

MARCH 1979 Volume 4, Number 3 \$2.00 in USA/\$2.40 in Canada

BYTE

the small systems journal





Someday all terminals will be smart.....

- ◆ 128 Functions—software controlled
 - ◆ 7 x 12 matrix, upper/lower case letters
 - ◆ 50 to 38,400 baud—selectable
- ◆ 82 x 16 or 92 x 22 format—plus graphics
 - ◆ Printer output port
 - ◆ "CHERRY" keyboard

CT-82 Intelligent Terminal, assembled and tested. \$795.00 ppd in Cont. U.S.



SOUTHWEST TECHNICAL PRODUCTS CORPORATION
219 W. RHAPSODY
SAN ANTONIO, TEXAS 78216

Circle 350 on inquiry card.

Foreground

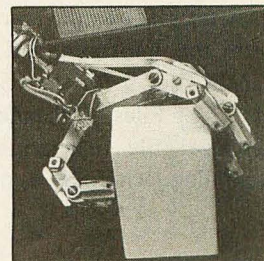
- 66 THE STANDARD DATA ENCRYPTION ALGORITHM, Part 1: An Overview, *by Robert V Meushaw*
A detailed description of a "trap door" algorithm
- 94 DESIGNING WITH DOUBLE SIDED PRINTED CIRCUIT BOARDS, *by David Lamkins*
This do-it-yourself technique can save you space
- 114 DESIGNING A ROBOT FROM NATURE, Part 2: Constructing the Eye, *by Andrew Filo*
Design details of the robot's eye in the second of this 2 part article
- 142 A STEPPING MOTOR PRIMER, PART 2, *by Paul Giacomo*
Interfacing to your computer, and other considerations
- 150 BUILD A COMPUTER CONTROLLED SECURITY SYSTEM FOR YOUR HOME, Part 3, *by Steve Ciarcia*
Ultrasonics, infrared beams and other exotic ways to make your home secure
- 196 THE POWER OF THE HP-67 PROGRAMMABLE CALCULATOR, Part 1, *by Robert C Arp Jr*
Learn to use one of the most powerful programmables

Background

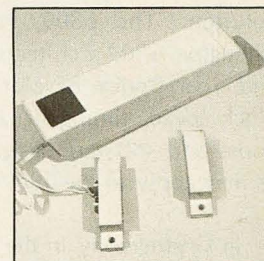
- 12 BUILDING THE HEATH H8 COMPUTER, *by Dr Paul R Poduska*
A review of a popular computer kit
- 14 A MAP OF THE TMS-9900 INSTRUCTION SPACE, *by Henry Melton*
Organizing one's approach to a machine with 2^{15.95} legal instructions
- 32 FILES ON PARADE, Part 2: Using Files, *by Mark Klein*
File protection systems and sundry other matters
- 46 A MICROPROCESSOR FOR THE REVOLUTION: THE 6809, Part 3, *by Terry Ritter and Joel Boney*
Final thoughts about the successor to the Motorola 6800 processor
- 56 CRYPTOGRAPHY IN THE FIELD, Part 1: An Overview, *by John P Costas, Phd*
A brief historical look at cryptography
- 80 PREVIEW OF THE Z-8000, *by Ira Rampil*
A look at Zilog's new 16 bit processor
- 170 COMMON MISTAKES USING WARNIER-ORR DIAGRAMS, *by David Higgins*
Avoiding pitfalls when using this alternate flowcharting method
- 194 PASSWORD PROTECTION FOR YOUR COMPUTER, *by R Jordan Kreindler*
How to keep data and information "for your eyes only"
- 230 WHAT IS AN INTERRUPT? *by R Travis Atkins*
Learn how to use peripherals efficiently with interrupts
- 238 HISTORY OF COMPUTERS: THE IBM 650, *by Keith S Reid-Green*
A glance at a past favorite



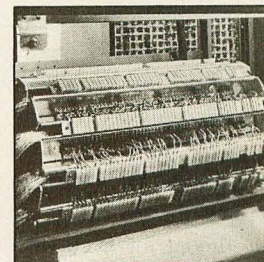
page 46



page 114



page 150



page 238



Nucleus

- | | |
|--|--|
| 6 Don't Overlook LISP | 182 Technical Forum |
| 10 Letters | 206 Nybbles: Computer Assisted Flight Planning |
| 26 Desk Top Wonder: Race Car for the SR-52 | 222 Clubs and Newsletters |
| 42 Book Review | 224 BYTE's Bits |
| 53 Event Queue | 241 What's New? |
| 92 Programming Quickie: Inverse Trig Functions | 270 Unclassified Ads |
| 92 Machine Language Puzzler: Odd Tones | 272 BOMB |
| 107 BYTE News | 272 Reader Service |

Cover Art:
THROUGH THE TRAP DOOR
by Robert Tinney.

BYTE is published monthly by BYTE Publications Inc, 70 Main St, Peterborough NH 03458. Address all mail except subscriptions to above address; phone (603) 924-7217. Address subscriptions, change of address, USPS Form 3579, and fulfillment questions to BYTE Subscriptions, PO Box 590, Martinsville NJ 08836. Second class postage paid at Peterborough NH 03458 and at additional mailing offices—USPS Publication No. 102410 (ISSN 0360-5280). Subscriptions are \$15 for one year, \$27 for two years, and \$39 for three years in the USA and its possessions. In Canada and Mexico, \$17.50 for one year, \$32 for two years, \$46.50 for three years. \$25 for one year air delivery to Europe. \$25 surface delivery elsewhere. Air delivery to selected areas at additional rates upon request. Single copy price is \$2 in the USA and its possessions, \$2.40 in Canada and Mexico, \$3.50 in Europe, and \$4 elsewhere. Foreign subscriptions and sales should be remitted in United States funds drawn on a US bank. Printed in United States of America.

Address all editorial correspondence to the editor at the above address. Unacceptable manuscripts will be returned if accompanied by sufficient first class postage. Not responsible for lost manuscripts or photos. Opinions expressed by the authors are not necessarily those of BYTE. Entire contents copyright © 1979 by BYTE Publications Inc. All rights reserved.

BYTE is available in microform from University Microfilms International, 300 N Zeeb Rd, Dept PR, Ann Arbor MI 48106 USA or 18 Bedford Row, Dept PR, London WC1R 4EJ ENGLAND.

The Heath H8 is part of the family of Heath computer kits. Dr Paul R Poduska describes his experience of assembling this well-documented kit in **Building the Heath H8 Computer**.

page 12

One way to see what the Texas Instruments TMS-9900 processor can do is to cover the instruction set using **A Map of the TMS-9900 Instruction Space** by Henry Melton as a guide. His short article gives a summary of the available operations plus details for all the possible operation codes of the machine.

page 14

After setting up a computer system with the hardware and software to handle files, how do you use it? In part 2 of **Files on Parade**, Mark Klein describes file management and programming techniques using files.

page 32

In **A Microprocessor for the Revolution: The 6809, Part 3: Final Thoughts**, 6809 architects Terry Ritter and Joel Boney of Motorola discuss clock speed, timing signals, condition codes and software design philosophy as they apply to the 6809.

page 46

In **Cryptography in the Field, Part 1**, Dr J P Costas gives a brief history of the fascinating world of cryptography, to be concluded next month with a programmable calculator encryption and decryption program.

page 56

Robert V Meushaw's article describes the workings of and some of the theory involved with **The Standard**

In this BYTE

Data Encryption Algorithm, one of a class of algorithms known as "trap door" algorithms.

page 66

The Z-8000 is Zilog's new entry into the field of 16 bit processors. In addition to its impressive speed, the Z-8000 in conjunction with an out-board memory management device allows programmers to employ virtual memory techniques. Read about it in **Ira Rampil's Preview of the Z-8000**.

page 80

If you'd like to double your pleasure and double your fun, try designing with two printed circuit board sides instead of one. David Lamkins shows you how to get more for your money in **Designing with Double Sided Printed Circuit Boards**. Perhaps that topology course you took might come in handy after all.

page 94

Andrew Filo concludes his article **Designing a Robot from Nature** with an overall description of the system as well as construction details for building a net convexity detector, which mimics the frog's ability to detect insect flight patterns.

page 114

This month Paul Giacomo concludes his 2 part **Stepping Motor Primer** with a look at interfacing the stepping motor to a computer as well as a discussion of damping, inertia and other related topics.

page 142

This month Steve Ciarcia completes his 3 part article **Build a Computer Controlled Security System for Your Home** with a discussion of burglar alarms, intrusion detectors, and the rest of the circuitry you'll need to make your home secure.

page 150

First time users of Warnier-Orr diagrams consistently have many questions about the correct usage of the technique. David A Higgins describes some conceptual errors and other **Common Mistakes Using Warnier-Orr Diagrams**.

page 170

If many people have access to your computer, you may want to protect the information contained within it. One way is to implement **Password Protection for Your Computer** as described by R Jordan Kreindler.

page 194

This month Robert C Arp Jr begins a 2 part article about **The Power of the HP-67 Programmable Calculator**. Part 1 is a review of the features and performance of this powerful desk top wonder.

page 196

What Is an Interrupt? In brief, it is the act of safely stopping one process and causing your computer to start (resume) another process. For some background information on interrupt processing, see R Travis Atkins' tutorial in this issue.

page 230

Keith S Reid-Green continues his **History of Computers** with a discussion of one of the early minicomputers, **The IBM 650**.

page 238

Publishers

Virginia Londoner
Gordon R Williamson
Vice-President Periodicals
John E Hayes
Assistant
Jill E Callihan

Editorial Director

Carl T Helmers Jr
Executive Editor
Christopher P Morgan
Editor in Chief

Raymond G A Cote
Senior Editor

Blaise W Liffick
Editor

Richard Shuford, N4ANG
Editorial Assistant

Gale Britton
New Products Editor

Clubs, Newsletters

Laura A Hanson
Drafting

Jon Swanson

Production Manager

Karen Gregory
Production Editors
David William Hayward
Peter Perin

Typographers

Cheryl A Hurd
Stephen Kruse
Production Art
Ellen Bingham
Wai Chiu Li
Christine Dixon

Advertising Director

Patricia E Burgess
Adv/Prod Coordinator
Thomas Harvey
Assistant

Ruth M Walsh
Advertising Manager
Noreen Bardsley
Don Bardsley

Receptionist

Jacqueline Earnshaw

Circulation Manager

Gregory Spitzfaden
Assistants
Pamela R Heaslip
Ann Graves
Agnes E Perry
Melanie Bertoni
Dealer Sales
Ginnie F Boudrieau
Anne M Baldwin

Book Division:

Publisher
Edmond C Kelly Jr
Production Editors
Patricia Curran
William Hurlin

Traffic Managers

Rick Fuetter
Mark Sandagata

Printing

The George Banta Company

Comptroller

Kevin Maguire
Assistant
Mary E Fluhr

National Advertising Sales Representatives:

Hajar Associates Inc
East
280 Hillside Av
Needham Heights MA 02194
(617) 444-3946
521 Fifth Av
New York NY 10017
(212) 682-5844

Midwest

664 N Michigan Av
Suite 1010
Chicago IL 60611
(312) 337-8008
West, Southwest
1000 Elwell Ct
Suite 227
Palo Alto CA 94303
(415) 964-0706/(714) 540-3554

Distributors:

Eastern Canada
RS-232 Distribution Company
186 Queen St W, Suite 232
Toronto ONTARIO M5V-1Z1
Western Canada
Kitronic Ltd
26236 26th Av RR 5
Aldergrove BC V0X 1A0

Drafting

Techart Associates
Typography
Goodway Graphics
Photography
Ed Crabtree

Editorial Associate

Daniel Fylstra
Associates
Walter Banks
Steve Ciarcia
David Fylstra
Ira Rampil

How to buy a personal computer.

Suddenly everyone is talking about personal computers. Are you ready for one? The best way to find out is to read Apple Computer's "Consumer Guide to Personal Computing." It will answer your unanswered questions and show you how useful and how much fun personal computers can be. And it will help you choose a computer that meets your personal needs.

Who uses personal computers.

Thousands of people have already discovered the Apple computer—businessmen, students, hobbyists. They're using their Apples for financial management, complex problem solving—and just plain fun.

You can use your Apple to analyze the stock market, manage your personal finances, control your home environment, and to invent an unlimited number of sound and action video games. That's just the beginning.

What to look for.

Once you've unlocked the power of the personal computer, you'll be

using your Apple in ways you never dreamed of. That's when the capabilities of the computer you buy will really count. You don't want to be limited by the availability of pre-programmed cartridges. You'll want a computer, like Apple, that you can also program yourself. You don't want to settle for a black and white display. You'll want a computer, like Apple, that can turn any color tv into a dazzling array of color graphics.* The more you learn about computers, the more your imagination will demand. So you'll want a computer that can grow with you as your skill and experience with computers grows. Apple's the one.

How to get one.

The quickest way is to get a free copy of the Consumer Guide to Personal Computing. Get yours by calling 800/538-9696. Or by writing us. Then visit your local Apple dealer. We'll give you his name and address when you call.

*Apple II plugs into any standard TV using an inexpensive modulator (not included).



 **apple computer** T.M.
10260 Bandlely Dr., Cupertino, CA 95014

Look for Shugart drives in personal computer systems made by these companies.

Altos Computer Systems
2378-B Walsh Avenue
Santa Clara, CA 95050

Apple Computer
10260 Bandley Dr.
Cupertino, CA 95014

Digital Microsystems Inc.
(Formerly Digital Systems)
4448 Piedmont Ave.
Oakland, CA 94611

Imsai Mfg. Corporation
14860 Wicks Blvd.
San Leandro, CA 94577

Industrial Micro Systems
633 West Katella, Suite L
Orange, CA 92667

North Star Computer
2547 9th Street
Berkeley, CA 94710

Percom Data
318 Barnes
Garland, TX 75042

Polymorphic Systems
460 Ward Dr.
Santa Barbara, CA 93111

Problem Solver Systems
20834 Lassen Street
Chatsworth, CA 91311

Processor Applications Limited
2801 E. Valley View Avenue
West Covina, CA 91792

SD Sales
3401 W. Kingsley
Garland, TX 75040

Smoke Signal Broadcasting
6304 Yucca
Hollywood, CA 90028

Technico Inc.
9130 Red Branch Road
Columbia, MD 21045

Texas Electronic Instruments
5636 Etheridge
Houston, TX 77087

Thinker Toys
1201 10th Street
Berkeley, CA 94710

Vista Computer Company
2807 Oregon Court
Torrance, CA 90503

Circle 320 on inquiry card.

 **Shugart**

Editorial

Don't Overlook LISP

John R Allen
18215 Bayview Dr
Los Gatos CA 95030

Most programming languages do very little to reinforce the creative process of algorithm discovery and creation. They are more concerned with the execution of already constructed algorithms. This month's guest editorial by John R Allen elaborates on this idea and discusses the relative merits of LISP, along with some general philosophy about personal computing. . . .CPM

Articles Policy

BYTE is continually seeking quality manuscripts written by individuals who are applying personal computer systems, designing such systems, or who have knowledge which will prove useful to our readers. For a more formal description of procedures and requirements, potential authors should send a large (9 by 12 inch, 30.5 by 22.8 cm), self-addressed envelope, with 28 cents US postage affixed, to BYTE Author's Guide, 70 Main St, Peterborough NH 03458.

Articles which are accepted are purchased with a rate of up to \$50 per magazine page, based on technical quality and suitability for BYTE's readership. Each month, the authors of the two leading articles in the reader poll (BYTE's Ongoing Monitor Box or "BOMB") are presented with bonus checks of \$100 and \$50. Unsolicited materials should be accompanied by full name and address, as well as return postage. ■

Pascal has reached critical mass; it has flashed through the mainframe, minicomputer, and now the microcomputer field. It has much to support its popularity; however, it represents but one point of view about computing.

This discussion offers a contrasting position, as "personified" by LISP. I will discuss not relative expressive power or syntax, but rather that the forces and attitudes which shaped the languages (and the kinds of problems which the languages address) represent diverse views of computation. In the 1969 Software Engineering Conference, Niklaus Wirth (creator of Pascal) said:

I would like to discuss the trend towards conversationality in our tools. There has been, since the development of timesharing and on line consoles, a very hectic trend towards development of systems which allow the interactive development of programs. Now this is certainly nice in a way, but it has its dangers, and I am particularly wary of them because this conversational usage has not only gained acceptance among software engineers but also in universities where students are trained in programming. My worry is that the facility of quick response leads to sloppy working habits and, since the students are going to be our future software engineers, this might be rather detrimental to the field as a whole.

Wirth was addressing programming development in particular, but the question of "sloppy work habits" has a broader connotation. Many industrial and educational personnel still question the viability of interactive composition of any kind of text. Supposedly on line composition is wasteful and inefficient; one should carefully think out the text, writing it out in longhand or by typewriter, then revise and amend, cut and

Continued on page 212

"My Shugart followed me home."



"After working all day with the computer at work, it's a kick to get down to Basic at home. And one thing that makes it more fun is my Shugart minifloppy™. We use Shugart drives at work, so when I bought my own system I made sure it had a minifloppy drive.

"Why? Shugart invented the minifloppy. The guys who designed our system at work tell me that Shugart is the leader in floppy design and has more drives in use than any other manufacturer. If Shugart drives are reliable enough for hard-working business computers, they've got to be a good value for my home system.

"When I'm working on my programs late at night, I can't wait for cassette storage. My minifloppy gives me fast random access and data

transfer. The little minidiskettes™ store plenty of data and file easily too.

"I made the right decision when I bought a system with the minifloppy. When you lay out your own hard-earned cash, you want reliability and performance. Do what I did. Get a system with the minifloppy."

If it isn't Shugart, it isn't minifloppy.

 **Shugart**

435 Oakmead Parkway, Sunnyvale, California 94086

For a list of manufacturers featuring Shugart's minifloppy in their systems, circle reader response number.

TM minifloppy is a registered trademark of Shugart Associates

Here it is at last... **THE FIRST FLOPPY DISK BASED COMPUTER FOR UNDER \$1000**



The C1P MF
\$995



- Complete mini-floppy computer system
- 10K ROM and 12K RAM
- Instant program and data retrieval

The Challenger 1P Mini-disk system features Ohio Scientific's ultra-fast BASIC-in-ROM, full graphics display capability and a large library of instant loading personal applications software on mini-floppies including programs for entertainment, education, personal finance, small business and now *home control!*



The C1P MF configuration is very powerful. However, to meet your growth needs it can be directly expanded to 32K static RAM and a second floppy by simply plugging these options in. It also supports a printer, modem, real time clock and AC remote interface as well as the OS-65D V3.0 development oriented operating system.

Or Start with the C1P CASSETTE BASED Computer for just \$349.

The cassette based Challenger 1P offers the same great features of the mini-disk system including a large software library except it has 4K RAM and conservative program retrieval time. Once familiar with personal computers, you'll be anxious to expand your system to the more powerful C1P MF.

You can move up to mini-disk performance at any time by adding more memory and the disk drive. Contact your local Ohio Scientific dealer or the factory today.

*Both systems require a video monitor, modified TV or RF converter and home television for operation. Ohio Scientific offers the AC-3 combination 12" black and white TV/monitor for use with either system at \$115.00 retail.

All prices, suggested retail.

OHIO SCIENTIFIC

1333 S. CHILLICOTHE RD., AURORA, OHIO 44202 (216) 562-3101



Here's how you can be fully computerized for so much less than you thought

BUSINESS — EDUCATION — ENGINEERING — MANUFACTURING

We are pleased to announce the first professional time-sharing system in the microcomputer field.

Naturally, it's from Cromemco.

This new multi-user system will do all of the tasks you usually associate with much more expensive time-sharing computers. Yet it's priced at an almost unbelievably low figure.

Look at these features:

- You can have up to 7 terminals plus a fast, 132-column line printer
- You can have a large system RAM memory that's expandable to 1/2 megabyte using the Bank Select feature
- Each user has an independent bank of RAM
- You can have floppy disk storage of up to 1 megabyte
- You have confidentiality between most stations
- And, make no mistake, the system is fast and powerful. You'll want to try its fast execution time yourself.



PROGRAMMERS LOVE OUR BASIC

This new system is based on Cromemco's well-known System Three Computer and our new Multi-User BASIC software package.

Programmers tell us that Cromemco Multi-User BASIC is the best in the field. Here are some of its attractions:

- You can use long variable names and labels up to 31 characters long — names like "material on order" or "calculate speed reduction."
- You get many unusual and helpful commands that simplify programs and execution — commands such as PROTECT, LIST VARIABLES, NOLIST, and many more.

- No round-off error in financial work (because our BASIC uses binary-coded decimal rather than binary operation). And we've still been able to make it FAST.
- Terminals and printer are interrupt-driven — no additional overhead until key is pressed.
- The conveniences in this Multi-User BASIC make it much easier to write your own application software.
- A line editor simplifies changes.

BENCHMARK IT — NOW

In the final analysis, the thing to do is see this beautiful new system at your dealer. See its rugged professional quality. Evaluate it. Benchmark it for speed with your own routine (you'll be agreeably surprised, we guarantee you).

Find out, too, about Cromemco's reputation for quality and engineering.

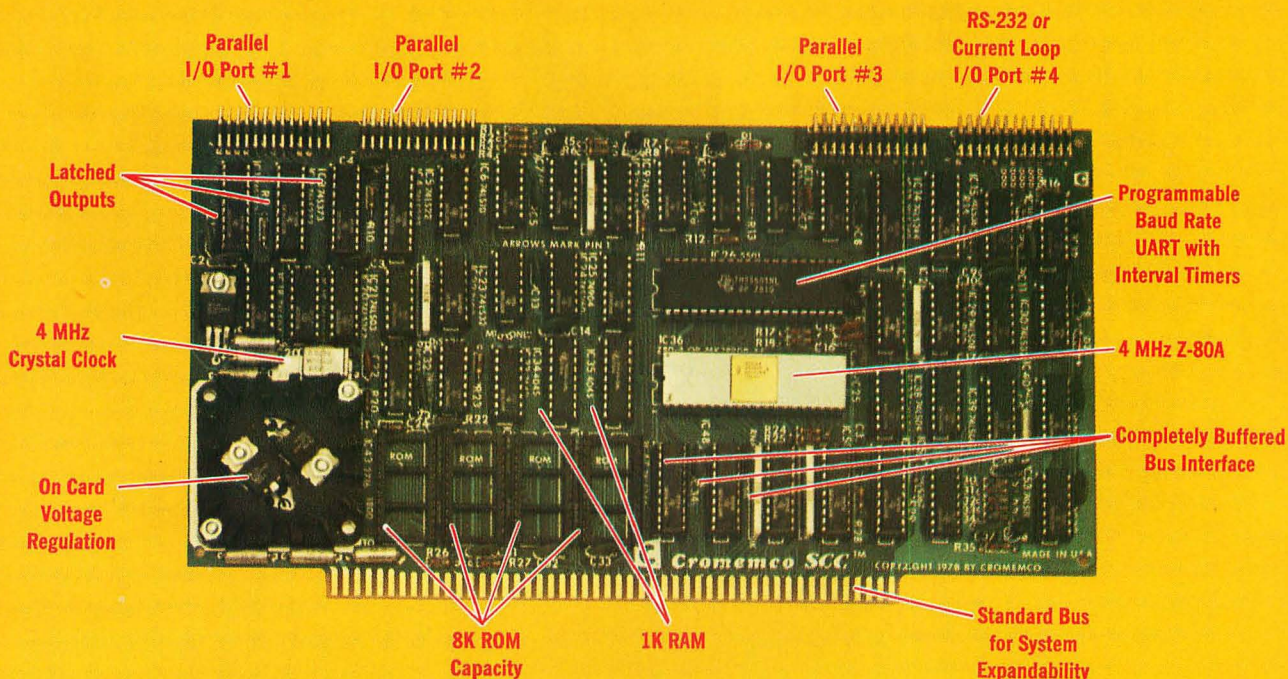
Look into it now because you can have the capabilities of a fully computerized operation much quicker and for much less than you ever thought.



Cromemco
i n c o r p o r a t e d

Microcomputer Systems

280 BERNARDO AVE., MOUNTAIN VIEW, CA 94040 • (415) 964-7400



The single card computer with the features that help you in real life

COMPLETE COMPUTER

In this advanced card you get a professional quality computer that meets today's engineering needs. And it's one that's complete. It lets you be up and running fast. All you need is a power supply and your ROM software.

The computer itself is super. Fast 4 MHz operation. Capacity for 8K bytes of ROM (uses 2716 PROMs which **can be programmed by our new 32K BYTESAVER[®]** PROM card). There's also 1K of on-board static RAM. Further, you get straightforward interfacing through an RS-232 serial interface with ultra-fast speed of up to 76,800 baud — software programmable.

Other features include 24 bits of bi-directional parallel I/O and five on-board programmable timers.

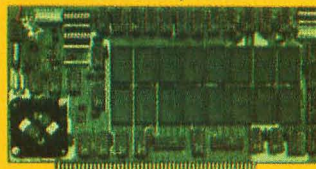
Add to that vectored interrupts.

ENORMOUS EXPANDABILITY

Besides all these features the Cromemco single card computer gives you enormous expandability if you ever need it. And it's easy to expand. First, you can expand with the new Cromemco 32K BYTESAVER PROM card mentioned above. Then there's Cromemco's broad line of S100-bus-compatible memory and I/O interface cards. Cards with features such as relay interface, analog interface, graphics interface, optoisolator input, and A/D and D/A conversion. RAM and ROM cards, too.



Card Cage



32K BYTESAVER PROM card

EASY TO USE

Another convenience that makes the Model SCC computer easy to use is our Z-80 monitor and 3K Control BASIC (in two ROMs). With this optional software you're ready to go. The monitor gives you 12 commands. The BASIC, with 36 commands/functions, will directly access I/O ports and memory locations — and call machine language subroutines.

Finally, to simplify things to the ultimate, we even have convenient card cages. Rugged card cages. They hold cards firmly. No jiggling out of sockets.

AVAILABLE NOW/LOW PRICE

The Cromemco Model SCC is available now at a low price of only \$450 factory assembled (\$395 kit).

So act today. Get this high-capability computer working for you right away.



Cromemco
i n c o r p o r a t e d

Specialists in computers and peripherals

280 BERNARDO AVE., MOUNTAIN VIEW, CA 94040 • (415) 964-7400

The Personal Computer Line by OHIO SCIENTIFIC

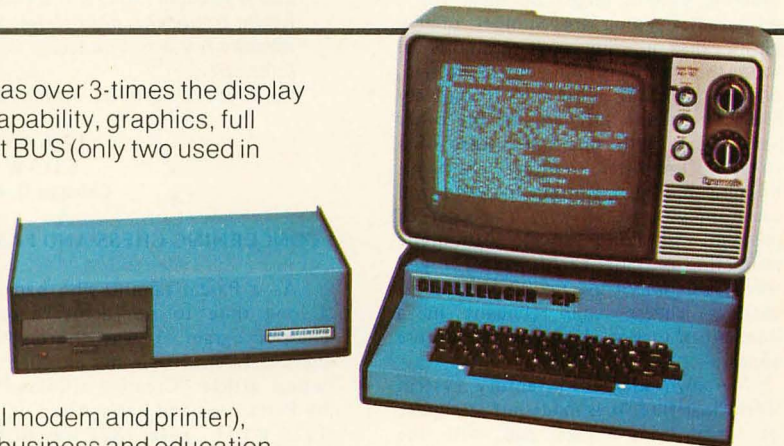


C1P: \$349! A dramatic breakthrough in price and performance. Features OSI's ultra-fast BASIC-in-ROM, full graphics display capability, and large library of software on cassette and disk, including entertainment programs, personal finance, small business, and home applications. It's a complete programmable computer system ready to go. Just plug-in a video monitor or TV through an RF converter, and be up and running. 15K total memory including 8K BASIC and 4K RAM — expandable to 8K.

C1P MF: \$995! First floppy disk based computer for under \$1000! Same great features as the C1P plus more memory and instant program and data retrieval. Can be expanded to 32K static RAM and a second mini-floppy. It also supports a printer, modem, real time clock, and AC remote interface, as well as OS-65D V3.0 development disk operating system.

C2-4P: \$595! The professional portable that has over 3-times the display capability of 1P's. Features 32 x 64 character display capability, graphics, full computer type keyboard, audio cassette port, and 4 slot BUS (only two used in base machine). It has 8K BASIC, 4K RAM, and can be expanded to 32K RAM, dual mini-floppies and a printer.

C2-4P MF: \$1599! It's a big personal computing mini-floppy system at a special package price. Contains the famous C2-4P microcomputer with 20K static RAM, 5" mini-floppy unit for instant program and data loading, RS-232 circuitry (for optional modem and printer), and four diskettes featuring exciting games, personal, business and education applications.



C2-8P: \$799! The personal class computer that can be expanded to a full business system. Has all the features of the C2-4P plus an 8 slot BUS (3-times greater expansion ability than the C2-4P). Can be expanded to 48K RAM, dual floppies, hard disk, printer and business software.

C2-8P DF: \$2599! A full business system available at a personal computer price! The system includes the powerful C2-8P microcomputer (32K RAM expandable to 48K), dual 8" floppy unit (stores 8-times as much information as a mini-floppy), and 3 disks of personal, educational and small business applications software. Has all the capabilities of a personal system including graphics plus the ability to perform Accounting, Information Management, and Word Processing tasks for small business. Contact your local Ohio Scientific dealer.

All prices, suggested retail

OHIO SCIENTIFIC

America's largest full-line microcomputer manufacturer
1333 S. CHILLICOTHE RD., AURORA, OHIO 44202 (216) 562-3101

Letters

OF KITCHENS AND COMPUTERS

As a data processing professional of twelve years experience, I have come to have great respect for the principle: "Don't make things more complicated than they are." In particular, this means don't put applications on a computer if they are more easily done some other way, no matter how much you like computers. I refer in particular to Richard Shuford's "Proposal for a Kitchen Inventory System, or Don't Byte the Wand that Feeds You" (December 1978 BYTE, page 184).

An automated food inventory and ordering system might be ideal for a restaurant. Feeding large numbers of people means ordering large amounts of food; the cost of running out of an item, or of overstocking perishables is relatively high. The home kitchen, on the other hand, deals with small quantities of a virtually unlimited number of items. Impulse buying is frequent, and will cause menus to change. The cost of mistakes is fairly small. Automatic reordering is fraught with danger — just when you *finally* use up the last can of cheddar cheese soup (bought in a moment of madness), *shazam*; four more appear.

My own kitchen inventory system works just fine. It is made out of a piece of paper from a legal pad, with the words CHOPIN LISZT (sorry about that) printed across the top, affixed to the door of my refrigerator with a bar magnet. The input device is a number two pencil.

There are thousands of applications which lend themselves to automation very well, and many where nothing else will do — but a computerized shopping list isn't one of them. For computers and computerists to gain the respect (and avoid the enmity) of the rest of the world, we need to be simplifiers, not complicators. So please, don't make things any more complicated than they are!

Bob Brown
Medical Association of Georgia
938 Peachtree St NE
Atlanta GA 30309

The kitchen inventory system may not be every family's cup of tea. My own buying habits are regular enough that the system may help; perhaps yours are not. Impulse purchases do not necessarily disrupt the system. The user may simply choose not to scan a product which is not to be restocked.

In a related communication, Mr Brown advises us that a reprint of "The Characteristics and Decodability of the Universal Product Code" which appeared in the IBM Systems Journal, volume 14, number 1, is available as form G321-5002 for \$0.50 from IBM's General Systems Division offices . . . RSS

COMPUTER HUMOR

Perhaps your readers will enjoy the following bit of doggerel. Every once in a while my husband Pat comes up with a good one like the one below:

*Count Dracula's micro, it seems,
Would trouble his diurnal dreams.
What he felt was, you see,
Inferiority,
For it got all its bytes without screams.*

Leah O'Connor
6315 W Raven
Chicago IL 60646

CONCERNING CHESS AND PASCAL

As a Pascal fanatic who had waited a long time to run across a readable chess program, I was thoroughly delighted to find that the excellent theoretical article "Creating a Chess Player" by Peter Frey and Larry Atkin (October 1978 BYTE, page 182) was to be followed by a complete Pascal listing that put the principles into practice. Having said that, may I be allowed to voice a few minor reservations?

First, although the authors are in general admirably clear about separating machine dependent and machine independent code, I feel they should have made clear that the contorted treatment of bit boards results from a machine dependent implementation restriction: in CDC Pascal, sets may not have more than 59 elements, so that a bit board must be represented as two sets of 32 elements. Other implementations, such as UCSD Pascal, do not have this restriction, so that the bit board manipulations which form the backbone of the program may be represented much more naturally. Thus, IORRS (INRS, INRS, IMRS) could become simply INRS := INRS + IMRS.

Secondly, I find that the program does not exploit Pascal's self-documenting potential as much as it might, because the authors chose a cryptic naming convention instead of using mnemonics. After ten hours of intensive study,

Continued on page 226

See Sol[®] at all these fine computer centers

AL: Birmingham: Computer Center Inc., (205) 942-8567. CA: Costa Mesa: Orange County Computer Center, (714) 646-0221. Los Angeles: Computers Are Fun, (213) 475-0566. Modesto: Computer Magic, (209) 527-5156. Mountain View: Digital Deli, (415) 961-2670. San Rafael: The Byte Shop, (415) 457-9311. Walnut Creek: MicroSun Computer Center, (415) 933-6252. CT: Bethel: Technology Systems, (203) 748-6856. FL: Ft. Lauderdale: Byte Shop of Ft. Lauderdale, (305) 561-2983. Miami: Byte Shop of Miami, (305) 264-2983. Tampa: MicroComputer Systems, (813) 879-4301. IL: Lombard: Midwest Microcomputer, (312) 495-9889. IA: Davenport: Memory Bank, (319) 386-3330. MA: Walpham: Computer Power, (617) 890-4440. MD: Silver Springs: Computers Etc., (301) 588-3748. Towson: Computers Etc., (301) 296-0520. MO: Florissant: Computer Country, (314) 921-4434. NH: Nashua: Computerland of Nashua, (603) 889-5238. NJ: Cherry Hill: Computer Emporium, (609) 667-7555. Iselin: Computer Mart of New Jersey, (201) 283-0600. NY: Endwell: The Computer Tree, (607) 748-1223. Syracuse: Computer Shop of Syracuse, (315) 637-6208. White Plains: The Computer Corner, (914) 949-3282. NC: Raleigh: ROM's 'N' RAM's, (919) 781-0003. OH: Akron: The Basic Computer Shop, (216) 867-0808. OR: Beaverton: Byte Shop Computer Store, (503) 644-2686. Portland: Byte Shop Computer Store, (503) 223-3496. PA: King of Prussia: Computer Mart of Pennsylvania, (215) 265-2580. RI: Warwick: Computer Power, Inc., (401) 738-4477. TN: Kingsport: Microproducts & Systems, (615) 245-8081. TX: Arlington: Computer Port, (817) 469-1502. Arlington: Micro Store, (817) 461-6081. Houston: Interactive Computers, (713) 772-5257. Houston: Interactive Computers, (713) 486-0291. Lubbock: Neighborhood Computer Store, (806) 797-1468. Richardson: Micro Store, (214) 231-1096. UT: Salt Lake City: Home Computer Store, (801) 484-6502. VA: McLean: Computer Systems Store, (703) 821-8333. WA: Bellevue: Byte Shop Computer Store, (206) 746-0651. Seattle: Byte Shop of Seattle, (206) 622-7196. WI: Madison: The Madison Computer Store, (608) 255-5552. Milwaukee: The Milwaukee Computer Store, (414) 445-4280. DC: Georgetown: Georgetown Computer Emporium, (202) 337-6545. CANADA: London, Ontario: The Computer Circuit Ltd., (519) 672-9370. Toronto, Ontario: Computer Mart Ltd., (416) 484-9708. Vancouver, B.C.: Basic Computer Group Ltd., (604) 736-7474. ARGENTINA: Buenos Aires: Basis Sistemas Digitales, 93-1988 or 57-7177. AUSTRALIA: Sydney: Automation Statham, (02) 709.4144. Sydney: A.J.F. Systems and Components Pty. Ltd., 8076878. BELGIUM: Bruxelles: Computer Land, 02/511.34.45. COLUMBIA: Bogota: Video National, 326650. DENMARK: Copenhagen: Peter W. Holm Trading ApF 01-543466. MEXICO: Mexico City: Industrias Digitales, (905) 524-5132. SPAIN: Barcelona: Interface S.A., (93) 301 7851. SWEDEN: Stockholm: Wernor Elektronik, (0) 8717-62-88. UNITED KINGDOM: Huntingdon, England: Comart, Ltd., (0480) 74356. London: The Byte Shop Ltd., 015542177. VENEZUELA: Los Ruices, Caracas: Componentes Y Circuitos Electronicos TTLCA, 355591.

Circle 305 on inquiry card.



Sol.® The small computer that won't fence you in.

A lot of semantic nonsense is being tossed around by some of the makers of so-called "personal" computers. To hear them tell it, an investment of a few hundred dollars will give you a computer to run your small business, do financial planning, analyze data in the engineering or scientific lab — and when day is done play games by the hour.

Well, the game part is true. The rest of the claims should be taken with a grain of salt. Only a few personal computers have the capacity to grow and handle meaningful work in a very real sense. And they don't come for peanuts.

Remember, there's no free lunch.

So before you buy any personal computer, consider Sol.® It costs more at the start but less in the end. It can grow with your ability to use it. Sol is not cheap. But it's not a delusion either.

Sol small computers are at the very top of the microcomputer

spectrum. They stand up to the capabilities of mini systems costing four times as much.

No wonder we call it the serious solution to the small computer question.

Sol is the small computer system to do the general ledger and the payroll. Solve engineering and scientific problems. Use it for word processing. Program it for computer aided instruction. Use it anywhere you want versatile computer power!

Build computer power with our software.

At Processor Technology we've tailored a group of high-level languages, an assembler and other packages to suit the wide capabilities of our hardware.

Our exclusive Extended BASIC is a fine example. This BASIC features complete matrix functions. It comes on cassette or in a disk version which has random as well as sequential files.

Processor Technology FORTRAN is similar to FORTRAN IV and

has a full set of extensions designed for the "stand alone" computer environment.

Our PILOT is an excellent text oriented language for teachers.

Sold and serviced only by the best dealers.

Sol Systems are sold and serviced by an outstanding group of conveniently located computer stores throughout the U.S. and Canada.

For more information contact your nearest dealer in the adjacent list. Or write Department B, Processor Technology, 7100 Johnson Industrial Drive, Pleasanton, CA 94566. Phone (415) 829-2600.

In sum, all small computers are not created equal and Sol users know it to their everlasting satisfaction.

Processor Technology

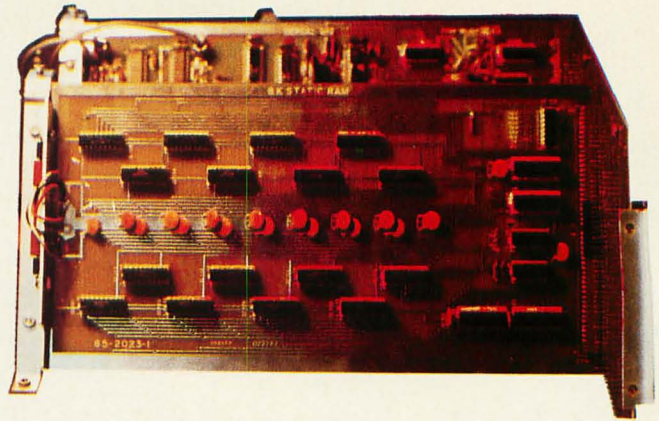


Photo 1: The H8 programmable memory board.

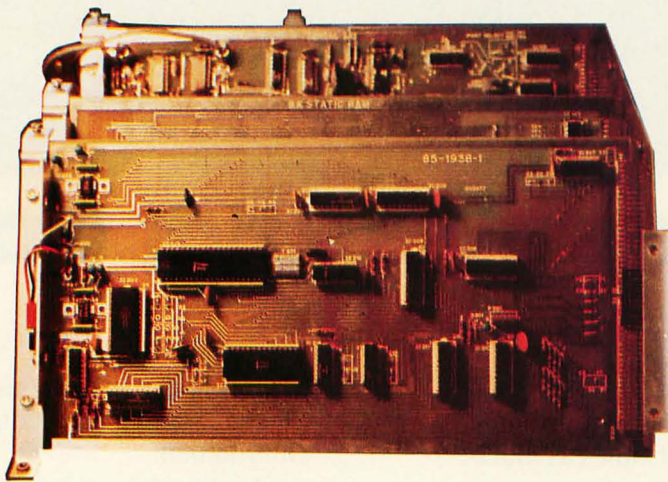


Photo 2: The H8 processor board in position in the chassis.

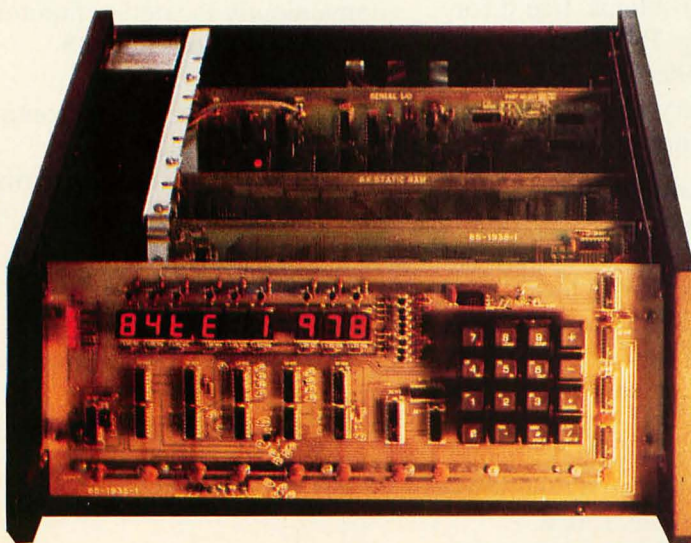


Photo 3: Assembled H8 ready for testing.

Building

Dr Paul R Poduska
21G Hampshire Dr
Nashua NH 03060

In response to growing public interest in microcomputing during the past several years, a number of microcomputer kits have been marketed.

The Heathkit H8 microcomputer represents a departure from the S-100 bus design mainstream. It has the full instruction set capabilities of other 8080A systems as well as an innovative, user oriented front panel control subsystem and a 10 position mother board; yet it does not use the type of large power supply found in some larger systems.

It was the kind of design I was hoping for. I was seriously considering the purchase of a computer for some time, and prior to the introduction of the H8, I almost did buy one. But I had a hunch that the Heath Company might resolve some of the design drawbacks that discouraged me from buying other 8 bit kits.

What follows are my experiences, thus far, of building, testing, and running this computer kit. By the time you've finished reading this article you should have a good feel for what the H8 is, what it can do, and how it compares with other kits on the market. In addition, I'll give you a few pointers and short programs that will enable you to take advantage of some of the H8's many features.

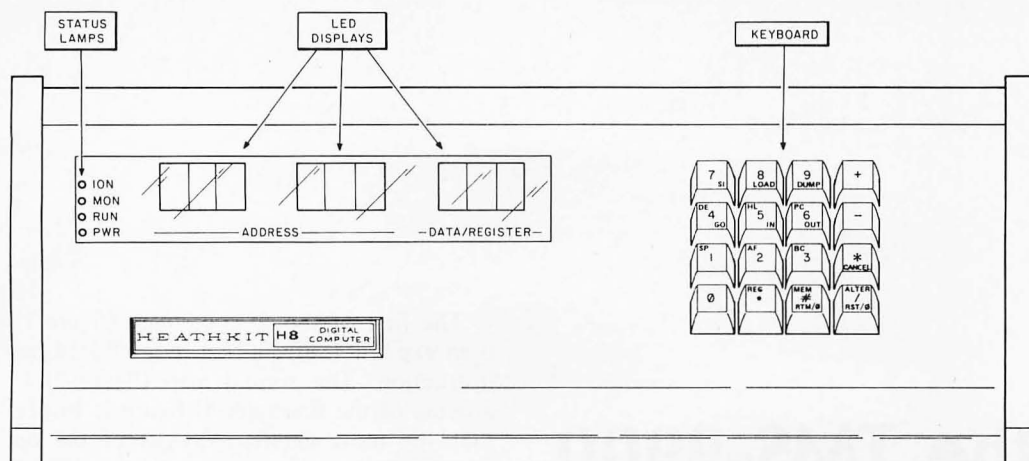


Figure 1: The Heath H8 front panel. Many of the 16 keys are multifunctional. The panel allows quick entry of data and programs into the computer. Drawn from a diagram courtesy of Heath Company.

the Heath H8 Computer

Unpacking and Building

My first few evenings with the H8 kit were leisurely spent getting acquainted with the materials and manuals. Opening the 22 lb carton, the first thing that caught my eyes was a loose slip of paper with a notice on it. It warned me to review all of the manuals supplied with the kit before putting anything together, and that if I found it to be too complicated for my knowledge and skill level, I could return it to the Heath Company for a full refund. I know of no other computer kit manufacturer who includes that kind of built-in consumer protection from the outset.

The next items were the sets of manuals and an attractive 3 ring binder to store them in. I had assembled Heathkits before and knew how thorough their documentation has always been; and I had seen some mediocre documentation provided by other companies in the computer kit industry. I found 503 pages worth of assembly and operating manuals which were far superior to any that I had seen on the market.

In all fairness, I don't feel that this point can be overemphasized. Building a microcomputer is not like building a stereo or piece of test equipment. The technology and associated hardware of a computer are unique in many ways. You may have assembled and tested electronic kits before,

but unless you've also assembled digital equipment, you probably won't be an expert on this type of hardware. If you ever need to troubleshoot your computer kit, much of your previous knowledge about *conventional* analog electronics won't be of use. Therefore, *it is important that you know what you are assembling and how to do so correctly.* You don't have to be an electronics wizard to build and operate the H8. Your chances of building a computer kit that works the first time you turn on the power are nearly 100 percent with an H8, due in part to the support services that the manufacturer provides.

After the first few evenings of studying the manuals, I found a reasonably undisturbed space and, with tools in hand, began the first stage of assembly.

The Chassis

Chassis assembly consists of installing the power supply, frame, and several accessories, including a small cone speaker. The frame is made out of heavy sheet metal on the top, bottom and back panel, and structured foam on the sides. The bottom is covered with rows of small holes necessary for the H8's convection cooling system. The ample 10 A power supply is located

Continued on page 124

A Map of the TMS-9900

Instruction Space

Henry Melton
2511 Dovemeadow
Austin TX 78744

Now that the TMS-9900 16 bit computer is being marketed to the computer experimenter, some easy way to handle its 63,480 individual op codes at a level of "hand assembly" is going to be necessary. The standard method of programming the 16 bit machine involves higher level languages, or at the very least, a good symbolic assembler. The op codes of an 8 bit machine are smaller in number and can be fairly easily memorized by a machine level programmer confined to the limited resources of hand assembly. But nearly every instruction on the TMS-9900 has to be *constructed*, calculated from the instruction's format, depending on the selected options of the moment. That is the essence of the machine's power, but it makes building and analyzing programs at a machine language level difficult. The charts in this article should help simplify the matter.

Organizing One's Approach
to a Machine
with 2^{15.95} Legal Instructions

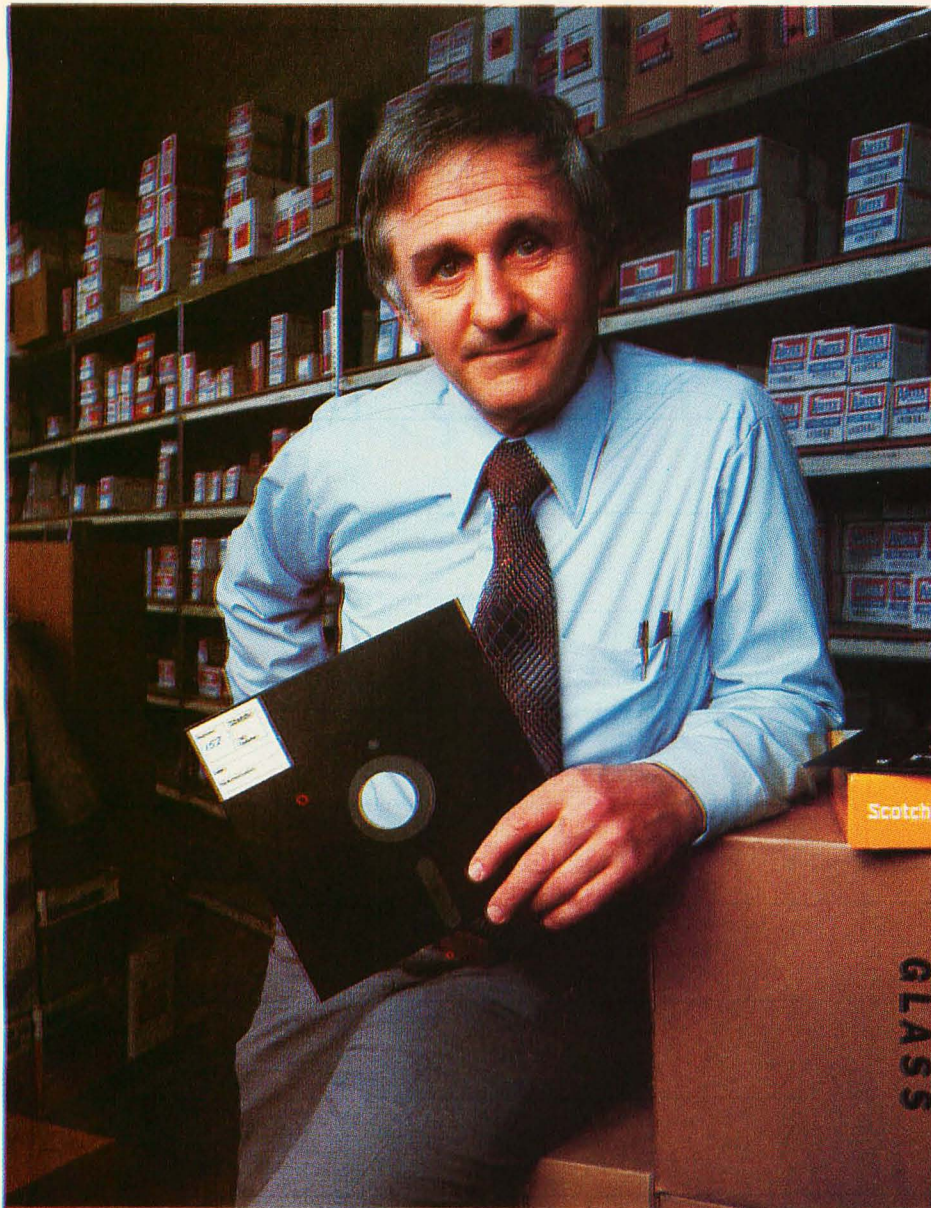
The first of the op code maps (figure 1) is an expansion of the first byte of a 16 bit instruction. The second map (figure 2) is a detail of the first rank of figure 1. Notice that the most significant digits of the op codes go down and the least significant digits go across the charts. Each block contains the mnemonic of the instruction, the format type of that instruction, and the number of variations (ie: the number of different instructions that the mnemonic represents).

For example, the instruction MOV, for MOVE WORD, has a source and a destination word address, with one of four addressing codes for each, referenced to one of the 16 registers in the workspace for each. That gives 16 times 4 times 16 times 4, or 4096 possible individual instructions. Let's take a specific example. Suppose you come across a C835 instruction in a hexadecimal program dump. You look up that code on the op code space map (figure 1 in this case). It lies in the block for instruction MOV, with an instruction format of I. Comparing C835 with format I in table 1, you find that:

Base op code	= 1100.
Address mode of destination	= 10.
Destination operand register	= 0000.
Address mode of source	= 11.
Source operand register	= 0101.

Since the destination is indexed, the word following the C835 is an address, and thus part of the instruction. The index register, however, is 0000 and the zero register isn't allowed for index mode. Thus the following address *is* the destination address without address modification. If it had been one of the other registers, the following word would have been *added* to the register value to form the indexed address. The addressing mode for the source is register 5, indirect and autoincremented. The source operand's address is in register 5. Once the operand is fetched, the address value in register 5 is incremented by 2 (since it was a word instruction and the 9900 addresses specify *bytes*). Thus the end result of the instruction is that this source operand is moved to the immediate address specified by the word following C835.

"Our inventory is our existence. Think we'd trust it to anything less than Scotch® Brand Diskettes?"



Don Stone, Vice-President,
Mass. Auto Supply Company,
Inc., Boston, Mass.

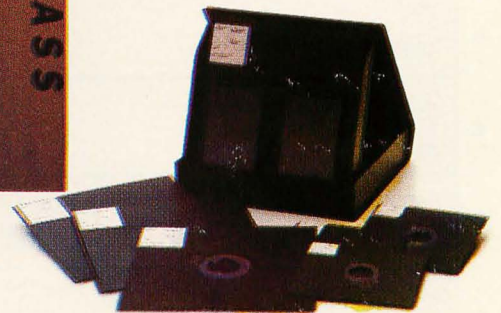
Scotch Diskettes are the diskettes you can depend upon with the information *your* business depends upon.

Each one is tested and certified error-free before it leaves our factory. Because we know nothing less than perfection is acceptable for *your* vital business data.

Scotch Diskettes are available in regular or mini sizes, compatible with almost any system.

To find out where you can find Scotch Diskettes, call toll free: 800-328-1300. (In Minnesota, call collect: 612-736-9625.) Ask for the Data Recording Products Division.

**If it's worth remembering,
it's worth Scotch
Data Recording Products.**



3M

Key

JLE — Mnemonic
 II — Tape
 256 — Number of
 possible
 op codes

Figure 1: General map of all TMS-9900 instructions. This map covers operation codes from 00XX to FFXX hexadecimal, with reference to the detail of table 2 for op codes from 00XX to 0FXX. In interpreting a machine dump in hexadecimal, the first step is to look up a 2 byte operation code in this table, or in figure 2.

	0XX	1XX	2XX	3XX	4XX	5XX	6XX	7XX	8XX	9XX	AXX	BXX	CXX	DXX	EXX	FXX
0	See figure 2															
1	JMP II 256	JLT II 256	JLE II 256	JEQ II 256	JHE II 256	JGT II 256	JNE II 256	JNC II 256	JOC II 256	JNO II 256	JL II 256	JH II 256	JOP II 256	SBO II 256	SBZ II 256	TB II 256
2	COC III 1024				CZC III 1024				XOR III 1024				XOP IX 1024			
3	LDCR IV 1024				STCR IV 1024				MPY IX 1024				DIV IX 1024			
4	SZC I 4096															
5	SCZB I 4096															
6	S I 4096															
7	SB I 4096															
8	C I 4096															
9	CB I 4096															
A	A I 4096															
B	AB I 4096															
C	MOV I 4096															
D	MOVB I 4096															
E	SOC I 4096															
F	SOCB I 4096															

Concerto in A Flat Mini.

Victor Borge demands the world's finest piano for his concert work. And when he performs at the computer keyboard, he naturally expects the best. The quality mini recording media. That's why he specifies Verbatim.

At Verbatim Corporation the whole message is quality. Our Verbatim brand diskettes, cartridges and cassettes capture your data and play it back bit for bit, byte for byte, verbatim.

Quality mini media is all we make. When you want to be sure *your* data will play, specify Verbatim.

Verbatim Corporation

FORMERLY INFORMATION TERMINALS CORP.

323 Soquel Way, Sunnyvale,
CA 94086

(408) 245-4400. TWX: 910-339-9381

For the name of your nearest
Verbatim distributor, call toll free:

(1) 800-821-7700, Ext. 515. (In
Missouri call: 800-892-7655, Ext. 515)

In Europe:
Information Terminals S.A.
Case Postale 296
1215 Genève 15
Switzerland
Telephone: 41 (22) 34-90-55
Telex: 22647 ITGE CH

In the Far East:
IT Far East Ltd.
Hayama Building 6F
3-14, 1-Chome
Hiroo, Shibuya-Ku
Tokyo 150, Japan
Tel. (03) 446-2917 Telex: J47879

PEOPLE
WHO PLAY THE
COMPUTER
**Specify
Verbatim**
MINI MAGNETIC MEDIA

Figure 2: For operation codes 00XX to 0FXX, the details of interpreting a hexadecimal dump can be further understood with the aid of this map. Once the format is determined, refer to table 1 for details of formats V, VI, VII and VIII.

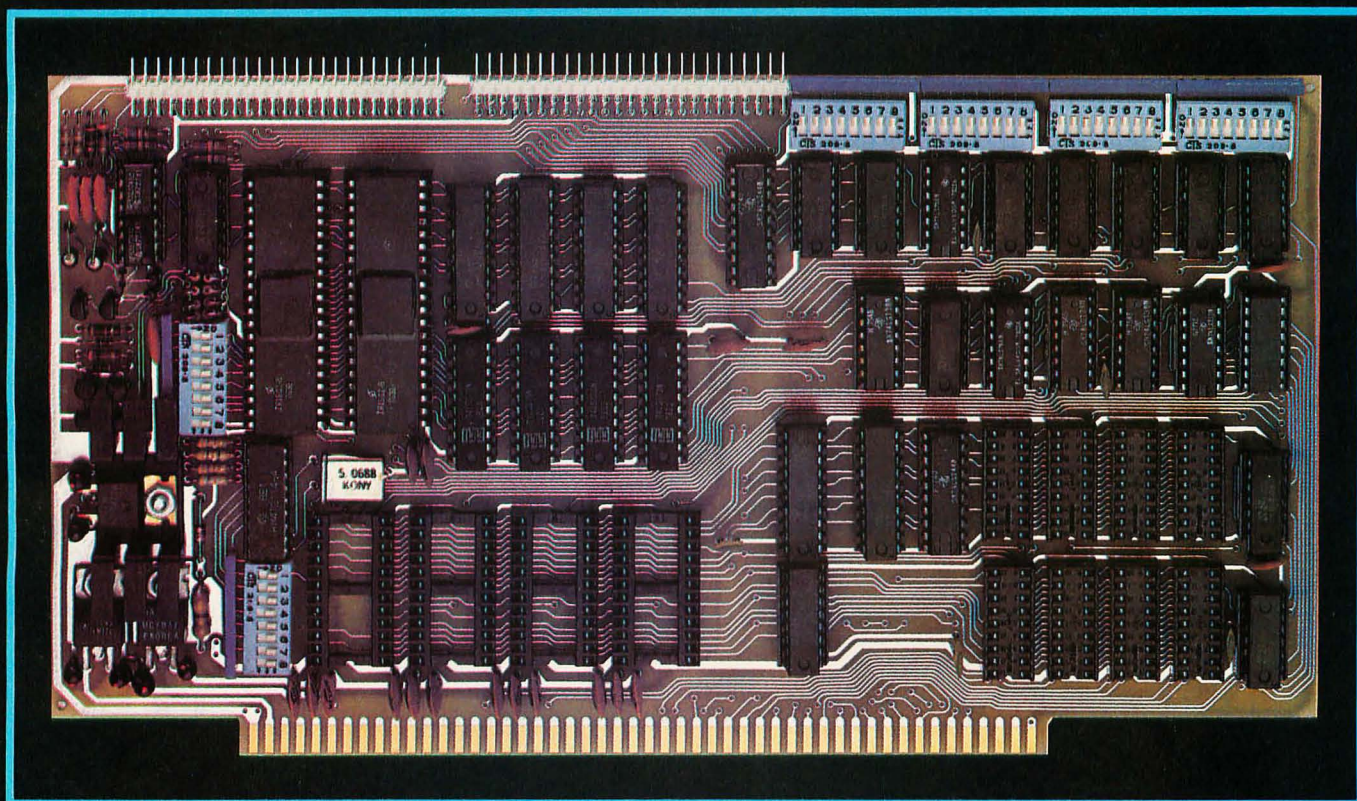
	0X	1X	2X	3X	4X	5X	6X	7X	8X	9X	AX	BX	CX	DX	EX	FX
00	Illegal op codes															
01	Illegal op codes															
02	LI VIII 16		AI VIII 16		ANDI VIII 16		ORI VIII 16		CI VIII 16		STWP VIII 16		STST VIII 16		LWPI VIII 1	
03	LIMI VIII 1				IDLE VII 1		RSET VII 1		RTWP VII 1		CKON VII 1		CKOF VII 1		LREX VII 1	
04	BLWP VI 64				B VI 64				X VI 64				CLR VI 64			
05	NEG VI 64				INV VI 64				INC VI 64				INCT VI 64			
06	DEC VI 64				DECT VI 64				BL VI 64				SWPB VI 64			
07	SETO VI 64				ABS VI 64				Illegal op codes							
08	SRA V 256															
09	SRL V 256															
0A	SLA V 256															
0B	SRC V 256															
0C	Illegal op codes															
0D	Illegal op codes															
0E	Illegal op codes															
0F	Illegal op codes															

ANNOUNCING!

the SWITCHBOARD

S-100 I/O INTERFACE

TM



4P+2S+Strobe+Attention+RAM*+EPROM*=\$199

Introducing The SwitchBoard™ I/O Interface, the most complete interface available for S-100 systems... designed by George Morrow exclusively for Thinker Toys™.

