CATALOG OF COMPUTER EQUIPMENT AND HARD-TO-FIND TOOLS

Jensen's new catalog is jam-packed with hard-to-find precision tools, tool kits, tool cases, test equipment and computer accessories used by electronic technicians, sophisticated hobbyists, scientists, engineers, laboratories and government agencies.

Call or write for your free copy today.

JENSEN TOOLS INC.

7815 S. 46th St., Phoenix, Arizona 85040 (602) 968-6231

Circle No. 8 on Free Information Card



RATED #1 for SERVICE and RELIABILITY

FOR INFORMATION OR ORDERING, CALL TOLL FREE
800-221-8180
IN NEW YORK STATE
(212) 732-8600

J&R MUSIC WORLD

23 PARK ROW, N.Y.C.
NEW YORK, 10038

ATARI 600XL
•Home Computer
•16K RAM
Expandable to 64k

\$159.95

ATARI SOFTWARE
•64K RAM/256 Colors
•Built in High Level BASIC

\$269.95

ATARI HARDWARE
ATARI 1010 Program Recorder \$74.95
ATARI 1050 Disk Drive \$359.95
ATARI 850 Acoustic Modem \$139.95
ATARI 850 Interface Module \$159.95
ATARI AX2025 Microsoft Basic II \$64.95
ATARI CX5003 Assembler Editor \$84.95
ATARI CX604 Word Processor \$89.95
ADVENTURE INT. REAR GUARD \$14.95
AVALON HILL NEWBARD \$49.95
AVALON HILL TELECARD \$17.95
DATA SORT SOUNDS OF EGYPT Disc \$17.95
SYNAPSE PHOENIX CASSETTE \$24.95
THORN SUBMARINE COMMANDER \$34.95
M NETWORK Lock n Chase \$19.95
MICROSPEC HELICAT ACE \$17.95
ATARI PRIDE EASTERN FRONT Disc \$24.95
CX2000 GAMEWARE
STRAT BATTLE AT NORMANDY \$24.95
COLECO Zaxxon \$24.95
ATARI CX2875 MS Pac Man \$29.95
ATARI CX276C Centipede \$24.95
ATARI CX2681 Battle Zone \$29.95
ATARI CX2689 Kangaroo \$23.95
ATARI CX2684 Pole Position \$23.95
ACTIVISION AQ208 Robot Tank \$24.95
PARKER 3560 O Bent \$29.95
M NETWORK Lock n Chase \$19.95
COLECO Smart \$24.95

WE ALSO CARRY
APPLE COMPUTER SOFTWARE
TEXAS INSTRUMENTS T199/4A
•Home Computer
•16K RAM

\$599.95

TI 99/4A HARDWARE
TI PHP1220 RS232 Card \$119.95
TI PHP1250 Internal Disk Drive \$279.95
TI PHP1260 32K RAM Card \$209.95
TI PHP1600 Modem \$139.95
TI PHP1850 Disk Memory Drive \$349.95

TI 99/4A SOFTWARE
TI PH16003 Pers Finance Aids \$12.95
TI PH16004 Programming Aids \$12.95
TI PH5002 Trek (Wm) Special \$13.95
TI PHM3004 Number Magic \$17.95
TI PHM3007 Household Budget \$13.95
TI PHM3023 Hunt The Wumpus \$13.95

MONITORS
MC C1702 114" Color \$126.95
TI PHC1202A 112" Color \$249.95
TI PHK4100 10" Color \$319.95
SONY KV1311 13" Color Game Comp Ready II \$309.95

TIMEX SINCLAIR TS1000

\$399.95

•Includes TS1016 16K RAM Expander
•Backgammon, Presidents and Stock Options
•Friendly Computer System
•Call for information

TIMEX HARDWARE
TIMEX TS1500 16K Computer \$64.95
TIMEX 2050 Dot Matrix Printer \$79.95
COLECO MOO 1 for Atari Cart \$74.95
COLECO Gemini Video Game \$74.95
MEMOTECH 16K Ram for TS1000 \$22.95
MEMOTECH 32K Ram for TS1000 \$74.95
ODYSSEY 16K Ram for TS1000 \$109.95
MEMOTECH Keyboard \$74.95

FREE GIANT CATALOGS
•300 PAGE AUDIO/VIDEO/COMPUTER CATALOG •GIANT VIDEO MOVIE CATALOG •GIANT RECORD AND CASSETTE CATALOG
Filled with over 10,000 different listings of the most popular artists and titles (pop, rock, jazz, country & western)

MATTEL COMPUTER KEYBOARD
•For use with Intellivision

\$999.95

MATTEL INTERVISION #
MATTEL 4188 Music Synthesizer \$84.95
MATTEL 4183 Hand Controller \$14.95
MATTEL 4549 Burger Time \$28.95
MATTEL Bowling \$19.95
MATTEL 3350 Voice Box for 2609 \$29.95
MATTEL 3412 USC Chess \$38.95
MATTEL 3804 87 Key Voice Box \$32.95

COLECO ADAM

\$199.95

•Includes 16K RAM
•Expandable to 64k
•32K ROM

VIDEO GAMES
COLEVISION Expandable \$149.95
Video Game Console \$149.95
COLECO MOO 1 for Atari Cart \$74.95
COLECO Gemini Video Game \$74.95
ATARI CX2300 Game Console \$79.95
VICTREX Video Arcade System \$99.95
ODYSSEY II Master Component \$79.95
ATARI 5200 Super Game System \$99.95

TOMY TUTOR 8000
•16K RAM
Expandable to 64k
•32K ROM

\$119.95

TOMY 8021 Voice Synthesizer \$44.95
TOMY 8022 Data Recorder \$84.95
TOMY 8024 TI Software Adap \$19.95
TOMY 8020 Joy Controller \$9.95/Pr
TOMY 8023 Joy Stick \$12.95/Pr
TOMY 8100 Cave Crawlers \$16.95
TOMY 8104 Demon Diggers \$14.95
TOMY 8107 Wm. Tale Thrax \$14.95

COMMODORE 64
•64K RAM
•Home Computer

\$199.95

COMMODORE 64 HARDWARE
VIC V1541 Disk Drive \$229.95
VIC V1312 Parallel Controllers \$11.95
VIC 1650 Auto Dial Modem \$79.95
V64 CPM Card (Version 2.1) \$59.95

COMMODORE 64 SOFTWARE
V64 EASY LESSON/QUIZ \$12.95
V64 RADAR RAT RACE \$9.95
AUTOMATED 64 Juggernaut \$24.95
EVENT 64 Sorcerer's Apprentice \$39.95
HEX Helpster \$29.95
INFO DESIGN General Ledger \$59.95
INFOCOM 64 The Whines \$29.95
VIC V1507 Audio Lander \$24.95
MICRO 64 Data Base Mng. (Disk) \$49.95
RWEST 64 Terminals Program \$24.95
ON-ICE \$12.95
POWER-BYTE At Home Inventory \$24.95
RAINBOW 64 Personal Finance \$14.95
SOFTSYMC 64 Personal Catalog \$19.95
UMI 64 Checkbook \$14.95
VERSA 64 Business Pack \$64.95

COMMODORE VIC 20 HARDWARE
VIC V1110 16K RAM Expander \$39.95
VIC V1211 16K more graphics \$64.95
VIC V1311 Joystick \$7.95/Pr
VIC V1330 Data Set \$59.95
VIC V1525 Graphic Printer \$199.95
VIC V1600 Telephone Modem \$49.95
VIC V1650 Auto Dial Modem \$79.95
CARDBOARD 64 Expandable User Port to hold 8 cartridges \$59.95

VIC 20 SOFTWARE
VIC V1103 Intro to Basic, Pt. 2 \$19.95
VIC V1110 Gortek Microchip \$7.95
VIC V1307 Justice Lander \$10.95
VIC V1810 Radar Rat Race \$7.95
VIC V1930 Variable Solar Systems \$19.95
UMI WORD20 Word Processor \$69.95
VIC V1933 Golf \$14.95
NUFEKOP Krazy Kong \$8.95
NUFEKOP VicMan \$10.95
NESMON Machine Language \$29.95
HEXWRITER Word Processor \$24.95

FLOPPY DISCS
ELEPHANT GOLD (Box of 10) \$29.90
MAXELL M020 (Box of 10) \$39.90
BASE 100 (Box of 10) \$32.90
SCOTCH 7450 (Box of 10) \$49.90
VERBATIM M025 (Box of 10) \$34.90

SPECTRAVIDEO COMPUTER
•32K RAM Expandable to 256k
•Microsoft Basic
•CP/M Compatible

\$269.95

TYPEWRITERS/PRINTERS

SMITH CORONA Lincro Portable \$79.95
SMITH CORONA Lincro \$129.95
SMITH CORONA LETTER QUALITY PRINTER \$139.95
TOP-100 (10-Prnt) \$199.95
STAR MICRONICS GEMINI-10X 100 CPS \$199.95
STAR MICRONICS GEMINI-15X 100 CPS \$199.95
STAR MICRONICS GEMINI-15X 100 CPS Full Size Tractor Feed \$199.95
NEC PD2023 Impact Mtro Prnt \$79.95
EPSON PRINTERS \$CALL

WRITE OR CALL FOR FREE 300 PAGE AUDIO/VIDEO/COMPUTER CATALOG

Circle No. 23 on Free Information Card

location 0100, the next is at 0101, the next at 0102, and so on. Similarly, the first byte on the second row is at 0110, the second at 0111, etc.

The "F" Command. Want to see the display change? An easy way to do this is to use DEBUG's "F" or FILL command. This command fills a part of memory with a particular hex number.

To use FILL, you enter "f" followed immediately by three numbers separated by spaces. The first of these numbers is the address where you want to *start* filling, the second is the address where you want to *stop* filling, and the third is the constant (from 00h to FFh) that you want the locations from the first address to the second to be filled with. Notice that while the data to be filled in consists of two-digit hex numbers (representing bytes), the addresses are four-digit hex numbers. Of course, you don't need to type leading zeros, so you can type fewer than four digits for the addresses when appropriate, as it is here. At the DEBUG prompt ("—") enter this:

```
f 120 14f ff
```

The first "F" (remember, it can be upper or lower case) is the FILL command. It is followed by, respectively, the starting address of the fill, the ending address of the fill, and the value (FFh) that will be used. When you hit ENTER, nothing appears to happen. To see what's changed, you have to dump the same part of memory again. A dump of locations 100h through 170h is shown in Fig. 6.

Look at that! All the memory locations between 120h and 14Fh are now filled with FF, just as you specified with the "F" command. As for the rest, if you started out with numbers other than zero in memory, they'll still be there instead of the zeros shown in the dump.

ASCII Codes. You may be wondering about all the little dots and odd characters on the right-hand side of the dump display. These are the characters (like "A", "B", and so on) that the numbers to the left represent. The number that represents a particular character is called its *ASCII value*. (ASCII stands for "American Standard Code for Information Interchange.") As you probably know, the ASCII code is the normal way to represent characters in a computer's memory.

Since neither 00 nor FF represents a printable ASCII character, the positions in the ASCII display corresponding to those numbers are filled with dots, which indicate "no printable char-

acter." (If your computer's memory was filled with junk rather than all zeros to begin with, some of the numbers—20h through 7Eh—may have represented printable characters.) To see the character display change, along with the numbers, let's try filling in parts of memory with numbers that we know represent characters.

Enter the following three DEBUG commands (the "--" is, of course, DEBUG's prompt):

```
- f 100 117 61
- f 178 17f 24
- d 100
```

You'll get the display shown in Fig. 7. The character corresponding to 61h is a small "a," and 24 hex is the code for the dollar sign, "\$." We can see them both as numbers, and to the right as characters.

So far we've talked about how assembly language differs from higher-level languages, and also explained something about the operation of the DEBUG utility program. You may find it useful at this point to experiment a bit with DEBUG. Try filling in different constants to see how they look when you dump them. Examine different parts of memory. (You may be surprised at what you find!) You'll be using DEBUG a great deal as we go on, and you should feel comfortable with it.

Your First Program. Although you're now going to write your first assembly-language program, you don't know as-

sembly language yet. There will be many aspects of the process that won't seem completely clear to you. Don't worry about this! Our approach is to show you first *what* something looks like, and afterwards explain *why* it looks that way and *how* it works.

By moving in this direction, from the concrete to the abstract, rather than the other way around, we hope to avoid the sort of academic theory-oriented descriptions that leave most readers confused, bored, and frustrated. Instead, you'll first get the *feeling* of the process (the roar of the motor and the rush of the wind in your hair, to return to our earlier flying analogy); later we'll explain what happened.

Different DOSs. There's a small problem we'd better deal with right away. This has to do with which version of DOS you're using. As noted previously, the DEBUG in DOS Version 2 (that is, Versions 2.0 and later) contains a built-in mini-assembler that will help in the creation of assembly-language programs. The DEBUG in DOS Version 1 (Versions 1.0 and 1.1) does not have this capability, so for those readers using this version we need to take a slightly different tack.

We'll handle the situation in the following way. We'll first explain how to type in a program if you're using DOS Version 1. Even if you have Version 2, you should read this part, try it out, and understand it. There are two good reasons for this. The first is that you will be introduced to a new DEBUG com-

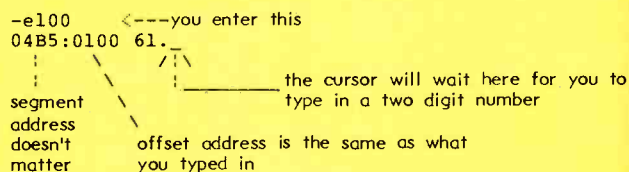


Fig. 8

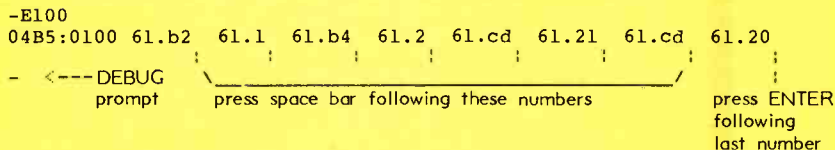


Fig. 9

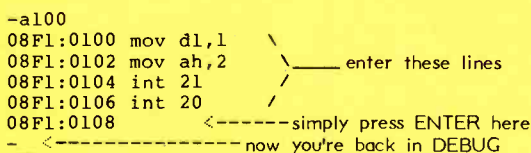


Fig. 10

Get all the facts about the IBM Personal Computer.

Get PC™ Magazine!

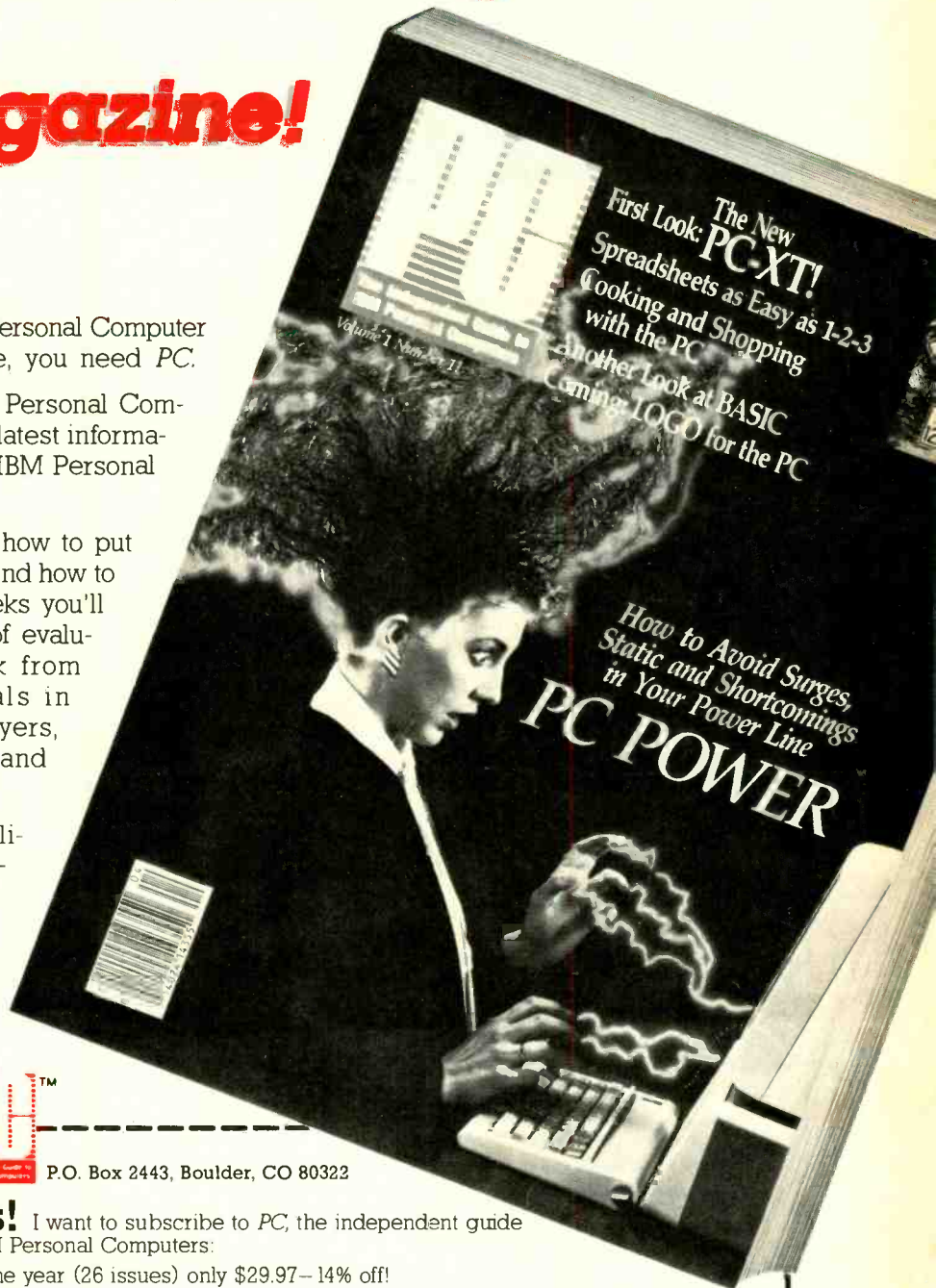
Whether you already own an IBM Personal Computer or you're thinking about buying one, you need *PC*.

PC is the independent guide to IBM Personal Computers. Each issue is packed with the latest information for everyone who's interested in IBM Personal Computers.

This is *the* magazine for finding out how to put together the best IBM "PC" system...and how to get the most out of it. Every two weeks you'll receive hundreds of colorful pages of evaluations, insights, and straight talk from respected experts—professionals in computer science as well as lawyers, businessmen, writers, educators and many others.

PC covers software, hardware, applications, and every other topic of importance to the thousands of IBM Personal Computer users who read it. To make sure that we give you the facts you need, we include a special "User-to-User" section, a "PC Wish List," and news about IBM Personal Computer clubs, events and publications.

Right now you can save up to 24% on an introductory subscription. And if you're ever dissatisfied with *PC*, just write and tell us—you'll receive a prompt refund for all the unmailed issues remaining in your subscription.



P.O. Box 2443, Boulder, CO 80322

Yes! I want to subscribe to *PC*, the independent guide to IBM Personal Computers:

- One year (26 issues) only \$29.97—14% off!
 Two years only \$52.97—24% off!

Savings based on full one-year subscription rate of \$34.97.

CHECK ONE: Payment enclosed Bill me later

Mr./Mrs./Ms. _____ (please print full name) 8H443

Company _____

Address _____

City _____ State _____ Zip _____

Offer valid only in the U.S., its territories and possessions. Please allow 30 to 60 days for delivery of first issue.

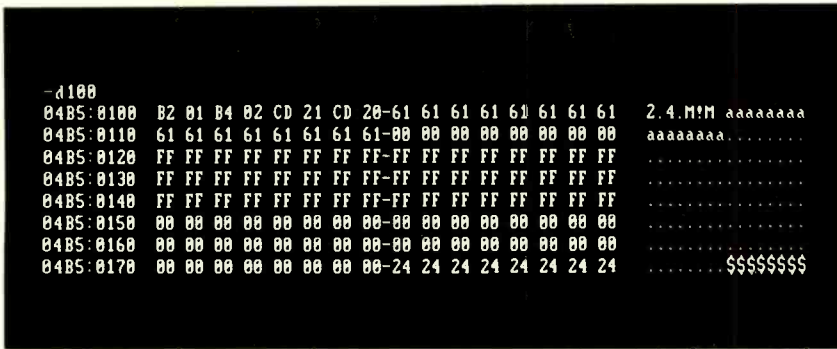


Fig. 11

mand: the "E" (for Enter) command. The second is that, after you've typed in the program using "E," you'll be better able to appreciate how lucky you are to have DOS Version 2, with its advanced version of DEBUG and its mini-assembler.

Using the "E" Command. Now we'll create an assembly-language program using DEBUG's "E" command. (The term "assembly language" is actually not quite right in this particular instance, as we'll see later on, but that needn't concern us now.) If you have DOS Version 1, this is the *only* way to use DEBUG to create a program. If you have Version 2, you should follow along anyway, typing in the commands.

The purpose of the "E" command is to enter a byte (or bytes) of data into memory. It's like the "F" command, except that you can enter a series of *different* bytes; they don't all have to have the same value, as they do with "F."

The series of bytes we're going to enter with "E" will constitute our program. To insert this program into memory, when you see the DEBUG prompt, you enter the command "E," followed immediately by the address where you want the program to go. In our case, we're going to put it at location 100h, so we enter "e" followed by "100." The program will respond by printing out the address, followed by its current contents, as shown in Fig. 8.

As shown there the content of location 100 happens already to be 61h, since that's what we put there with the "F" command earlier. However, it doesn't really matter what was there before: The important thing is that we're going to put it there now.

To "enter" a two-digit hex number into this location we type the number followed by—not the ENTER key—the *space bar*. The space bar has the effect of entering a number into one memory location and then advancing to the next one. The ENTER key, on the other hand, enters the number and then terminates the entire "E" command and returns us

to the DEBUG prompt. After you have entered a number and pressed the space bar, the command will then print out the old contents of the next location and wait for you to type in the new contents.

The series of hexadecimal numbers we want to type in is the following:

```
B2
1
B4
2
CD
21
CD
20
```

These are the numbers that constitute our program. Type each number, press the space bar, type the next number, and so on. After you've typed in all eight numbers, the screen should look like Fig. 9 (minus our comments, of course).

Note that if you don't type any number at all before hitting the space bar, the byte in that location will remain un-

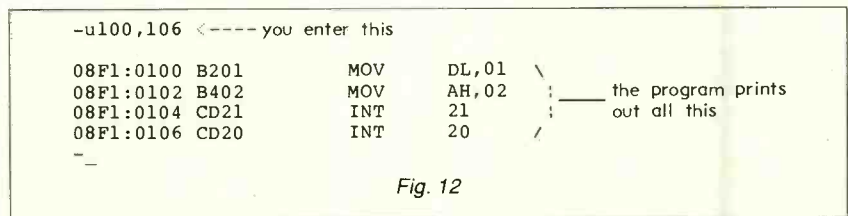


Fig. 12

changed, as you will discover if you make a typing mistake.

After you type the last number, press ENTER to tell DEBUG you're through. This should cause the DEBUG prompt ("—") to reappear.

If you make a mistake at any time, just press ENTER to get back to the DEBUG prompt and start over.

You've now placed your program in the computer's memory, from location 100 to location 107, using the "E" command. We'll explain how to execute, or "run," the program in a moment.

Using the "A" Command. Here's where you DOS Version 1 users become, briefly, just spectators. You should read

through this section so you know what you're missing and, more important, because future program descriptions are going to be based on the "A" command approach outlined here. You'll need to know both approaches so you can use "E" even though we're talking about "A"; that is, translate our descriptions of the "A" approach into operations with "E." This won't be as difficult as it probably seems, so read on. (Or, better yet, hurry out and buy a copy of DOS Version 2.)

The "A" command accomplishes the same thing as the "E" command. Therefore, it is putting the bytes that constitute our program into memory—but it does so in a different way.

When we use the "A" command we don't insert hexadecimal bytes into memory directly. Instead, we type in a series of *mnemonic* symbols. ("Mnemonic" simply means "easy to remember." The idea is that these symbols are supposed to be easier to remember than the hexadecimal numbers they represent.) These codes are two- or three-character names that stand for certain assembly-language *instructions*. The instruction tells the microprocessor *what operation is to be done*. The instruction mnemonic is usually followed by a space and then by some letters and numbers that indicate what the operation is to be done *to*.

Expressed in mnemonic symbols, our program looks like this:

```
mov dl, 1
mov ah, 2
int 21
int 20
```

It looks short, but absolutely incomprehensible, doesn't it? That's all right, it won't be long before you can churn out this kind of thing in your sleep. We're going to type in this program, then dissect it a little and see if we can get a feel for how the "A" approach differs from the "E" approach, and for what assembly language is all about.

Enter the letter "A," followed by the address where you want the program to start. Here's a rule you should remember: *Programs written in DEBUG should always start at 100h*. The reasons for this will become clear later when we talk about the difference between COM files and EXE files.

When you enter "A" followed by an

address, DEBUG will automatically echo the address:

```
-a 100
08f1:0100 -
```

DEBUG will then sit there waiting for you to type in the mnemonic codes for your program.

On the first line, enter "mov dl,1". That's "mov" as in the first three letters of "move," followed by a space, which is important, then "dl,1" with the *letter* "l", followed immediately by a comma and the *number* "1." Don't confuse letters and numbers. The screen should now look like this:

```
08F1:0100 mov dl,1
08F1:0102_
```

You've just typed your first line of assembly language!

The assembler is waiting for line two. Enter "mov ah,2". Then the third line, "int 21" and the fourth, "int 20".

After you've finished these four lines, you're done. So when the program says:

```
08f1:0108
```

you simply press ENTER to let it know you're through assembling this program and want to get back to DEBUG's prompt. Your screen should then look like Fig. 10.

So you now have two different ways to enter your program, depending on which version of DOS you have. In either case the program itself should be sitting in memory, waiting to be executed. There's a lot to say about the relationship between these two approaches to putting a program into memory, but if you're a real red-blooded programmer you can't wait to run the program. Let's do that first, and talk later.

Running the Program. What does the program do? Does it balance your checkbook? Calculate accounts receivable? We're afraid it's not as ambitious as that. Let's see what happens when we run it. To execute the program we use the "G" (for "Go") command. Simply enter the letter "g." It's not followed by any numbers (at this time). This will cause the program to be executed, just as entering "RUN" does in BASIC, and you'll see a little happy face on the screen smiling at you. Isn't that the cutest thing you ever saw? (No? Well, what did you expect from an 8-byte program?)

If you didn't get a happy face, you probably made a mistake typing in the program. It's easy to mistype something, what with all the numbers and unfamiliar symbols. Start with the "E" or "A" command and

try again.

Unfortunately, mistakes in assembly-language programs can have more serious consequences than those in higher-level languages like BASIC. In higher-level languages the interpreter or compiler usually protects the operating system from the consequences of errors in programming by keeping your machine running and displaying something like, "Error in line 2034."

In assembly language, however, there is no such protection. Assembly language is the most fundamental level of the machine. There is nothing on a "supervisory level" overseeing the assembly-language program, as the interpreter or compiler does in higher-level languages. So if you make a mistake in assembly language it is woefully easy to "crash" your operating system—that is, alter parts of it in memory so that it no longer works and you need to reset the entire computer, either by hitting the ALT, CTRL, and DEL keys simultaneously or, in even worse cases, by turning the entire computer off and then on again. But all this is academic. You're never going to make a programming error! Are you?

Figure 11 shows the results of dumping locations 100 through 170 using the "D" command. And there, in the first eight locations, from 100 to 107, is our program. You can see this by comparing the numbers on the display with those typed in using "E." Our program has overlaid the 61s that were there before.

The symbols at the right—2.4.M!M—are meaningless. They just happen to be the ASCII equivalents of the numbers that make up the program.

What Assemblers Really Do. If you typed in the program using "E," you probably aren't too surprised to see these numbers reappear when you look in memory with "D." After all, you entered the numbers into memory, and there they are, just where you put them.

But how did they get there if you used the "A" command? You typed in mnemonic instructions and, lo and behold, there are the numbers sitting in memory. What's happened here is what this series is all about: The "A" command *assembled* the mnemonic instructions into hex numbers. This is the function of an assembler; both of DEBUG's mini-assembler that you invoke with the "A" command and of its large-scale relatives ASM and MASM. We'll have more to say about this later. First let's look at our program from another perspective.