The SwitchBoard™ interface provides 4 parallel ports and 2 RS232/TTY serial ports. Plus, strobe and attention ports. Plus, on-board facilities for 4K of optional static RAM and 4K of user-supplied EPROM.

And every port is switch-programmable for total flexibility in interfacing complex peripherals... such as 12-bit daisywheel printers.

Each parallel port can be switched for input or latched output. Both serial ports can be switched to any of 16 baud rates from 110 to 19,200. Each strobe and attention port flip-flop can be switched for pos or neg pulsing.

And yet, The SwitchBoard™ Interface won't hang you up on price or delivery. In kit form, it's just \$199. \$259 assembled. 2114 4K static RAM option (4 MHz Z-80 compatible), \$70.

Ask your local computer shop to place your order immediately for priority shipping. Or, if unavailable locally, order direct from Thinker Toys™, 1201 10th St., Berkeley, CA 94710.

Or call for The SwitchBoard™ at (415) 524-2101 weekdays, 10-5 Pacific Time.

*Sockets provided; chip set optional.

A product of Morrow's Microstuff for
Thinker Toys™

Table 1: Instruction formats of the TMS-9900. This table details the fields of the TMS-9900 instructions and is used in decoding a machine dump once the instruction type has been determined from the two maps of tables 1 and 2.

		Bit Number																	
Type		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	Number	
I		Op code			B	Td		D				Ts		S				4096	
II		Op code								Displacement								256	
III		Op code					D				Ts		S				1024		
IV		Op code					C				Ts		S				1024		
V		Op code								K				W				256	
VI		Op code									Ts		S				64		
VII		Op code												N				1	
VIII		Op code												N	W			1 or 16	
IX		Op code					D				Ts		S				1024		

- B — Byte or word operation (1=byte)
 D — Destination operand register
 S — Source operand register
 W — Workspace register
 Td — Address mode of destination operand
 Ts — Address mode of source operand
 C, K — Bit or shift count
 N — Unused bits of the instruction. Set to zero.

Address Modes

Td or Ts

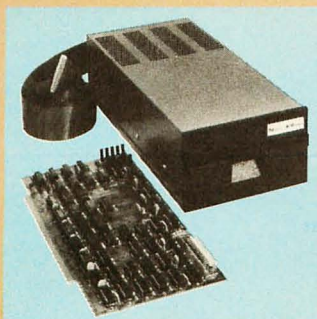
- 00 Workspace register
 01 Workspace register indirect
 10 Indexed memory
 11 Workspace register indirect, autoincrement

Hexadecimal modifiers for the Td (format I) and Ts (formats I, III, IV, VI and IX) fields. To generate an operation code reflecting the given addressing mode, add the hexadecimal values listed in this table:

Addressing Mode	Td	Ts
Workspace register	0000	0000
Workspace register indirect	0400	0010
Indexed memory (symbolic)	0800	0020
Workspace register indirect with autoincrement	0C00	0030

Shifted register or count values for D (formats I, III and IX), C (format IV) and K (format V) fields. In constructing operation codes for these formats, the modifiers for the register or count values indicated are added to the base op code from table 4:

Register or Count	D (C)	K
0	0000	0000
1	0040	0010
2	0080	0020
3	00C0	0030
4	0100	0040
5	0140	0050
6	0180	0060
7	01C0	0070
8	0200	0080
9	0240	0090
10	0280	00A0
11	02C0	00B0
12	0300	00C0
13	0340	00D0
14	0380	00E0
15	03C0	00F0



Specifications:

S-100 compatible. MFM encoding, 35 tracks with ten 512-byte sectors per track. 179,200 bytes on double density SA-400 and North Star BASIC, DOS, and Monitor included.

For further information, write for full color catalog or contact your local computer store.

New from North Star Double Density Performance at Single Density Prices

The new HORIZON computer and Micro Disk System now record in double density! That means each new Shugart SA-400 minifloppy disk drive accesses 180K bytes of on-line information. All double density HORIZON computers and Micro Disk Systems have a redesigned controller which allows the use of quadruple capacity disk drives as they become available in early 1979. A three-drive North Star System with quadruple capacity disk drives will access over a megabyte of on-line information. But, best of all there's no price increase for double density models.

North Star BASIC and DOS have been upgraded to accommodate the increased capacity and yet run existing programs with little or no change. The new disk system also supports single

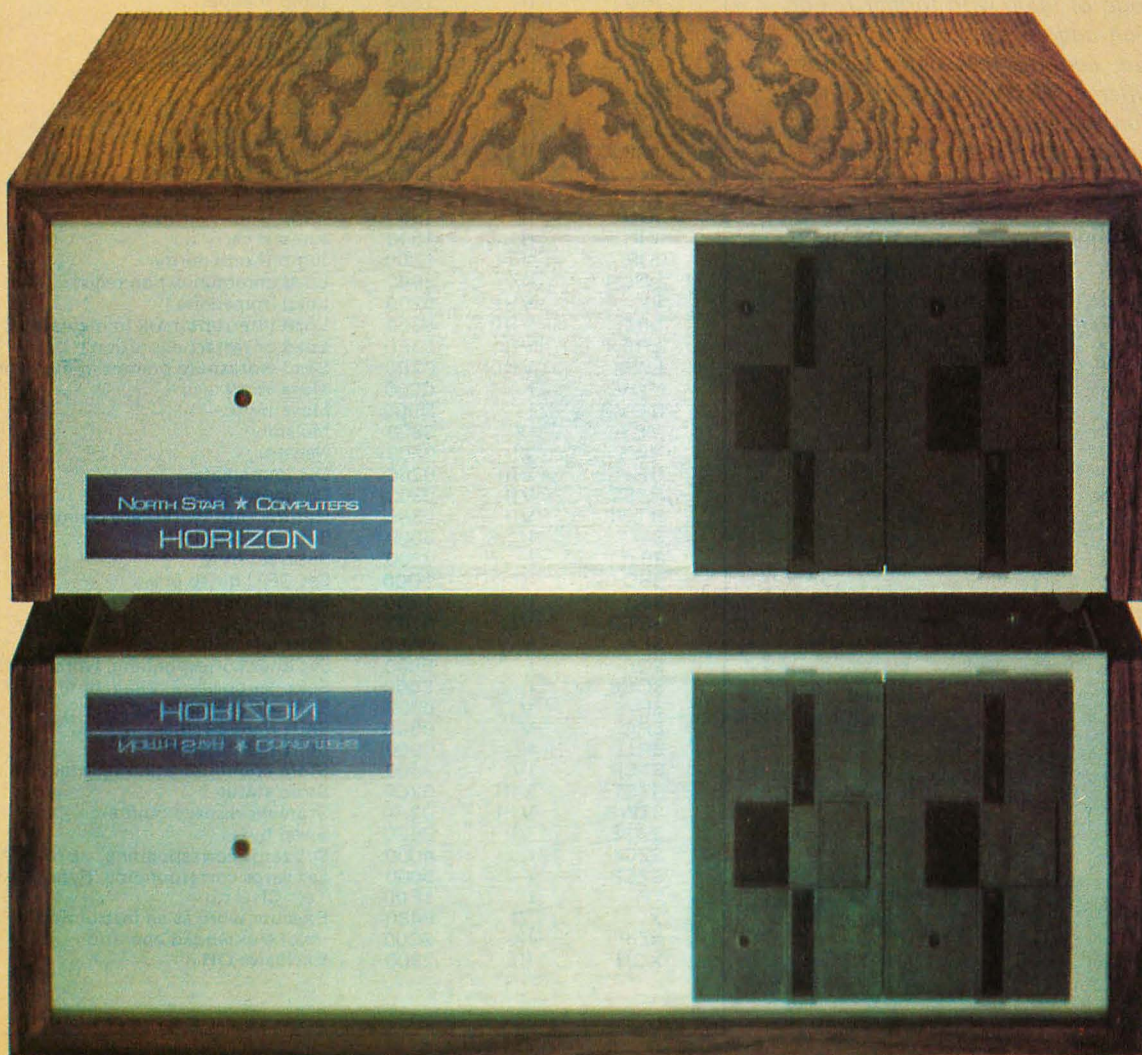
density, so existing single density diskettes can still be used. Single density SA-400 drives previously purchased with North Star systems can also be used.

Pricing

HORIZON with one double density SA-400 minifloppy (180K bytes), 16K RAM, Z80A processor and serial I/O port: \$1599 kit, \$1899 assembled.

MICRO DISK SYSTEM with one double density SA-400 minifloppy, controller board and power regulation: \$699 kit, \$799 assembled. (Cabinet and power supply \$39 extra each.)

NORTH STAR ★ COMPUTERS
2547 Ninth Street
Berkeley, California 94710
(415) 549-0858



TMS-9900 Alphabetical Instruction List

Mnemonic	Format	Hexadecimal	
		Base Op Code	Semantics
A	I	A000	Add words
AB	I	B000	Add bytes
ABS	VI	0740	Absolute value
AI	VIII	0220	Add immediate
ANDI	VIII	0240	AND immediate
B	VI	0440	Branch
BL	VI	0680	Branch and link
BLWP	VI	0400	Branch and load workspace pointer
C	I	8000	Compare words
CB	I	9000	Compare bytes
CI	VIII	0280	Compare immediate
CKOF	VII	03C0	Clock off
CKON	VII	03A0	Clock on
CLR	VI	04C0	Clear operand
COC	III	2000	Compare ones corresponding
CZC	III	2400	Compare zeros corresponding
DEC	VI	0600	Decrement by one
DECT	VI	0640	Decrement by two
DIV	IX	3C00	Divide
IDLE	VII	0340	Computer idle (ie: no operation)
INC	VI	0580	Increment by one
INCT	VI	05C0	Increment by two
INV	VI	0540	Invert
JEQ	II	1300	Jump if equal
JGT	II	1500	Jump if greater than
JH	II	1B00	Jump if high
JHE	II	1400	Jump if high or equal
JL	II	1A00	Jump if low
JLE	II	1200	Jump if low or equal
JLT	II	1100	Jump if less than
JMP	II	1000	Jump unconditional
JNC	II	1700	Jump if carry off
JNE	II	1600	Jump if not equal
JNO	II	1900	Jump if no overflow
JOC	II	1800	Jump if carry on
JOP	II	1C00	Jump if odd parity
LDCCR	IV	3000	Load communication register
LI	VIII	0200	Load immediate
LIMI	VIII	0300	Load interrupt mask immediate
LREX	VII	03E0	Load or restart execution
LWPI	VIII	02E0	Load workspace pointer immediate
MOV	I	C000	Move word
MOVB	I	D000	Move byte
MPY	IX	3800	Multiply
NEG	VI	0500	Negate
ORI	VIII	0260	OR immediate
RSET	VII	0360	Computer reset
RTWP	VII	0380	Return with workspace pointer
S	I	6000	Subtract word
SB	I	7000	Subtract byte
SBO	II	1D00	Set CRU bit to one
SBZ	II	1E00	Set CRU bit to zero
SETO	VI	0700	Set word to ones (FFFF)
SLA	V	0A00	Shift left arithmetic
SOC	I	E000	Set ones corresponding, word (OR)
SOCB	I	F000	Set ones corresponding, byte (OR)
SRA	V	0800	Shift right arithmetic
SRC	V	0B00	Shift right circular
SRL	V	0900	Shift right logical
STCR	IV	3400	Store communication register
STST	VIII	02C0	Store status
STWP	VIII	02A0	Store workspace pointer
SWPB	VI	06C0	Swap bytes
SZC	I	4000	Set zeros corresponding, word (\bar{S} AND D)
SZCB	I	5000	Set zeros corresponding, byte (\bar{S} AND D)
TB	II	1F00	Test CRU bit
X	VI	0480	Execute word as an instruction
XOP	IX	2C00	Invoke extended operation
XOR	III	2800	Exclusive OR

Table 2: Going the other way; this list of the complete TMS-9900 instruction set shows the format and semantics of each operation possible with the machine. The base operation code, in hexadecimal, is modified by arithmetic addition of appropriate codes for details of the instruction as shown in table 1. Thus for example, to generate the code for comparing bytes between two absolute memory addresses this table gives a base op code of 9000 with format I. For the destination address field, a modifier of 800 is added, and for the source address field a modifier of 020 is added, yielding a net instruction value of 9820 for comparing two bytes at arbitrary memory addresses. Information for this table is taken from appendix E of the January 1976 reissue of the TI Model 990 Computer and TMS-9900 Microprocessor Assembly Language Programmer's Guide, document manual number 943441-9701, eliminating operations not applicable to the TMS-9900. ■



HOW TO STAY ON TOP

Controlling Your World

Staying on top means keeping things under control. And, when it comes to staying on top of your applications world, we've got a way for you to do it at low cost.

Whether your particular application is business, professional or scientific systems, you can stay right on top of it with the DYNABYTE DB8/2 microcomputer.

Designed For Value. . .

When we designed the DB8/2, we knew that it had to be a dependable performer in handling large quantities of information. So, every design decision was made with quality and dependability in mind. The DB8/2 is a first-class producer.

For example, it uses two quad density 5.25-inch disk drives with our exclusive Dual Density Disk Controller for up to 1.2 megabytes of formatted storage. That gives you more capacity than two single-density 8-inch drives which means a lower cost per kilobyte. The DYNABYTE DB8/2 is the first microcomputer to offer enough storage capacity on 5.25-inch disk drives to fully utilize CP/M,* the most widely accepted disk operating system.

We also supply and support BASIC, FORTRAN and COBOL programming languages. As for applications, packages include general ledger, accounts receivable, accounts payable, word processing and many other CP/M compatible programs.

. . .For Dependability

We've also built in reliability with edge connectors that meet military specifications and a regulated power supply built to U.L. standards. Your DB8/2 will be cool and dependable.

Before we ship it to you, we conduct factory test and burn-in programs to assure reliability of the entire integrated system.

. . .For You

You'll stay on top through our customer support too. The DB8/2 is completely modular to allow speedy support in the field; and our bonded inventory of all subsystem modules means we can deliver replacement subassemblies overnight to almost anywhere in the U.S..

There's More

The DB8/2 has a 4MHz Z-80 processing module with 10 internal timers, interrupt control, real time clock, one parallel and

two RS232 or current loop serial ports with software selectable baud rates from 110 baud to 76800 baud; 32K of RAM, expandable to 64K without paging and up to 176K with paging; a 12-slot, fully-socketed backplane; preregulated 30 amp power supply.

If you need more storage, our DB8/4 Disk System is the mass storage companion to our DB8/1 microcomputer and includes two 8-inch floppy disk drives in either single or double-sided configuration for up to 2 megabytes of mass storage. Like the DB8/2, the combination of the DB8/1 and DB8/4 features our Dual Density Disk Controller, CP/M, 32K of RAM expandable to 176K, 2 serial I/O Ports and 1 parallel I/O port.

All three systems are designed to help you stay on top.

For more information, call Rick Mehrlich at (415) 965-1010, or see your local computer dealer.

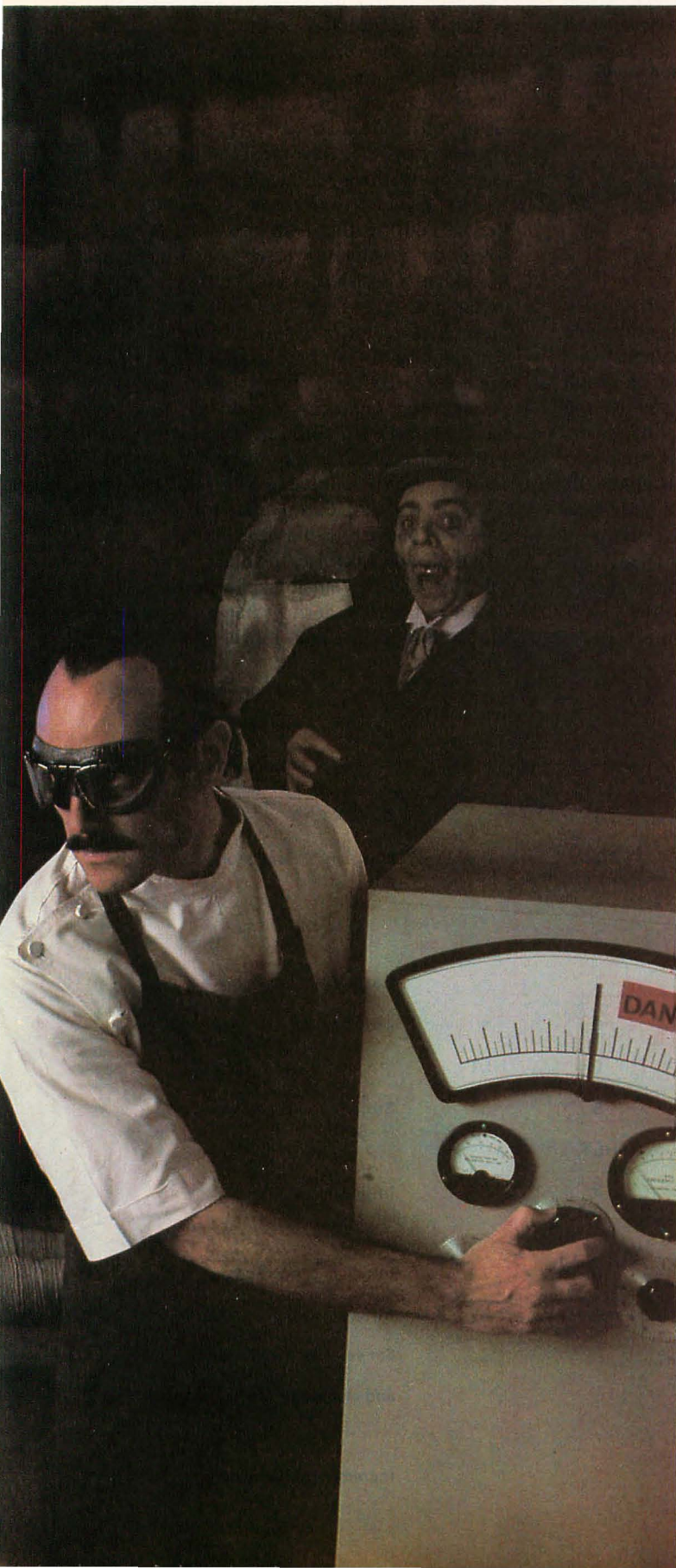
*CP/M is a trademark of Digital Research
1005 Elwell Ct., Palo Alto, CA 94303 (415) 965-1010

DYNABYTE

Why were all those



scientists of the '30s so mad?



That's easy. Because all they ever got was defective or missing parts, inferior workmanship, and garbled instructions. Sound familiar?

CCS: Here to Deliver

We're California Computer Systems. We'll deliver to you what old Doc ordered and never received. Kits without missing parts. Defect-free workmanship backed by years of solid experience. Quality engineering throughout. And easy-to-decipher support documentation.

Electronics mavericks will appreciate us. We intend to back the true computer hobbyist who wants to do his own S-100 system with everything from a bare metal box to etch and wire-wrap boards suitable for designing original circuits.

For All S-100, TRS-80* & Apple† Users

We can offer memories, I/Os and video products to S-100 users. And both TRS-80 and Apple enthusiasts are represented in our philosophy.

Remember our name—California Computer Systems—and look for our decal on display at a nearby computer store. It's your sure sign of complete satisfaction.

For additional information about CCS or any of its fantastic products, just write:



California Computer Systems

309 Laurelwood Road, Unit 18
Santa Clara, CA 95050



Circle 37 on inquiry card.

So Nobody Goes Away Mad.

*TRS-80 is a registered trademark of Radio Shack, a Tandy Co.
†Apple is a registered trademark of Apple Computers, Inc.



John E Bertsch
8677 Vickie Lynn Ln
Apt 9
Brighton MI 48116

Race Car for the SR-52

Race Car is a game of skill written for the Texas Instruments SR-52 programmable calculator, in which the player maneuvers a car around a race track drawn on graph paper. The object of the game is to drive the car from the start to the finish line in the best possible time without leaving the track. The program calculates the coordinates of the car based on steering, throttle and brake information entered by the driver. Players can choose to go left, straight or right (relative to the driver's seat), and to accelerate, brake or cruise. Each time the player makes a move, 1 second of time elapses.

For each move, the program calculates the X and Y coordinates of the car's new position and the elapsed time. The player simply plots the car's position and makes the new move based on the present position. Using different colored pens, two or more players can race on the same track and compete for the best finishing time.

The program moves the coordinates of the car during the 1 second time interval based on a velocity vector constructed by the player's decisions. Left and right steering increments are fixed at $+15^\circ$ and -15° , respectively. For example, if you go left, the velocity vector is rotated $+15^\circ$ from its present direction. The acceleration and deceleration constants are $+1$ division per second² and -1 division per second². If you wish to accelerate, the magnitude of the velocity vector is increased by one and the distance traveled during that move will be one division farther than the previous move. If you decide to cruise, the magnitude of the velocity vector remains constant and the distance traveled during that move will be the same as the previous move.

Text continued on page 30

Listing 1: The Race Car program, written for the SR-52.

Loc	Keys						Commentary
000	*LBL	*C'	STO	0	1		Store XX.YY.
005	INV	*D.MS	INV	*D.MS	*fix	0	Mask off YY and store XX.
011		*D.MS	INV	*fix			
014		STO	0	3			
017	+/-	+	RCL	0	1	=	Get XX.YY, mask off XX
023		x	1	0	0	=	and store YY.
028		STO	0	4	0	HLT	
033	*LBL	*D'	STO	0	5		Store the starting angle.
038		0	INV	*fix	HLT		
042	*LBL	*E'	RCL	0	3		Initialize X position.
047		STO	0	6			
050	RCL	0	4	STO	0	7	Initialize Y position.
056	RCL	0	5	STO	0	8	Initialize velocity angle.
062	0	STO	0	9			Set velocity magnitude
066		STO	1	0			and elapsed time = 0.
069	GTO	*A'					
071	*LBL	A	1	5			Increment velocity angle

"If this M-XVI from CCS had been available in the '30s, I would have had the secret of invisibility wrapped up in half the time"

THE INVISIBLE MAN



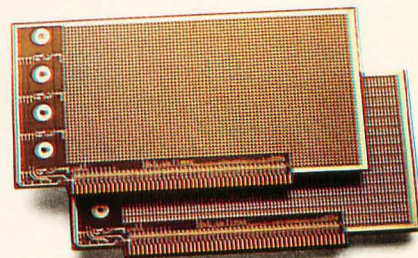
The place was alive with "mad doctors" 40 years ago. For good reasons. They couldn't get what they wanted. Labs were piled high with incomplete kits, defective gear, and undecipherable support documentation.

All that's history now that California Computer Systems has arrived on the computer hobbyist scene. We'll see that no electronics maverick goes away mad.

Three proofs positive: our new *M-XVI Static RAM Module* for S-100 bus systems...our new *PT-1 Wire-Wrap Board*...and our new *Soldertail Prototyping Board*. The M-XVI features include: fully static design, use of popular 2114 static RAMs, ability to meet IEEE proposed S-100 signal standards, full buffering, addressability in 4K blocks, and bank select by bank port and bank byte. The PT-1 Wire-Wrap Board has all S-100 signals specified and provisions for four regulators. The Soldertail Board has all S-100 signals labelled, provisions for four regulators, and can accept 16-24-and-40 pin spacing.

Take a tip from the Invisible Man. He's quit derailing

trains, robbing banks, and scaring helpless damsels since CCS gave him what he wants. If you're looking for satisfaction, too, check out our new product line today at your nearby computer store.



California Computer Systems

309 Laurelwood Road
Santa Clara, CA 95050
(408) 988-1620

So Nobody Goes Away Mad.

Circle 37 on inquiry card.

Listing 1, continued:

Loc	Keys						Commentary
075		SUM	0	8			by 15 degrees for left turn.
078		0	INV	*fix	HLT		
082	*LBL	B	1	5	INV		Decrement velocity angle
087		SUM	0	8			by 15 degrees for right turn.
090		0	INV	*fix	HLT		
094	*LBL	D					Increment velocity magnitude
096	1	SUM	0	9	GTO	C	by 1 for acceleration.
102	*LBL	E					Decrement velocity magnitude
104	1	INV	SUM	0	9		by 1 for brake.
109	*LBL	C	1	SUM	.1	0	Increment elapsed time.
115	RCL	0	9	STO	0	0	Convert velocity vector
121		RCL	0	8	*P/R		to rectangular coordinates.
125	SUM	0	7	RCL	0	0	Readjust X and Y coordinates.
131		SUM	0	6			
134	*LBL	*A'	RCL	0	7		Convert Y coordinate to
139		SBR	*1'	STO	1	1	integer value.
144	RCL	0	6				Convert X coordinate to
147		SBR	*1'				integer value.
149	+	.	0	1	x		Combine X and Y coordinate
154		RCL	1	1	+	.	and elapse time and
159		0	0	0	0	1	display result.
164		x	RCL	1	0	=	
169		*fix	5	HLT			
172	*LBL	*B'	RCL	0	9	=	Display magnitude of
178		INV	*fix	HLT			velocity vector.
181	*LBL	*1'	STO	0	1		Subroutine to convert
186		INV	*D.MS	INV	*D.MS		real number to integer form.
190	*fix	0	*D.MS				Mask off fractional part
193		INV	*fix	STO	0	2	of real number to convert
198		+/-	+	RCL	0	1	to integer.
203		=					
204	-	.	5	=	*ifpos	*2'	If fractional part of
210		RCL	0	2	*rtn		real number is greater than
214	*LBL	*2'	RCL	0	2		0.5, then add 1 to integer
219	+	1	=	*rtn			value.

ALTOS presents a new standard
in quality and reliability



WE'RE ALTOS COMPUTER SYSTEMS. Our SUN-SERIES ACS8000 business/scientific computer creates a new standard in quality and reliability in high technology computers.

HIGH TECHNOLOGY The ACS8000 is a single board, Z80®* disk-based computer. It utilizes the ultra-reliable Shugart family of 8 inch, IBM compatible, disk drives. A choice of drives is available: single or double density, single or double sided. Select the disk capacity you need, when you need it: ½M, 1M, 2M, or 4M bytes. The ACS8000 features the ultimate in high technology hardware: a fast 4 MHz Z80 CPU, 64 kilobytes of 16K dynamic RAM, 1 kilobyte of 2708 EPROM, an AMD 9511 floating point processor, a Western Digital floppy disk controller, a Z80 direct memory access, Z80 Parallel and Serial I/O (two serial RS232 ports, 1 parallel port), and a Z80 CTC Programmable Counter/Timer (real time clock). In essence, the best in integrated circuit technology.

BUILT-IN RELIABILITY The ACS8000 is a true single board computer. This makes it inherently reliable and maintainable. The board and the two Shugart drives are easily accessible and can be removed in less than five minutes. All electronics are socketed for quick replacement. Altos provides complete diagnostic utility software for drives and memory.

QUALITY SOFTWARE Unlimited versatility. The ACS 8000 supports the widely accepted CP/M®** disk operating system and FOUR high level languages: BASIC, COBOL, PASCAL and FORTRAN IV. All available NOW.

PRICE ACS 8000-1, single density, single-sided [½ Mb] \$3,840
ACS 8000-2, double density, single-sided [1 Mb] \$4,500
ACS 8000-3, single density, double-sided [1 Mb] \$4,800
ACS 8000-4, double density, double-sided [2 Mb] \$5,300

Brackets show disk capacity per standard two drive system. All models come standard with 32 Kb RAM and two 8" disk drives as shown above. Expansion to 64 Kb is \$363 per 16 Kb. FPP, DMA, software optional. Dealer/OEM discounts available. Delivery: 30 days ARO, all models.

*Z80 is a trademark of Zilog, Inc.

**CP/M is a trademark of Digital Research, Inc.

Circle 6 on inquiry card.

ALTOS

COMPUTER SYSTEMS

2338A WALSH AVENUE • SANTA CLARA • CA 95050 • (408) 244-5766

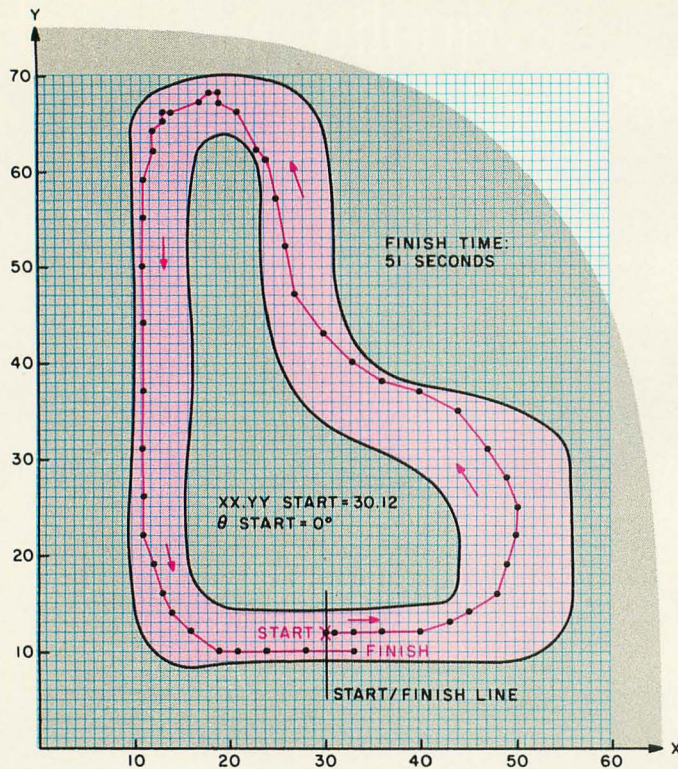


Figure 1: A typical route for one player in the game of Race Car, written for the Texas Instruments SR-52 programmable calculator. Players must stay within the bounds of the track (which is arbitrarily drawn on graph paper) or risk disqualification. Increments of change to acceleration and steering are deliberately restricted in order to make the game more challenging, but players have free choices within these limitations.

Remember that you are steering the race car as if you were sitting in the driver's seat, so don't confuse your left and right directions. The degree of difficulty can also be set in the layout of the race track. Hair-pin turns and straightaways will test your skill and make the game exciting. I've had hours of fun racing with my friends and family; I hope you will, too. ■

User Accessible Labels:

A = Left	A' = X.YT
B = Right	B' = Vel
C = Cruise	C' = X.Y Start
D = Accel	D' = θ Start
E = Brake	E' = Init

Register Utilization:

00 = P/R conversion
01 = Work area
02 = Work area
03 = Initial X coordinate
04 = Initial Y coordinate
05 = Initial velocity angle
06 = X coordinate
07 = Y coordinate
08 = Angle of velocity vector
09 = Magnitude of velocity vector
10 = Elapsed time
11 = Work area
12 = Work area

Race Car Operating Instructions

1. Draw the race track on a suitable piece of graph paper, preferably ten divisions to the inch. Figure 1 shows an example of a typical race track. The race track must be located in the area bound by the lines $X=0$, $X=100$, $Y=0$ and $Y=100$. It is a good idea to leave space between the edge of the race track and the boundaries, since the car might leave the track. Select the combination start and finish line on the track and the initial direction of the car.
2. Enter sides A and B of the program.
3. Set the D/R switch to D.
4. Enter the starting coordinates of the car in the form XX.YY, where XX is the initial X coordinate and YY is the initial Y coordinate. Both numbers must be positive integers between 0 and 100. Press *C.
5. Enter the initial direction of the car. This is a positive angle in degrees measured from the positive X axis to the initial direction of the car. This angle should equal $n \times 15^\circ$, where $n = 0, 1, 2, 3, \dots, 23$. Press *D.
6. Press *E' to initialize the game. The initial X and Y coordinates will be displayed in the form XX.YY000.
7. Select the direction in which you will steer the car.

Press A to steer left. Zero will be displayed.
Press B to steer right. Zero will be displayed.

If you want to go straight, skip this step and proceed to step 8.

8. Select the throttle and brake conditions.

Press C to cruise.
Press D to accelerate.
Press E to brake.

The position of the car and the elapsed time will be displayed in the form XX.YYTTT, where:

XX = X coordinate of the car.
YY = Y coordinate of the car.
TTT = Elapsed time in seconds.

9. Repeat steps 7 and 8 for each move. If the car should leave the track, the player is disqualified. Once the car passes the finish line, the winning time is read from the display.
10. To display the magnitude of the velocity vector, press *B'. To return the display back to XX.YYTTT, press *A'.
11. To play a new game on the same race track, press *E'.

North Star Systems Go To Work

More and more, you see the North Star HORIZON computer at work: in business, research, and education. Its high performance qualifies the HORIZON for demanding professional applications. Over 10,000 users during the past two years have proven that North Star hardware has the reliability for day-in, day-out computing. The HORIZON is now a serious candidate for any small system installation.

SOFTWARE IS THE KEY TO HORIZON MATURITY

North Star BASIC and DOS have been used to develop hundreds of commercial program packages. These packages establish that North Star software has the completeness and convenience necessary for serious program development. Because of the many independent vendors offering software using North Star BASIC and DOS, the HORIZON owner now has the widest selection of software in the microcomputer industry! Software available includes: word processing, general ledger, accounts payable/receivable, mailing list processing, inventory and income tax preparation. Program development systems such as assemblers, debuggers, editors, PILOT and FORTRAN are also available.

EXPAND YOUR HORIZON

The basic HORIZON computer includes a Z80 microprocessor, 16K bytes of RAM memory, an I/O interface and one Shugart minifloppy disk drive. The HORIZON can be expanded to 60K bytes or more of RAM, three disk drives, and three I/O interfaces. Performance can be enhanced by the addition of the North Star hardware floating point board. Also, S-100 bus products from other manufacturers may be used to expand the HORIZON.

For more information, contact your local computer store.

NORTH ★ STAR
COMPUTERS

2547 Ninth Street
Berkeley, California 94710
(415) 549-0858

Files on Parade

Mark Klein
Sanborn Regional School District
Kingston NH 03848

Part 2: Using Files

File Management

In part 1 we discussed the concept of the file. In part 2 we conclude with some practical techniques for using files.

Getting a list of the files on your system is a task you probably perform often. Table 6 is a sample directory (which also appeared in part 1 as table 4a). Notice the command string used to produce the table just above the directory itself. In table 6 the first asterisk is the *prompt*, the computer's signal to enter a command. The letter Q is the Query command, used to produce file directories. The next asterisk is a *wild card* name instead of the file name: it means "give me (a list of) all the files on this device." Finally there is a software switch, /1, specifying floppy disk drive number 1.

Depending on the operating system, wild card characters can also be used. The PerSci controller, for example, allows a command string like:

Q FIL???.MPK/1

which means:

List [Q] all files on drive number 1 whose extension (version) is MPK, and whose file name begins with the letters FIL, regardless of what the next few letters are.

This article was produced on a text editor and for convenience the different parts were given different file names: FILFIG.MPK held the list of figures; FILCAP.MPK held the figure captions; FILAR1, FILAR2, etc, held text proper. The extension .MPK

identified the files as belonging to me. Thus the command string above would produce a directory listing of all files holding parts of this article.

Using Defaults

If parts of a command string are omitted the operating system automatically inserts a proper type of specification chosen from a preprogrammed list. This preprogrammed list is called the system default specification or just defaults. If the /1 is left off the microcomputer command string in table 6, that system would automatically search for the files on floppy disk drive 0, which happened to be the default device when the directory was made.

Defaults are used as a convenience not just in specifying file devices but also in file names. Large and small timesharing systems usually assign to each user some identifying code number, referred to by terms like account number, user ID, or programmer number. This number is incorporated into the file name, to associate a particular file with a particular user. A common system default lets a user omit this part of the file specification when the user is referencing his or her own files.

Another useful and common kind of default provides extensions to the file name according to the program that produced the file. For example, data files created in Multi-user BASIC have a default extension beginning with .D. Other data files might have an extension .DAT; FORTRAN files could have default extensions .FOR; input files for a macroassembler could be expected to have the extension .MAC; and that assembler might produce binary object files with a default extension of .OBJ.

File Names

T S Eliot understood the complexities of a similar subject when he wrote, in *Old Possum's Book of Practical Cats*, that:

"The Naming of Cats is a difficult matter.

It isn't just one of your holiday games;

Excerpts from "The Naming of Cats" in OLD POSSUM'S BOOK OF PRACTICAL CATS by T S Eliot are reprinted by permission of Harcourt Brace Jovanovich Inc, copyright 1939 by T S Eliot; copyright 1967 by Esme Valerie Eliot.

Table 6: Floppy disk directory generated by microcomputer. This table is repeated from part 1 of this article.

k						
Q/1						
FILES 08-09 09 771219						
TEXTPROC.TDL	01-01	0023	0022	064	771219	771219
BIGRUMP.TDL	01-24	0074	0073	033	771219	771219
BASIC.TDL	04-20	0065	0064	001	771219	771219
EDIT.TDL	07-07	0023	0022	001	771219	771219
IODRIVER.EEN	08-04	0005	0004	051	771219	771219

(a)

Position		Significance
F I L E N A M E	1	determines access for all users in same group
	2	determines access for all other users
	3 thru 6	no special significance
• •		separates name and extension
E X T E N S I O N	7	B → BASIC program; D → data file
	8	group identifier
	9	positions 8 and 9 together form the user's ID

You may think at first I'm as mad as a hatter

When I tell you, a cat must have THREE DIFFERENT NAMES."

As it is with cats, so it is with files. First, it's good to give a file a family (or group) name. The extension is one place for this, and some of the default extensions make good group names. Properly chosen extensions or family names will allow the use of wild card file names and thus greatly accelerates getting directories of groups of files.

Old Possum can help with the other two names. "First of all," he says, "there's the name that the family use daily." These should be "sensible, everyday names" such as Spacewar, Mastermind, Payroll, Heatplan or Help. They can be plain or fancy, but they must be descriptive. Often these everyday names actually refer to a system of programs, perhaps linked together. The user may not even be aware of this linkage and might refer to this system of programs by its everyday name. "Run the Help program" one user might advise another, without considering or needing to consider that this is really a collection of programs, subprograms and data files.

Finally, a file:

"... needs a name that's particular, A name that's peculiar, and more dignified. ..."

If each file on a device does not have a unique name there will be serious problems. Further, computer operating systems put stringent restrictions on file names, restrictions necessary if the operating system is to efficiently handle requests dealing with files. A common restriction is the one on the number of characters in a file name. In

(b)

Character	Meaning
6	read, run and update (only useful for virtual arrays)
7	read and run
8	run only
9	run only, but allows program to perform any privileged file operation
any other character	— for group library file, your group, or a public library file: read and run — any other file: no access

Table 7: A multiuser file protection system. Table 7a summarizes the significance of position in the file name. If position 9 is blank, it is assumed to be a group library file. If positions 8 and 9 are blank, a public library file is assumed. Table 7b shows the characters in file names that affect file access when they are used in positions 1 and 2. The number 8 causes the user's storage area to be erased when the program terminates.

TDL's 8 K BASIC, names must be one character. DEC's RT-11 permits six characters, the PerSci controller allows eight, and the latter two provide for additional extensions. Thus keeping the name particular and peculiar requires some thought.

File Protection Systems

Another consideration in choosing a particular and peculiar file name is how it fits into the local file security system. As soon as more than one person begins using a computer system there should be some way of controlling access to files. A simple way is to have users keep their files on their own cassettes or disks. But when user A creates a splendid new program and user B borrows A's cassette to copy the program, problems begin.

It is painful to remember how many times I thought the file I wanted to erase was on drive 0, and the good version was on drive 1.

Physically controlling your media gives good file security, but we often loan out our tapes and disks. Write protecting the media or device helps also, but is often impossible, inconvenient or overlooked. Carefully chosen file names are a further protection. There are several degrees of file access which can be controlled in part on many systems by the file name. These degrees of access might be:

RUN: allows executing the file.

READ: allows copying or listing the file.

UPDATE: allows modifications to the file.

Table 7 partially describes the way to

Note: "Using Files" concludes the 2 part series, "Files on Parade." The table and listing numbering is continued from part 1.

Table 8: Representative file transfer commands from several processors.

Command	Controlling Program	Computer	What Is Being Done
OLD BAGELS	BASIC (most versions)	Micro, PDP-11, etc	The program Bagels is copied from secondary memory (disk) to primary memory.
SAVE B	TDL 8K BASIC	Micro	A program called B is transferred to cassette tape.
L BASIC.TDL/1	PerSci Disk Operating System	Micro	The TDL BASIC interpreter is loaded from floppy disk drive 1 into memory.
SY:9BAGEL.B=CT0:BAGELS.MPK	RT-11 Peripheral Interface Program	PDP-11	A version of Bagels on cassette drive 0 is copied onto the system disk, where it is given the name 9Bagel, and the extension .B.

choose names in Multiuser BASIC to control user access. When working with several files at once, on different devices or media, it is good practice to use procedures similar to those in table 7, and to make sure your file names are uniquely chosen. Mastermind might now have to be called 7MASTR.BAS, but it will still be there tomorrow after others finish using it today.

So choose your file names well. Many times I have seen a programmer who has created a file and is about to name it. He sits in front of his terminal:

“ . . . in profound meditation,
The reason, I tell you, is always the same:
His mind is engaged in a rapt contemplation
Of the thought, of the thought, of the thought of his name:
His ineffable effable
Effan ineffable
Deep and inscrutable singular Name.”

[All quotations from “The Naming of Cats,” Old Possum’s Book of Practical Cats, by T S Eliot, Harcourt, Brace, New York, 1939.]

Computer Operation	Microcomputer (PerSci DOS)	Minicomputer (DEC RT-11, PIP)
FILE DELETION	D BAGELS.MPK/1 (delete BAGELS.MPK from floppy drive #1)	CT1: *.MPK/D (delete all files with extension .MPK from cassette drive #1)
DIRECTORY SQUISH	G /1 (“Gap” drive 1)	SY:/S (Squish the system disk)
RENAME	N 9BAGEL.B BAGELS.B	BAGELS.B=9BAGEL.B/R (rename 9BAGELS)

Table 9: Comparison of some microcomputer and minicomputer file house-keeping functions. DEC uses the term squish rather than pack.

Manipulating Files

There are many file operations besides the assembling of directories that are performed at the command level. Most of these operations fit into the general framework of moving a file from one place (device, library, etc) to another. The transfer can be represented symbolically as:

DESTINATION: FILENAME.
EXTENSION ←SOURCE: FILENAME.
EXTENSION.

Copying a file from one floppy disk to another, listing a file on a terminal, and moving a file from cassette to primary memory are examples of file transfer. The specific commands vary greatly from system to system, and, even within a system, from one language or utility tool to another. Table 8 illustrates a small selection of these commands.

Deleting a file is also a kind of file transfer; the file is moved to “nowhere.” On a directory device, the directory reference to the deleted file is usually removed; the file itself is probably still on the medium and can often be recovered if its absolute location is known.

Another file transfer operation, the media pack, eliminates gaps on disks and tape due to deleted files, and packs together the remaining files to make room for more. A disk can usually be packed without the use of a second disk drive, but cassettes often require repacking on another medium.

Finally, renaming a file can be thought of as a file transfer within the symbolic format above. The destination and source do not change, but the file name and extension do. Table 9 compares typical minicomputer and microcomputer pack, delete and rename operations.

Now You Can Make Your Own Magic

Unleash the Full Power
of Your
Personal Computer
With the
All-New Aladdin
Personal
Programs™

Aladdin Automation now offers you the magic of a full range of Personal Program™ series especially designed to support the most popular personal computers available today.

Some Personal Programs™ will take you to faraway places of exciting, action-packed adventures. Others will bring fun-filled learning experiences home to you and your child. Still others are designed for your own

use in the home or office.

All Aladdin Personal Programs™ are moderately priced.

Visit your personal computer dealer today to see and experience the magic waiting for you in every one of the Aladdin Personal Programs™. (And if your dealer hasn't ordered his supply yet, then ask him to write Aladdin Automation for complete information on all the Personal Programs™ available now.)

**Welcome To The All-New
World Of Aladdin. And Get Ready
To Make Your Own Magic**



ALADDIN AUTOMATION, INC.

ALADDIN COMPUTER CORP.

3420 Kenyon St. San Diego, Ca. 92110

Function	Multiuser BASIC Implementation
assign a status; assign a mode; assign a channel	10 OPEN "9VISR0. B53" FOR OUT- PUT AS FILE #2
write on a file	20 PRINT #2: L\$
read information from a file	30 INPUT #2: A, B1, T3
test for end of file	40 IF END #2 THEN 100
move data pointer within the file	50 RESTORE #2
make the file per- manent; deassign the channel; change the file status	60 CLOSE #2

Table 10: Types of program file control statements. The line numbers used in the examples are to emphasize that these are statements within a program.

File Control

In addition to the file manipulations previously described, there are several kinds of file control statements designed to be part of an application program. Instead of a file handling operation happening in response to a command from the keyboard, using perhaps the monitor system or operating system commands, this second kind of file control happens in response to a program statement. Again, the specific format varies from language to language; unfortunately it also seems to vary within a language like BASIC from manufacturer to manufacturer. However the functions performed in response to these statements are fairly standard. Table 10 is a summary of these functions, with examples from BASIC.

Assigning a unique channel, or data path, to each active file is one way for the operating system to allow simultaneous (or at least parallel) access to several files. Obviously this is necessary in a timesharing system, but it is also convenient for a single user reading text from one file, editing it, and then writing it into an output file. In the first example in table 10, the file 9VISR0 is assigned to channel number 2. (The maximum number of channels will depend on the system configuration.)

The file status can be open or closed. Here again the requirements vary from system to system, and within systems according to file access types. The PerSci disk operating system, for example, allows *stream* access regardless of file status. But stream access usually happens at command level. *Rel-*

ative access, used for data base applications, requires a file status of open to store or retrieve file data.

The file mode requirements (input or output) depend on access type too. For this function, though, the distinction is clearer. Once random access files are open, the mode does not usually need to be specified because individual bytes can be changed without touching other parts of the file. However sequential files must be updated as a unit, and therefore a sequential file must generally be set into either input or output (read or write) mode. Remember that input and output refer to the direction of information flow relative to the processor, and not to the storage medium: information comes into the processor from the disk; information goes out of the processor to the disk.

Testing for the end of a file and moving a data pointer within a file are operations characteristic of sequential access files. A random access file has a fixed length, so presumably one knows where the end of it is. Similarly, since individual bytes of a random access file are directly addressable, it is unnecessary to move a data pointer. In practice these functions are performed by program logic statements.

Some kinds of files are more rugged than others; they stand up better to programmer or user abuse. Aborting an information transfer to a sequential file in the midst of the transfer can cause the loss of the whole file, for example. The close command, for both access types, puts a lock on the file door and frees up a data channel, too. Other BASIC program statements (such as CHAIN, END) will often do the same thing. Good programming practice is to do it explicitly, with statements such as CLOSE.

Explicit file initialization is also good practice. Random access files, occupying a specific part of a disk, could contain information left on the disk by a previous program. (Recall that file deletion usually means that the directory entry, not the file itself, is deleted.) At the other end of the line, it is wise to erase a file containing sensitive information when its usefulness is over. These operations can all be done with file control statements in programs.

Programming Techniques Using Files

Whole articles, even whole books, are written to discuss file programming techniques. This final section is not meant to be that comprehensive. Rather, it is a quick dip into the programmer's bag of tricks—a look at some of the methods used to deal with the limitations of smaller systems. The em-

A Beautiful Way To Interface

IQ 140

SOROC's first and foremost concern, to design outstanding remote video displays, has resulted in the development of the IQ 140. This unit reflects exquisite appearance and performance capabilities unequaled by others on the market.

With the IQ 140, the operator is given full command over data being processed by means of a wide variety of edit, video, and mode control keys, etc.

The detachable keyboard, with its complement of 117 keys, is logically arranged into 6 sections plus main keyboard to aid in the overall convenience of operation. For example, a group of 8 keys for cursor control / 14 keys accommodate numeric entry / 16 special function keys allow access to 32 pre-programmed commands / 8 keys make up the extensive edit and clear section / 8 keys for video set up and mode control / and 8 keys control message and print.

Two Polling options available: 1) Polling compatible with Lear Siegler's ADM-2. 2) Polling discipline compatible with Burroughs.

IQ 120

The SOROC IQ 120 is the result of an industry-wide demand for a capable remote video display terminal which provides a multiple of features at a low affordable price.

The IQ 120 terminal is a simple self-contained, operator / computer unit.

The IQ 120 offers such features as: 1920 character screen memory, lower case, RS232C extension, switch selectable transmission rates from 75 to 19,200 bps, cursor control, addressable cursor, erase functions and protect mode. Expansion options presently available are: block mode and hard copy capability with printer interface. The IQ 120 terminal incorporates a 12-inch, CRT formatted to display 24 lines with 80 characters per line.

Circle 342 on inquiry card.



165 FREEDOM AVE., ANAHEIM, CALIF. 92801
(714) 992-2860 / (800) 854-0147


```

100 PRINT "TYPE THE LETTER CORRESPONDING TO YOUR CLASS:"
110 PRINT "  A--PRACTICAL BIOLOGY, PER. A"
120 PRINT "  B--PRACTICAL BIOLOGY, PER. B"
130 PRINT "  C--BISCI"
140 PRINT "  E--PRACTICAL BIOLOGY, PER. E"
170 PRINT "CLASS"; \ INPUT S$
200 PRINT "TYPE THE NUMBER OF THE OPTION YOU NEED:"
210 PRINT "  1-ENTER SCORES FOR WHOLE CLASS"
220 PRINT "  2-ENTER SCORES FOR SOME STUDENTS"
230 PRINT "  3-LIST STUDENTS WHO HAVE COMPLETED A GIVEN ITEM"
240 PRINT "  4-LIST STUDENTS WHO HAVEN'T COMPLETED A GIVEN ITEM"
250 PRINT "  5-DISPLAY SCORES PROFILE FOR AN INDIVIDUAL STUDENT"
260 PRINT "  6-DISPLAY PROFILE FOR A SELECTED GROUP OF STUDENTS"
270 PRINT "  7-DISPLAY CUMULATIVE TOTALS FOR ALL STUDENTS"
280 PRINT "  8-LIST OR MODIFY STUDENT NAMES OR ITEM HEADERS"
290 PRINT "  9-CREATE BACKUP FILES"
300 F$="9VISR0.BB"+S$ \ CHAIN F$

```

Listing 2: BASIC code for an option choice menu. When the option is chosen, the required code is chained into main memory by line 300.

phasis is on techniques available in versions of BASIC that support named files which can be called from secondary memory devices such as cassettes or floppy disks.

Shortening Program Size

For student programmers at Sanborn Regional High School, where I teach, and especially for students with grandiose plans and unprivileged user numbers, the most frustrating error message is PTB, which means the *program is too big*. There are three file related approaches to this problem that we urge on the students—approaches that fit into our push for modular program design.

First, for programs that have a linear logical flow, we encourage breaking the program into small segments that can be connected by CHAIN statements. A CHAIN statement such as

```
110 CHAIN "WUMPS2.BAS"
```

erases the program currently in main memory (perhaps called WUMPUS.BAS), and replaces it with the program file WUMPS2.BAS. Variables whose values are needed in the second, or chained-to, segment, can be declared in a COMMON statement in the first segment. A typical usage of the CHAIN statement is to segment some long game. The first segment might request information from the user: "Do you want instructions?" If yes, instructions are given; if no, there is a branch directly to the end of segment 1. In either case, the logical flow reaches the end of the first segment, where there is a CHAIN statement to a program file that contains the code for the main body of the game.

A second method works well for application programs that give the user a choice of options. This method puts the *menu* of choices in one program file and each of the various options, or "meals," in separate program files. Listing 2 shows the code for a typical option menu. The menu file and the meals files could be connected by CHAIN statements or by OVERLAY statements.

The OVERLAY statement calls a named program file from secondary memory and "lays it on top of" the program currently in memory. Suppose the original program has a line 100. After the OVERLAY statement in the original program is executed, line 100 in memory will be the one from the overlay file. A line with a number either in the original program or in the overlay file, but not in both, will always be in memory after the overlay.

For the multiple branch logical flow characteristic of the menu and meal method, the decision to use CHAIN or OVERLAY to connect the program files usually depends on how much logic and code can be shared by the various meals. If several of the options utilize the same set of subroutines, or if the options access the same set of data files, it makes sense to use overlay files. Then, in lines that will not be overlaid, the original program can hold the shared subroutines or statements opening and closing the shared data files. If the meals are quite disjoint, and there is little need to pass information back and forth, chaining the segments will increase the modularity of the code.

In either case the goals are to keep the modules small and the interface between them independent of the module used. Smaller segments fit into more machines and are easier to understand. The interface should allow adding options or replacing an option with an improved version without having to modify all of the other options. This plug-in quality facilitates writing code that is easy to change and easy to use.

Data Files

The third technique for using files to achieve modular program design is to separate the data from the program operating on it. An example is the payroll program mentioned in part 1. Another application is to the tutorial, drill and practice, and testing programs used in computer assisted instruction. A common type of program in this group is one that gives a multiple choice quiz. Variety can be added by putting a large bank of questions and accompanying choices in a data file. The main program can then pick five or ten numbers randomly and call

DIGI-KIT-IZER

What it means to you.

dig-i-kit-izer/dij-e-kit-izer/ *n.* (1): a high-value low-cost computer graphic input device designed to be assembled by the user (2): the most advanced graphics tablet in kit form (3): An instrument that, when assembled, allows the user innumerable methods of design and analysis functions (4): The latest addition to the most extensive, accurate and reliable line of digitizers, by Talos



\$449.



No adjustments. No calibration.

OPTIONS

- APPLE Interface
- TRS-80 Interface
- RS 232 Interface
- Power Supply
- IC Sockets
- Unit Enclosure

Dealer inquiries invited

PLEASE RUSH ADDITIONAL INFORMATION ON THE
TALOS DIGI-KIT-IZER

Name _____
Company _____
Title _____
Address _____
City _____ State _____ Zip _____
Phone _____



by **talos**

TALOS SYSTEMS INC.
7419 E. Helm Drive
Scottsdale, Arizona 85260
(602) 948-6540
TWX (910) 950 1183

CHECK YOUR LOCAL DEALER NOW


```

120 REM *** OPEN DATA FILE
130 OPEN "GRIPE.D22" AS FILE VF1$(20)=250
140 REM *** NUMBER OF GRIPES = N
145 N=VAL(VF1(0))
160 PRINT "WHAT IS THE NUMBER OF THE GRIPE YOU WISH TO DELETE";
170 INPUT D
180 VF1(D)=" "
190 FOR K=D+1 TO N
200 VF(K-1)=VF(K)
210 NEXT K
250 REM *** RESET N AND SAVE UNDER VF(0)
260 N=N-1
270 VF1(0)=STR$(N)

```

Listing 3: Using a virtual array with Multiuser BASIC. This allows the user to think he is using an array when actually there is a random access device which is holding the bulk of the information.

out the questions and choices matching those numbers to make up a particular test from the file. Using essentially the same kind of programming, the words for the computer's side of a game like Hangman can be kept on a data file.

A slightly more sophisticated method is to use one master program to administer several different multiple choice tests. The user might supply the name of the test, and the program would open the data file containing the appropriate bank of questions. The first word of the data file might hold in-

formation about how many questions are in the file, how many choices per question, how many questions comprise a test, etc. The same master program can handle many different question and answer banks.

Still another type of program can extract information from more than one data file to construct a question. For example, a quiz on chemical formulae can be designed by randomly taking one element name (calcium, aluminum, sodium, . . .) from one file, and another (chloride, sulfide, sulfate, . . .) from a second file.

A common feature of these examples is that space-eating dimensioned arrays are avoided by keeping the data in files, and calling and using only a few elements at a time from a file. When new data is called out, it can be given the same variable name as the previous small group of data. Virtual arrays stored in random access files can be thought of as extensions of this technique. As listing 3 shows, the items in the file can be addressed as if they were part of a dimensioned array in memory. However no dimension statement is necessary in the program, and the programmer has the best of both approaches: access and update as if the variables were in main memory, but space utilization corresponding to their actual

Mass storage for the

Now users of the most popular microcomputers can add truly massive disk storage to their systems with **Micromation's Megabox**. It features dual 8" drives with double density recording to provide over one Megabyte of disk storage. Or you can choose optional double-headed drives to provide over two megabytes. Micromation is a leading supplier of floppy disk systems for micros.

A **TRS-80*** compatible Megabox plugs directly into the TRS-80. This version of Megabox includes provision to add up to 32K of RAM to your TRS-80* system, so you can have up to 4 Megabytes of disk storage and 48K of RAM without an expansion interface. This Megabox brings big system performance to your system at one-third the cost per byte of mini-floppy systems.

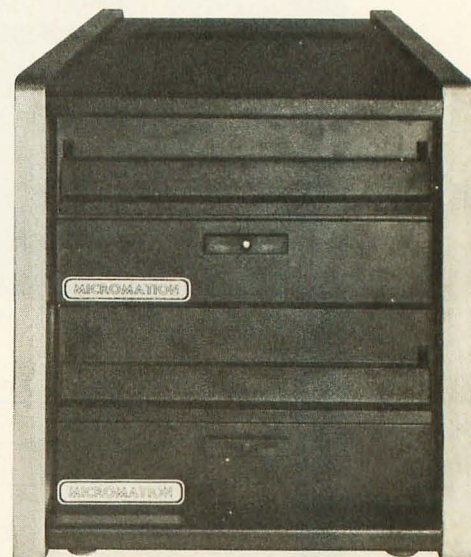
Our **SOL*** version of the Megabox installs without modification, and the software is all ready to go. Micromation's double density recording gives you nearly twice the storage of the Helios* at a substantially lower price — and most importantly, you can run CP/M* so you have access to the broadest range of software available in microcomputing.

Combine an **Exidy Sorcerer*** with a Megabox by plugging the controller into the Sorcerer's* S-100 expansion bus. Boot from our Sorcerer* system diskette and you're up and running without any modifications to your hardware or software.

Our **DOUBLER** double density floppy disk controller features true double disk density recording with a capacity of 512K bytes on each side of the diskette. Doubler systems are easy to install and use. A hardware UART is included on the controller to provide instant system communications. The controller can do a power-on-jump to the on-board PROM bootstrap. And its fast and reliable because the board's hardware includes a phase-lock oscillator and CRC error detection circuitry.

Micromation disk systems are designed to run **CP/M***, the industry standard operating system. You can choose higher level languages such as MBASIC, CBASIC, FORTRAN, COBOL, or PASCAL. And there's a wide selection of business application packages to choose from.

Megabox systems open new opportunities for owners of today's most popular microcomputers. They feature the highest available capacity, performance, and reliability. And they are compatible with your system. But best of all, at \$2295 a Megabox is priced for value. Ask for details at your local computer store or contact Micromation, 1620 Montgomery St., San Francisco, CA 94111 or phone (415) 398-0289.



MICROMATION

The Megabox with 1,000,000 existing software to easily keep a

Circle 223 on inquiry card.

storage on files, an ideal arrangement for a data base.

Files as Buffers

Finally, one more data file technique deserves mention: using files as buffers, as temporary collection boxes for string or numeric information. The names of the elements for the chemistry tutorial and the text for a Help program are examples of data stored in files on a relatively permanent basis. In contrast to this kind of use, files can provide transient storage for data. They might be used as extra workspace for calculations or manipulations like sorts or holding intermediate results.

Perhaps the chemistry tutorial program creates three problems for the student to do at home using random numbers. A file could contain the answers to those problems, to be accessed once the next day when the student checks his or her answers against those in the file. The answers would then be erased.