The "U" Command. There's a more elegant and useful way to look at our program than by using "D" as we did above:

the "U" command. We've assembled our program with "A" or typed in the pre-assembled hex numbers with "E." Now let's use the "U" command to *unassemble* it. "U" is the opposite of the "A" command. Where "A" takes us from symbolic mnemonic codes to the hex digits of machine language. "U" takes us from hex digits back to mnemonic codes. (Actually, the usual word for "unassemble" is "disassemble.")

To "unassemble" your program, enter "U," followed by the address where you want to start disassembling, then a comma, and then the address where you want to *stop* disassembling, as you see it in Fig. 12.

"U" shows the program in *both* hex codes and mnemonic instructions, all nicely arranged for you to admire! Thus the new number B201 is the machine-language equivalent of the assembly language statement "MOV DL,01," and so on for the other instructions. As before, the numbers on the left, such as "08F1:0100" are the addresses of the locations occupied by the program. There's an address printed for each instruction, and since each of the instructions happens to occupy just two bytes, the addresses are all even numbered: 100, 102, 104, and 106.

Machine Language and Assembly Language.

The hex numbers on the left in the "U" listing in Fig. 12 are what is called *machine language*. These numbers occupy specific memory locations, and the 8088 microprocessor looks in these locations, takes the numbers out of them, figures out what they mean, and executes them. These numbers are called "machine language" because it's the *machine*—the microprocessor—that understands them and operates on them. As far as we humans go, such numbers are hard to understand and virtually impossible to remember. For a human to decipher a program written entirely in hex numbers requires the most masochistic form of mental discipline, while the microprocessor chip, no larger than a fingernail, handles it easily. It is perhaps better not to dwell on the philosophical implications of this.

Take heart, however. The mnemonic instructions in the column on the right in the listing are *not* comprehensible to the microprocessor, clever though it may be. They form what is properly called "assembly language." And while you may not understand them now, you will when you finish reading this material.

If you want to pursue learning assembly language with the IBM PC, additional articles that build on this one can be read in upcoming issues of our sister publication, *PC magazine*. ◇

Converting Programs for VIC-20, PET, and C-64 Computers

Using a few tricks and knowing what can and cannot be done allow you to make your programs transportable

By Ron Gunn

QUESTIONS often fly at our local Commodore-user meetings regarding the interchangeability of VIC, PET, and Commodore-64 programs. We've found out a lot and this article will supply precise answers to many of those questions, since the programs are quite transportable once you know the rules. Now you can renumber your VIC or C-64 program on a nearby PET, and then run it. Additionally, you can find out when it's practical to permanently convert that great game or utility and when it's not. For now, let's see what works and what doesn't.

[*Editor's Note:* The ROM sets in some Commodore computers may be different from those in the ones used by the author. This may result in different memory locations being used for certain functions. If you encounter difficulties, try peeking memory locations around the ones suggested to see what happens as you change modes. This can tell you a lot.]

The first thing to realize is that PET, VIC, and C-64 programs use different parts of memory. This is why a VIC program seems to disappear when you load it into a PET. It is not really gone; it's still there if you know where to look. PET programs start at location 1024 in memory; C-64 programs start at 2048; and, just to make it interesting, VIC programs can start at 4096, 1024, or 4608. What does all of this mean to you?

You can use the above numbers to tell the PET where to look for the program.

VICs and C-64s don't need to be told because they have been set up to do the correct thing automatically when programs load in. To run a C-64 or VIC program on a PET, use the following procedures: If it's a C-64 program, type the following line onto the screen and press RETURN.

```
POKE 2048,0:POKE 41,8
```

The C-64 program can now be loaded, listed, manipulated, saved, and even run. Once the PET knows where it's located, all is well.

The same is true of a VIC program, except that some guesswork may be required. Use one of the following three lines to load your VIC program into your PET:

```
POKE 4096,0:POKE 41,16  
POKE 1024,0:POKE 41,4  
POKE 4608,0:POKE 41,18
```

The first line locates a program saved from a plain 5K VIC, the second line locates a program saved when the VIC has a 3K expander installed, and the third line locates a program saved from a VIC with 8K or more of expansion memory working. Use only one of these lines at a time, then try a load and see what's there. You can't hurt anything from the keyboard, so if you guess wrong, just try again.

The second line above represents the normal state of the PET when it's

turned on, so if you haven't poked the PET yet, it's still in that state. Use that second line when you want it to find PET programs after you've already entered one of the others. (Or you can turn it off to reset.)

Color. Color characters can be transferred between the VIC and C-64 and show up in screen listings on all three computers. When running, the PET simply ignores them. You can add color symbols if you're using a VIC or C-64, but they don't even exist on the PET keyboard. If you intend to do some color editing on a PET, then add a line to the VIC or C-64 program while it's in that computer:

```
9998 PRINT"12345678"
```

The statement at 9998 is an example of an unused line—one that isn't intended to be a functional part of a program. Be sure to hold the CTRL key down while typing in the numbers within the quotes. You will get a set of weird reverse characters, the ones that invoke color. Use this line within quotes in PRINT statements on the PET. Whenever you need a color character, just type the line number you will need instead of 9998 and then edit around these color characters you can't type in.

You will need a list of the colors those weird characters represent. If you use the numerical sequence above, they will stand for black, white, red, cyan, purple, green, blue, and yellow. If you want more colors, then continue on. Once you have typed "12345678" with the CTRL key held down, then do it again with the COMMODORE key held down. You will get eight more symbols that represent, in sequence, orange, brown, light red, gray 1, gray 2, light green, light blue, and gray 3. Now you will be sure to have plenty of color in that converted program.

Here's an example: Your C-64 program is in a PET and you want to edit in a print statement that says "HOLD IT" in red. It will become line 1212. Go to line 9998 and neatly type 1212 over the 9998. Press RETURN. This will replicate line 9998 at 1212. With the new line at 1212, delete everything inside the quotes except the third weird character, which is the symbol for red. Add the rest of the new line. The result will be:

```
1212 PRINT"[RED]HOLD IT"
```

Remember, too, the pokes that control the screen background colors. For a white screen, for instance, you would "POKE 53281,1" on your C-64; and you would "POKE 36879,27" on your VIC.

Sound. This is the one area where the three computers are the least compatible. That's the bad news. The good news is that the computers usually ignore each other in the sound areas, so few unexpected crashes occur. You are looking at PET sound programming when you see POKE at locations 59464 and 59466 in a program. VIC programs will have a sound POKE at 36874 through 36878. The significant sound capabilities of the C-64 are accessed through a POKE at locations 54272 through 54296.

Each computer has a different ability to create sound, so when you are considering a program conversion, you are limited to finding out what the original sound was and where it was, and then finding substitute coding for it. The one constant thing is that the original coding will not produce what you want.

In the PET, sound is usually produced by manipulating the CB2 line of the user port. This is single-channel sound and it has to be turned off within the program before the program ends. The VIC has three channels of sound with relatively coarse adjustments available. The C-64 supports elaborate control of its three sound channels. Sound for both VIC and C-64 stops when you hold down the RUN/STOP key and press RESTORE.

Screen Size. The Commodore 64 and the PET both have the same 40-column screen width and 24-line screen height. Screen output written for one will fit the other exactly. The VIC screen is 22 columns wide by 23 lines high and will handle about half a screenful of information from the other machines in its own way, with wild wraparounds and strangely linked lines. Reading VIC material on a C-64 or PET yields a well-formatted output along the left half of the screen.

To properly read screen displays from the other machines on your VIC, you will have to do modifications to your screen-print statements. A quick and dirty method is to create these lines in the program:

```
9996 GET Z$: IF Z$=" " THEN
    9996
9997 RETURN
```

Put a new line in the original program at every half-screen of information:

```
1291 GOSUB 9996
```

This will force the display to stop until you tap a key. All of this is shown in Table I. While the original screen formatting won't be preserved, at least you'll get to see most of it.

Function Keys. These keys are unique

to the VIC and C-64 and do not exist on the PET. The values they return are CHR\$(133) through CHR\$(140) on both machines. These values are consecutive, so unshifted function keys F1, F3, F5, and F7 will return values of 133, 134, 135, and 136. There is no key on the PET that will return these values, so a trick is in order.

Find the places in a VIC or C-64 program where CHR\$ values between 133 and 140 are used. That's where the function keys are detected. For operation on a PET, let's use the numbers 1 through 8 as substitute function keys. Since the number 1 is actually CHR\$(49), we can make a substitution in the program. If the program says:

```
220 IF A$=CHR$(133)
```

and we change it to:

```
220 IF A$=CHR$(49)
```

then we can dummy up the number keys to operate the program. With this kind of change, the number keys will act like the function keys in the original VIC/C-64 program.

This example of use of the function keys

```
2000 GET A$: A=ASC(A$)-132
2010 ON A GOTO
    2050, 2060, 2180, 3500
```

would convert to:

```
2000 GET A$: A=ASC(A$)-48
2010 (no change)
```

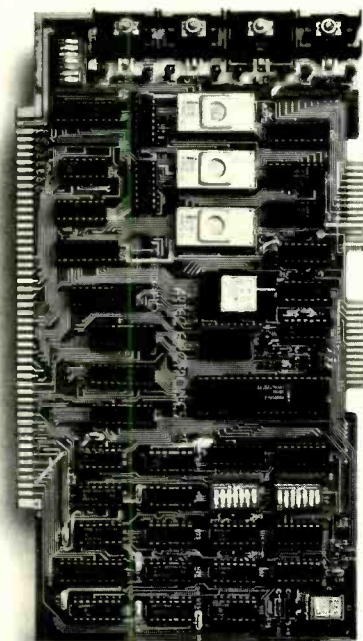
Here, the first function key would be converted to a value of 1 in variable A because it has a value of 133, and 132 is subtracted from it. This would send program execution to line 2050. After the conversion, the number 1 would send program execution to line 2050.

Upper- and Lower-case. Many programs will initialize the UPPER/LOWER or UPPER/GRAPHICS mode while setting up. Table II shows the numbers you can use to make the appropriate conversions.

You can confirm these values yourself. Try this one on your VIC. Enter: PRINT PEEK(36869) RETURN. Now press SHIFT/COMMODORE key to change character sets, and enter the PRINT PEEK statement again. The number in 36869 should originally have been 194. Then it should have changed to 192.

Screen Manipulations. Some programs bypass the programmable cursor movements and poke directly to the screen memory. This is done for conve-

Hire a fast thinker.



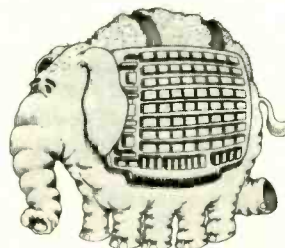
5 MHz CPU Card

- Intel 8085A-2 microprocessor
- Hardware 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—\$375

(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

nience and speed. Screen memory starts at 32768 on the PET and 1024 on the C-64. In the VIC, the screen memory locations vary for different amounts of memory. A good description of how to find the screen memory is in the VIC manual.

To avoid confusion in converting a program that pokes values directly into the screen memory, convert it on the original machine to accept an offset from the "start of screen" location. On a PET, for example, set a variable SC=32768. Now use SC in all screen poke calculations and debug the program. When it works, set SC=1024 and load it into a C-64.

You will need the description in the VIC programmer's manual to simplify the job of POKING the VIC screen. You will rapidly find out why some software written for the VIC doesn't work when extra memory is switched in.

Automatic Conversion. It is possible and, in fact, practical to make a program conversion that will work on two machines. This could even be automatic if the program could sense which machine it was running on. Consider the following:

```
9991 SC=1024:IF
  PEEK(62006)=73 and
  PEEK(41)=4 THEN SC=32768
```

This sets the beginning of screen-memory variable SC to the start of a C-64 screen. If two conditions are met that are true in 4.0 PETs, then the start of the screen variable is one the PET can use. This program can poke to either a PET or a C-64 screen. Moreover, now that the identification has been made, all kinds of adjustments can occur. The correct upper-case or graphics poke can be made, the correct sound code switched in, and so on.

For example: The program is running in a C-64, and line 9991 has just executed, so SC=1024. Program execution continues at line 9992:

```
9992 IF SC=1024 THEN POKE
  53281,1:POKE
  53272,21:
  S=1:GOTO 9994
9993 POKE 59468,12:S=0:REM
  LINE 9992 IF C-64,9993
  IF PET-VARIABLE S SETS
  SOUND
9994 (next actual line in
  program)
```

Random Tidbits. A PET with a Programmer's Toolkit installed can load VIC or C-64 programs directly into the PET's normal program area starting at location 1024. Simply type NEW and

TABLE I

```
1200 PRINT ' THIS TEXT IS FORMATTED TO PRINT OUT ON '
1210 PRINT ' THE FORTY COLUMN SCREEN OF A PET OR '
1220 PRINT ' COMMODORE-64. IF IT IS PRINTED ON A '
1230 PRINT ' VIC, THEN HALF OF IT WILL SCROLL OFF '
1240 PRINT ' THE SCREEN BEFORE YOU CAN READ IT. '
1250 PRINT ' THE WAY TO STOP THIS IS TO ADD A LINE '
1260 PRINT ' AT THE HALF SCREEN POINT THAT HOLDS '
1270 PRINT ' THE REST UNTIL YOU TAP A KEY. YOU '
1280 PRINT ' MUST HAVE ADDED TWO LINES: 9996/9997 '
1290 PRINT ' FIRST. THESE LINES WOULD JUST ABOUT '
1291 GOSUB 9996:REM LINE ADDED FOR VIC OPERATION ***
1300 PRINT ' FILL A VIC SCREEN NOW, AND NEEDED TO '
1310 PRINT ' BE STOPPED BY THE ADDED LINE 1291 '
1320 PRINT ' TO STOP IT FOR READING. NOW, YOU MAY '
1330 PRINT ' NOT NEED THIS TRICK IF YOU ARE AN '
1340 PRINT ' EXCELLENT SPEED READER, BUT THE REST '
1350 PRINT ' OF US SURE DO! '
```

TABLE II

	PET	VIC	C-64
UPPER/LOWER	POKE 59468, 14	36869, 194	53272, 23
UPPER/GRAPHICS	POKE 59468, 12	36869, 192	53272, 21

then APPEND. This may be necessary in the case of large C-64 programs since all of the PET's memory is then utilized.

VIC and PET data handling on cassette is excellent. If you are having data (or program) problems with your cassette, have the head aligned at 10 kHz using a standard audio test tape. Timing problems cause C-64 handling of cassette data to be shaky. If you have to work with large amounts of data, use a disk, which is very reliable.

Long Lines. You may be aware of the VIC's 88-character (4 × 22) line length. Will VIC programs with lines this long fit into a PET or C-64, both of which have 80-character program lines? The answer is yes, they *will* fit, and the excess won't be unceremoniously dumped into that great bit-bucket in the sky. There is one limitation: The PET and C-64 screen editors won't handle more than 80 characters, so you've got to be tricky in editing the longer VIC lines in those machines.

There are two things to do: Read the section of the VIC manual that shows how to abbreviate BASIC keywords with a letter followed by a shifted second letter, and then use this shorthand to create lines of 80 characters or less. Such lines will expand to more than two lines on the 40-character screen when listed, which is all right. They must be entered on two lines, however, or the wraparound past the second line will disappear.

The following example will make this

clearer. Consider this VIC line:

```
30440 CLOSE2:CLOSE3:
  PG$="":RESTORE:
  AT=PEEK(1):INPUTB$:
  PRINTRIGHT$(C$,3):
  FOR I1=0TO1250
```

This line is 85 characters. Let's say that you are editing it on a C-64 and you want to change the 1250 to 1750. If you simply edited the change, the last few characters would be over the editor's 80-character limit, and those characters would be lost. Try it and you'll see. Now try reentering the line this way:

```
30440 CL[shift-0]2:CL
  [shift-0]3:PG$=
  "":RE[shift-S]:
  AT=P[shift-E](1):
  INPUTB$:?R[shift-I]
  (C$,3):F[shift-0]
  I1=0TO1750
```

Agreed, this is shifty, but when you enter the above with single-shifted characters in place of the brackets, the line will be only 65 characters and will fit easily within the two-line limit. Try it, then list it. The listed version will run over onto a third line on the screen. The loop value will be 1750. The impossible edit has just been made.

Conversions to Avoid. There are times when the chances for a successful conversion are less than if you were to rewrite the program from scratch. Let's

identify these turkeys so you won't waste a lot of time.

Be sure that all of the program you are converting is practical to replace. If it has machine-language sections and you aren't interested in machine-language programming, then avoid it. If you are interested in machine language, then by all means give it a try, as the conversion of existing routines is one of the very best ways to learn any kind of programming.

If the program runs on a C-64 and uses sprites for graphics, then you won't be able to duplicate them in any VIC or PET program. Any substitute you come up with will be much slower and will move around in increments of one character, not one pixel. On the other hand, the use of sprites in a program converted for use on a C-64 may allow for significant enhancement. This is well worth doing, and there is always extra room in a C-64 when any VIC or PET program is loaded in.

If the program features sound, then be prepared to rewrite the whole thing. There is virtually nothing that will transport from machine to machine. Atari 800 sound programs would be just as close!

If the conversion is to a VIC, then the

limited size of the VIC's screen must be considered. Watch out for one other quirk also: The VIC screen editor will wrap up to four lines together. This is because of the 88-character VIC logical line and is due to a system bug. This then produces blank lines that you didn't program in and don't want. To avoid this, only print lines on the screen that are less than 22 characters long. Any character in the 22nd space sets the wraparound and brings on the problem. The screen is small enough already without the extra blank lines.

Simple Conversions. If a program performs lots of calculations—trig functions like SIN or TAN, string manipulations like LEFT\$ or RIGHT\$, math functions like LOG or EXP, useful things like RND, DEF FN or the clock, TI\$—these are identical for all the machines and will run perfectly on any one. The only exception is the RND function (often used in games) where the seed may have to be changed. If you start with the same "random" sequence each time and your program has the command RND(1) in it, then change it to RND(-1) and a truly random sequence will be delivered each time in all three machines.

If you have data stuffed everywhere in floating point, integer, or string-subscripted arrays, then convert with confidence. These arrays are very powerful ways of handling data and will look like A(X) or B%(X,Y) or C\$(X,Y,Z) or even D(X,Y,Z,T). All of these machines handle these important arrays in the same way and your data and results will be identical.

You may wish to temporarily stuff a program from one type of Commodore computer into another just to take advantage of enhancements it might have like RENUMBER, FIND, or REPLACE. Or, your objective may be to permanently convert a program running on one of these machines to work on another. The information above will show you how to do this.

Some conversions are simple, and the information above may lead you to them right away. Others are more difficult and a cost-to-benefit analysis is very much in order. Don't forget to consider the added knowledge that you will gain from doing the job. If you have the interest, then converting something that already works so that it will work on some other machine is one of the best ways to learn any phase of programming. ♦

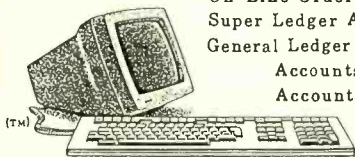
PROFESSIONAL SOFTWARE FOR MICRO'S



- * Insurance Agency Management
- * Medical Office Management
- * Dental Office Management
- * Property Management
- * Legal Time Accounting
- * Professional Time Accounting



On-Line Order Entry
Super Ledger Accounting
General Ledger Accounting
Accounts Receivable
Accounts Payable



Data Base Management

Runs On CP/M, CP/M-86 & MS-DOS

UNIVAIR SYSTEMS

UNIVAIR INTERNATIONAL
9024 ST. CHARLES ROCK ROAD
ST. LOUIS, MISSOURI U.S.A. 63114

(314) 426-1099

MS-DOS is a registered trademark of Microsoft
CP/M and CP/M-86 are registered trademarks of Digital Research

Dealers
Welcome

CATCH ON

MASTER COMPUTERS IN YOUR OWN HOME!

LEARN PROGRAMMING AND APPLICATIONS

Now you can learn about computers... operations... programming... applications... software. Everything you always wanted to know. Write your own programs. Or customize pre-written programs. Make a computer do exactly what you want it to do. Benefit from becoming "computer-wise" today. It's all in this one educational package!

A COURSE IN COMPUTERS AND BASIC PROGRAMMING

NO PREVIOUS COMPUTER EXPERIENCE NEEDED. The entire course is "user friendly", written in simple language, that's easy for a beginner to understand. You will LEARN BY DOING—programming from the very first lesson using any computer, IBM, APPLE, ATARI, COMMODORE, TRS, TI... even the tiny Timex-Sinclair!

A CONVENIENT WAY TO LEARN

Progress at your own speed, in your spare time, in your own home. Take the mystery out of word processing... computerized accounting... maintaining data files and much, much more.

Get started now in the fast-growing field of computers, and CATCH ON to the technology of the future... **COMPUTERS!**

Send today for your free information package.

HALIX INSTITUTE CENTER FOR COMPUTER EDUCATION
1743 So. Vermont Ave., Los Angeles, CA 90008

...if you don't have a computer yet, don't buy one until you receive this free information.

halix An affiliate of Hemphill Schools and IPIG
INSTITUTE... The International Choice Since 1920

YES! Send me information on how I can learn about computers and programming at home!

Name _____ Age _____

Address _____

City _____ State/Zip _____

I already have a computer available.

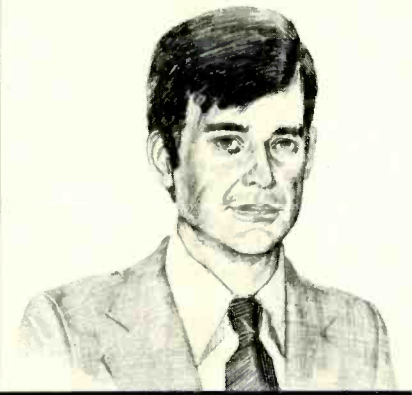
Make _____ Model _____

HALIX INSTITUTE
CENTER FOR
COMPUTER EDUCATION
1743 So. Vermont Ave.
Los Angeles, CA 90008

44H-A0301

Circle No. 4 on Free Information Card

Circle No. 79 on Free Information Card



Rediscovering the Transistor Low-Budget Radio Control Output Interface for a Digital Timer

By Forrest M. Mims, III

CHANCES are the last circuit you assembled used one or more integrated circuits and few, if any, transistors. That's because falling prices and a wealth of functions have made integrated circuits so pervasive that circuits employing discrete transistors alone are fast becoming rare.

Nearly all the circuits I design and build use integrated circuits. However, while writing a new book last summer ("Getting Started in Electronics," Radio Shack, 1983), I was reminded that there remain many simple applications for which individual transistors are ideally suited.

In this column we'll examine several simple but very useful transistor circuits you may have overlooked in favor of more complicated integrated circuit versions. We'll also compare a few transistor circuits with versions made with IC's to determine if the transistor versions are indeed simpler.

Next, we'll experiment with an inexpensive radio control module kit with many possible applications. Finally, we'll greatly expand the capabilities of a midget digital timer by adding a do-it-yourself output interface.

Rediscovering the Transistor

With the availability of literally hundreds of different kinds of integrated circuits, it's common to design even the simplest circuit around one or more

IC's when a transistor or two would suffice. For example, the usual way to drive a meter or trigger a relay in response to a changing voltage or current is to use an operational amplifier or comparator. Often the same function can be performed with one or two transistors.

Another common example is the pulse generator. Most designers use a timer, such as the popular 555 or a pair of cross-coupled gates, when a simple pulse generator is required. Often, however, a simple two-transistor circuit will perform the same function with fewer components.

Let's look at several practical examples of how a simple transistor circuit can provide some or all the functions of an integrated circuit version. I think you'll agree with me that simple transistor circuits still have an important role to play in electronics today.

Moisture Detection Circuits. If asked to design a moisture detection circuit, the typical design engineer will use an op amp or comparator as the principal active circuit element. Figure 1 shows a much simpler approach.

The ultra-simple circuits in Fig. 1 each use a single bipolar transistor as the active element. Most common silicon npn small-signal transistors (2N2222, 2N3904, etc.) can be used.

The moisture meter can be used to measure the level of moisture in a flower pot or in garden soil. Probes can be made from nails or, even better, stainless steel wire. The circuit is calibrated by adjusting R_2 for a meter reading of 1 milliamperes when the soil moisture is at the desired level.

The moisture-activated relay in Fig. 1 is a modified version of the moisture meter. The relay is actuated when the moisture level exceeds the level determined by R_2 . If you replace the sensor probes with a circuit board upon which has been etched an interlacing, comb-like grid, the circuit will be actuated when a rain-drop bridges the gap between the two foil patterns.

It's interesting to compare these circuits with integrated versions. The most obvious difference is cost. A suitable transistor can be purchased for under 15 cents if you're willing to pay a dollar or two for a bag of a dozen or more.

Another advantage of the transistor version is simplicity. A transistor has only three connection leads, while connections must be made to at least five of the eight pins of a typical op amp. Furthermore, since most transistors are equipped with leads rather than pins, the transistor moisture detection circuits can be easily assembled on a perforated board the size of a postage stamp.

Finally, at least one of the transistor circuits can be powered by a pair of penlight cells. (The relay circuit requires more voltage to drive the relay.) Though CMOS op amps that can be powered by as little as a volt or two are available, they are far more costly than a single transistor.

A Two-Transistor Metronome/Tone Source. Figure 2 shows a simple metronome circuit that, together with its two transistors and a speaker, includes only

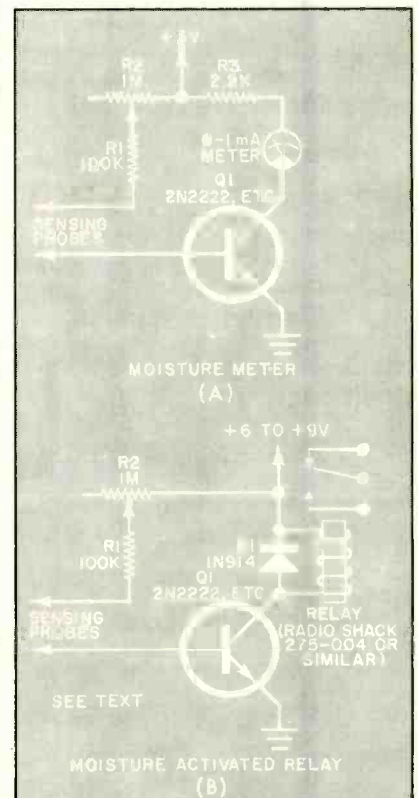


Fig. 1. Transistorized moisture sensing circuits.

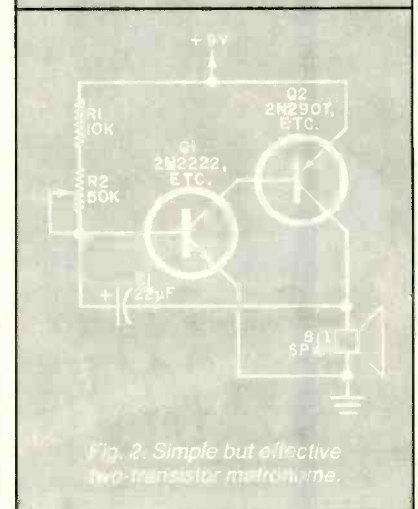


Fig. 2. Simple but effective two-transistor metronome.

TO KEEP UP WITH TODAY'S TECHNOLOGY

...YOU HAVE TO KNOW WHERE TO TURN.



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

Microcomputer Developments

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

New Peripherals and Software

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

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

Increase Your Computer Science I.Q.

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

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



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

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

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

Get Every Issue... PLUS Savings up to 37%!

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

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



Computers & Electronics

P.O. Box 2774, Boulder CO 80322

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

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

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

Mr./Mrs./Ms.

(please print full name)

4S101

Address

Apt.

City

State

Zip

CHECK ONE: Payment enclosed. Bill me later.

Please charge my credit card: American Express MasterCard Visa

Card No.

Exp. Date

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

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

six components. Ordinarily the ubiquitous 555 timer is used to make a simple circuit like this. However, the 555 version also requires six components (assuming it, too, employs a resistor in series with its frequency-control potentiometer).

Many common silicon switching and small-signal transistors can be used for *Q1* and *Q2* in Fig. 2. The click rate can be adjusted by adjusting *R1* or changing *C1*'s value. Since the transistors have leads rather than pins, it's easy to build this circuit on a small perforated board.

FET Electrometer. The electrometer in Fig. 3 is a good circuit to try on a dry winter day. Though it uses only four components, its meter will indicate the presence of static charges up to several feet away. The circuit I tried, for instance, can detect from several feet away the presence of a plastic comb which I charged by stroking through my hair. Even very small movements of the charged comb will cause the meter needle to respond in kind. Potentiometer *R2* allows the circuit to be calibrated.