The list of books or equipment loaned to friends can be placed in the buffer file of a home information program, with items removed from the file as they are returned. Buffer files can also be used to hold mes-

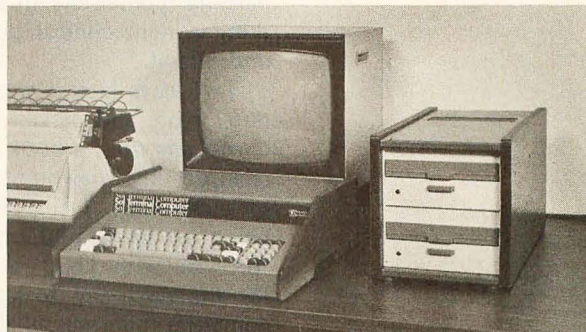
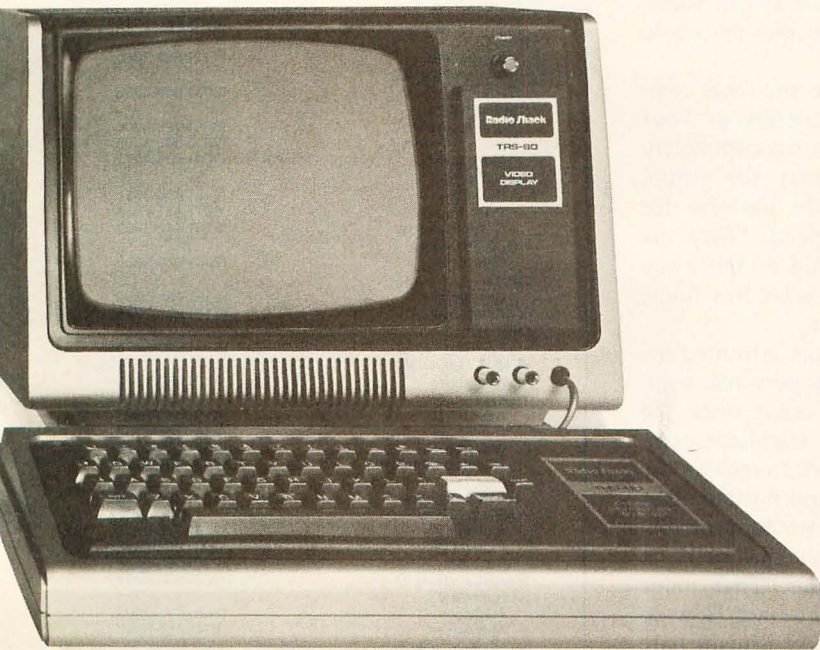
sages taken by a computer interfaced to an automatic answer phone modem, or by a computerized suggestion box (a gripe file), or to hold mail in a computer conference.

Sometime there will be a secondary program to examine, modify, and erase these buffer files. At our high school, for instance, a secondary program reads the gripe file and removes meaningless or obscene comments before the file is posted on the bulletin board.

A Qualification

This article, an introductory tutorial, has skimmed the surface of the concept of files. The richness of file structures and the power of the many techniques have led to varied implementations, only a few of which are illustrated here. Readers are urged to study the manuals for the systems they use both to learn the capabilities of those systems and to find the exact syntax for the techniques described in this article. With respect to file structures and types, microcomputer systems in particular are closer to the Tower of Babel end of the spectrum than they are to any monolithic standard. Now is the time to write about files, to learn about files and to build file systems.■

TRS-80*, Sol*, Sorcerer*



byte storage capacity can be operated with general ledger, accounts receivable, and payable.

Circle 223 on inquiry card.

*TRS-80 is a TM of Tandy Corp.
SOL and Helios are TM's of Processor Technology Corp.
Sorcerer is a TM of Exidy Inc. CP/M is a TM of Digital Research.

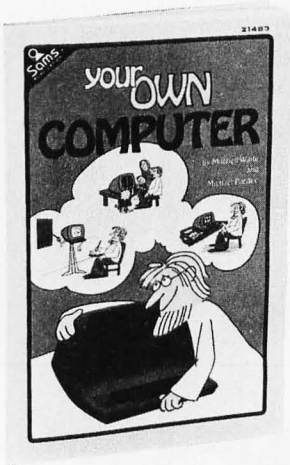
March 1979 © BYTE Publications Inc

41

Book Reviews

Your Own Computer

by Mitchell Waite and Michael Pardee
Howard Sams Co Inc
Indianapolis IN, 1977
80 pages
\$1.95



The last three books I read were *Passages*, *Star Wars* and *Your Own Computer*. You see, in between the second and third books a rather futuristic friend loaned me a copy of BYTE, saying, "You won't believe this!"

I didn't. A computer in every home? In department stores? Right now? Being a writer with a science fiction orientation, I was shocked and simultaneously exalted to find that companies were already selling all kinds of low cost home computers, and that perhaps I could buy and use one.

After devouring BYTE in less than two hours, I called my friend and asked him if he knew of any books that explained these personal computers in simple terms, something a nontechnical person like me could understand.

Two days later I went to the local computer store and picked up a copy of *Your Own Computer*, a book that has completely changed my viewpoint about the future of technology. I thanked the universe for being so kind, told my friend, "May the force be with you," and hid myself away for the next day to learn what this home computer thing was all about.

In the preface, the authors informed me that the invention of the personal computer is the most historic event since the automobile, television and transistor combined. This book was designed to remove the stigma of complexity and mystery that surrounds computers, and would probably be my first investment on the road to acquiring my own computer. That made me rather suspicious from the start. How do they know I'll like computers? I might hate them, but I'll admit I was interested.

Chapter 1 was quite interesting. Called "Introduction," it defined what computers

ComputerLand®

ALABAMA	
Huntsville	(205) 539-1200
ARIZONA	
Phoenix	(602) 956-5727
ARKANSAS	
Little Rock	(501) 224-4508
CALIFORNIA	
Dublin	(415) 828-8090
El Cerrito	(415) 233-5010
Hayward	(415) 538-8080
Lawndale	(213) 371-7144
Los Altos	(415) 941-8154
Los Angeles	(213) 776-8080
Pasadena	Call Directory Assistance
Saddleback Valley	(714) 770-0131
San Bernardino	(714) 886-6838
San Diego	(714) 560-9912
San Diego East	(714) 464-5656
San Francisco	(415) 546-1592
San Jose	(408) 253-8080
Santa Maria	(805) 928-1919
Santa Rosa	(707) 528-1775
Thousand Oaks	(805) 495-3554
Tustin	(714) 544-0542
Walnut Creek	(415) 935-6502
COLORADO	
Colorado Springs	(303) 574-4150
Denver	(303) 759-4685
CONNECTICUT	
Fairfield	(203) 374-2227
DELAWARE	
Newark	(302) 738-9656
FLORIDA	
Boca Raton	(305) 368-1122
Ft. Lauderdale	(305) 566-0776
Jacksonville	(904) 731-2471
GEORGIA	
Atlanta	(404) 953-0406
HAWAII	
Honolulu	(808) 521-8002
ILLINOIS	
Arlington Heights	(312) 255-6488
Downers Grove	(312) 964-7762
Niles	(312) 967-1714
Oak Lawn	(312) 422-8080
Peoria	(309) 688-6252
KANSAS	
Overland Park	(913) 492-8882
KENTUCKY	
Louisville	(502) 425-8308
MARYLAND	
Rockville	(301) 948-7676
MICHIGAN	
Grand Rapids	(616) 942-2931
Southfield	(313) 356-8111
MINNESOTA	
Bloomington	(612) 884-1474
MISSOURI	
Springfield	(417) 883-7085
NEW HAMPSHIRE	
Nashua	(603) 889-5238
NEW JERSEY	
Cherry Hill	(609) 795-5900
Bergen County	(201) 845-9303
Morristown	(201) 539-4077
NEW YORK	
Buffalo	(716) 836-6511
Ithaca	(607) 277-4888
Nassau County	(516) 742-2262
NO. CAROLINA	
Charlotte	(704) 536-8500
OHIO	
Cleveland	(216) 461-1200
Columbus	(614) 888-2215
OREGON	
Portland	(503) 620-6170
PENNSYLVANIA	
Harrisburg	(717) 763-1116
TEXAS	
Austin	(512) 452-5701
Dallas	(214) 363-2223
Houston	(713) 977-0909
Houston Bay Area	(713) 488-8153
UTAH	
Salt Lake City	(801) 364-4416
WASHINGTON	
Bellevue	(206) 746-2070
Federal Way	(206) 838-9363
Tacoma	(206) 581-0388
WASHINGTON, D.C.	(703) 893-0424
WISCONSIN	
Madison	(608) 273-2020
Milwaukee	(414) 466-8990
INTERNATIONAL	
Brisbane, Australia	07 221 9777
Brussels, Belgium	43 29 05
Manila, Philippines	58-36-66
Sydney, NSW Australia	29-3753
Winnipeg, Canada	(204) 772-9519

BEFORE YOU BUY COMPUTER^{#1}, VISIT^{#1} COMPUTERLAND

If the truth is that you want a computer . . . then we want to be your computer store.

We're ComputerLand, the #1 computer store chain in the U.S. What's meaningful about that fact is, that ComputerLand has been chosen by more people as having what they've been looking for. And, since you're looking, let us tell you what you'll find, when you visit a ComputerLand store.

You'll find a product line that's continually evaluated to provide you with the widest and best selection in quality, brand name microcomputers anywhere. You'll find an enthusiastic and knowledgeable staff able to interpret all the equipment specifications, in terms of how they apply to you, and in a way you'll understand. You'll find demonstration areas where you can get a firsthand experience of running a computer yourself.

COMPUTERS FOR BUSINESS



You'll find educational materials to give you a total insight into the world of microcomputers.

You'll find a fully equipped service department to provide whatever assistance is required to keep your computer running in top-notch condition. You'll find computer user's clubs to join, where you can share ideas with people as enthusiastic as yourself. And, with each new visit, you'll find excitement—from the people you deal with, the equipment they offer, and from your own ever-growing personal involvement.



Enough about us. How about what computers do. To attempt to describe all the things your computer might do, would be to describe your imagination. So instead, we'll briefly list some of the many things for which small computers are already being used.

In business, the advent of the versatile and compact microcomputer has put the benefits of computing within reach of small companies. With systems starting at less than \$6000, the businessman can

COMPUTERS FOR THE HOME



computerize things like accounting, inventory control, record keeping, word processing and more. The net result is the reduction of administrative overhead and the improvement of efficiency which allows the business to be managed more effectively.

In the home, a computer can be used for personal budgeting, tracking the stock market, evaluating investment opportunities, controlling heating to conserve energy, running security alarm systems, automating the garden's watering, storing recipes, designing challenging games, tutoring the children . . . and the list goes on.

In industry, the basic applications are in engineering development, process control, and scientific and analytical work. Users of microcomputers in industry have found them to be reliable, cost-effective tools which provide computing capability to many who would otherwise have to wait for time on a big computer, or work with no computer at all.

COMPUTERS FOR INDUSTRY



And now we come to you, which leads us right back to where we started: **If you want a computer, then we want to be your computer store.**

Whether you want a computer for the home, business or industry, come to ComputerLand first. We'll make it easy for you to own your first computer. Because, simply put, we really want your business. When you come right down to it, **that's what makes us #1.**

ComputerLand Corp.
14400 Catalina St.
San Leandro, CA 94577
(415) 895-9363
Franchise Opportunities Worldwide.

ComputerLand[®]
WE KNOW SMALL COMPUTERS

ComputerLand Europe
Europa Terrassen
8 Rue Jean Engling
Dommeldange, Luxembourg
Phone 43 29 05 Telex 2423

for the average consumer were like, and where they evolved (a natural evolution of big computers, the further miniaturization of electronic components due to the space race, the development of large scale integration [LSI] by the semiconductor makers, the pocket calculator, the digital watch and the TV game).

Chapter 2, called "Personal Computer Applications," goes into just what personal computers can do for you. Applications for the home, business, classroom and just plain fun are explained, using cartoons for punctuation.

What really impressed me was that one computer could do so many different things. The examples that turned me on the most were: "In the Office," where the computer would automatically display my next appointment while it balanced the company's books; and "Organizing Your Hobby," where the computer would maintain a cross file of my photography collection. I was definitely getting turned on.

The next chapter, "Program for Your Computer," made it clear that it takes a great deal of concentrated thought to write computer programs, and that I probably wouldn't need to know much about programming, since thousands of people were already available to do the programming for me. However, I would need to learn to communicate my needs to a programmer if I wanted to do something special with my computer that wasn't already available from a manufacturer, or someone else. Still, I was assured that most of the programs I would ever want would be furnished by the people who sold me the computer; so the pressure to learn programming apparently was off. That's good because then I began to see a computer as just another consumer product, rather complex but still quite manageable.

In the next chapter, "Nuts and Bolts," I learned what kinds of things make a computer tick. Computers have many hookup parts and equipment. In a way, they are a lot like cameras. Just as camera owners buy lenses and other attachments to enhance the power of their equipment, computer owners may purchase "peripherals" to beef up their systems and give them more flexibility.

Although the authors promised to give me enough information to enable me to walk into any computer store and not be snowed by the equipment, I felt rather rained upon during one such visit. The range of products offered in these computer stores is amazing. I didn't see any two

computers that looked, worked, or even cost the same. However, after I finally started talking to the store owner, I was very glad that I had read the chapter about nuts and bolts. Each time he would show me a particular computer system, I would say something like, "Does it have a software front panel?", or "How much memory and read only memory is there in the minimum system?" My questions seemed to elicit surprise, and I found the owner gleefully explaining everything in fine detail.

One of the nicest things about the nuts and bolts chapter was that I learned about the most often used computer I/O devices: keyboards, video displays, front panels, Teletypewriters, cassette tape mass storage, floppy disk mass storage, etc. Photographs of each device were included.

The final chapter in the book, entitled "Getting Started," explains how one goes about taking the next logical step in understanding, or perhaps even buying, a personal computer. Like the others, this chapter is illustrated with our friendly computer enthusiast trying his luck at learning more about personal computers by going to conventions, reading books and magazines such as BYTE, visiting computer clubs, and of course going to a store.

For me one of the most useful parts of the book was the appendix called "Glossary of Computer Buzz Words." Here I quickly learned the meanings of the crazy words used by computer people. I read the entire glossary from A to X; it was very interesting. Each word was defined and then used in a typical sentence. I memorized a few of these buzz words and used them on the computer store owner. For example, while he showed me a computer game called Star Trek that didn't seem to be working right, I informed him that perhaps his "buffer had overflowed." All I got was a chuckle, and then a sigh.

Well, I finished the book and can honestly say that for someone who previously knew nothing about computers, I really got my money's worth. Besides learning that computers are here to stay, I discovered that the future of home computing is changing fast and furiously. Although delaying my purchase for a few years may save me a lot of money, it will also mean I'll miss out on a whole lot of fun and excitement.

Keystone Elliot

POB 38

San Rafael CA 94901■



Hands-on microprocessor experience from day one ... **The Instructor 50.**

Learning by doing is still the best method of education. And when it comes to learning about the world of microcomputers, you won't find a better method than the Instructor 50.

It's the fast, ready-to-use learning device that immediately provides "hands on" experience for gaining microprocessor knowledge—in your home, office, or in the classroom.

Superior to other microprocessor learning aids, the Instructor 50 is a COMPLETE package—including a built-in power supply (50/60 Hz), an LED prompting display, and both functional and hexadecimal keyboards. You also get S-100 compatibility for adding memory and other peripherals. This lets you expand the machine's capability—and your microprocessing applications knowledge. Moreover, you can easily build a program library by recording your own audio cassettes.

The Instructor 50 comes complete with a *Users' Guide*, along with step-by-step instructions for those with no previous microprocessor experience.

Signetics offers one of the broadest choices of microprocessors in the industry. This knowledge stands behind the Instructor 50. When you need to learn about microprocessors, start with Signetics. Start with the Instructor 50. Send for your descriptive brochure today.

We can help you understand microprocessors.

signetics
a subsidiary of U.S. Philips Corporation



ANCRONA
P.O. Box 2208Y
Culver City, CA 90230

Phone Orders
(213) 641-4064

ARIZONA
ANCRONA
4518 E. Broadway
Tucson, AZ 85711
(602) 881-2348

GEORGIA
ANCRONA
3330 Piedmont Rd. N.E.
Atlanta, GA 30305
(404) 261-7100

CALIFORNIA
ANCRONA
11080 Jefferson Blvd.
Culver City, CA 90230
(213) 390-3595
1300 E. Edinger Ave.
Santa Ana, CA 92705
(714) 547-8424
1054 E. El Camino Real
Sunnyvale, CA 94087
(408) 243-4121

OREGON
ANCRONA
1125 N.E. 82nd Ave.
Portland, OR 97220
(503) 254-5541

TEXAS
ANCRONA
2649 Richmond
Houston, TX 77098
(713) 529-3489

CANADA, B.C.
ANCRONA
5656 Fraser St.
Vancouver, B.C.
V5W 2V4
(604) 324-0707



ANCRONA
P.O. Box 2208Y
Culver City, CA 90230

Please send me _____ Instructor 50(s) @ \$350.00 plus \$3.00 ea. postage and handling. Calif. residents add 6% sales tax.

☐ Check enclosed ☐ Master Charge ☐ VISA
Interbank Number _____
Account Number _____
Signature _____ Exp Date _____

Send To:
Name _____
Address _____
City _____ State _____ Zip _____

A Microprocessor for



Photo 1: Processing. Photosensitized wafers are exposed with a particular mask pattern using ultraviolet light. The entire environment is otherwise ultraviolet-free.



Photo 2: Breadboard debug. The gate level TTL model of the processor involves ten boards of 80 to 120 integrated circuits each. Many of the required 10,000 connections will be wrong. The system must be tested to find and correct construction and logic errors.

Crowds are not unusual; here we have Don Tietjen, Katy Miller, James Tietjen, Steve Messinger (almost hidden), Mike Shapiro and Bill Keshlear.

Terry Ritter and Joel Boney
Motorola Inc
3501 Ed Bluestein Blvd
Austin TX 78721

Part 3:

Clock Speed

In part 3 we conclude our discussion of the Motorola 6809 processor with some thoughts on clock speed, timing signals, condition codes and software design philosophy for the 6809.

We expect that our logic and circuit design cohorts will be able to get significant production at a 2 MHz bus rate (and possibly faster) with the 6809. But this value alone means next to nothing as a figure of processor merit (we did consider using a very high frequency on chip oscillator so we could win the clock rate race, but decided at the last minute that a resonant cavity would not be acceptable to most users).

Other processors use an internal state machine to implement the required internal operations. These processors frequently require multiple states and multiple clock edges to implement operations which are done in one cycle on 6800 class processors.

The 6800 class machines are all random logic machines with multiple dynamic sequencers. This method of microprocessor design selects a different set of engineering trade-offs as opposed to the state machine approach. In particular, less critical timing is necessary, but suspending the processor for a long time is difficult. We provide two external methods of stopping the machine: \overline{DMAREQ} (which has a maximum asynchronous latency of 1.5 bus cycles, and which will recover the bus from DMA (direct memory access) periodically to allow the dynamic microprocessor to perform a refresh cycle) and \overline{HALT} (which has a maximum latency of 21 cycles, but releases this bus completely).

Signals

The 6809 processor will be made in two versions: the on chip clock version (for small systems) and the off chip clock version (with extra signal lines for additional processor status information). This will allow a cost-effective utilization of pins for each proposed market.

The bus timing signals are E and Q. E is

the Revolution: The 6809

Copyright 1978 by Terry Ritter
and Joel Boney

Final Thoughts

the same as on 6800 systems (previously called $\emptyset 2$), a square wave clock with a period equal to one bus cycle. Q is the quadrature clock, and leads E by one quarter bus cycle. Good addresses should be available from the processor on the leading edge of Q; data is latched (by the processor or selected memory or peripheral) on the trailing edge of E.

Two signals are used for clock control in the on chip clock version. DMAREQ halts the processor internally (and puts the output lines of the processor in the high impedance state using three state circuitry) but allows E and Q to continue to run to provide system clocks for a DMA transfer. MREADY being low extends a memory access in increments of the high frequency oscillator period until MREADY is brought high.

If BA=0 (the processor is running) BS=1 means that a vector fetch is occurring (IACK). This signal can be used to develop vector-by-interrupting-device hardware that transfers control directly into the desired interrupt handler without polling.

Two signals are available in the off chip clock version to assist in multiprocessor systems. The last instruction cycle (LIC) pin is high during the last execution cycle of any instruction, thus giving bus arbitration a head start. BUSY is high during read modify write, (from the read through to modify) to indicate that memory exclusion is required. Exclusion is required in multiprocessor systems.

Condition Codes

The 6809 condition code flags are the same as those used in the 6800 (N, Z, V and C), and are affected similarly by most operations. Some exceptions are the double byte operations, since the flags are always set to represent the result of the entire operation, whether single or double byte. (This is implied by the fact that both data length operations have the same root mnemonics).

While very simple in concept (the condition flags being mere by-products of arithmetic and logic unit [ALU] operations), their use with various data representations

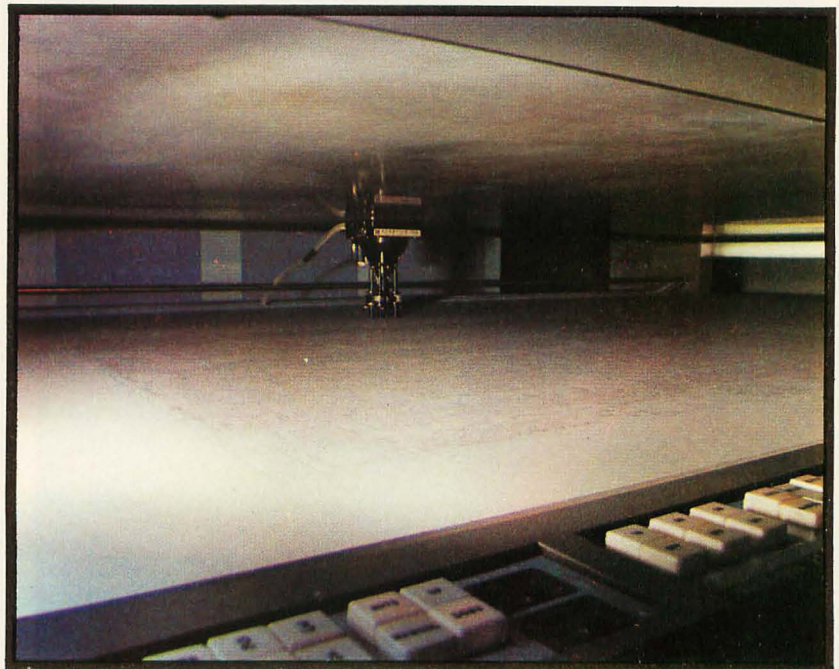


Photo 3: Plotting the circuit layout. Huge precision plotters display the computer data base which will become the chip. The layout plot is then checked by circuit engineers both for proper interconnection and exact transistor sizing. Any problems thus uncovered will be repaired by editing the data base.

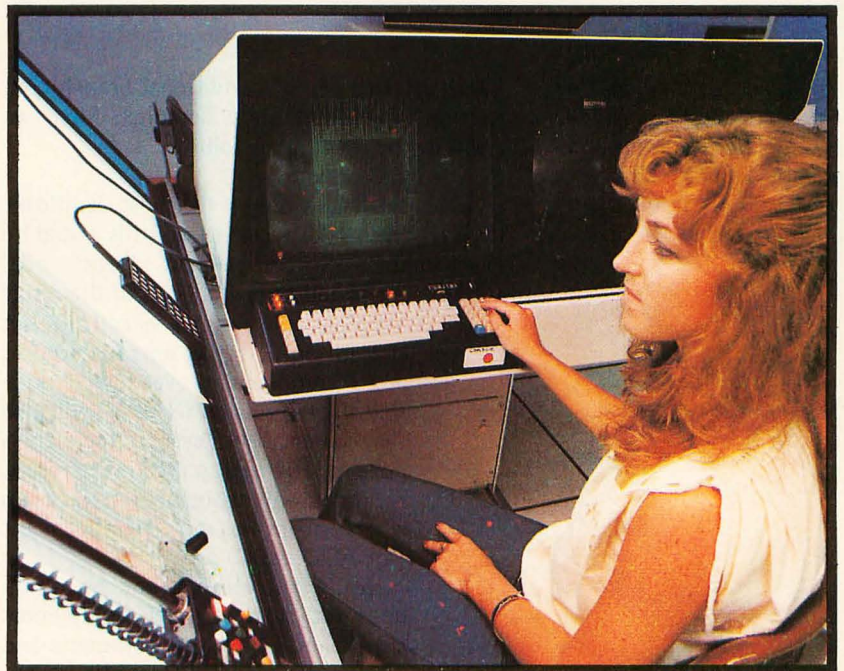


Photo 4: Digitizing. Computer aided design (CAD) technician Lisa Fink enters a cell layout into the data base. The cursor on the light table is used to transfer precision measurements to the computers. An already digitized cell is shown on the video display.

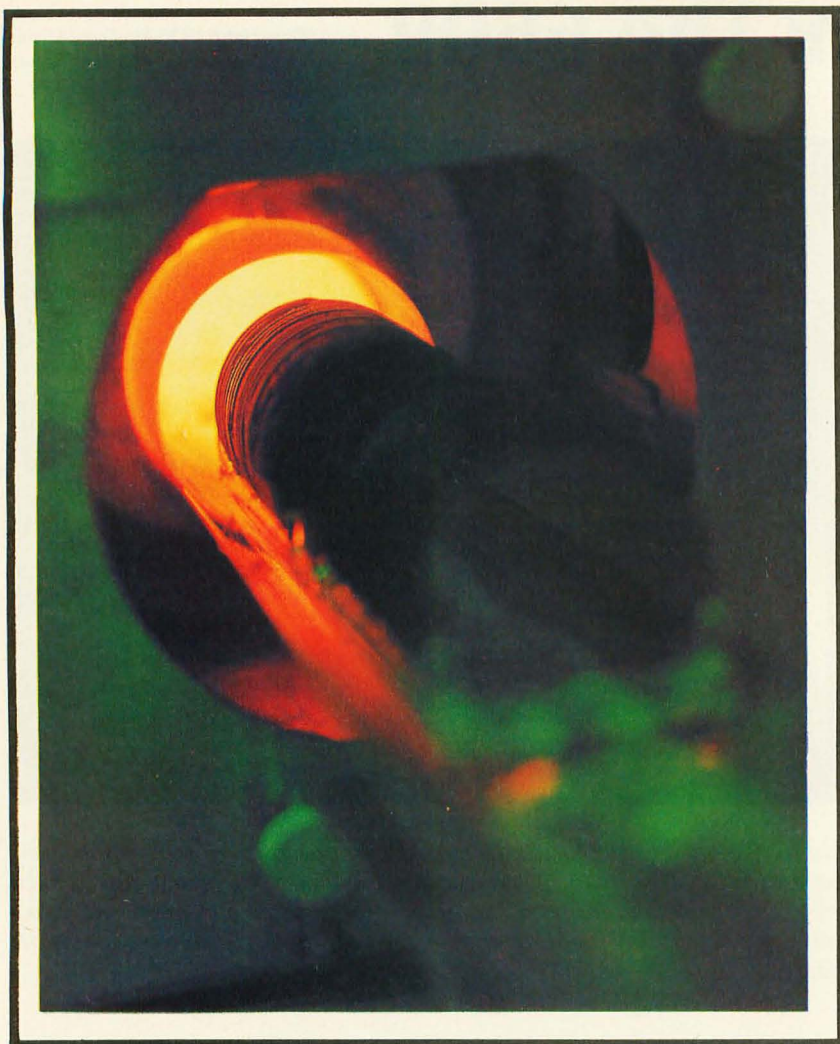


Photo 5: Diffusion. Into the furnace goes another batch of wafers in the process of becoming integrated circuits. Operating near 1000° C, the quartz liner glows incandescent.

and the rich set of conditional branch conditions can seem quite complex. First, we will define the flags as follows.

- N: set if and only if the most significant bit of the result is set (this would be the 2's complement "sign" bit).
- Z: set if and only if all bits of the result are clear (the result is exactly 0). set
- V: if and only if the operation causes a 2's complement overflow. Notice that the expression $(N \oplus V)$ will give the correct sign, even if the sign is not properly represented in the result.
- C: set if and only if the operation causes a carry from the most significant bit (for ADD, ADC) or, set if and only if the operation does not cause a carry from the most significant bit of the arithmetic and logic unit (for subtract-like operations — SUB, SBC, CMP — carry flag represents a borrow) or, set according to rules for rotate or shifts or, set if and only if bit 7 of the

result is set (for MUL).

- Notice that the C flag is not the simple result of the carry in the 8 bit arithmetic and logic unit, but depends on the type of operation performed.
- Notice also that the carry flag represents a borrow after subtract-like operations. This was done on the 6800, for convenience.

Next, let's define the use of the branches. Simple conditional branches:

Test	True	False
Z=1	BEQ	BNE
N=1	BMI	BPL
C=1	BCS	BCC
V=1	BVS	BVC

Signed conditional branches:

Test	True	False
$\overline{(N \oplus V)} \wedge \overline{Z}=1$	BGT	BLE
$\overline{(N \oplus V)} =1$	BGE	BLT
Z=1	BEQ	BNE
$\overline{(N \oplus V)} \vee Z=1$	BLE	BGT
$\overline{(N \oplus V)} =1$	BLT	BGE

Unsigned conditional branches:

Test	True	False
$\overline{C} \wedge \overline{Z}=1$	BHI	BLS
$\overline{C}=1$	BHS	BLO
$\overline{Z}=1$	BEQ	BNE
$C \vee Z=1$	BLS	BHI
C=1	BLO	BHS

Note: The unsigned branches are not, in general, useful after INC, DEC, LD, ST, TST, CLR or COM.

And finally, the flag results of known conditions of comparison are as follows.

After SUB, SBC, CMP:

If register is less than memory value (2's complement values) $(N \oplus V)=1$.
 If register is lower than memory value (unsigned values) C=1
 If register is equal to memory value (signed or unsigned) Z=1.

Because some instructions do not (and should not) affect carry, only the equal and not equal branch tests (BEQ, BNE) are useful after these instructions (INC, DEC, LD, ST, TST, CLR, COM) operate on unsigned values. When operating on 2's complement

GOOD BUY, OEM's!



GOOD-BYE COMPETITION!

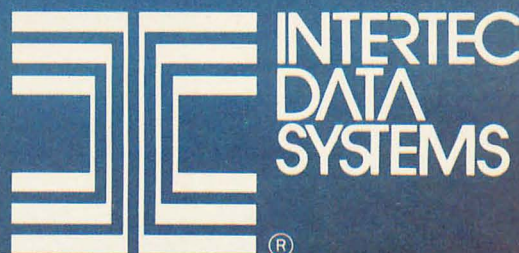
Since Intertec introduced its new INTERTUBE Video Terminal, a lot of OEM's (and dealers, too) are saying "good-bye" to their high cost, low performance terminals. The INTERTUBE is such a good buy that OEM's find it almost impossible to justify using anything else.

You'll say good-bye too when you compare INTERTUBE's price / performance ratio with any other terminal on the market today. Standard INTERTUBE features include: a 12" display in a 24 line by 80 column format, 128 upper and lower case ASCII characters, reverse video, blinking, complete cursor addressing and control, an 18 key numeric keypad, separate back-space, tab, shiftlock, local, on-line and print keys, special user-defined function keys, protected and unprotected fields, line insert/delete and character insert/delete editing, eleven special line drawing symbols, 15 selectable baud rates from 75 to 9600 BPS, half and full duplex operation, an RS-232 interface, and ... would you believe it ... there is more! A special "Status Protect" key allows you to enable only those features required in your system and "lock-out" all others, thereby assuring flexible operation in both "smart" and "dumb" environments.

By now you're probably becoming very uneasy if your last terminal purchase wasn't an INTERTUBE. Brace yourself. You're going to become sick! OEM's realize there are no hidden costs of ownership with the INTERTUBE. You can have all the performance you need without having to add expensive options. Standard user-oriented features are: an RS-232 printer port, "block" transmission modes, parity and baud rate error detection, a self-test mode, a 25th "STATUS" Line which displays the current status of the terminal, a transparent mode to simplify program debugging, and selectable display intensities for "easy-on-the-eyes" operation with minimized operator fatigue.

Price, performance, design, reliability ... what more could an OEM want? Availability? We've got it! Our new 120,000 square foot manufacturing facility turns out a lot of INTERTUBES each day. And because we control the manufacturing process right down to injection molding our own cover assemblies, your delivery schedules are never interrupted. Order today and chances are your first units will be on their way within 48 hours. Incredible!

Call or write us now. We'll show you what a "good buy" the INTERTUBE really is and why more and more OEM's are saying "good-bye" to the competition.



2300 Broad River Road, Columbia, S.C. 29210
(803) 798-9100
TWX: 810-666-2115

values, all signed branches are correctly available.

Some Software Design Philosophy

The design of successful software differs from other types of engineering design in that good software can be easily changed, but is exceedingly unforgiving. The creation of working software involves intimate contact with *quality*.

Any program, working or unworking, is a representative of the philosophy of *truth*; the machine will execute the program, good or bad. Only applicable programs are useful, however, and utility is where we encounter quality. Many individuals indoctrinated into a society founded upon truth can scarcely understand why such truthful programs do not work, for isn't one truth just as good as another?

Any program that is to be fixed or changed must be analyzed: the written code must be read and understood. Reading is a problem — most computer languages are very difficult to read simply because so many options are possible from each statement. Finding the coherent design of a program is nearly impossible when, as it is being read, thousands of options exist. It is the paradox of programming that a disciplined, restricted, structured programming language gives programmers

greater freedom to understand their programs.

Consider the analysis of programs: any program segment having multiple conditional branches that cannot be separated must be analyzed for all possible conditions of input data before we can be assured that the program will operate correctly.

Program segments having branch paths that cross may be impossible to analyze rigorously due to the combinatorially larger number of paths that the program may execute. Where control structures are always properly nested, crossed branch paths cannot occur and analysis is easier.

Programming structures which have basically one entry point and one exit are easily detached from surrounding code and are easier to understand and test. This is the fundamental tenet of structured programming.

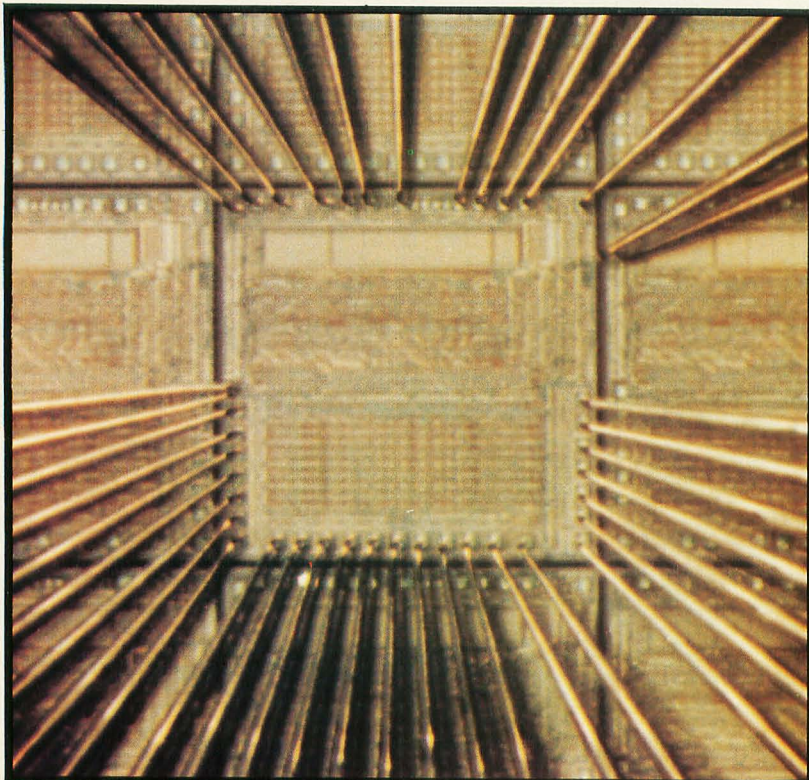
Every attempt should be made to code in modules. Modules are self-contained entities (usually subroutines) which allocate and deallocate their own local storage. Naturally, the actual code should be heavily commented to allow a reader to understand what is being attempted. But one mark of a good module is that it contains a header block which fully describes *all* aspects of the inputs to the module and results from it. This description should be so detailed as to allow the module to be totally recoded from this information alone. We hope that the description was arrived at *before* the module was written. It is a mark of good software design that the actual coding is but a minor part of the project; it occurs after all modules have been completely described. The finished modules should be individually tested for all possible input values, and should demonstrate that error handlers will operate when a supposedly invalid input value occurs. Modules which are recoded at a later date must pass the original tests.

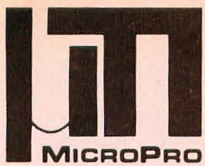
Software in the Revolution

The microprocessor revolution is fueled by continual technical advancement that produces hardware with ever higher capability and ever lower cost. Yet, it is a requirement of the revolution that software be written to make that cheap hardware *do* anything.

Most present microprocessor software is custom software written for a specific project. Project specific software is rarely published, partly in the (unreasonable) hope of maintaining trade secret protection, and partly because finished project software is rarely of publication quality. Commercial software is rare for a number of reasons:

Photo 6: Wafer probe. Each circuit is separately checked while still on the wafer. This equipment automatically steps to the next chip after any bad result or when all tests are good. A production 6800 is shown.





MICROPRO INTERNATIONAL CORPORATION

MICROPRO
SUPER-SORT™

COBOL
FORTRAN
BASIC

COBOL/S™
FORTRAN/S™
BASIC/S™

*

*MicroPro International Corporation proudly announces the incorporation of SUPER-SORT™ into Microsoft COBOL, FORTRAN and BASIC. Now, exclusively from MicroPro you can have the full level 2 COBOL sort verb implemented by joint cooperation between Microsoft and MicroPro. Enjoy the fastest, most flexible sort/merge/extract available together with Microsoft's compilers! COBOL/S™ \$850, FORTRAN/S™ \$600, BASIC/S™ \$450.

Other Quality Software from MicroPro:

- **WORD-MASTER™** — Screen Oriented word processing on any CRT \$150.00
or Video Board using CP/M** TEX** — Output Formatter \$ 75.00
- **ISAM-ANSI** standard level two, multiple key access, three level indexing, .. \$150.00
written in M-80 Assembler, relocatable, interfaces to COBOL,
FORTRAN, and BASIC, uses less than 6K, up to 9 disks in 1 file.
- **CORRESPONDER™** — Powerful form letter generation to user mailing
lists. Handles correspondence and volume mailings with custom
salutations and variable file-derived or user-specified substitutions in
letter text. Creates mailing list files and prints cheshire
or vertical labels. w/o CBASIC \$95.00
with CBASIC (requires CBASIC to run) \$185.00
- **SUPER COMBO I** — Word-Master, Super-Sort (stand alone), \$475.00
Tex, & Corresponder (\$520 value)

**CP/M and TEX are Trademarks of Digital Research.

Prices and Specifications subject to change without notice.

©1978, MicroPro International Corporation. All rights reserved.

Clip and Mail This Form to: **MicroPro International Corporation** at 1299 - 4th Street, San Rafael, CA 94901

Please Type or Print Clearly

ORDER FORM — Dealer/OEM Inquires Welcomed

SPECIFY MEDIA 5 1/4" ☐ 8" ☐

Send To:

Name _____

Company _____

Address _____

City, state, zip code _____

Check Attached or Charge

Mastercharge _____

Visa No. _____

Exp. Date _____

COD (10% deposit required) ☐

I agree to abide by MicroPro's End-User Agreement
and return the signed End-User Agreement or return
software unopened.

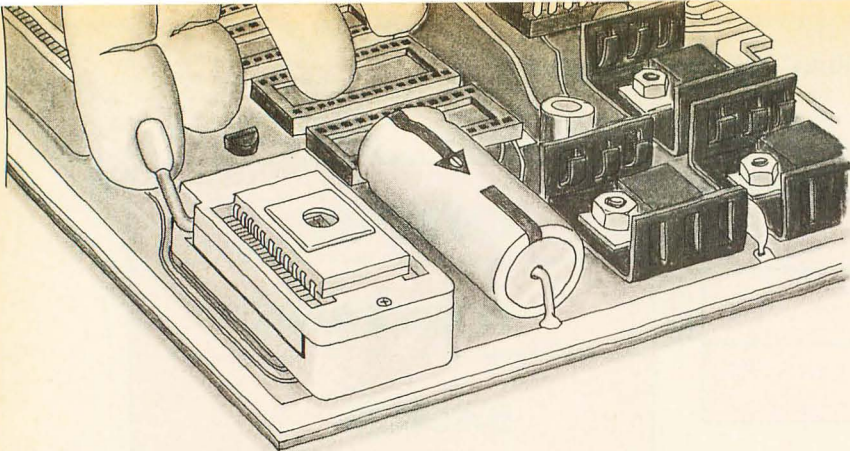
- | | | |
|--|---|-------|
| <input type="checkbox"/> COBOL \$750.00 | <input type="checkbox"/> COBOL/S™ \$850 | _____ |
| <input type="checkbox"/> FORTRAN \$500 | <input type="checkbox"/> FORTRAN/S™ \$600 | _____ |
| <input type="checkbox"/> BASIC \$350 | <input type="checkbox"/> BASIC/S™ \$450 | _____ |
| <input type="checkbox"/> SUPER-SORT I™ \$250 | <input type="checkbox"/> Manual only \$25 | _____ |
| <input type="checkbox"/> SUPER SORT II without relocatable feature (standalone) | \$200 | _____ |
| <input type="checkbox"/> SUPER SORT III Stand Alone — without select/exclude feature | \$150 | _____ |
| <input type="checkbox"/> WORD-MASTER™ \$150 | <input type="checkbox"/> Manual only \$25 | _____ |
| <input type="checkbox"/> TEX** \$75 | <input type="checkbox"/> Manual only \$15 | _____ |
| <input type="checkbox"/> ISAM \$150. | <input type="checkbox"/> Manual only \$25 | _____ |
| <input type="checkbox"/> CORRESPONDER™ \$95 | <input type="checkbox"/> Manual only \$15 | _____ |
| <input type="checkbox"/> SUPER COMBO I \$475 | | _____ |

POSTAGE & HANDLING \$2.50 _____

Signature (if ordering diskettes or paying with credit card) _____

TOTAL _____

Dealer Inquiries Invited: 1299 - 4th Street, San Rafael, CA 94901 (415) 457-8990 (new) or (707) 544-2865 (old)



EPROMs out at the touch of a finger.

After programming a 2708 or 2716 EPROM you won't need a screwdriver to pry it out of **SSM's new PB1 board** equipped with Textool sockets. Just flip the lever and lift it out. And on the same board there are 4 sockets waiting for 2708 or 2716 EPROMs that can be independently addressed to any 4k or 8k boundary above 8000 hex. Two boards in one.

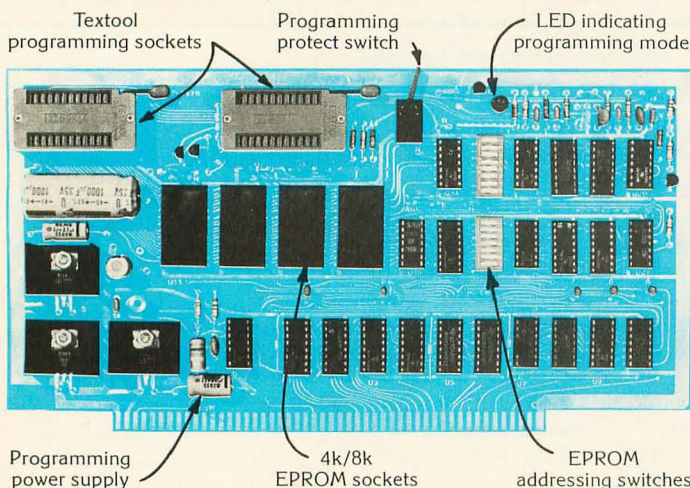
PB1 has two separate programming circuits so 2708 or 2716 (5v) type of EPROMs can be programmed without modifying the board. Programming voltage is generated on-board by a DC-DC converter; no need for an external power supply. Programming sockets are Dip Switch addressable to any 4k boundary. And complete software is provided for programming and verifying EPROMs.

With our Magic Mapping™ feature, unused EPROM sockets don't take memory space, so you are never committed to the full 4k or 8k of memory. The board can be configured for 0 to 4 wait states. Use fast or slow EPROMs. All lines are buffered.

The PB1 kit is available at over 150 retail locations or directly from SSM for \$139.95 (with Textool sockets) or \$119.95 (without Textool sockets). All SSM kits are backed by a 90 day warranty. Assembled, one year warranty.

SSM manufactures a full line of S-100 boards, including CPU, Video, I/O, RAM, EPROM, Music, Prototyping, Terminator, Extender and Mother boards. For complete details just send for our new, free brochure.

PB1 2708/2716 Programmer & 4k/8k EPROM Board



2116 Walsh Ave., Santa Clara, CA 95050
(408) 246-2707

We used to be Solid State Music. We still make the blue boards.

there must be a market for the (machine specific) software before the investment in program development is made, but the customer base may not exist until good programs are available. It is also difficult to consider investing in software that can be so easily copied (stolen) and used.

The copying problem is not new; musical reproductions have long coexisted with the possibility of consumer recording and reproduction for a close circle of friends. This occasionally happens, but it is usually too much bother to tape the music you want (assuming that the original product is available at a reasonable cost). Software should be distributed as a reasonably priced physical product that is useful to a broad consumer base.

This is an old idea, but it just hasn't worked. The problem is not in the idea, but in the second generation microcomputer architectures which limit the applicability of any particular program read only memory. The 6809 microprocessor is designed specifically — through the use of position independent code, stack indexing, and indirect addressing — to allow the creation of standard program read only memories. This creates a market opportunity for a brand new standard software industry. We knew this when we included these features; you're welcome, entrepreneurs!

Summary

We wrote this series of articles not only to disclose the 6809 but mainly to put down in print the rationale and reasoning behind the 6809. It would have benefited us if the designers of the 6800 had documented their rationale. We would also like to think we have stimulated some interest in the personal computing community for solutions to the software problem and for the study of computer architecture. The big challenge for architects in the next decade and beyond will be to design computers that can effectively utilize the huge number of devices — 1,000,000 transistors by 1985 — that semiconductor technology will be able to put on one 25 mm² piece of silicon.

No computer is designed in a vacuum, and we would like to thank all of our customers and the people at Motorola who gave us valuable input. Special thanks go to the dozens of people — too many to enumerate — who have been or are still actively involved in the design, implementation and production of the MC6809. Without their individual talents and dedication to what seemed to be impossible tasks and impossible schedules, the MC6809 could not have been realized.■

Event Queue

March 3-4, Micro-Expo '79, Texas A and M University Memorial Student Ctr, College Station TX. Sponsored by The Texas A and M Microcomputer Club, the activities at the third annual Micro-Expo '79 will include exhibits by dealers and hobbyists, a programming contest, and a computer chess tournament, as well as seminars on topics of interest to both the novice and the experienced computer enthusiast. Contact Larry Brown at (713) 693-5748 or Scott Edwards at (713) 845-5531.

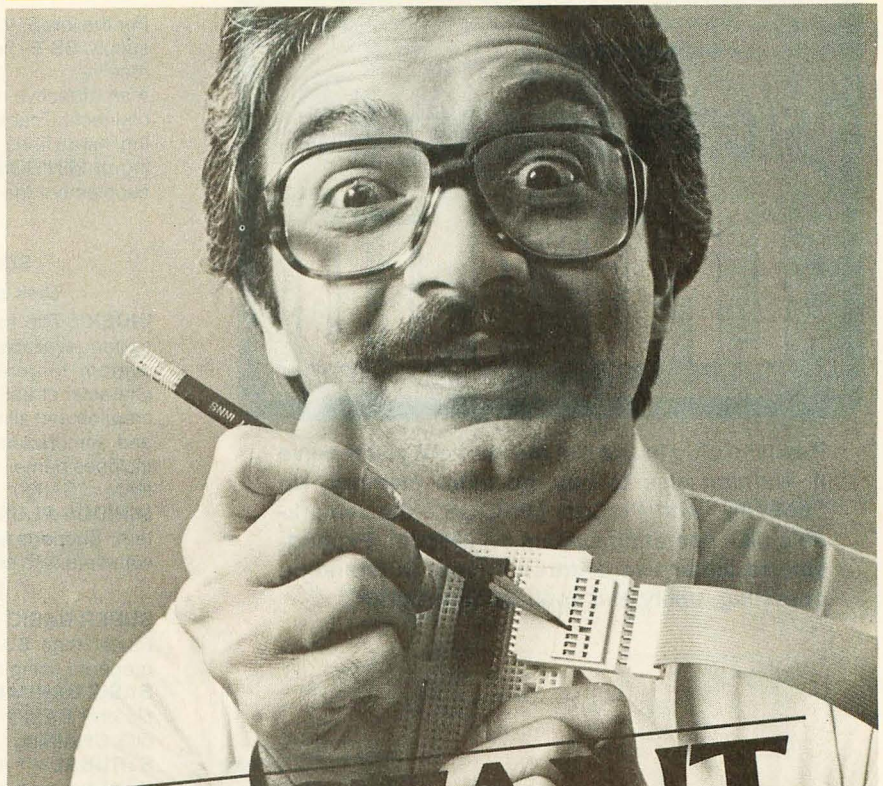
March 10-11, Personal Computer Fair, Pacific Science Ctr, Seattle WA. The fair will acquaint people with personal, home and hobby computer applications. Visitors will see a variety of nontechnical demonstrations and have numerous opportunities for hands-on experimentation. Contact Susan Stocker, Pacific Science Ctr, 200 Second Av N, Seattle WA 98109.

March 17, The Computer Faire, Delaware State College, Dover DE. This faire will deal with current technology of computers for the classroom and personal use. Contact Lynda Baker, New Castle County School District Area II, Henry B duPont Middle School, Bengel and Meeting House Rds, Hockessin DE 19707.

March 19-20, Microcomputers: Operating Principles, Hardware and Software Seminar, Holiday Inn, Palo Alto CA. Polytechnic Institute of New York and the Institute for Advanced Professional Studies are presenting this 2 day seminar for engineers, programmers, and technical managers involved with selection of microprocessors and design of microprocessor-based systems. The seminar will cover the underlying concepts governing microprocessor operation, architecture, and systems design. Microcomputer elements and their interrelationships will be discussed, emphasizing features important in determining whether a particular microcomputer will be suitable for a given task. Contact Prof Donald D French, Institute for Advanced Professional Studies, 1 Gateway Ctr, Newton MA 02158, (617) 964-1412.

March 19-21, Federal DP Expo Conference and Exposition, Sheraton Park Hotel, Washington DC. This fifth annual government show will feature computer related hardware, software and service.

Continued on page 76



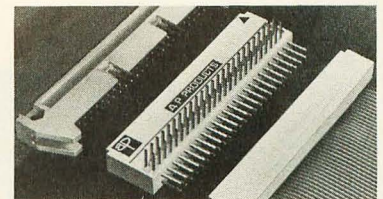
INSTANT.

The way you check line-by-line with an A P Intra-Switch or Intra-Connector.

You plug your Intra-Switch in-line with standard socket connectors, and instantly you've got a separate, independent on-off switch for each and every line in your flat ribbon cable. To switch, you nudge with a pencil point. It's that quick.

Imagine how much time and trouble Intra-Switch will save you in your diagnostic and quality testing, your programming and selective line inhibiting.

Or, plug in your Intra-Connector (see box) the same way, and you have an extra set of male contacts



at right angles. Instant line-by-line probeability—and an easy way to tap your system and daisy chain it into new areas.

Both Intra-Connectors and Intra-Switches come in 20, 26, 34, 40 and 50-contact models.

Where? At your nearby A P dealer. Where's that? Phone (toll-free) 800-321-9668. And ask for the complete A P catalog, The Faster and Easier Book.



A P PRODUCTS INCORPORATED

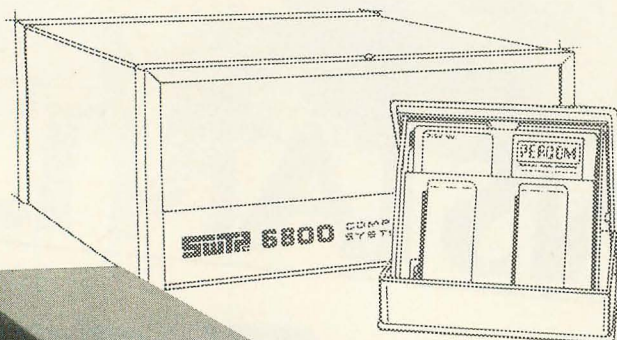
Box 110D • 72 Corwin Drive
Painesville, Ohio 44077
Tel. 216/354-2101
TWX: 810-425-2250

Faster and Easier is what we're all about.

For your SWTP 6800 Computer . . .

PERCOM'sTM FLOPPY DISK SYSTEM the LFD-400

Ready to plug in and run the moment you receive it. Nothing else to buy, no extra memory. No "booting" with PerCom MINIDOSTM, the remarkable disk operating system on EPROM. Expandable to either two or three drives. Outstanding operating, utility and application programs.



For more
information
see your local
PerCom dealer
or call
toll free
1-800-527-1592

only
\$599⁹⁵

fully assembled and tested
shipping paid



PERCOM DATA COMPANY, INC.
Dept. B 318 Barnes Garland, Texas 75042
(214) 272-3421

For the low \$599.95 price, you not only get the disk drive, drive power supply, SS-50 bus controller/interface card, and MINIDOSTM, you also receive:

- an attractive metal enclosure • a fully assembled and tested interconnecting cable • a 70-page instruction manual that includes operating instructions, schematics, service procedures and a complete listing of MINIDOSTM • technical memo updates — helpful hints which supplement the manual instructions • a 90-day limited warranty.

SOFTWARE FOR THE LFD-400 SYSTEM

Disk operating and file management systems

INDEXTM The most advanced disk operating and file management system available for the 6800. Interrupt Driven Executive operating system features file-and-device-independent, queue-buffered character stream I/O. Linked-file disk architecture, with automatic file creation and allocation for ASCII and binary files, supports sequential and semi-random access disk files. Multi-level file name directory includes name, extension, version, protection and date. Requires 8K RAM at \$A000. Diskette includes numerous utilities . . . \$99.95
MINIDOS-PLUSX An easy-to-use DOS for the small computing system. Supports up to 31 named files. Available on ROM or diskette complete with source listing . . . \$39.95

BASIC Interpreters and Compilers

SUPER BASIC A 10K extended disk BASIC interpreter for the 6800. Faster than SWTP BASIC. Handles data files. Programs may be prepared using a text editor described below . . . \$49.95
BASIC BANDAIDTM Turn SWTP 8K BASIC into a random access data file disk BASIC. Includes many speed improvements, and program disk CHAINing . . . \$17.95
STRUBAL +TM A STRUctured BASIC Language compiler for the professional programmer. 14-digit floating point, strings, scientific functions, 2-dimensional arrays. Requires 16K RAM and Linkage Editor (see below). Use one of the following text editors to prepare programs. Complete with RUN-TIME and FLOATING POINT packages \$249.95

Text Editors and Processors

EDIT68 Hemenway Associates' powerful disk-based text editor. May be used to create programs and data files. Supports MACROS which perform complex, repetitive editing functions. Permits text files larger than available RAM to be created and edited . . . \$39.95
TOUCHUPTM Modifies TSC's Text Editor and Text Processor for PerCom disk operation. ROLL function permits text files larger than available RAM to be created and edited. Supplied on diskette complete with source listing . . . \$17.95

Assemblers

PerCom 6800 SYMBOLIC ASSEMBLER Specify assembly options at time of assembly with this symbolic assembler. Source listing on diskette . . . \$29.95
MACRO-RELOCATING ASSEMBLER Hemenway Associates' assembler for the programming professional. Generates relocatable linking object code. Supports MACROS. Permits conditional assembly . . . \$79.95
LINKAGE EDITOR — for STRUBAL+TM and the MACRO-Relocating assembler . . . \$49.95
CROSS REFERENCE Utility program that produces a cross-reference listing of an input source listing file . . . \$29.95

Business Applications

GENERAL LEDGER SYSTEM Accommodates up to 250 accounts. Financial information immediately available — no sorting required. Audit trail information permits tracking from GL record data back to source document. User defines account numbers . . . \$199.95
FULL FUNCTION MAILING LIST 700 addresses per diskette. Powerful search, sort, create and update capability . . . \$99.95
PERCOM FINDERTM General purpose information retrieval system and data base manager . . . \$99.95

TM trademark of PERCOM Data Company, Inc.

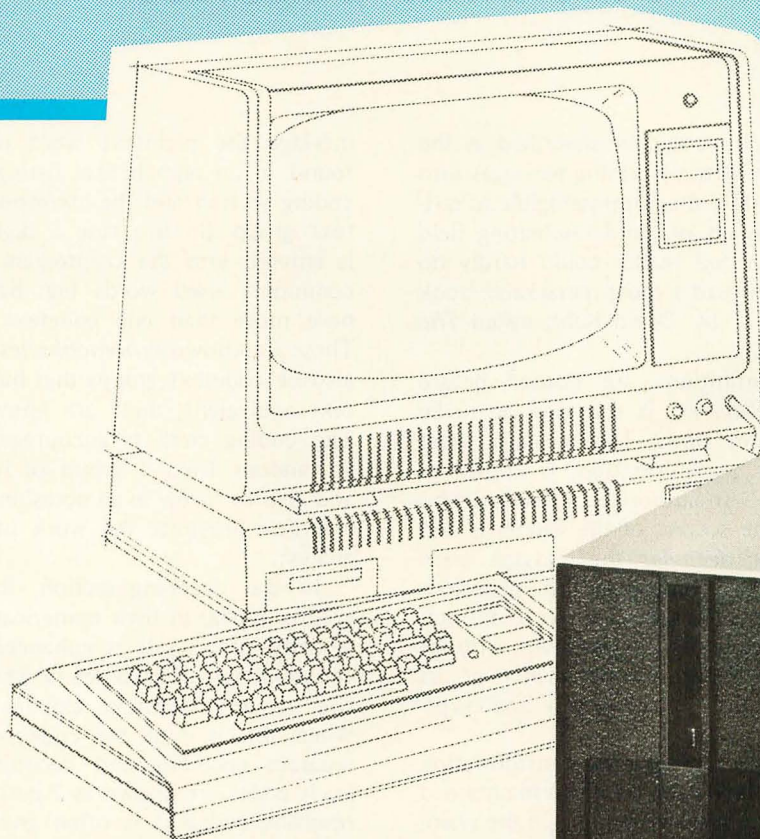
Ordering information

To order, call toll free 1-800-527-1592. MC and VISA welcome. COD orders require 30% deposit plus 5% handling charge. Allow three weeks for delivery. Allow three extra weeks if payment is by personal check. Texas residents add 5% sales tax.

PERCOM 'peripherals for personal computing'

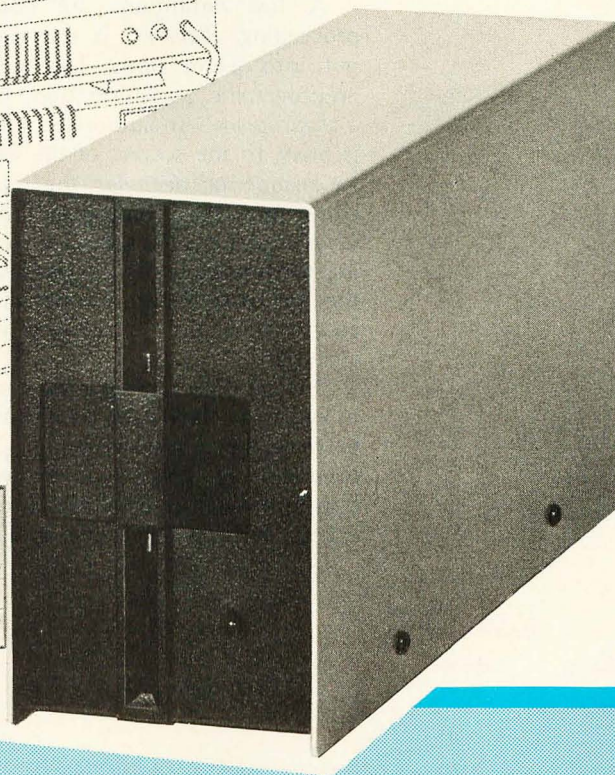
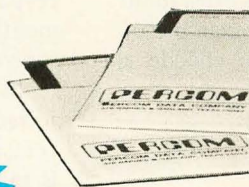
NOW...