You can make a permanent version of the electrometer to check for the pres-

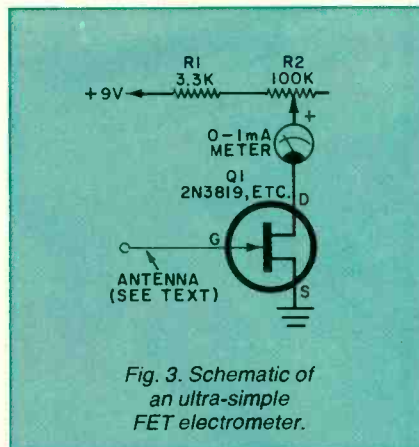


Fig. 3. Schematic of an ultra-simple FET electrometer.

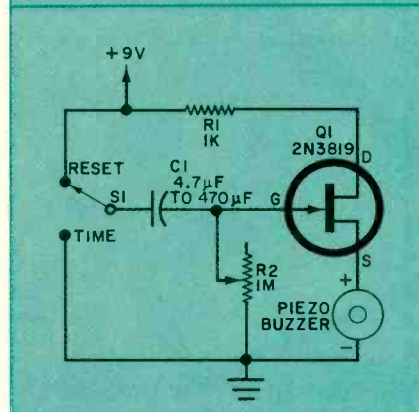
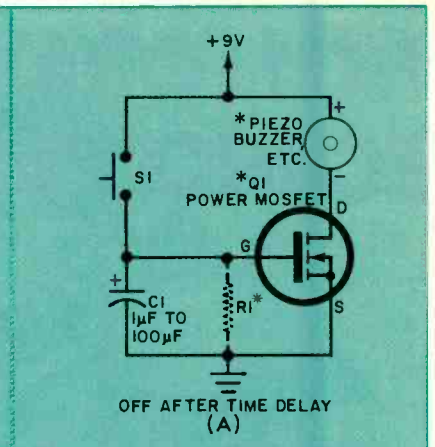
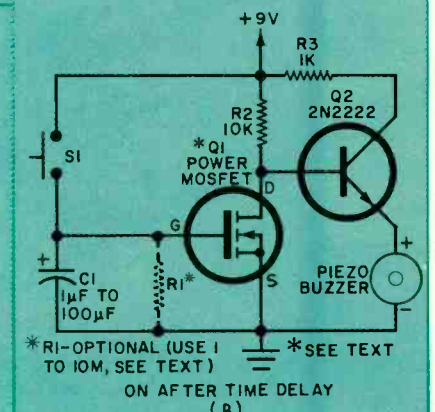


Fig. 4. Schematic of a single-FET timer circuit.



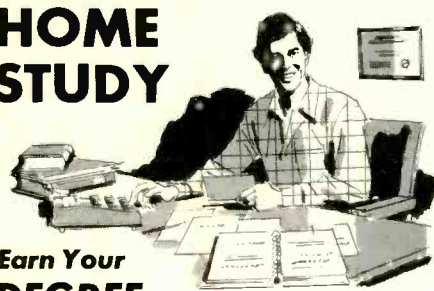
OFF AFTER TIME DELAY (A)



*R1-OPTIONAL (USE 1 TO 10M, SEE TEXT) *SEE TEXT ON AFTER TIME DELAY (B)

Fig. 5. Two power MOSFET timer circuits.

Put Professional Knowledge and a COLLEGE DEGREE in your Electronics Career through HOME STUDY



Earn Your DEGREE

No commuting to class. Study at your own pace, while continuing your present job. Learn from easy-to-understand lessons, with help from your home-study instructors whenever you need it.

In the Grantham electronics program, you first earn your A.S.E.T. degree, and then your B.S.E.T. These degrees are accredited by the Accrediting Commission of the National Home Study Council.

Our free bulletin gives full details of the home-study program, the degrees awarded, and the requirements for each degree. Write for *Bulletin ET-84*.

Grantham College of Engineering
2500 So. LaCienega Blvd.
Los Angeles, California 90034

ence of static electricity near computers and other devices that can be affected by electrostatic discharges. For best results, install the circuit in a plastic box. A circuit board will not be necessary, since the leads of the FET and *R1* can be soldered directly to the meter and the potentiometer. *Q1* should be placed near the top portion of the box. A short, stubby "antenna" wire should extend from the top of the box.

More sophisticated electrometers can be made with CMOS op amps. But they are more costly, trickier to design, and harder to construct. For a simple indication of the presence of static electricity, the ultra-simple single FET circuit in Fig. 3 may be a better choice.

A FET Timer. When faced with the need to design a timer, I inevitably use a 555 or its CMOS counterpart, the 7555. For brief timing durations of a few minutes, the simple FET circuit in Fig. 4 may be a better choice. Certainly, it's simpler, easier to build, and less expensive.

In operation, when *S1* is switched to RESET, *C1* is charged to near the power supply voltage through *R2*. When *S1* is switched to TIME, *C1* is slowly discharged through *R2*. Eventually, the

voltage on *C1* falls low enough to allow *Q1* to switch on, thus allowing the piezoelectric buzzer to sound.

Power MOS Timers. VMOS, TMOS, DMOS, and other MOSFET power transistors can be used to make more effective, longer duration timing circuits than the simple FET version in Fig. 4. Thanks to the ultra-high-impedance input of the MOSFET, time delays of up to half an hour or even longer are possible. And, again, the necessary circuitry is simpler than an IC version using the 555, 7555 or similar timer chips.

Figure 5 shows two simple timers in which a power MOSFET (*Q1*) plays the key role. *Q1* can be a VN10, VN67, IRFD-1Z3 or other common power MOSFET.

The circuit in Fig. 5A is an "Off After Delay" timer. In operation, the piezoelectric buzzer is normally off. When *S1* is momentarily closed, however, *C1* is charged, thus switching on *Q1* and the buzzer. When *C1* eventually discharges through natural leakage paths, transistor *Q1* switches off and silences the buzzer.

Very long time delays are possible when *C1* has a high capacity. For best results, use a capacitor having a very

low-loss dielectric. To control the timing cycle, you can add a resistor across *C1*. This resistor, *R1*, will provide a discharge path for the charge on *C1*.

Figure 5B is a modified version of the circuit in Fig. 5A. Here a bipolar transistor (*Q2*) inverts the switching status of *Q1*, thus providing an "On After Delay" operating mode. In this case, the piezoelectric buzzer sounds *after* the time delay is complete.

Though I used a piezoelectric buzzer in both circuits in Fig. 5, you can use a relay, small lamp, motor, portable radio or other device. In any case, do *not* exceed the power rating of *Q1* in Fig. 5A or *Q2* in Fig. 5B. The latter circuit includes a series resistor (*R3*) to limit current through *Q2* and the piezoelectric buzzer. If it's necessary to reduce the drive current in the circuit in Fig. 5A, insert an appropriate series resistor between the positive supply and the controlled device.

Low-Cost Radio Control

Ever since I began experimenting with aerial photography from kites and balloons, I've maintained an active interest in low-cost radio-control equipment. In a previous installment of "Experimenter's Corner" in this magazine (January 1983), I described in some detail two moderately priced radio-control systems with which I've experimented. I also related how I used a simple radio-control system salvaged from a toy car as well as standard radio-control systems to control an airborne Kodak disc camera.

After experimenting with various kinds of radio-control systems, I found that those having both a crystal-controlled transmitter *and* receiver are far more reliable than those in which only the transmitter is crystal controlled.

Generally, the cheap systems used in radio-controlled toy cars do *not* have a crystal-controlled receiver.

My preference for crystal-controlled receivers is due to the serious noise and interference problems that often occur. Since a non-crystal-controlled receiver is broadly tuned, it may detect signals from CB radios and other sources being broadcast on nearby frequencies.

Though the commercial radio-control systems having crystal-controlled receivers are generally far superior to their non-crystal-controlled counterparts, there are some applications in which interference may not pose a serious problem. In these cases, if you have a need for a very low-cost radio control system, you may wish to consider a pair of pre-assembled remote control modules recently offered for sale by Radio Shack (catalog number 277-1012). These circuits appear very similar to those used in inexpensive radio-controlled cars.

The modules, which are sold together, include a crystal-controlled transmitter and a non-crystal-controlled receiver. The transmitter board is 1" wide and 3.6" long. The receiver board is 1.4" wide and 3" long. Both modules are powered by a 9-volt battery. In addition, the receiver requires a pair of 1.5-volt cells if the circuit is to drive the two small dc motors for which purpose it was originally designed.

Figure 6 is a block diagram showing both the transmitter and receiver. The transmitter consists of a 27.145-megahertz crystal-controlled oscillator which drives a single-stage radio-frequency amplifier. A two-transistor multivibrator modulates the amplifier with several switch-selectable combinations of audio-frequency control signals.

Figure 7 shows the circuitry of the

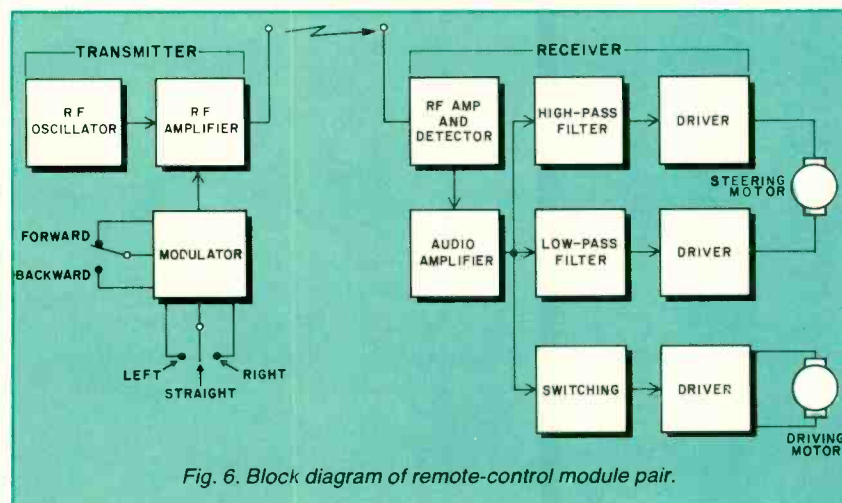


Fig. 6. Block diagram of remote-control module pair.

Make up to \$1250 an hour **Be Your Own Boss!**

Start your own money making business!

Hundreds of Foley-Belsaw trained men have succeeded in this fascinating and highly profitable field...

YOU Can Do It Too!

BE A LOCKSMITH

Never before have money-making opportunities been so great for qualified Locksmiths. Now lucrative regular lock and key business has multiplied a thousandfold as millions seek more protection against zooming crime. Yet there's only one Locksmith for every 17,000 people!

Train FAST at Home—Collect CASH PROFITS Right Away.

You're "in business" ready to earn up to \$1250 an hour 8 few days after you begin Foley-Belsaw's special training. Take advantage of today's unprecedented opportunities in Locksmithing for year-round EXTRA INCOME in spare time — or full time in a high-profit business of your own. Hundreds we've trained have done it, so can YOU! All lock plus professional Key Machine given you with course. These plus practice materials and equipment. Plus simple, illustrated lessons. Plus expert supervision, plus business-building guidance will enable you to KEEP THE MONEY COMING IN! Ideal for retirement — good jobs too.

FREE BOOKLET!

KEYS TO YOUR FUTURE!

Tells how you quickly train to be your own boss in a profitable Sparetime or Fulltime business of your own.

SEND FOR EXCITING FACTS—No Obligation!
ALL SPECIAL TOOLS AND EQUIPMENT INCLUDED!

PRO KEY MACHINE YOURS TO KEEP!

FREE 10-DAY NO RISK TRIAL!

RUSH COUPON! Send for your copy today!

FOLEY-BELSAW INSTITUTE
10378 Field Bldg.
Kansas City, MO. 64111

There is **NO OBLIGATION** and **NO SALESMAN** Will Call—ever!

FREE! **FOLEY-BELSAW INSTITUTE**
10378 Field Bldg., Kansas City, Mo. 64111
Please rush **FREE** Book "Keys to your Future."

NAME _____

ADDRESS _____

CITY STATE ZIP _____

Circle No. 12 on Free Information Card

CABLE TV

CONVERTERS

Largest Selection of Equipment Available
Buy Warehouse Direct & Save \$

36 channel converter **\$4595**

36 channel wired remote converter **only \$8895**

Send \$2 for complete catalog of converters and equipment

Quantity Discounts • Visa • Master Charge
Add 5% shipping—Mich. residents add 4% sales tax

C&D Electronics, Inc.
P.O. Box 21, Jenison, MI 49428
(616) 669-2440



**15" ATARI
GRAPHIC X,Y
DISPLAY UNIT**

Ideal for Arcade games, oscilloscope test equipment.

\$24.95 (plus \$5.00 shipping charge)

Model D10685



**AUDIO
CASSETTE TAPE**

90 minutes of recording.

\$.75 ea. (in lots of 10)

Model D10633



**CREDIT CARD SIZE
CALCULATOR**

Smaller than average credit card, 3/8" thick. Large keys for easy use. Adds, subtracts, multiplies, divides, sq. rt., percentage, & memory.

\$4.95 ea.

Model F10689



**"JOY STICK" VIDEO
GAME CONTROLLER**

Fits Atari video game, Sears video arcade & others.

\$5.91 ea.

Model F10584

**ELECTRONICS
INTERNATIONAL**

P.O. BOX 3919

SARASOTA, FLORIDA 33578

WRITE FOR FREE CATALOG.

\$10 Minimum Order

Many other VCR audio & electronic items

Circle No. 10 on Free Information Card

CALCULATOR SAVINGS



- HP-10C Scientific . . . \$57.99
- HP-11C Programmable . . . 74.99
- HP-12C Financial . . . 99.99
- HP-15C Programmable . . . 99.99
- HP-16C Hexadecimal . . . 99.99
- HP-32E Scientific . . . 29.99
- HP-34C Programmable . . . 54.99
- HP-38C Financial . . . 69.99
- HP-97 Programmable . . . 599.99
- HP-41C Alpha Progrmb . . . 149.99
- HP-41CV Full Memory . . . 207.99
- HP-41CX Extnd Functn . . . 259.99
- 82104A Card Reader . . . 149.99
- 82143A Printer . . . 289.99
- 82153A Wand . . . 99.99
- HP-75C Computer . . . 739.99
- 82700A 8K Mem for 75C . . . 149.99

- 82160A HP-IL Module . . . 94.99
- 82161A Cassette Drive . . . 347.99
- 82162A HP-IL Printer . . . 347.99
- 82164A RS-232 Interf. . . 249.99
- 92198A 80 col Video Int . . . 269.99
- 7470A HP-IL Plotter . . . 899.99
- 82180A Extnd Functns . . . 59.99
- 82181A Extnd Memory . . . 59.99
- 82182A Time Module . . . 59.99
- 82183A Extnd I/O . . . 59.99
- HP-41 System Case . . . 49.99
- Port-X-tender to 10 pts . . . 129.99

Call for Low Prices on all Accessories and Software

- Ti CC-40 Compact 6K Expandable Computer . . . \$199.99
- CC-40 Solid State Software . . . from 49.99
- TI-55-II Scientific Calculator w/ Statistics . . . 34.99
- L0D Programmer Hexadecimal Converter . . . 59.99
- BA-5S Advanced Handheld Financial . . . 49.99
- TI-5310 Desk Printing Financial . . . 109.99
- Sharp PC-1250 Pocket Extended BASIC Computer . . . 469.99
- CE-125 Printer/Microcassette for PC-1250 . . . 149.99
- PC-1500 Advanced Handheld Computer . . . 139.99
- PC-1500A Advanced 8K Handheld Computer . . . 179.99
- CE-150 Cassette Intrfc/4-color Printer Plotter . . . 179.99
- CE-151 4K Memory for 1500/A . . . 39.99
- CE-155 8K Memory Expansion Box for 1500/A . . . 79.99
- CE-158 RS-232C & Parallel Interface for 1500/A . . . 179.99
- CE-159 8K Memory Expan with Battery Back-up . . . 99.99
- CE-161 16K Memory Expan with Battery Back-up . . . 149.99
- PC-1500/A ROM Software Modules . . . 49.99
- Casio FX-700P Handheld Computer, 1568 steps . . . 469.99
- FA-3 Cassette Adapter for FX-700P . . . 34.99
- FP-12 20-column printer for FX-700P . . . 59.99
- FX-98 Credit card Solar Scientific Calculator . . . 24.99
- FX-450 Scientific Calculator with Hexadecimal . . . 29.99
- TE-2500 Spanish Translator Watch . . . 69.99
- TC-500 Touch Sensor Calculator Watch . . . 59.99
- CFX-20 Scientific Calculator Watch . . . 34.99

Use cashier's check, postal money order, VISA or M/C. Foreign checks take five weeks to clear. Add shipping: 1% of your order (\$3.95 minimum). East of Missip Rv extra \$1.50. CA res add 6%. Subject to availability. USA prices.

ORDER TOLL-FREE **800-421-5188** Outside CA, AK, HI
Information line (213) 633-3262



Tam's Inc, Dept CE-1
14932 Garfield Ave.
Paramount, CA 90723
(213) 633-3262

Circle No. 42 on Free Information Card

transmitter's oscillator (*Q2*) and r-f amplifier (*Q1*). Transformers *T1* and *T2* can both be adjusted for peak operating performance. For simplicity, Fig. 7 shows the audio-frequency modulator as a function block. I'll have more to say about the modulator later.

The receiver consists of an inductively-tuned (non-crystal) radio-frequency amplifier and detector followed by a stage of audio-frequency amplification. Two filters and a network of output driver transistors complete the circuit.

In its intended operating mode, the receiver's output stages are connected to two small dc motors. One motor, the one which propels the toy car, is always on when the receiver is on. It propels the car in a forward direction when the transmitter signal is tone-modulated. When the carrier from the signal is not modulated, the motor's direction of rotation is reversed, and the car is propelled backwards.

The second motor controls the direction of travel. It steers the car either left or right, depending upon which of two modulation frequencies is selected.

Figure 8 is a simplified view of one of the two receiver's motor drive circuits. Depending upon the control signals at the inputs to each output stage, the polarity of the voltage at output terminals A and B is reversed. See the truth table in Fig. 8 for details.

Incidentally, the circuit in Fig. 8 can be implemented with power MOSFETs. I once described one way this can be done in a "Project of the Month" column for this magazine (October 1982).

Modifying the Transmitter. In this month's lead topic I discussed the advantages of using discrete transistors rather than integrated circuits in some

simple circuits. Radio Shack's radio-controlled modules, however, go too far. Both circuits use transistors exclusively, the receiver having 18 of them!

Although both the transmitter and receiver work well, I decided to modify the transmitter to permit transmission of a much wider range of carrier signals. I also designed a relatively simple circuit that replaces the mechanical switches used to control the carrier tone with logic signals. The external modulator circuit shown in Fig. 9 illustrates the latter circuit.

Though the transmitter's on-board, two-transistor multivibrator can be modified, I chose to use a 555 timer IC. This is a good example of where an IC

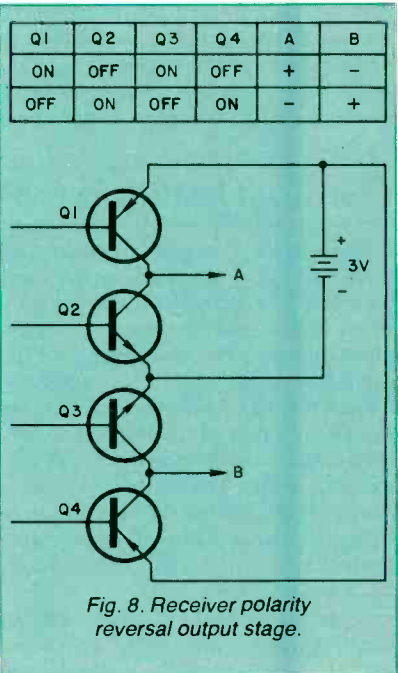


Fig. 8. Receiver polarity reversal output stage.

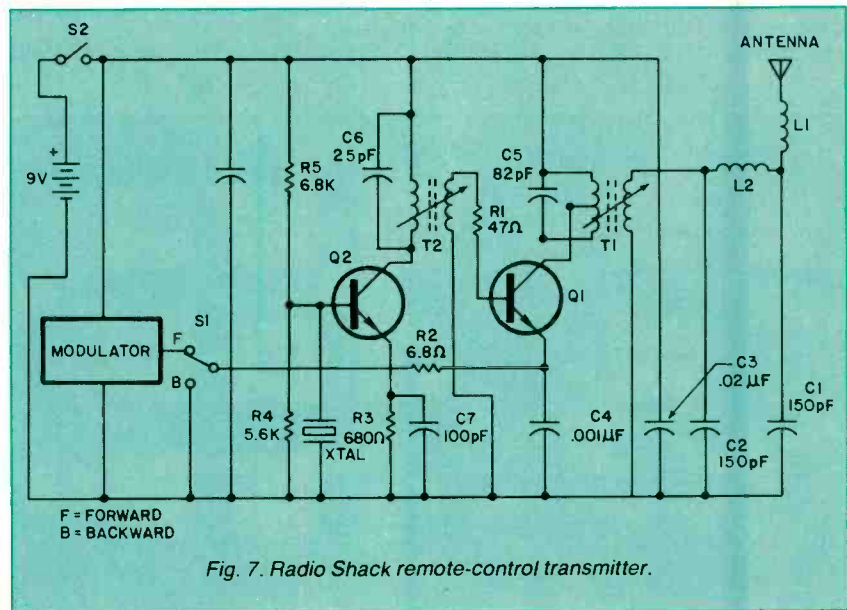


Fig. 7. Radio Shack remote-control transmitter.

provides more versatile operation than a transistor version.

In operation, the 555 oscillates at a frequency determined by *R2* and *C1*. Logic signals at inputs A and B determine which of two values of *R1* is selected, thereby controlling the modulation frequency. The output from the modulator (pin 3 of the 555) should be connected directly to the 68-ohm resistor shown as *R2* in the circuit diagram supplied with the transmitter module. Use the transmitter's 9-volt battery to power the circuit.

You can easily modify the modulator circuit in Fig. 9 by changing the values of *R1*, *R2*, and *C1*. For fast carrier-frequency changes, you can substitute potentiometers for *R1* and *R2*. The receiver can also be modified.

Modifying the Receiver. Though the Radio Shack receiver was designed to drive small dc motors, it will also drive other devices. Figure 10, for example, shows how it can be used to drive a pair of *tricolor* LEDs.

It's very simple to connect the LEDs to the receiver module. Be sure to use the two series resistors to limit the current to the LEDs to a safe value.

The truth table in Fig. 9 shows the various color and on-off combinations of the two LEDs for all four logic combinations that can be applied to inputs A and B. Of course, the LEDs will also respond to the various control combinations available from the unmodified transmitter.

Going Further. If you're interested in

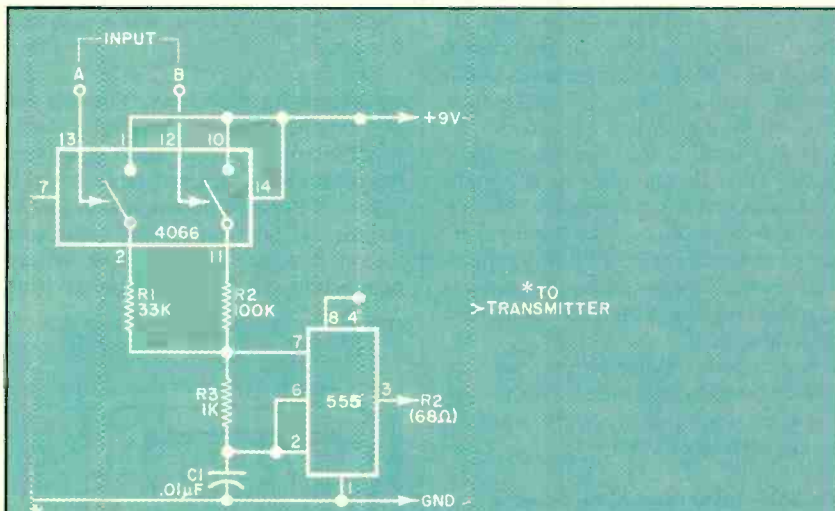


Fig. 9. External modulator circuit for radio-control transmitter.

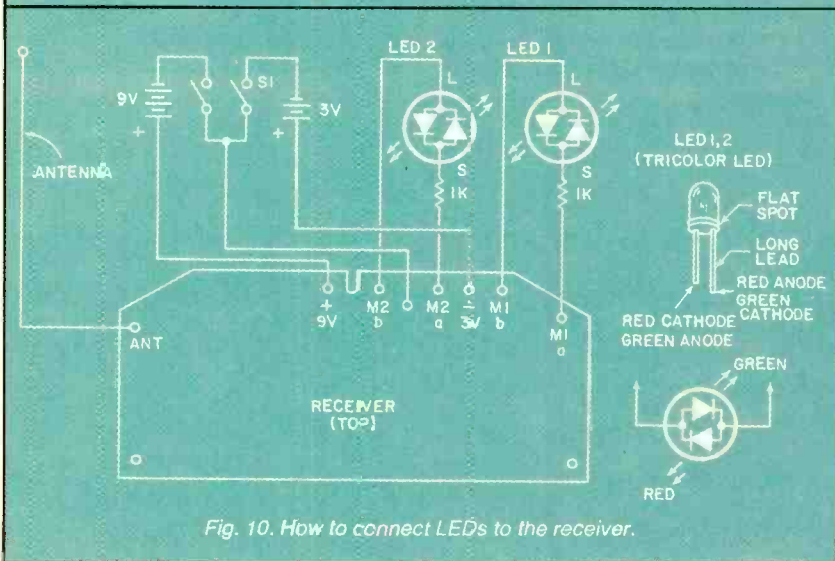


Fig. 10. How to connect LEDs to the receiver.

Planer Molder Saw

3 Power TOOLS in 1 Feed



Now you can use this ONE power-feed shop to turn rough lumber into moldings, trim, flooring, furniture — ALL popular patterns. RIP-PLANE-MOLD . . . separately or all at once with a single motor. Low Cost . . . You can own this power tool for only \$50 down.

30-Day FREE Trial! SEND FOR
NO OBLIGATION—NO SALESMAN WILL CALL
RUSH COUPON TODAY! **EXCITING FACTS**
FOLEY-BELSAW CO.
 90396 FIELD BLDG.
 KANSAS CITY, MO. 64111

FOLEY BELSAW Foley-Belsaw Co.
 90396 Field Bldg.
 Kansas City, Mo. 64111

YES Please send me complete facts about **PLANER—MOLDER—SAW** and details about 30-day trial offer.

Name _____
 Address _____
 City _____
 State _____ Zip _____

Circle No. 13 on Free Information Card

AMAZING DEVICES

LASERS

- RUBY LASER RAY GUN** — Intense visible red beam, burns and welds the hardest metals. HAZARDOUS device. Kits available. RUB3 PLANS includes part sources \$15.00
- CARBON DIOXIDE BURNING AND CUTTING LASER** — produces a continuous beam of energy. HAZARDOUS device — Kits available. LC5 PLANS includes part sources \$15.00
- VISIBLE LASER LIGHT GUN** — produces intense red beam for special effects and other various optical applications. Hand-held enclosure houses batteries. LGU3 PLANS \$10.00 LGU3K KIT/PLANS (minus tube) \$99.50
- IR PULSED LASER RIFLE** — produces 15-30 watt pulses at 9000x at 200-2000 per second.
- LRG3 PLANS \$10.00 LRG3K KIT/PLANS (minus diode) \$119.50**
- BEGINNER POCKET LASER** — visible red simulated device produces an excellent monochromatic source of light. LHC2 PLANS \$5.00 LHC2K KIT/PLANS \$24.50

PHASORS

- HIGH ENERGY VARIABLE AND PROGRAMMABLE PAIN FIELD GENERATORS. REQUIRE NO CONTACT** — Recently developed device produces directional fields of moderate to high SPL capable of producing intense pain and discomfort. HAZARDOUS IF NOT USED WITH DISCRETION. SOLO FOR ANIMAL CONTROL — MAY BE USED IN CERTAIN INSTANCES TO DISCOURAGE UNWANTED ENCOUNTERS.
- PPF1 PROG/VAR PLANS \$15.00 PPF1K KIT/PLANS \$175.00**
- PSP3 VAR HAND-HELD PLANS \$7.00 PSP3K KIT/PLANS \$44.50**
- PHASOR BURNING WAND** — capable of burning flesh. generates 3500 volts of continuous DC power. PSW3 PLANS \$8.00 PSW3K KIT/PLANS \$59.50
- PARALYZING SHOCKING WAND** — produces 100,000 watt pulses of stunning power. PG1W PLANS \$10.00 PG1WK KIT/PLANS \$79.50

Above electrical devices are hand-held and may be used for **PERSONAL DEFENSE**

SECURITY

- SNOOPER PHONE** — allows user to call his premises and listen in without the phone ever ringing. SNP2 PLANS \$7.00 SNP2K KIT/PLANS \$49.50
- LONG RANGE WIRELESS MIKE** — miniature device clearly transmits over 1 mile. FBT9 PLANS \$7.00 FBT9K KIT/PLANS \$34.50
- WIRELESS TELEPHONE TRANSMITTER** — long range all automatic, undetectable. VWPM5 PLANS \$7.00 VWPM5K KIT/PLANS \$34.50
- TALK AND TELL** — clearly and automatically records both sides of a telephone conversation when phone is being used. TAT2K KIT/PLANS \$14.50 TAT20 READY TO USE \$24.50

Our order phone is available 24 HOURS, 7 DAYS A WEEK. Write for **FREE** catalog of our many products. We accept Master Charge or Visa. Please allow 10% for shipping. On orders OVER \$50.00 **WE PAY** freight.