Add-on Mini-Disk for the TRS-80*



*Trademark of Tandy Corporation.

Dual and triple drives
also available.



only
\$399⁰⁰

Requires 16K RAM,
Level II BASIC and
Expansion Interface.

PERCOM™

PERCOM DATA COMPANY, INC.
Dept. B 318 Barnes Garland, Texas 75042
(214) 272-3421

To Order Call 1-800-527-1592

*RADIO SHACK and TRS-80 are trademarks of Tandy Corporation which has no relationship to PERCOM DATA COMPANY, INC.

Cryptography in the Field

Part 1: An Overview

John P Costas PhD
Senior Consulting Engineer
General Electric
Court St, Bldg 4, Rm 38A
Syracuse NY 13201

Cryptography could be described as the science or art of transforming messages into forms that render them unintelligible to outsiders. This is an old and fascinating field and the interested reader could hardly do better than to read a most remarkable book on this subject by David Kahn called *The Codebreakers*.

A few definitions are needed before proceeding. *Plaintext* is the message to be put into secret form. The message, after cryptographic transformation, is known as a *cryptogram*. An authorized individual who is privy to the secrets of the system is said to *decode* or *decipher* the message when converting the cryptogram to plaintext. *Cryptanalysis* is the science or art of extracting the meaning of a cryptogram without the key. *Cryptology* is the science or art encompassing both cryptography and cryptanalysis.

A code is a cryptographic transformation in which no fixed relationship is maintained between the number of symbols in the plaintext and the corresponding cryptographic transformation or *codetext*. An example of a code is shown in table 1. To encode a

message the plaintext word or phrase is found in an alphabetical listing in the encoding section and the corresponding codetext group (in this case 5 digit numbers) is entered into the cryptogram. Note that commonly used words (eg: ballistic) may have more than one codetext equivalent. These are known as *homophones*. There may also be codetext groups that have no plaintext equivalent; these are known as *nulls*. The coding clerk is encouraged to select at random from a group of homophones and also to throw in an occasional null in an effort to frustrate the work of the cryptanalyst.

In the decoding section, the codetext groups appear in their numerical order. The security of a code is enhanced when the codetext numerical order is scrambled relative to the plaintext alphabetical order. When this is done the codebook contains separate encoding and decoding sections. Such codes are known as *2 part* codes. The resulting codetext is often given a further cryptographic transformation (encipherment); the overall process is then known as *superencipherment*.

In many applications, a cipher is preferred to a code. A cipher is a cryptographic transformation in which a fixed relationship is maintained between the number of plaintext symbols and the number of symbols in the resulting cryptographic transformation (ciphertext). An example of a simple cipher would involve replacement of each plaintext letter by the next letter in alphabetical order. Plaintext A becomes ciphertext B, plaintext B becomes ciphertext C, etc. Some feeling for the difference between codes and ciphers may be obtained by noting that linguists are often assigned to break codes while mathematicians handle the ciphers.

This article deals mostly with field ciphers, of which there are two main classifications: substitution and transposition. In the former, new symbols are substituted for the plaintext symbols to form the ciphertext. In the latter, the original symbols are

Encoding		Decoding		
plaintext	codetext	nulls	codetext	plaintext
.
BALANCE	78452	17593	17590	AFTERBURNER
BALANCE SHEET	43987	43874	17591	DETACHED
BALL	15638	12958	17592	UNLIKELY
BALLAST	28457	84355	17593	(NULL)
BALLISTIC	12953		17594	JAMMING
BALLISTIC	87465		17595	STATUTE OF LIMITATIONS
BALLISTIC	72589		17596	BALLOON
MISSILE			.	.
BALLOON	17596		.	.
.	.		.	.
.	.		.	.

Table 1: A simple 2 part code example. The encoding section is alphabetically arranged and the decoding section is numerically arranged. To further frustrate the efforts of anyone intercepting the message, nulls are frequently used (a null is a portion of ciphertext having no plaintext equivalent).


```
plaintext alphabet: A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
ciphertext alphabet: P A T R I C Z L O N K B D E F G H J M Q S U V W X Y
```

Table 2: This relatively simple cryptographic procedure can be used as a field cipher. First the plaintext alphabet is written, then the ciphertext is written underneath it. The message is coded by using the ciphertext alphabet in place of the plaintext alphabet. The former is arrived at by using a keyword. In this case, the keyword Patricia Zlotnik is written followed by the unused letters of the alphabet. No letters are allowed to repeat.

retained but the order of appearance is scrambled to prevent disclosure of meaning.

Field Ciphers

Field ciphers are traditionally relatively simple cryptographic procedures which can be implemented readily in the field using only pencil and paper. The definition of *pencil and paper* is updated here to include the ubiquitous electronic pocket calculator. Common to these systems is the use of an easily remembered word or phrase which serves as a *key* in the cryptographic process. In the illustrative examples that follow we will use as a demonstration keyphrase:

PATRICIA ZLOTNIK

and as a demonstration message:

MAY UP BID PRICE TWENTY PERCENT ON TRACT ONE ONLY.

In one form of a monoalphabetic substitution, the key is first written by eliminating repeated letters, followed by the remainder of the alphabet in order as shown in table 2. By substitution from this table, M becomes D, A becomes P, etc. The following cryptogram results for the demonstration message:

D P X S G A O R G J
O T I Q V I E Q X G
I J T I E Q F E Q J
P T O F E I F E B X

The ciphertext is represented here in the standard form used by cryptographers, in groupings of five characters. The ciphertext should be read across both columns rather than across one (eg: the ciphertext in this example would be DPXSGAORGJOTIQV).

The cryptogram purposely does not preserve word groupings. How good is this cipher? It is both unbreakable and worthless. If the only message ever sent is the single 3 letter word:

CAT

then the cryptogram:

TPO

is beyond rational cryptanalysis. On the other hand, even very light usage (such as the demonstration message) allows simple frequency analysis to begin the destruction of the cipher. The fact that the letter I has been used to replace the plaintext E will not remain a mystery for long. By any practical measure, monoalphabetic ciphers of this type are clearly useless.

Useless or not, one can present a superficially convincing argument for monoalphabetic substitution. It could be correctly noted that there are approximately 4×10^{26} possible plaintext to ciphertext alphabet equivalents using this system. (This, of course, is the number of permutations possible in a 26 character alphabet.) Therefore, even if a fast computer could be found that would check, say, one billion trial solutions per second, it would still take over ten billion years to exhaust all the possibilities. These are impressive but totally meaningless statistics. Presenting the cryptanalyst with a large number of possibilities is a necessary but not a sufficient condition for cryptographic success.

Improved security may be obtained by the use of polyalphabetic ciphers, which may be demonstrated using the Vigenère tableau of table 3. (The Vigenère tableau is named after the French cryptographer Blaise de Vigenère who popularized the

ciphertext alphabet	plaintext alphabet																										
	A B C D				- - - - -																		X Y Z				
	A	A B C D				- - - - -																		X Y Z			
	B	B C D E				- - - - -																		Y Z A			
	C	C D E F				- - - - -																		Z A B			
	D	D E F G				- - - - -																		A B C			
																							
																							
																							
	X	X Y Z A				- - - - -																		U V W			
Y	Y Z A B				- - - - -																		V W X				
Z	Z A B C				- - - - -																		W X Y				

Table 3: The Vigenère tableau is used to generate a polyalphabetic cipher. To encipher, the plaintext message is first written out. Then the keyword is repeatedly written on top of the plaintext. The ciphertext is obtained by selecting the letter which is at the intersection of the plaintext alphabet column and the keyword character row.

key: P A T R I C I A Z L O T N I K P A T R - - - -
plaintext: M A Y U P B I D P R I C E T W E N T Y - - - -
ciphertext: B A R L X D Q D O C W V R B G T N M P - - - -

Table 4: An example of the encryption process using the Vigenère tableau shown in table 3.

method although he did not invent it.) This table is bordered by the plaintext alphabet at the top and ciphertext alphabet designators at the left. The ciphertext alphabets in the body of the table are merely rotations of the normal alphabet. Enciphering is done by writing the key phrase repeatedly over the plaintext and enciphering each plaintext character by the corresponding keyphrase alphabet designator. In the example shown in table 4, letter M is enciphered from alphabet P, letter A is enciphered from alphabet A, letter Y from T, etc. By switching alphabets in this way we frustrate the simple frequency analysis which was so effective in the previous cipher example. Clearly, any given plaintext letter (such as E) has a different ciphertext equivalent in each of the different alphabets.

The cryptanalyst can attack this system by searching for the repeating key length (in this case 15). Once the keylength is established, he or she will rearrange the ciphertext in matrix form in which the row length is equal to the keylength. The columns of this matrix each involve the same ciphertext alphabet. Frequency analysis by columns soon reveals the specific key used and the whole structure then collapses.

One ploy sometimes used to frustrate the cryptanalyst is to use a coherent running key. The key could be taken from a readily available book, for example. By this method, the repetitions of the key are eliminated and the cryptanalyst is forced to work harder for a solution, which he or she can get, given enough cryptogram material and time.

A very significant advance in cryptography was introduced by a concept which may be generally described as *autokey*. In this system, the plaintext itself is used as the key. A given plaintext character selects the

alphabet for encipherment of the next plaintext character, and so forth. One of the problems of using autokey is that the key and the recovered plaintext are one and the same. Thus the system tends to self-destruct after the first error. The error propagation properties of autokey are often cited as the reason for not using this technique in field ciphers.

Transposition Ciphers

An important cipher class is the transposition cipher. As the name implies, the meaning of the message is hidden because the order of the characters is scrambled in the ciphertext. To demonstrate transposition, we again call upon our friend Patricia, but this time her name is written out completely to form the keyphrase. The letters in the keyphrase are then numbered according to alphabetical order. When two or more identical letters exist, they are sequentially numbered from left to right. When this is done, there results a scrambled set of integers from 1 to the number of characters in the keyphrase (in this case 15). The message is then written under these column designators in rows of keyphrase length. An example for the demonstration key and message is shown in table 5.

Once this is done, the ciphertext is read out in column order: ANC, DCN, BEE, etc. When put in the standard 5 letter groups, the cryptogram becomes:

A	N	C	D	C	N	B	E	E	P
P	N	I	R	O	T	T	W	R	R
N	Y	E	N	I	T	M	E	A	U
Y	O	Y	T	T	C	O	P	E	L

Since the deciphering clerk knows both the key and message lengths, he or she can quickly determine the length of each column in the original matrix. The cryptogram is then copied in column form and the message read out by rows. Multiple transpositions are often done using the same or different keyphrases. Null cells in the transposition matrix are sometimes used to strengthen the cipher.

Substitution ciphers replace characters but leave them in their original positions. The cryptanalyst can use this invariant to advantage. Transposition destroys the order but does not hide the content. Combinations of transposition and substitution can provide complementing strengths to produce very effective ciphers.

Playfair Cipher

It is interesting to consider briefly an

key: P A T R I C I A Z L O T N I K
column order: 11 01 13 12 04 03 05 02 15 08 10 14 09 16 07
M A Y U P B I D P R I C E T W
E N T Y P E R C E N T O N T R
A C T O N E O N L Y

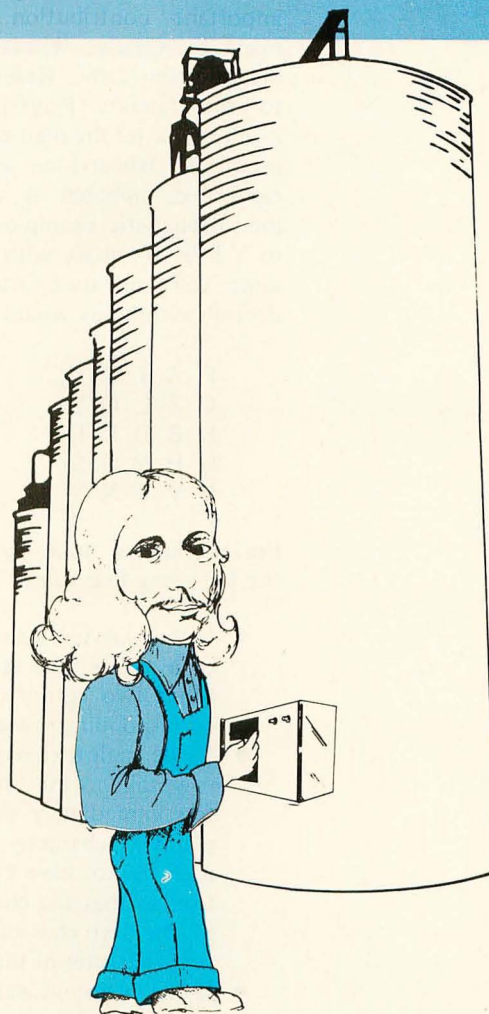
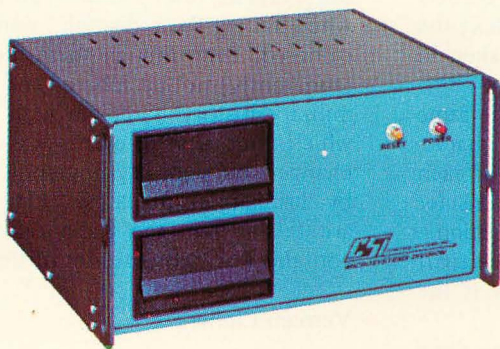
Table 5: A transposition table arranged for the keyword Patricia Zlotnik and the example message "May up bid price twenty percent on tract one only." In the transposition method, the keyword is first written out and numbered in alphabetical order. The message is then written in columns under the keyword. The resulting columns are read out in numerical order to produce the ciphertext.

PASCAL IS ALIVE . . . AND WELL . . . AND WORKING IN A GRAIN ELEVATOR!

When you've decided to let PASCAL work for you, give it the best home — Control Systems' UDS 470.

Our unique PASCAL-IN-PROM feature lets OEM's have their cake and eat it too: the simplicity of assembly-language plus the power of PASCAL. The PASCAL program is compiled (instead of assembled) and the compiler output (P-code) is burned into PROM/EPROM.

Hardware for our rugged UDS 470, designed for hostile environments, has performed successfully for over two years — controlling grain elevator operations in the U.S. and Canada.



- * UCSD PASCAL
- * 6800 based now; upgradable to 6809 or 68000
- * 32K RAM
- * 16K EPROM



1317 Central • Kansas City, KS 66102 • (913) 371-6136
5200 West 73rd Street • Minneapolis, MN 55435 • (612) 831-0214
Drawer EE • Williamsburg, VA 23185 • (804) 564-9350

K	X	J	E	Y	U	R	E	B	E	X	E	L	W	A	O	H	W	U	W		
Z	W	E	H	E	W	R	Y	T	H	U	Y	Z	M	W	I	H	O	M	N	E	
G	O	Y	F	I	K	R	E	T	H	E	O	B	T	F	W	M	S	S	P	I	
G	O	L	K	S	Y	W	T	T	T	U	A	O	J	L	U	O	E	A	O	N	G
B	O	T	E	I	C	A	J	P	O	E	F	E	X	T	T	F	E	X	T	T	
B	Y	B	N	T	Z	O	N	T	X	C	W	C	F	Z	Y	I	P	T	F		
C	U	Z	W	R	G	D	S	O	N	E	E	O	B	H	M	W	E	M	O	C	
S	X	B	O	U	Y	W	R	H	E	S	A	W	C	Z	S	N	Y	N	W		
B	A	A	H	Y	U	S	E	D	Q	F	N	Z	Y	L	H	E	Z	C	U		
															N	S	B	T	B		

Table 6: The two messages shown here were sent by coastwatchers in the South Pacific during World War II. The first message uses "ROYAL NEW ZEALAND NAVY" as the key and the second message uses "PHYSICAL EXAMINATION." These messages follow the Playfair cipher rules except that letter pairs, when falling in a digraph, were left unenciphered.

important contribution to cryptography made by Charles Wheatstone of electrical measurement fame. Reference is made here to the famous Playfair cipher (named, ironically, after the man who enthusiastically promoted Wheatstone and his idea). The ciphertext alphabet is written as in the monoalphabetic example but is reformatted to a 5 by 5 square with I, J occupying the same cell and used interchangeably. Our demonstration key would yield:

P	A	T	R	I/J
C	Z	L	O	N
K	B	D	E	F
G	H	M	Q	S
U	V	W	X	Y

Enciphering is done by letter pairs with the following four rules:

- If the plaintext pair falls in the corners of a *square*, use as the ciphertext the other two corner characters taken in corresponding row order.
- If the plaintext pair falls in the same row, take as the ciphertext the characters immediately to the right of each plaintext character in order. Consider each row to have cylindrical continuation so that the character to the right of the last character in a row is the first character of that row.
- If the plaintext pair falls in the same column, take as the ciphertext the character immediately below each plaintext character in order. Consider each column to have cylindrical continuation so that the character below the last character in a column is the first character in that column.
- Encipher double letters by inserting an X between the letter pair in the plaintext.

Deciphering merely reverses the above procedure. We have here one of those opera-

tions that is quicker to execute than to explain. Using the demonstration keyword square and the demonstration message yields:

H	T	U	V	A
P	N	D	R	X
Q	O	O	K	L
P	Z	R	L	O

K	T	F	A	I
D	L	I	U	I
I	N	C	R	I
F	N	C	N	W

This digraphic substitution procedure can be very effective considering its relative simplicity. The reasons for this may be seen from the fact that while there are only 26 characters in the alphabet, there are 676 digraphs (combinations of two letters). The highest letter frequencies are 12% (E) and 9% (T). The highest digraph frequencies are 3¼% (TH) and 2½% (HE). The cryptanalyst thus faces many more entities with a much more uniform frequency distribution in the Playfair than in the character-for-character processing examples given previously.

The Playfair can, of course, be broken, and had the Japanese done this in World War II for the two cryptograms in table 6, the course of contemporary American history might have been radically changed. These cryptograms were sent by coastwatchers in the South Pacific. There is no clear call to action as far as the first message is concerned. However, the reader must surely agree that the second message required immediate action. This is especially true since the Japanese had adequate vessels and troops in the area to resolve the matter without difficulty. Both messages follow the Playfair rules except that letter pairs, when falling in a digraph, were left unenciphered. Even though these messages were (apparently) not deciphered and acted upon, military history is replete with examples in which the course of events was dramatically changed by poor cryptographic practice or by brilliant cryptanalysis. (These messages are taken from the Kahn reference which contains fascinating stories of this type.)

Vernam Cipher

The only cipher generally accepted as being absolutely secure is the invention of an American, Gilbert S Vernam. His system is known in the trade as the onetime key or onetime pad. Some perspective on the contribution made to cryptography by this man may be gained by noting that his system, for which patents were filed in 1918, is the standard system used today, 61 years later, on the Washington to Moscow hot line. Vernam's work involved Exclusive OR operations with a random binary key. An equivalent set of operations is presented

Learn MICROPROCESSOR OPERATION, INTERFACING and PROGRAMMING faster, easier and at less cost with the HEATHKIT® Microprocessor Self-Instruction Program and Computer Trainer

Here's the newest, easiest and lowest-cost self-instruction microprocessor program ever! What's more, it's the fastest way to really learn about this fascinating field with applications in every phase of our everyday lives. From automotive diagnostics to the microwave oven in the kitchen to the computers that are taking on more jobs in the home, schools, government, business and industry every day!

Working with the popular 6800 microprocessor, you'll explore this exciting field using proven self-instruction text materials. You'll learn about micro-computer basics, number systems and codes, computer arithmetic, programming, 6800 capabilities and interfacing and more. With the aid of audio visuals included, you'll go deeper into programming, designing with microprocessors and semiconductor memories. And you'll actually perform a whole series of "hands on" experiments with the optional trainer designed to reinforce the theory you've mastered to that point!

The ET-3400 Trainer kit, designed to accompany your program, features the popular 6800 microprocessor. It is actually a miniature digital computer in itself, complete with a: 1K ROM monitor program; 6 digit LED display for address and data readout; 17-key hexadecimal keyboard for entering programs, data and control; 256 bytes of RAM (expandable to 512 bytes with the chips supplied in the course); breadboarding socket; 8 buffered LED's for display of logic states; 8 SPST switches for binary input plus an on-board power supply with +5, +12 and -12 volt outputs.

The Program comes complete with 62 electronic components, including a 6820 PIA, two 2112 RAM's, a 1406 digital-to-analog converter, 741 and 301 op amps and more. Includes audio visual aids such as an audio cassette, colorful flip charts and programmed learning text material in two deluxe permanent binders.

Complete the optional exam and receive a Certificate of Achievement and 8.0 Continuing Education Units (CEU's) — a nationally accepted means of recognizing participation in non-credit adult education. (Note: Microprocessor Program requires completion of Digital Techniques Program or equivalent knowledge.)

ORDER ETS-3400
(Program and Trainer kit) **\$269⁹⁵**
(Add \$4.54 shipping and handling)

ORDER YOUR PROGRAM WITHIN THE NEXT 30 DAYS AND GET THIS BONUS

FREE SOLDERING IRON!

A Comparable \$7.95 Value!

MAIL COUPON TODAY!

MONEY-BACK GUARANTEE!
If you are not 100% satisfied with your Heathkit Program, we will refund the full purchase price of the program text material, less trainer.



FOR THOSE WHO NEED DIGITAL TECHNIQUES TRAINING...

Comprehensive Digital Techniques Program — the background you need to understand computer and modern electronic technology! Digital fundamentals, semiconductor devices for digital applications, Boolean algebra, flip-flops and registers, sequential and combinational logic circuits, digital design and an introduction to computers and more! The program includes programmed instruction text, audio-visual aids, parts for experiments and more. The program includes programmed instruction text, audio-visual aids, parts for experiments and more. Digital Design Experimenter/Trainer lets you perform all the experiments in the program, then develop and test your own projects. Features solderless breadboard sockets, 4 binary data switches, 2 "no bounce" switches to pulse logic circuits, 3-frequency pulse clock generators, 4 LED's for visual indication of logic states plus 3 regulated power supplies. Upon completion of the optional final exam, you receive a Certificate of Achievement and 4.0 Continuing Education Units.

ORDER EES-3201 (Program and Trainer Kit) **\$129⁹⁵**
(Add \$3.94 shipping and handling)

SAVE TIME



ORDER BY PHONE!
Call (616) 982-3411

anytime day or night

HEATH Schlumberger	Heath Company, Dept. 334-510 Benton Harbor, Michigan 49022
Gentlemen: Please send me the item(s) checked below and include my FREE Soldering Iron (GDP-1105).	
<input type="checkbox"/>	Microprocessor Program and Trainer Kit (ETS-3400) \$269.95 (+ \$4.54 shipping & handling)
<input type="checkbox"/>	Microprocessor Program only (EE-3401) \$89.95 (+ \$3.09 shipping & handling)
<input type="checkbox"/>	Digital Techniques Program and Trainer Kit (EES-3201) \$129.95 (+ \$3.94 shipping & handling)
I enclose <input type="checkbox"/> check <input type="checkbox"/> money order for \$.....; OR, (Michigan residents, add 4% sales tax)	
CHARGE to my <input type="checkbox"/> VISA/BankAmericard <input type="checkbox"/> Master Charge	
Account #.....	Exp. Date.....
Master Charge Code #.....	
Signature..... (Necessary to send merchandise)	
NAME..... (Please print)	
ADDRESS.....	
CITY.....	STATE..... ZIP.....
Prices and specifications subject to change without notice. Prices are mail order net F.O.B. Benton Harbor, Michigan. ED-121	

encipher

key:	15(P)	0(A)	19(T)	17(R)	8(I)	-	-	-
plaintext:	+12(M)	+0(A)	+24(Y)	+20(U)	+15(P)	-	-	-
ciphertext:	1(B)	0(A)	17(R)	11(L)	23(X)	-	-	-

decipher

ciphertext:	1(B)	0(A)	17(R)	11(L)	23(X)	-	-	-
key:	-15(P)	-0(A)	-19(T)	-17(R)	-8(I)	-	-	-
plaintext:	12(M)	0(A)	24(Y)	20(U)	15(P)	-	-	-

Table 7: When all letters of the alphabet are numbered sequentially, messages may be enciphered and deciphered by adding together the numerical values of the plaintext and the keyword (modulo 26) to obtain the ciphertext. The deciphering process is performed by subtraction.

here except that a different base for the residue arithmetic is used.

Return now to table 3. Let the letters of the alphabet be replaced by the numbers 0 through 25. That is, A = 0, B = 1, C = 2, . . . , Y = 24, Z = 25. When this is done it will be immediately noted that in numerical form each of the ciphertext alphabets is equal to the plaintext alphabet plus the value of the ciphertext alphabet designator, modulo 26. In residue arithmetic all numbers lie in the range of 0 to 1 minus the base value. The base is repeatedly added to or subtracted from any arithmetic result until this range is achieved. For example, alphabet D (value 3) equivalents are obtained by adding 3 to the plaintext or alphabet A values. Once this numerical format is established, tables such as that of table 3 are no longer needed, since encipherment and decipherment may be done as shown in table 7 by simple addition and subtraction. The arithmetic used in this case is modulo 26.

Vernam realized that under heavy traffic loads substitution ciphers all broke down via the Achilles heel of the key, be it repeating keyphrase, coherent running key, or autokey. His solution to the problem was to generate a truly random key, make two or more copies, and arrange for the used key to be destroyed at both ends of the system after first use. In some cases the key is in paper tape format and a knife is provided at the exit position of the paper tape reader so that the keytape is destroyed automatically as soon as it is read (ie: a onetime tape). In other cases the key is written on pads of paper (digits 0 thru 9, base 10 system) and the sheets of the pad are torn off and destroyed as soon as each is used (ie: a onetime pad).

Trap Door Operations

The bulk of the open literature in the field of cryptography today takes us chronologically to the end of World War II. The state of cryptographic art at that time was

represented by the mechanical and electro-mechanical cipher machines. Some punch card sorting mechanization for cryptanalysis is also occasionally referenced. The security curtain has since fallen, and quite obviously that curtain hid a revolution in cryptography brought about by solid-state digital data processing technology. Until very recently this concrete curtain quietly separated two co-existing computer user groups. The emergence of large commercial data networks and the need for preserving the privacy of data in transmission and storage has resulted in cryptographic work on both sides of that curtain. Topics such as the one reviewed in this section have apparently opened an uneasy dialog between these two groups.

Residue arithmetic, as used by Vernam and demonstrated in the simple example of the previous section, plays a key role in some recent cryptographic techniques that have been disclosed. In these techniques the encryption key (which can be made public) is comprised of a pair of positive integers (E,N). The message is first converted by any consistent means to some integer number M between 0 and N-1. The encryption process is then:

$$C = M^E \text{ (modulo } N) \quad (1)$$

The message number M is raised to the power E, the result is divided by N and the *remainder* forms the ciphertext number C, which represents the cryptogram. (In one published example, E = 9007 and N is 129 decimal digits in length. This is residue arithmetic with a vengeance!)

The deciphering key (which is kept secret) involves two integer numbers (D,N), and the decryption process is:

$$M = C^E \text{ (modulo } N) \quad (2)$$

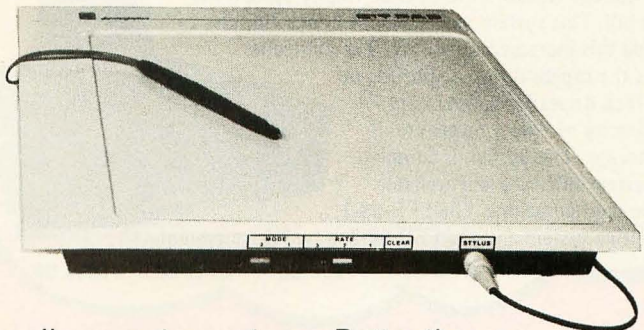
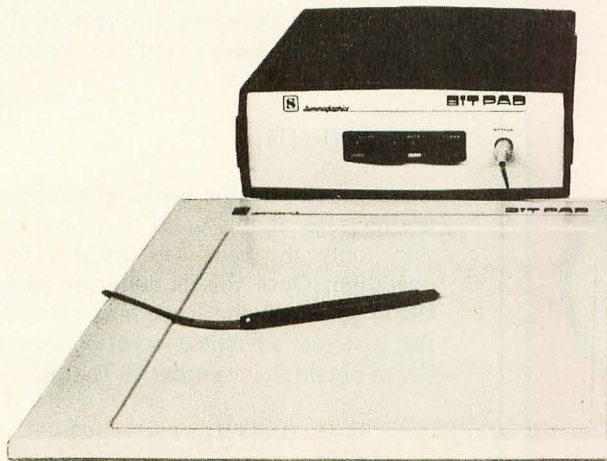
The ciphertext value C is raised to the power D, division by N is then done, and the *remainder* is the original message number M. This can be converted back to alphanumeric format for final delivery.

A 3 step process is used to generate N, D and E.

- Generate two random prime numbers P,Q (of the order of 100 decimal digits each in a practical system) and let $N = PXQ$. Thus N is typically a 200 decimal digit composite number.
- Select number D to be relatively prime to $(P-1) \times (Q-1)$. Any prime number greater than both P and Q is a possible selection.
- Select an E value such that the product $E \times D$ equals unity, modulo the product $(P-1) \times (Q-1)$.

Our Two Bits

Bit Pad Bit Pad One
Bit Pad Bit Pad One
Bit Pad Bit Pad One
Bit Pad Bit Pad One
Bit Pad Bit Pad One
Bit Pad One
Bit Pad One



Bit Pad™ is the low-cost digitizer for small computer systems. Better than a joystick or keyboard for entering graphic information, it converts any point on a page, any distance into its digital equivalents. It's also a menu for data entry. You assign a value or an instruction to any location on the pad. At the touch of a stylus, it's entered into your system.

Who can use it? Anyone from the educator and the engineer to the hobbyist and the computer games enthusiast. The data structure is byte oriented for easy compatibility with small computers, so you can add a power supply, stand alone display, cross-hair cursor and many other options.

Bit Pad by Summagraphics. The leading manufacturer of data tablet digitizers. Bit Pad. The only words you need to say when considering digitizers.

\$1,000 creativity prize. Just write an article on an original Bit Pad application and submit it to any national small-computer periodical. If the editors publish it—and the decision is solely theirs—Summagraphics will pay you \$1,000.



Summagraphics
 corporation

35 Brentwood Ave., Box 781, Fairfield, CT 06430
 Phone (203) 384-1344. TELEX 96-4348

Dealer inquiries invited

We're not just blowing smoke

SMOKE SIGNAL BROADCASTING PRESENTS IT'S NEW...

8-INCH FLOPPY DISK SYSTEM

- SS-50 Bus Compatible
- 500K Bytes of Online Storage
- Expandable to 1 Megabyte
- Completely Software Compatible with Existing BFD-68 Mini-Disk Systems

Users that require at least 500K of online data storage will find the LFD-68 floppy system fits the bill. This system uses standard 8-inch floppies to provide this increased capability. The controller provides the capability of supporting up to four 8-inch drives for a maximum system capacity of over 1 megabyte of online storage. This system is complete with system software and available in two configurations. The LFD-68-1, a one drive system and the LFD-68-2, a two drive system.



LFD-68-1 \$1395.00 LFD-68-2 \$1895.00

Users that require at least 500K of online data storage will find the LFD-68 floppy system fits the bill. This system uses standard 8-inch floppies to provide this increased capability. The controller provides the capability of supporting up to four 8-inch drives for a maximum system capacity of over 1 megabyte of online storage. This system is complete with system software and available in two configurations. The LFD-68-1, a one drive system and the LFD-68-2, a two drive system.



LFD-68-1 \$1395.00 LFD-68-2 \$1895.00

Ask about our new DFD-68-2 with two 8-inch double sided floppy disk drives with 512K bytes of storage per drive and capability of adding additional drives to provide over 2 megabytes of online storage

Users that require at least 500K of online data storage will find the LFD-68 floppy system fits the bill. This system uses standard 8-inch floppies to provide this increased capability. The controller provides the capability of supporting up to four 8-inch drives for a maximum system capacity of over 1 megabyte of online storage. This system is complete with system software and available in two configurations. The LFD-68-1, a one drive system and the LFD-68-2, a two drive system.



LFD-68-1 \$1395.00 LFD-68-2 \$1895.00

SMOKE SIGNAL BROADCASTING

31336 Via Colinas, Westlake Village, CA 91361, (213) 889-9340

SMOKE SIGNAL BROADCASTING

31336 Via Colinas, Westlake Village, CA 91361
(213) 889-9340

- ☐ Send information on your LFD-68 Systems
☐ Send name of nearest dealer

Name _____
Address _____
Company _____
City _____
State/Zip _____

Circle 328 on inquiry card.

This cryptographic process is novel in that knowledge of the enciphering process (E,N) does not reveal the deciphering process (D,N). The terms *one-way* and *trap door* have been applied to such operations. This is to be compared to the cryptographic processes we have been discussing in which knowledge of the key allows one to go in either direction between plaintext and ciphertext with equal ease. Consider now two parties to a transaction: a customer C and a bank B. Let E_c and E_b be the (public) encryption processes of the customer and bank, respectively. Let D_c and D_b be the (secret) corresponding decryption processes.

The customer may take a funds transfer order T in plaintext and apply his secret *decoding* operation to it to produce $D_c(T)$. This transformation may be converted by anyone back to T by applying the public E_c operation. For transmission to the bank, however, the customer encrypts $D_c(T)$ by applying the bank's (public) encryption operation E_b . Thus

$$E_b[D_c(T)]$$

is transmitted to the bank. Interception of the message at this point may be tolerated since only the bank can decipher the E_b operation. Once this is done the bank has $D_c(T)$ to which the bank may easily apply the customer's public encryption operation, E_c , to obtain the plaintext T. That is:

$$T = E_c(D_c(T)) \quad (3)$$

is done at the bank.

Three important features are to be noted. First, the data was protected in transit by the bank E_b operation. The bank is sure of the sender's identity from equation (3) because only c knows the *backward* D_c operation which was applied to T. Also the bank cannot alter T after receipt since $D_c(T)$ stands as verification. The bank cannot produce a $D_c(T')$ to correspond to some altered T' funds transfer order.

The security of these systems is dependent to a great extent on the computational difficulty of factoring the compound number N. It is claimed that this procedure is *computationally infeasible* for sufficiently large values of N using the best algorithms and the fastest computers. (The presentation in this section follows very closely material recently published by R L Rivest and his associates at MIT.)

In part 2 of this article I will discuss program Crypto which performs substitution and transposition. This part shows how a calculator can be converted to a field cipher machine of significant capability. ■

Build your own microcomputer as you learn computer technology at home.

New from NRI! The Most Complete and Up-to-date Home Study Course Ever Offered

As the microprocessor revolutionizes the computer world and microcomputers appear almost everywhere, NRI brings you a new, convenient, and effective way to keep up with this expanding technology. It's NRI's Computer Technology Course, created and designed exclusively for learning at home in your spare time.

Featuring NRI's Exclusive Dual Language Microcomputer

NRI goes beyond book learning to give you practical, "hands-on" experience in designing circuitry, interfacing components, programming, and troubleshooting. As you learn, you actually assemble NRI's designed-for-learning microcomputer, incorporating the latest advances in the state of the art. It looks and operates like the finest of its kind, actually does more than many commercial units. But NRI engineers have designed components and planned assembly so it demonstrates important principles, gives you working experience in detecting and correcting problems. And it's yours to keep, put to work in your own home or business.

You also build and keep your own test instruments, including a transistorized volt-ohm meter and CMOS digital frequency counter. And NRI's Discovery Lab® broadens your horizons with specialized experiments and theory demonstrations.

The Proven Way to Learn at Home

You don't have to worry with travel, classes, or time lost from work when you learn the NRI way. As they have for more than 60



years of teaching technical subjects, NRI brings the material to you. You study in your spare time, at your convenience, using "bite-size" lessons that program material into logical segments for easier assimilation. You perform experiments and build equipment using kits we supply. And your personal NRI instructor is always available for consultation should you have questions or problems. Over a million students have already shown the effectiveness of NRI training.

Choice of Courses

Several courses are available, depending

upon your needs and background. NRI's Master Course in Computer Technology starts with the fundamentals, explores basic electronics and digital theory, the total computer world, and the microcomputer. The Advanced Course, for students already versed in electronics and general computers, concentrates on the microprocessor and microcomputer. In both courses, you build all instruments and your own computer.

Send for Free Catalog... No Salesman Will Call

Get the details on these exciting new courses in NRI's free, 100-page catalog. Shows all kits and equipment, lesson outlines, and full information, including facts on other electronics courses. Mail the coupon today and we'll rush your catalog. No salesman will ever call. Keep up with the latest technology as you learn on your own computer. If coupon has been removed, write to NRI Schools, Computer Department, 3939 Wisconsin Ave., Washington, D.C. 20016.



NRI Schools
McGraw-Hill Continuing
Education Center
3939 Wisconsin Avenue
Washington, D.C. 20016

NO SALESMAN WILL CALL

Please check for one free catalog only.

- ☐ Computer Electronics Including Microcomputers
- ☐ TV/Audio/Video Systems Servicing
- ☐ Complete Communications Electronics with CB • FCC Licenses • Aircraft, Mobile, Marine Electronics
- ☐ CB Specialists Course
- ☐ Amateur Radio • Basic and Advanced



All career courses approved under GI Bill.
☐ Check for details.

- ☐ Digital Electronics • Electronic Technology • Basic Electronics
- ☐ Small Engine Repair
- ☐ Electrical Appliance Servicing
- ☐ Automotive Mechanics
- ☐ Auto Air Conditioning
- ☐ Air Conditioning, Refrigeration, & Heating Including Solar Technology

Name _____ (Please Print) _____ Age _____

Street _____

City/State/Zip _____

Accredited by the Accrediting Commission of the National Home Study Council

170-039

The Standard Data Encryption Algorithm

Part 1: An Overview

Robert V Meushaw
4188 Brittany Dr
Ellicott City MD 21043

Recently, I have seen many articles describing new commercial encryption equipment using the Standard Data Encryption Algorithm. There have also been recent announcements of integrated circuits, like the Intel 8294, which implement the standard. The Standard Data Encryption Algorithm has been published by the National Bureau of Standards for use in the protection of computer data. The algorithm is described in FIPS Publication 46, available from the US Department of Commerce. After months of being bombarded with publicity regarding the encryption method, it finally struck me that I had found a perfect project for my KIM. The challenge became to implement the algorithm with the basic memory provided and to achieve sufficient processing speed to make it practical for use by others. Along the way, I hoped to investigate the advantages and disadvantages of the 6502 in performing the necessary tasks.

Cryptography Basics

Cryptography involves the use of a scheme to transform intelligible text into an unintelligible form and to later recover the original text. The transformation process is known as *encryption* and the recovery process is known as *decryption*. Cryptographic techniques have been used for centuries to allow individuals to communicate without fear of outsiders discovering what they are saying. The individuals who communicate generally possess a cryptographic *key* which

controls the encryption and decryption process. Unless someone knows the key used to encrypt the data, he or she will not be able to correctly decrypt the data. The number of possible keys is usually made so large that it is impractical to try decrypting the data using all key possibilities. It must be clear that the critical factor in protecting the data is the secrecy of the key used.

The cryptographic technique employed in the Standard Data Encryption Algorithm is known as a *codebook*. In this case, a 64 bit block of data is transformed to a corresponding 64 bit block of data known as a *cipher*. Each time a particular set of data is provided as input, the same cipher will result: assuming the same key is used. The Standard Data Encryption Algorithm uses a 56 bit key to control the encryption. As mentioned before, this was chosen to give a large number of possible keys (ie: 2^{56}). Some estimates have been made that it would require, on the average, approximately 2500 years on a general purpose computer significantly faster than a CDC 7600 to examine all 2^{56} (ie: 7.2×10^{16}) possible keys in order to determine the particular key used to encrypt a block of data.

Restrictions

The National Bureau of Standards position on the implementation of the Standard Data Encryption Algorithm is that software implementations are not in compliance with the standard. The standard, however, applies to use on federal systems, not private com-

puters. If you have any reservations concerning your intended use of this method, check the applicable regulations.

Algorithm Overview

A very simple diagram of the operations involved in the encryption algorithm is shown in figure 1. The input (plaintext) is first subjected to an initial permutation operation, which reorders the bits. Most of the work of the encryption is done in the box labeled product transformation. Details of this transformation will be described later. The block transformation is a simple exchange of the left and right 32 bits of data. The last step is a permutation operation which is the inverse of the initial permutation operation. The output of this step is the *ciphertext*.

In case you're wondering where the key comes in, it is the controlling factor in the product transformation. Note also the relationship of the initial permutation to its inverse. The fact that they are inverses means that if you perform an operation using a function and then reorder again using the inverse of the function, the result will be the original word. Of course the same thing occurs if the inverse and then the function is applied to the word. Tables 1a and 1b show the permutation tables for the initial permutation and its inverse. The permutation operation should be interpreted as follows: proceeding from left to right, bit 1 of the permuted word is bit 58 of the input, bit 2 of the permuted word is bit 50 of the input, etc. I was originally confused about the numbering scheme chosen for the bits, since I was accustomed to bits being numbered 0 thru 7 going from right to left. The correspondence between the Standard Data Encryption Algorithm numbering scheme and typical computer numbering is depicted in figure 2.

Algorithm Operation

A more detailed diagram of the encryption algorithm is provided in figure 3. The basic operations are quite straightforward. What is shown is basically an expansion of the product transformation box from figure 1. Let's look at the basic operations involved after the initial permutation. The 64 bits of permuted input are split into two groups of 32 bits each, called left (L) and right (R). The subscripts on L and R indicate the iteration of the algorithm. The first thing that occurs is the generation of K1. K1 is known

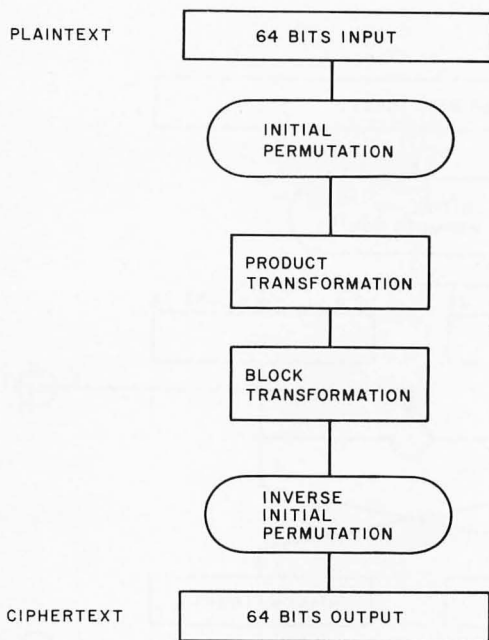


Figure 1: An overview of the Standard Data Encryption Algorithm.

(1a)

58	50	42	34	26	18	10	2
60	52	44	36	28	20	12	4
62	54	46	38	30	22	14	6
64	56	48	40	32	24	16	8
57	49	41	33	25	17	9	1
59	51	43	35	27	19	11	3
61	53	45	37	29	21	13	5
63	55	47	39	31	23	15	7

(1b)

40	8	48	16	56	24	64	32
39	7	47	15	55	23	63	31
38	6	46	14	54	22	62	30
37	5	45	13	53	21	61	29
36	4	44	12	52	20	60	28
35	3	43	11	51	19	59	27
34	2	42	10	50	18	58	26
33	1	41	9	49	17	57	25

Table 1: Permutation tables for the initial and inverse initial permutation (1a and 1b respectively). The initial permutation table is read as follows: bit 1 of the input goes to bit 58 of the output, bit 2 of the input goes to bit 50 of the input, etc.

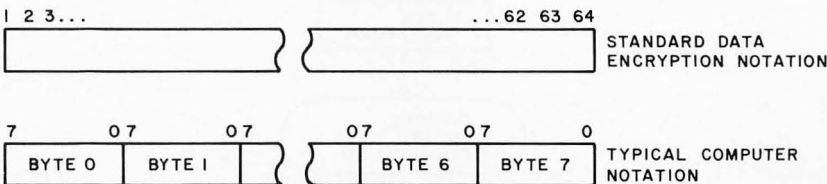
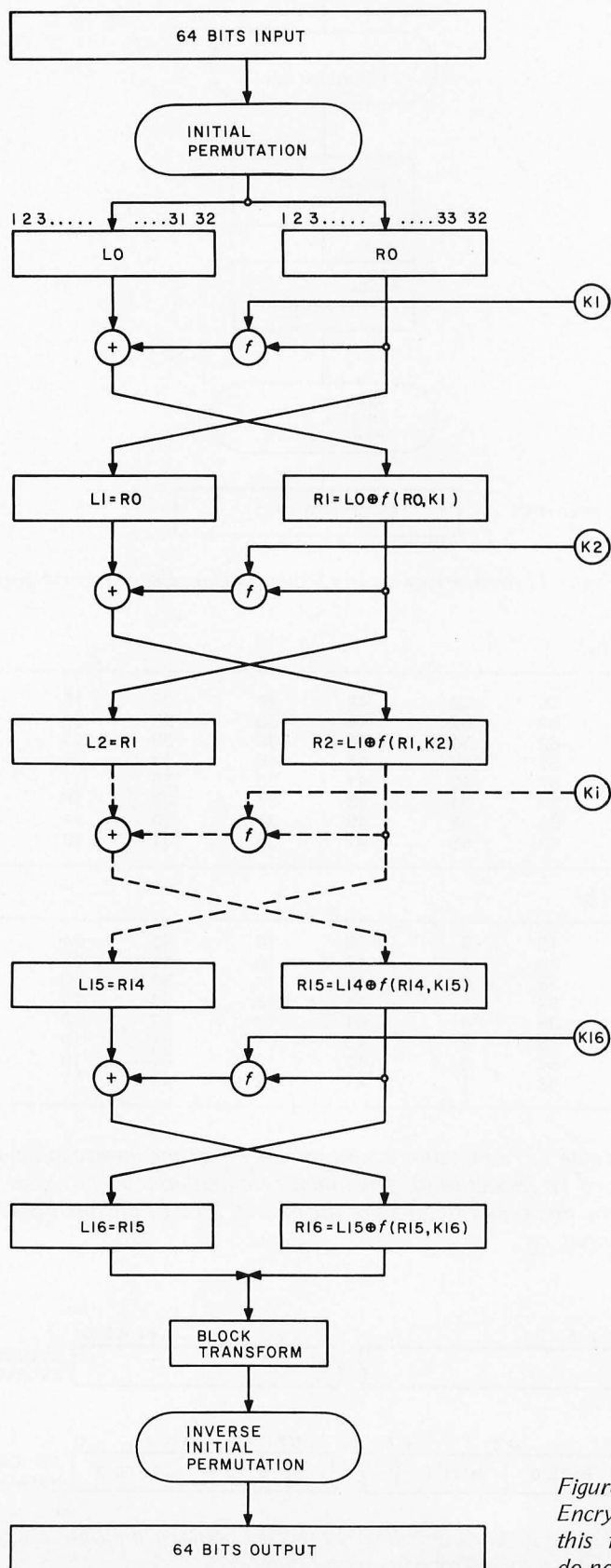


Figure 2: Corresponding numbering between the Data Encryption Standard and typical microcomputer bit numbering.

PLAINTEXT



CIPHERTEXT

as the *subkey*, and is generated directly from the encryption key. In fact, each K_i is generated from the key. Don't worry yet about exactly what each K_i is or where it comes from — that will soon be explained. A function, $f(R_0, K_1)$, is now generated using K_1 and R_0 as inputs (again, the details will be explained shortly). The next operation is the modulo 2 addition (ie: exclusive OR) of $f(R_0, K_1)$ to L_0 . Therefore, $L_0 \oplus f(R_0, K_1)$ replaces the old L_0 . Finally, the current leftmost 32 bits are exchanged with the current rightmost 32 bits. This completes one iteration of the algorithm and involves all the basic operations. To complete the product transformation, the steps above are repeated as shown in figure 3. The encryption process is completed by performing the block transformation and the inverse initial permutation operation.

An important fact about the modulo 2 addition step is that it is reversible. This reversibility allows the decryption process to recover the original plaintext. In fact, as I will show, you can use the same algorithm steps to do the decryption as you used for encryption.

Something for Nothing?

In case my arguments of the simplicity of the Standard Data Encryption Algorithm haven't convinced you, I should point out that it wouldn't be fair to expect 2500 years of protection from an algorithm which wasn't somewhat involved. Figures 4a and 4b provide illustrative examples of the encryption and decryption processes. I have used only two iterations in the product transformation, but the principle is the same for 16 iterations. Note in particular how the same algorithm is used for decryption, except that the subkeys are applied in reverse sequence. In figure 4b, the results of each transform are shown after the modulo 2 addition. For example, the first transform results of L_1 are obtained by computing $R_2 \oplus f(L_2, K_2) = [L_1 \oplus f(R_1, K_2)] \oplus f(R_1, K_2) = L_1$. Remember how modulo 2

Figure 3: A detailed operation of the Standard Data Encryption Algorithm encryption process. Note that this flow diagram (and the following flow diagrams) do not use standard flowchart symbology.

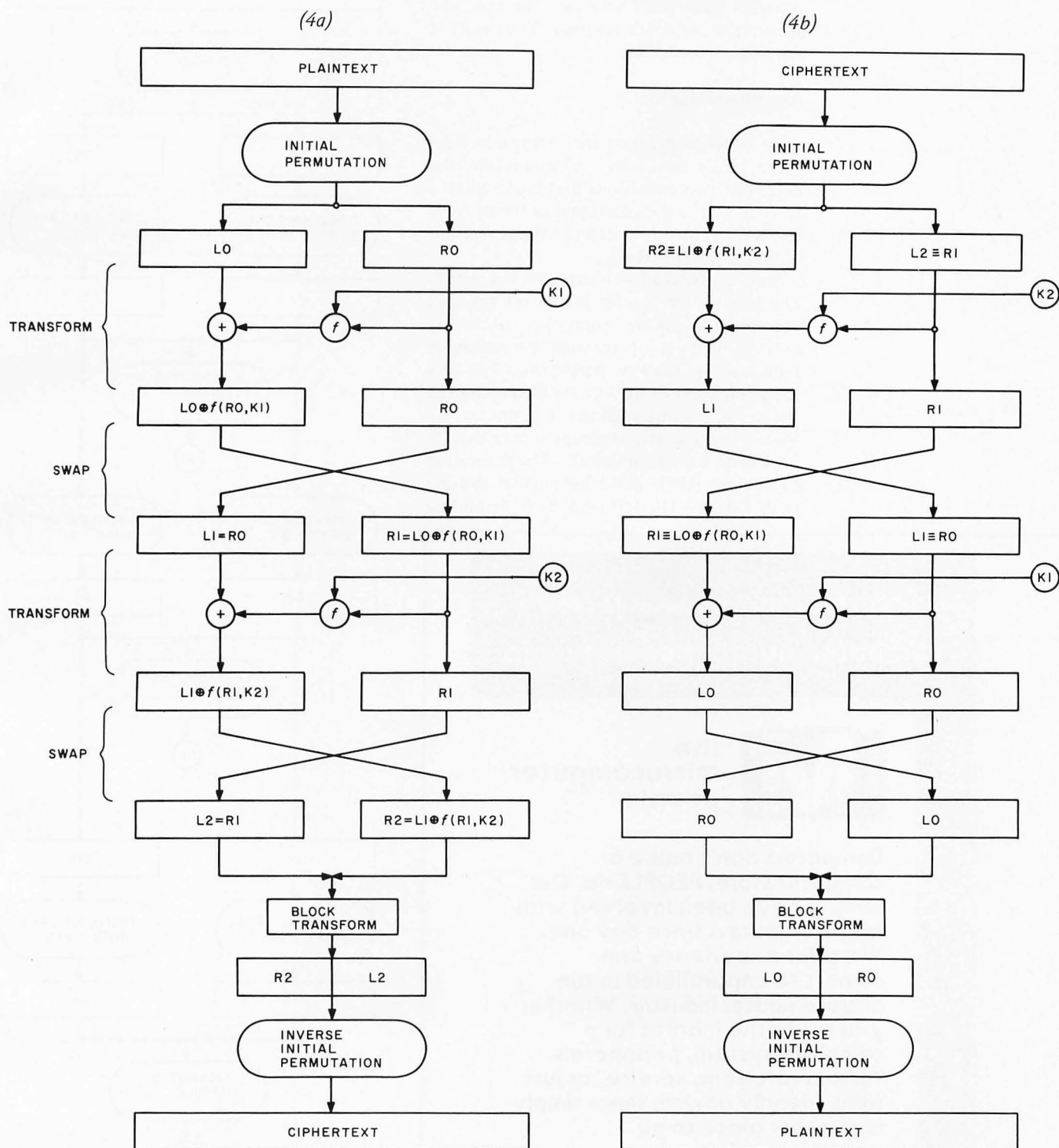


Figure 4: A simplified encryption and decryption process using the Standard Data Encryption Algorithm. Figure 4a shows a plaintext message being processed into a ciphertext and figure 4b shows the inverse process. Although only two iterations of transformation and swapping are shown, 16 are actually performed.

addition works. Following the decryption through figure 4b, you can see how the encryption steps are reversed. The result is the original plaintext.

Algorithm Details

In order to program the encryption algorithm, it is necessary to understand the details of two operations that I have alluded to. The first is the generation of the subkeys K_1, K_2, \dots, K_{16} ; the second is the generation of the function $f(R, K)$.

Subkey generation is depicted in figure 5. The process starts with the 64 bit key that you provide for the encryption. Actually, only 56 of these bits are used; the remaining eight can be used as parity bits. The first transformation of the key is called permuted choice 1. Permuted choice 1 permutes the 56 bit key and also regroups it into two 28 bit words, called C_0 and D_0 . The generation of subkey K_1 is done by circular shifting both C_0 and D_0 left and then permuting

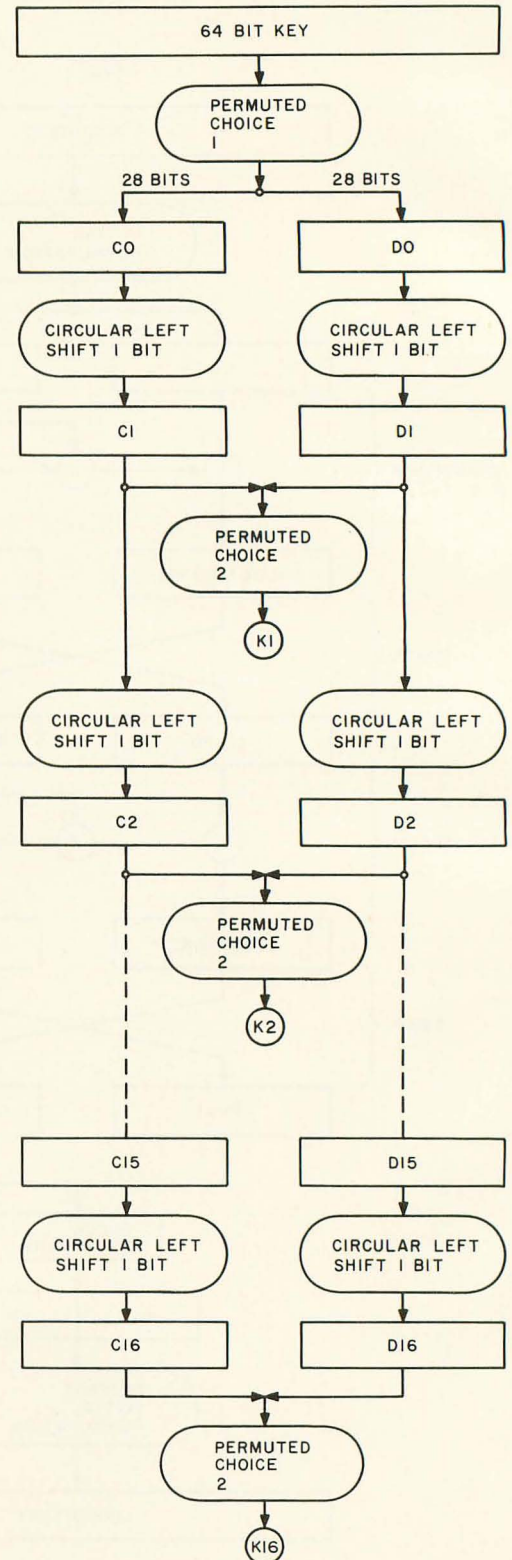


Figure 5: A process flow diagram showing how subkeys K_1 thru K_{16} are produced from a single key.

computer mart of new jersey computer mart of pennsylvania



**the
microcomputer
people®**

Computers don't make a computer store, PEOPLE do. Our people have been involved with microcomputers since day one. We offer experience and expertise unparalleled in the microcomputer industry. Whether you are in the market for a complete system, peripherals, custom software, service, or just some friendly advice; there simply is no other place to go.

Computer Mart of New Jersey

304 Route 27
Iselin, NJ 08830
(201) 283-0600

STORE HOURS

Tues. - Sat. 10am - 6pm
Tues. & Thurs. 'till 9pm
CLOSED MONDAYS

Computer Mart of Pennsylvania

550 DeKalb Pike
King of Prussia, PA 19406
(215) 265-2380

**FREE
OFFER!**
No Purchase Necessary!

Get the **BIG NEW 2nd Edition**
of *The Computer Data Directory*.....
Absolutely FREE!! (A \$6.00 value!)

It's the first true microcomputer shopping guide. Loaded with advertisements, photos and useful information on thousands of companies and products. Over 150 pages. There's nothing else like it anywhere! You can get your free copy by filling out the questionnaire and mailing it to us. Do it today. Offer expires May 15, 1979

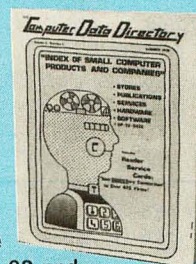
Second edition will be printed and mailed Summer 1979

Foreign orders (except Canada) must include \$2.00 for postage.

Offer void where prohibited

Please limit:
One book per family
Companies — one per department
(one per questionnaire)

1st Edition
Still Available
Only \$5.98 ppd.



Send to:
The Computer Data Directory
P. O. Box 598
Cleveland, Ohio 44107
(216) 221-5440

Questionnaire

Please type or print clearly

Name _____ Title _____
Company _____ Phone () _____
Address _____ ☐ Business ☐ Home
City _____ State _____ Zip _____
Signature _____ Date _____

You must answer all questions for FREE offer

Occupation :

- | | |
|--|--------------------------------------|
| A. <input type="checkbox"/> Professional | E. <input type="checkbox"/> Student |
| B. <input type="checkbox"/> Engineer | F. <input type="checkbox"/> Hobbyist |
| C. <input type="checkbox"/> Business | G. <input type="checkbox"/> Other |
| D. <input type="checkbox"/> Education | |

My system brandnames include:

Processor _____ Memory _____
Mainframe _____ Disk _____
Software _____ Other _____

Approximate investment to date: \$ _____

My system is/will be used for:

- | | |
|--|--|
| A. <input type="checkbox"/> Business only* | D. <input type="checkbox"/> Education |
| B. <input type="checkbox"/> Hobby only | E. <input type="checkbox"/> Research and Development |
| C. <input type="checkbox"/> Business & Hobby | F. <input type="checkbox"/> _____ |

* If for business, what applications do you use now?

- | | |
|--|---|
| A. <input type="checkbox"/> Accounting/Inventory | D. <input type="checkbox"/> Legal |
| B. <input type="checkbox"/> Word Processing | E. <input type="checkbox"/> Engineering |
| C. <input type="checkbox"/> Medical | F. <input type="checkbox"/> _____ |

* Which ones do you plan for the future:

- A. ☐ B. ☐ C. ☐ D. ☐ E. ☐ F. ☐ _____

What type of business? _____

How many employees? _____

Main interest:

- A. ☐ Hardware B. ☐ Software C. ☐ Both

Do you write your own software?

- A. ☐ All B. ☐ Most C. ☐ Some D. ☐ None

In order of preference, what would you like to see in our new shopping guide?

- | | |
|--|---|
| A. <input type="checkbox"/> Advertisements | E. <input type="checkbox"/> Computer Stores |
| B. <input type="checkbox"/> Product Descriptions | F. <input type="checkbox"/> Computer Clubs |
| C. <input type="checkbox"/> Product Photos | G. <input type="checkbox"/> Reader Service Card |
| D. <input type="checkbox"/> Suggested Systems | H. <input type="checkbox"/> _____ |

What will you use our guide for?

- | | |
|---|---------------------------------------|
| A. <input type="checkbox"/> Product Comparisons | C. <input type="checkbox"/> Research |
| B. <input type="checkbox"/> Price Comparisons | D. <input type="checkbox"/> Marketing |

Which of these magazines do you read?

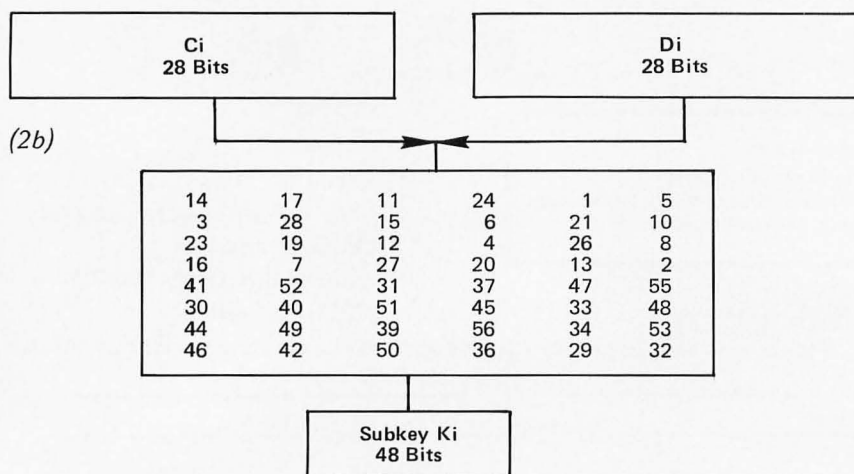
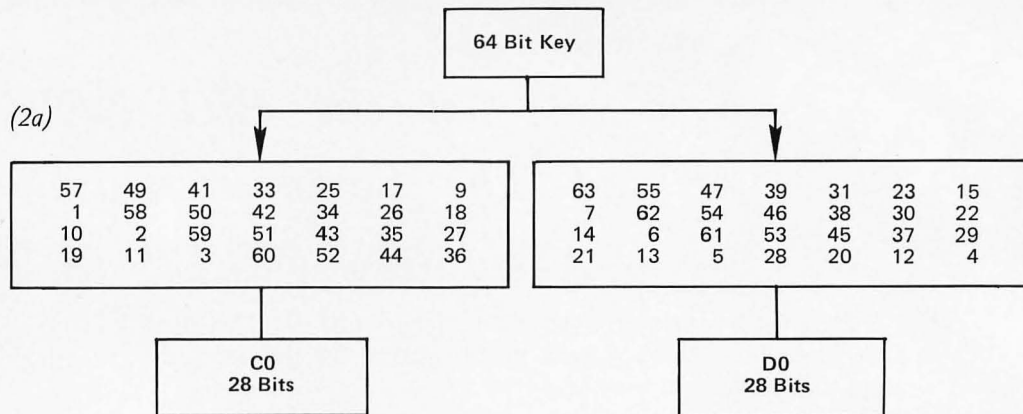
- | | |
|--|--|
| A. <input type="checkbox"/> Byte | G. <input type="checkbox"/> On_Line |
| B. <input type="checkbox"/> Creative Computing | H. <input type="checkbox"/> Personal Computing |
| C. <input type="checkbox"/> Computer Dealer | I. <input type="checkbox"/> Computerworld |
| D. <input type="checkbox"/> Computer Retailing | J. <input type="checkbox"/> Computer Decisions |
| E. <input type="checkbox"/> Kilobaud | K. <input type="checkbox"/> Small Business Computers |
| F. <input type="checkbox"/> Interface Age | L. <input type="checkbox"/> _____ |

Tell a Friend

Companies...Do we have your product information?

Call or write today!

Table 2: Tables for using permuted choice 1 and permuted choice 2 (table 2a and 2b respectively). The permuted choice 1 table (table 2a) is used to develop C0 and D0 from the key. Bits 8, 16, 24, 32, 40, 48, 56, and 60 of the key are not used. The permuted choice 2 table (table 2b) is used to develop subkey Ki from Ci and Di.



Iteration Number	Number of Circular Left Shifts
1	1
2	1
3	2
4	2
5	2
6	2
7	2
8	2
9	1
10	2
11	2
12	2
13	2
14	2
15	2
16	1

Table 3: A summary of the number of left circular shifts applied to Ci and Di at each iteration of subkey generation.

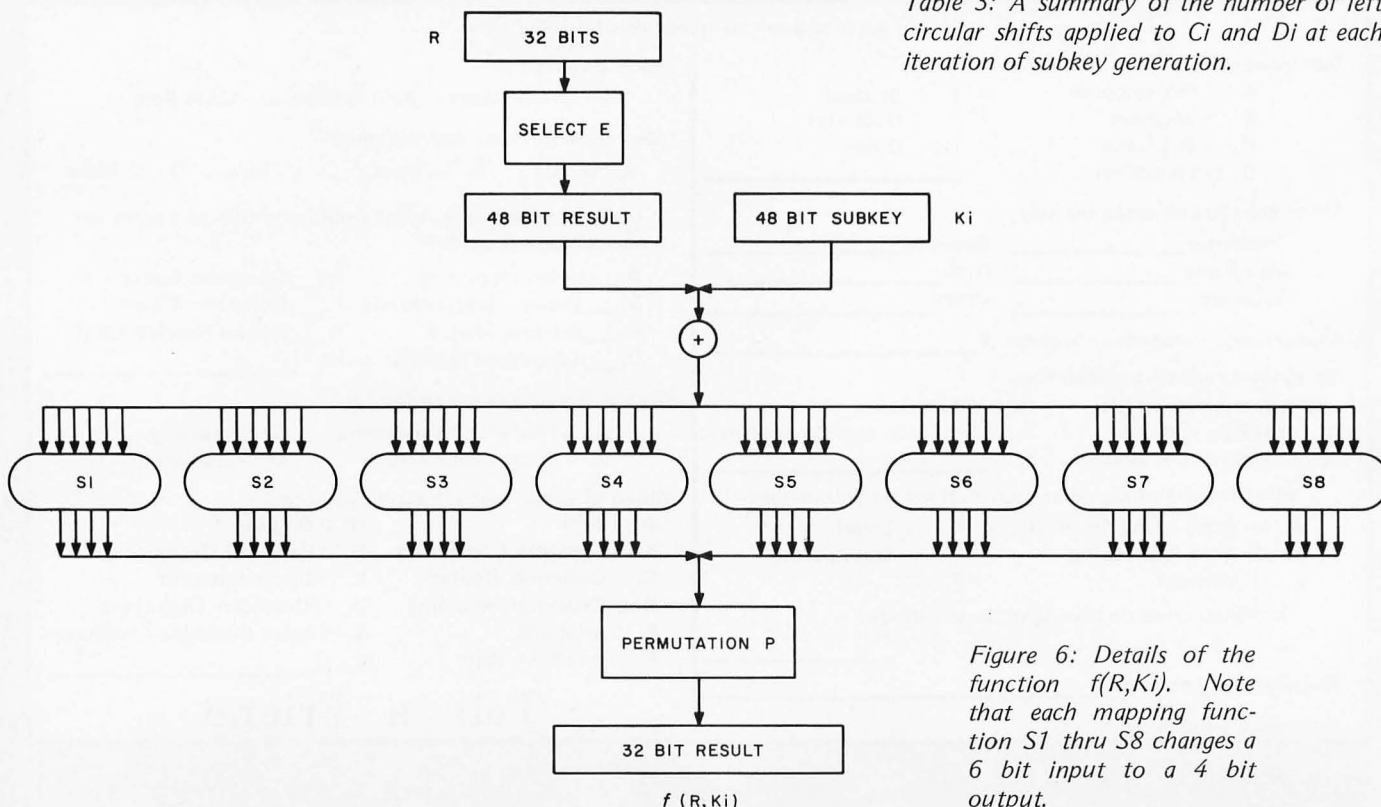


Figure 6: Details of the function $f(R, K_i)$. Note that each mapping function S1 thru S8 changes a 6 bit input to a 4 bit output.

C1 and D1 using permuted choice 2 to form a 48 bit subkey. Permuted choice 1 and permuted choice 2 are shown in tables 2a and 2b. Each successive subkey is generated in the same way: by shifting C_i and D_i left (by one or two bits) and then using permuted choice 2. Table 3 shows the number of left shifts to be applied to C_i and D_i for each iteration in the subkey generation.

Once K_1, K_2, \dots, K_{16} have been generated, it is not necessary to generate them again until the key is changed. The same set of subkeys is used for each encryption and decryption operation shown in figures 4a and 4b.

The final operation to understand is $f(R, K)$, depicted in figure 6. The first operation is called select E. This is really a

permutation operation similar to the initial permutation operation previously discussed, except that the result has more bits than the input. Table 4 shows the select E permutation table. The 48 bit result of this operation is then added modulo 2 to the subkey. This result is reduced to a 32 bit result using a set of mapping functions known as S_1, S_2, \dots, S_8 . These are used as shown in figure 6. Each group of six bits, going left to right, is mapped into a 4 bit word using a distinct mapping function. The mapping functions are shown in figure 5, and an example of how they are used is shown in figure 6. The six bits input to each S mapping function are used to generate a row address and column address as shown. The selected matrix entry is converted from its

S_1															
14	4	13	1	2	15	11	8	3	10	6	12	5	9	0	7
0	15	7	4	14	2	13	1	10	6	12	11	9	5	3	8
4	1	14	8	13	6	2	11	15	12	9	7	3	10	5	0
15	12	8	2	4	9	1	7	5	11	3	14	10	0	6	13
S_2															
15	1	8	14	6	11	3	4	9	7	2	13	12	0	5	10
3	13	4	7	15	2	8	14	12	0	1	10	6	9	11	5
0	14	7	11	10	4	13	1	5	8	12	6	9	3	2	15
13	8	10	1	3	15	4	2	11	6	7	12	0	5	14	9
S_3															
10	0	9	14	6	3	15	5	1	13	12	7	11	4	2	8
13	7	0	9	3	4	6	10	2	8	5	14	12	11	15	1
13	6	4	9	8	15	3	0	11	1	2	12	5	10	14	7
1	10	13	0	6	9	8	7	4	15	14	3	11	5	2	12
S_4															
7	13	14	3	0	6	9	10	1	2	8	5	11	12	4	15
13	8	11	5	6	15	0	3	4	7	2	12	1	10	14	9
10	6	9	0	12	11	7	13	15	1	3	14	5	2	8	4
3	15	0	6	10	1	13	8	9	4	5	11	12	7	2	14
S_5															
2	12	4	1	7	10	11	6	8	5	3	15	13	0	14	9
14	11	2	12	4	7	13	1	5	0	15	10	3	9	8	6
4	2	1	11	10	13	7	8	15	9	12	5	6	3	0	14
11	8	12	7	1	14	2	13	6	15	0	9	10	4	5	3
S_6															
12	1	10	15	9	2	6	8	0	13	3	4	14	7	5	11
10	15	4	2	7	12	9	5	6	1	13	14	0	11	3	8
9	14	15	5	2	8	12	3	7	0	4	10	1	13	11	6
4	3	2	12	9	5	15	10	11	14	1	7	6	0	8	13
S_7															
4	11	2	14	15	0	8	13	3	12	9	7	5	10	6	1
13	0	11	7	4	9	1	10	14	3	5	12	2	15	8	6
1	4	11	13	12	3	7	14	10	15	6	8	0	5	9	2
6	11	13	8	1	4	10	7	9	5	0	15	14	2	3	12
S_8															
13	2	8	4	6	15	11	1	10	9	3	14	5	0	12	7
1	15	13	8	10	3	7	4	12	5	6	11	0	14	9	2
7	11	4	1	9	12	14	2	0	6	10	13	15	3	5	8
2	1	14	7	4	10	8	13	15	12	9	0	3	5	6	11

Table 5: Matrices for the selection functions S_1 thru S_8 . Each S_i maps a 6 bit input into a 4 bit output.

Table 4: The Select E permutation table. The output contains more bits than the input in order to match length of subkey.

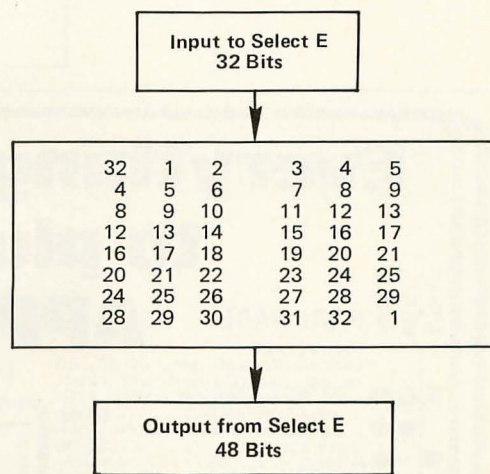


Table 6: Illustration of the use of S1 mapping function. The middle four bits of input give the column index. The first and last bits are the row index. The binary value of the selected table entry is output.

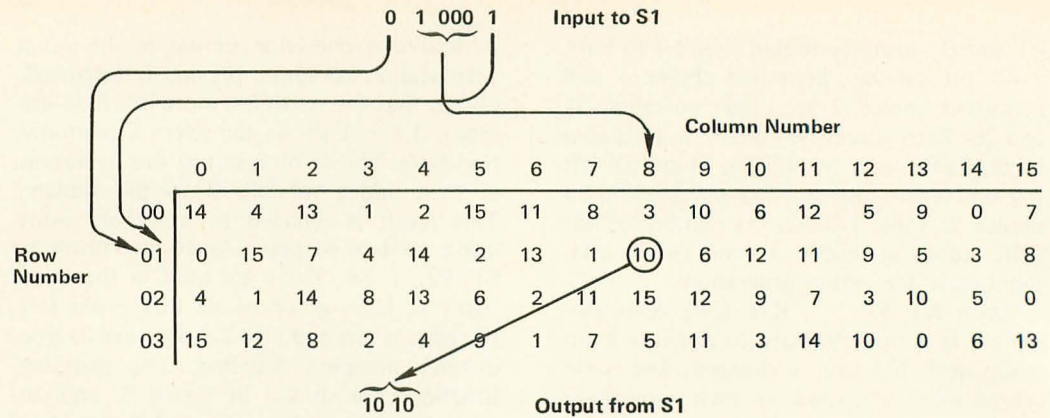
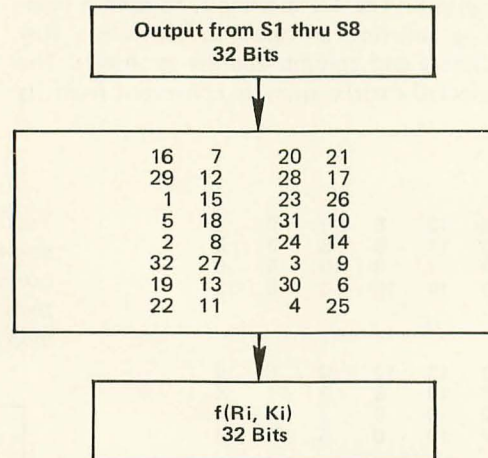


Table 7: Table for permutation P.



decimal representation to binary. A final 32 bit permutation, P, is then performed as shown in figure 6 to give the output f(R,K). Table 7 shows this permutation table.

This completes the details of the Standard Data Encryption Algorithm and should allow you to develop your own implementation. My particular implementation for the 6502 on the basic KIM-1 is given in part 2. It should provide you with some interesting insights into program optimization. ■

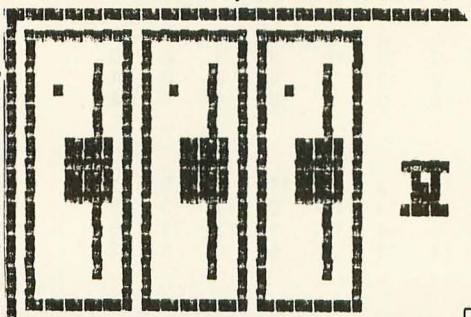
Everything you always wanted to plug into your PET, APPLE or TRS-80*

(*but were afraid you couldn't afford)

TRS-80
PET
APPLE

HARDWARE

- PRINTERS
- Centronics 150 lpm, of 20, 40 or 80 char.(Upper/lower case).
- P1 Parallel Model (cable, software, add \$50) . . . \$449
- S1 Serial Model (cable, software add \$50). . . \$549.
- Anderson-Jacobsen I/O Selectric, Bidirectional. . . \$995.
- PET Graphics Ball . . . \$200.
- RS 232C Serial Option. \$200.
- TRS Graphics Ball . . . \$100.
- Expander 123P impact with tractor feed . . . \$495.
- Integral Data IP-125 impact Upper/lower case . . . \$795.
- Pet, TRS-80 graphics option with 4 char. sizes, tractor feed \$1195, Pet Modem, \$320, Serial Int. \$98, (Apple \$62).
- Apple Modem. . . \$120
- MEMORY (Save \$100 or more)
- 16K Dynamic RAM (TRS-80 Specify keybd, or exp. int.) \$140
- 16K RAM Board, options \$435
- Additional 8K. . . \$200
- CONNECTORS, ETC.
- TRS-80 40 pin edge. \$9.95.
- Exp. Int. Ext. cord \$19.95+2*(Ft-2)
- IEEE or User Port w/cover \$9.95
- Cassette w/cover . . . \$4.95
- Dual Stereo Cassette Deck Ideal for micro tapes w/prompts \$250.
- C-10 Blank cassettes . . . \$1.49
- Minidisks (5")..\$4.95 10 for \$40



Microtronix disc system seen by TRS-80 with A/J 841.

- CASE, FAN, 16 AMP PWR. SUP. \$299.
- (FITS ALL MINIFLOPPIES INCL. TRS-80)
- SHUGART SA400 (RADIO SHACK 89K) . . . \$349.
- PERTEC FD280 (WRITE EITHER SIDE) . . . \$349.
- MICROFOLIS (QUAD DENSITY 315K) . . . \$399.
- 4 OR 1/2" CABLE
- SINGLE DRIVE ONLY W/CASE, PWR. SUP. \$399.
- * COMPATIBLE WITH TRS-80.

microtronix

Call or write for free brochure.

Exclusive JOYSTICK package

SOFTWARE

- TRS-80: 1. Data Management/Report Generator Package (L-II-16K). Tape System: \$200; Disk System: \$300. Give your TRS-80 the editing features of a \$4000+ Burrough's TD800 series terminal. Automatic data entry and custom reports. Generate complete screen graphics with full cursor control. 2. MICROCHESS (LI or II-4K) \$19.95. 3 difficulty levels. 3. Statement renumbering and cross reference.
- PET: 1. Joystick Microchess- (needs dual joystick package)-\$19.95 Play against an opponent while your PET checks and saves moves. Options: Play by phone, play against your PET.
- 2. Astrology: \$14.95. 3. Statement renumbering and cross reference: \$9.95.
- APPLE II: 1. 3 Dimensional Maze (16K) \$14.95. 2. Hi-Res Graphics Editor (16K) \$17.95
- 3. Statement renumbering \$9.95 (8K)

TOLL FREE
MICROLINE for:
Orders, TRS-80
Tech. Newsletter
Info, free catalogue
800-523-4550
In PA & CAN
(215) 665-1112

Cash prices shown. Major credit cards accepted. Minimum shipping \$2.50. Pa. residents add 6%.

Post Office Box Q, Dept. C Philadelphia, PA 19105

Color. VP-590 add-on Color Board allows program control of 8 brilliant colors for graphics, color games. Plus 4 selectable background colors. Includes sockets for 2 auxiliary keypads (VP-580). \$69.*

Sound. VP-595 Simple Sound Board provides 256 tone frequencies. Great for supplementing graphics with sound effects or music. Set tone and duration with easy instructions. \$24.*

Music. VP-550 Super Sound Board turns your VIP into a music synthesizer. 2 sound channels. Program control of frequency, time and amplitude envelope (voice) independently in each channel. Program directly from sheet music! Sync provision for controlling multiple VIPs, multitrack recording or other synthesizers. \$49.*

Memory. VP-570 RAM Expansion Board adds 4K bytes of memory. Jumper locates RAM in any 4K block of up to 32K of memory. On-board memory protect switch. \$95.*

EPROM Programmer. VP-565 EPROM Programmer Board comes complete with software to program, copy and verify 5-volt 2716 EPROMs—comparable to units costing much more than the VP-565 and VIP put together! Programming voltages generated on board. ZIF PROM socket included. \$99.*

EPROM Interface. VP-560 EPROM Interface Board locates two 5-volt 2716 EPROMs (4K bytes total) anywhere in 32K of memory. VIP RAM can be re-allocated. \$34.*

ASCII Keyboard.** Fully encoded, 128-character ASCII encoded alpha-numeric keyboard. 58 light touch keys including 2 user defined keys! Selectable upper and lower case. Handsomely styled. Under \$50.*

Tiny BASIC.** VP-700 Expanded Tiny BASIC Board puts this high-level language on your VIP. BASIC stored in 4K of ROM. Ready for immediate use—no loading necessary. This expanded BASIC includes the standard Tiny BASIC commands plus 12 additional—including color and sound control! Requires external ASCII encoded alpha-numeric keyboard. \$39.*

Auxiliary Keypads. Program your VIP for 2-player interaction games! 16-key keypad VP-580 with cable (\$15*) connects to sockets provided on VP-590 Color Board or VP 585 Keyboard Interface Card (\$10*).

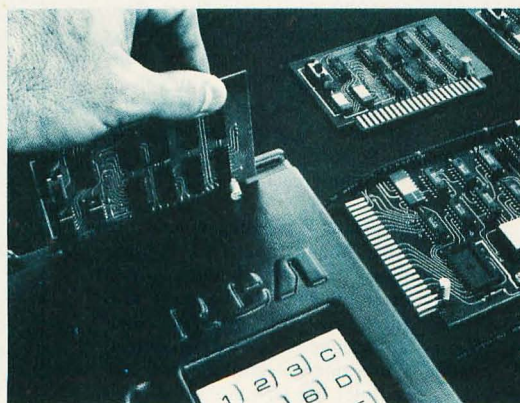


COSMAC VIP lets you add computer power a board at a time.

With these new easy-to-buy options, the versatile RCA COSMAC VIP (CDP18S711) means even more excitement. More challenges in graphics, games and control functions. For everyone, from youngster to serious hobbyist. And the basic VIP computer system starts at just \$249* assembled and ready to operate.

Simple but powerful—not just a toy.

Built around an RCA COSMAC micro-processor, the VIP includes 2K of RAM. ROM monitor. Audio tone with a built-in speaker. Plus 8-bit input and 8-bit output port to interface relays, sensors or other peripherals. It's



easy to program and operate. Powerful CHIP-8 interpretive language gets you into programming the first evening. Complete documentation provided.

Take the first step now.

Check your local computer store or electronics parts house. Or contact

RCA VIP Marketing, New Holland Avenue, Lancaster, PA 17604. Phone (717) 291-5848.

*Suggested retail price. CDP18S711 does not include video monitor or cassette recorder.
**Available 1st Quarter, 1979.

The fun way
into computers.

RCA

Continued from page 53

March 19-21, **Modern Integrated Circuits**, George Washington University, Washington DC. This course is structured to meet the needs of engineers, scientists, and technical managers who desire a better understanding of the latest technological advances in the area of integrated circuits. As such it examines all aspects of integrated circuit technology, starting from fundamental principles of construction and operation, to the most recent devices, their characteristics and specifications. A significant part of the course deals with the application of integrated circuits in linear and digital systems. Specific topics to be covered include detailed design examples of circuits using operational amplifiers and active filters, as well as computer arithmetic units, registers, and memories. Contact George Washington University, Continuing Engineering Education Program, Washington DC 20052.

March 19-21, **Project Management for Computer Systems**, Atlanta GA. This seminar is designed for the computer oriented professional responsible for the development and implementation of complex EDP systems. The seminar will illustrate techniques for planning, implementing, installing, and controlling projects. Contact The University of Chicago, Center for Continuing Education, 1307 E 60th St, Chicago IL 60637.

March 21-23, **Microcomputer Hardware and System Design Seminar**, Holiday Inn, Palo Alto CA. Polytechnic Institute for New York and the Institute for Advanced Professional Studies are presenting this 3 day seminar for engineers, programmers and technical managers with a working knowledge of digital hardware design and familiarity with the underlying concepts governing microprocessor operation, architecture, and systems design. This seminar will cover the operation, architecture, instruction set, and design techniques for 8 bit microprocessors. Contact Prof Donald D French, Institute for Advanced Professional Studies, 1 Gateway Ctr, Newton MA 02158, (617) 964-1412.

March 25-28, **Expo '79 Los Angeles** Marriott, Los Angeles CA. Expo '79 is held in conjunction with the 16th Numerical Control Society Annual Meeting and Technical Conference. Contact Numerical Control Society, 1800 Pickwick Av, Glenview IL 60025, (312) 724-7700.

March 26-28, **Data Processing Operations Management**, Houston TX. This seminar will emphasize the management skill and techniques applicable to the data processing operations function. The curriculum is designed toward practical, applied management techniques to provide a sounder understanding of the ways of managing data processing operations more effectively. Contact The University of Chicago, Center for Continuing Education, 1307 E 60th St, Chicago IL 60637.

March 26-28, **Minicomputers and Distributed Processing**, New York NY. This seminar will examine the uses, economics, programming and implementation of minicomputers. Current hardware and software will also be evaluated. Contact The University of Chicago, Center for Continuing Education, 1307 E 60th St, Chicago IL 60637.

March 26-30, **Data Base Concepts and Design**, AMA Management Center, Chicago IL. Sponsored by the American Management Associations, this course will feature practical information to help the participant understand structure, concepts, design, software, and management. Contact American Management Associations, 135 W 50th St, New York NY 10020, (212) 586-8100.

March 27-29, **The Midwestern Computer Expo**, McCormick Pl, Chicago IL. Exposition by the leading vendors of data processing equipment and services. Contact Lee Mulder, The Caravan Group, 60 Austin St, Newton MA, (617) 964-4550.

April 3-5, **Specifications of Reliable Software**, Hyatt Regency Hotel, Cambridge MA. This conference is sponsored by the IEEE Computer Society. Contact Douglas T Ross, Softech Inc, 460 Totten Pond Rd, Waltham MA 02154, (617) 890-6900.

April 5-6, **Computers in Ophthalmology**, St Louis MO. This is a course in application of computers to ophthalmic patient care and clinical research. Sessions dealing with data bases, automated patient testing, artificial intelligence, and image processing are being planned. Contact Robert Greenfield, DSc, Biomedical Computer Laboratory, Washington University School of Medicine, 700 S Euclid Av, St Louis MO 63110.

April 5-6, **1979 Computer Users Conference**, East Texas State University, Commerce TX. The theme of this conference will be "Educating in a Computer Society." Contact Henrietta Gale, conference coordinator, Dept of Computer Science, East Texas State University, Commerce TX 75428.

April 9-11, **Data Processing Operations Management**, Miami FL. This seminar will emphasize the management skill and techniques applicable to the data processing operations function. The curriculum is designed toward practical, applied management techniques to provide a sounder understanding of the ways of managing data processing operations more effectively. Contact The University of Chicago, Center for Continuing Education, 1307 E 60th St, Chicago IL 60637.

April 9-12, **Interface '79**, McCormick Pl, Chicago IL. This is the seventh annual conference and exposition on data communications and computers. Contact The Interface Group, 160 Speen St, Framingham MA 01701.

Get Your Up-Grade Kit Here:

AL: Birmingham: Computer Center, (205) 942-8567; Huntsville: Computerland, (205) 539-1200. **AZ:** Tucson: Myotis Enterprises, (602) 326-5306. **CA:** Berkeley: Byte Shop, (415) 845-6366; Davis: Capitol Computer Systems, (916) 483-7298; El Cerrito: Computerland, (415) 233-5010; Hayward: Computerland, (415) 538-8080; La Mesa: EDP Management Inc., (714) 462-5400; Los Altos: Computerland, (415) 941-8154; Marina Del Rey: Base 2, (213) 822-4499; Mt. View: Byte Shop Computer Store, (415) 969-5464; Digital Deli, (415) 961-2670; Palo Alto: Byte Shop, (415) 327-8080; Sacramento: Capitol Computer Systems, (916) 483-7298; San Diego: Byte Shop of San Diego, (714) 565-8008; San Francisco: Byte Shop, (415) 434-2983; Computer Center Inc., (415) 387-2513; Computer Store of San Francisco, (415) 431-0640; Computerland, (415) 546-1592; San Jose: Electronic Systems, (408) 226-4064; San Rafael: Computer Demo Room Inc., (415) 457-9311; Santa Clara: Byte Shop Computer Store, (408) 249-4221; Walnut Creek: Computerland, (415) 935-6502. **CO:** Denver: Computerland of Denver, (303) 759-4685; Englewood: Byte Shop, (303) 761-6232. **CT:** Fairfield: Computerland of Fairfield, (203) 374-2227; New London: R & R Computer Store, (203) 447-1079. **FL:** Ft. Lauderdale: Computer Age, (305) 791-8080; Computerland, (305) 566-0776; Jacksonville: Williams Radio & TV, (904) 354-5460; Panama City: Boyd Ebert Corp., (904) 769-4492; Tampa: Microcomputer Systems, (813) 879-4301. **GA:** Smyrna: Computerland of Atlanta, (404) 953-0406. **HI:** Honolulu: Computerland, (808) 521-8002. **IL:** Champaign: Byte Shop, (217) 352-2323; Niles: Computerland, (312) 967-1714; Oak Lawn: Computerland, (312) 422-8080; Peoria: Computerland, (309) 688-6252. **KY:** Louisville: Computerland, (502) 425-8380. **MA:** Cambridge: Computer Shop, (617) 661-6270; Waltham: Computer Mart Inc., (617) 899-4540. **MD:** Rockville: Computerland of Gaithersburg, (301) 948-7676. **MI:** Ann Arbor: Newmann Computer Exchange, (313) 994-3200; East Lansing: New Dimensions in Computing Inc., (517) 337-2880; Kentwood: Computerland of Grand Rapids, (616) 942-2931; Royal Oak: Computer Mart, (313) 576-0900. **MN:** Bloomington: Computerland of Bloomington, (612) 884-1474; Minneapolis: Computer Depot Inc., (612) 927-5601. **NB:** Omaha: America Computers, (402) 592-1518. **NC:** Raleigh: Byte Shop, (919) 833-0210. **NJ:** Budd Lake: Computer Lab of NJ, (201) 691-1984; Clark: S-100, (201) 382-1318; Iselin: Computer Mart of NJ, (201) 283-0600; Succasunna: Computer Hut, (201) 584-4977. **NY:** Carle Place: Computerland of Nassau, (516) 742-2262; Elmira Heights: Red Ten Electronics, (607) 734-3566; Ithaca: Computerland of Ithaca, (607) 277-4888; Johnson City: Micro World, (607) 798-9800; New York City: Computer Mart of NY, (212) 686-7923; Syracuse: Computer Shop of Syracuse Inc., (315) 446-1284; White Plains: Computer Corner, (914) 949-3282. **OH:** Cincinnati: Digital Design, (513) 561-6733; Columbus: Mini Micro Computer World Inc., (614) 235-5813; Ohio Microcomputer Specialists, (614) 488-1849; Dayton: Computer Solutions, (513) 223-2348. **OK:** Oklahoma City: Microlithics Inc., (405) 947-5646; Micronics, (405) 942-8152. **PA:** Frazer: Personal Computing Corp., (215) 647-8463; Philadelphia: Microtronix, (215) 665-1112; State College: Micro Computer Products Inc., (814) 238-7711. **TX:** Austin: Computerland, (512) 452-5701; Dallas: KA Electronic Sales, (214) 634-7870; Ft. Worth: Patrick Associates, (817) 531-2761; Garland: Digital Research Corp., (214) 271-2461; Houston: Computerland of SW Houston, (713) 977-0909; Houston Computer Mart, (713) 649-4188; San Antonio: Micromart, (512) 222-1426. **UT:** Orem: Johnson Computer Electronics, (801) 224-5361. **VA:** Alexandria: The Computer Hardware Store Inc., (703) 548-8085; Computers Plus, (703) 751-5656; Arlington: Arlington Electronics Wholesalers, (703) 524-2412. **WA:** Bellevue: Computerland of Bellevue, (206) 746-2070; Seattle: Magnolia Microsystems, (206) 285-7266. **WI:** Madison: Computerland of Madison, (608) 273-2020; Neenah: Fox Valley Computer Store, (414) 725-3020. **CANADA:** **ONTARIO:** Mississauga: Arisia Microsystems, (416) 274-6033; Toronto: Computer Mart Ltd., (416) 484-9708. **BRITISH ISLES:** **CHESHIRE:** Cheadle: New Bear Computing Store, 061-491-0134. **ESSEX:** Ilford: Byte Shop Ltd., 01-554-2177. **HARTFORDSHIRE:** New Barnet: Computer Components, 14 Station Rd. **ISRAEL:** Haifa: Microcomputer Eng. Ltd., 31-070. **WEST GERMANY:** Munich: ABC Computer Shop, Schellingstrasse 33, 8000 München 40; Microcomputer Shop, Toelzerstr. 8, D-815 Holzkirchen; Wedel: Digitronic Computer Systems, Bei der Doppelte 3-5.

Ithaca Audio

The Simple Up-Grade™

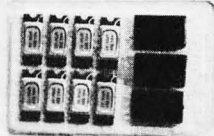
Trying to add computer memory is not much fun if you don't get everything you need.

step directions and diagrams. And if a personality jumper is required, *It's premade.*

The TRS-80* memory expansion was our first Simple Up-Grade. Now there are two more—for owners of Apple II† and Exidy Sorcerer‡ computers. Each kit is 100% guaranteed—if a part ever fails, we replace it FREE. Your Ithaca Audio dealer has them in stock, only \$140. Now you can afford to add high quality, high density memory to your system for remarkably little—far less than you would expect to pay from Radio Shack, Apple, or Exidy directly.

The Simple 16K APPLE II UP-GRADE KIT

Everything you need to up-grade your Apple II in blocks of 16K.



- 8 tested and guaranteed 16K RAMs.
- New Memory Select Units.
- Use only a household screwdriver.
- Easy instructions.

ITHACA AUDIO
P.O. Box 91 Ithaca, New York 14850

*Apple II is a registered trademark of Apple Computer, Inc.

16K TRS-80 UP-GRADE KIT

Everything you need to up-grade your TRS-80 to a 16K system.



- 8 tested and guaranteed 16K RAMs.
- New programming jumpers.
- Easy-to-follow instructions.
- Only tool required is a household screwdriver.

ITHACA AUDIO
P.O. Box 91 Ithaca, New York 14850

These Simple Up-Grades are Ithaca Audio's first step in adding more capability and reliability to your computer at lower cost. Other Up-Grades are on the way to your dealer now.

Receiving unprogrammed jumpers and having to program them yourself is not much better. Most important, that's the place where the problems are introduced.

So Ithaca Audio's better idea is the Simple Up-Grade. Each Simple Up-Grade is specially designed to make adding memory foolproof. We include all the parts you'll need; 8 prime, tested 16K RAMs, along with concise step by

The Simple 16K SORCERER UP-GRADE KIT

Everything you need to up-grade your Sorcerer in blocks of 16K.



- 8 tested and guaranteed 16K RAMs.
- New programming jumpers.
- Use only a screwdriver and soldering iron.
- Easy instructions.

ITHACA AUDIO
P.O. Box 91 Ithaca, New York 14850

*Sorcerer is a registered trademark of Exidy, Inc.

ITHACA AUDIO

P.O. Box 91
Ithaca, New York 14850
Phone: 607/257-0190

*TRS-80 is a registered trademark of Tandy Corp.

†Apple II is a registered trademark of Apple Computer, Inc.

‡Sorcerer is a registered trademark of Exidy, Inc.

Get a **PASCAL ENGINE**TM

*Not just a machine
that emulates one.*

The Pascal engine doesn't merely interpret P-Code, its instruction set *is* P-Code. This powerful computer runs the full UCSD Pascal Operating System and includes all of the following items:

- Pascal microengineTM with 32 bit **FLOATING POINT** instructions including floating point **MULTIPLY & DIVIDE** with provision for expanding instruction set to include double precision.
- **64K** bytes (32K words) of RAM expandable to **128K** bytes. (64K words)
- **FLOPPY DISC CONTROLLER** with direct memory access (DMA) switch selectable for:
 - single, or double density
 - 8" floppy or mini floppy
 - 1 to 4 drives (same type)
- Complete UCSD Pascal Operating System
 - PASCAL compiler — File Manager
 - BASIC compiler — Screen oriented editor
 - GRAPHIC package — Debugger
- Two RS-232 asynchronous ports (110-19,200 baud)
- Two 8-bit parallel ports
- Auto test microdiagnostics
- Documentation

\$2900 Complete with stylized low profile housing and power supply

Special Introductory price **\$2500** through 3/31/79



**CUTTING EDGE OF
TECHNOLOGY, Inc.**

19th floor, 61 Broadway, New York, N.Y. 10006
212-480-0480

April 16-20, Data Communication Systems and Networks, George Washington University, Washington DC 20052. See March 5-9, Washington DC.

April 23-26, Middle Eastern Electronic Communications Show and Conference, Bahrain Exhibition Ctr, Bahrain. The exhibition will consist of companies marketing communication systems, products, and services. Contact Gerry Dobson, MECOM '79, Arabian Exhibition Management, 11 Manchester Sq, London W1M 5AB.

April 23-27, Data Base Concepts and Design, San Francisco CA. See March 26-30, Chicago IL.

April 24-26, Electro/79 Show and Convention, New York Coliseum and American Hotel. Contact William C Weber Jr, general manager, Electronic Conventions Inc, 999 N Sepulveda Blvd, El Segundo CA 90245.

April 30-May 2, First Annual International Conference on Computer Capacity Management, Washington DC. This conference is sponsored by the Institute for Software Engineering. Contact the Institute for Software Engineering, POB 637, Palo Alto CA 94302.

May 7-11, Data Base Concepts and Design, Kansas City KS. See March 26-30, Chicago IL.

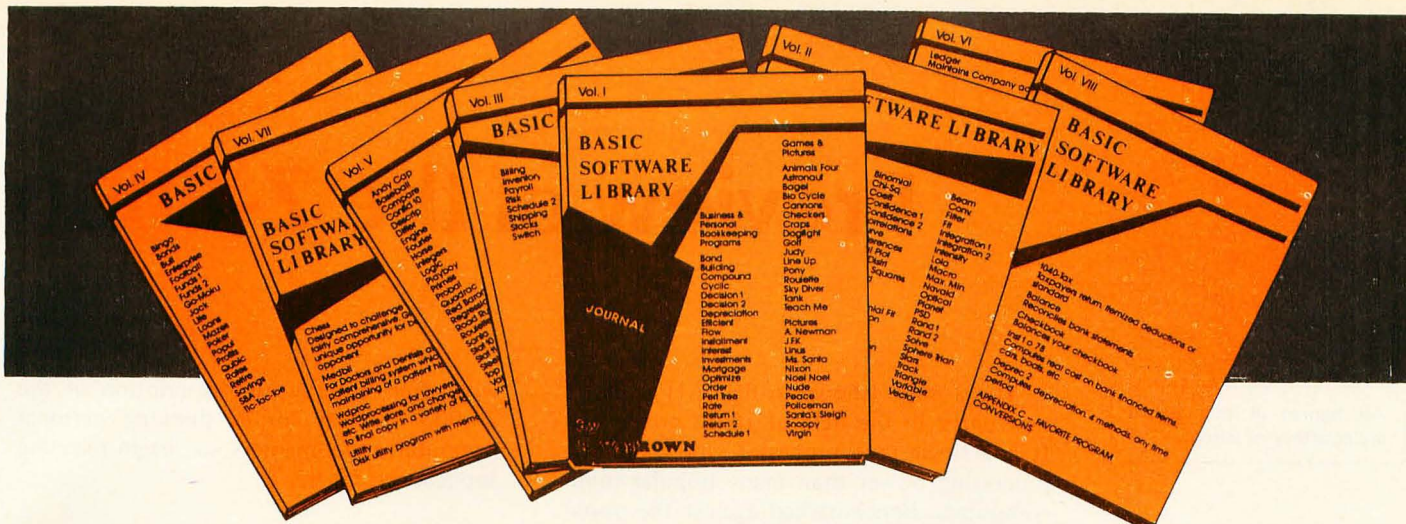
May 15-17, Micro/Expo 79, Centre International de Paris, Paris FRANCE. Contact Sybex Inc, 2020 Milvia St, Berkeley CA 94704.

May 15-17, First Education Computer Fair, Detroit Plaza Hotel, Detroit MI. This fair will be held in conjunction with 1979 Association for Educational Data Systems 17th Annual Convention. The theme of the fair will be the use of microprocessors in education. Contact Bruce G Alcock, Riverdale Country School, W 253 St and Fieldston Rd, Bronx NY 10471.

May 15-18, 1979 Association for Educational Data Systems 17th Annual Convention, Detroit Plaza Hotel, Detroit MI. The convention program will focus on computer applications, computer resources, computer related curriculum, application development methodologies, and futures. Exhibits, user group meetings and vendor sessions will also be offered. Contact Arthur W Daniels Jr, 31202 Dorchester, Madison Heights MI 48071.

May 21-24, Eighth Annual Incremental Motion Control Symposium, Ramada Inn, Urbana IL. Contact Dr B C Kuo, POB 2772, Station A, Champaign IL 61820.

Northeast Personal and Business Computer Show, Hynes Auditorium, Boston MA. See BYTE's Bits, page 224, for information concerning change from previously published date.■



COMPUTER SOFTWARE

For Homeowners, Businessmen, Engineers, Hobbyists, Doctors, Lawyers, Men and Women

We have been in business for over nine years building a reputation for providing a quality product at nominal prices — NOT what the traffic will bear. Our software is:

- **Versatile** — as most programs allow for multiple modes of operation.
- **Tutorial** — as each program is self prompting and leads you through the program (most have very detailed instructions contained right in their source code).
- **Comprehensive** — as an example our PSD program not only computes Power Spectral Densities but also includes FFT's, Inverse-transforms, Windowing, Sliding Windows, simultaneous FFT's variable data sizes, etc. and as a last word our software is:
- **Readable** — as all of our programs are reproduced full size for ease in reading.

- **Virtually Machine Independent** — these programs are written in a subset of Dartmouth Basic but are not oriented for any one particular system. Just in case your Basic might not use one of our functions we have included an appendix in Volume V which gives conversion algorithms for 19 different Basic's; that's right, just look it up and make the substitution for your particular version. If you would like to convert your favorite program into Fortran or APL or any other language, the appendix in Volume II will define the statements and their parameters as used in our programs.

Over 85% of our programs in the first five volumes will execute in most 8K Basic's with 16K of free user RAM. If you only have 4K Basic, because of its lack of string functions only about 60% of our programs in Volumes I through V would be useable, however they should execute in only 8K of user RAM.

For those that have specific needs, we can tailor any of our programs for you or we can write one to fit your specific needs.

Vol. I	Vol. II	Vol. III	Vol. IV	Vol. V	Vol. VI	Vol. VII	Vol. VIII
Business & Personal Bookkeeping Programs	Games & Pictures	Binomial	Beam	Bingo	Ledger	Maintains Company accounts and generates financial reports. Includes routines for: Pyri, Inv, Depr, A/R, A/P.	1040-Tax
Bond Building Compound Cyclic Decision 1 Decision 2 Depreciation Efficient Flow Installment Interest Mortgage Optimize Order Pert Tree Rate Return 1 Return 2 Schedule 1	Animals Four Astronaut Bagel Bio Cycle Cannons Checkers Craps Dogfight Golf Judy Line Up Pony Roulette Sky Diver Tank Teach Me Pictures A. Newman J.F.K. Linus Ms. Santa Nixon Noel Noel Nude Peace Policeman Santa's Sleigh Snoopy Virgin	Chl-Sq. Coeff Confidence 1 Confidence 2 Correlations Curve Differences Dual Plot Exp-Distri Least Squares Paired Plot Plotpts Polynomial Fit Regression Stat 1 Stat 2 T-Distribution Unpaired Variance 1 Variance 2 XY	Conv Filter Fit Integration 1 Integration 2 Intensity Lola Macro Max. Min. Navald Optical Planet PSD Rand 1 Rand 2 Solve Sphere Trian Track Triangle Variable Vector	Bonds Bull Enterprise Football Funds 1 Funds 2 Go-Moku Jack Life Loans Mazes Poker Popul Profits Qubic Rates Retire Savings SBA Tic-Tac-Toe	Confid 10 Descript Differ Engine Fourier Horse Integers Logic Playboy Primes Probal Quadrac Red Baron Regression 2 Road Runner Roulette Santa Stat 10 Stat 11 Steel Top Vary Xmas	Chess	Balance
						Medbll	Checkbook
						Wdproc	Inst 1 o 78
						Utility	Deprec 2
							APPENDIX C — FAVORITE PROGRAM CONVERSIONS

Vol. I — \$24.95 Bookkeeping Games Pictures	Vol. II — \$24.95 Math/Engineering Plotting/Statistics Basic Statement Def.	Vol. III — \$39.95 Advanced Business Billing, Inventory Investments Payroll	Vol. IV — \$9.95 General Purpose	Vol. V — \$9.95 Experimenter's Program	Vol. VI — \$49.95 Mini-Ledger	Vol. VII — \$39.95 Professional Programs	Vol. VIII — \$19.95 Homeowner's Programs
--	--	---	-------------------------------------	---	----------------------------------	--	--

AVAILABLE AT MOST COMPUTER STORES
Master Charge and Bank Americard accepted.

Our Software is copyrighted and may not be reproduced or sold.

Add \$150 per volume handling, all domestic shipments sent U.P.S. except APO and PO. Box which go parcel post. Foreign orders add \$8.00/volume for air shipment and make payable in U.S. dollars only.



SCIENTIFIC RESEARCH

P.O. Box 490099-B

Key Biscayne, FL 33149

(305) 361-1153

Preview of the Z-8000

All figures in this article are courtesy of Zilog.

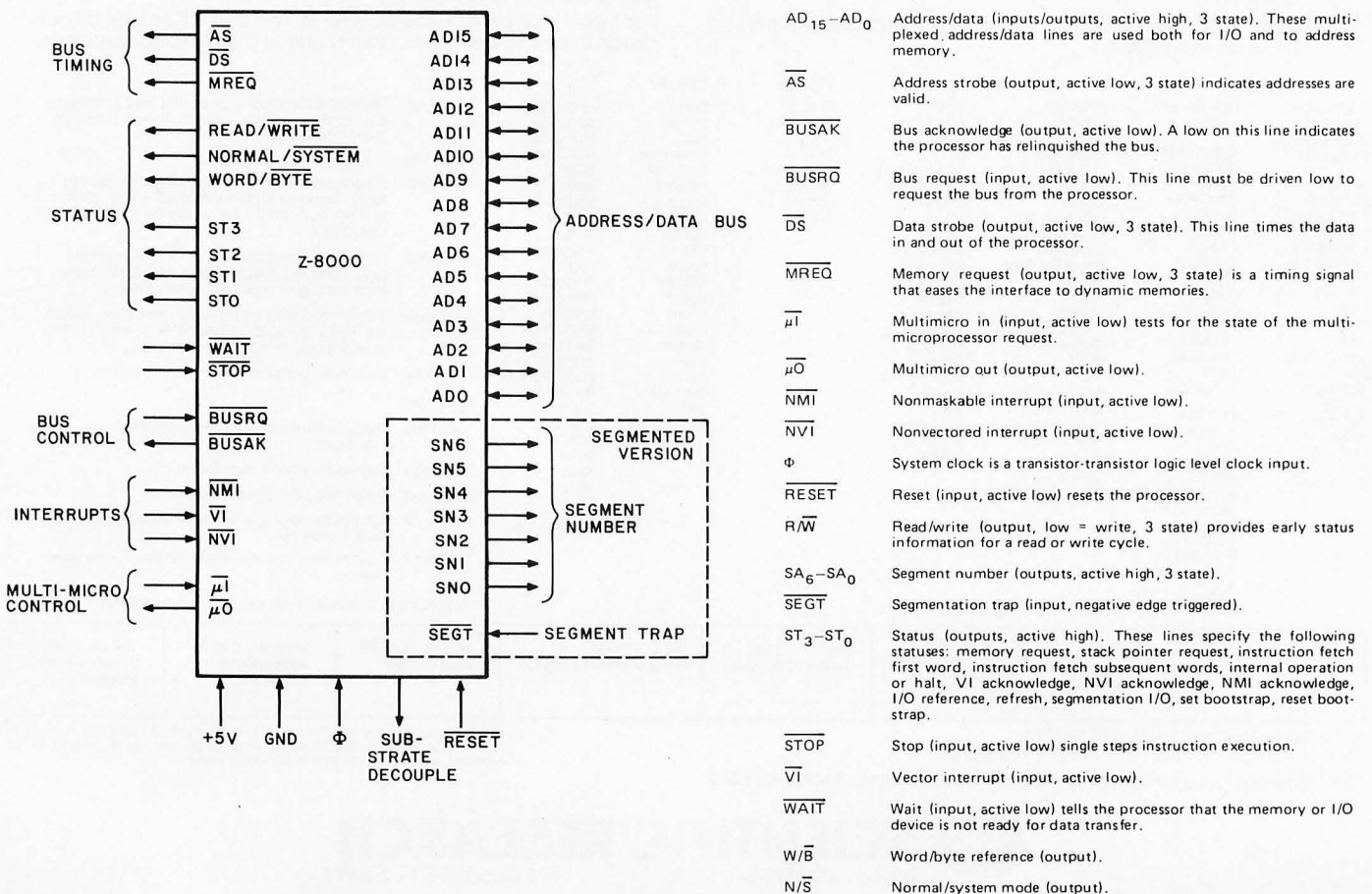
The Z-8000 (shown in figure 1) is Zilog's new entry in the field of 16 bit processors. It is a single chip processor with more raw processing power than many popular mini-computers. Benchmarked against the popular PDP-11 family, the Z-8000 is between the 11/45 and the 11/70 in speed for many simple instructions. The processor also introduces several sophisticated minicomputer hardware techniques such as memory management, separate system/user operation modes, separate memory space for data, stack contents and code, and long word instructions. The remainder of this review

will offer a very brief description of the Z-8000 so that future thinking personal computer experimenters can begin planning applications for it.

Architecture

The Z-8000 is a general register machine with 1 and 2 address instructions, faintly reminiscent of a PDP-11. It comes in two varieties: segmented or nonsegmented, in reference to the memory management capability which will be discussed later. I will discuss only the segmented processor

Figure 1: Pin diagram of Zilog's new Z-8000 16 bit processor. The device is both fast and versatile, with over 110 instructions in its instruction set. The Z-8000 is available in two versions: segmented and unsegmented. The segmented version uses an outboard auxiliary integrated circuit called a memory management device to provide memory segment mapping or relocation and memory protection (the memory in the Z-8000 is divided into 64 K byte blocks called sections).



since the nonsegmented processor is a functional subset of the former. Nonsegmented mode is a software selectable option in the segmented processor.

The processor has sixteen 16 bit registers which are logically subdivided (figure 2) into sixteen 8 bit registers, eight 32 bit registers and four 64 bit registers. All of the 8 and 16 bit registers are available as general purpose accumulators. Fifteen of the 16 bit registers are available as index registers. Registers 14, or 14 and 15 serve as stack pointer depending on the segmentation mode in effect. There are two sets of these registers to provide for separate system and user stacks. There is a 64 bit status register which contains the program counter and various flags. There is also a rate programmable refresh counter for servicing dynamic memories.

There are seven discrete data types recognized by the Z-8000. In ascending order of size they are bits, BCD (binary coded decimal) digits (4 bits), bytes (8 bits), words (16 bits), long words (32 bits), byte strings ($8n + 8$ bits), and word strings ($16n + 16$ bits). The string types consist of sequential bytes or words preceded by a word count. Strings may be accessed in either ascending or descending address order. Bytes are the smallest directly addressable data type. Bits and binary coded decimal are dealt with using special instructions such as SET B (set bit), and DAB (decimal adjust).

One of the most unusual features of this processor is the large memory space. The segmented Z-8000 has 24 address lines yielding 16,777,216 directly addressable bytes. The system and the user may both have their own memory, as may program code, data, and data stack, for a grand total of 96 M bytes of on line memory. The memory is arranged in 64 K byte blocks called segments. An outboard support integrated circuit, called the memory management unit (MMU), is available to provide, transparently to the user, segment mapping or relocation and memory protection. To access this mountain of memory, there are eight addressing modes, illustrated in figure 3.

The Z-8000 has over 110 different instructions, many of which have several possible addressing modes. The instruction set is summarized in table 1. There are many

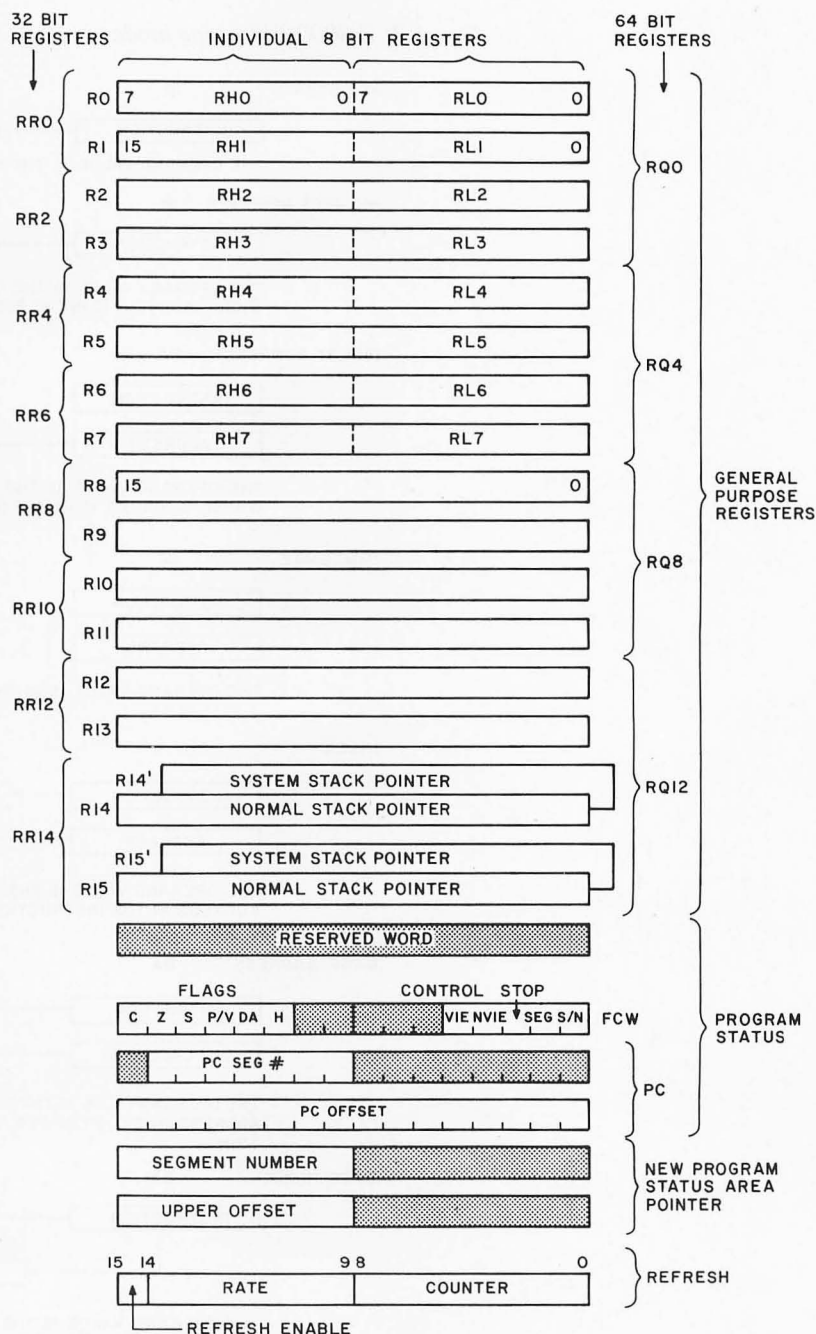
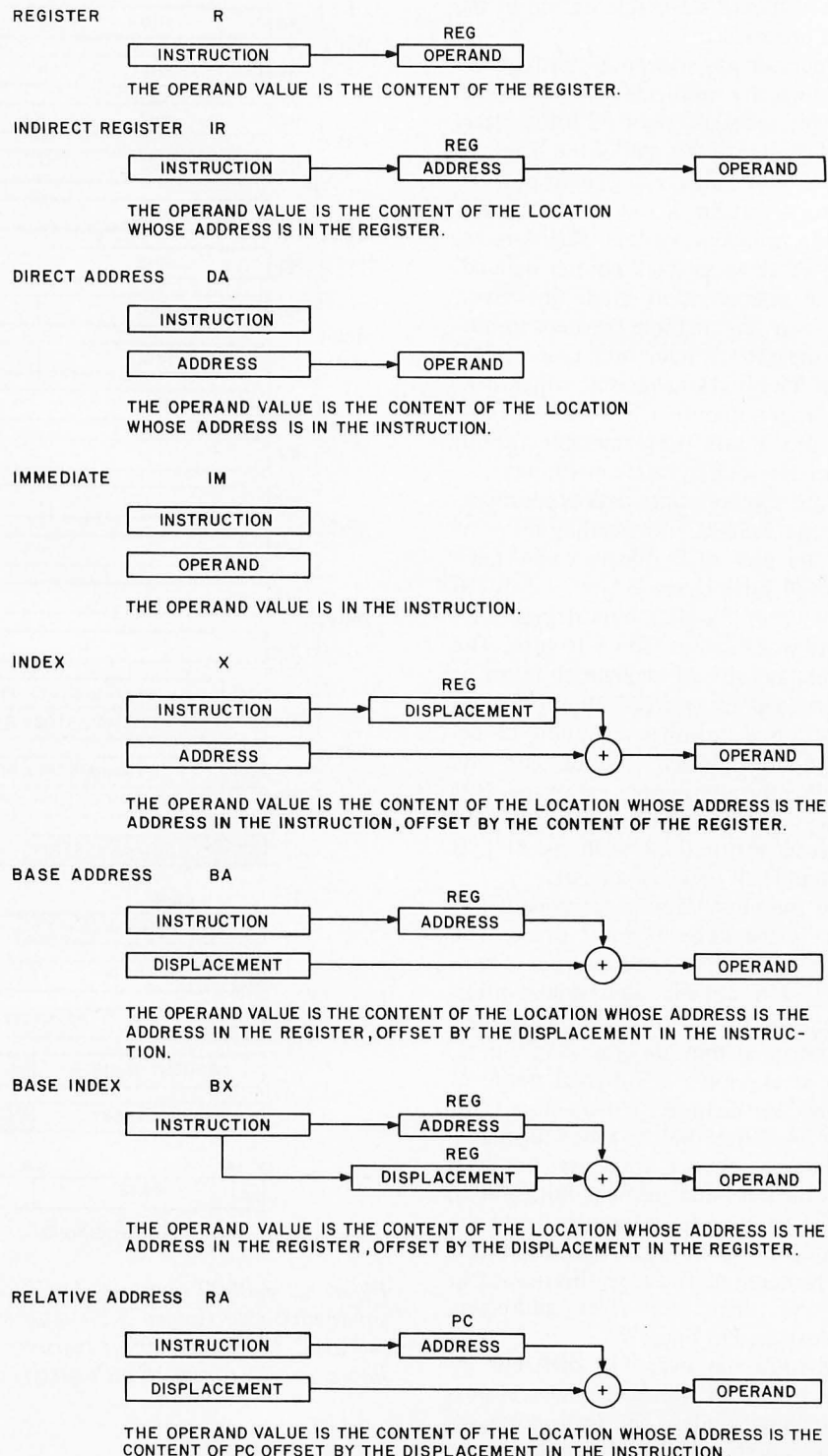


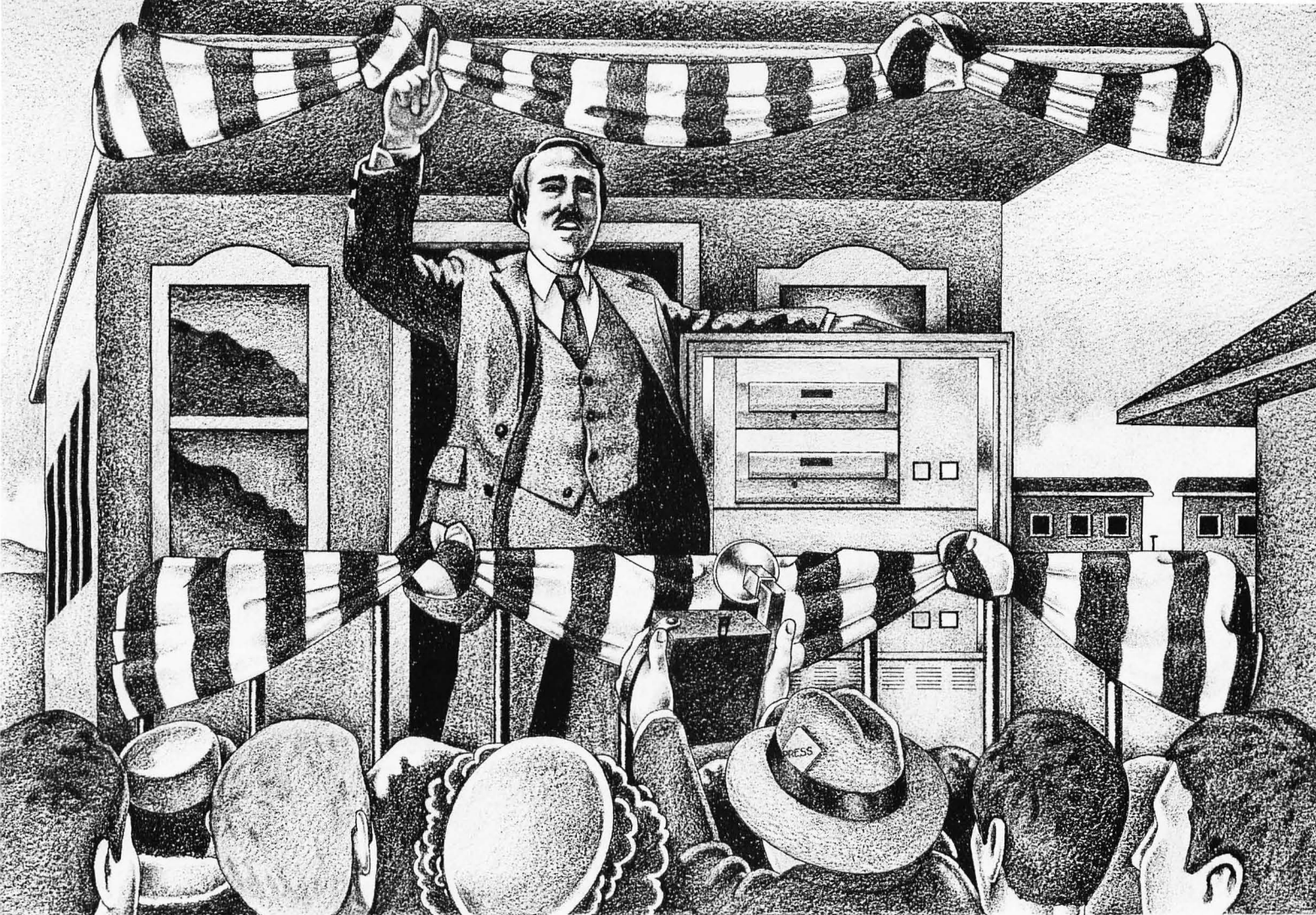
Figure 2: Z-8000 registers. The Z-8000 has sixteen 16 bit registers logically subdivided into sixteen 8 bit registers, eight 32 bit registers, and four 64 bit registers. The 8 and 16 bit registers are available as general purpose accumulators, and 15 of the 16 bit registers are available as index registers.

powerful instructions which are not usually seen in microcomputers. Not many microcomputers or small minicomputers have extended precision multiply and divide, or translate, increment, and repeat. There are string comparison operations and block move operations. The decrement and jump-on-nonzero instruction of the Z-80 has been extended to allow any word or byte length

register as an index counter. There is also a system call instruction which performs a software interrupt to the operating system. This is a very convenient means of communication between the user and system. There are other so-called traps that imitate an interrupt to the operating system. They are used to preserve software integrity, and occur when there is an illegal memory or instruction reference, or when a user mode program attempts to execute a privileged or I/O (input/output) instruction. A parti-

Figure 3: Z-8000 addressing modes.