SEND TO: SCIENTIFIC SYSTEMS
 DEPT. 01, P.O. BOX 716 AMHERST, NH 03031
 OR CALL FOR ORDERING ONLY 1-603-673-4730

experimenting with these low-cost radio-control units, by now you may have already thought of other possible modifications. Besides electronic modifications and enhancements, you can physically modify the circuits so they will better fit a pair of small enclosures.

The transmitter is particularly well-suited for physical modification since the carrier modulator and r-f oscillator are at opposite ends of the circuit board. It's a simple matter to cut the board in half and mount the r-f oscillator section on a separate board upon which you can then assemble an IC modulator like the one in Fig. 9. Or you can stack the two halves of the existing board to form a more compact transmitter assembly.

Summing up, this pair of radio-control modules offers many possibilities for experimentation. Be sure to keep in mind the limitations of the receiver and the low power of the transmitter. For applications requiring more range and better noise and interference immunity, spend more money and buy a system that's completely crystal-controlled and includes on-board noise rejection circuitry.

Adding an Output Interface to a Digital Timer

One of the handiest gadgets in my office is a West Bend Electronic Timer™. This compact, crystal-controlled device is a digital countdown timer that sounds an alarm at the conclusion of a preset, user-programmable interval. The interval can range from 1 second to 99 minutes and 99 seconds.

Figure 11 is a pictorial view of the timer's front panel. The unit is operated by keying in the desired interval and pressing START. When the count reaches 00M 00S, the timer emits a rapid series of attention-getting chirps. The chirps will sound for one minute or until the STOP/RESET key is pressed.

The countdown can be halted temporarily by pressing STOP/RESET. The countdown will resume when START is pressed. Pressing STOP/RESET twice clears the display to 00M 00S.

Adding Output Leads. On the back of the timer is a handy clip that allows the unit to be attached to a belt or pocket. It also functions as a desk stand. A magnet in the clip permits the timer to be temporarily attached to a metal surface.

Just below the bottom of the clip is a small Phillips screw. When this screw is removed, the back panel of the timer can be gently pried away from the front

panel by inserting a flat screwdriver blade in the continuous, thin slot that separates the two panels. Be sure to pry along the bottom slot near the screw hole to avoid breaking the plastic snap retainers on the inside, upper edge of both panels.

After you lift the back panel away, temporarily set aside the power cell. Note the wires leading to a cylindrical component in the back panel. This is the piezoelectric alerter. The volume of sound that can be delivered by an alerter so small is truly remarkable.

Use a grounded or battery powered soldering iron to remove both alerter leads from the circuit board. Wrap appropriately colored lengths of wrapping wire around the exposed wires of each lead, solder in place, and then solder the two pairs of connection wires back to their original locations on the circuit board. Be sure to solder the leads to the correct locations, for if their polarity is reversed the alerter will not sound.

Drill a small hole in the timer's back panel. Then thread the two wrapping wire leads through the hole and replace the back panel. Be sure the battery contacts are properly aligned *before* replacing the screw. (You can see the contacts by removing the battery cover on the back panel.)

Replace the battery (plus polarity side up) and check the timer for proper operation. Now you are ready to assemble the interface circuit.

An SCR Interface. The timer alarm signal consists of approximately eight bursts per second of 125-microsecond pulses having a 2.4-volt peak-to-peak amplitude. The pulses have a frequency of 4 kilohertz. Figure 12 shows a simple SCR interface that switches on upon arrival of the first pulse and remains on until manually reset.

The SCR alone can control loads up to its rated capacity. I used a relay to

provide isolation between the timer and the load and to increase the circuit's switching power. *D1* reduces the possibility of 8-Hz chatter while the timer's alarm is sounding. *D2* protects the SCR from reverse voltage developed across the relay's coil when the reset switch is opened.

Not all SCR's will be reliably triggered by the timer's alarm signal. I had good results with Motorola's SCR1128 and Radio Shack's 276-1067.

Incidentally, you're on your own when you modify a manufactured electronic device such as this timer! Any warranty may be voided. And you must exercise caution to avoid damaging the timer's internal circuitry. You *must* also use caution and follow appropriate safety requirements should you use the modified timer to control line-powered devices.

Interface Applications. You can use the modified timer to control a dark-room enlarger, outdoor lighting, battery chargers, appliances, radios, and television sets. For best results, install the interface and relay on a small board and mount it adjacent to a 9-volt battery holder in a suitable enclosure. Provide

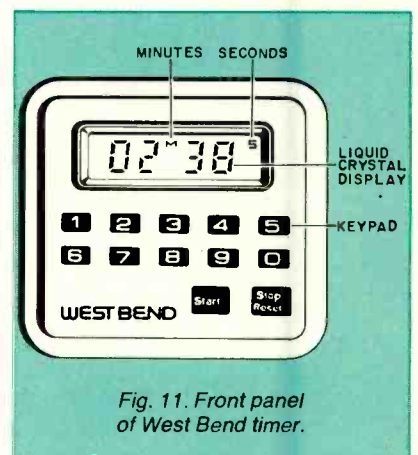


Fig. 11. Front panel of West Bend timer.

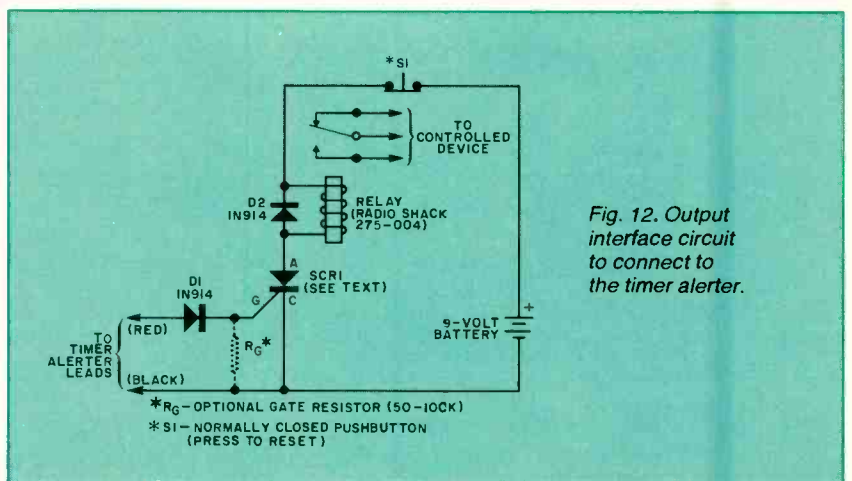


Fig. 12. Output interface circuit to connect to the timer alerter.

suitable plugs and jacks for connecting the timer to the interface and the interface to the device being controlled.

The timer can be clipped to a suitable shoulder or extension on the interface enclosure. Alternatively, you can use adhesive-backed squares of hook and loop fasteners. This will allow you to remove the timer when it's not being used to control the interface.

WARNING: You *must* follow safe wiring procedures if you use this circuit to control devices powered by the household line. Insulate *all* exposed connections. Do *not* exceed the contact ratings of the relay. The timer and interface should *not* be used for any application in which a circuit malfunction might cause injury to people or property.

Going Further. The timer I used is made by The West Bend Company (Box 1976, West Bend, WI 53095). I purchased mine at a department store for about \$12.

Recently I've seen advertisements from three other companies showing timers having an almost identical appearance to the West Bend unit, but selling for as much as \$29.95! You may be able to modify these and other digital timers with the help of the circuit in Fig. 12. In any case, shop around for the best buy. You may save more than enough to pay for the interface circuit . . . and possibly enough to buy a second timer!

A New Fiber-Optic Breakthrough

For the past decade, several major telecommunications companies and laboratories have engaged in an unofficial contest to establish a world record for the transmission of lightwave communications through the longest length of uninterrupted optical fiber. The signal must not be boosted along its path by the use of lightwave repeaters or regenerators.

The winner of this contest changes every few months and sometimes more often than that. The previous champion, Bell Laboratories, held the record for four months. Recently, however, scientists at Japan's Nippon Telegraph and Telephone announced a new record at a Tokyo conference on lightwave communications. The Japanese scientists successfully transmitted a 445.8-megabits-per-second signal through an optical fiber 134 kilometers (83.27 miles) long!

The optical source for this latest telecommunications achievement was a

state-of-the-art distributed-feedback laser emitting at a wavelength of 1.53 micrometers in the near-infrared. At this wavelength, the optical fiber used in the demonstration had an optical attenuation of only 0.23 dB/km.

Incidentally, while the Japanese record may stand for a while, it will inevitably fall before the onslaught of new technological advances. Though the eventual distance record for conventional sources and fibers may not far exceed the recent Japanese figure, new sources and fibers designed to operate farther into the infrared may eventually provide repeaterless links of up to a thousand miles or more!

Device Developments

An Integrated Tone Ringer.

Motorola has introduced the MC34012 tone ringer IC, the latest in a rapidly growing family of chips designed for telephone applications. The MC34012 permits the heavy and bulky electromechanical bell assembly in a conventional telephone to be replaced by a piezoelectric alerter.

In operation, the MC34012 is powered by the ac ring signal transmitted through the telephone line. The chip rectifies this signal and generates a square wave that drives the alerter. The chip's internal oscillator and frequency dividers provide a 12.5-Hz warble and tones that alternate between a high and low frequency. The sound volume can be adjusted by means of an external potentiometer between the chip and the alerter.

Telephone circuitry and equipment must be highly reliable and remain unaffected by voltage transients that may arrive through the telephone line. The MC34012 incorporates an internal SCR that fires when the on-chip voltage regulator draws more than 50 milliamperes, thereby protecting the chip's input circuitry.

Though primarily intended for telephone applications, the MC34012 would make an ideal sound generator chip for any kind of electronic, audible warning device. Three different versions of the chip in 8-pin miniDIP packages are available: 400/500 Hz, 800/1000 Hz, 1600/2000 Hz.

When this chip reaches the experimenter market, it should be reasonably priced because it sells for only \$1.24 in quantities of 100. As soon as I can obtain a sample, I'll experiment with it and relate the results in a future column. ♦

Build Your Own IBM-PC Compatible!

Here are the boards, assembly instructions and parts you need. . . plus full back-up service from Netronics!

Complete instructions show you how to build an IBM-PC compatible that can run ANY—not just "popular"—IBM-PC programs!

Motherboard functionally duplicates IBM-PC . . . features IBM-PC compatible BIOS ROM plus five empty sockets for ROMs of your choice. Sockets will accept IBM-PC PROMs or other PROMs.

Instructions include step-by-step procedure for transferring ROMs from a pc onto a floppy disk, which can then be mailed away for ROM duplication.

Board kits include printed circuit board, some hard-to-get parts, and detailed assembly instructions. Complete kits include printed circuit boards, all parts, and detailed assembly instructions. Manuals only, \$5.00 per kit.

IBM-PC Compatible 16-bit Motherboard with IBM compatible BIOS ROM—□ Board kit, \$89.95/□ Complete kit, add \$140.00

IBM-PC Compatible Keyboard in cabinet (wired & tested), \$229.95

64k/256k Memory with serial port with DB-25 connector □ Board kit (64k), \$39.95/□ Complete kit (64k), add \$134.00/□ Each additional 64k block (to 256k), add \$75.00

Four Drive Disk Controller with hard disk SASI interface, parallel printer port, clock/calendar—□ Board kit, \$69.95/□ Parts for Four Drive Disk Controller, add \$130.00/□ Parts for Parallel Printer Port, add \$30.00/□ Clock/Calendar, add \$45.00/□ SASI Interface, add \$50.00/□ All 4 functions wired and tested, \$329.95

IBM-PC Compatible Color Board (or B&W)—□ Board kit with ROM, \$89.95/□ Wired and tested, \$299.95

Printer/Spooler Board with 64k buffer, clock calendar, parallel printer ports—□ Board kit with ROM, \$49.95

Modem Board, 300 BPS, direct connect/originate/auto-dial/auto answer plus 2 serial ports—□ Board kit with telephone company connectors, \$49.95

Power Supply □ Complete kit, \$179.95/□ Extra power for hard disk option, add \$20.00

□ Cabinet for PC, steel with brushed aluminum front panel and simulated oak cover, \$199.95

□ 5 1/4" Disk Drive, DSDD (wired & tested), \$269.95

□ 10 Megabyte Hard Disk with controller & software (wired & tested), \$1295.50

Netronics offers complete service department to customers.

TERMINALS

(Terminals require ASCII keyboard and power supply.)

□ **Power Transformer** for either terminal, \$9.95

□ **SmartVid Deluxe Terminal**, 80 characters by 24 lines, microprocessor controlled with editing, reverse video and more—□ Board kit (includes board, character generator, video controller, 2k system ROM), \$99.95/□ Complete kit, add \$100.00

□ **FastVid Deluxe Terminal**, 64 or 32 characters x 16 lines, baud rate to 19 kilobaud—□ Board kit (includes controller, character generator, and PROM), \$49.95/□ Complete kit, add \$50.00

SPEECH

□ **Electric Mouth Apple/S-100 Speech Board**, with National NSC Digitaltalker speech chip—□ Apple/□ S-100 (Please check your choice!)/□ Board kit (with Digitaltalker and 150 word vocabulary set), \$69.95/□ Complete kit, add \$30.00/□ 2nd Word Set (150 words), add \$39.95

□ **SpeakEasy Universal Talking Board**, operates with computers and terminals or in the stand-alone mode. Uses same power supply as terminals (see above). □ Board kit (includes VORTRAX speech chip and system ROM), \$89.95/□ Complete kit, add \$60.00/□ Cabinet, add \$15.00

S-100 DYNAMIC RAM BOARD

□ **16k/64k RAM Board** uses popular 4116 chips—□ Board kit (includes 8202 controller), \$69.95/□ Complete kit (16k), add \$79.95/□ Each additional 16k, add \$50.00

ELF II BEGINNER'S PAK

□ **ELF II** is a complete 256 byte, fully expandable learning computer with excellent documentation that explains hardware and software fundamentals. Learn to program in machine language! Learn the essence of how all computers operate and "think"! If you can afford to think about an IBM-PC or IBM-PC compatible, you can't afford *not* to have an ELF II beginner's pak! □ Complete kit, \$139.95

USE YOUR CREDIT CARD! CALL TOLL FREE 1-800-243-7428 (In Connecticut call 203-354-9375)

To order by mail, check boxes above for products you desire. Mail entire ad with remittance to:

Netronics R & D, Ltd.

333 Litchfield Road, New Milford, CT 06776

Total enclosed \$ _____ (Conn. res. add tax) □ Visa

□ MasterCard Acct. # _____

Exp Date _____ Signature _____

Print Name _____

Address _____

City _____

State _____ Zip _____

QUALITY PARTS AT DISCOUNT PRICES!

SUB-MINIATURE D-TYPE CONNECTOR

SOLDER TYPE SUB-MINIATURE CONNECTORS USED FOR COMPUTER HOOK UPS.

DB-15 PLUG	\$2.75
DB-15 SOCKET	\$4.00
DB-15 HOOD	\$1.50
DB-25 PLUG	\$2.75
DB-25 SOCKET	\$3.50
DB-25 HOOD	\$1.25

WIRE 15 CONDUCTOR

COLOR CODED 24 GA STRANDED GRAY JACKET
25 FEET \$12.00 100 FEET \$37.50

KEY ASSEMBLY 5 KEY

CONTAINS 5 SINGLE-POLE NORMALLY OPEN SWITCHES. MEASURES 3/4" LONG

5 KEY	\$1.00 EACH
6 KEY	\$1.25 EACH

BCD DIP SWITCH

10 POSITION ROTARY SCREWDRIVER ADJUST. FITS 6 PIN DIP

\$1.85 EACH

SOLID STATE RELAYS

2 AMP MOTOROLA #MP 120D2 RATED:

CONTROL—3-6 VDC LOAD—120VAC 2 AMPS T.L. COMPATIBLE. SIZE: 1 1/2" x 3/4" x 1" HIGH
\$3.50 EACH 10 FOR \$32.00

10 AMP TELEDYNE P/N 615-1

CONTROL—3-32 VDC LOAD: 10 AMP 140 VAC

\$9.50 EACH

FREE! FREE! FREE! SEND FOR NEW LARGER 48 PAGE CATALOG

MINIATURE TOGGLE SWITCHES

ALL ARE RATED 5 AMPS @ 125 VAC

S.P.D.T. (on-on)	S.P.D.T. (on-on)	S.P.D.T. (on-off-on)
P.C. STYLE NON-THREADED BUSHING 75¢ EACH 10 FOR \$7.00	SOLDER LUG TERMINALS \$1.00 EACH 10 FOR \$9.00 100 FOR \$80.00	SOLDER LUG TERMINALS \$1.00 EACH 10 FOR \$9.00 100 FOR \$80.00
S.P.D.T. (on-off-on)	S.P.D.T. (on-on)	D.P.D.T. (on-on)
NON-THREADED BUSHING P.C. STYLE 75¢ EACH 10 FOR \$7.00	P.C. LUGS, THREADED BUSHING \$1.00 EACH 10 FOR \$9.00 100 FOR \$80.00	SOLDER LUG TERMINALS \$2.00 EACH 10 FOR \$19.00 100 FOR \$180.00

POWER SUPPLY

REGULATED FULLY ADJUSTABLE 5 VDC AT 3 AMPS
\$18.50 EACH

EDGE CONNECTORS

22/44 22/44 GOLD PLATED CONTACTS
156 CONTACT SPACING
\$2.00 EACH 10 FOR \$18.00

28/56

28/56 GOLD PLATED CONTACTS 156 CONTACT SPACING
\$2.50 EACH 10 FOR \$22.00

50/100

MICRO PLASTIC #MP-0125-50 DS-1 STANDARD S-100 CONNECTOR 125" SPACING. GOLD PLATED P.C. MOUNT.
\$3.75 EACH 10 FOR \$35.00

ALL ELECTRONICS CORP.

905 S. VERMONT • P.O. BOX 20406 • LOS ANGELES, CA 90006

TOLL FREE ORDERS • 1-800-826-5432 (IN CALIFORNIA: 1-800-258-6666)

AK, HI, OR INFORMATION • (213) 380-8000

QUANTITIES LIMITED • FOREIGN ORDERS
MINIMUM ORDER \$10.00 • INCLUDE SUFFICIENT SHIPPING
USA \$2.50 SHIPPING • CALIF. RES. ADD \$1.2
NO C.O.D.'s

Circle No. 50 on Free Information Card



Active Electronics

NUMBER ONE IN QUALITY SERVICE AVAILABILITY

THE WORLD'S MOST COMPLETE PROFESSIONAL AND HOME ELECTRONICS ENTHUSIAST INVENTORY

- Semiconductors + Memories
- Microprocessors + Support Circuits
- Microcomputer Systems + Peripherals
- Passive Electronic Components
- Hand Tools, Wire Wrapping, Soldering Equipment + Hardware

NOW AVAILABLE — FREE 1983 80-page catalog

A complete listing of products and specifications

Call, write or circle the inquiry card for your free copy today.

P.O. Box 8000, Westboro, Mass. 01581
CALL TOLL FREE: 1-800-343-0874

Mass customers call (617) 366-0500



QUALITY COMPONENTS - NOT MAIL ORDER "SECONDS"

Send SASE for FREE Flyer or send \$1.00 postage and handling for FREE COMPLETE CATALOG which includes coupon for \$1.00 OFF purchase.

ARIES ZERO INSERTION FORCE SOCKETS

Cam actuated, true zero insertion—tin plated solder tail pins—capable of being plugged into dip sockets, including wire wrap.

Stock No.	No. of Pins	1-9	10-49	50
11055	24	4.98	14.35	33.90
11056	28	5.15	4.50	4.05
11057	40	6.81	5.95	5.35
11058	64	12.02	10.50	9.45

IC-KOOLERS

from UNITRACK™ dissipate over 2 watts of heat from ICs, producing longer and better performance just as an IC cooler on heat is collected from top and bottom of IC and dissipated without ake losses!

Stock No.	No. Pins	Price
22225	14	\$2.29
22226	16	2.29
22228	18-20	.29

MIC 600CZ

\$7500
1 year warranty

DIGITAL MULTIMETER

Single rotary switch operation. Large easy to read 5 1/2 digit display 800 hours operating life with single 9v battery. Seven functions—DC Vols, DC Amps, Ohms, AC Vols, AC Amps, Diode and Resistor Function, Audible Continuity Check.

Stock No.	Carrying Case with belt hook	Price
82504		\$10.00

TI WIRE WRAP SOCKETS

Tin plated phosphor bronze contact—3 wrap

Stock No.	No. Pins	1-99	100-499	500
11301	8	\$4.00	\$36	\$30
11302	14	5.9	54	45
11303	16	6.4	58	48
11304	18	7.3	66	55
11305	20	9.9	90	75
11306	22	1.12	1.02	.95
11307	24	1.25	1.14	.95
11308	28	1.52	1.38	1.15
11309	40	2.05	1.86	1.55

TI LOW PROFILE SOCKETS

Tin plated copper alloy 688 contact pins with gas tight seal

Stock No.	No. Pins	1-24	25-99	999
11201	8	\$1.0	\$0.9	\$0.8
11202	14	1.4	1.3	1.2
11203	16	1.6	1.5	1.4
11204	18	1.8	1.7	1.5
11205	20	2.0	1.8	1.6
11206	22	2.2	2.0	1.8
11207	24	2.4	2.2	2.0
11208	28	2.8	2.6	2.5
11209	40	4.0	3.7	3.3

EKI KITS

with all parts necessary to assemble:
• Stock No. 88844 TV Jammer Kit "wipes out" your TV screen — \$ 7.71
• Stock No. 88850 Whooper Alarm Kit makes a great alarm or siren — \$11.33
MANY, MANY MORE KITS AVAILABLE! FULL LINE CATALOG

ELPAC POWER SUPPLIES - DC/DC CONVERTERS

SINTEC Stock No.	ELPAC No.	Input Voltage (VDC)	Output Voltage (VDC)	Output Current (mA)	Dimensions (HxWxD) in inches	Price
13825	C83801	3-0-7.0	12±0.6	0-25	.48x.51x3.05	\$ 7.95
13826	C83811	3-0-7.0	12±0.6	0-25	.48x.51x3.05	7.95
13827	C83802	3-0-7.0	15±0.7	0-20	.48x.51x3.05	7.95
13828	C83812	3-0-7.0	15±0.7	0-20	.48x.51x3.05	7.95
13829	C83804	3-0-7.0	28±1.0	0-10	.48x.51x3.05	7.95
13830	C83814	3-0-7.0	28±1.0	0-10	.48x.51x3.05	7.95

Special of the Month!

INDUCTION AMMETER

No direct electrical connections—the current-carrying conductors are simply slipped into channels on the back of the meter. The magnetic field set up by the current actuates the moving magnet mechanism. The dual scale is for zero center ranges 75-0-75 and 400-0-400, and is suitable for monitoring both the alternator/generator and starter of a motor vehicle. Metal case and bright chrome plate bezel.

Stock No. 13734 Price \$7.50

OPCOA

Single Digit Displays - Common Cathode

Stock No.	Color	1	100
12082	Red	\$1.12	\$ 9.99
12085	Green	1.84	1.63
12087	Yellow	1.92	1.70
12089	Orange	2.08	1.84

OPTEL LCD's with pins

Stock No.	Description	1	10
47005	3 1/2 dig, 5" x 5"	\$ 5.95	\$ 5.50
47006	4 dig, 5" x 5"	5.95	5.50
47007	4 dig, 7" x 5"	11.90	11.00

OK MACHINE AND TOOL

IC INSERTION/EXTRACTION KIT
The battery DIP IC insertion and extraction tool for common IC's. Features 14 to 40 pins. Tools that engage under the surface of the IC's safely and in full length—no bending leads. Stock No. 13309 \$37.74

MINI-DRILL

This portable hand drill is appropriate for circuit board drilling. Runs at 2500 RPM on a 2A batteries (not included). Supplied with one .038 dia drill bit. Drill stand is designed like a drill press for precise hole drilling.

Stock No.	Description	Price
13345	Hand drill with 039 dia bit (no batteries)	\$24.95
13347	Replacement bits 2 each of .040 and .060 dia	5.95
13348	Replacement bit	1.95

PIN FORMING TOOL

puts IC's on their true row to row spacing. One side for 300 centers. Flip tool over for devices on 600 centers. Put device in tool and squeeze.

NEW! ANTI-STATIC MODEL
ONE TOOL DOES 8 thru 40 PINS! Stock No. 11059 \$12.55

IC EXTRACTOR

One-piece, spring steel construction. Will extract all LSI, MSI and SSL devices with 8 to 24 pins.

Stock No. 13313 Price \$2.10

SINTEC CORP.