What this country needs is a good \$8000 small business computer.

We agree! Now for less than \$8000, you can purchase an Ohio Scientific small business computer system complete with software packages for Accounting, Information Management and Word Processing. Here are the system's capabilities in detail:

Accounting: Supports accounts receivable, payables, cash receipts and disbursements, general ledger, balance sheet, P & L statement, payroll, inventory and order entry for small businesses.

Information Management: Stores any collection of information in disk files via a Data Base Manager. Can instantly retrieve information, generate lists, reports and mailing labels from this data as well as perform statistical analysis. All without any additional software. An optional "Query" system can answer conventional "English" questions pertinent to information in the system asked by untrained office users.

Word Processing: Can handle letters, reports and manuscripts. Uses totally electronic editing with disk file storage. Has character and line Edit, Find, Change, Delete, Transfer, Duplicate and Append capabilities. On output, it has text justification, proportional spacing, hyphenation and many more features.

Yes, an under \$8000 Ohio Scientific small business system includes all this software as well as 48K bytes of 180 nanosecond main memory, dual 8" floppy disk drives for 600K bytes of disk storage, a 1920 character upper/lower case CRT terminal, a 132 column tractor feed line printer, and the programming language BASIC for user generated programs if desired. And the system doesn't stop here, it has the performance and modular construction for growth with your use. The system can be expanded to nearly one million bytes of main memory, 80 megabytes of disk storage and 16 users (time share configuration), or it can be connected to a network of other small computers (distributed processing configuration). Numerous optional systems and applications software packages are available including the programming languages FORTRAN and COBOL and applications software for specific businesses.

Ohio Scientific small business systems are sold, leased and serviced nationwide by a network of business system dealers. Call or write to arrange a demonstration with your local dealer.

OHIO SCIENTIFIC

1333 S. CHILLICOTHE RD., AURORA, OHIO 44202 (216) 562-3101

cularly interesting subset of instructions concerns the use of a pair of pins on the Z-8000 packaged called μI and μO . These pins, and the instructions which govern them, allow for the combination of Z-8000 into efficient multi-processor or network systems. The only regrettable lack I've noticed thus far is the absence of memory-to-memory instructions.

Performance, in terms of execution speed, is a major factor in the selection of a processor. In table 2, I have tabulated the

approximate speed of several common processors for simple tasks. Obviously, the Z-8000 is way out in front, competing very favorably with a popular medium sized mini-computer whose processor's cost is more than two orders of magnitude greater. The Z-8000's speed and memory make it the best thing yet for personal applications which involve number crunching. I can easily imagine it as the heart of a personal FORTRAN or

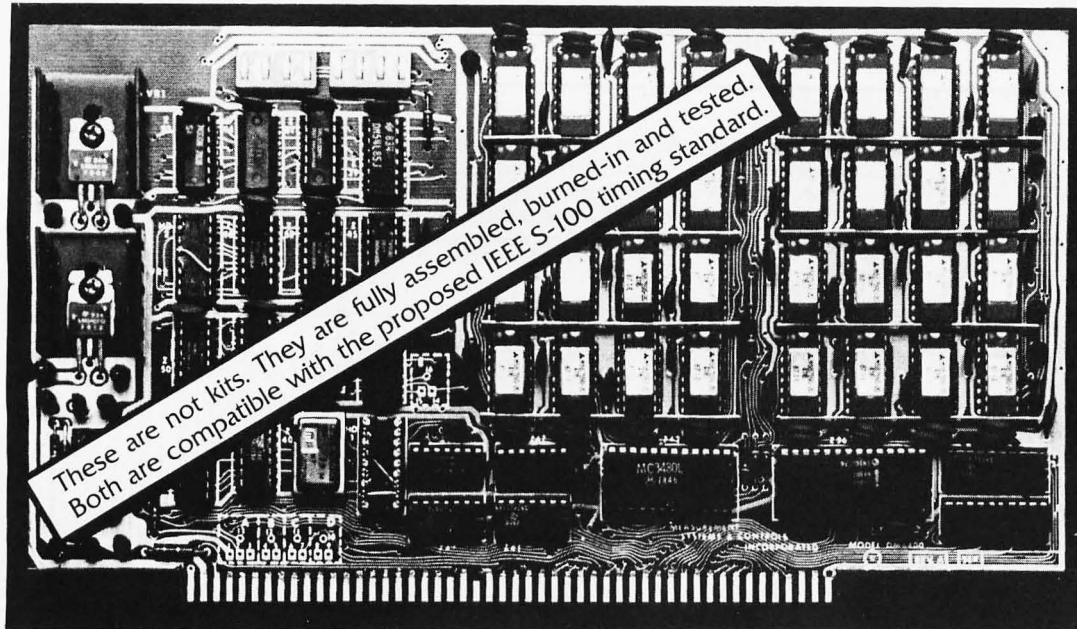
Text continued on page 91

Memory Management

Memory management, as the name implies, is a clever technique to handle large amounts of memory in a flexible fashion. In most computer systems, this management requires the large memory to be broken up into smaller (eg: 64 K byte) chunks. Each program or task residing in memory is assigned into its own unique chunk or segment. In general, segments may vary in length, but a program residing in a particular segment may not exceed that segment in length. Often a program will not need to directly address a vast amount of memory, and if a particular application program or set of programs will fit into segments, then management can be used. Management provides three main advantages in the Z-8000:

1. Since programs are constrained to fit in 64 K bytes or less, a 16 bit address is sufficient instead of the 24 bits required to address 16 M bytes. This obviously leads to a more compact and efficient code.
2. Programs residing in segments are mapped into what is known as logical or virtual address space. Virtual addresses are simply the addresses of locations in a segment from hexadecimal 0000 to FFFF. They are called virtual because they are relative only to the start of their segment and need not bear any relation to the actual physical addresses in the memory circuitry. Programs in segments are thus totally relocatable, needing only to inform the memory management device of the physical starting address of the particular segment. Figure 4 demonstrates this principle. Note that consecutive segments need not appear consecutively mapped into physical memory and also that segments may overlap physical memory.
3. Segmenting easily provides for memory protection. Since the memory management device knows the length of each segment, any attempt by a user task to access physical memory outside of its segment causes a segment violation and a software interrupt to the operating system. This is very useful when running a time-sharing system or debugging a new program.

The memory management device works simply by adding a constant base address for each segment to any memory references issued by that segment. The device in the Z-8000 also checks a number of conditions such as system versus user state, code versus data, read write versus read only, and valid base address in addition to the segment size. If any mismatches or faults occur, the operating system is informed.



64K bytes of
fast, low
power dyna-
mic RAM.

\$695⁰⁰

32K bytes of
faster static
RAM.

\$595⁰⁰

Both Our UNCommon Dynamic and our UNCommon Static RAMS have the following features and specifications:

- Compatible with: IMSAI, VECTOR, SOL, TDL, MITS, IA, CROMEMCO, NORTH STAR, and most other S-100 systems.
- Inputs buffered with 1 LS TTL load.
- Outputs are all three state.
- Memory selectable and deselectable in 4K increments.
- DIP switch selectable addressing.
- Phantom selectable on pin 67.
- Disc compatible. DMA compatible to 1MHz.
- Reliability — all boards are fully tested
 - a. Bus address and control line timing skew.
 - b. Word pattern sensitivity.
 - c. All boards are burned-in.
- Full documentation.
- Industrial quality design and components. Glass epoxy boards. Silk screened legends. Gold plated edge connectors. All IC's on sockets.
- Delivery — Stock to 30 days.
- Guaranteed performance for one year on parts and labor. Full refund if returned undamaged within 14 days.

Our UNCommon Dynamic RAM Features:

- 64K bytes of dynamic RAM with on board transparent refresh.
- S-100 interface compatible with crystal controlled timing INDEPENDENT of bus or processor timing.
- No wait states or cycle stealing with 8080 or Z80 to 4MHz. Up to 5MHz with 1 wait state.

Our UNCommon Static RAM Features:

- 32K bytes of static RAM using 300n Sec low power static RAMS.
- No wait states or cycle stealing with 8080, 8085, or Z80 processors up to 5MHz.
- Organized in 8 independently addressable 4K byte increments at 4K boundaries.

I would like to order the following fully assembled and tested UNCommon memory:

UNCommon Dynamic RAMS

- ☐ DM6400 64K RAM — \$695⁰⁰
- ☐ DM4800 48K RAM — \$559⁰⁰
- ☐ DM3200 32K RAM — \$429⁰⁰
- ☐ DM1600 16K RAM — \$295⁰⁰

UNCommon Static RAM

- ☐ SM3200 32K RAM — \$595⁰⁰

Enclosed is a check or money order for:
(Calif. residents please add 6% sales tax. Please allow 14 days for checks to clear bank. Thank you.)

Please bill my ☐ BA, ☐ VISA, or ☐ MASTERCHARGE account.

Card No.: _____ Expiration date: _____

Four digits above name on Mastercharge card: _____

Name _____

Address _____

City State _____ Zip _____

Phone _____

All orders shipped postpaid. All orders in U.S. funds. Please add 10% on all orders outside U.S.A., Canada, and Mexico.

**MEASUREMENT
systems & controls**
incorporated

867 North Main Street
Orange, California 92668
Telephone: (714) 633-4460

Table 1: Summary of the Z-8000 instruction set, slightly condensed.

The instruction set table is somewhat abridged due to space considerations. For example, almost all data manipulation type instructions (ie: data transfers, or arithmetic) have associated forms for the handling of byte length and long word length operands. The mnemonic for an alternate length operand is created by appending a B (for byte) or an L (for long word) to the standard op code mnemonic. For example, a byte length COMPARE (CP) would be CP B = CPB. The symbols and abbreviations used in this table are defined as follows:

Operands

b - bit number
CC - condition code
CTLR - a control register
dst - destination
FLGR - flag register
int - any interrupt enable bit
n - a small integer
src - source

Addressing Modes

BA - base address
BX - base index
DA - direct address
IM - immediate
IR - indirect register
R - register
RA - relative address
X - index

Miscellaneous

← - is replaced by
@ - indirect
 R_n, R_{n+1} - register pair

Loads and Exchanges

Op code	Operands	Operation	Addressing Modes	SBC	R_{src}	Subtract with carry $R \leftarrow R - src - carry.$	R
CLR	dst	Clear $dst \leftarrow 0.$	R,IR,DA,X	SUB	R_{src}	Subtract $R \leftarrow R - src.$	R,IR,DA,X,IM
EX	R_{src}	Exchange $temp \leftarrow src$ $src \leftarrow R$ $R \leftarrow temp.$	R,IR,DA,X				
LD	R_{src}	Load src to register $R \leftarrow src.$	R,IR,DA,X,IM, BA,BX,RA				
LD	dst,R	Load register to dst $dst \leftarrow R.$	IR,DA,X,BA, BX,RA	AND	R_{src}	And $R \leftarrow R \text{ AND } src.$	R,IR,DA,X,IM
LD	dst,IM	Load to memory immediate $dst \leftarrow IM.$	IR,DA,X	COM	dst	Complement $dst \leftarrow \text{NOT } dst.$	R,IR,DA,X
LDA	R_{src}	Load address The address is computer from src and stored in R.	DA,X,BA,BX,RA	OR	R_{src}	Or $R \leftarrow R \text{ OR } src.$	R,IR,DA,X,IM
LDM	R_{src},n	Load multiple memory to registers Load n registers starting at register R from location starting at src (n=1 to 16).	IR,DA,X	TEST	dst	Test $dst \text{ OR } 0.$	R,IR,DA,X
LDM	dst, R,n	Load multiple register to memory Load n words starting at dst from n registers starting with R (n=1 to 16).	IR,DA,X	TCC	CC,dst	Test condition code Set lower bit of register if CC is true, reset otherwise.	R
POP	dst,IR	Pop $dst \leftarrow IR$ (autodecrement).	R,IR,DA,X	XOR	R_{src}	Exclusive or $R \leftarrow R \text{ XOR } src.$	R,IR,DA,X,IM
PUSH	IR, R_{src}	Push (autodecrement) $IR \leftarrow src.$	R,IR,DA,X,IM				

Arithmetic

Op code	Operands	Operation	Addressing Modes	Op code	Operands	Operation	Addressing Modes
ADC	R_{src}	Add with carry $R \leftarrow R + src + carry.$	R	CALL	dst	Call subroutine Autodecrement SP @ $SP \leftarrow PC$ $PC \leftarrow dst.$	IR,DA,X
ADD	R_{src}	Add $R \leftarrow R + src.$	R,IR,DA,X,IM	CALR	dst	Call relative Autodecrement SP @ $SP \leftarrow PC$ $PC \leftarrow PC + dst$ Range +4094 to -4096 bytes.	RA
CP	R_{src}	Compare $R - src$ Flags are affected.	R,IR,DA,X,IM	CPBJR	R,IM,CC,dst	Compare and jump relative $R - IM.$ If CC is true $PC \leftarrow PC + dst$ Range +254 to -256 bytes Flags are not affected.	RA
CP	dst,IM	Compare memory with immediate $dst - IM.$	IR,DA,X	DJNZ	R,dst	Decrement and jump on nonzero $R \leftarrow R - 1$ If $R \neq 0$ $PC \leftarrow PC + dst$ Range 0 to -256 bytes Flags are not affected.	RA
DAB	dst	Decimal adjust	R	IRET		Interrupt return $PS \leftarrow @ SP$ Autodecrement SP.	-
DEC	dst,n	Decrement by n $dst \leftarrow dst - n$ (n is 1 to 16).	R,IR,DA,X	JP	CC,dst	Jump conditional If CC is true $PC \leftarrow dst.$	IR,DA,X
DIV	R_{src}	Divide (signed) $R_{n+1} \leftarrow (R_n, R_{n+1}) / src$ $R_n \leftarrow remainder.$	R,IR,DA,X,IM	JR	CC,dst	Jump conditional relative If CC is true $PC \leftarrow PC + dst$ Range +254 to -256 bytes. Flags are not affected.	RA
EXTS	dst	Extend sign Extend sign of R_{n+1} to $R_n.$	R	RET	CC	Return conditional If CC is true $PC \leftarrow @ SP$ Autodecrement SP.	-
INC	dst,n	Increment by n $dst \leftarrow dst + n$ (n is 1 to 16).	R,IR,DA,X	SC	n	System call Push instruction Autodecrement SP @ $SP \leftarrow Old PS$ $PS \leftarrow New system call PS$ (N=0 to 255).	-
MULT	R_{src}	Multiply (signed) $(R_n, R_{n+1}) \leftarrow (R_{n+1}) * src.$	R,IR,DA,X,IM				
NEG	dst	Negate $dst \leftarrow 0 - dst.$	R,IR,DA,X				

NEW!

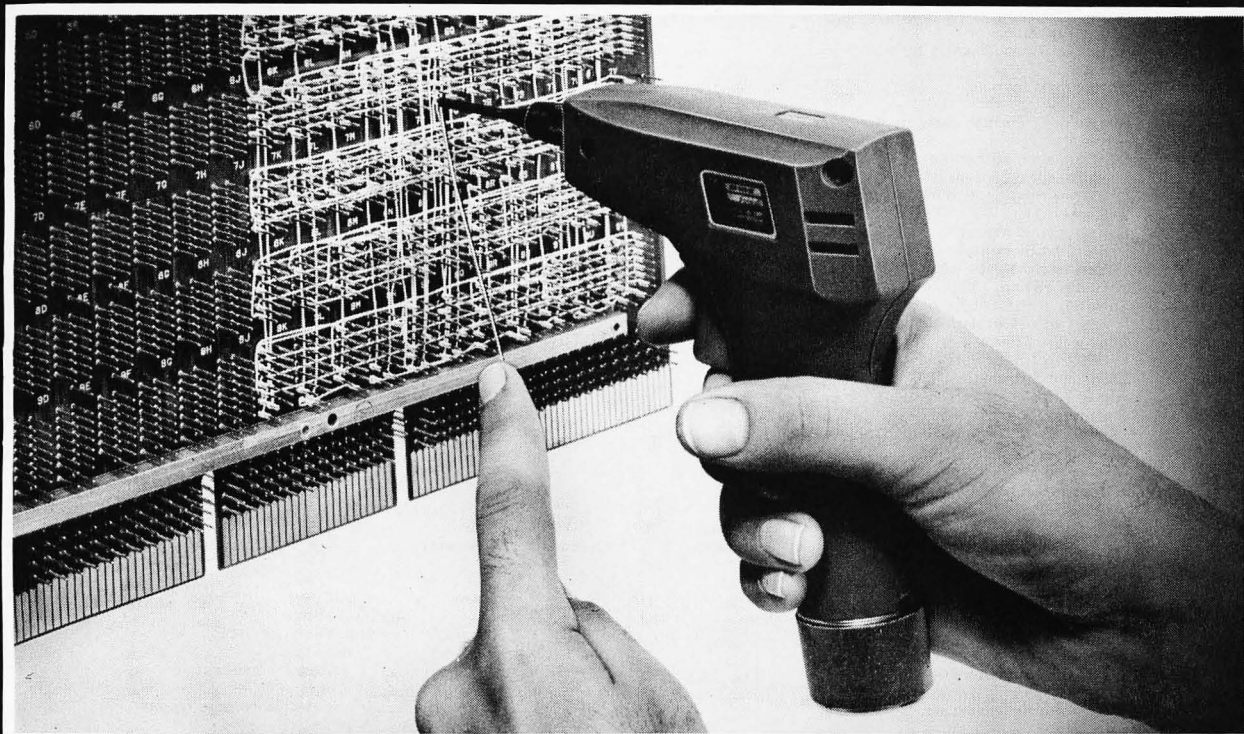
"INDUSTRIAL"

WIRE-WRAPPING TOOL

MODEL BW928

\$49⁹⁵

BATTERIES NOT INCLUDED
BIT & SLEEVE NOT INCLUDED



- BATTERY OPERATED
(2) Standard "C" Ni Cad Batteries (not included)
- INTERCHANGEABLE BITS & SLEEVES
(not included)
- REVERSIBLE ROTATION
For unwrapping, reverse batteries

- BACKFORCE OPTIONAL
Model BW928-BF \$52.95
- POSITIVE INDEXING
- LEIGHT WEIGHT
*LEXAN™ Housing

*LEXAN™ GENERAL ELECTRIC



OK MACHINE & TOOL CORPORATION

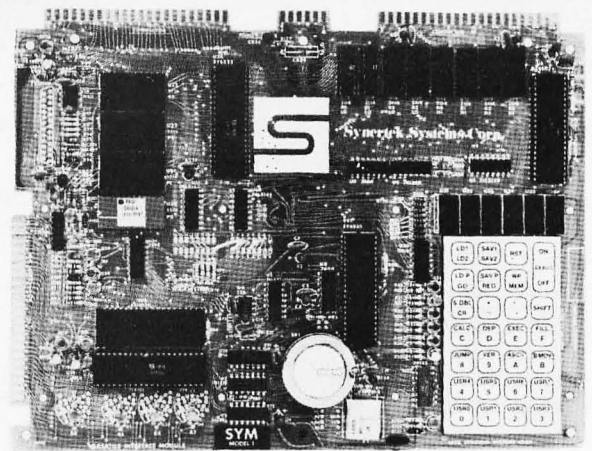
3455 Conner St., Bronx, N.Y. 10475 • (212) 994-6600 • TELEX 125091

Table 1, continued:

Bit Manipulation				Input Output			
Op code	Operands	Operation	Addressing Modes	Op code	Operands	Operation	Addressing Modes
BIT	b,dst	Test bit static Z flag ← NOT dst _b .	R,IR,DA,X	IN	R,src	Input R ← src.	IR,DA
BIT	R,dst	Test bit dynamic Z flag ← NOT dst _R .	R	IND	dst,src,R	Input and decrement dst ← src Autodecrement dst R ← R - 1.	IR
RES	b,dst	Reset bit static dst _b ← 0.	R,IR,DA,X	INDR	dst,src,R	Input, decrement and repeat dst ← src Autodecrement dst R ← R - 1 Repeat until R=0.	IR
RES	R,dst	Reset bit dynamic dst _R ← 0.	R	INI	dst,src,R	Input and increment dst ← src Autoincrement dst R ← R + 1.	IR
SET	b,dst	Set bit static dst _b ← 1.	R,IR,DA,X	INIR	dst,src,R	Input, increment and repeat dst ← src Autoincrement dst R ← R + 1 Repeat until R=0.	IR
SET	R,dst	Set bit dynamic dst _R ← 1.	R	OUT	dst,R	Output dst ← R.	IR,DA
TSET	dst	Test and set S flag ← sign of dst dst ← All "1s."	R,IR,DA,X	OUTD	dst,src,R	Output and decrement dst ← src Autodecrement src R ← R - 1.	IR
Rotate and Shift				OTDR	dst,src,R	Output, decrement and repeat dst ← src Autodecrement src R ← R - 1 Repeat until R=0.	IR
Op code	Operands	Operation	Addressing Modes	Block Transfer and String Manipulation			
RLDB	R,src	Rotate digit left.	R	Op code	Operands	Operation	Addressing Modes
RRDB	R,src	Rotate digit right.	R	CPD	Rx,src,Ry,CC	Compare and decrement Rx ← src Autodecrement src Ry ← Ry - 1.	IR
RL	dst,n	Rotate left by n n is 1 or 2.	R	CPDR	Rx,src,Ry,CC	Compare, decrement and repeat Rx ← src Autodecrement src Ry ← Ry - 1 Repeat until CC false or R = 0.	IR
RLC	dst,n	Rotate left through carry by n n is 1 or 2.	R	CPI	Rx,src,Ry,CC	Compare and increment Rx ← src Autoincrement src Ry ← Ry + 1.	IR
RR	dst,n	Rotate right by n n is 1 or 2.	R	CPIR	Rx,src,Ry,CC	Compare, increment and repeat Rx ← src Autoincrement src Ry ← Ry + 1 Repeat until CC false or Ry=0.	IR
RRC	dst,n	Rotate right through carry by n n is 1 or 2.	R	CPSD	dst,src,R,CC	Compare string and decrement dst ← src Autodecrement dst and src R ← R - 1.	IR
SDA	dst,R	Shift dynamic arithmetic Shift dst by content of R Left or right depending on sign Range +31 to -32.	R	CPSDR	dst,src,R,CC	Compare string, decrement and repeat dst ← src Autodecrement dst and src R ← R - 1 Repeat until CC false or R=0.	IR
SDL	dst,R	Shift dynamic logical Shift dst by content of R Left or right depending on sign Range +31 to -32.	R	CPSI	dst,src,R,CC	Compare string and increment dst ← src Autoincrement dst and src R ← R + 1.	IR
SLA	dst,n	Shift left arithmetic by n n is 1 to size of data element.	R				
SLL	dst,n	Shift left logical by n n is 1 to size of data element.	R				
SRA	dst,n	Shift right arithmetic n is 1 to size of data element.	R				
SRL	dst,n	Shift right logical by n n is 1 to size of data element.	R				

SYM-1, 6502-BASED MICROCOMPUTER

- FULLY-ASSEMBLED AND COMPLETELY INTEGRATED SYSTEM that's ready-to-use
- ALL LSI IC'S ARE IN SOCKETS
- 28 DOUBLE-FUNCTION KEYPAD INCLUDING UP TO 24 "SPECIAL" FUNCTIONS
- EASY-TO-VIEW 6-DIGIT HEX LED DISPLAY
- KIM-1* HARDWARE COMPATIBILITY
The powerful 6502 8-Bit MICROPROCESSOR whose advanced architectural features have made it one of the largest selling "micros" on the market today.
- THREE ON-BOARD PROGRAMMABLE INTERVAL TIMERS available to the user, expandable to five on-board.
- 4K BYTE ROM RESIDENT MONITOR and Operating Programs.
- Single 5 Volt power supply is all that is required.
- 1K BYTES OF 2114 STATIC RAM onboard with sockets provided for immediate expansion to 4K bytes onboard, with total memory expansion to 65, 536 bytes.
- USER PROM/ROM: The system is equipped with 3 PROM/ROM expansion sockets for 2316/2332 ROMs or 2716 EPROMs
- ENHANCED SOFTWARE with simplified user interface
- STANDARD INTERFACES INCLUDE:
 - Audio Cassette Recorder Interface with Remote Control (Two modes: 135 Baud KIM-1* compatible, Hi-Speed 1500 Baud)
 - Full duplex 20mA Teletype Interface
 - System Expansion Bus Interface
 - TV Controller Board Interface
 - CRT Compatible Interface (RS-232)
- APPLICATION PORT: 15 Bi-directional TTL Lines for user applications with expansion capability for added lines
- EXPANSION PORT FOR ADD-ON MODULES (51 I/O Lines included in the basic system)
- SEPARATE POWER SUPPLY connector for easy disconnect of the d-c power
- AUDIBLE RESPONSE KEYPAD



Synertek has enhanced KIM-1* software as well as the hardware. The software has simplified the user interface. The basic SYM-1 system is programmed in machine language. Monitor status is easily accessible, and the monitor gives the keypad user the same full functional capability of the TTY user. The SYM-1 has everything the KIM-1* has to offer, plus so much more that we cannot begin to tell you here. So, if you want to know more, the SYM-1 User Manual is available, separately.

SYM-1 Complete w/manuals	\$269.00
SYM-1 User Manual Only	7.00
SYM-1 Expansion Kit	75.00

Expansion includes 3K of 2114 RAM chips and 1-6522 I/O chip.

SYM-1 Manuals: The well organized documentation package is complete and easy-to-understand.

SYM-1 CAN GROW AS YOU GROW. Its the system to BUILD-ON. Expansion features that are soon to be offered:

8K Basic ROM	\$159.00
TV Interface Board	349.00

QUALITY EXPANSION BOARDS DESIGNED SPECIFICALLY FOR KIM-1, SYM-1 & AIM 65

These boards are set up for use with a regulated power supply such as the one below, but, provisions have been made so that you can add onboard regulators for use with an unregulated power supply. But, because of unreliability, we do not recommend the use of onboard regulators. All I.C.'s are socketed for ease of maintenance. All boards carry full 90-day warranty.

All products that we manufacture are designed to meet or exceed industrial standards. All components are first quality and meet full manufacturer's specifications. All this and an extended burn-in is done to reduce the normal percentage of field failures by up to 75%. To you, this means the chance of inconvenience and lost time due to a failure is very rare; but, if it should happen, we guarantee a turn-around time of less than forty-eight hours for repair.

Our money back guarantee: If, for any reason you wish to return any board that you have purchased directly from us within ten (10) days after receipt, complete, in original condition, and in original shipping carton; we will give you a complete credit or refund less a \$10.00 restocking charge per board.

VAK-1 8-SLOT MOTHERBOARD

This motherboard uses the KIM-4* bus structure. It provides eight (8) expansion board sockets with rigid card cage. Separate jacks for audio cassette, TTY and power supply are provided. Fully buffered bus.

VAK-1 Motherboard	\$129.00
--------------------------	-----------------

VAK-2/4 16K STATIC RAM BOARD

This board using 2114 RAMs is configured in two (2) separately addressable 8K blocks with individual write-protect switches.

VAK-2 16K RAM Board with only	\$239.00
--------------------------------------	-----------------

8K of RAM (1/2 populated)	
-----------------------------------	--

VAK-3 Complete set of chips to	\$175.00
---------------------------------------	-----------------

expand above board to 16K	
----------------------------------	--

VAK-4 Fully populated 16K RAM	\$379.00
--------------------------------------	-----------------

VAK-5 2708 EPROM PROGRAMMER

This board requires a +5 VDC and ± 12 VDC, but has a DC to DC

multiplier so there is no need for an additional power supply. All software is resident in on-board ROM, and has a zero-insertion socket.

VAK-5 2708 EPROM Programmer	\$269.00
------------------------------------	-----------------

VAK-6 EPROM BOARD

This board will hold 8K of 2708 or 2758, or 16K of 2716 or 2516 EPROMs. EPROMs not included.

VAK-6 EPROM Board	\$129.00
--------------------------	-----------------

VAK-7 COMPLETE FLOPPY-DISK SYSTEM (May '79)

VAK-8 PROTOTYPING BOARD

This board allows you to create your own interfaces to plug into the motherboard. Etched circuitry is provided for regulators, address and data bus drivers; with a large area for either wire-wrapped or soldered IC circuitry.

VAK-8 Prototyping Board	\$49.00
--------------------------------	----------------

POWER SUPPLIES

ALL POWER SUPPLIES are totally enclosed with grounded enclosures for safety, AC power cord, and carry a full 2-year warranty.

FULL SYSTEM POWER SUPPLY

This power supply will handle a microcomputer and up to 65K of our VAK-4 RAM. ADDITIONAL FEATURES ARE: Over voltage Protection on 5 volts, fused, AC on/off switch. Equivalent to units selling for \$225.00 or more.

Provides +5 VDC @ 10 Amps & ± 12 VDC @ 1 Amp

VAK-EPS Power Supply	\$125.00
-----------------------------	-----------------

*KIM is a product of MOS Technology

KIM-1* Custom P.S. provides 5 VDC @ 1.2 Amps

and +12 VDC @ .1 Amps

KCP-1 Power Supply	\$41.50
---------------------------	----------------

SYM-1 Custom P.S. provides 5 VDC @ 1.4 Amps

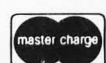
VCP-1 Power Supply	\$41.50
---------------------------	----------------

RNB ENTERPRISES
INCORPORATED

Circle 315 on inquiry card.

2967 W. Fairmount Avenue
Phoenix AZ. 85017

(602)265-7564



Prices in effect Nov. '78

BYTE March 1979 89

Table 1, continued:

				SOTIRB	dst,src,R	Special output, increment and repeat dst ← src Autoincrement src R ← R + 1 Repeat until R=0.	IR
OUTI	dst,src,R	Output and increment dst ← src Autoincrement src R ← R + 1.	IR				
OTIR	dst,src,R	Output, increment and repeat dst ← src Autoincrement src R ← R + 1 Repeat until R=0.	IR			Processor Control	
SINB	R,src	Special input R ← src.	DA	Op code	Operands	Operation	Addressing Modes
SINDB	dst,src,R	Special input and decrement dst ← src Autodecrement dst R ← R - 1.	IR	COMFLG	flag	Complement flag Any combination of flags Z, C, V, P, S.	—
SINDRB	dst,src,R	Special input, decrement and repeat dst ← src Autodecrement dst R ← R - 1 Repeat until R=0.	IR	DI	int	Disable interrupt Any combination of NVI,VI.	—
SINIB	dst,src,R	Special input and increment dst ← src Autoincrement dst R ← R + 1.	IR	EI	int	Enable interrupt Any combination of NVI,VI.	—
SINIRB	dst,src,R	Special input, increment and repeat dst ← src Autoincrement dst R ← R + 1 Repeat until R=0.	IR	HALT		HALT.	
SOUTB	dst,src	Special output dst ← src.	DA	LDCTL	CTLR,src	Load to control register CTLR ← src.	R
SOUTDB	dst,src,R	Special output and decrement dst ← src Autodecrement src R ← R - 1.	IR	LDCTL	dst,CTLR	Load from control register dst ← CTLR.	R
SOTDRB	dst,src,R	Special output, decrement and repeat dst ← src Autodecrement src R ← R - 1 Repeat until R=0.	IR	LDCTLB	FLGR,src	Load to flag byte FLGR ← src.	R
SOUTIB	dst,src,R	Special output and increment dst ← src Autoincrement src R ← R + 1.	IR	LDCTLB	dst,FLGR	Load from flag byte dst ← FLGR.	R
				LDPS	src	Load program status PS ← src.	IR,DA,X
				MBIT		Test μI Z ← μI.	—
				MREQ	dst	Multimicro request.	R
				MRES		Reset μ0 μ0 ← 0.	
				MRLSE		Multimicro release.	—
				MSET		Set μ0 μ0 ← 1.	
				NOP		No operation.	
				RESFLG	flag	Reset flag Any combination of flags Z, C, V, P, S.	—
				SETFLG	flag	Set flag Any combination of flags Z, C, V, P, S.	—

Z-8000 Peripheral Support Circuits

Name Function

- Z-MBU** Microprocessor buffer unit for high speed elastic buffering between processors, and processors and peripherals. Organized in a 256 by 8 bit FIFO (first in first out) configuration. Can be used to interface Z-Bus systems to most other microprocessors.
- Z-FIFO** First in first out buffer memory provides expansion of the Z-MBU to 16 bit words and any depth.
- Z-CIO** Counter/timer and parallel I/O circuit contains three counter/timers and three parallel ports. Two of the parallel ports are eight bits wide and provide four handshaking modes, including IEEE-488 instrument bus protocol. The third port is four bits wide. The counters are all 16 bits wide.
- Z-SIO** Serial I/O circuit contains two independent full duplex synchronous/asynchronous receiver/transmitters (USARTs). Each data channel contains full modem controls, programmable clock generator, and parity or CRC error code generation and checking.
- Z-UPC** Universal peripheral controller is a Z-Bus compatible version of Zilog's new Z-8 8 bit microcomputer on a chip. It includes 124 general purpose registers, 2 K of masked read only memory, an internal UART, and two counter/timers.
- Z-Bus RAM** There are two versions of these programmable memory circuits which directly interface to the Z-Bus. Both are organized as byte-wide structures to reduce the complexity of small, local memory design.
1. 4 K by 8 pseudostatic programmable memory has internal and transparent refresh circuitry. Its access time is in the range of 200-300 ns.
 2. 2 K by 8 fully static programmable memory has access times below 150 ns.

Table 2: Comparison of the Z-8000 to several popular processors in the performance of several simple tasks.

Task	Z-8000 ¹	8080A-1 ²	Z-80A ³	LSI-11 ⁴	PDP 11/45 ⁵
Load Byte (Register to Register) (A register in Z-80, 8080)	0.75	1.6	1.0	2.95	0.90
Load Word (Memory to Register) (to HL in Z-80, 8080)	2.25	5.12	4.0	5.6	2.86
Add (16 bit)	2.25	9.61 ⁶	5.25 ⁷	6.3	2.86
Multiply (16 bit)	17.50	—	—	27 — 64	5.64

Notes:

- 4 MHz clock, no memory wait, no refresh; data from Zilog Z-8000 advance specification, April 1978.
- 3.125 MHz clock, no memory wait, no refresh; data from Intel 8080 Microcomputer System Users Manual, 9/75.
- 4 MHz clock, no memory wait, no refresh; data from Z-80 Reference Manual.
- 4 K byte onboard memory disabled; data from LSI-11/PDP 11/03 Processor Handbook, 1975-1976.
- 11/45 with 8 K byte core stacks, even bytes; data from PDP 11/04/34/45/55 Processor Handbook, 1976-1977.
- BC ← (nn) LD BC, (MEM)
HL ← HL + BC ADD HL, BC.
- HL ↔ DE XCHG
HL ↔ (nn) LHL D (MEM)
HL ← HL + DE DAD D.

Text continued from page 84

APL machine which could run large application packages such as SPICE for circuit analysis or SPSS for statistics, and solve dynamics equations on line for real time graphics simulations like lunar lander, or very large chess playing programs.

According to sources at Zilog, the Z-8000 and its memory management device support chip will soon be available in large quantity. The Z-8000 is compatible with the already available Z-80 family of support chips such as the SIO (serial I/O), the CTC (timers), and the PIO (parallel I/O), etc. A new series of extended support chips for the Z-8000 is also in the works. So far five LSI peripheral devices and a new memory family have been announced. The text box on opposite page contains a brief description of these new devices. The usual line of microprocessor support products including single board computers, evaluation boards and development systems will also be available. Although details are not available as I write this, the system bus structure will probably be oriented toward high performance multiprocessor systems. As for software, Zilog has announced a disk based development system and the PLZ, BASIC, COBOL, FORTRAN languages. Also there is a Z-80-to-Z-8000 translator. I expect a real time, multitasking and multiprocessing operating system to be available soon in order to take advantage of this processor's many resources. ■

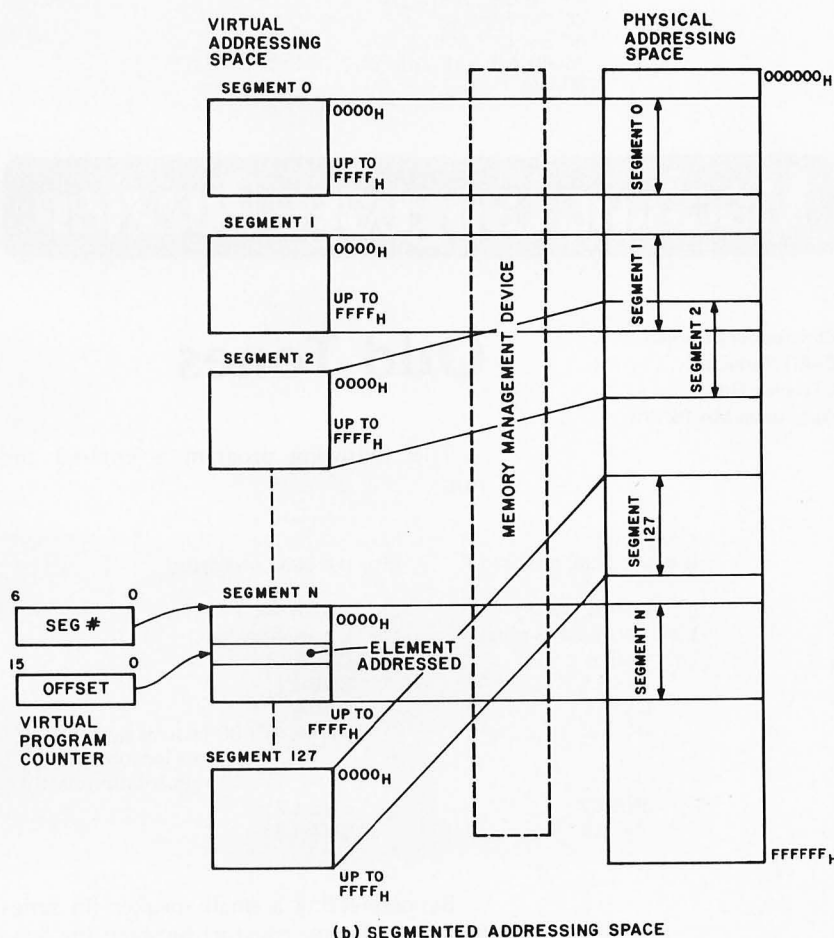


Figure 4: Logical to physical address translation using the memory management device. The Z-8000 allows the programmer to make use of virtual memory addresses, which are simply the addresses of locations in a memory segment from hexadecimal 0000 to FFFF. Virtual addresses are relative only to the start of their segment and need not bear any relation to physical addresses in memory. The clever use of virtual memory techniques can yield high-powered programming results.

Inverse Trig Functions

Alan R Miller
New Mexico Tech
Socorro NM 87801

All except the very smallest BASIC interpreters provide sine, cosine, tangent and inverse tangent functions. None, that I am aware of, have the inverse sine or inverse cosine functions. These two functions are very simple to generate using the inverse tangent function. Lines 10 and 20 of listing 1 contain the definition of the inverse sine and inverse cosine, respectively. Lines 30 to 80 contain a driver function for demonstration purposes. ■

Listing 1:

```
10 DEF FNSN (X) = ATN (1/SQR(1/(X*X)-1))
20 DEF FNCS (X) = ATN (SQR(1/(X*X)-1))
30 PRINT "A "; "ARC SIN"; " SIN"; "ARC COS"; "COS"
40 INPUT "ARC"; A
50 B=FNSN(A)
60 C=FNCS(A)
70 PRINT A; B, SIN(B),C,COS(C)
80 GOTO 40
```

Machine Language Puzzler

Christopher Strangio
CAMI Research
43 Bailey Rd
Watertown MA 02172

Odd Tones

The following program is entered and run:

(For the 6800 processor)	(For the 8080 processor)
L3: MVI A, #X	L3: LDAA #X
L2: MVI B, #A8 (hex)	L2: LDAB #A8 (hex)
L1: DCR B	L1: DECB
JNZ L1	BNE L1
DCR A	DECA
OUT 00	STAA @FF00 (assume port 0 is this location as a simple output latch)
JNZ L2	BNE L2
JMP L3	BRA L3

By connecting a small speaker (in series with a 220 ohm resistor) between the least significant bit of port 0 and ground, we hear a tone. However, for X equal to an odd number, an audible blip is heard periodically, while for X equal to an even number, no blip is heard at any time. Why is a blip heard for odd Xs only? Try these programs or simply analyze the waveforms, then turn to page 178 for an answer. ■

See the BrighterWriter™ at these stores.

Computerland
At most stores, nationwide.

Arizona
Byte Shop: Phoenix, Tempe, Tucson
California
Byte Shop: Lawndale, San Jose, Citrus Heights
Capital Computer, Davis
Computer Demo Room: San Rafael, Sunnyvale
Computer Store, Santa Monica
Computer Merchant, San Diego
Jade Computer Products, Hawthorne
Colorado
Computer Tech., Denver
District of Columbia
Georgetown Computer, Washington
Florida
Computer Age, Pompano Beach
Micro Computer, So. Daytona
Professional Computing, W. Palm Beach
Georgia
Roy Abell & Assoc., Columbus
Hawaii
MicroComputer Systems, Honolulu
Illinois
Illini Micro, Naperville
Indiana
Data Domain, Bloomington
Iowa
Memory Bank, Davenport
Kansas
Computer System, Wichita
Kentucky
Pragma Tech, Louisville
Louisiana
Micro Computer, New Orleans
Massachusetts
Computer Mart, Wallham
CPU Shop, Charlestown
Michigan
Computer Mart, Royal Oak
Hobby Elec., Flint
Newman Computer, Ann Arbor
Tri-Cities Computer Mart, Saginaw
United Micro Systems, Ann Arbor
Nebraska
Omaha Computer, Omaha
New Hampshire
Computer Mart, Nashua
New Jersey
Computer Mart, Iselin
New York
Computer Mart, New York
CompuWorld, Inc., Rochester
Mini-Micro Mart, Syracuse
Ohio
Cybershop Micro, Columbus
Dayton Computer, Dayton
21st Century Shop, Cincinnati
Oklahoma
Vern St. Products, Pappulpa
Oregon
Computer Pathways, Salem
Real Oregon Computer, Eugene
Pennsylvania
Microtronics, Philadelphia
Texas
Byte Shop, Richardson
Interactive Computer, Houston
Micro Mike's, Amarillo
Micro Mart, San Antonio
Vermont
Computer Mart, Essex Junction
Virginia
Computer Place, Roanoke
Computer Systems Store, McLean
Computers Plus, Alexandria
Washington
Empire Electronics, Seattle
West Virginia
Micro Data Systems, Osage
Wisconsin
Byte Shop, Greenfield

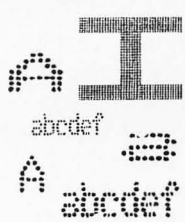


Pay a little bit more and get a printer that's brighter than your computer. The BrighterWriter.™

When a few dollars more buys you a first-class impact printer, why settle for a toy? The BrighterWriter gives you quality to start with. And versatility that stays even if you outgrow your present personal computer.

Built smart like the big ones.

The BrighterWriter's a smart printer. There's a microcomputer inside. It outwits even the bigger, higher-priced printers. So you get versatility to do all kinds of printing. And power to grow on.



Prints fat, skinny, tall, small.*

This printer can be as creative as your imagination. Stretch out your characters. Squeeze them close. Make them high. Low. Bold. Banner. You name it.

Plugs into your computer.

Most popular personal computers interface to the BrighterWriter. Simply and quickly. Hundreds of BrighterWriters are working in Apple, TRS-80, Heathkit, S-100 and many other personal computer systems right now.

Pictures and fancy symbols.*

The BrighterWriter draws out your creativity. You can print drawings, graphs, diagrams, bold symbols, or just about any graphic you can imagine.



Picture your page as thousands of dots. The BrighterWriter can fill in the dots, plot them contiguously, stack them, or scatter them. And its special set of graphic characters simplifies the process.



Prints any character a typewriter can. Faster...

The BrighterWriter can print plain and simple. With 7x7 dot matrix clarity. You get all the letters, numbers, and standard symbols of a regular

button to turn it on. A test button to self-test your printer. A paper feed button to advance the sheets or forms. A line feed button to advance the paper a line at a time.

Prints any-which-way.

The BrighterWriter comes in two models. The IP-225, at \$949, gives you a BrighterWriter with tractor-feed drive for precision forms control. This one can handle everything from labels to 8½" paper widths.

It has eight form lengths and gives you all the features of our IP-125.

A brighter buy.

Our IP-125, friction-feed, BrighterWriter has a 96 character set and prints on 8½" wide paper.

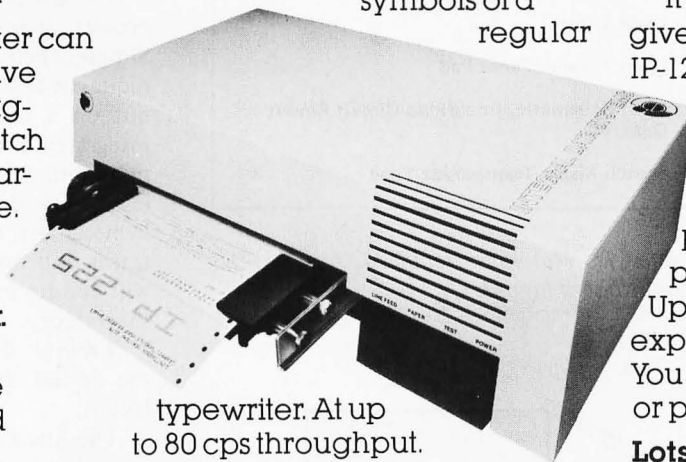
Upper and lowercase. It prints expanded characters, too. You can choose a RS-232 serial or parallel interface. \$799

Lots of goodies.

There's more. Choose all kinds of options for your BrighterWriter. Up to 132 characters per line, variable character densities, larger buffers, special graphics packages, interface cables, and more.

Give us a call or write. Integral Data Systems, 14 Tech Circle, Natick, MA 01760, (617) 237-7610.

Better yet, see the BrighterWriter at the store nearest you.



typewriter. At up to 80 cps throughput.

Ordinary paper.

Fancy or plain, the BrighterWriter prints on ordinary paper. Better yet, it prints on many shapes of paper. Single sheets. Roll. Fanfold.

Want more copies? The BrighterWriter prints multiple copies without extra adjustments.

Four easy buttons.

Operating the BrighterWriter couldn't be simpler. Up-front controls are easy to get to. A power

*Some of these advantages require extra-cost options.



Integral Data Systems, Inc.

Designing with Double Sided

Printed Circuit Boards

David Lamkins
DBL Electronics
83 Morgan Cir
Amherst MA 01002

Materials Required for Layout Design
Pencils: Red, Blue and Black
Eraser and Pencil Sharpener
Tracing Vellum
Grid
Printed Circuit Design Template
Light Table
Large Scratch Paper Pad
Your Schematic, Integrated Circuit Pinout Data, etc
Scotch Magic Transparent Tape

Table 1: Materials required for printed circuit board layout.

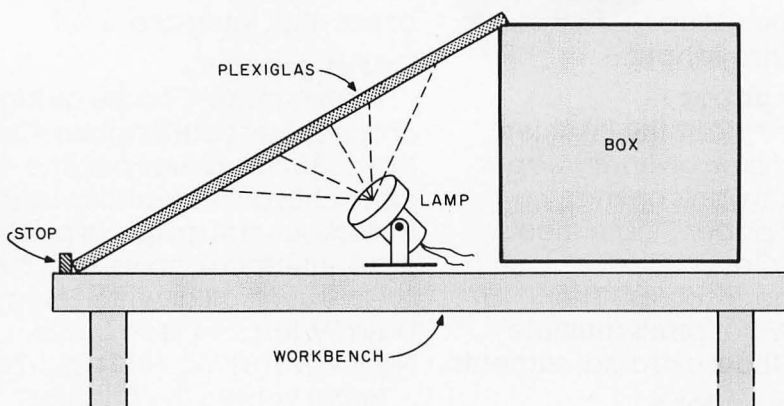


Figure 1: The author's design for a homebrew light table used for drawing printed circuit board layouts. A sheet of Plexiglas or other clear plastic illuminated by a lamp is used as the drawing surface.

Magazines for electronic hobbyists sometimes run articles about do-it-yourself printed circuit layout and construction. Unfortunately I never saw an article which presented a unified printed circuit design strategy for large and very large systems (eg: a board with 20 or more integrated circuits).

Consequently, when the time came for me to design the printed circuit boards for a system involving more than 900 semiconductors, with greater than 60 percent of that count being integrated circuits, I didn't know where to begin.

Determination is the prime motive force in a project that large, so I went ahead and started. Along the way I took notes about what I learned. Using the methods I developed, you should be able to design double sided printed circuits for your own behemoth kluge without undue anger or frustration.

To undertake a large printed circuit project, you should be properly equipped. Simple "pen and ink on grid paper" techniques may be adequate for small boards, but on a larger layout, even with only 20 integrated circuits, you will have an absolute minimum of almost 300 integrated circuit leads. Try drawing that many pads on 0.1 inch centers, not to mention interconnecting traces and associated components, and you will end up in a sobbing heap on your workshop floor.

Table 1 lists the materials necessary to the initial design of your printed circuit layout.

The black pencil will be used to delineate components and pads on your drawing. The red pencil is used to mark conductor runs for the solder side of the board, while the blue pencil marks runs on the component side. A necessary adjunct to the pencils is the eraser and pencil sharpener. Most likely, neither will see as much use as the pencils themselves, but both should be close at hand.

The tracing vellum should be good quality. You will not appreciate tears or holes as a result of the erasing you will be doing.

A grid is essential to good planning. Grids are precision printed on dimensionally stable Mylar and are available in a variety

of styles. Your selection will depend largely on the scale to which you draw your design. The most commonly used scales are 4x, 2x, and 1x. The 4x and 2x scales find wide use commercially, where use of automated manufacturing techniques requires extremely tight tolerances on component positioning. The other advantage of a larger scale is reduced eyestrain. For our purposes, the 1x scale is probably best since materials cost is lowest and the need for photoreduction facilities is alleviated. Therefore, your grid should have 20 lines per inch to allow component placement to the nearest 0.05 inch. You might find a grid with 10 lines per inch adequate, but many lead spacings do not fit exactly on a 0.1 inch grid, and you will quickly tire of trying to visually approximate the halfway mark.

The printed circuit design template helps you draw resistors, capacitors, diodes, transistors, integrated circuits, trimmers and edge fingers accurately and repetitively. Be sure you get the 1x size.

A light table is necessary to light your grid from the back and make the grid lines visible through the vellum. Commercial light tables are available, but they are not inexpensive. A homemade substitute can be as simple as a piece of Plexiglas leaning against a box on a table with an incandescent or fluorescent desk lamp providing the illumination (see figure 1). Should you use an incandescent lamp, a low wattage is recommended to minimize heating of the grid.

A pad of scratch paper should be kept handy for sketching of trial layouts, quick computations, doodles, etc.

I use Scotchbrand Magic transparent tape; it is the only readily available tape I have found that will hold the grid and artwork in place on the light table without oozing or creeping due to the heat of the light.

These materials along with your schematic and related pertinent data are all you need to lay out a printed circuit board.

Table 2 outlines the layout strategies I follow in order of execution by heading, and in order of relative importance by subheading.

Initially, you should study your schematic to identify functional groups of components. Carry this out to as detailed a level as you are able. The procedure will

- **Divide circuit into functional groups.**
- **Define board interface.**
- **Calculate board size.**
- **Position integrated circuits.**

1. Locate analog circuitry close to interface.
2. Group components by functional groups.
3. Arrange circuits symmetrically around shared integrated circuits.
4. Arrange functional groups to minimize number of interconnects.

- **Position other Components.**

1. Keep analog traces short with inputs separated from outputs.
2. Provide supply bypassing at each linear and TTL integrated circuit and at any other circuitry sensitive to supply noise or circuitry generating fast edges.

- **Don't crowd components.**

- **Route traces.**

1. Shortest runs first.
2. Runs local to functional group.
3. Inter-group runs.
4. Runs to interface.
5. Power runs last.

- **Check spacings.**

Avoid blocking power and ground pins.

Table 2: Some printed circuit board layout strategies.

enhance your understanding of the circuit in general as well as the interrelations among subcircuits and the correspondence between circuits and components that influence your design. Additionally, you may be able to define critical areas at this time, such as the need for shielding, isolation, or heat removal. Be sure that all unused logic inputs and nonstandard supply pinouts are explicitly included in your schematic.

Your board interface is a definition of how signals connect to and from the printed circuit board. The interface may be configured as edge connections, solder pads for single leads or ribbon cable, a special connector, or any combination of these. Your system's physical design may place constraints on the locations of the interface connections. If your system is so large that a single board implementation is impractical, or if your system is being constructed modularly, you should define macrofunctions or subsystems into which your overall system can be partitioned. First, define a system by which individual boards can be interconnected. Then, treating each partition as a complex component, define any requirements for shielding, isolation, or heat removal. You may want to consider using a printed circuit backplane or mother board to make system interconnections (see figure 2). The mother board is a good place to locate your power supply and front panel controls if you want a truly modular system.

Now calculate the board size. An ab-

About the Author

David Lamkins is a twenty-three year old consultant in the analog and digital electronics field, and has been working since 1974 on a digital electronic music system. David's hobbies also include playing the guitar and reading science fiction.

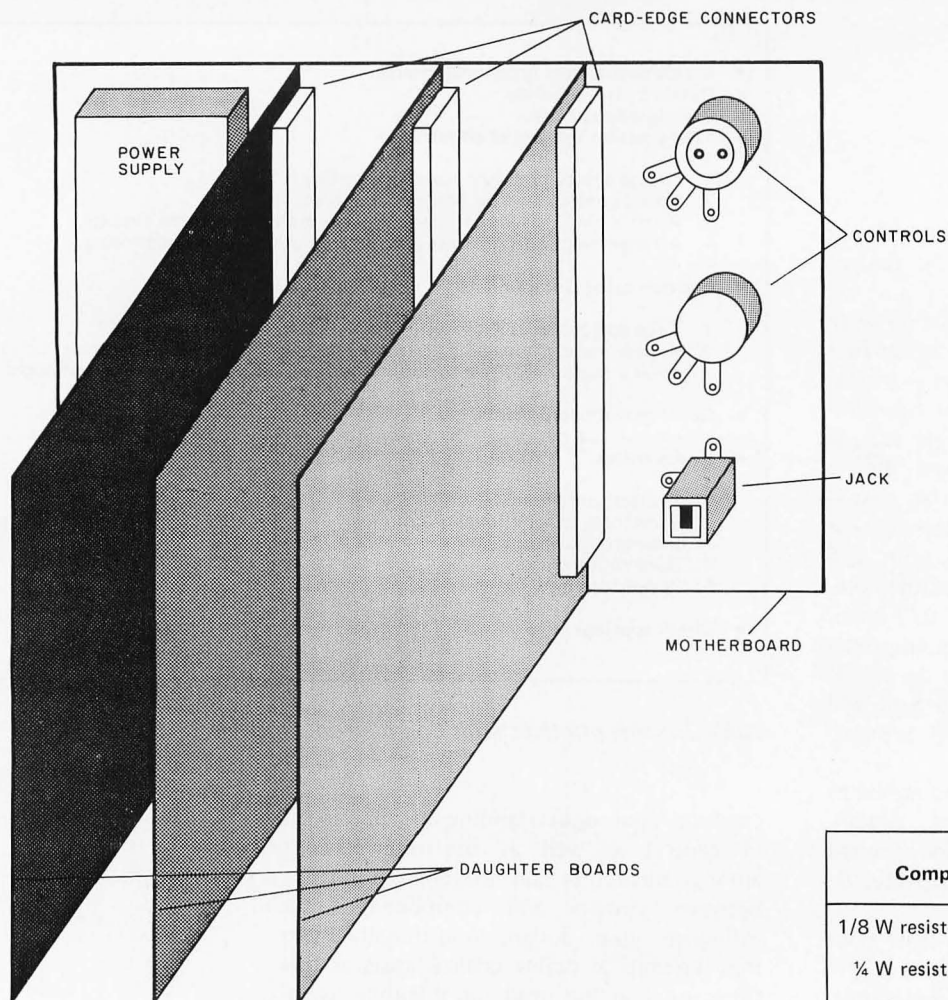


Figure 2: A typical arrangement of printed circuit boards used for large circuit designs. Several "daughter" boards are shown plugged into a "mother" board. The latter is used to facilitate board interconnections and reduce wiring to a minimum.

Table 3: Average printed circuit board areas taken up by commonly used electronics components.

solute minimum figure can be obtained by calculating the total area occupied by components (table 3). In practice, you will never achieve this minimum figure with a double sided board, but it is helpful to know how much component area you have. A more realistic figure to start with is 2 to 3 square inches per integrated circuit, tending toward the higher side if the board has many discrete components, large passive components, or a large number of edgeboard IO pins. If the board is constrained to be a certain size, you will have to try to make it all fit, although it could be very difficult if you have much less than 2 square inches per integrated circuit.

Now, take a sheet or two from your scratch pad and sketch a few trial arrangements for your integrated circuits. There are several things you should strive for. Most important is to locate any analog circuitry close to its associated board interface. This minimizes any adverse effects due to coupling or feedback that could be caused by long analog lines. Next is the arrangement of components by functional groups. If a multi-

Component Type	Board Area (Square Inches)
1/8 W resistor	0.075
¼ W resistor	0.09
½ W resistor	0.14
1 W resistor	0.27
2 W resistor	0.44
RN55 precision resistor	0.12
Signal diode (D035)	0.06
Power diode (D07)	0.09
Small disk capacitor (CK60-61)	0.06
Large disk capacitor (CK62-64)	0.16
TO-18	0.09
TO-5	0.16
TO-66	0.64
TO-3	1.0
14 lead DIP	0.18
16 lead DIP	0.21
24 lead DIP	0.66
28 lead DIP	1.9
40 lead DIP	2.34
.156 inch connector finger	0.06

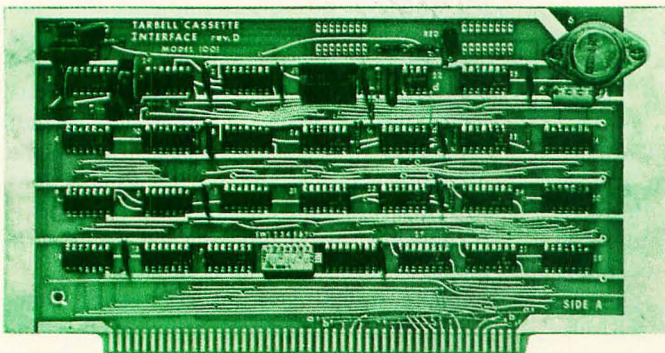
TARBELL SETS STANDARDS

For Hobbyists and Systems Developers

Sales to thousands of hobbyists over the past two years have proven the Tarbell Cassette Interface to be a microcomputer industry standard. Tarbell Electronics continues research and development to produce new and efficient components to fill hobbyists' changing needs.

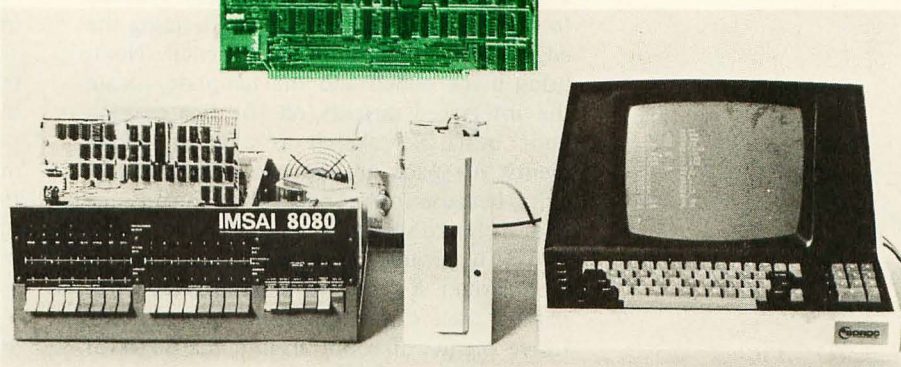
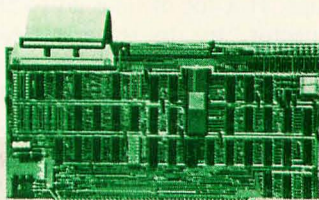
TARBELL CASSETTE INTERFACE

- Plugs directly into your IMSAI or ALTAIR*
- Fastest transfer rate: 187 (standard) to 540 bytes/second
- Extremely Reliable—Phase encoded (self-clocking)
- 4 Extra Status Lines, 4 Extra Control Lines
- 37-page manual included
- Device Code Selectable by DIP-switch
- Capable of Generating Kansas City tapes also
- No modification required on audio cassette recorder
- Complete kit \$120, Assembled \$175, Manual \$4
- Full 6 month warranty on kit and assembled units



TARBELL FLOPPY DISC INTERFACE

- Plugs directly into your IMSAI or ALTAIR* and handles up to 4 standard single drives in daisy-chain.
- Operates at standard 250K bits per second on normal disc format capacity of 256K bytes.
- Works with modified CP/M* Operating System and BASIC-E Compiler.
- Hardware includes 4 extra IC slots, built-in phantom bootstrap and on-board crystal clock. Uses WD 1771 LSI Chip.
- Full 6-month warranty and extensive documentation.
- PRICE:
Kit \$190 Assembled \$265

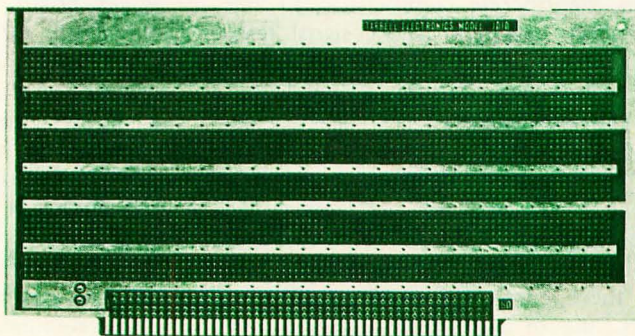


CP/M with BASIC-E
and manuals: \$100

Compatible Disc Drives

Ask about our disc drives priced as low as \$525.

TARBELL PROTOTYPE BOARD Model 1010



- Gold plated edge pins
- Takes 33 14-pin ICs or
- Mix 40-pin, 18-pin, 16-pin and 14-pin ICs
- Location for 5 volt regulator
- Suitable for solder and wire wrap
- ALTAIR/IMSAI compatible
- Price: \$28.00

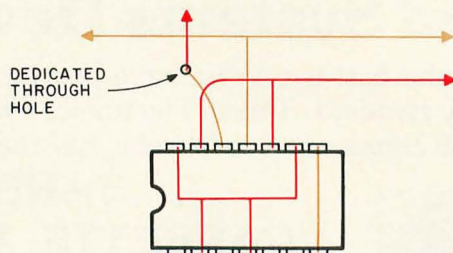
For fast, off the shelf delivery, all Tarbell Electronics products may be purchased from computer store dealers across the country. Or write Tarbell Electronics direct for complete information.

*ALTAIR is a trademark/tradename of PERTEC
CP/M is a trademark/tradename of Digital Research

Tarbell
Electronics

950 DOVLEN PLACE • SUITE B • CARSON, CALIFORNIA 90746
(213) 538-4251 • (213) 538-2254

Figure 3: Typical routing of conductors on a two sided printed circuit board. Contrasting colors are used to show wire runs on the respective sides of the board. Note the use of the dedicated through-hole.



section integrated circuit is shared by two or more functional groups, try to arrange these groups close to the shared integrated circuit. It is often advantageous to make use of the symmetrical layout of many multisection integrated circuit pinouts. Functional groups should be arranged relative to each other to minimize the number and length of interconnections between groups. If a lot of lines go to an edgeboard connector, try to leave a clear route for them.

Tape the grid to the light table, then tape a sheet of vellum over the grid and proceed to lay out the board. Begin by defining the edges of the board in black pencil. Next, using black pencil and the template, locate the integrated circuits on the board using your best trial sketch as a guide. Leave plenty of space around the integrated circuits, because interconnections can consume a lot of board space.

Try to arrange the integrated circuits in a consistent XY grid to maximize the open paths a trace can follow from here to there. Leave plenty of room around the edges of the board; some of the longer traces are most easily routed there.

Still using template and black pencil, position the discrete components. In analog circuitry, maintain short signal leads and separation between input and output of high gain stages. Be sure to provide adequate bypassing: One bypass capacitor per integrated circuit is not too much. Don't crowd components. Keep in mind that you may need access to integrated circuit pins for servicing, and leave room to adjust trimpots. Also, keep important test points out in the open. Avoid locating small components out of sight below larger, overhanging components, and don't allow components or groups of components to block access to integrated circuit pins. During this process, you may find you'll have to move things around somewhat to fit everything where you want it. This may require some erasing.

Now comes the difficult part. Using red and blue pencils and eraser, draw the traces

on the vellum. Red is used for solder-side runs and blue for component-side runs. Trying things out on scratch paper can save you much erasure.

The shortest traces will be those interconnecting the pins of a single integrated circuit to one another. Do these first. Use red whenever possible to minimize the number of component-side runs. You should be able to get this far without creating any connections that start on one side of the board and finish on the other side (except via a hole used for a component lead). The next longest runs will be interconnections within a functional group: Do these next. If possible, avoid blocking access to integrated circuit power and ground pins.

Next should be runs connecting functional groups together, followed by runs to the edge-board interface, if used. Somewhere along the way you'll have to start using dedicated through-holes to run signals past areas that are blocked in completely (see figure 3). Depending on the complexity of your circuit, you shouldn't really need more than one or two through-holes per integrated circuit on the board.

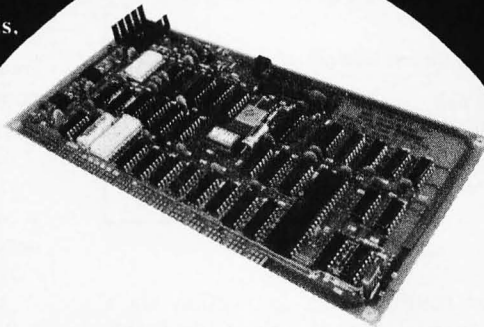
As you proceed, you'll want to keep track of the connections made. I usually do this by numbering the integrated circuits on the layout, then marking them on the schematic to correspond. As I make a connection, I mark a slash through the lead on the schematic. For circuitry that uses identical sections repeatedly, I simply copy the first section as required.

The last connections are power and ground to the integrated circuits. The practice of saving these connections until last is uncommon, but it reduces drastically the number of dedicated through-holes on a larger board. It's easier to route two or three runs through a jungle of interconnections than it is to individually reroute each trace of that same jungle to go around two or three power runs. At any rate, the power runs should be heavy enough for the type and amount of logic being used. When working with TTL integrated circuits, be aware that some formidable current transients are coupled to ground; be sure to beef up that trace accordingly. CMOS at low speeds is relatively immune to power supply noise.

In routing some of the longer traces, you may think that access to some places is blocked by runs on both sides of the board. In such a case group all the interconnections in one area on one side of the board and move them in one direction; then move the interconnections on the opposite side of the board in that area in the other direction. You now have a clear space between the two

ANNOUNCING!

A computer without communications can only WHISPER. Give a computer a modem and it can SHOUT—to other computers, to time-share systems, to remote terminals, to CBBSs, to your friends with computers, and to devices and places only you can think of.



For a modem connection to be legal in the eyes of the Federal Communications Commission (FCC), it must have an approved Data Access Arrangement (DAA-CBT or CBS) or the modem must be approved for direct connection. The MM-103 accomplishes all the protective functions required by the FCC with a miniaturized, proprietary protective coupler and on-board billing delay and level control. We have thereby saved you, the user, the cost of the DAA.

THE MM-103 DATA MODEM AND COMMUNICATIONS ADAPTER

Unless you need more than one,

it's the last S-100 modem you'll ever have to buy!

FCC APPROVED

HIGH QUALITY

WARRANTY

ASSEMBLED & TESTED

LOW PRICE—\$319.⁹⁵ For Modem AND Coupler

Both modem and telephone system interface are FCC approved as "Multifunction Data Equipment" which allows control and sensing of auxiliary equipment.

-50 dBm sensitivity

Auto answer

Auto originate

Auto dialer with computer-controlled dial rate

61 to 300 baud (anywhere over the long-distance telephone network)—rate selection under computer control

600 baud over local telephone systems

Flexible, software-controlled, maskable interrupt system

Precision dial-tone detector

Phone is answered under software control.

One year limited warranty

Ten-day unconditional return privilege

Minimal cost, 24-hour exchange policy for units not in warranty

Not a kit—FCC registration prohibits kits

**micro
magic**

Potomac Micro-Magic, Inc.

P.O. Box 11149 Alexandria, VA 22312

(703) 750-3727

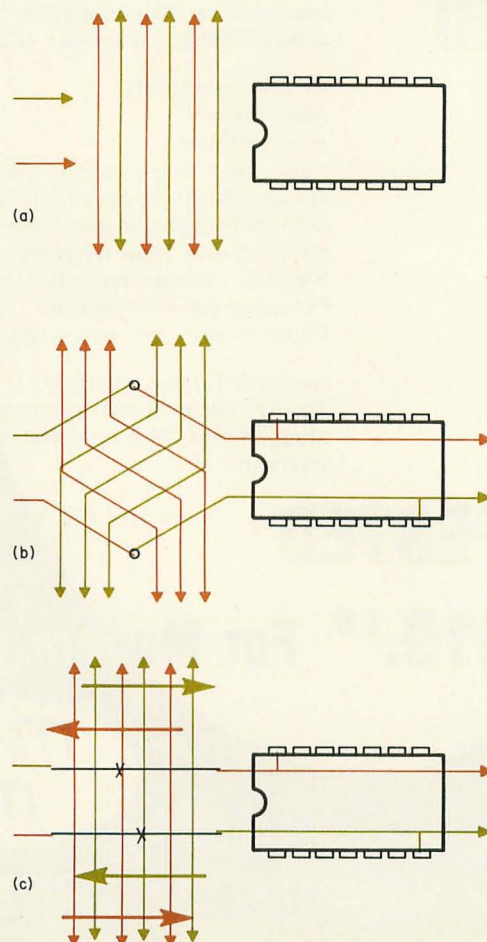
Table 4: Materials required to construct a printed circuit board artwork master.

Mylar sheets	
Black donut pads	
0.093 inch (essential)	
0.075 inch and 0.111 inch (helpful)	
(Other sizes per personal preference)	
Black drafting Tape	
0.015 inch, 0.040 inch, 0.062 inch suggested	
Integrated Circuit lead pattern stick-ons	
Targets	
Drafting pen	
PC design template	
Grid	
Light table	
Scotch Magic transparent tape	
	} From table 1

groups for routing your connection via a dedicated through-hole (see figure 4a & 4b). At this point, you probably don't want to erase and move all those lines. I use a short-hand method to indicate this rearrangement (see figure 4c).

Once all the traces are drawn in place, make sure you have enough room to route traces through the crowded spots. Signal traces can be as narrow as 0.015 inch, in

Figure 4: Figure 4a illustrates a common printed circuit board problem. The designer wishes to run conductors across a group of existing perpendicular conductor runs. Figure 4b shows how the problem can be solved by using a two sided printed circuit board with two through-holes. Figure 4c is a short-hand notation for the configuration shown in figure 4b. As before, contrasting colors indicate conductors on the respective sides of the board.



fact, you will find this width very easy to work with because tape in this width is extremely flexible. Spacings of 0.050 inch between conductors are easy to achieve. Avoid, if possible, running conductors closer than 0.1 inch to pads where no connection is intended. Leave at least 0.1 inch between a trace and the board edge. If you find you will have too little room for traces in a given area, calculate how much related components will need to move and mark the distance and direction on the vellum.

Congratulations! You now have a design that will be the basis of your tape-on-Mylar artwork master. Table 4 lists those materials necessary for the preparation of the artwork master.

Mylar drafting film comes in sheets and rolls. The price advantage of buying in roll form is slight and the curl of sheets cut from a roll is a nuisance at best.

Black donut pads come 500 to a pack. The 0.093 inch size will work for almost everything, but it's nice to have 0.075 inch pads on hand for the finer leads of transistors and diodes plus 0.111 inch pads to connect lead wires to the board.

I use three tape widths for most of my designs. The 0.015 inch width finds the greatest use. Power and ground runs usually use 0.040 inch or 0.062 inch widths.

Integrated circuit patterns are worth every penny for the time they save. If your requirements are modest, buy just one pack of 16 lead DIP patterns. These can be cut down to make 14 or 8 lead DIP patterns, and they can be split down the middle and arranged to make 24, 28, or 40 lead DIP patterns. Round 8, 10, or 12 lead TO-5 patterns can be accommodated by bending the device leads to fit DIP spacing. I find the 0.075 inch round pad style most suitable. Check the catalogs of the sources listed at the end of this article; many styles are available.

Targets come 250 per package, and, although expensive, are absolutely essential to assure accurate alignment of the three or four layers of artwork.

A drafting pen is used with the printed circuit design template to make an assembly drawing of your board. It will cost about \$7.50 at an art supply store and is truly a joy to own.

Remove your vellum layout sheet from the light table and keep it nearby. Securely tape a Mylar sheet over the grid. Locate two targets in diagonally opposite corners of the Mylar and carefully align the centers with a grid intersection. The targets may be located inside or outside of the board area. If located within the board area, they can

BEYOND TRS-80^{T.M.}

When Microsoft put Level II BASIC on TRS-80, you got a glimpse of its full potential.

Now Microsoft introduces:

TRS-80 Fortran

and TRS-80 will never be the same!

Plus

TRS-80 FORTRAN includes the finest Z-80 development software available:

Z-80 Macro Assembler, versatile Text Editor, and Linking Loader.

Circle 228 on inquiry card.

Total price: Only \$350.00

TO: Microsoft, 10800 NE Eighth, Suite 819, Bellevue, WA 98004

- ☐ Send me free TRS-80 FORTRAN overview.
- ☐ Send me TRS-80 FORTRAN and Z-80 development software for \$350.00.

☐ Check enclosed ☐ Master Charge ☐ VISA

Card Number _____ Exp. Date _____

Cardholder's Signature _____

Name _____

Address _____

City _____ State _____ Zip _____

Clip the coupon and ORDER NOW, or send for free overview for more details about TRS-80 FORTRAN.

TRS-80 FORTRAN is supplied on two minidiskettes and requires a 32K system with one disk drive. Dealer inquiries invited.

MICROSOFT

**10800 NE Eighth, Suite 819
Bellevue, WA 98004**

Figure 5: Two techniques for applying drafting tape around corners. Figure 5a shows the preferred method for narrow traces; figure 5b shows the technique for wide traces.

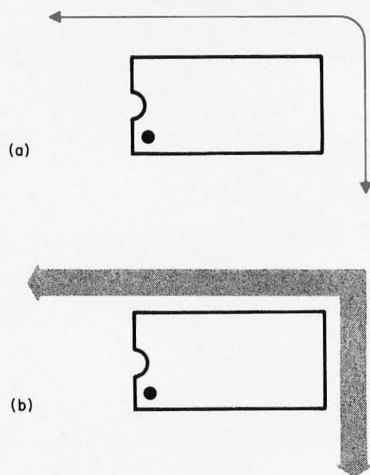


Table 5: Recommended drill sizes for drilling standard printed circuit board pad holes.

0.075 inch pad	#71 drill
0.093 inch pad	#64 drill
0.111 inch pad	#55 drill
0.125 inch pad	1/16 inch drill

double later as mounting holes. Define the board edges with short pieces of tape at the board's corners.

Now, working with a ruler marked in tenths of an inch and your vellum layout, transfer the component and through-hole locations to the Mylar using donut pads and stick-ons. Be sure to take into account the shifts notated as the last step of the layout preparation. Once all the components and through-holes appear as pad groups on the Mylar, align the vellum over the Mylar and check for missing or misplaced pads. This sheet now contains all the component pads that will appear on both sides of the board. Remove the vellum.

Tape a second sheet of Mylar directly over the first. Align targets with those on the first sheet. Using black tape, transfer all the lines appearing in red on the vellum to this sheet of Mylar. Take heed of any notes on the vellum to shift traces from their indicated positions. Narrow tapes are best routed directly with gentle corners where necessary. Wider tapes do not curve as easily and require cut corners for sharp bends (see figure 5). This sheet now contains all traces located on the solder side of the board. There are no pads on this sheet. The same procedure is followed using a third Mylar sheet and the blue lines for the component side traces.

For the sake of completeness, you should now make an assembly drawing on a fourth layer of Mylar sheet. This is done using the template by inking the component outlines aligned with their respective pads. The

component designation or value should be included within or beside the outline using pen and ink or dry transfer lettering.

Your master artwork is now complete and should be rechecked for accuracy.

To make negatives of solder-side and component-side artwork for use in photographically etching your board, simply align the Mylar sheet containing only pads with either of the sheets containing only traces before making a contact negative. The details of the negative-producing operation are well covered in the hobbyist magazines, and most local electronics stores sell printed circuit board etching kits.

You now have a negative for each side of your printed circuit board. Before coating your board with photoresist, pick two holes near diagonally opposite corners and accurately transfer their locations to the laminate. Use a very small drill to make these two holes. You now have reference points by which you can align the negative on each side of the board. The board is now photo etched on both sides.

All that remains is to drill the holes, mount the components, and solder the leads. Table 5 shows recommended drill sizes for various sizes of pads. When mounting components, crimp the leads flat against the solder side. Dedicated through-holes are stuffed with a short piece of wire crimped to the board on both sides. Solder leads on both sides of the board where necessary for through-board connections. As an alternative to soldering on both sides, you can crimp eyelets in the holes or get someone to process your board with plated through-holes.

Well, that's all there is to it. Now you can put that very large project of yours on a printed circuit board. (The very first printed circuit board I ever designed had 26 integrated circuits, 144 resistors, 44 capacitors, 28 transistors, 30 diodes, and 23 indicators. I completed the master artwork using the techniques I have just described in less than 40 hours.) A homebrew double sided printed circuit board may be just the solution you're looking for.■

Sources of printed circuit board artwork supplies:

1. Bishop Graphics Inc.
20450 Plummer St
Chatsworth CA 91311
(213) 993-1000
2. Chartpak Graphic Products
1G River Rd
Leeds MA 01053
(413) 584-5446



ANNOUNCES DDS II

THE FAMOUS OPEN-HEART SURGEON FOR MICROCOMPUTERS

DDS II IS AN INCREDIBLY POWERFUL LEARNING AND DEBUGGING SYSTEM

DDS II the famous Dynamic Debugging System is an incredibly powerful, learning and debugging system. Although designed for microcomputers, it is even more sophisticated than the built-in debugging environments supported by most large main frames. DDS II is a remarkably expanded version of DDS I. And with its 50 commands, DDS II is much different from DDT.

A FEW OF DDS II's MANY FEATURES

- Assembles and disassembles all 8080 code for fast and easy patching.
- Performs "software open-heart surgery" on the microprocessor and the memory, artfully displaying on the screen all registers, program instructions and memory.
- Simulates dual screen capability by offering you the ability to switch on command from the DDS II display to the program output. It's like having two video monitors for the price of one.
- Updates the display while monitoring every step of the program.
- Offers alteration at will of all registers, instructions or memory.
- Includes a full array of monitoring tools, e.g., breakpoints, conditional stops, stack range errors, etc.
- Comes in different versions running on either the VDM videoboard or the Lear Siegler ADM 3A.

DDS II's EXTRA BENEFIT FOR BEGINNERS

DDS II is an ideal tool to learn how to write assembly language programs. It is like a window exposing the inner workings of your computer.

PRS DDS II comes with a complete and instructive handbook explaining every procedure step by step. This unique documentation is written in clear and easy-to-understand English and avoids esoteric technical language.

But PRS documentation for DDS II is more than clear and precise instructions in a graphically appealing manual. You learn at the same time.

Indeed, PRS DDS II documentation offers you a true fluency in computer-user dialogue.

DDS II IS PROTECTED IN A BEAUTIFUL CASSETTE OR DISK FOLDER

The PRS cassette (or floppy disk) and manual for your DDS II program are protectively nestled in an efficient and durable gold-imprinted folder. Wherever you file it, in your room or office, the decor will be enhanced by its elegance.

DDS II FROM PRS IS SUPPORTED BY MAJOR BRANDS

- CUTS relocatable cassette VDM version:

runs with SOLOS/ CUTER monitor; or ADM3A version: runs with SOLOS/ CUTER monitor on the Lear Siegler ADM3A terminal.

- XITAN (TDL) relocatable cassette VDM or ADM3A version: interfaced to ZAPPLE monitor and VDM board or the Lear Siegler ADM3A terminal
- TARBELL VDM or ADM3A cassette version: interfaced to the APPLE monitor (8080A version of ZAPPLE) and VDM board or the Lear Siegler ADM3A terminal.
- CP/M 8" single density floppy disk VDM version or ADM3A version
- CP/M 5 1/4" MICROPOLIS floppy disk VDM version or ADM3A version
- CP/M 5 1/4" NORTH*STAR floppy disk VDM version or ADM3A version

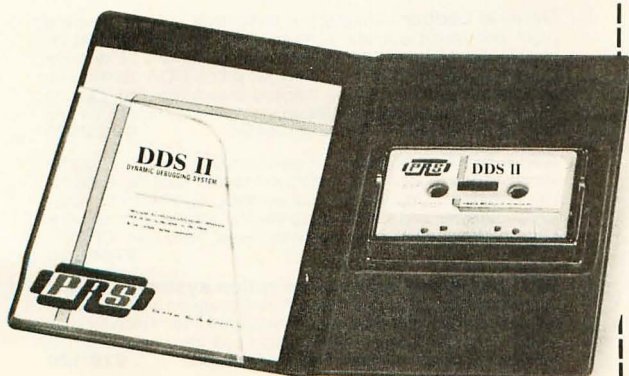
IMPORTANT NOTE:

DDS II can easily be patched to run with other DMA videoboards or other cursor addressed video terminals.

AN AD CAN NOT DO JUSTICE TO DDS II You must run it to appreciate its completeness.

**VISIT YOUR NEAREST DEALER
TODAY TO OBTAIN YOUR DDS II
FROM PRS FOR ONLY \$49.95 PER
CASSETTE OR \$64.95 PER DISK**

Let your dealer demonstrate the excellence of PRS DDS II. Use the coupon below to obtain the name of a dealer in your area.



New Product Releases From PRS THE PROGRAM OF THE MONTH CORPORATION

257 Central Park West, New York, N.Y. 10024

Gentlemen:

- ☐ Please place my name on your priority mailing list to receive your descriptive advance releases of all new programs developed by PRS at regular intervals.
- ☐ Please send me a list of dealers in my area.

Name _____

Title _____

Corporation _____

Address _____

City _____ State _____ Zip _____

Reference 3B9

Aw, cut it out!

NEWS FLASH
Modified CP/M
for TRS-80
now available

Our Micro
iCOM CP/M
has 78K
storage
per drive.

**New CP/M
implementations:**
Double Density
North Star,
Helios, Altair,
Micro and 8" iCOM.

Software / Manual
with / Alone

DIGITAL RESEARCH

- ☐ **CP/M FDOS** — Diskette Operating System complete with Text Editor, Assembler, Debugger, File Manager and system utilities. Available for wide variety of disk systems including North Star, Helios II, Micropolis, iCOM (all systems) and Altair. Supports computers such as Sorcerer, Horizon, Sol System III, Versatile, Altair 8800, COMPAL-80 and iCOM Attache. Specify desired configuration **\$145/\$25**
- ☐ **MAC** — 8080 Macro Assembler. Full Intel macro definitions. Pseudo Ops include RPC, IRP, REPT, TITLE, PAGE, and MACLIB. Z-80 library included. Produces Intel absolute hex output plus symbols file for use by SID (see below) **\$100/\$15**
- ☐ **SID** — 8080 symbolic debugger. Full trace, pass count and break-point program testing system with back-trace and histogram utilities. When used with MAC, provides full symbolic display of memory labels and equated values **\$85/\$15**
- ☐ **TEX** — Text formatter to create paginated, page-numbered and justified copy from source text files, directable to disk or printer **\$85/\$15**
- ☐ **DESPOOL** — Program to permit simultaneous printing of data from disk while user executes another program from the console **\$50/\$1**

MICROSOFT

- ☐ **Disk Extended BASIC*** — New version, ANSI compatible with long variable names, WHILE/WEND, chaining, variable length file records **\$300/\$25**
- ☐ **FORTRAN-80*** — ANSI '66 (except for COMPLEX) plus many extensions. Includes relocatable object compiler, linking loader, library with manager. Also includes MACRO-80 (see below) **\$400/\$25**
- ☐ **COBOL-80*** — ANSI '74 Pseudo-compiler with relocatable object runtime package. Format same as FORTRAN-80 and MACRO-80 modules. Complete ISAM, interactive ACCEPT/DISPLAY, COPY, EXTEND **\$625/\$25**
- ☐ **MACRO-80** — 8080/Z80 Assembler. Intel and Zilog mnemonics supported. Relocatable linkable output. Loader, Library Manager and Cross Reference List utilities included **\$149/\$15**
- ☐ **MACRO-80 plus FORTRAN** subroutine library available. Library includes ABS, SIGN, EXP, DLOG, SQRT, DSQRT, ATAN, DATAN etc. etc. **\$219/\$15**
- ☐ **EDIT-80** — Very fast random access text editor for text with or without line numbers. Global and intra-line commands supported. File compare utility included **\$89/\$15**

*See MICROPRO for Microsoft languages with sort capabilities.

XITAN (software requires Z-80 CPU)

- ☐ **Disk BASIC** — Fast powerful interactive interpreter. PRIVACY password security. Can dynamically open a large number of files simultaneously for random or sequential I/O **\$159/\$20**
- ☐ **Z-TEL** — Text editing language. Expression evaluation iteration and conditional branching ability. Registers available for text and commands. Macro command strings can be saved on disk for re-use **\$69/\$20**
- ☐ **ASM Macro Assembler** — Mnemonics per Intel with Z-80 extensions. Macro capabilities with absolute Intel hex or relocatable linkable output modules **\$69/\$20**
- ☐ **LINKER** — Link-edits and loads ASM modules **\$69/\$20**
- ☐ **Z-BUG debugger** — Trace, break-point tester. Supports decimal, octal and hex modes. Disassembler to ASM mnemonic set. Emulation technique permits full tracing and break-point support through ROM **\$89/\$20**

TOP Text Output Processor — Creates page-numbered, justified documents from source text files. Available only as part of A3 or A3+ package.

- ☐ **SUPER BASIC** — Sub-set of Xitan Disk BASIC with extensive arithmetic and string features but without random access data file support. Available optionally with features to support VDB Xitan video output board **\$99/\$20**
- ☐ **A3 package** includes Z-TEL, TOP, ASM and Super BASIC **\$249/\$40**
- ☐ **A3+ package** includes Disk BASIC, Z-TEL, TOP, ASM, Z-BUG and LINKER **\$409/\$40**

MICROPRO

- ☐ **Super Sort I** — Sort, merge, extract utility as absolute executable program or linkable module in Microsoft format. Sorts fixed or variable records with data in binary, BCD, Packed Decimal, EBCDIC, ASCII, floating, fixed point, exponential, field justified, etc. etc. Even variable number of fields per record! **\$250/\$25**
- ☐ **Super Sort II** — Above available as absolute program only **\$200/\$25**
- ☐ **Super Sort III** — As II without SELECT/EXCLUDE **\$150/\$25**
- ☐ **ISAM** — Callable system with triple level index full ANSI level II COBOL capability. Utility included to convert existing sequential files to ISAM **\$145/\$25**
- ☐ **Word Master Text Editor** — In one mode has super-set of CP/M's ED commands including global searching and replacing, forward and backwards in file. In video mode, provides full screen editor for users with serial addressable-cursor terminal **\$150/\$25**
- ☐ **Corresponder** — Mail list system, supporting form letter generation with personalized greetings. Reference fields permit sorting and extraction by name, address fields or reference data using Super Sort. Requires CBASIC **\$95/\$25**
- ☐ **BASIC/S** — Microsoft BASIC with Super Sort Capability **\$400/\$25**
- ☐ **FORTRAN/S** — Microsoft FORTRAN-80 with Super Sort capability **\$550/\$25**
- ☐ **COBOL/S** — Microsoft COBOL-80 with Super Sort capability **\$800/\$25**

SOFTWARE SYSTEMS

- ☐ **CBASIC Disk Extended BASIC** — Non-interactive BASIC with pseudo-code compiler and runtime interpreter. Supports full file control, chaining, integer and extended precision variables etc. Version 1 users can receive Version 2 and new manual for \$45 with return of original diskette **\$95/\$15**

STRUCTURED SYSTEMS GROUP

- ☐ **General Ledger** — Interactive and flexible system providing proof and report outputs. Customization of COA created interactively. Multiple branch accounting centers. Extensive checking performed at data entry for proof, COA correctness etc. Journal entries may be batched prior to posting. Closing procedure automatically backs up input files. All reports can be tailored as necessary. Requires CBASIC **\$995/\$20**
- ☐ **Accounts Receivable** — Open item system with output for internal aged reports and customer-oriented statement and billing purposes. On-Line Enquiry permits information for Customer Service and Credit departments. Interface to General Ledger provided if both systems used. Requires CBASIC **\$750/\$20**
- ☐ **NAD Name and Address selection system** — Interactive mail list creation and maintenance program with output as full reports with reference data or restricted information for mail labels. Transfer system for extraction and transfer of selected records to create new files. Requires CBASIC **\$79/\$20**

All
Microsoft
prices are
discounted!!

Filled out any huge coupons lately? Here's your chance. Check off the items you want, furnish all of the necessary information and send us this whole advertisement. Big coupon ... big values ... big savings, from Lifeboat Associates, your Software Supermarket.

Software
with
Manual
Alone

- ☐ **QSORT** — Fast sort/merge program for files with fixed record length, variable field length information. Up to five ascending or descending keys. Full back-up of input files created. Parameter file created, optionally with interactive program which requires CBASIC. Parameter file may be generated with CP/M assembler utility **\$95/\$20**

OTHER

- ☐ **WHATSIT** — Interactive data-base system using associative tags to retrieve information by subject. Hashing and random access used for fast response. Requires CBASIC **\$125/\$25**
- ☐ **SOURCE 8080/Z-80 Disassembler** — Disassembles disk binary file to disk source files. Output may be created for processing by MAC with its Z-80 library or by the Xitan ASM **\$70/\$1**
- ☐ **ZASM Assembler** — Disk-based assembler for Zilog/Mostek mnemonic Z-80 code. Creates output in absolute Intel hex. Requires Z-80 to operate **\$45/\$10**
- ☐ **XYBASIC Interactive Process Control BASIC** — Full disk BASIC features plus unique commands to handle bytes, rotate and shift, and to test and set bits. Available in Integer, Extended and ROMable versions **From \$295/\$25**
- ☐ **SMAL/80 Structured Macro Assembler Language** — Package of powerful general purpose text macro processor and SMAL structured language compiler. SMAL is an assembler language with IF-THEN-ELSE, LOOP-REPEAT-WHILE, DO-END, BEGIN-END constructs **\$75/\$15**

Software
with
Manual
Alone

- ☐ **Selector II** — Data Base Processor to create and maintain single Key data bases. Prints formatted, sorted reports with numerical summaries. Available for Microsoft and CBASIC (state which). Supplied in source code **\$195/\$20**
- ☐ **Selector III** — Multi (i.e., up to 24) Key version of Selector II. Comes with applications programs including Sales Activity, Inventory, Payables, Receivables, Check Register, Expenses, Appointments, and Client/Patient. Requires CBASIC. Supplied in source code **\$295/\$20**
- ☐ **BASIC Comparison** — A comprehensive features and performance analysis of five 8080 disk BASIC languages — CBASIC, BASIC-E, XYBASIC, Microsoft Disk Extended BASIC, and Xitan's Disk BASIC. Itemizes results of 21 different benchmark tests for speed and accuracy and lists instructions and features of each BASIC (send 20¢ S.A.S.E.) **FREE**

**TRS-80
FORTRAN PACKAGE
Professional Disk-Based
Language and Utility Package**

Written by Microsoft, creators of Level II BASIC, the package runs on a TRS-80 system with 32K RAM, one or more drives and TRSDOS. The software is supplied on diskettes and consists of a relocatable machine code FORTRAN Compiler, Macro Assembler, a Linking Loader, Subroutine Library, Text Editor **\$325**

Fill it in.

All
software
requires CP/M
for operation
except
TRS-80 FORTRAN

Lifeboat Associates, 164 West 83rd Street, New York, N.Y. 10024 (212) 580-0082

Please send me:

Software	Price
<input type="checkbox"/> manual alone	
<input type="checkbox"/> manual alone	
<input type="checkbox"/> manual alone	
<input type="checkbox"/> Check enclosed <input type="checkbox"/> U.P.S. COD	Sub total
<input type="checkbox"/> Visa <input type="checkbox"/> Master Charge	Shipping
Account # _____ Exp. Date _____	\$1.00 for C.O.D.
Signature _____	Total

My computer configuration (specifying disk system):

Name _____

Address (No. P.O. Box) _____

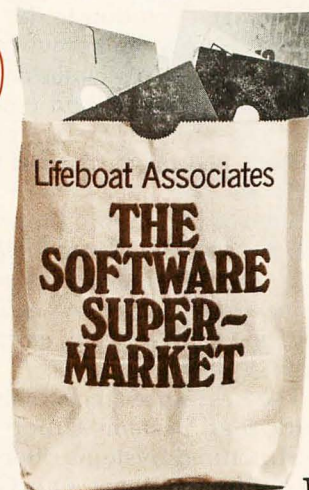
City _____

State _____

Zip _____

EFFECTIVE 1/15/79

™ The Software Supermarket is a trademark of Lifeboat Associates

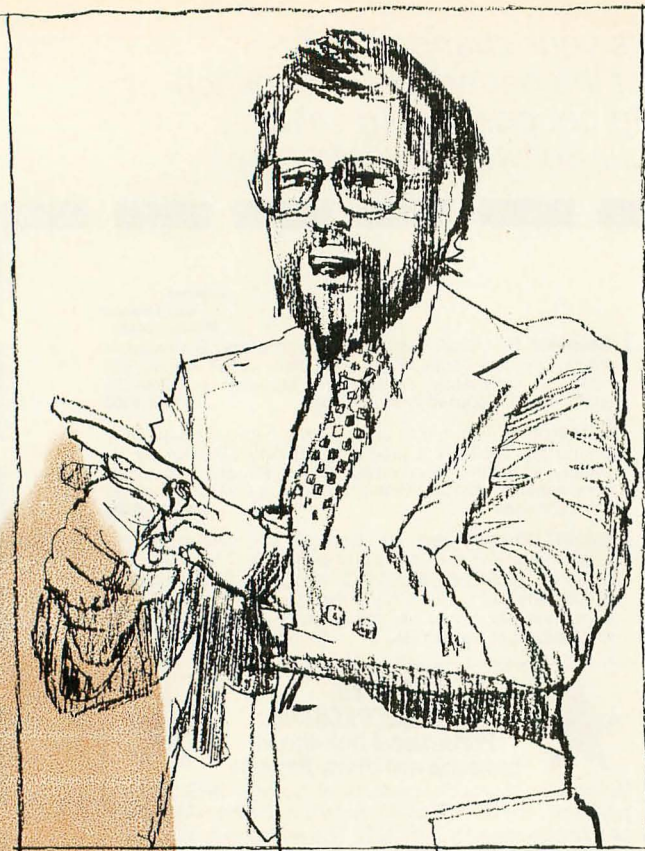


Disk systems and formats: North Star single or double density, IBM single or 2D 256, Altair, Helios II, Micropolis Mod I or II, 5 1/4" soft sector (Micro iCOM/SD Sales Dynabyte), etc.

Add \$1 item shipping (\$2 min.). Add \$1 additional for UPS C.O.D.

Manual cost applicable against price of subsequent software purchase.

The sale of each proprietary software package conveys a license for use on one system only.



"My Structured Systems business software has paid for itself in labor hours saved alone."

Mr. Ken Tunnah, Colloid-A-Tron Inc., Buffalo, New York

Ken Tunnah is one of many innovators bringing the micro revolution to the small business. As a programmer, he knows computers and their languages. As a businessman, he knows business and its languages. And when Mr. Tunnah decided to micro-computerize the accounting function at Colloid-A-Tron, he turned to Structured Systems software.

Says Mr. Tunnah: *"The program is designed from a CPA standpoint, for multiple corporations, which we have. It is flexible and gives me the ability to change reporting by profit centers easily. It is up and running quickly, and it just keeps on running. I think it's the best business software available."*

The best software available. That's what Structured Systems Group set out to create.

Structured Systems offers three sophisticated accounting systems. Our General Ledger software is big enough for multi-client write-up by the CPA, or multi-corporate reporting for the business, but small enough for the micro budget. The very comprehensive Accounts Receivable and Accounts Payable packages will operate independently, or they will coordinate with the General Ledger.

Our systems record transactions easily and correctly, and provide an audit trail from source document to financial statements. And they will maintain monthly and year-to-date information in

dollars and in percentages. And they are reliable.

The three systems interact with the user to set up parameters such as format and headings, account titles and numbering, automatic billing or reminder notices, credit limits, sales reports, a check register, and much more.

The software is designed to run on an 8080 or Z-80 CPU with 48K of memory, dual disks with CP/M®, printer, keyboard, and CRT. To make it all work for you, we have provided the most extensive documentation and support in the industry.

We provide the capability to computerize complex accounting functions on relatively inexpensive micro-computer equipment. Ken Tunnah has told us what that means: *"I've bucked some trends. I looked around, and decided that with the right software, I could get a micro to outperform a \$45,000 mini. I'm satisfied. It's simple economics."*

We can refer you to a growing number of sophisticated retailers experienced in Structured Systems Group business systems. Or we can work directly with you. We'd be happy to provide you with more information on our product line, which includes QSORT (a sort/merge program), CBASIC (a business BASIC), NAD (a mailing and addressing system), and our General Ledger, Accounts Receivable, and Accounts Payable packages.

*CP/M is a registered trademark of Digital Research

Structured Systems Group

5208 Claremont Avenue
Oakland, CA 94618
Call us at (415) 547-1567. Or write.

BYTE News....

MORE COMPANIES JUMPING ON THE PASCAL BANDWAGON. The list of computer manufacturers committing themselves to support Pascal on their systems is growing rapidly. The list now includes American Microsystems (AMI) on their 6800 based system, Western Digital Corp on their 16 bit Pascal oriented microprocessor, National Semiconductor on their SC/MP-II, General Automation on their 16 bit microprocessor, Apple on their 8 bit microcomputer and, soon, Intel, on their 8080/8085 development system.

INTEL, TEXAS INSTRUMENTS AND IBM MAKE MEMORY NEWS. Intel has again beat its competitors to the marketplace with a new product. This time it is the 32 K byte programmable read only memory, called the 2732, following in the footsteps of the 2716 and the 2708. It is pin compatible with the 2716 16 K erasable byte read only memory, and is organized as 4 K by 8 bit words. It has a 450 ns access time and operates from a single 5 V power supply. Further, a separate chip-enable input reduces power dissipation by 80 percent (from 150 mA to 30 mA) when the device is not selected. The single unit price is \$147.30 and drops to \$91.65 in quantity. Intel claims the 2732 is now available in production quantities.

Texas Instruments has been sampling their new 64 K bit dynamic programmable memory (TMS-4164) since last fall to selected customers and expects to be in quantity production by the last quarter of this year. Motorola also recently began sampling their 64 K bit programmable memory and hopes to be in production by year-end (initial price is \$130).

IBM, at a recent International Electron Devices meeting, disclosed that they had made an experimental MOS gate with channel lengths of 1.3 to 1.0 micrometers. This represents a significant breakthrough in very large scale integrated (VLSI) circuit technology. Using this technology it is now possible to build a 256 K bit memory part. Further, IBM reports that these devices have switching times of 230 picoseconds, which is three to four times faster than previous MOS circuits, and dissipate one tenth the power.

BUBBLE MEMORIES INCREASING IN AVAILABILITY. Texas Instruments and Rockwell are currently the only two manufacturers of bubble memories and their maximum size devices are only 256 K bits. National Semiconductor is expected to start sampling their 256 K device later this year. Also, look for Intel to enter the market before year-end. However, prices are still very high, compared to disk storage technology, and production is still very limited. Don't look for their use in microcomputers until the early 1980s, when bit capacity is up in the megabyte size and competition develops. Currently, bubble memories are being used in applications where the electro-mechanical disk systems are not rugged enough.

FLOPPY DISK IMPROVEMENTS COMING. Floppy disks are going to be with us for some time to come. It is expected that next year will see the introduction of 5 to 10 M byte floppy disks due to higher track density. This will be made possible by having the disk supply its own track positioning data and by improvements in media technology, allowing for narrower tracks. 5 inch floppies will be expanded to the 1 to 2 M byte range, per disk.

Projections for 1980 are that bubble memory will drop to 0.1 cent per bit while disk will cost 0.0001 cent per bit. Further, projections are for bubble memory prices to drop to only 0.02 cent per bit by 1985.

In the meantime, floppy disks, first introduced in 1973, saw sales of close to 270,000 units last year with sales for this year expected to be over 350,000.

FLAT SCREEN TERMINALS ARE COMING. General Telephone and Electronics (GT&E) has announced that they are far along in development of a flat screen display using cathodoluminescence. They are working on it jointly with Lucitron Inc. GT&E predicts that the display will be in production by 1981 at the latest. A color display, using the same technique, is also being developed. The system will permit large displays, up to 50 inches (127 cm, measured diagonally) and approximately three inches thick. The Lucitron panels use a "self-scanning" system which does not require complex drive circuitry. The initial display panels will be used for computer terminals, with television type displays, providing good gray scale, following a year or two later.

APL ON A MICROCOMPUTER FOR \$2000 AVAILABLE SOON. APL buffs waiting patiently for a home APL system will finally get their dream. Alan Rose, of Scientific Time-Sharing Corp, considered one of the APL authorities, reports that he and a small company called Quark will soon introduce a microcomputer system dedicated to APL. It will run the full APL language, as implemented by IBM and Scientific Time-Sharing Corp. It will be easily expandable in I/O and peripheral mass storage and will execute two to four times faster than the IBM 5100 APL machine. The unit, which will use the Intel 8086 16 bit processor, will contain its own keyboard and display and can be used in either a stand-alone mode or as an intelligent APL terminal to a host system. The best news is that the system price will start at only \$2000. Look for availability this summer.

Although several "tiny APL" interpreters have been brought out for microcomputers, and IBM has a micro-APL in their 5100 desktop computer, these implementations have left a great deal to be desired. Vanguard Systems in Austin TX has available an excellent Z-80 APL interpreter which we understand will be licensed soon to one or more computer manufacturers. Microsoft had advertised their version of APL for some time, but as far as we know have not started delivery yet.

FCC TAKING ACTION ON RADIATING COMPUTERS AND GAMES. After severe interference problems that occurred with Citizen's Band radio interference on television sets, the FCC sought to regulate devices which employ radio frequency modulators. This is also the case with computers and electronic games that are connected to standard television sets via radio frequency modulators. Manufacturers are required to submit their units to the FCC for approval and licensing. Passing the standards appears quite difficult and so far only a few units have obtained approval. Several manufacturers have gotten around the problem by providing only video signal output, which means that the user must use a video monitor or TV set with special video input. Some manufacturers have ignored the FCC regulations and sold unlicensed units.

Recently the FCC served a cease-and-desist order on some personal computer system owners because of interference on neighbors sets. The FCC is also talking about imposing marketing sanctions on those companies who fail to meet interconnect qualifications.

PERSONAL COMPUTERS GOING GREAT IN EUROPE. Sales of personal computer systems are going great on the Continent. The Germans report that sales are soaring. An estimated 4000 PETs were sold in 1978, primarily to home users. Commodore is manufacturing the PET in England. Tandy also reports greater than expected sales, but has not disclosed figures. Tandy started selling the TRS-80 last summer through 340 stores. In Germany the TRS-80 (Level I) sells for \$935 compared to \$595 in the states. The Apple computer is being handled by ITT, who reports excellent sales. The TRS-80 and Apple are manufactured in the USA. Things will change this year as Seimens, one of the largest European electronics manufacturers, will soon announce their own personal computer system.

Interestingly, one of the major sales outlets for personal computer systems has become department stores. Several US department stores have tried selling personal computer systems but have withdrawn.

MICROPROCESSOR MAKERS MOVE INTO COMPUTER SYSTEMS BUSINESS. Integrated circuit manufacturers are going into competition with their customers, the computer systems manufacturers. Texas Instruments was one of the first. They have been selling complete minicomputer systems for several years now. Additionally, they have been selling 16 bit systems using their 9900 processor and now also will soon introduce a personal computer system using the 9900.

National Semiconductor is now selling a large system to replace IBM-370s and will soon offer for sale a microprocessor version of the DEC PDP-11 16 bit computer system. Also, Fairchild will soon sell a system that is compatible with the Data General NOVA computer system.

Zilog late last year introduced their system using the Z-80. It is a business-oriented system and has a full complement of computer languages, including BASIC, FORTRAN and COBOL; business application software packages are also offered. A Z-8000 based system is expected in the fall.

Intel is rumored to be working on a very powerful data base system using an associative processor to handle searching, inserting, deleting, etc, among an array of storage devices and host interfaces. The system will utilize a 16 bit processor and CCD memory that will represent a breakthrough in data base computer technology. Introduction is expected in 1980.

TANDY REVAMPS ITS COMPUTER MARKETING. Early last year Tandy opened a computer store in its Fort Worth TX building complex and also issued a computer catalog. The store and the catalog carried the Radio Shack TRS-80 and a wide variety of products ranging from the IMSAI 8080 to the Video Brain computers. Tandy considered it an experiment. The TRS-80 accounted for 80 percent of the sales. Now Tandy has decided on a new marketing approach. They have already opened five computer stores (Richardson, Dallas and Fort Worth TX, and New York City and Washington DC) and plans to open others soon in Tampa, Atlanta, San Francisco and Los Angeles. Each store will have a classroom and repair facilities.

Further, the stores will carry only three different computer systems. The TRS-80, Tandy-10 and Tandy-150 systems. The Tandy-10 is made for Tandy by Digital Data Systems (DDS) and will have a base price of \$8995. Using an 8080, it will have a video display, keyboard, 48 K bytes of programmable memory, two 8 inch floppy disk drives, BASIC and a disk operating system similar to CP/M. The initial order placed by Tandy with DDS was reportedly for 250 systems. The Tandy-150 will be assembled by Tandy and use a Computer Automation 16 bit processor. Starting at \$21,995, it will include a 10 M byte hard disk.

Sol Libes
ACGNJ
995 Chimney Rdg
Springfield NJ 07081



"BOOKS OF INTEREST TO COMPUTER PEOPLE"



**More BYTE BOOKS
in your future...**

...And the future

THE BYTE BOOK OF COMPUTER MUSIC combines the best computer music articles from past issues of BYTE Magazine with exciting new material—all written for the computer experimenter interested in this fascinating field.

You will enjoy Hal Chamberlin's "A Sampling of Techniques for Computer Performance of Music", which shows how you can create four-part melodies on your computer. For the budget minded, "A \$19 Music Interface" contains practical tutorial information—and organ fans will enjoy reading "Electronic Organ Chips For Use in Computer Music Synthesis".

New material includes "Polyphony Made Easy" and "A Terrain Reader". The first describes a handy circuit that allows you to enter more than one note at a time into your computer from a musical keyboard. The "Terrain Reader" is a remarkable program that creates random music based on land terrain maps.

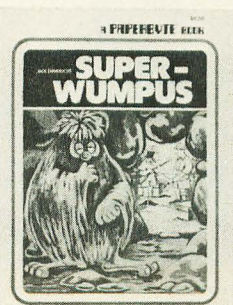
Other articles range from flights of fancy about the reproductive systems of pianos to Fast Fourier transform programs written in BASIC and 6800 machine language, multi-computer music systems, Walsh Functions, and much more.

For the first time, material difficult to obtain has been collected into one convenient, easy to read book. An ardent do-it-yourselfer or armchair musicologist will find this book to be a useful addition to the library.

NEW

ISBN 0-931718-11-2
Editor: Christopher P. Morgan
Pages: approx. 128
Price: **\$10.00**

SUPERWUMPUS is an exciting computer game incorporating the original structure of the WUMPUS game along with added features to make it even more fascinating. The original game was described in the book **What To Do After You Hit Return**, published by the People's Computer Company. Programmed in both 6800 assembly language and BASIC, **SUPERWUMPUS** is not only addictively fun, but also provides a splendid tutorial on setting up unusual data structures (the tunnel and cave system of **SUPERWUMPUS** forms a dodecahedron). This is a **PAPERBYTE™** book.



ISBN 0-931718-03-1
Author: Jack Emmerichs
Pages: 56
Price: **\$6.00**

TINY ASSEMBLER 6800, Version 3.1 is an enhancement of Jack Emmerichs' successful Tiny Assembler. The original version (3.0) was described first in the April and May 1977 issues of BYTE magazine, and later in the **PAPERBYTE™** book **TINY ASSEMBLER 6800 Version 3.0**.



In September 1977, BYTE magazine published an article entitled, "Expanding The Tiny Assembler". This provided a detailed description of the enhancements incorporated into Version 3.1, such as the addition of a "begin" statement, a "virtual symbol table", and a larger subset of the Motorola 6800 assembly language.

All the above articles, plus an updated version of the user's guide, the source, object and **PAPERBYTE™** bar code formats of both Version 3.0 and 3.1 make this book the most complete documentation possible for Jack Emmerichs' Tiny Assembler.

ISBN 0-931718-08-2
Author: Jack Emmerichs
Pages: 80
Price: **\$9.00**

A walk through this book brings you into **Ciarcia's Circuit Cellar** for a detailed look at the marvelous projects which let you do useful things with your micro-computer. A collection of more than a year's worth of the popular series in BYTE magazine, **Ciarcia's Circuit Cellar** includes the six winners of BYTE's On-going Monitor Box (BOMB) award, voted by the readers themselves as the best articles of the month: **Control the World** (September 1977), **Memory Mapped IO** (November 1977), **Program Your Next EROM in BASIC** (March 1978), **Tune In and Turn On** (April 1978), **Talk To Me** (June 1978), and **Let Your Fingers Do the Talking** (August 1978).

Each article is a complete tutorial giving all the details needed to construct each project. Using amusing anecdotes to introduce the articles and an easy-going style, Steve presents each project so that even a neophyte need not be afraid to try it.

NEW

ISBN 0-931718-07-4
Author: Steve Ciarcia
Pages: approx. 128
Price: **\$8.00**

is right now!

BASEX, a new compact, compiled language for microcomputers, has many of the best features of BASIC and the 8080 assembly language—and it can be run on any of the 8080 style microprocessors: 8080, Z-80, or 8085. This is a **PAPERBYTE™** book.

Subroutines in the **BASEX** operating system typically execute programs up to five times faster than equivalent programs in a BASIC interpreter—while requiring about half the memory space. In addition, **BASEX** has most of the powerful features of good BASIC interpreters including array variables, text strings, arithmetic operations on signed 16 bit integers, and versatile IO communication functions. And since the two languages, **BASEX** and BASIC, are so similar, it is possible to easily translate programs using integer arithmetic data from BASIC into **BASEX**.

The author, Paul Warne, has also included a **BASEX** Loader program which is capable of relocating programs anywhere in memory.

NEW

ISBN 0-931718-05-8
Author: Paul Warne
Pages: 88
Price: \$8.00

PROGRAMMING TECHNIQUES is a series of **BYTE BOOKS** concerned with the art and science of computer programming. It is a collection of the best articles from **BYTE** magazine and new material collected just for this series. Each volume of the series provides the personal computer user with background information to write and maintain programs effectively.

The first volume in the Programming Techniques series is entitled **PROGRAM DESIGN**. It discusses in detail the theory of program design. The purpose of the book is to provide the personal computer user with the techniques needed to design efficient, effective, maintainable programs. Included is information concerning structured program design, modular programming techniques, program logic design, and examples of some of the more common traps the casual as well as the experienced programmer may fall into. In addition, details on various aspects of the actual program functions, such as hashed tables and binary tree processing, are included.

ISBN 0-931718-12-0
Editor: Blaise W. Liffick
Pages: 96
Price: \$6.00



SIMULATION is the second volume in the Programming Techniques series. The chapters deal with various aspects of specific types of simulation. Both theoretical and practical applications are included. Particularly stressed is simulation of motion, including wave motion and flying objects. The realm of artificial intelligence is explored, along with simulating robot motion with the microcomputer. Finally, tips on how to simulate electronic circuits on the computer are detailed.

ISBN 0-931718-13-9
Editor: Blaise W. Liffick
Pages: approx. 80
Price: \$6.00
Publication: Winter 1979

RA6800ML: AN M6800 RELOCATABLE MACRO ASSEMBLER is a two pass assembler for the Motorola 6800 microprocessor. It is designed to run on a minimum system of 16 K bytes of memory, a system console (such as a Teletype terminal), a system monitor (such as Motorola MIKBUG read only memory program or the ICOM Floppy Disk Operating System), and some form of mass file storage (dual cassette recorders or a floppy disk).

The Assembler can produce a program listing, a sorted Symbol Table listing and relocatable object code. The object code is loaded and linked with other assembled modules using the **Linking Loader LINK68**. (Refer to **PAPERBYTE™** publication **LINK68: AN M6800 LINKING LOADER** for details.)

There is a complete description of the 6800 Assembly language and its components, including outlines of the instruction and address formats, pseudo instructions and macro facilities. Each major routine of the Assembler is described in detail, complete with flow charts and a cross reference showing all calling and called-by routines, pointers, flags, and temporary variables.

In addition, details on interfacing and using the Assembler, error messages generated by the Assembler, the Assembler and sample IO driver source code listings, and **PAPERBYTE™** bar code representation of the Assembler's relocatable object file are all included.

This book provides the necessary background for coding programs in the 6800 assembly language, and for understanding the innermost operations of the Assembler.

ISBN 0-931718-10-4
Author: Jack E. Hemenway
Pages: 184
Price: \$25.00

to order books see next page

LINK68: AN M6800 LINKING LOADER is a one pass linking loader which allows separately translated relocatable object modules to be loaded and linked together to form a single executable load module, and to relocate modules in memory. It produces a load map and a load module in Motorola MIKBUG loader format. The Linking Loader requires 2 K bytes of memory, a system console (such as a Teletype terminal), a system monitor (for instance, Motorola MIKBUG read only memory program or the ICOM Floppy Disk Operating System), and some form of mass file storage (dual cassette recorders or a floppy disk).

It was the express purpose of the authors of this book to provide everything necessary for the user to easily learn about the system. In addition to the source code and **PAPERBYTE™** bar code listings, there is a detailed description of the major routines of the Linking Loader, including flow charts. While implementing the system, the user has an opportunity to learn about the nature of linking loader design as well as simply acquiring a useful software tool.

ISBN 0-931718-09-0
Authors: Robert D. Grappel
& Jack E. Hemenway
Pages: 72
Price: **\$8.00**
Winter 1979

TRACER: A 6800 DEBUGGING PROGRAM is for the programmer looking for good debugging software. TRACER features single step execution using dynamic break points, register examination and modification, and memory examination and modification. This book includes a reprint of "Jack and the Machine Debug" (from the December 1977 issue of BYTE magazine), TRACER program notes, complete assembly and source listing in 6800 assembly language, object program listing, and machine readable **PAPERBYTE™** bar codes of the object code.