28 8th St., Box 410
Frenchtown, NJ 08825



TOLL 800-526-5960
FREE in NJ (201) 996-4093

We accept VISA, MC, C.O.D., CHECK or M.O.
*INCLUDE SHIPPING CHARGES
\$100 to \$250 - \$4.00
over \$250 - \$5.00

Circle No. 36 on Free Information Card

4164

64K DYNAMIC
200 NS

\$595

TMM2016

2KX8 STATIC
200 NS

\$415

STATIC RAMS

2101	256 x 4 (450ns)	1.95
5101	256 x 4 (450ns) (cmos)	3.95
2102-1	1024 x 1 (450ns)	.89
2102L-4	1024 x 1 (450ns) (LP)	.89
2102L-2	1024 x 1 (250ns) (LP)	1.49
2111	256 x 4 (450ns)	2.49
2112	256 x 4 (450ns)	2.99
2114	1024 x 4 (450ns)	8/9.95
2114-25	1024 x 4 (250ns)	8/10.95
2114L-4	1024 x 4 (450ns) (LP)	8/12.95
2114L-3	1024 x 4 (300ns) (LP)	8/13.45
2114L-2	1024 x 4 (200ns) (LP)	8/13.95
TC5514	1024 x 4 (650ns) (cmos)	2.49
TC5516	2048 x 8 (250ns) (cmos)	9.95
2147	4096 x 1 (55ns)	4.95
TMS4044-4	4096 x 1 (450ns)	3.49
TMS4044-3	4096 x 1 (300ns)	3.99
TMS4044-2	4096 x 1 (200ns)	4.49
MK4118	1024 x 8 (250ns)	9.95
TMM2016-200	2048 x 8 (200ns)	4.15
TMM2016-150	2048 x 8 (150ns)	4.95
TMM2016-100	2048 x 8 (100ns)	6.15
HM6116-4	2048 x 8 (200ns) (cmos)	4.75
HM6116-3	2048 x 8 (150ns) (cmos)	4.95
HM6116-2	2048 x 8 (120ns) (cmos)	8.95
HM6116LP-4	2048 x 8 (200ns) (cmos)(LP)	5.95
HM6116LP-3	2048 x 8 (150ns) (cmos)(LP)	6.95
HM6116LP-2	2048 x 8 (120ns) (cmos)(LP)	10.95
Z-8132	4096 x 8 (300ns) (Qstat)	34.95
HM6264	8192 x 8 (150ns) (cmos)	49.95

LP = Low Power Qstat = Quasi-Static

EPROMS

1702	256 x 8 (1us)	4.50
2708	1024 x 8 (450ns)	3.95
2758	1024 x 8 (450ns) (5v)	5.95
2716	2048 x 8 (450ns) (5v)	3.95
2716-1	2048 x 8 (350ns) (5v)	5.95
TMS2516	2048 x 8 (450ns) (5v)	5.50
TMS2716	2048 x 8 (450ns)	7.95
TMS2532	4096 x 8 (450ns) (5v)	5.95
2732	4096 x 8 (450ns) (5v)	4.95
2732-250	4096 x 8 (250ns) (5v)	8.95
2732-200	4096 x 8 (200ns) (5v)	11.95
2732A-4	4096 x 8 (450ns) (5v) (21vPGM)	6.95
2732A	4096 x 8 (250ns) (5v) (21vPGM)	9.95
2732A-2	4096 x 8 (200ns) (5v) (21vPGM)	13.95
2764	8192 x 8 (450ns) (5v)	9.95
2764-250	8192 x 8 (250ns) (5v)	14.95
2764-200	8192 x 8 (200ns) (5v)	24.95
TMS2564	8192 x 8 (450ns) (5v)	17.95
MC68764	8192 x 8 (450ns) (5v) (24 pin)	39.95
27128	16384x8 (300ns) (5v)	29.95

5v = Single 5 Volt Supply 21vPGM = Program at 21 Volts

EPROM ERASERS

	Timer	Capacity Chip	Intensity (uW/Cm ²)	
PE-14		9	8,000	83.00
PE-14T	X	9	8,000	119.00
PE-24T	X	12	9,600	175.00
PL-265T	X	30	9,600	255.00
PR-125T	X	25	17,000	349.00
PR-320T	X	42	17,000	595.00

ORDER TOLL FREE
800-538-5000
800-662-6279
 (CALIFORNIA RESIDENTS)

CRYSTALS

32.768 khz	1.95
1.0 mhz	4.95
1.8432	4.95
2.0	3.95
2.097152	3.95
2.4576	3.95
3.2768	3.95
3.579545	3.95
4.0	3.95
5.0	3.95
5.0688	3.95
5.185	3.95
5.7143	3.95
6.0	3.95
6.144	3.95
6.5536	3.95
8.0	3.95
10.0	3.95
10.738635	3.95
14.31818	3.95
15.0	3.95
16.0	3.95
17.430	3.95
18.0	3.95
18.432	3.95
20.0	3.95
22.1184	3.95
32.0	3.95

74LS00

74LS00	.24	74LS173	.69
74LS01	.25	74LS174	.55
74LS02	.25	74LS175	.55
74LS03	.25	74LS181	2.15
74LS04	.24	74LS189	8.95
74LS05	.25	74LS190	.89
74LS08	.28	74LS191	.89
74LS09	.29	74LS192	.79
74LS10	.25	74LS193	.79
74LS11	.35	74LS194	.69
74LS12	.35	74LS195	.69
74LS13	.45	74LS196	.79
74LS14	.59	74LS197	.79
74LS15	.35	74LS221	.89
74LS20	.25	74LS240	.95
74LS21	.29	74LS241	.99
74LS22	.25	74LS242	.99
74LS26	.29	74LS243	.99
74LS27	.29	74LS244	1.29
74LS28	.35	74LS245	1.49
74LS30	.25	74LS247	.75
74LS32	.29	74LS248	.99
74LS33	.55	74LS249	.99
74LS37	.35	74LS251	.59
74LS38	.35	74LS253	.59
74LS40	.25	74LS257	.59
74LS42	.49	74LS258	.59
74LS47	.75	74LS259	2.75
74LS48	.75	74LS260	.59
74LS49	.75	74LS266	.55
74LS51	.25	74LS273	1.49
74LS54	.29	74LS275	3.35
74LS55	.29	74LS279	.49
74LS63	1.25	74LS280	1.98
74LS73	.39	74LS283	.69
74LS74	.35	74LS290	.89
74LS75	.39	74LS293	.89
74LS76	.39	74LS295	.99
74LS78	.49	74LS298	.89
74LS83	.60	74LS299	1.75
74LS85	.69	74LS323	3.50
74LS86	.39	74LS324	1.75
74LS90	.55	74LS352	1.29
74LS91	.89	74LS353	1.29
74LS92	.55	74LS363	1.35
74LS93	.55	74LS364	1.95
74LS95	.75	74LS365	.49
74LS96	.89	74LS366	.49
74LS107	.39	74LS367	.45
74LS109	.39	74LS368	.45
74LS112	.39	74LS373	1.39
74LS113	.39	74LS374	1.39
74LS114	.39	74LS375	.95
74LS122	.45	74LS377	1.39
74LS123	.79	74LS378	1.18
74LS124	2.90	74LS379	1.35
74LS125	.49	74LS385	3.90
74LS126	.49	74LS386	.45
74LS132	.59	74LS390	1.19
74LS133	.59	74LS393	1.19
74LS136	.39	74LS395	1.19
74LS137	.99	74LS399	1.49
74LS138	.55	74LS424	2.95
74LS139	.55	74LS447	.95
74LS145	1.20	74LS490	1.95
74LS147	2.49	74LS624	3.99
74LS148	1.35	74LS640	2.20
74LS151	.55	74LS645	2.20
74LS153	.55	74LS668	1.69
74LS154	1.90	74LS669	1.89
74LS155	.69	74LS670	1.49
74LS156	.69	74LS674	14.95
74LS157	.65	74LS682	3.20
74LS158	.59	74LS683	3.20
74LS160	.69	74LS684	3.20
74LS161	.65	74LS685	3.20
74LS182	.89	74LS688	2.40
74LS163	.65	74LS689	3.20
74LS164	.69	81LS95	1.49
74LS165	.95	81LS96	1.49
74LS166	1.95	81LS97	1.49
74LS168	1.75	81LS98	1.49
74LS169	1.75	25LS2521	2.80
74LS170	1.49	25LS2569	4.25

UARTS

AY3-1014	6.95
AY5-1013	3.95
AY3-1015	6.95
PT1472	9.95
TR1602	3.95
2350	9.95
2651	8.95
IM6402	7.95
IM6403	8.95
INS8250	10.95

GENERATORS

MC14411	11.95
BR1941	11.95
4702	12.95
COM5016	16.95
COM8116	10.95
MM5307	10.95

FUNCTION

MC4024	3.95
LM566	1.49
XR2206	3.75
8038	3.95

MISC.

UPD7201	29.95
TMS99532	29.95
ULN2003	2.49
3242	7.95
3341	4.95
MC3470	4.95
MC3480	9.00
11C90	13.95
95H90	7.95
2513-001 UP	9.95
2513-002 LOW	9.95

CLOCK CIRCUITS

MM5314	4.95
MM5389	3.95
MM5375	4.95
MM58167	12.95
MM58174	11.95
MMS5832	3.95

KEYBOARD CHIPS

AY5-2376	11.95
AY5-3600	11.95
AY5-3600 PRO	11.95

DYNAMIC RAMS

TMS4027	4096 x 1 (250ns)	1.99
UPD411	4096 x 1 (300ns)	3.00
MM5280	4096 x 1 (300ns)	3.00
MK4108	8192 x 1 (200ns)	1.95
MM5298	8192 x 1 (250ns)	1.85
4116-300	16384 x 1 (300ns)	8/11.75
4116-250	16384 x 1 (250ns)	8/11.95
4116-200	16384 x 1 (200ns)	8/12.95
4116-150	16384 x 1 (150ns)	8/14.95
4116-120	16384 x 1 (120ns)	8/29.95
2118	16384 x 1 (150ns) (5v)	4.95
MK4332	32768 x 1 (200ns)	9.95
4164-200	65536 x 1 (200ns) (5v)	5.95
4164-150	65536 x 1 (150ns) (5v)	6.95
MCM6665	65536 x 1 (200ns) (5v)	8.95
TMS4164-15	65536 x 1 (150ns) (5v)	8.95

5V = single 5 volt supply

6800

68000	59.95
6800	3.95
6802	7.95
6803	19.95
6808	13.90
6809E	19.95
6809	11.95
6810	2.95
6820	4.35
6821	3.25
6828	14.95
6840	12.95
6843	34.95
6844	25.95
6845	14.95
6847	11.95
6850	3.25
6852	5.75
6860	9.95
6875	6.95
6880	2.25
6883	22.95
68047	24.95
68488	19.95

8200

8202	24.95
8203	39.95
8205	3.50
8212	1.80
8214	3.85
8216	1.75
8224	2.25
8226	1.80
8228	3.49
8237	19.95
8237-5	21.95
8238	4.49
8243	4.45
8250	10.95
8251	4.49
8253	6.95
8253-5	7.95
8255	4.49
8255-5	5.25
8257	7.95
8257-5	8.95
8259	6.90
8259-5	7.50
8271	79.95
8272	39.95
8275	29.95
8279	8.95
8279-5	10.00
8282	6.50
8283	6.50
8284	5.50
8286	8.50
8287	6.50
8288	25.00
8289	49.95

Z-80

2.5 Mhz	
Z80-CPU	3.95
Z80-CTC	4.49
Z80-DART	10.95
Z80-DMA	14.95
Z80-PIO	4.49
Z80-SIO/0	16.95
Z80-SIO/1	18.95
Z80-SIO/2	16.95
Z80-SIO/9	16.95

4.0 Mhz

Z80A-CPU	4.95
Z80A-CTC	4.95
Z80A-DART	11.95
Z80A-DMA	16.95
Z80A-PIO	4.95
Z80A-SIO/0	16.95
Z80A-SIO/1	16.95
Z80A-SIO/2	16.95
Z80A-SIO/9	16.95

6.0 Mhz

Z80B-CPU	11.95
Z80B-CTC	13.95
Z80B-PIO	13.95
Z80B-DART	19.95
Z80B-SIO/2	39.95

2732

32K EPROM

\$495

2764

64K EPROM

\$995

7400

7400	.19	74123	.49
7401	.19	74125	.45
7402	.19	74126	.45
7403	.19	74132	.45
7404	.19	74136	.50
7405	.25	74143	2.95
7406	.29	74145	.60
7407	.29	74147	1.75
7408	.24	74148	1.20
7409	.19	74150	1.35
7410	.19	74151	.55
7411	.25	74153	.55
7413	.35	74154	1.25
7414	.49	74155	.75
7416	.25	74157	.55
7417	.25	74159	1.65
7420	.19	74160	.85
7421	.35	74161	.69
7425	.29	74163	.69
7427	.29	74164	.85
7430	.19	74165	.85
7432	.29	74166	1.00
7437	.29	74167	2.95
7438	.29	74170	1.65
7442	.49	74173	.75
7445	.69	74174	.89
7446	.69	74175	.89
7447	.69	74177	.75
7448	.69	74181	2.25
7451	.23	74184	2.00
7473	.34	74185	2.00
7474	.33	74191	1.15
7475	.45	74192	.79
7476	.35	74193	.79
7482	.95	74194	.85
7483	.50	74195	.85
7485	.59	74197	.75
7486	.35	74198	1.35
7489	2.15	74221	1.35
7490	.35	74246	1.35
7492	.50	74247	1.25
7493	.35	74259	2.25
7495	.55	74273	1.95
7497	2.75	74276	1.25
74100	1.75	74279	.75
74107	.30	74366	.65
74109	.45	74367	.65
74116	1.55	74368	.65
74121	.29	74393	1.35
74122	.45		

74S00

74S00	.32	74S168	3.95
74S02	.35	74S169	3.95
74S03	.35	74S174	.95
74S04	.35	74S175	.95
74S05	.35	74S181	3.95
74S08	.35	74S182	2.95
74S09	.40	74S188	1.95
74S10	.35	74S189	6.95
74S11	.35	74S194	1.49
74S15	.35	74S195	1.49
74S20	.35	74S196	1.49
74S22	.35	74S197	1.49
74S30	.35	74S201	6.95
74S32	.40	74S225	7.95
74S37	.88	74S240	2.20
74S38	.85	74S241	2.20
74S40	.35	74S244	2.20
74S51	.35	74S251	.95
74S64	.40	74S253	.95
74S65	.40	74S257	.95
74S74	.50	74S258	.95
74S85	1.99	74S260	.79
74S86	.50	74S273	2.45
74S112	.50	74S274	19.95
74S113	.50	74S275	19.95
74S114	.55	74S280	1.95
74S124	2.75	74S287	1.90
74S132	1.24	74S288	1.90
74S133	.45	74S289	6.89
74S134	.50	74S301	6.95
74S135	.89	74S373	2.45
74S138	.85	74S374	2.45
74S139	.85	74S381	7.95
74S140	.55	74S387	1.95
74S151	.95	74S412	2.98
74S153	.95	74S471	4.95
74S157	.95	74S472	4.95
74S158	.95	74S474	4.95
74S161	1.95	74S482	15.25
74S162	1.95	74S570	2.95
74S163	1.95	74S571	2.95

LINEAR

LM301	.34	LM340 (see 7800)		LM566	1.49
LM301H	.79	LM348	.99	LM567	.89
LM307	.45	LM350K	4.95	NE570	3.95
LM308	.69	LM350T	4.60	NE571	2.95
LM308H	1.15	LM358	.69	NE590	2.50
LM309H	1.95	LM359	1.79	NE592	2.75
LM309K	1.25	LM378	3.75	LM709	.59
LM310	1.75	LM377	1.95	LM710	.75
LM311	.64	LM378	2.50	LM711	.79
LM311H	.89	LM380	.89	LM723	.49
LM312H	1.75	LM380N-8	1.10	LM723H	.55
LM317K	3.95	LM381	1.60	LM733	.98
LM317T	1.19	LM382	1.60	LM741	.35
LM318	1.49	LM383	1.95	LM741N-14	.35
LM318H	1.59	LM384	1.95	LM741H	.40
LM319H	1.90	LM386	.89	LM747	.69
LM319	1.25	LM387	1.40	LM748	.59
LM320 (see 7900)		LM389	1.35	LM1014	1.19
LM322	1.65	LM390	1.95	LM1303	1.95
LM323K	4.95	LM392	.69	LM1310	1.49
LM324	.59	LM393	1.29	MC1330	1.69
LM329	.65	LM394H	4.60	MC1349	1.89
LM331	3.95	LM399H	5.00	MC1350	1.19
LM334	1.19	NE531	2.95	MC1358	1.69
LM335	1.40	NE555	.34	MC1372	6.95
LM336	1.75	NE556	.65	LM1414	1.59
LM337K	3.95	NE558	1.50	LM1458	.59
LM337T	1.95	NE561	24.95	LM1488	.69
LM338K	6.95	NE564	2.95	LM1489	.69
LM339	.99	LM565	.99	LM1496	.85

H = TO-5 CAN

T = TO-220

K = TO-3

RCA

CA 3023	2.75	CA 3082	1.65
CA 3039	1.29	CA 3083	1.55
CA 3046	1.25	CA 3086	.80
CA 3059	2.90	CA 3089	2.99
CA 3060	2.90	CA 3096	3.49
CA 3065	1.75	CA 3130	1.30
CA 3080	1.10	CA 3140	1.15
CA 3081	1.65	CA 3146	1.85
CA 3160	1.19		

TI

TL494	4.20	75365	1.95
TL496	1.85	75450	.59
TL497	3.25	75451	.39
75107	1.49	75452	.39
75110	1.95	75453	.39
75150	1.35	75454	.39
75154	1.35	75491	.79
75188	1.25	75492	.79
75189	1.25	75493	.89
75494	.89		

BI FET

TL071	.79	TL084	2.19
TL072	1.19	LF347	2.19
TL074	2.19	LF351	.60
TL081	.79	LF353	1.00
TL082	1.19	LF355	1.10
TL083	1.19	LF356	1.10
LF357	1.40		

SWITCHES

SPDT mini-toggle	1.25
DPDT mini-toggle	1.50
SPST mini-pushbutton	.39

EXAR

XR 2206	3.75
XR 2207	3.75
XR 2208	3.75
XR 2211	5.25
XR 2240	3.25

INTERSIL

ICL7106	9.95
ICL7107	12.95
ICL7660	2.95
ICL8038	3.95
ICM7207A	5.59
ICM7208	15.95

9000 SERIES

9316	1.00
9334	2.50
9368	3.95
9401	9.95
9601	.75
9602	1.50
96S02	1.95

IC SOCKETS

3 pin ST	.13	.11
14 pin ST	.15	.12
13 pin ST	.17	.13
13 pin ST	.20	.18
23 pin ST	.29	.27
22 pin ST	.30	.27
24 pin ST	.30	.27
23 pin ST	.40	.32
40 pin ST	.49	.39
64 pin ST	4.25	call

ST = SOLDDERTAIL

3 pin WW	.59	.49
14 pin WW	.89	.52
18 pin WW	.69	.58
18 pin WW	.99	.90
20 pin WW	1.09	.98
22 pin WW	1.39	1.28
24 pin WW	1.49	1.35
28 pin WW	1.69	1.49
40 pin WW	1.99	1.80

WW = WIRETAIL

16 pin ZIF	6.75	call
24 pin ZIF	9.95	call
28 pin ZIF	10.95	call
ZIF = TEXTTOOL		
(Zero Insertion Force)		

CMOS

4000	.29	4528	1.19
4001	.25	4531	.95
4002	.25	4532	1.95
4006	.89	4538	1.95
4007	.29	4539	1.95
4008	.95	4541	2.64
4009	.39	4543	1.19
4010	.45	4553	5.79
4011	.25	4555	.95
4012	.25	4556	.95
4013	.38	4581	1.95
4014	.79	4582	1.95
4015	.39	4584	.75
4016	.39	4585	.75
4017	.69	4702	12.95
4018	.79	74C00	.35
4019	.39	74C02	.35
4020	.75	74C04	.35
4021	.79	74C08	.35
4022	.79	74C10	.35
4023	.29	74C14	.59
4024	.85	74C20	.35
4025	.29	74C30	.35
4026	1.65	74C32	.39
4027	.45	74C42	1.29
4028	.69	74C48	1.99
4029	.79	74C73	.65
4030	.39	74C74	.65
4034	1.95	74C76	.80
4035	.85	74C83	1.95
4040	.75	74C85	1.95
4041	.75	74C86	.39
4042	.69	74C89	4.50
4043	.85	74C90	1.19
4044	.79	74C93	1.75
4046	.85	74C95	.99
4047	.95	74C107	.89
4049	.35	74C150	5.75
4050	.35	74C151	2.25
4051	.79	74C154	3.25
4053	.79	74C157	1.75
4060	.89	74C160	1.19
4066	.39	74C161	1.19
4068	.39	74C162	1.19
4069	.29	74C163	1.19
4070	.35	74C164	1.39
4071	.29	74C165	2.00
4072	.29	74C173	.79
4073	.29	74C174	1.19
4075	.29	74C175	1.19
4076	.79	74C192	1.49
4078	.29	74C193	1.49
4081	.29	74C195	1.39
4082	.29	74C200	5.75
4085	.95	74C221	1.75
4086	.95	74C244	2.25
4093	.49	74C373	2.45
4098	2.49	74C374	2.45
4099	1.95	74C901	.39
14409	12.95	74C902	.85
14410	12.95	74C903	.85
14411	11.95	74C905	10.95
14412	12.95	74C906	.95
14419	7.95	74C907	1.00
45202	.95	74C908	2.00
45203	.65	74C909	2.75
45208	1.95	74C910	9.95
45110	.85	74C911	8.95
45111	.85	74C912	8.95
45112	.85	74C914	1.95
45114	1.25	74C915	1.19
45115	1.79	74C918	2.75
45116	1.55	74C920	17.95
45118	.89	74C921	15.95
45119	.39	74C922	4.49
45207	.79	74C923	4.95
45222	1.25	74C925	5.95
45226	1.25	74C926	7.95
45227	1.95	74C928	7.95
		74C	

SHACK® HAS THE PARTS YOU NEED AT LOW PRICES!

Highest Quality!

Factory Fresh!

No Mail-Order Delays!

Special-Purpose ICs

NEW!

1295 Set of 2 ICs **799** MF10

A Voice Synthesizer Set. Get into solid-state talk! The SPO256 speech processor, a 28-pin NMOS LSI device, uses a stored program to synthesize speech or complex sounds. Works with a few simple support parts, or use the 14-pin SPR16 serial speech ROM, included, for computer interfacing. With data. 276-1783 Set 12.95

B MF10 Dual Switched Filter. Versatile CMOS building block for active filters—eliminates the need for expensive, close-tolerance parts. High performance, yet very easy to use. 20-pin DIP with data. 276-2329 7.99

Voltage Regulator ICs

Type	Adjustable	Cat. No.	Each
LM723	0 to 40 VDC	276-1740	.89
LM317T	1.2 to 37 VDC	276-1778	2.79

Type	Fixed Output	Cat. No.	Each
7805	+ 5 VDC	276-1770	1.59
7812	+ 12 VDC	276-1771	1.59
7815	+ 15 VDC	276-1772	1.59
7905	- 5 VDC	276-1773	1.59
7912	- 12 VDC	276-1774	1.59

4000-Series CMOS ICs

With Pin-Out and Specs

Type	Cat. No.	Each
4001	276-2401	.79
4011	276-2411	.79
4013	276-2413	.99
4017	276-2417	1.49
4023	276-2423	.99
4049	276-2449	.99
4066	276-2466	.99

TTL Digital ICs

With Pin-Out and Specs

Type	Cat. No.	Each
7400	276-1801	.59
7404	276-1802	.79
7408	276-1822	.79
7447	276-1805	1.19
7490	276-1808	.89

Replacement Transistors

Type		Cat. No.	Each
2N1305	PNP	276-2007	1.19
MPS222A	NPN	276-2009	.79
PN2484	PNP	276-2010	.89
MPS3904	NPN	276-2016	.69
TIP31	NPN	276-2017	.99
TIP3055	NPN	276-2020	1.59
MPS2907	PNP	276-2023	.79
MJE34	PNP	276-2027	1.49
2N3053	NPN	276-2030	.89
MPS3638	PNP	276-2032	.79
TIP120	NPN	276-2068	1.29
2N3055	NPN	276-2041	1.99
MJ2955	PNP	276-2043	2.19
2N4124	NPN	276-2057	.59
2N4401	NPN	276-2058	.59
MPSA06	NPN	276-2059	.59
MPSA13	NPN	276-2060	.59
MPSA42	NPN	276-2061	.69
MU4891	UJT	276-2029	.99
2SD313	NPN	276-2048	1.79
2SC945	NPN	276-2051	.79
2SC1308	NPN	276-2055	7.95
2N3819	N-FET	276-2035	.99
MPP102	N-FET	276-2062	.99

Operational Amplifiers

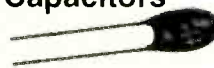
Type		Cat. No.	Each
741	(Single)	276-007	.79
MC1458	(Dual)	276-038	.99
LM324	(Quad)	276-1711	1.29
TL082	(Dual)	276-1715	1.89
TL084	(Quad)	276-1714	2.99
LM3900	(Quad)	276-1713	1.39
LM339	(Quad)	276-1712	1.49

Audio Power Amplifiers

Type	Cat. No.	Each
LM383/TDA2002	276-703	3.19
LM386	276-1731	1.09
TA7205AP	276-705	2.99
LM380	276-706	1.59

Tantalum Capacitors

- 20% Tolerance
- Standard IC Pin Spacing



µF	WVDC	Cat. No.	Each
0.1	35	272-1432	.49
0.47	35	272-1433	.49
1.0	35	272-1434	.49
2.2	35	272-1435	.59
10	16	272-1436	.69
22	16	272-1437	.79

Electrolytic Capacitors

Axial Leads

µF	WVDC	Cat. No.	Each
4.7	35	272-1012	.49
10	35	272-1013	.59
22	35	272-1014	.69
47	35	272-1015	.69
100	35	272-1016	.79
220	35	272-1017	.89
470	35	272-1018	.99
1000	35	272-1019	1.59
2200	35	272-1020	2.49
3300	35	272-1021	2.99
4700	35	272-1022	3.59
470	50	272-1046	1.59
1000	50	272-1047	1.99
2200	50	272-1048	3.49

PC-Mount Leads

µF	WVDC	Cat. No.	Each
220	16	272-956	.79
470	16	272-957	.89
1000	16	272-958	.99
4.7	35	272-1024	.49
10	35	272-1025	.59
22	35	272-1026	.69
47	35	272-1027	.69
100	35	272-1028	.79
220	35	272-1029	.89
470	35	272-1030	.99
1000	35	272-1032	1.59
100	50	272-1044	.89

SPST DIP Switches

Low As **149**

For digital or low-current switching. Mount in DIP sockets or on PC boards. Style may vary.

Fig.	Positions	Fits Socket	Cat. No.	Each
C	8	16-pin DIP	275-1301	1.99
D	4	8-pin DIP	275-1304	1.49

Computer Connectors

Type	Positions	Cat. No.	Each
ID Card Edge	34	276-1564	4.95
ID Card Edge	50	276-1566	4.95
Card-Edge Socket	44	276-1551	2.99
ID D-Sub Male	25	276-1559	4.99
ID D-Sub Female	25	276-1565	4.99
Solder D-Sub Male	25	276-1547	2.99
Solder D-Sub Female	25	276-1548	3.99
Hood	—	276-1549	1.99

Power Transformers

120VAC Primaries

Type	Volts	Current	Cat. No.	Each
Mini	6.3	300 mA	273-1384	2.59
Mini	12.0	300 mA	273-1385	2.79
Mini	24.0	300 mA	273-1386	2.99
Mini	12.0	CT 450 mA	273-1365	3.59
Mini	24.0	CT 450 mA	273-1366	3.99
Std.	6.3	1.2A	273-050	3.79
Std.	12.6 CT	1.2A	273-1505	3.99
Std.	25.2	1.2A	273-1480	4.39
H-D	12.6 CT	3.0A	273-1511	5.99
H-D	25.2 CT	2.0A	273-1512	6.29
H-D	18.0 CT	2.0A	273-1515	6.99

¼-Watt, 5% Resistors

39¢ Pkg. of 5

Ohms	Cat. No.	Ohms	Cat. No.
10	271-1301	10k	271-1335
100	271-1311	15k	271-1337
150	271-1312	22k	271-1339
220	271-1313	27k	271-1340
270	271-1314	33k	271-1341
330	271-1315	47k	271-1342
470	271-1317	68k	271-1345
1k	271-1321	100k	271-1347
1.8k	271-1324	220k	271-1350
2.2k	271-1325	470k	271-1354
3.3k	271-1328	1 meg	271-1356
4.7k	271-1330	10 meg	271-1365
6.8k	271-1333	—	—

21-Range, 30,000 Ohms/Volt Multitester

4995

- 5" Color-Coded Scale
- Overload Protected

Our best VOM! Features "beep" continuity function and easy access to battery/fuse compartment. Measures AC and DC volts, DC current up to 10 amps, resistance and decibels. 6" 1/16" x 5 7/16" x 2 5/8". Includes probes, leads, owner's manual. Batteries extra. 22-210 49.95

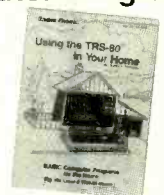


Home Computer Programs

Reg. 7.95

Save \$5
295

For TRS-80® 16K Models I, III, 4



Listings for over 75 useful programs—financial, automotive, kitchen helpmates, filing, math tutoring, metric and temperature conversions, games and more. 330 pages. 62-2069 Sale 2.95

Computers & Electronics Marketplace

CLASSIFIED RATES: Per Word, 15 Word Minimum. **COMMERCIAL:** \$5.00. **PERSONAL:** \$3.00. **EXPAND-AD®:** \$7.50. Ads set in all bold type @ 20% premium. Ads set with background screen @ 25% premium. **DISPLAY:** 1" x 2 1/4", \$605.00. 2" x 2 1/4", \$1,165.00. 3" x 2 1/4", \$1,675.00. **GENERAL INFORMATION:** Frequency rates and prepayment discounts available. Payment must accompany order except credit card—Am. Ex., Diners, MC, VISA (include exp. date)—or accredited ad agency insertions. Copy subject to publisher's approval; must be typewritten or printed. First word set in caps. Advertisers using P.O. Boxes MUST supply permanent address and telephone number. Orders not acknowledged. They will appear in next available issue after receipt. Closing date: 1st of the 2nd month preceding cover date (e.g., Mar. issue closes Jan. 1). Send order & remittance to: Classified Advertising, **COMPUTERS & ELECTRONICS Magazine**, 1 Park Avenue, New York, NY 10016. To Charge your ad to a major credit card, call Lois Price at (212) 725-4312.

FOR SALE

GOVERNMENT and industrial surplus receivers, transmitters, snooper scopes, electronic parts, Picture Catalog 25 cents. Meshna, Nahant, Mass. 01908.

ELECTRONIC PARTS, semiconductors, kits. **FREE FLYER.** Large catalog \$1.00 deposit. **BIGELOW ELECTRONICS**, Bluffton, Ohio 45817.

RECONDITIONED TEST EQUIPMENT \$1.00 for catalog. **WALTER'S TEST EQUIPMENT**, 2697 Nickel, San Pablo, CA 94806. (415) 724-0587.

ELECTRONIC CATALOG. Over 4,500 items. Parts, & components. Everything needed by the hobbyist or technician. \$2.00 postage & handling (United States Only), refundable with first \$15.00 order. T & M Electronics, 472 East Main St., Patchogue, NY 11772. (516) 289-2520.

PRINTED CIRCUIT BOARDS, your artwork. Quick delivery. Reasonable. **Atlas Circuits**, Box 892, Lincolnton, NC 28092. (704) 735-3943.

SATELLITE TELEVISION...**HOWARD/COLEMAN** boards to build your own receiver. For more information write...**ROBERT COLEMAN**, Rt. 3, Box 58-APE, Travelers Rest, S.C. 29690.

RF MODULATORS for SATELLITE TELEVISION, MICRO-COMPUTERS CCTV. Also monitors, cameras, kits. **FREE VIDEO CATALOG.** Phone (402) 987-3771. Dealers Welcomed. **ATV RESEARCH**, 13-P Broadway, Dakota City, NE 68731.

CABLE TV CONVERTERS & EQUIPMENT. Plans and parts. Build or buy. For more information send \$2.00: **C & J ELECTRONICS INC.**, P.O. Box 21, Jenison, MI 49428.

FREE FLYER! IC's, resistors, capacitors, jacks, etc., plus SSM music synthesizer/audio IC's, power amp modules, analog delay IC's, computer books, and more. Also plans for analog delay/chorus unit! **PGS Electronics**, Route 25, Box 304 Terre Haute, IN 47802.

POLICE CODE UNSCRAMBLERS, lets you hear the coded messages of Police, Fire and Medical channels; plus other scanner accessories, satisfaction guaranteed. **DNE Inc.**, Rt. 7, Box 257-A, Hot Springs, AR 71901. (501) 623-6027.

CABLE TV

CONVERTERS & EQUIPMENT

We have the largest selection of **JERROLD** and **OAK** cable converters and equipment. Such as: Jerrold SB-3, Oak N12 and Jerrold 61 channel remote control converter with **FULL** features **DRX3-DIC-105**. Plus others.

CABLE TV KITS

Cable TV Kit (Jerrold gated pulse) 39.95.

We also have a large selection of cable TV and kits including all parts, silk screen, PC board and complete instructions.

Send for informative catalogue \$2.00

J & W ELECTRONICS, INC.

P.O. BOX 61-K

CUMBERLAND, RI. 02864

WHOLESALE: MATV/CATV/VCR equipment, Antennas, Audio, Cables, Adapters, Original and Replacement Cartridges, Styli, Telephone Accessories, Radios, Cassette Recorders, Speakers, etc. Send letterhead for catalog, 212-897-0509, D&WP, 68-12 110th St., Forest Hills, NY 11375.

FREE CATALOG. Large selection of electronic kits and parts. **Chaney Electronics**, Box 27038, Denver, Colorado 80227. (303) 781-5750.

FREE Catalog of special function IC's and quality components. **Goldsmith Scientific**, Box 318M, Commack, New York 11725.

ELECTRONIC KITS—Low cost Power Supplies, Amplifiers, Alarm Systems, etc. Catalog \$0.25. **CBB1**, Box 222, North Granby, CT 06060.

Worlds Most Remarkable Radar Jammer!



Causes speed radar guns and devices to read out your choice of either a percentage of your true speed when in automatic mode (example: Your speed; 76 mph, auto mode set for 75%, speed displayed — 57 mph), or the speed that you dial in when in manual mode. Transmits only in the presence of speed radar, or by manual override. Operates on both X and K bands. **WARNING: The device described in this literature is not legal for use against police radar, and is not FCC approved.**

For complete literature and plan package, send \$14.95 to:

Phillips Instrument Design Co. Inc.
8135 S.W. Nimbus Building #11, Suite #114 C
Beaverton, Oregon 97005

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**, PO Drawer G, Waikiki, Hawaii 96815.

PRINTED CIRCUIT BOARDS... Projects this issue. Also custom boards, your artwork or ours. Quality. Competitive prices. **Century Instruments**, 400 Maxey Court, #4, Yukon, Oklahoma 73099. (405) 354-0347.

MICROWAVE ANTENNA SYSTEMS

Freq. 2.1 to 2.6 GHz • 34 db Gain • COMPLETE SYSTEMS (as pictured)

Commercial 40" Rod Style	\$89.95
Parabolic 20" Dish Style	\$79.95

TWO YEAR WARRANTY PARTS AND LABOR

CALL OR WRITE FOR KITS • PARTS • INDIVIDUAL COMPONENTS

We Repair All Types Down Converters & Power Supplies

Phillips-Tech Electronics
P.O. Box 34772
Phoenix, AZ 85067
(602) 285-8255

Special Quantity Pricing • Dealers Wanted

NEW! MULTI-CHANNEL MICROWAVE

Complete Antenna Systems from \$69⁹⁵

Full 800 Mhz Range
Tune 1.9-2.7 Ghz
Includes all
ITFS Channels

GOLD STAR

SILVER STAR

TELE STAR

DEALERS WANTED

COD's and Credit Card
Orders call TOLL FREE
1-800-247-1151

GALAXY ELECTRONICS
6009 N. 61 Avenue
Glendale, AZ 85301
1-602-247-1151

STAR II

SEND FOR FREE DISCOUNT CATALOG: electronic components, parts. **HORIZON SALES**, P.O. Box 646, Framingham, MA 01701. (617) 875-4433.

DIGITAL TRAINERS AND POWERED BREADBOARDS... The most complete selection available... at the lowest prices. For free catalog write, **C-Systems**, Box 2482, Evergreen, CO 80439.

LOWEST POSSIBLE PRICES ANYWHERE! Computers Hardware—Software—Printers, Audio, Video, Car Stereo. **ELECTRIFIED DISCOUNTERS**, 996 Orange Ave., West Haven, CT 06516. MC/VISA. (203) 937-0106.

PRINTED CIRCUIT ARTWORK, DESIGN/LAYOUT. Quality, professional, prompt (216) 263-6930. **SOMMER CIRCUIT DESIGN**, P.O.B. 635, Wooster, OH 44691.

CABLE T.V. EQUIPMENT. Channel 3 or 4 notch filter \$20.00. Information \$1.00. **Goldcoast**, P.O. Box 63/6025A, Margate, FL 33063. (305) 752-9202.

FREE! 1984 CATALOGUE. 1001 bargains. Speakers-parts-tubes-video cassettes—record changers—tape recorders—kits. **EVERYTHING IN ELECTRONICS**. Write: **McGEE RADIO & ELECTRONICS**, 1901 McGee Street, Kansas City, MO 64108-1891.

PARABOLIC DISHES AND BRACKETS 20" \$6.70 ea., 28" \$15.00 ea. lots of 100. **VIKING PRECISION INC.**, 4631 South 35th Place, Phoenix, AZ 85040. (602) 276-6218

CABLE TV

Buy Direct & Save

SUPER SPECIALS

40 CHANNEL CONVERTER \$29⁹⁵

Advanced Solid State design and circuitry allows you to receive mid & super band channels. Restores programming to Video Recorders

36 CHANNEL REMOTE CONTROL CABLE CONVERTER \$69⁹⁵

JERROLD 400 THE ULTIMATE CABLE TV CONVERTER

60 CHANNEL INFRARED REMOTE CONTROL \$129⁹⁵

Send \$5 for Complete Catalog

DIRECT VIDEO SALES
P.O. BOX 1329
JEFFERSONVILLE, INDIANA 47130

CALL 1-812-282-4788

IF YOU ARE READY TO BUY OR SELL COMPUTER EQUIPMENT, YOU NEED...

COMPUTER SHOPPER

Over 100 pages each month Deal with individuals nationwide Low ad rate, only 12¢ a word. Subscription \$15/year MC & VISA. Money back guarantee. 407 S. Washington, P.O. Box F596, Titusville, FL 32781 (305) 269-3211

RESISTORS. 1/4W/25% C.F., 3" ea., 1% Metallfilms. NO MINIMUMS. Quantity Discounts. Write: J.R. INDUSTRIES, 5834-A Swancreek, Toledo, OH 43614.

PRINTED CIRCUIT BOARDS. QUICK PROTOTYPES production design reflow solder. Send print or description for quote to: KIT CIRCUITS, Box 235, Clawson, MI 48017.

T. & RADIO TUBES 59¢ each. Send for free catalog. Corroll, 4212 University San Diego, CA 92105.

SATELLITE TV RECEIVER BREAKTHROUGH! Build your own commercial quality receiver now! Instruction manuals, schematics, circuit boards! Send stamped envelope. XANDY, Box 25647 Dept 22V, Tempe, AZ 85282.

MULTI-CONDUCTOR CABLE—2 TO 36 COND. AVAIL. FOR FREE INFO SHEET, WRITE: GORDON DEWEY RD1, Central Square NY 13038.

CABLE TV products. Wireless, corded & settop converters. Send \$3.00 for information. ADDITIONAL OUTLET CORP. 111 E Commercial Blvd., Ft. Lauderdale, FL 33334.

CABLE TV SECRETS, the informative publication the cable companies are trying to ban. HBO, Movie Channel, Showtime converters, etc. Send \$8.95 to: **CABLE FACTS**, Box 711-PE, Pataskala, Ohio 43062.

30 CHANNEL WIRED remote CA TV converter kits. Complete with everything 39.95. Cable Sales 3868 Trade Ctr. Dr. Ann Arbor Mich 48104 C.O.D. or Certified Funds Other Credits Available. (313) 971-7010

U-FIX M Oak CA TV converters-M-26 Buy one get one free 19.95 Cable Sales 3868 Trade Ctr. Dr. Ann Arbor Mich. 48104 C.O.D. or Certified Funds Other Converters available



A SINGER'S DREAM!

REMOVES VOCALS FROM RECORDS!

Our VOCAL ELIMINATOR can remove most or virtually all of a lead vocal from a standard stereo record and leave most of the background untouched! Record with your voice or perform live with the backgrounds. Used in Professional Performance yet connects easily to a home component stereo system. Not an equalizer! We can prove it works over the phone. Write or call for a free brochure and demo record.

Write to: **LT Sound, Dept. CE, PO Box 338**
Stone Mountain, GA 30086
In Georgia Call (404)493-1258
TOLL FREE: 1-800-241-3005 — Ext. 37



TIME-SHARE
Only you and your fellow computer experts will know what time it is with this binary numeral wall clock. Handsome simulation.

ted walnut finish, accurate quartz movement with sweep second hand. Perfect for office or home. Runs on one AA battery (not incl). 11 1/2" diagonal. 1 yr. warranty. 10 day money-back guarantee.

***39⁹⁹** Plus \$3.50 ea. for ship. & handling. Fla. residents add 5% sales tax.

Visa or MasterCard accepted. Include card #, Expiration date and signature with order.

Send for our free **COMPUTERMANIA** Catalog of other unique items for the computer buff.

Call Toll-Free Mon.-Fri. 9am-6pm
1-800-B-E-S-W-E-E-T • In Fla. (305) 687-9338

sweet gum inc.
15490 NW 7th Ave., Dept. CE123, N. Miami, FL 33169

12 SATELLITE DISH AND POLAR MOUNT. Total weight 125-lbs. For \$189.00. For information send \$4.95 (Refundable u.p.) to: Satellite Operational Systems, P.O. Box 2002, Titusville, FL 32781.

LCD PEN WATCH, excellent for everyone. Special, 2 for \$7.00. Calculator alarm wrist watch \$14.00. Wireless telephones. Water purification system—plans \$5.00. Guaranteed, fantastic, unusual gift items available. Send \$1.00 for catalog. Next day shipment. Visa/Master card. Starburst Industries, 6354 Van Nuys Blvd., Suite 161, Van Nuys, CA 91401. (213) 994-5671.

COMMUNICATIONS SECURITY and electronics are our specialty. Send \$3.00 for our incredible catalog. A.T.I.S., Dept. E, 61 Gatchell, Buffalo, NY 14212.

HOW TO STOP unauthorized use of your computer, car, stereo, etc. Details \$1.00 (refundable). Stark Electronics, Box 11963, Edmonton, Alta. T5J 3L1. US INQUIRIES.

ELECTRONIC LOCKS! Keypad operated. Pushbutton privacy for autos, homes, computers, bench equipment, VCR's, stereos, telephones.... Complete ILLUSTRATED PLANS \$6.95 ppd., MILTON OMNISEARCH, Box 5044, Dept. C, Ormond Beach, FL 32074.

COMPUTER EQUIPMENT/PARTS

SAVE 90% Build Your Own Minicomputer. Free Details. Digatek, 2723 West Butler Dr., Suite 20C, Phoenix, AZ 85021.

APPLE BUILDERS—Send stamp for our flyer of Apple parts. IC sets, ROM sets, component packages, Shugart—Apple modification kits, Apple 9-track tape drives etc. Electrovalve, P.O. Box 376-P, Morris Plains, NJ 07950.

HARD DISK DRIVE LIQUIDATION. Major OEM is liquidating inventory of unused Shugart 8" SA 1002 5.33 megabyte hard disk drives. \$380 each. Western Digital's controller, \$350. Call: LIQUIDATORS, 803-877-9828, or send check/money order to: 105 S. Main St., Greer, SC 29651.

FREE DISCOUNT CATALOG OF SYSTEMS, PERIPHERALS AND SOFTWARE. Most major brands. Descriptions complete with options and accessories. Please indicate your specific interest and application. MICRO TREND INC., 2001 Kirby Drive, Suite #906, Houston, TX 77019. (713) 520-0107.

FREE! Computer supplies catalog—Low prices—Satisfaction guaranteed—DATA SYSTEMS, Box 99, Fern Park, Florida 32730. (305) 788-2145.

QUALITY VINYL DUST COVERS. VIC-20, Atari 400/800, Apple, Coleco, VCS. Only \$6.50. Topware, Box 92, Princeton, IL 61356.

FREE 56-PAGE COMPUTER CATALOG crammed full of thousands of the best buys and lowest prices around! A.P. Computer Products, 8 Division St., Holtsville, NY 11742, (516) 698-8636.

USED COMPUTER terminals, printers, modems, cables, surplus electronic parts. Specials: CRT's \$20.00, Modems \$20.00, Modems \$35.00. Catalog \$1.00. Rondure Company, "The Computer Room" CE, 2522 Butler Street, Dallas, TX 75235. (214) 630-4621.

DISK FILE—\$9.95 holds 150 disks: includes dividers, labels, backstops for 5 1/4" and 8". Call: 800/225-0044. Weber's, Box 104CA, Adelphia, NJ 07710.

MONEY BACK GUARANTEE. Easy to install circuit adds intercom/Hold capability to phones for under \$10. Plans \$5.00. Information SASE dB Enterprises, Box 8, Oradell, NJ 07649.

48K computer U.S. \$380.00 or hundreds Apple compatible software details U.S. \$1.00 Reliant P.O. Box 33610. Sheungwan Hong Kong.

AUDIO DEN, call us for our service, our experience and especially our prices. We carry Adcom, Audio Research, Denon, Infinity, Nakamichi, Polk, SAE, Revox and Klipsch. We ship anywhere in the USA. Experienced with overseas sales. AUDIO DEN LTD., Smith Haven Plaza, 2021 Nesconset Highway, Lake Grove, New York 11755. (516) 360-1990.

COMPUTER SOFTWARE

DISCOUNT SOFTWARE—Available for Apple, TRS-80, IBM/PC and TI 99/4 personal computers. Professional applications for the doctor, dentist, attorney, school administrator, teacher, contractor and general office personnel. Catalog \$1.00. Write for MONTHLY SPECIAL OFFERS! Creative Discount Software, 256 S. Robertson Blvd., Suite 2156, Beverly Hills, CA 90211.

COMPUTER PAPER—SAVE\$\$\$; Top quality. Low single carton prices. Free shipping via UPS. Call A-1, 405 Third, Long Beach, Ca., (800) 628-8736 or (213) 804-1270.

TI-99/4A PROGRAMMERS: Affordable Software! Catalog, only \$1. PROGRAMS SOFTWARE, 1435 Burnley Square North, Columbus, Ohio 43229.

FREE VIC-20 and COMMODORE 64 USERS GROUP MEMBERSHIP with software purchase. Why pay to belong to a users group when you don't have to? Benefits: Newsletter, extensive club library, discounts, contests, questions hot-line and more! Free details—(803) 979-1533. Lords of Basic, P.O. Box 459, Dept. 102 Ladson, SC 29456.

DISKETTE FORMAT CONVERSIONS/DOWNLOADING, from \$500. Port-A-Soft, 423 #800 N, Orem, UT 84057. 801/226-6704.

VIC 20 40 COLUMN DISPLAY. On tape, 8.95: NDPE, 102 Hickory Ct., Portland, IN 47371.

MONEY BACK GUARANTEE. Easy to install circuit adds intercom/Hold capability to phones for under \$10. Plans \$5.00. Information SASE dB Enterprises, Box 8, Oradell, NJ 07649.

DISKETTE FORMAT CONVERSIONS/DOWNLOADING, from \$500. Port-A-Soft, 423 #800 N, Orem, UT 84057. 801/226-6704.

HORSE RACE SOFTWARE-TRS-80, C64 VIC20, CALL OR WRITE for free catalog, Computer Research Tools, 725 South Evanwood Ave., West Covina, Calif. 91790 (213) 962-1688.

TI-99/4A OWNERS: 8-Program cassette—\$9.95 p.p. TI-basic, free list. V&S Software, 2709 Chollet Dr., Tallahassee, FL 32303.

TOP NAME BRAND PROGRAMS and Games. Try before you buy! Don't get burned, info: SEMI-Z, R.D. #4, Box 69, Danville, PA 17821.

VIC 20/s64—WHOLESALE PRICES ON ALL PRODUCTS! Send SASE: Omni Micronics, 404 Auburn Road, Waynesville, NC 28786.

TI-99/4A OWNERS. Send for free catalog of new and exciting, low cost software. D.E., Box 690, Hicksville, NY 11801.

VIC 20/COMMODORE 64 SOFTWARE-FREE CATALOG! Inexpensive, practical programs: Education/Home/Business. Over 50 titles! FARTHEST FRINGE S.A., 101 Highway Blvd., N. Pekin, IL 61554.

SUPERIOR VIC-20 SOFTWARE! Educational programs and Adventure games. FREE program summaries with price list. Creative Workshop, PO Box 2725, Dept. 22, Spring Valley, CA 92077.

FREE CATALOG OF DISCOUNT SOFTWARE. Specify computer. The Floppy Disk, Box 5392C, North Hollywood, CA 91616.

TI-99/4A SOFTWARE: Programs for astronomy, Mathematics, Finance, Education. Send 40¢ for catalog East-bench Software, 1290 Cliffside Drive, Logan, UT 84321.

TI-99/4A "99-CALC" Electronic Spreadsheet Program In Extended Basic. 16K. Cassette and instructions \$20.00 PP. P.C. BARNES, 24631 Via San Fernando, Mission Viejo, CA 92692.

TAX-HELP PROGRAM for ATARI, 1040, 1040A, 1040EZ. \$7.95 cassette. Krause & Son, P.O. Box 624, Severna Park, MD 21146.

HORSE-CYBER-TRS 80, I, III, IV, Color/VIC-20/C64. Horse race programs that teach themselves how to handicap. Write Computer Research Tools, 725 South Evanwood Ave., W. Covina, CA 91790, or call for message (213) 962-1688.

FREE ATARI 400800/Commodore—64/TI99-4A/Timex/VIC-20 programs! Send stamps. Dealers welcome! Box 5222-CD, San Diego, California 92105.

COMMODORE 64/Vic 20—Assembler, Disassembler, Basic Compiler, Spread Sheet. \$15 each. Specify computer. Free complete list for SASE: Software Solutions, PO Box 542, Sylvania, OH 43560.

COMPUTER HARDWARE

Eagle PC-2 \$2738; Compu Pro 816A \$3998; Daisy Rider 2000 \$1197; Epson, Call: Okodata 92 \$509; Hayes 1200 \$505; etc. WCB (707) 544-5304, 1800C Hobbie Lane, Santa Rosa, CA 95407.

DISCOUNT HARDWARE/SOFTWARE—30% MINIMUM BELOW RETAIL! Educational, business, entertainment software for Apple II, Atari 400/800, TI 99/4A, Vic 20, Commodore 64, IBM-PC. HARDWARE: Gemini 10x—\$300. Okidata 82A—\$370.00 Microprint 480—\$490. RANA 1000—\$300. Send \$1 for complete hardware/software catalog. Specify make. MULTI VIDEO SERVICES, P.O. BOX 246, East Amherst, NY 14051 (716) 688-0469.

COMPUTER PUBLICATIONS

USER'S BOOK for HP-41C/41CV. Hundreds of techniques and RPN subroutines. Send \$15 per copy U.S.A./Canada, (elsewhere \$20) to: Corvallis Software Dept. 3, P.O. Box 1412, Corvallis, Oregon. 97339. (503) 754-9245.

"HOW to Debug BASIC Programs." \$6 PP, MBG. TIS, Box 921, Dept. C1, Los Alamos, NM 87544.

DON'T WASTE YOUR MONEY! If you are buying a computer you need to read 101 QUESTIONS AND ANSWERS YOU MUST CONSIDER BEFORE YOU BUY. Also included as a FREE Bonus, THE PLAIN ENGLISH COMPUTER GLOSSARY—over 40 pages. \$5.00. Triple-C Publishing, P.O. Box 699A, Demopolis, Alabama 36732.

"HOW to Debug BASIC Programs." \$6 PP, MBG. TIS, Box 921, Dept. C1, Los Alamos, NM 87544.

ROBOTICS BOOKS—Design, Theory, Construction. Send \$1.00 for catalog. KOHN/CE1 Box 16265, Alexandria, VA 22302.

COMPUTER REPAIR

COMPUTER REPAIRS—SIX MONTH WARRANTY. Our highly qualified technicians will diagnose and repair all makes of computers and peripherals including OSI, Osborne, Apple, Diablo, Hazeltine, and TeleVideo. Computer Development Systems Inc., 18 Matthews St., Terryville, CT. 06786. (203) 583-5993.

TIMEX/SINCLAIR

KROK., STAR SEARCH, NOAH'S ARK, finest programs available. Machine Language action, graphics. SASE Brown Cottage, 5486 Bright Hawk, Columbia, MD 21045.

ZX DATA-FINDER, ZX PRO/FILE & much more professional/game/hobby machine language software. Free Catalog. ROBOTEC, INC., Box 55, Rossford, OH 43460. (419) 666-2410. VISA/MC.

TIMEX SINCLAIR owners—get monthly news, tips, programs, projects to expand 1000/1500/ZX81, \$29 per year. Back issues available. SYNTAX, RD2 Box 457, Harvard, MA 01451.

5 TS/1000 PROGRAMS FOR \$5. Send SASE for details: Programs 3763 W. Crocus, Phoenix, AZ 85023.

"MUST-HAVE" UTILITY SOFTWARE. Cassettes-relocatable machine language. SASE for BROCHURE—SIR-IUS WARE, 6 Turning Mill Rd., Lexington, MA. 02173.

TIMEX/SINCLAIR VIC-20 Bible pack design build any peripheral imaginable includes cassettes \$39.95. Info. \$6.00 refundable. Jorge Sampson, Box 38663, Houston, TX 77288.

ARTIFICIAL INTELLIGENCE PROGRAM. Converse with ZX-81/TS 1000. 16K. Cassette, \$10. Dynabyte, Box 2021 Michigan City, IN 46360.

BIO-RHYTHMS PLOTTED. Know your critical days and your good days—30 day plots-cass. Tape \$6.75, listing \$2.50, both 16K and 2K included, LAKAR, 36 Western Ave. Morristown, NJ 07960.

MR. BARTENDER—lists over 200 drinks alphabetically and by liquor, cass tape—\$6.75, listing \$2.50, 16K, LAKAR, 36 Western Ave., Morristown, NJ 07960.

"HOW TO MARKET YOUR TIMEX/SINCLAIR SOFTWARE". Informative guide for turning your programs into profits—\$14.95, money order, VISA, M.C. (incl. card no & exp. date). Softmark Associates, Dept. CE2, 210 Fifth Ave., NY, NY 10010.

TS/1000—Great values on home/finance software. Free information: Ace Software, 2 E. Oak Ave., Moorestown, NJ 08057.

C.B. EQUIPMENT

CB MODIFICATIONS, conversions, books, plans, kits, repairs. Catalog \$2. CBCI, Box 31500PE, Phoenix, AZ 85046. (602) 996-8700.

PLANS AND KITS

FREE KIT CATALOG contains test equipment. Phone (209) 772-2076. DAGE SCIENTIFIC, Box 144, Valley Springs, CA 95252.

ROBOTICS—BOOKS—build your own robot. Write now for FREE catalog! Kohn Co./CE1, Box 16265, Alexandria, VA 22302.

PROJECTION TV ... CONVERT your TV to project 7 foot picture... Results comparable to \$2,500 projectors... Total Cost less than \$30.00... PLANS AND 8" LENS \$19.95 ... Illustrated information FREE. Macrocoma-co, Washington Crossing, Pennsylvania 18977. Creditcard orders 24 Hours, (215) 736-3979.

DIGITAL OSCILLOSCOPE—4" x 6½" size screen. Build for less than \$150.00. Plans \$6.00. Mike McGlinchy, 1878 Newell Ave., Walnut Creek, CA 94595.

BATON WITH LIGHTS writes your messages in thin air! Fabulous educational toy! Complete plans using inexpensive parts \$5.00. WORDWAND, POB 595, Ozone, FL 33560.

MAILING LISTS

COMPUTER SHOW ATTENDEES N.Y., N.J.: 15,000 NAMES. \$30/M. P/S labels. For info, (201) 297-2526.

ALARMS

BURGLAR-FIRE ALARMS for home, business, auto. Install yourself and save. Installation manual/catalog shows how. Shows latest equipment, accessories. Lowest prices. Send \$1.00 (refundable). BURDEX SECURITY, Box 82802-CEL, Lincoln, NE 68501.

WANTED

GOLD, electronic, circuit board scrap, silver, platinum, tantalum, mercury, Ores, metals assayed. Samples evaluated. Wholesale Terminal, toll free 1-800-932-1010, (617) 326-3442 in Mass.

WANTED: Old Western Electric, RCA, tubes, Amplifiers, Speakers. McIntosh, Marantz, Amplifiers, THORENS, Garrard Turntable. 713-728-4343.

AUTHOR SEEKS TRUE COMPUTER experiences in hacking/crime/twisting. Pay if used. Box 5115, Tahoe City, CA 95730.

TUBES

TUBES: "Oidies". Latest. Supplies, components, schematics. Catalog Free (stamp appreciated). Steinmetz, 7519-PE Maplewood, Hammond, Ind. 46324.

TV & RADIO TUBES, 59¢ each. Send for free catalog. Cornell, 4213 University, San Diego, CA 92105.

PERSONALS

SUNBELT SINGLES looking for a person of quality. Check our group. Details Box 83395, Oklahoma City, OK 73148.

UNIVERSITY DEGREES BY MAIL! Bachelors, Masters, Ph.Ds. Free revealing details. Counseling, Box 317-EP1, Tustin, California 92680.

SCANDINAVIAN SINGLES, ALL AGES, seek correspondence, sincere, friendships. Details: (send stamp). Scanclub CE, Box 4, Pittsford, NY 14534.

FREE WORLD'S LARGEST PARTNER PHOTO CATALOG for friendship and marriage. Personalized introductions INTERCONTACT, Box 12, Toronto, Canada M4A 2M8.

INSTRUCTION

REPAIR ELECTRONIC ORGANS—Revised home study course covers all current makes and models. Free booklet. Niles Bryant School, P.O. Box 20153, Sacramento, CA 95820.

UNIVERSITY DEGREES BY SPECIAL EVALUATION of existing credits and Job Experience. Fast, inexpensive. Call (614) 863-1791. Or write: EVALUATION, Box 13151-A1, Columbus, Ohio 43213.

F.C.C. COMMERCIAL RADIOTELEPHONE LICENSE. Home Study. Fast, Inexpensive! Free details. COM-MAND, D-100 Box 2223, San Francisco 94126.

UNIVERSITY DEGREES BY MAIL! Bachelors, Masters, Ph.D.s ... Free revealing details. Counseling, Box 317-PE1, Tustin, California 92680.

UNIVERSITY Degrees! Economical home study for Bachelor's, Master's, Doctorate. Prestigious faculty counsels for independent study and life experience credits. Free proof—Richard Crews, M.D. (Harvard), President, Columbia Pacific University, 1415 Third Street, Suite D511, San Rafael, CA 94901; Toll Free: 800/227-1617, Ext. 480; California: 800/772-3545, Ext. 480.

EXPERIMENTAL ANALYSES of solar activity and Pacific area meteorology and seismology. Info: Sase. IWS, 11625 W. McKinney Ave., Fresno CA 93711.

FOR INVENTORS

INVENTORS! IDEAS HAVE VALUE!

Ever think of an idea, forget it and see it later on the market? Many people don't forget, act quickly and are rewarded by American Industry. Write down your idea! We offer free disclosure registration and initial consultation regarding your idea's potential value. Call or write without delay for your free information package.

AMERICAN INVENTORS CORPORATION
82 Broad St., Dept. CE
Westfield, MA 01086
413-568-3753

A fee Based Marketing Company
Offices Coast to Coast

INVENTIONS, IDEAS, NEW PRODUCTS WANTED! Industry presentation/national exposition. Call free 1-800-528-6050—Arizona, 1-800-352-0458. X831.

PATENT AND DEVELOP your invention. FREE PATENT INFORMATION. Richard L. Miller, P.E., 3612-E, Woolworth Building, New York, NY 10007, (212) 267-5252.

NONPROFIT foundation helps inventors. Widest range of services. Free recording forms. Free evaluation. Affiliated Inventors Foundation, 501-D Iowa, Colo. Spgs. CO 80909.

*****CLASSIFIED ADVERTISING ORDER FORM*****

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15 (MINIMUM)
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30
31	32	33	34	35
36	37	38	39	40
41	42	43	44	45
46	47	48	49	50

Please refer to heading on first page of this section for ad placement information:

COMMERCIAL: \$5.00. PERSONAL: \$3.00, EXPAND-AD®: \$7.50.

OF WORDS _____ # OF INSERTIONS _____

PAYMENT ENCLOSED \$ _____

CHARGE You will be billed monthly. American Express Diners Visa MasterCard-Interbank # _____

Account # _____ Exp. Date _____

SIGNATURE _____

PRINT NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

CE-184

BUSINESS OPPORTUNITIES

FREE CATALOGS. Repair air conditioning, refrigeration. Tools, supplies, full instructions. Doolin, 2016 Canton, Dallas, Texas 75201.

MECHANICALLY INCLINED individuals desiring ownership of Small Electronics Manufacturing Business—without investment. Write: BUSINESSSES, 92-K11 Brighton 11th, Brooklyn, New York 11235.

ERASE DEBTS with little-known law—create wealth!! Details FREE—Wealth Kit, No. EE1, Billings, NY 12510.

MAILORDER OPPORTUNITY! Start profitable home business without experience or capital. Information free. Mail Order Associates Inc., Dept 566, Montvale, NJ 07645.

ONE MAN CRT FACTORY. T.V.s, Business machines, Monitors, Scopes, VDT's. \$3.00 rebuilding nets \$100-\$500 each tube. Higher profits overseas. New/used. FACTORY, 1909 Louise, Crystal Lake, IL 60014. (815) 459-0666.

BORROW \$300-\$30,000 INTEREST FREE! Keep indefinitely! Free Details. Write: American, 1601 Main, Plainfield, Indiana 46168.

LCD WATCH \$2.50, Penwatch \$2.00, catalogue \$1.00. Reliant Engineering Company, P.O. Box 33610, Sheungwan, Hong Kong.

BORROW \$300,000 without interest! All eligible. Repay anytime. Free details! Infohouse—508CE, 533 Sutter, San Francisco, CA 94102.

SMALL COMPUTER BUSINESSES... Over 100 you can start anywhere-anytime. Unique 40 pg. catalogue—\$1. C.B.I.E.K., P.O. Box 4759, Santa Barbara, CA 93103.

BUMPER STICKER PRINTING DEVICE. Cheap, simple, portable. Free details. Bumper, POB 22791 (PE), Tampa, FL 33622.

PROJECTION TV... MAKE \$\$\$'s assembling Projectors... Easy... Results comparable to \$2,500 projectors... Your total cost less than \$20.00... PLANS, 8" LENS & Dealers Information \$17.50... Illustrated information FREE... Macrocoma-cex, Washington Crossing, Pennsylvania 18977. Creditcard orders 24 Hours (215) 736-2880.

ACQUIRE WEALTH! Borrow \$30,000 interest free! Keep indefinitely. Erase debts with little-known law! Free details: Financial Technologies, Box 40434C, Fayetteville, N.C. 28309.

MOONLIGHT WITH YOUR MICRO! Handbook describes 25 proven money-making Ideas! \$5. Microbucks, PO Box B, Southfields, NY 10975.

REAL ESTATE

NEW... FREE CATALOG! Top real estate values coast to coast! Please specify types, property and location desired. UNITED FARM AGENCY, 612-EP West 47th, Kansas City, MO 64112.

EMPLOYMENT OPPORTUNITIES

ELECTRONICS/AVIONICS EMPLOYMENT OPPORTUNITIES. Report on jobs now open. Details FREE. Aviation Employment Information Service, Box 240E, Northport, New York 11768.

JOBS OVERSEAS - Big money fast. \$20,000 to \$50,000 plus per year. Call 1-216-453-3000, ext. 4601.

GOVERNMENT JOBS—Thousands of vacancies must be filled immediately. \$17,634 to \$50,112. Call 716-842-6000, Ext 3909.

SAUDI ARABIA. Send stamped, self-addressed envelope to Ralph Lemons, Box 6805, Thousand Oaks, CA 91360.

OVERSEAS Positions. Hundreds of top paying positions available. TAX free incomes. Attractive benefits. Opportunities for all occupations, skilled trades, professionals, management, technicians etc. Free details. Overseas Employment Services, Dept. CE, P.O. Box 460, Town of Mount Royal, Quebec, Canada H3P3C7.

GOVERNMENT SURPLUS

IS IT TRUE YOU CAN BUY JEEPS FOR \$44 THROUGH THE U.S. GOVERNMENT? Get the facts today! Call (312) 742-1142 Ext. 4649.

BOOKS & MAGAZINES

PUBLISHERS' OVERSTOCKS. BARGAIN BOOKS 2,000 titles, all subjects! Free catalog: Hamilton's, 98-85 Clapboard, Danbury, CT 06810.

GAMES

ATTENTION-VIC20 SOFTWARE! Writer for a free catalog: ORA, 22 Georgia Avenue, Providence, RI 02905.

RUBBER STAMPS

RUBBER STAMPS, BUSINESS CARDS. Free catalog 1-800-851-4945, Jackson's, E-100, Brownsville Rd., Mt. Vernon, Ill. 62864.

RETAIL ROSTER

CALIFORNIA

P.C. COMPUTERS, 10166 San Pablo Ave., El Cerrito 94530. (415) 527-6044. Commodore 64, VIC-20, Pet Specialists. In-House Maintenance.

CONNECTICUT

C&E DISTRIBUTING—Edgewood Drive, Jewett City 06351 (203) 423-0657. Retail outlet and wholesaling for dealers.

NEW HAMPSHIRE

COMPUTER MART of NEW HAMPSHIRE, 170 Main Street, Nashua 03060. 603-883-2386. THE APPLE SPECIALISTS. Full line Hardware/Software. Training/Service.

BUILD THE LATEST ELECTRONIC DEVICES IN YOUR WORKSHOP

Create 27 exciting, low-cost, useful electronic devices for your home, car hi-fi, dark-room and personal computer with the new 1984 *Electronic Handbook*, from the publishers of *Computers & Electronics*. A perfect gift for the electronic hobbyist.

Send \$4.95—
\$3.95 plus \$1.00 shipping & handling to:

ELECTRONIC EXPERIMENTER'S HANDBOOK
CN 1914, Morristown, NJ 07960

\$6.00 outside U.S.A. Residents of CA, CO, CT, DC, FL, IL, MA, MI, MO, NJ, NY State & VT, please add local sales tax.

ANNOUNCING CREATIVE COMPUTING'S 1984 BUYER'S GUIDE

TO PERSONAL COMPUTERS & PERIPHERALS

Advice you can trust on selecting personal computers, peripherals and electronic games—in a comprehensive collection of product reviews and consumer-oriented shopping advice from *Creative Computing* magazine.

Send to: **Creative Computing Buyer's Guide**
CN 1914, Morristown, NJ 07960

YES! Please rush me *Creative Computing's 1984 Buyer's Guide to Personal Computers & Peripherals*. Enclosed is my check or money order for \$3.95 plus \$1 for postage and handling.

Mr./Mrs./Ms. _____ (please print)
Address _____

City _____ State _____ Zip _____

Please make check payable to Creative Computing Buyer's Guide. CA, NJ and NY State residents please add applicable sales tax. Price outside U.S.A. is \$6.

Computer Mart

RATE: Ads are " by 3". 1 insertion: \$935.00. 6 insertions: \$900.00 ea. 12 insertions: \$865.00 ea. Closing date: 1st of the 2nd mo. preceding cover date. Send order and remittance to Computer Mart, Computers & Electronics, 1 Park Ave., N.Y., N.Y. 10016. Direct inquiries to (212) 725-4215.

64K for VIC 20™

SELECT-A-RAM™



SELECT-A-RAM

STANDARD FEATURES

- 64K SELECTABLE FROM THE KEYBOARD OR BY SOFTWARE COMMAND
- TWO EXPANSION SLOTS
- WRITE PROTECTION
- RESET SWITCH
- EXPANDIBLE TO 128K WITH ADDITION OF 64K EXPANSION MODULES
- COMPATIBLE WITH ROM CARTRIDGES
- ONE YEAR WARRANTY ON PARTS AND LABOR
- 15 DAY MONEY BACK GUARANTEE

SELECT-A-RAM \$100
64K EXPANSION MODULE \$149
 TRADE-IN ACCEPTED
 3K \$5 8K \$10 16K \$20

APS-52A
52K MEMORY FOR ATARI
400/800 \$119.00

The APS 52A memory expansion boards come assembled and tested with a 90 day warranty covering materials and workmanship. Boards come with complete documentation including operation and installation instructions and a memory test program.

16K TRADE-INS ACCEPTED \$15.00
OR ATARI INC.

VIC 20 IS A TRADEMARK OF COMMODORE ELECTRONICS LIMITED. ATARI 400 AND 800 ARE TRADEMARKS OF ATARI INC.

512-441-3202 PO BOX 43006 Austin, TX 78745-0001



JKS
ADVANCED PROCESSOR SYSTEMS

CIRCLE NO. 99 ON FREE INFORMATION CARD

DISCOUNT COMPUTER EQUIPMENT

LOWEST PRICES on Printers, Disk Drives, Software, and Other Computer Equipment!
EPSON, Star Micronics, Okidata, Tandon, TEAC, & Many Others.

Call toll-free for a **FREE** catalog:
800-331-3896
 In Oklahoma Call 918/825-4844

918/825-4844
AMERICAN Small Business COMPUTERS
118 30 MILL ST. PRYOR, OK 73861

CIRCLE NO. 100 ON FREE INFORMATION CARD

EPROM ERASER \$39.95

EPROM PROGRAMMER \$146



ERASER

- contains same features as competitors' but cost less than one half their price
- erases up to 9 chips
- 6 mW/cm² on chips
- chip drawer prevents UV exposure to users
- long life UV tube

PROGRAMMER

- PROGRAMS & COPIES: 2516, 2532, 2716, 2732, 2732A.
- 4K INTERNAL RAM BUFFER STORAGE CAPACITY.
- NO PERSONALITY MODULE REQUIRED.
- POWER CAN BE REMOVED FROM ZIF SOCKET WHEN LOADING EPROMS.
- BINARY ADDRESS AND DATA DISPLAY.
- INDEPENDENT UNIT - VERIFIES, PROGRAMS, INPUTS DATA FROM BINARY KEYBOARD, LOADS DATA FROM EPROM TO RAM, AND CHANGES ANY BIT OF DATA.
- FULL 90-DAY GUARANTEE ON ALL PRODUCTS FOR ANY DEFECTS IN MATERIALS AND WORKMANSHIP.

ANGO ELECTRONICS CORP.
 P.O. BOX 112 HARRISON, NJ 07029
212-685-6336
 TLX: 421531 ARTIST11

MAIL ORDER: PLEASE ADD \$3.00 HANDLING CHARGE
 NEW JERSEY RESIDENTS: PLEASE ADD 6% SALES TAX

CIRCLE NO. 106 ON FREE INFORMATION CARD

Now we can make any computer sing as well as talk, for only \$219.



As featured in Garcia's Circuit Cellar, "BYTE" Magazine, September, October 1982.

Microvox.

MICROVOX is a completely self contained professional voice quality text-to-speech synthesizer. MICROVOX may be easily interfaced to any computer, modem, RS-232C serial or parallel output device.

- 6502 Microprocessor based text-to-speech algorithm
- SC-01A phoneme based speech synthesizer
- 64 crystal controlled inflection levels
- 3000 character buffer
- RS-232C and parallel port interfaces
- On board power supply
- Music and sound effects capability

MV01 Microvox Assembled & Tested \$299.00
MV02 Microvox, complete kit \$219.00



To Order: Call Toll Free 1-800-645-3479 In N.Y. 1-516-374-6793
MICROMINT, INC.
561 Willow Avenue
Cedarhurst, NY 11516

MICROSETTE

5 1/4-Inch DISKETTES

- Single or double sided, all double density (SSDD, DSDD).
- Soft sector, reinforced hub.

CASSETTES

- Error-free computer grade.

ITEM	10 PACK	50 PACK
SSDD	\$25.00	\$100.00
DSDD	35.00	150.00
C-10	7.50	32.50
C-20	9.00	39.00
C-60	11.00	50.00
C-90	15.00	70.00

UPS SHIPPING INCLUDED
In Continental USA
CA Customers add taxes

MICROSETTE CO.
475 Ellis St., Mtn. View,
CA 94043 (415) 968-1604

CIRCLE NO. 122 ON FREE INFORMATION CARD



LEO ELECTRONICS, INC.
8921 S. Sepulveda # 208
Los Angeles, CA 90045
(213) 641-3101 (800) 421-2418
TLX: 664-688 Interline LSA

PRICE!

QUALITY!

SERVICE!

RAMS			
4116 (150ns)	1.35	16K UPGRADE	
4116 (200ns)	1.25		
4164 (150ns)	4.95	64K UPGRADE	
4164 (200ns)	4.75		
6116P-3	4.40		
EPROMS			
2708	3.00	2532	4.50
2716	3.20	2732	3.95
TMS2716	4.75	2764	7.00

TERMS: Check, Visa, Mastercard. Call for C.O.D.
U.S. Funds only. California residents add 6% sales tax.
SHIPPING: Add \$2.00 for Ground and \$5.00 for Air.
ALL MAJOR MANUFACTURERS
ALL PARTS 100% GUARANTEED
Pricing subject to change without notice.

CIRCLE NO. 118 ON FREE INFORMATION CARD

TS1000 ZX81



3-Color Keyboard Symbols with Conversion Instructions

- Plastic TS1000-ZX81 keyboard symbols in Black, Red and Blue. Opaque background. Will fit all standard-size keys. Adhesive backing for easy application.
- Simple illustrated instructions will show you how to convert a cheap (about \$20) surplus keyboard to a full-size TS1000/ZX81 console. "...as easy as stringing wire on a fence."
- Do's and Don'ts for selecting a surplus keyboard.
- Bonus for the "pro" - Schematic Diagram of Computer.

MULE Electronics \$12*
Dept. 310
444 Lincoln Blvd.
Venice, California 90291

*Add \$1.50 P&H. California residents add 6.5% tax. Money-back guarantee, of course.

CIRCLE NO. 109 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. NA9X, 39 East Hanover Ave., Morris Plains, NJ 07950.

TIMEX SINCLAIR ZX81
\$99.95
64K RAM PACK
No Ram Pack Wobble
Genex INTERNATIONAL
48945 VAN DYKE, UTICA MI 48087
Check or Money Order add \$5.00 s/h
Michigan residents add 4% tax

EXTENSIVE CATALOG AVAILABLE

CIRCLE NO. 125 ON FREE INFORMATION CARD

maxell®

Floppy Discs
CALL NOW - TOLL FREE
1-800-328-DISC

Dealer inquiries invited. C.O.D.'s and charge cards accepted.

All orders shipped from stock, within 24 hours. Call toll FREE.



North Hills Corporation
3564 Rolling View Dr.
White Bear Lake, MN 55110
1-800-328-DISC
MN Call Collect 1-612-770-0485

THE ONE - THE ONLY
"THE BOX"

New Innovation for TIMEX SINCLAIR users.

- Eliminates Save-Load Program troubles
- Saves time on Save-Load Programs
- Stops ground loops - Easy VU METER MONITOR
- Remote pause cassette switch
- Easy hook up between Computer and recorder (Pin plug cable included)

DOES NOT VOID TIMEX-SINCLAIR Warranty



Dimensions 3" x 2" x 4"

Send \$26.95 Check or Money Order To: SCONZO & SONS
724 Montauk Hwy., Bayport, NY 11705
M/C - VISA Call: (516) 472-1700 or (212) 297-0976
COD - ADD \$2.00 - Allow 4-6 week delivery
N.Y.S. Res. add sales tax
90 DAY GUARANTEE

CIRCLE NO. 127 ON FREE INFORMATION CARD

Votrax® SC-01A
SPEECH SYNTHESIZER

Votrax® \$42 Each (\$32 in hundreds)

Order in Ones or Thousands

The SC-01A Speech Synthesizer is a completely self-contained solid state device. This single chip phonetically synthesizes continuous speech of unlimited vocabulary.

Computer interlaces and text-to-speech algorithms also available for product development.

Micromint is the largest U.S. distributor of the SC-01A. Call us for a price quote.

Call 1-800-645-3479, in N.Y. 1-516-374-6793

MICROMINT, INC.
561 Willow Avenue
Cedarhurst, NY 11516



Add \$2.00 for shipping & handling.

www.americanradiohistory.com

SPEECH SYNTHESIS **NEW!** **SAVE \$\$\$ ONLY \$59 KIT**

IBM TRS 80 ZX81 TIMEX VIC20 APPLEII

UNLIMITED VOCABULARY
AMPLIFIER + SPEAKER BUILT IN
INPUT FOR TAPE - MUSIC UNITS

SMART EARS! **SPEECH RECOGNITION \$99**

SPEECH INPUT FOR ABOVE LISTED COMPUTERS & OTHERS (SOME NEED I/O)

MUSIC SYNTHESIS STEREO + IGLINE CONTROL PORT PLAY 3 PART MUSIC EFFECT DRUMS ECT. I/O PORT TO CONTROL ROBOT (BUILT IN) HOME SECURITY EARTH ECT. BUILT \$59

Hugely successful Speech Recognition System complete with microphone software and full instructions. BUILT TESTED & GUARANTEED

SPEECH CHIP SX-01 \$36
ADD \$ SHIPPING (CA, Tex, 45% TAX)
(213) 8605217

AUDIO VISION 1279 N. NORMANDIE LOS ANGELES, CA 90027

HAVING LOADING PROBLEMS ?

GET A Z-DUBBER

Because of the great variation in cassette recorders used with the ZX80/81/TS1000 (some in very poor shape), you may be having a hard time loading cassette programs. The Z-Dubber connects between the cassette recorder and the computer, and its circuitry produces a much better signal for the computer to read. The Z-Dubber also allows you to connect two cassette recorders together to make perfect backup copies. The Z-Dubber can be yours for \$31.95 post-paid. Add \$2.50 for shipping outside the US, Canada or Mexico.

CHARGE OR COD ORDERS CALL 1-800-227-3800
ASK FOR OPERATOR 225

BYTESIZE MICRO TECHNOLOGY PO BOX 12309 DEPT C/J SEATTLE, WA 98111 (206) 236-BYTE

CALL OR WRITE FOR DEALER INFORMATION

GET THE MOST FROM YOUR VIC-20/C64

CASSETTE INTERFACE

- USE ANY STANDARD CASSETTE RECORDER
- CONNECTS TO THE CASSETTE PORT
- CONTROLS THE CASSETTE MOTOR
- NEEDS NO BATTERIES
- COPY FROM RECORDER TO RECORDER
- THIS IS THE BEST ONE FOR LESS \$\$\$ ONLY \$34.95 POSTPAID. ADD \$2.50 FOR SHIPPING OUTSIDE US CANADA, MEXICO

THE MODEM INTERFACE

- CONNECTS TO THE USER I/O PORT
- NEEDS NO BATTERIES/SOLDERING
- CONNECTS ANY STANDARD MODEM
- USE MODEM AUTODIAL/ANSWER FEATURES
- COMES WITH A FREE TYPE IN BASIC TERMINAL PROGRAM
- ONLY \$24.95 POSTPAID. ADD \$2.50 FOR SHIPPING OUTSIDE US CANADA, MEXICO

CHARGE OR COD ORDERS CALL 1-800-227-3800
ASK FOR OPERATOR 225

BYTESIZE MICRO TECHNOLOGY PO BOX 12309 DEPT C/J SEATTLE, WA 98111 (206) 236-BYTE

CALL OR WRITE FOR DEALER INFORMATION

CALL US for Medical Systems

Below are just a handful of our special features:

- AMA Claim Form
- Multiple Providers
- Superbill
- RVS/ICDA Codes
- Private A/R Aged
- Manual and Training Systems Available

Medical systems available for the Apple, IBM, TRS-80 and Wang Personal Computers. Also, inquire about our Construction, Dental, Accounting and Educational Administrative programs.

GMA

MICRO COMPUTER DIVISION
55722 Santa Fe Trail, Yucca Valley, CA 92284
(619) 365-9718

CIRCLE NO. 102 ON FREE INFORMATION CARD

Apple Compatible Drives

\$195

Includes:

- 40 TRK, 163 K Drive
- Cabinet & Cable
- Free Shipping
- 6 Month Warranty

Free Shipping

Order Toll Free:  

1-800-531-5475 (Outside Of Texas)
(512) 250-1489 (In Texas)

CompuAdd Corp

13010 Research Blvd., Suite 101
Austin, Texas 78750

CIRCLE NO. 105 ON FREE INFORMATION CARD

SALES POWER

Computers & Electronics not only sells itself at a nice profit, it helps sell the hardware and software in your store too. Because it goes home with customers and continues to influence buying decisions long after you're closed for the day. Let's talk now.

CALL COLLECT: (212) 725-7679

Or write:
Ziff-Davis Publishing
One Park Avenue
New York, NY 10016

Minimum order, 10 copies. We pay all shipping costs.

PROTECT YOUR COMPUTER FROM DESTRUCTIVE POWER LINE SURGES

Surges—momentary variations of thousands of volts strike daily on your home AC power line. Unchecked surges can disrupt normal computer operation and damage hardware.

Now, CUTS Company offers surge protectors engineered specifically for personal computers.

- Both models protect your system from losing memory, misregistering programs, and blowing out components
- Both models contain a unique, three-stage filter that clamps, limits, and dissipates incoming surges instantaneously for reliable and effective surge protection
- Both models are compatible with all makes of computers and accessories

DON'T DELAY—PROTECT YOUR INVESTMENT NOW, ORDER TODAY:

SURGE BLOCK (shown) Portable protected dual outlet that plugs into any 3 wire outlet. Includes neon light that monitors protector and ground path. 125V 10A \$29.95

SURGE BUS Five outlet, surge protected plug strip with 6' power cord, includes line fuse, ON/OFF switch with pilot light in a sturdy steel case. 125V 10A \$49.95

12-Month Warranty on all Products

Specify model, send name, address and check or M.O. to include \$2 postage (NY Res. add Sales Tax) to
PO. Box 6918
SYOSSET, N.Y. 11791
(516) 921-2327

CUTS COMPANY

CIRCLE NO. 104 ON FREE INFORMATION CARD

SAVE 90%

IBM Machine with a 40% plus in performance-8086 based system with 128KB memory two RS232 Ports plus a Centronics Port for ~\$235 Upgradable!

CPMachine-4MHz Z80A based 64KB memory, two RS232 Ports for ~\$120.00

16/32 bit commercial workhorse a 68000 based, 128KB memory three RS232 Ports for ~\$265 Expandable!

Floppy Interface \$60, 25 x 80 CRTs \$200, Software, Boards ROMs, Parts and MORE!

FREE CATALOG

DIGATEK CORPORATION SUITE 7
2723 West Butler Drive
Phoenix AZ 85021

Why waste money on a Commodore, Atari, TI, etc. when a system with a future costs less?

CIRCLE NO. 104 ON FREE INFORMATION CARD

TRS-80+ MOD I, III, COCO, TI99/4a
TIMEX 1000, OSBORNE, others

GOLD PLUG - 80

Eliminate disk reboots and data loss due to oxidized contacts at the card edge connectors. **GOLD PLUG 80** solders to the board edge connector. Use your existing cables. (if gold plated)

GOLD PLUG 80 Mod I (6)	\$54.95
Keyboard/EI (mod I)	18.95
Individual connectors	9.95
COCO Disk Module (2)	18.95
Ground tab extensions	1.00
Disk Drives (all R.S.)	9.95
Gold Disk Cable 2 Drive	29.95
Four Drive Cable	39.95
GOLD PLUG 80 Mod III (6)	54.95
Internal 2 Drive Cable	29.95
Mod III Expansion port	10.95
USA shipping \$1.45	
Foreign \$7.	Can/Mex \$4. TEXAS 5% TAX

 **E.A.P. CO.**
P.O. BOX 14
KELLER, TEXAS 76248
(817) 498-4242

 **MC/VISA**
+ trademark Tandy Corp

TRS-80 COMPUTER DISCOUNTS

- Factory Direct
- Best Prices Anywhere
- No Out-of-State Taxes
- 100% Radio Shack Warranty
- Free Price List
- Authorized TRS-80

SCOTT TASSO ASSOCIATES

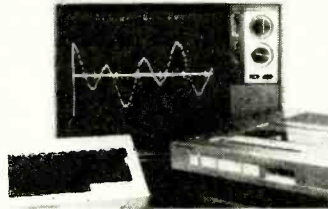
175 North Delsea Drive
Vineland, N.J. 08360

800-257-0426

NJ 609-691-7100

CIRCLE NO. 134 ON FREE INFORMATION CARD

CONVERT YOUR TV TO A HIGH QUALITY MONITOR



USE WITH COMPUTERS, VCR's & CAMERAS

Kit permits Dual Mode operation on B&W or Color sets
• Hi-resolution • Up to 80 characters per line • Wide bandwidth • Direct Video • Safe Easy installation

34⁹⁵
ACVM

DVM-1 Hot Chassis kit with Audio available
Send for complete Audio/Video equipment catalog.

VAMP
Inc.

Box 411, Los Angeles, CA 90028
(213) 466-5533

CIRCLE NO. 113 ON FREE INFORMATION CARD

ATTENTION APPLE LOVERS 100% APPLE COMPATIBLE

DISK DRIVE \$199.
DUAL DISK CONTROLLER \$49.
Z-80 BOARD \$85.
80 COLUMN BOARD \$159.

MONITORS

ZENITH ZVM 121
12" Green Screen \$ 89.
AMDEK COLOR I+
13" Color \$289.

FREE BROCHURE

!!CALL US FOR LOWEST PRICES ON OTHER ACCESSORIES!!

XICOM COMPUTER PRODUCTS
414 B. West Fifth Street
Naperville, Illinois 60566
(312) 961-1616

MC, Visa

CIRCLE NO. 137 ON FREE INFORMATION CARD

R.I.S.T. Inc. ANNOUNCES SPEECH SYNTHESIZER

ORDER NOW **SALE** ORDER NOW

\$59.95
plus \$4.00 sh/hd

ACT NOW
RECEIVE

FREE

Phone Entry Program
Speech Synthesis Manual

NEAR THE POWER

TRS80 Models I, III
Apple II, II+
ZX80/81 TS1000
Com 64, VIC 20

Regularly \$89.95
Now Only \$59.95

Complete or Starter
Kits Available

10 Day Money-Back Guarantee
Send check or M.O. COD add \$1.50 to R.I.S.T. Inc.
Dept. GZ1083, P.O. Box 499 Ft. Hamilton Station
Brooklyn NY 11209 212-259-4934
N.Y.S. RESIDENTS ADD 8% TAX

CIRCLE NO. 126 ON FREE INFORMATION CARD

TOROIDAL POWER TRANSFORMERS Small size • Low noise • Easy mounting



Ideal for audio amps, CRT monitors and computers where low hum is required.

Includes mounting washer with center hole for screw.

A wide selection of toroidal power transformers for 117V-60Hz available from stock. Included are transformers in sizes below with dual secondaries 2 x 8.5V or 2 x 15V or 2 x 18V, your choice. (Rated current = Power/2 x Volts)

Power	Size OD x H	Net wt. lbs.	Price 1	Price ea. 2-4
20VA	2.4" x 1.2"	.7	\$24.30	\$20.40
40VA	2.8" x 1.3"	1.1	\$26.10	\$22.00
70VA	3.2" x 1.4"	1.5	\$27.90	\$24.20
100VA	3.7" x 1.4"	2.2	\$30.00	\$25.70
150VA	3.7" x 1.8"	2.9	\$34.60	\$29.30

Call to place order, or write for complete listing of US made off-the-shelf toroidal power transformers in sizes 20VA-800VA.

We custom make toroids 20VA-3,600VA.

Terms: C.O.D. VISA, MASTERCARD or Money Order
Shipping: Add \$1.00/lbs for UPS (+\$1.50 for C.O.D.)

(811) 459-8898 **TOROID CORPORATION OF MARYLAND**
4720 Q Boston Way, Lenham, MD 20704

CIRCLE NO. 129 ON FREE INFORMATION CARD

PERSONAL ROBOT'S PERIPHERALS FOR HEALTH'S HERO-1 ROBOT

VOICE COMMAND SYSTEM: PRICE: \$595
- VOREC-CMOS Microprocessor (65C02) based speech recognition board mounts next to and interfaces with the HERO MEMCOM BOARD.

- Speaker-dependent with nearly instantaneous word recognition rates.
 - Recognition accuracy about 98%.
 - Operates without need for microphone.
 - 256 word vocabulary.
 - 16K onboard battery backed static RAM.
- VOCOL-High level language firmware in EPROMS for the HERO MEMCOM BOARD.
- Supports Immediate and Deferred execution of voice commands.
 - Automatic command training session handled by robot.

- VOCOL Source Code: \$55.00 extra (not sold separately)

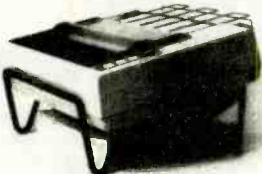
HERO MEMCOM BOARD: PRICE: \$295
- Provides means to develop programs for the robot using a personal computer. Expands robot's memory with an additional 30K of RAM.

APPLE-HERO COMMUNICATOR: PRICE: \$159
- Hardware and software to implement two-way high speed parallel communication between an APPLE* computer and HERO-1 robot equipped with our HERO MEMCOM BOARD.

MICROMATION, INC. VISA/MASTERCARD/
9104 Red Branch Road Check/Money Order
Columbia, MD 21045 Add \$3.00/Shipping
(301) 730-1237

CIRCLE NO. 138 ON FREE INFORMATION CARD

- DATUM - 2-WAY PRINTER STANDS



ANGLED FOR VISIBILITY OR LEVEL FOR MORE PAPER
NON-SKID VINYL PROTECTS FURNITURE
STURDY STEEL CONSTRUCTION
LOAD PAPER FROM ANY SIDE

AVAILABLE IN 2 SIZES: DM 8 FOR 80 COLUMN PRINTERS \$16.95
DM 10 FOR 132 COLUMN PRINTERS \$19.95

SEND CHECK OR MONEY ORDER TO: **DATUM MFG. CO.**
12028 VENICE BLVD., # 209
LOS ANGELES, CA 90066

ADD \$2.00 FOR SHIPPING & HANDLING
CALIF. RESIDENTS ADD 6% SALES TAX

PLEASE SEND ME: QUANTITY _____ DM # _____ DM 10 _____

NAME _____

ADDRESS _____

STATE _____ ZIP _____

PROMPT DELIVERY! AND TRY TO BEAT THESE IC PRICES:

DYNAMIC RAM

64K	200 ns	\$ 5.65
64K	150 ns	5.95
64K	120 ns	6.27
16K	200 ns	1.56

EPROM

27128	300 ns	\$19.20
2764	250 ns	5.99
2732	450 ns	4.25
2716	450 ns	3.60
2532	450 ns	4.75

STATIC RAM

6264P-15	150 ns	\$38.00
6116P-3	150 ns	5.62
6117P-3	150 ns	4.20

Prices 10/18/83

MasterCard VISA or UPS CASH COD
Factory New, Prime Parts **JIPCO**
MICROPROCESSORS UNLIMITED
24,000 South Peoria Ave
BEGGS, OK 74421 (918) 267-4961

Prices subject to change. Please expect higher prices on some parts due to world wide shortages. Call for volume prices. Subject to available quantities. Shipping & insurance extra. Cash/Discount prices shown. Federal Express Standard Air - \$9.99/Order received by 5 PM CST can be delivered to you by the next morning.

CIRCLE NO. 108 ON FREE INFORMATION CARD

The World's Largest Selection of Cross Assemblers

Z-80 CP/M Based or MSDOS/CPM-86 Based
Macroassemblers and Crossassemblers.

All feature: Powerful linker that will link up to 400 modules, no limit on program size, fast operation. Intel hex format converter. Powerful Macro sections. Full Satisfaction Guaranteed or your money back!

Z-80. 6502, Z-8, 6800-6809, 8748, 8051
Only \$79.50 each!
Z-8000 and 8086/88 With 8080/Z-80
Transiator Only \$179.50 each!
8086/88 Macroassembler with linker and
8080/Z-80 Transiator \$99.50
Z-80 Macroassembler with 8080 to Z-80
converter, Linker Only 49.50

To Order: Call us at (303) 752-4382
M/C, Visa and COD orders accepted. Add \$6.50 ea for S&H.
Full satisfaction Guaranteed.

ORDER TODAY!

2500AIDS SOFTWARE INC

17200 E. Ohio Dr.
Aurora, Co 80017
(303) 753-4382

CIRCLE NO. 115 ON FREE INFORMATION CARD

Put 64K CP/M 2.2 in your TRS-80 Model III.

Our plug-in Shuffleboard 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 RUM software from Osborne, Xerox, Superbrain, Kaypro II, HP 125 and TeleVideo. You can even READ/WRITE IBM PC software for CP/M 86.

Simple to install. Shuffleboard III plugs into two existing sockets inside your Model III. No permanent modifications, no cut traces, 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 Shuffleboard 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) 786-9685

Memory Marchant

24219 Clawiter Rd. Hayward, CA. 94545

\$299.

CIRCLE NO. 120 ON FREE INFORMATION CARD

"CONTROL YOUR WORLD" WITH YOUR VIC-20

With simple circuits using low cost parts and our program supplied on cassette tape, we'll show you how to use your COMMODORE VIC-20 for:

- Digital Thermometers
- Digital Clock
- Burglar Alarm - 2 Zone, Time Controlled
- Fire Alarm - 2 Zone, Time Controlled
- Dusk to Dawn Lighting with Photo Cell
- Furnace and Air Cond., Clock and Thermostat
- Clock Controlled Appliance Switches

Simple program variations in basic can operate lights, motors, furnaces, machines, heat pumps, radios, sound systems, test equipment, swimming pools, garden watering, and more.

Your video screen will display simultaneously:
• Two Digital Temperatures • Digital Time • Two Analog Inputs • Five Input Ports Status • Eight Output Ports Status.

GET A LOW COST EDUCATION IN COMPUTER CONTROL. ORDER YOUR CASSETTE AND INSTRUCTION BOOK NOW! \$39.90 PRICE INCLUDES POSTAGE.

Terms: MASTER CARD/VISA

The Continental Press, Inc., Elizabethtown, PA 17022
Toll free: 800-233-0759 Collect in PA: (717) 367-1836

YORK 10 CASSETTES

DATA TRAC
BLANK CASSETTES

C-05, C-06, C-10, C-12, C-20, C-24, C-30

From the leading supplier of Computer Cassettes, new, longer length C-12's (6 minutes per side) provide the extra few feet needed for some 16K programs

BASF-LHD (DPS) world standard tape
Premium 5 screw shell with leader.
Error Free • Money back guarantee.

ITEM	1 DOZEN	DOZEN
C-05	7.00	13.00
C-06	7.00	13.00
C-10	7.50	14.00
C-12	7.50	14.00
C-20	8.00	17.00
C-24	9.00	17.00
C-30	11.00	21.00
Hard Box	2.50	4.00

FREE STORAGE CADDY WITH EVERY 400 CASSETTES PURCHASED

SHIPPING/HANDLING \$3.50

NOTE: Outside 48 Contine. States shipping \$3.50 PLUS \$1 per caddy, per dozen cassettes per dozen boxes in Cont. U.S. shipments are by UPS unless Parcel Post requested. California residents add Sales Tax

Call or write for FREE BROCHURE
Call: 213/700-0330

FOR IMMEDIATE SHIPMENT USE YOUR VISA OR MASTERCARD

YORK 10 9525 Vasar Ave., #P1
Chatsworth, CA 91311

COMMODORE TIMEX

1983 TAX RETURN HELPER

Fast and easy
income tax preparation.

- Form 1040 and Schedules A,B,C,D,E
- Enter and modify data on a screen copy of the form
- Works like a spreadsheet - all the lines affected by a change are instantly updated.
- Form 1040 and Schedule A are automatically correlated.
- Price is tax deductible.
Cassette: VIC 20 (16K RAM) or C64 \$23
TIMEX 1000 (16K RAM) \$14
TIMEX 2068 \$18
Disc: VIC 20 (16K RAM) or C64 \$33
(Add \$1.50 S & H). Check, MO or credit card.

KSOFT CO.

845 WELLNER RD
NAPERVILLE, IL 60540
(312) 961-1250

Dealer inquiries welcome



Music Teacher in a Box?

To get ahead in music, you need to know music theory. PAIA's Chord Computer helps you understand both music and keyboards better by cramming the equivalent of pages and pages of music theory into a compact, calculator-style package.

The Chord Computer is easy to use. Simply select a chord letter, and the Chord Computer's LCD 31-key piano keyboard display will show which notes to play for the selected chord. Press another button to choose sharp, flat, major, minor, augmented, diminished, 6th, 7th or 9th chords - including inversions. The Chord Computer can also display complete scales for all keys, or even transpose them at the touch of a button.

Serious about music? The Chord Computer could be the best investment you'll ever make. only \$59.95 (+\$2.50 postage/handling) Order yours today

CHARGE TO VISA OR MC TOLL-FREE

1-800-654-8667, 9AM to 5PM CST MON-FRI

Ask for your free PAIA catalog.

Direct mail orders and inquiries to: Dept. 10-P

PAIA Electronics, Inc.

1020 W. Wilshire, Oklahoma City, OK 73116 (405) 843-9626

SAVE MORE THAN EVER ON 3M Scotch DISKETTES!

\$1.95 ea. 5 1/4" SSDD (746) → (744) **\$2.70** ea.
Qty. 20 5 1/4" DSQD (745) → Qty. 20

5 1/4" SSQD-96TPI (746) \$2.89 ea.
5 1/4" DSQD-96TPI (747) \$3.95 ea.
(Specify soft, 10 or 16 sector.)

8" SSDD (740) \$2.07 ea.
8" SSDD (741) \$2.54 ea.
8" DSQD (743) \$3.30 ea.
(Specify soft or 32 sector.)

Save even more on quantity orders!

Minimum Order: 20 diskettes. Add \$3.00 shipping per 200 diskettes. C.O.D. charge \$1.65 additional

Visa • Mastercard • Checks

For fast service, call

DISK WORLD!

Nationwide: 1-800-621-6827

In Illinois: 312-944-2788

Suite 4806 • 30 East Huron Street • Chicago, Illinois 60611

Authorized Distributor
Information Processing Products



MAGIC COMPUTER "INPUT/OUTPUT" MUGS

When hot liquid is poured in, one message disappears and another takes its place on the computer screen. Fascinating to watch. Big 10 oz. size. Fine quality white English porcelain.
MUG "B" - "Computer Expert on/off duty."

*\$8.95 ea. Plus \$2 ea. for ship. & handling. Fla. residents add 5% sales tax.

Visa or MasterCard accepted. Include card #, Expiration date and signature with order. Send for our free COMPUTERMANIA Catalog of other unique items for the computer buff.

Call Toll-Free Mon.-Fri. 9am-6pm

1-800-B-E-S-W-E-E-T • In Fla. (305) 687-9338

sweet gum inc.

15490 NW 7th Ave., Dept. CE014, N. Miami, FL 33169

PLEASE....

Give us a chance to save you the largest amount possible on...

TRS-80 PRODUCTS

Get your Best Price

Then...



Call Us At:

1-800-762-6661

Rand's

COMPUTER CORNER

101 Fry Blvd. Sierra Vista

Instate: (602) 488-4080

SALES POWER

Syne not only sells itself at a nice profit, it helps sell the hardware and software in your store too. Because it goes home with customers and continues to influence buying decisions long after you're closed for the day. Let's talk now.

CALL COLLECT:
(212) 725-7679

Or write:
Ziff-Davis Publishing
One Park Avenue
New York, NY 10016



Minimum order, 10 copies. We pay all shipping costs.

COMPUTER FURNITURE

CD 3624

PS 3024



Genuine Oak

Veneer **\$89⁹⁵** Each

Completely Finished — Ready for Use
Excellent for Student, Home or Office

Send name and address with check or money order for \$89.95 per unit. Specify model no. Add \$15.00 for castors. Include \$10.95 for prompt shipping. Mail to: **C.F.M.**

P.O. Box 520652 • Salt Lake City, UT 84152

MONEY BACK GUARANTEE

Timeless Computer Furniture Manufacturers

Join the Click!

FOR FASTER & EASIER DATA ENTRY WITH YOUR E-Z KEYBOARD... FEEL THE CLICK! FEEL THE SLAP! FEEL THE SLAP!

FOR THE ONLY KEYBOARD WITH ALL OF THESE FEATURES:

- 60 thousand keystroke (100 million) lifetime warranty
- 8 function keys (F1-F8) for easy access to the most commonly used functions
- 12 numeric keys (N1-N12) for easy access to the most commonly used numeric functions
- 12 function keys (F9-F12) for easy access to the most commonly used function keys
- 12 numeric keys (N13-N24) for easy access to the most commonly used numeric keys
- 12 function keys (F13-F24) for easy access to the most commonly used function keys
- 12 numeric keys (N25-N36) for easy access to the most commonly used numeric keys
- 12 function keys (F25-F36) for easy access to the most commonly used function keys
- 12 numeric keys (N37-N48) for easy access to the most commonly used numeric keys
- 12 function keys (F37-F48) for easy access to the most commonly used function keys
- 12 numeric keys (N49-N60) for easy access to the most commonly used numeric keys
- 12 function keys (F49-F60) for easy access to the most commonly used function keys

NOT JUST A KEYBOARD REPLACEMENT... BUT AN INVESTMENT THAT DOES EXCELLENCE... FEEL THE CLICK! FEEL THE SLAP! FEEL THE SLAP!



\$84.95

90 day warranty

... FEEL THE SLAP! FEEL THE SLAP! FEEL THE SLAP!

... FEEL THE SLAP! FEEL THE SLAP! FEEL THE SLAP!

E-Z KEY

... FEEL THE SLAP! FEEL THE SLAP! FEEL THE SLAP!

MODULES FOR TIMEX-Sinclair

NEW MD-2 DIRECT CONNECT MODEM

\$119.95 Kit
\$149.95 W&T

with New SMART, Menu Driven, SOFTWARE Included FREE

- Send & Receive Programs by Phone
- Copy Information Into Memory, Print It, Review It, Save It On Tape, Send Text From Memory
- Use Timex 2040 Printer or Any RS-232 Printer
- RS-232 Printer Port Provided
- No Extra Memory Required, But With 64K Memory You Can Store Up To 60 Full Screens

RS-232 Printer Interface \$59.95 Kit \$69.95 Ass.
BB-1 Control Module 8 Relays 8 TTL Inputs \$69.95

UM-64 64K Memory
Battery Backup, Prom/Rom Socket, Reset Sw. Plus Exclusive Feature: Copy the Timex Rom into the 0-8K Area of Ram, flip a Sw & operate out of RAM. MODIFY it to suit your needs. Add new commands.
\$119.95 Kit \$129.95 Assembled

Gorilla/Banana Printer Discounted to only \$239.95
See "Leading Edge" Ad in this magazine

BYTE-BACK CO. Rt. 3 Box 147 Brodie Rd.
Leesville, S.C. 29070 Ck. COD VISA M/C AM EXP
Ph. 803-532-5812 Add \$4.95 shipping to all orders
10 day money back guarantee plus 90-day warranty

CIRCLE NO. 114 ON FREE INFORMATION CARD

WE SELL TIME!

TIME FOR DECISIONS. TIME FOR LEISURE. YOUR TIME. ISA's software gives it back to you.

SUPER™ DATABASE - \$199.00

- EASY! FAST!
- General purpose business program DBMS

ManageMint™ — \$395.00 & up.
• PERT/CPM project control system

(Both menu driven for IBM PC, CPM & all TRS-80)

INSTITUTE FOR SCIENTIFIC ANALYSIS
P.O. BOX 7186, DEPT. C-1
WILMINGTON, DE. 19803

(215) 358-3735 / orders only (800) 441-7860
M.C. & VISA accepted.

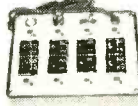
CIRCLE NO. 117 ON FREE INFORMATION CARD

POWER LINE PROBLEMS?

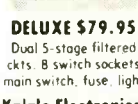


SPIKE-SPIKERS™... The Solution!

Minimize equipment damaging spikes and conducted RF noise to or from sensitive equipment. Transient surge protection plus low pass RFI hash filtering. All units 120V 15A.



MINI II \$44.95
Wall Mount
3-stage filter
2 sockets



QUAD II \$59.95
Wall mount Dual 3-stage filter
4 sockets & light

DELUXE \$79.95
Dual 5-stage filtered ckt. 8 switch sockets main switch, fuse, light

Kalgio Electronics Co., Inc. Order Factory Direct
65 84 Ruch Rd., Dept. C, E
Bethlehem, PA 18017 **215-837-0700**

DEALERS INVITED
PA Res. Add 6% • COD add \$3.00 + Shipping
800-523-9685

CIRCLE NO. 133 ON FREE INFORMATION CARD



Best Prices On TRS-80 Computers

Our 6th year of discounts
Ed or Joe McManus
Fgt. Prepaid. Save Tax.
Toll Free 800-231-3680

Marymac Industries, Inc.
22511 Katy Fwy., Katy
(Houston) Tx 77450
1-713-392-0747
Telex 774132

See us in the Wall Street
Journal every Tues., Wed, Thurs.

Get more out of your Apple with the MICRO on the Apple Series

Vols. 1, 2, & 3 **\$24.95**
+ \$2.00 shipping each volume

Each book includes more than 30 programs — all on DISKETTE

- Machine Language Aids
- I/O Enhancements
- Runtime Utilities
- Graphics & Games
- Hardware & Reference Information

To order toll free:
1-800-345-8112
In PA 1-800-662-2444
MICRO INK, Dept. CE
P.O. Box 6502
Amherst, NH 03301
603-889-4330

CIRCLE NO. 121 ON FREE INFORMATION CARD

It's simple. . . . CALL & SAVE MONEY 1-800-841-0860

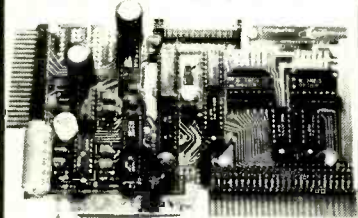
Commodore 64
DRIVES • PRINTERS
MONITORS • SOFTWARE
CALL FOR BEST PRICES

TRS-80 FRANKLIN
COLUMBIA EPSON
Albert SGM SMITH CORONA

MICRO MANAGEMENT SYSTEMS
TELEMARKET DEPT. # 12
2803 THOMASVILLE RD. EAST
CAIRO, GEORGIA 31728
GA. & INFO 912-377-7120

CIRCLE NO. 107 ON FREE INFORMATION CARD

A/D 8 channels + D/A 8 channels



APPLY YOUR MICRO TO ANALOG SIGNAL PROCESSING & CONTROL

Connects to μ processor buss of most Z80 & 6502 computers including Timex, TRS-80, Apple, CBM 64. Our pin rearrangement feature eases interfacing.

FAST: 200,000 samples per sec with Z80A.

EASY TO PROGRAM: One PEEK chooses the channel, starts conversion & gets data. Routines provided.

SOFTWARE AVAILABLE: FFT in Z80, 256 points in one second, storage scope for Timex.

LOW COST: Assembled & tested \$195. Cable \$15. Please call or write for free catalog.

Computer Continuum

301 Sixteenth Avenue
San Francisco, CA 94118 (415) 752-6294

SALES POWER

Microsystems not only sells itself at a nice profit, it helps sell the hardware and software in your store too. Because it goes home with customers and continues to influence buying decisions long after you're closed for the day. Let's talk now.

**CALL COLLECT:
(212) 725-7679**

Or write:
Ziff-Davis Publishing
One Park Avenue
New York, NY 10016



Minimum order: 10 copies. We pay all shipping costs.



Scotch
DISKETTES

Call Toll-Free
1-800-328-DISC for prices and information. Dealer inquiries invited. C.O.D. and charge cards accepted. All orders shipped from stock, within 24 hours. Call toll FREE



North Hills Corporation
3564 Rolling View Dr.
White Bear Lake, MN 55110
1-800-328-DISC
MN Call Collect 1-612-770-0485

Computers & Electronics

ADVERTISERS INDEX

RS no.	ADVERTISER	PAGE no.
50	Active Electronics	105
3	All Electronics Corp.	105
	Apple Computer	32-33
55	Artec	93
9	Atari	36-37
	C & D Electronics	99
	Classified Advertising	111-120
	Cleveland Institute of Electronics, Inc.	44-47
29	Commodore Computer	C-4
19	Communication Electronics	25
60	CompuServe	43
11	Computer Mail Order	27
14	Digi-Key Corp.	106-107
66	Discwasher	7
10	Electronics International	100
25	Epson	15
12,13	Foley-Belsaw	99,101
	Fuji SVEA	55
	Grantham College of Engineering	98
4	Halix Institute	95
24,28	Heath Co.	53,31
41	IBM	4-5
	ICS	80
21	Jameco Electronics	104
22	JDR Microdevices	108-109
23	J & R Music World	87
8	Jensen Tools	87
20	Leading Edge	Cover 2
48	3M	65
	MacMillan Book Club	1
30	Maxell	3
	Memtek Products	Cover 3
	National Technical Schools	18-21
	Netronics, R & D Ltd.	103
17	New Horizons	17
	NRI Schools	8-11
40	Protecto	23
	Radio Shack	41,110
	Scientific Systems	101
36	Sintec Co.	105
39	Tab Books	71-73
42	Tam's Inc.	100
79	Univair, Inc.	95

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION (Required by 39 U.S.C. 3685)

- Title of publication: Computers & Electronics
a. Publication No. 00324485
- Date of filing: October 1, 1983
- Frequency of issue: Monthly
a. No. of issues published annually: 12
b. Annual subscription price: \$15.97
- Location of known office of publication: One Park Avenue, New York, New York 10016.
- Location of the headquarters or general business offices of the publishers: One Park Avenue, New York, New York 10016.
- Names and complete addresses of publisher, editor, and managing editor: Publisher: William S. David, One Park Avenue, New York, New York 10016; Editor: Arthur P. Salsberg, One Park Avenue, New York, New York 10016; Managing Editor: John R. Riggs, One Park Avenue, New York, New York 10016.
- Owner: Ziff-Davis Publishing Company, One Park Avenue, New York, N.Y. 10016; Ziff Corporation, One Park Avenue, New York, N.Y. 10016.
- Known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages or other securities: None.
- Extent and Nature of Circulation:

	Average No. Copies Each Issue During Preceding 12 Months	Actual No. Copies of Single Issue Published Nearest to Filing Date
A. Total No. Copies Printed (net press run)	591,231	718,991
B. Paid circulation		
1. Sales through dealers and carriers, street vendors and counter sales	134,592	167,900
2. Mail subscriptions	346,646	437,400
C. Total Paid Circulation (sum of 10B1 and 10B2)	481,238	605,300
D. Free distribution by mail, carrier or other means, samples, complimentary, and other free copies	28,901	20,864
E. Total distribution (sum of C and D)	510,139	626,164
F. Copies not distributed		
1. Office use, left over, unaccounted, spoiled after printing	1,817	1,527
2. Returns from news agents	79,275	91,300
G. Total (sum of E, F1, and 2 —should equal net press run shown in A)	591,231	718,991
- I certify that the statements made by me above are correct and complete.

WILLIAM L. PHILLIPS,
Assistant Treasurer



ALL THE HARD PART IS MAKING SURE MINI DISKS COME ERROR FREE. THEY STAY THAT WAY.

A disk is built with certain safeguards. That's why most disk makers offer guarantees that the product you receive comes to you error free.

We at Memtek Products are concerned that the minidisk remains error free. *Every* time you use it. After exposure to dust, cigarette smoke, fingerprints, even wear caused by your computer. And so, we have built safeguards around the disk, as well.

Memtek Products' latest innovation... acknowledgment of a real world beyond the laboratory.

The hub ring. Designed to prevent our minidisks from jamming in your machine. Rigid. Durable. Reinforced.

The coating. A critically-controlled coating of high-energy magnetic oxide particles that covers the disk's surface, which is then micro-polished to improve head to disk contact, preventing dropouts, lowering head abrasion.

The lubrication system. A constant lubricant protects both the disk surface and the drive head from wear.

The sleeve. Comes with a soft liner that protects the disk while gently cleaning the surface.

The guarantee.

We'll replace, free, any minidisk if it fails to accurately store and retrieve data due to a defect in materials or workmanship for up to 5 years from date of purchase. Simply mail the disk back.

The Memtek lineup.

Premium, double and quad density minidisks as well as 10- and 15-minute computer cassettes and a 5 1/4" disk drive head cleaner.



WE PLAY FOR KEEPS™

INDISPENSABLE SOFTWARE

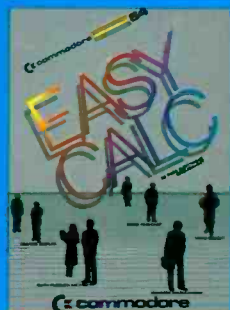
For Your Most Important Computing Needs



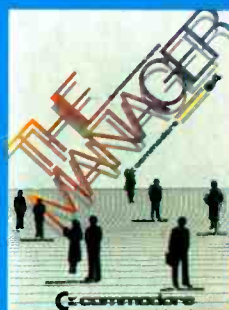
EasyScript 64
Displays 764 lines x 240 characters. Prints to 130 columns. Works with EasySpell 64.



EasySpell 64
20,000 word Master Dictionary and automatic spelling checker. Works with EasyScript 64.



EasyCalc 64
Multiple electronic spreadsheet with color bar graph feature. 63 columns x 254 rows.



The Manager
Sophisticated database system with 4 built-in applications, or design your own. Text, formulas, graphics.



SuperExpander 64
21 special commands. Combine text with high resolution graphics. Music and game sounds.



Easy Finance I—Loan Analysis
12 loan functions. Bar graph forecasting as well as calculation.



Easy Finance II—Basic Investment Analysis
16 stock investment functions. Investment bar graph.



Easy Finance III—Advanced Investment Analysis
16 capital investment functions. Bar graphs.



Easy Finance IV—Business Management
21 business management features. Bar graphs.



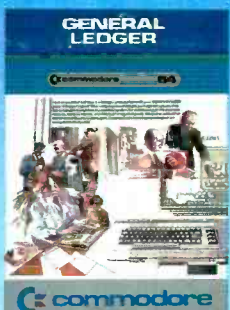
Easy Finance V—Statistics and Forecasting
Assess present/future sales trends with 9 statistics and forecasting functions.



Accounts Payable/Checkwriting
11 functions. Automatic billing. 50 vendors/disk.



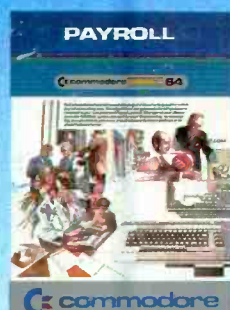
Accounts Receivable/Billing
11 billing functions. Printed statements.



General Ledger
8 general ledger options. Custom income statement, trial balances, reports.



Inventory Management
1000 inventory items. Full reports.



Payroll
24 different payroll functions. Integrated with G/L system.

commodore
COMPUTERS

First In Quality Software

CIRCLE 29 ON READER SERVICE CARD