ISBN 0-931718-02-3
Authors: Robert D. Grappel
& Jack E. Hemenway
Pages: 24
Price: **\$6.00**

MONDEB: AN ADVANCED M6800 MONITOR-DEBUGGER has all the general features of Motorola's MIKBUG monitor as well as numerous other capabilities. Ease of use was a prime design consideration. The other goal was to achieve minimum memory requirements while retaining maximum versatility. The result is an extremely versatile program. The size of the entire MONDEB is less than 3 K.

Some of the command capabilities of MONDEB include displaying and setting the contents of registers, setting interrupts for debugging, testing a program-mable memory range for bad memory locations, changing the display and input base of numbers, displaying the contents of memory, searching for a specified string, copying a range of bytes from one location in memory to another, and defining the location to which control will transfer upon receipt of an interrupt. This is a **PAPERBYTE™** book.

ISBN 0-931718-06-6
Author: Don Peters
Pages: 88
Price: **\$5.00**

BAR CODE LOADER. The purpose of this pamphlet is to present the decoding algorithm which was designed by Ken Budnick of Micro-Scan Associates at the request of BYTE Publications, Inc., for the **PAPER-BYTE™** bar code representation of executable code. The text of this pamphlet was written by Ken, and contains the general algorithm description in flow chart form plus detailed assemblies of program code for 6800, 6502 and 8080 processors. Individuals with computers based on these processors can use the software directly. Individuals with other processors can use the provided functional specifications and detail examples to create equivalent programs.

ISBN 0-931718-01-5
Author: Ken Budnick
Pages: 32
Price: **\$2.00**

BYTE BOOKS Division • 70 Main Street • Peterborough, New Hampshire 03458

Name _____ Title _____ Company _____
Street _____ City _____ State/Province _____ Code _____

☐ Check enclosed in the amount of \$ _____
☐ Bill Visa ☐ Bill Master Charge Card No. _____ Exp. Date _____

Please send the books I have checked.

- ☐ Computer Music \$10.00
- ☐ SUPERWIMPUS \$6.00
- ☐ Tiny Assembler (3.1) \$9.00
- ☐ Circuit Cellar \$8.00
- ☐ BASEX \$8.00
- ☐ Program Design \$6.00

- ☐ Simulation \$6.00
- ☐ RA6800ML \$25.00
- ☐ Link68 \$8.00
- ☐ TRACER \$6.00
- ☐ Mondeb \$5.00
- ☐ Bar Code Loader \$2.00

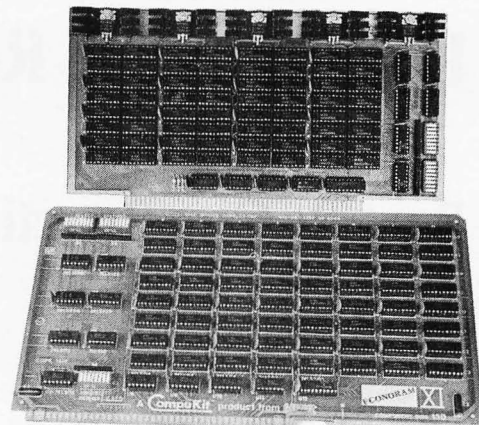
BYTE BOOKS, BYTE BOOKS logo, and PAPERBYTE are trademarks of BYTE Publications, Inc.

Add **50¢** per book to cover postage and handling

Please allow 6-8 weeks for processing your order.

ECONORAM™ DEFINED.

- 4MHz operation guaranteed on high-density (16K and up) boards, with no price penalty
- Low current consumption with guaranteed specs
- Static technology used exclusively
- Buffered inputs for minimum buss loading
- Buffered tri-state outputs for maximum output drive
- Unique multi-block configurations for addressing flexibility
- All memories conform to industry standard board sizes
- 1 year limited warranty (not just 90 days)
- Double-sided, plate through, solder masked and legended circuit board
- Complete documentation
- Gold-plated edge connector teeth that stand up to repeated insertions
- DIP switch address selection/deselection
- Sockets for all ICs, including low power Schottky support chips
- Optimized thermal design
- Over 4 years of experience in the design and manufacture of memories



Most Econorams are available in 3 forms: **unkit** (sockets, bypass caps pre-soldered in place for easy assembly); **assembled and tested**; or qualified under the **Certified System Component (CSC)** high-reliability program (200 hour burn-in, 4 MHz operation over full temperature range, serial numbered, immediate replacement in event of failure within 1 year of invoice date).

NAME	STORAGE	BUSS	SPEED	UNKIT	ASSM	CSC
ECONORAM II™	8K X 8	S-100	2 MHz	\$139	\$159	N/A
ECONORAM IV™	16K X 8	S-100	4 MHz	\$295	\$329	\$429
ECONORAM VI™	12K X 8	Heath H8	2 MHz	\$200	\$270	N/A
ECONORAM VII™	24K X 8	S-100	4 MHz	\$445	\$485	\$605
ECONORAM IX™	32K X 8	Dig Group	4 MHz	\$649	N/A	N/A
ECONORAM X™	32K X 8	S-100	4 MHz	\$599	\$649	\$789
ECONORAM XI™	32K X 8	Intel/National 80/10 & 80/20	4 MHz	N/A	N/A	\$1050

OTHER MEMORY PRODUCTS AND SPECIALTY ITEMS

TRS-80 CONVERSION KIT \$109

Our kit is guaranteed for 1 year, includes DIP shunts, and uses 240 ns chips for operation at 4 MHz. Upgrades 4K TRS-80 to 16K or populates Memory Expansion Module; our novice level instructions make it easy. Also expands memory in Apple and Exidy Sorcerer computers. 3 kits/\$320.

MEMORY CHIP SPECIALS !!

2102L-1 (low power, better than 450 ns) 1K static RAMs **now only 99¢ while they last.** Only good on orders of 10 or more.

TMS4044 4K static RAMs, 450 ns, prime parts — **\$7.95 each, 8 or more \$6.95 each, 32 or more \$5.95 each, 64 or more \$4.95 each.** While they last.

HEATH H8 BARE BOARD MEMORY SPECIAL \$35

Don't need the full 12K of our standard H8 memory? We now offer the board, mounting bracket, edge connector, and print for only \$35. Populate it with a few support chips and readily available, low cost 2102s to build your memory up to a full 12K whenever your budget permits.

ACTIVE TERMINATOR KIT \$29.50

Our much imitated design plugs into any S-100 motherboard slot to treat the S-100 buss as the RF system it really is, thereby reducing noise, glitches, ringing, overshoot, and other buss-related problems. Improves reliability, saves power compared to passive termination.

PET TO S-100 INTERFACE BOARD \$199.95

From HUH Electronics (designed by Mark Garetz). Mates S-100 boards to the Commodore PET, or serves as nucleus of stand-alone 6500 series system.

11 SLOT S-100 MOTHERBOARD UNKIT \$90

Includes 11 edge connectors soldered in place for simplified assembly, and active termination for reliable data transfer. Dimensions: 8.5" x 11".

18 SLOT S-100 MOTHERBOARD UNKIT \$124

Same as above, but 18 slots and edge connectors. Dimensions 8.5" x 16.7".

... AND HERE'S WHAT WE DO FOR AN ENCORE!

We've got some great new products up our sleeves. How about 16K and 24K bank select memories (perfect for the Alpha Microsystems machine)? Or a memory management board that retrofits S-100 machines (Altair, IMSAI, etc.) so that they can address half-a-Megabyte of memory? Then there's our super S-100 I/O board, with two hardware UARTs (no software UARTs that tie up your buss), full RS-232 specs, handshaking, and true S-100 compatibility... well worth waiting for. Watch this space for details in the months ahead.

WANT TO SEE OUR PRODUCTS? VISIT YOUR LOCAL COMPUTER STORE.

TERMS: Orders under \$15 add \$1 handling. Cal res add tax. VISA®/Mastercharge® (\$15 min) call our 24 hour answering service at (415) 562-0636. Allow 5% shipping, excess refunded. COD OK with street address for UPS. Prices good through cover month of magazine.

CompuKit™

from

GODBOUT
BILL GODBOUT ELECTRONICS
BOX 2355, OAKLAND AIRPORT, CA 94614

Designing a Robot from Nature

Part 2: Constructing the Eye

Andrew Filo
4621 Granger Rd
Akron OH 44313

1(a)

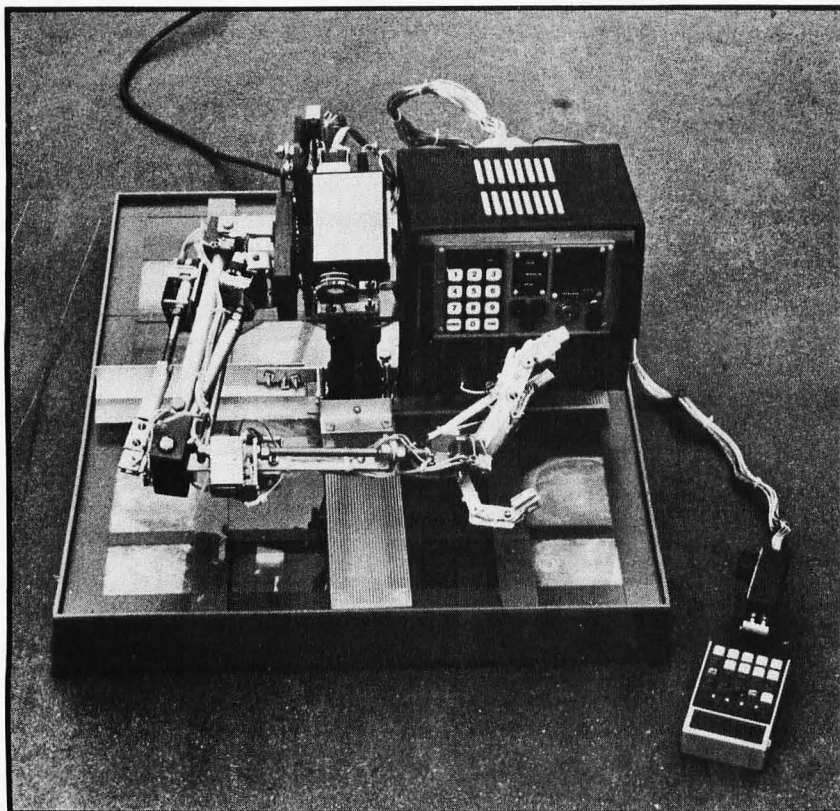


Photo 1: The author's NELOC (neural logic cyberanimate). The manipulator arm (with five degrees of freedom) and the 8008 computer (at upper right) are shown. The object resembling a TV camera is actually a sustained contrast detector used to obtain a rough image of the object to be grasped (see photos 4a and 4b and figure 7). Just below and to the right of the sustained contrast detector is a small box called the net convexity detector (see photo 5), which detects the direction of motion of an LED mounted on the hand of the manipulator and feeds this information into the homebrew computer. Photos 1(b), 1(c), and 1(d) show the arm in action.

The first piece of hardware to be built in my system was the manipulator. From the start it was obvious that a tongue-manipulator concept would be impractical; I chose remote operator control over the manipulator arm because I wanted to program manipulator motion by "teaching," and also to assist the system during its operation if necessary.

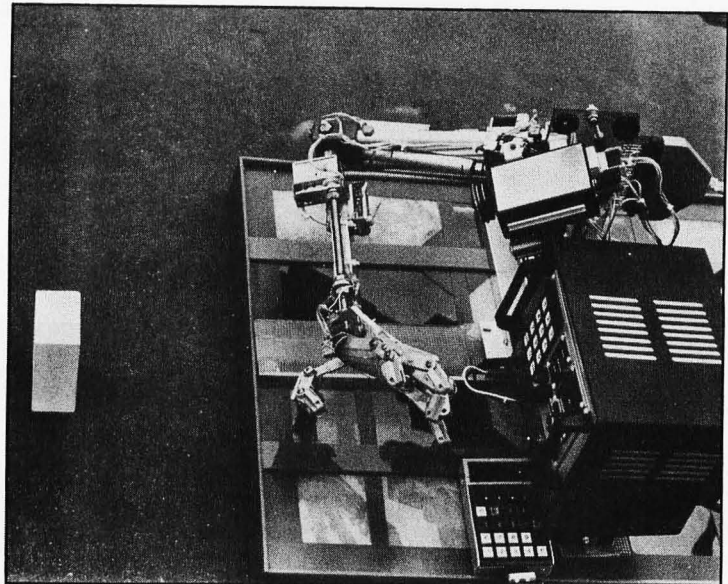
The manipulator I designed was roughly modeled after a human arm, with regard to its actions and dimensions. The manipulator is capable of five degrees of freedom, making it suitable for control by the motion of joints in a remote operator's arm. The prototype arm was originally designed to be pneumatically operated, but electric motors were substituted for convenience during testing. The motors (which accurately simulate the actions of pneumatic pistons and their servo valves) are electro-optically controlled. To start a motor or open a valve, the optocoupler connecting the motor or valve to the circuit's ground must be activated. Next, the forward or reverse coupler must be illuminated, connecting the motor or valve to a positive or negative voltage source, thereby causing the motor or air piston to extend or retract its portion of the manipulator. The only feedback devices located on the arm are two microswitches located just before the limit of travel of each joint. These microswitches provide either a full extension or full retraction signal for each joint. There is also a set of tactile sensor switches located in the fingertips of the device. Even though this manipulator may appear to have little in common with the frog, almost every facet of its design has been mentioned, in one form or another, in the previous (see February 1979 BYTE, page 12) analysis. The optoisolators, for instance, resemble the neuromuscular junctions in function, being the point where control signals leave the processing system and enter the motive system. The switches in the joints approximate the neuromuscular spindles. The tactile switches resemble the innervated capsules in the skin. And the entire manipulator itself is a folding, prehensile device, as is the frog's tongue.

Net Convexity Detector

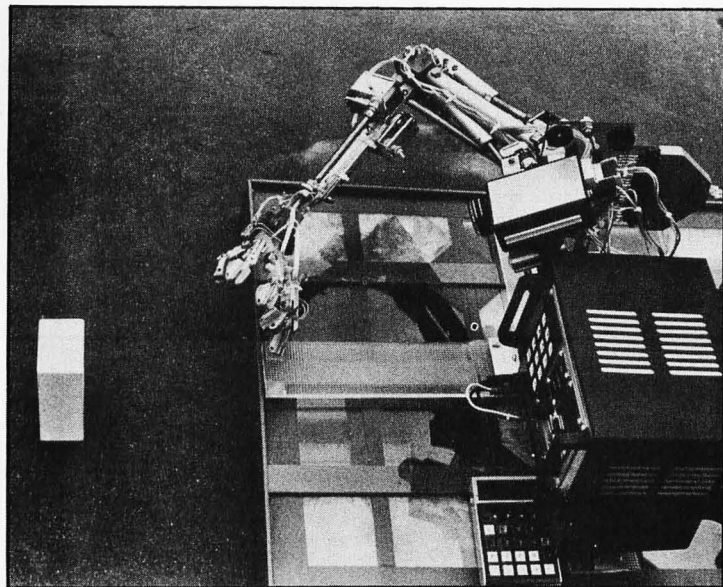
Other structures developed for the turret system more closely resemble their biological counterparts. To monitor the motion of the manipulator more closely, my system requires a device that can track the motion of the arm. A matrix of net convexity detectors proved more than adequate for the task. By monitoring a small bright spot of light either reflected from a retroreflector or emitted from a brilliant LED (light emitting diode) source located on the manipulator, the net convexity detectors can easily monitor the motion of the manipulator. The net convexity detectors built for the turret system utilize the concepts of receptor geometry, weighting (for processing), and output suppression for size discrimination.

Building a small matrix of net convexity detectors could involve the use of possibly hundreds of sensors and many processing devices, but since I was not concerned with building an accurate model of the net convexity detector in the frog's retina, I could trade off various design features. For example, I deduced that 20 is the minimum number of receptors required to define motion on at least four axes. The geometry of these receptors has to be in a matrix of four columns by five rows with the high sensitivity receptor occurring in the fifth row, third column (see figure 6 and boxed text at end of article). In the frog, a net convexity detector may have up to 100 receptors in its receptor field, allowing the frog to precisely monitor the angle of the insect's trajectory, but to duplicate this would require the use of a monolithic digital sensor of photodiodes if the system were to be portable. Even a 4 by 5 matrix would require a 1 inch square surface to contain all of the detectors. This means that four net convexity detectors would require a 2 by 2 inch imaging surface — impractical both in terms of size and optics. Another serious problem was scanning and processing the information from the photoelectric devices.

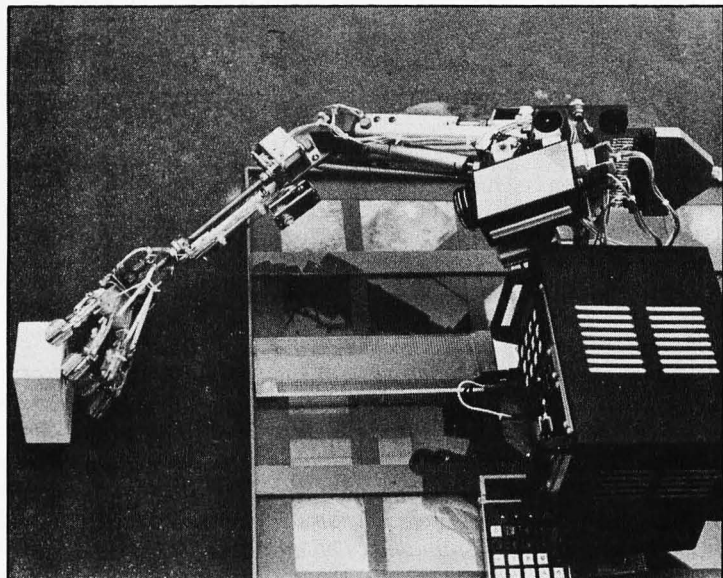
Text continued on page 119



1(b)



1(c)



1(d)

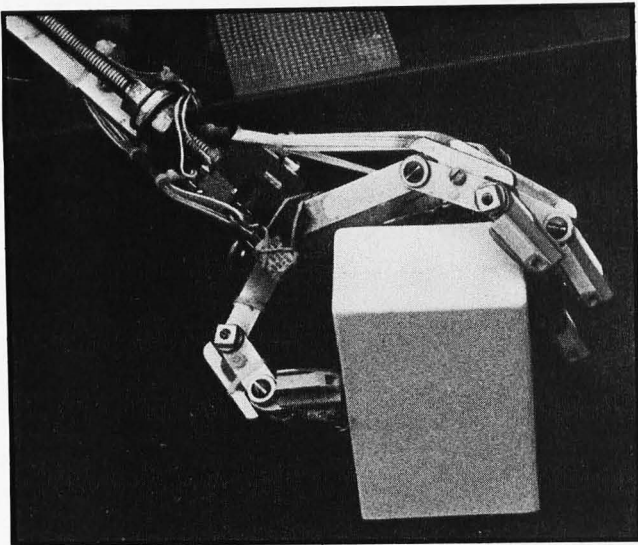


Photo 2: Close-up of the manipulator's hand.

Sources of Parts

A few items mentioned are available only from single sources:

National Semiconductor 650 calculator modules are available from Poly Packs, POB 942, South Lynnfield MA 01940.

The best sheet plastic and cement I have found for hobby use can be purchased from Plastruct Inc, 61 Monterey Pass Rd, Monterey Park CA 91754.

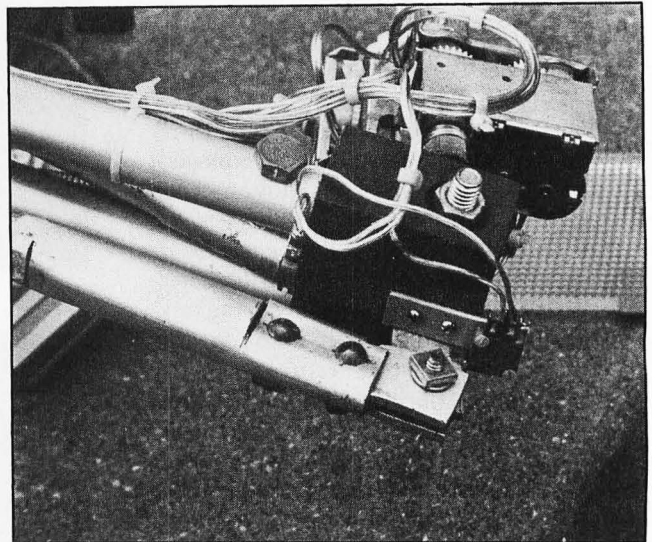


Photo 3: Elbow of the manipulator.

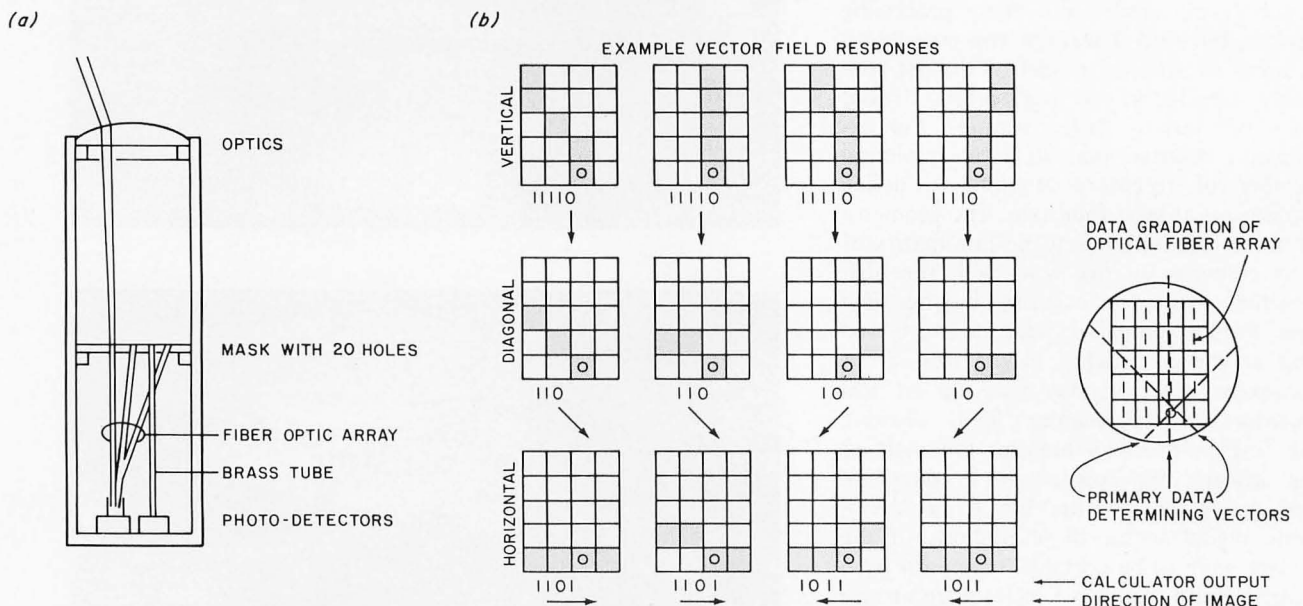


Figure 6: Shown at (a) is a sectional view of the net convexity detector, used to determine the motion vector of the manipulator arm. Light entering the lens passes through one of 20 holes in a 4 by 5 array at any instant of time, and impinges on one of a corresponding set of phototransistors. 19 of these photo-darlingtons (the low sensitivity detectors) activate the 1 key of a calculator module. The remaining photo-darlington activates the 0 key; its off-center location is used to uniquely determine the arm's direction of travel. (The final version of the unit does not use fiber optics bundles, except inside the brass tube. See figure 9 and accompanying text box.) At (b) are some examples of typical vectors passing over the retina, along with the corresponding calculator outputs.



Introducing the Monday Machine.

For under \$10,000 we give you Sol[®], the small computer system for electronic typing and general purpose data processing, to brighten your Monday and speed the workload all the way through Friday.

Are you looking for a way to handle your typing load faster and far more efficiently? Are you looking for an easy to use electronic typing system that you or your secretary can learn in a matter of hours? And are you looking for a general purpose data processing system capable of doing other tasks around the office such as mailing lists, general ledger, accounts payable/receivable and payroll?

Then you're looking for the Sol "Monday Machine."

It's simply the best small computer system!

You can store, edit and print out text as long as 110 pages. You get 750,000 bytes of memory on diskette. Plus a letter quality SolPrinter that runs at

480 w.p.m. And a video monitor.

For the past few months, we've been selling our Sol Systems to selected businesses prior to formal introduction. One of our customers, a legal firm, uses their Sol System to type wills and contracts. Precedents and standard paragraphs are stored on diskettes for easy access.

The staff of this law firm was trained to use the Sol System on a Saturday. By the next Friday, no one could figure out how the workload was handled without it. The secretarial staff told us our keyboard has a nicer feel than that of the well-known maker of typewriters and computers. When they aren't using the Sol System for word processing, they do the legal accounting and update the work-in-progress report.

Processor Technology knows computers and knows programs.

In the past two years, more than 10,000 Sol computers have been installed.

We're easily one of the most successful pioneers in the small computer field because our systems are sophisticated yet easy to use.

More information or a demonstration

Arrange for a demonstration now. Dial the toll free number below to find your local dealer. Or send in the coupon.

Processor Technology

Processor Technology Corporation
7100 Johnson Drive, Pleasanton, CA 94566
☐ Please send more information on your electronic typing and general purpose data processing system.
☐ Please arrange a demonstration too.

Name/Title _____

Firm _____

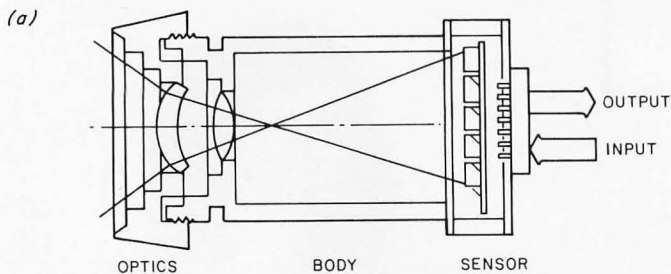
Telephone _____

Address _____

City/State/Zip _____

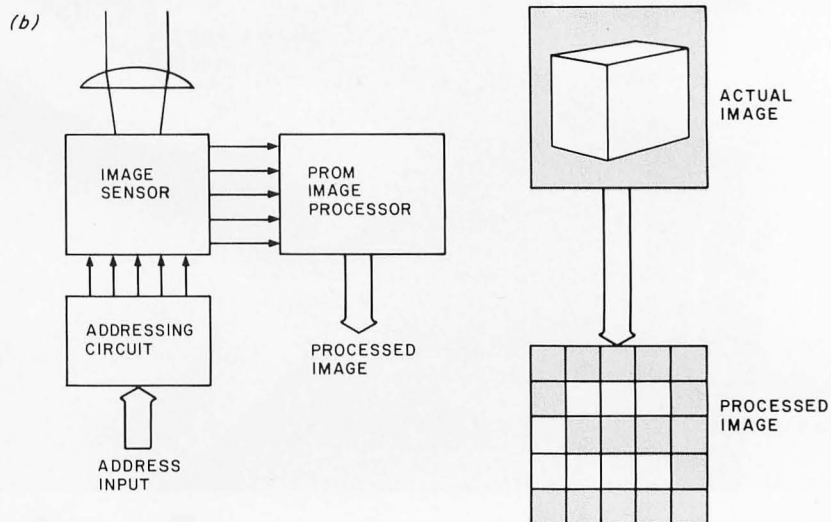
TOLL-FREE DEALER LOCATOR HOTLINE (800) 227-1241. In CA (800) 972-5951.

Dealerships available in selected areas.

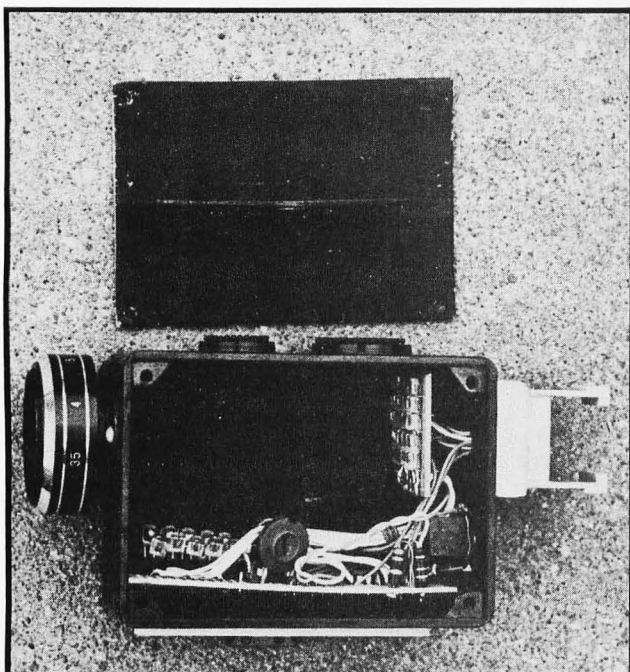


The figure numbering sequence for this article has been continued from part 1 (February 1979 BYTE, page 12).

Figure 7: Details of the sustained contrast detector. At (a) is a cross section of the unit, which resembles a television camera; (b) is a simplified block diagram of the system. The sustained contrast detector is used to obtain a rough image of the object to be grasped by the manipulator.



4(a)



4(b)



Photo 4: Interior of the sustained contrast detector. Shown at (a) is the lens (at left), the array of phototransistors (at right), and the associated electronics. 4b shows the 4 by 5 prototype array (compare with final version in figure 7).

I solved both problems by using a simple 6 digit, 4 function calculator integrated circuit, the National Semiconductor MM 50736. Before I began work on the neural logic cyberanimate, I had experimented with this device and found it to be compatible with photo-darlington transistors 2N5777 thru 2N5780. With the photo-darlington transistors as input devices, the calculator circuit could register pulsations of light from a diffused LED source more than two feet away. Clearly this device was capable of detecting bright objects at short distances. Additionally, it was possible to use the data processing nature of the calculator circuit to assign different values to the receptors and, based on these values, produce two distinct output signals. The weighted inputs were made simply by attaching one photo-darlington amplifier to the calculator circuit where the 1 switch of the keyboard would normally be connected, and a second photo-darlington to what would normally be the 0 position.

The two types of output signals are the results of the data which the photo-darlingtons receive. Note that there are only two photo-darlingtons connected to the calculator circuit in figure 6, yet I had previously stated that the minimum configuration for the net convexity detector was a matrix of 20. This is because I used fiber optic pipe for "receptors" and the photo-darlington devices as detectors. Figure 6b shows the arrangement of the optical fibers. 19 fibers have a value of 1 (they are equivalent to the low sensitivity receptors). All 19 of these fibers are fused to the photo-darlington that has a numerical value of 1. The remaining fiber is fused to the 0 value photo-darlington (to simulate the high sensitivity receptor). The completed device can detect and record the trajectory of a small moving penlight flashlight at a distance of 4 feet (well beyond the extended length of the manipulator); obviously, if the object's path does not cross the high sensitivity detector, the data is invalid.

Sustained Contrast Detector

Another structure derived from my analysis is a sustained contract detector (figure 7). This device is a spinoff of a previous electro-optic project. But without the analysis of the frog's eye I would never have considered this application. The sensor consists of a matrix of five rows by five columns of photo-darlington transistors (see photo 4). The columns of the sensor

are scanned by TTL (transistor-transistor logic) devices controlled by the computer. The 5 row output is fed into a programmable read only memory that serves two functions. First, the logic voltage level on the address lines of the programmable read only memory sets the on/off contrast levels for the sensors, thus eliminating the gray scale conversion problem. Second, the programmable read only memory is encoded with a truth table that can vertically reduce

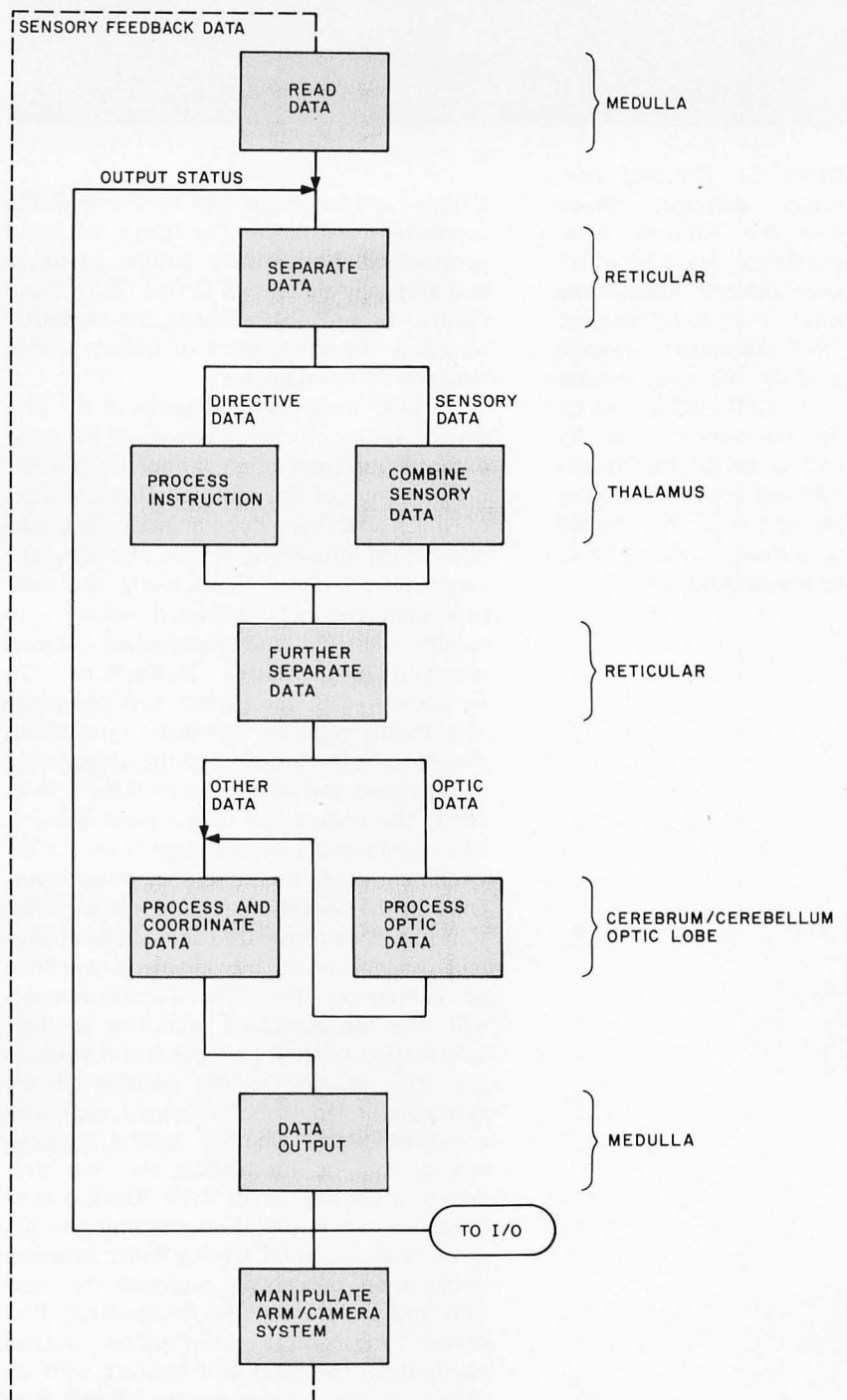


Figure 8: Simplified system flowchart, showing parallel functions in the brain.

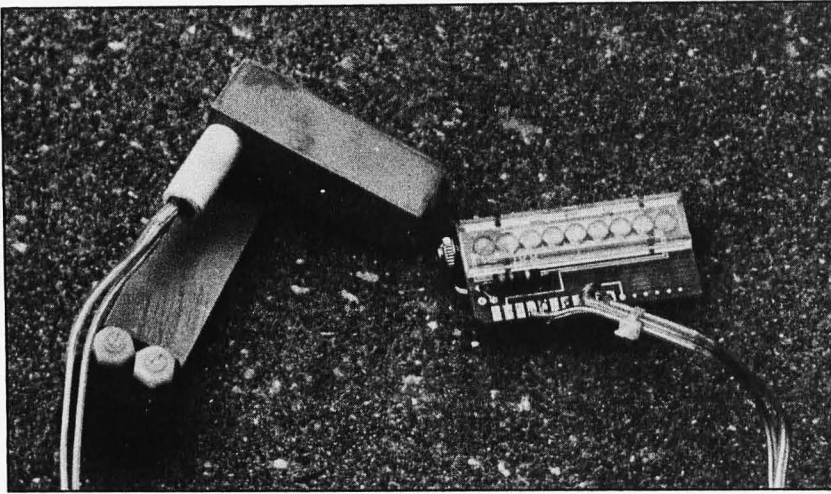


Photo 5: The net convexity detector, shown with the National Semiconductor NS 650 calculator module (connecting wires not fully visible). The calculator module used in the final version is an MM 50736, which has no readout. The NS 650 is useful for readers who will not be interfacing the unit to a computer immediately, since it does have a readout.

a high contrast image line by line with the computer's assistance. The image reduction process will horizontally outline an image and vertically dimension it (see figure 7 and photos 4a and 4b), enabling the computer to gauge the dimensions of objects within reach of the manipulator.

Finally, there was the design of the processing system. By designing all of the most external appliances first, I hoped to further define some of the required characteristics of the neural logic cyberanimate. The purpose of my processing system (including the computer program, preprocessing, and post-processing elements) as stated before, is to locate, classify, and manipulate objects specified by control instructions. To accomplish this, the system first has to be able to recognize the command instructions that specify the location of the object to be manipulated and what is to be done with it. Next, the system has to use measurements of pressure and reflected light from the environment made by the sensory instruments. Once in the processing system, this information has to be recognized and labeled. Incorrect or unnecessary measurements will then be eliminated. The filtered measurements will then be combined according to their information content (ie: optical and mechanical data relating to the position of the manipulator would be combined, etc). The combined data, whether optical, optical-mechanical, or mechanical, is then processed according to its type. Optical data is reduced to information pertaining to object size and location. Optical and mechanical information processing describes the location and position of the manipulator. Processed mechanical information relates manipulator position and contact with an object. Based on the results of this processing, the system then has to grasp and move the object as specified by the com-

mand instructions. Following this, the system notifies the command system.

The processing system uses an 8008 processor (not the best choice, but one which was chosen for expediency since I already owned one) interfaced to a series of 8223 programmable read only memories used to decode gray scale images, fire the LEDs in the optocouplers, and perform the various other tasks in the system.

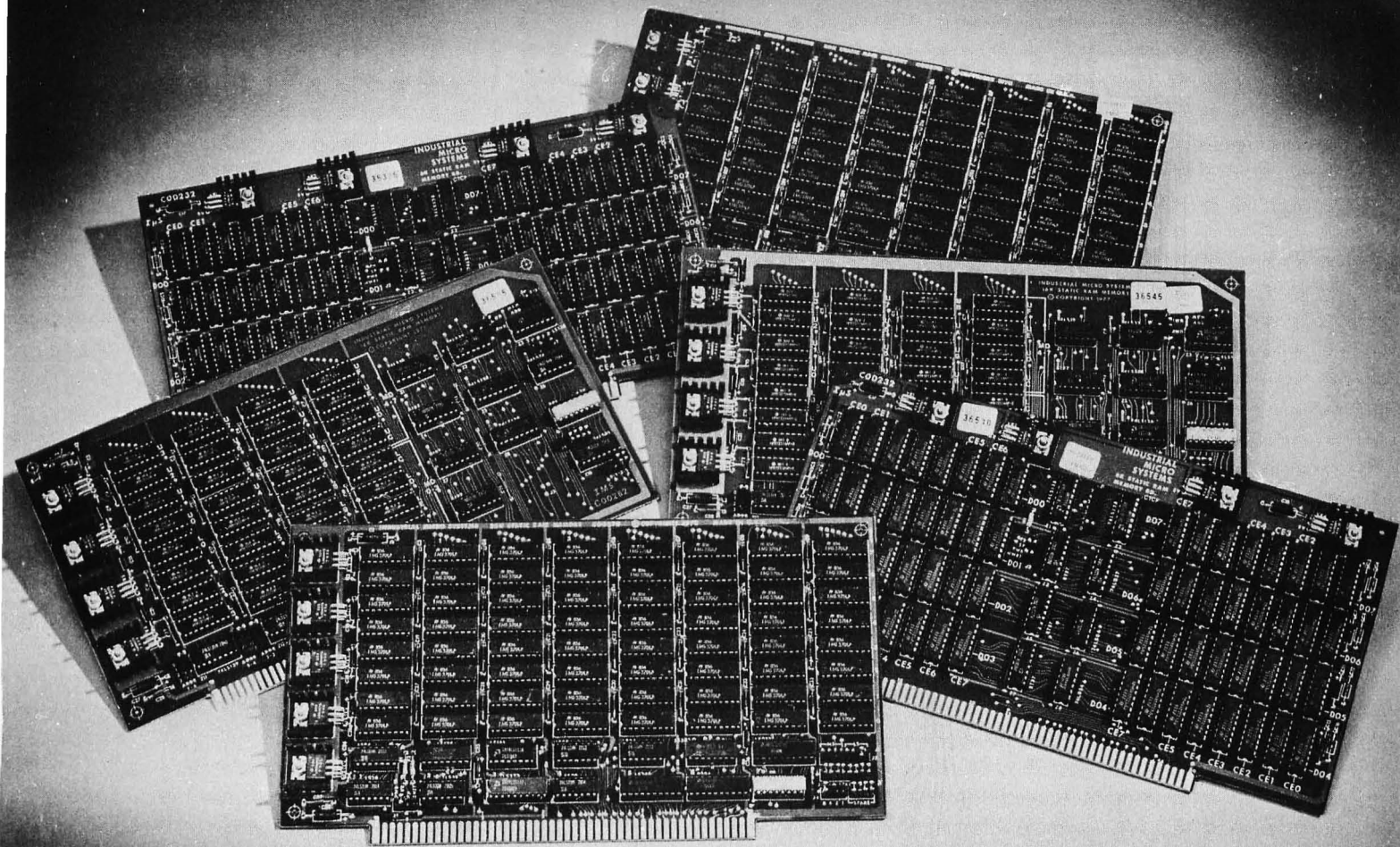
The algorithm for the NELOC system is diagramed in figure 8. Notice in the algorithm that sections of the program perform functions similar to those discussed in the cyberanimetric analysis of the brain. For example, monitoring, filtration, and suppression of sensory data, which are reticular functions, are performed in the program. Also in the algorithm are routines that combine sensory data, process and coordinate it, and control the input and output of data-functions that simulate those of the frog's brain. Another routine placed in the algorithm accepts instructions from the I/O and converts them into a form that can be used by the rest of the program. This routine makes it possible to control the system by external command.

During its trial operation, the neural logic cyberanimate performed quite well. With electric motors driving the manipulator arm, it took the system about 60 seconds to find and manipulate a test object. The most impressive feature of the system's operation is its ability to resolve the position of the manipulator and the test object.

Conclusion

During the design and construction of the NELOC system I encountered no major design problems because, from the start, it was possible to determine what portions of the system would be difficult to design or construct, and, therefore, I could budget my time and money accordingly. The benefits of clearly defining the organization of the system before designing the hardware are obvious. I put about 120 hours into the research, design, and construction of the prototype neural logic cyberanimate. If I had tried to develop these structures without the cyberanimetric philosophy, it would probably have taken much longer to design a net convexity detector or a reticular system.

Of course the NELOC system itself represents the equivalent of only a very thin neurological slice through a simple organism. By no measure is the neural logic cyberanimate intelligent, but I believe this design philosophy could be useful for designing systems beyond the simple servo system.



Remember our name if your memory goes blank

Sooner or later, you might have to replace a defective memory board in your system.

And if your present boards are built to "hobby" specifications, it'll probably be sooner.

That's when to remember our name — **INDUSTRIAL MICRO SYSTEMS, INC.** Every board we produce is built to industrial specs throughout; we don't stop at gold-plated contacts.

Remember our name when you're ready to expand your memory capacity, too. Our 16K and 32K boards feature Memory Management and Memory Mapping, respectively, which let you grow beyond the 64K limit.

We make six different static RAM memory boards for the S-100 bus, including 250 nanosecond

and 450 nanosecond versions of 8K, 16K and 32K sizes.

Although we've sold thousands, our name is unknown. That's because other quality-minded manufacturers and systems houses bury us in their products.

Now, however, you can select Industrial Micro Systems brand memory boards at retail computer stores everywhere. And get memorable quality at unforgettable prices.

For full details call your nearest dealer today. Industrial Micro Systems, 628 N. Eckhoff, Orange, CA 92668. (714) 633-0355.

Dealer inquiries answered promptly.

INDUSTRIAL MICRO SYSTEMS, INC

The great unknown.

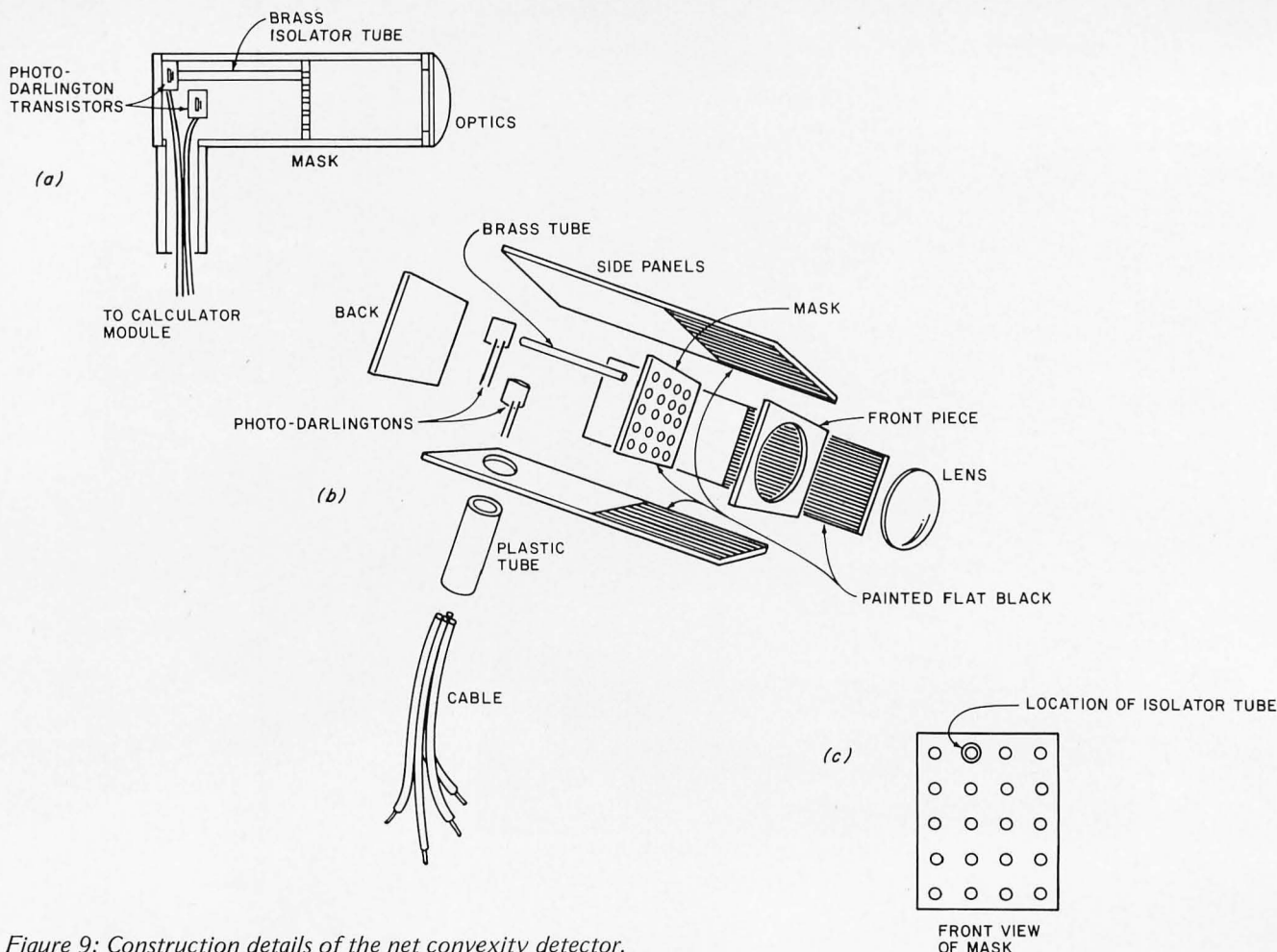


Figure 9: Construction details of the net convexity detector.

Building the Net Convexity Detector

The net convexity detector used in my system is a good example of how a calculator circuit can be used for noncalculator application. As illustrated in figure 9, the net convexity detector is a very simple device. The whole idea behind the circuit's operation is that the sensory head can, in effect, push the right keys on the calculator in response to the motion of an image that is a certain size and brightness. As explained previously, the purpose of the net convexity detector is primarily to define angle and direction of a small bright object. In this design, a mask is used as a template to gauge the diameter of an image. If a bright, moving image is small enough to illuminate only one hole of the template at a time, the calculator will register its movement as a series of numbers. If the image is too large, and illuminates more than one hole at a time, the calculator will display only one number that, in terms of a trajectory, would mean nothing.

To build the net convexity detector it is first necessary to build the sensor head. Figure 9b is an exploded view of the sensor. In the construction of the sensor it is necessary to use a lens that forms a focal point at a distance no shorter than 25 mm. Next a case is constructed from sheet plastic. This case should be at least twice as long as the focal point of the lens and must be able to hold a mask containing a 4 by 5 matrix of holes. The simplest way to make the mask is to use a piece of unclad perforated circuit board with holes 2.5 mm on center. Just cut a corner of the board off so the piece will have four by five holes. The mask must then be secured in the case so it will be at the lens's focal point. The inside of the forward end of the case must now be painted flat black. Two end pieces are cut, one is drilled to accommodate the lens and is glued to the front of the case. Next, a 4 lead cable is brought through a hole drilled in the end of the case. A short piece of plastic tube is glued over this hole and filled with epoxy to block light. Two photo-darlingtons are

attached to this cable. Notice in figure 9 how a length of brass tube is aligned with one of the photo-darlingtons. This tube must be located in the second column of the first row for the sensor to work properly. This tube carries the image to the 0 value darlington only. The tube must be carefully glued to the mask and the darlington by a very small amount of epoxy glue. The photo-darlington and epoxy joint are then painted black. Before attaching the back of the case, make sure that the 1 value photo-darlington is in the center of the case.

After the sensor has been completed, it is a simple matter to complete the circuit. A National Semiconductor calculator module, the NS 650, has all of the solid state electronics for a calculator, including a 6 digit display. By adding a battery, switch, and the sensor head (see figure 10), the circuit is finished.

To test the circuit, use a small penlite type flashlight, moving it in board circles at a distance of 3 feet away from the sensor. Many 1s and a few 0s should fill the display until the calculator indicates an overflow. If you move the light source on a straight vector that crosses the hole to the isolated

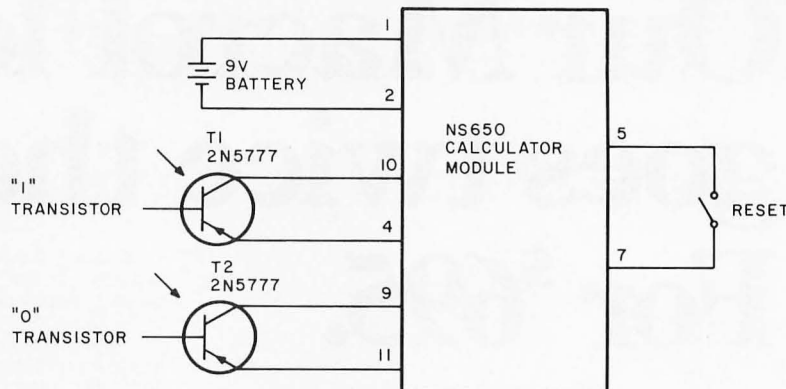


Figure 10: Circuit for the net convexity detector (pins numbered left to right as in the orientation in photo 5).

darlington you will get a certain readout. Figure 6b shows all of the possible fields of vectors, the direction that the object must be traveling, and the output that should be displayed by the calculator. All other combinations are illegal.

Although the net convexity detector is a very simple device, it must be built very precisely. All surfaces should be flush, parallel, or perpendicular. Optics should be carefully aligned and all seams should be checked for light leaks. ■

BIBLIOGRAPHY

Listed are 15 books, some containing information about amphibians, others concerning robot and artificial intelligence systems built by cognitionists and neural cybernetists. The books range from elementary to very complex.

Some of the data about the biological frog was obtained from the following sources:

Chiasson, R, *Laboratory Analysis of the Necturus*, Iowa, William C Brown Co, 1971.

Keeton, W T, *Biological Sciences*, New York, W W Norton and Co Inc, 1972.

Tansley, K, *Vision in Vertebrates*, London, Chapman and Hall Ltd, 1968.

The following are some simple introductory books on robots:

Calder, N, *Robots*, Roy, 1958.

Gennings, G, *March of the Robots*, New York, Dial Press, 1962.

Wells, R, *Bionics: Nature's Way for Man's Machines*, New York, Dodd, Mead, and Co, 1969.

Books at a more advanced level:

Cote, A J, *The Search for Robots*, New York, Basic Books Inc, 1967. (Neural cybernetics approach.)

Feigenbaum, E A (editor), et al, *Computers and Thought*, New York, McGraw-Hill Book Co Inc, 1958. (Cognition approach.)

Nilsson, N J, *Learning Machines*, New York, McGraw-Hill Book Co, 1965. (Perceptrons).

Wiener, N, *Cybernetics*, New York, The MIT Press and John Wiley and Sons Inc, 1955.

Some of the more technical books available are:

Collins, N L (editor), et al, *Machine Intelligence*, volumes 1 thru 8, New York, American Elsevier Publishing Co Inc, 1967. (Cognition approach.)

Jackson, P C, *Introduction to Artificial Intelligence*, New York, Petrocelli Books, 1974. (Cognition approach.)

Jaki, S L, *Brain, Man, and Computer*, New York, Herder and Herder, 1969. (Cognition approach.)

Mendel, J M, et al, *Mathematics in Science and Engineering*, volume 66, New York, Academic Press, 1970. (Cognition approach.)

Minsky, M, et al, *Perceptrons*, New York, Maple Press Co, 1965.

Rosenblatt, F, *Principles of Neurodynamics*, Washington DC, Spartan Books, 1962. (Neural cybernetics approach.)

Our MacroFloppy™ goes twice the distance. For \$695.

Introducing the Micropolis MacroFloppy™:1041 and :1042 disk drive sub-systems. For the S-100/8080/Z-80 bus. Packing 100% more capacity into a 5¼-inch floppy disk than anyone else. 143K bytes, to be exact. For as little as \$695.

The MacroFloppy:1041 comes with the Micropolis Mod I floppy packaged inside a protective enclosure (without power supply). And includes an S-100 controller, Interconnect cable, Micropolis BASIC User's Manual. A diskette containing Micropolis BASIC, and a compatible DOS with assembler and editor. The :1041 is even designed to be used either on your desk top, or to be integrated right into your S-100 chassis.

The MacroFloppy:1042 comes with everything the :1041 has, and more. Such as d.c. regulators, its own line voltage power supply, and, to top it off, a striking cover. Making it look right at home just about anywhere.

Both MacroFloppy systems are fully assembled, tested, burned-in, and tested again. For zero start-up pain, and long term reliability. They're also backed up by our famous Micropolis factory warranty.

And both systems are priced just right. \$695 for the MacroFloppy:1041 and \$795 for the MacroFloppy:1042.

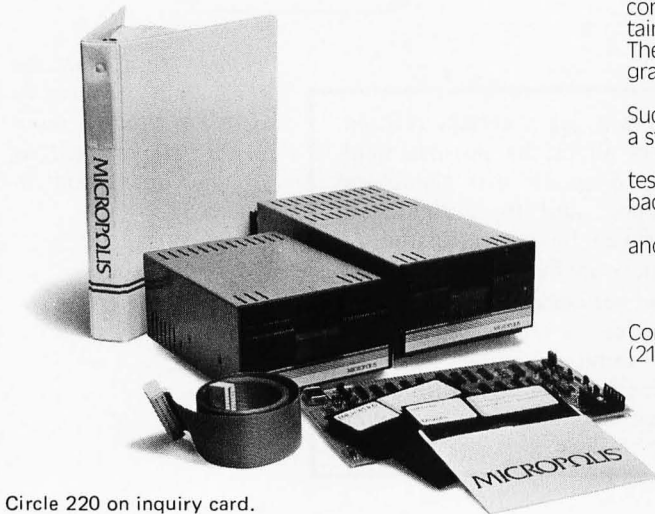
You really couldn't ask for anything more.

At Micropolis, we have more bytes in store for you.

For a descriptive brochure, in the U.S. call or write Micropolis Corporation, 7959 Deering Avenue, Canoga Park, California 91304. Phone (213) 703-1121.

Or better yet, see your local dealer.

MICROPOLIS™
More bytes in store for you.



Circle 220 on inquiry card.

Continued from page 13

along the entire back panel as well as the lower back corner of the mother board (5 VDC voltage regulators are on each circuit board). With two exceptions, everything went together easily, and exactly as presented in the assembly manual.

The first problem occurred when I attempted to install the self-retaining nuts in the side panels. For one thing, it can be very difficult to press these nuts into the very sturdy composition board unless they are gently tapped with a hammer. In addition, the part numbers for one of the nuts on the left side panel as illustrated in the assembly manual didn't correspond to the associated detail pictorial in the illustration booklet.

The only other problem I encountered during this stage of assembly was the installation of the side panels. Access to the side panel self-retaining nuts at the bottom rear corner of the chassis was obstructed by the previously installed screws and nuts that hold the rubber feet to the bottom of the chassis. My solution was to turn the chassis onto the side panel to be attached and insert and tighten the remaining screws to the appropriate panel.

The Mother Board

The mother board consists of two sections: a portion of the power supply, and ten rows of paired 25 pin plugs used later for connecting circuit boards and cables to the system bus. The installation of the plugs can be tedious. If you have not had much soldering experience, practice before you begin this board.

The most challenging part of the mother board assembly process is soldering some 500 pins which form the connectors for the individual boards of the system. The remainder of the board consists of a few capacitors, resistors, and diodes. There are, however, two instructions whose sequence should probably be reversed. Specifically, you are instructed to solder two electrolytic capacitors to the board and then secure each to the board with a self-locking cable tie. Reversing this sequence insures that no strain will be placed upon the soldered capacitor leads by the cable ties when they are tightened. The finished board is installed on the righthand side panel of the chassis after the twisted pair of 18 V leads from the power supply transformer are connected to the board. I had no trouble obtaining the proper resistance and power supply

MetaFloppy™ goes beyond.

The Micropolis MetaFloppy™ gives you more than four times the capacity of anyone else's 5¼-inch floppy. Because it uses 77 tracks instead of the usual 35.

The field-proven MetaFloppy, with thousands of units delivered, comes in a complete family of models. And, like our MacroFloppy™ family of disk drives, MetaFloppy is designed for the S-100/8080/Z-80 bus.

For maximum capacity, choose our new MetaFloppy:1054 system. Which actually provides you with more than a million bytes of reliable on-line storage. For less money than you'd believe possible.

The MetaFloppy:1054 comes complete with four drives in dual configuration. A controller. Power supply. Chassis. Enclosure. All cabling. A new BASIC software package. And a DOS with assembler and editor. There's even a built-in Autoload ROM to eliminate tiresome button pushing.

If that's more storage than you need right now, try our MetaFloppy:1053, with 630,000 bytes on-line. Or our MetaFloppy:1043, with 315,000 bytes on-line. Either way, you can expand to over a million bytes on-line in easy stages, when you need to. Or want to.

In other words, if your application keeps growing, we've got you covered. With MetaFloppy.

The system that goes beyond the floppy.

For a descriptive brochure, in the U.S. call or write Micropolis Corporation, 7959 Deering Avenue, Canoga Park, California 91304. Phone (213) 703-1121.

Or better yet, see your local dealer.

MICROPOLIS™
More bytes in store for you.



Circle 221 on inquiry card.

test readings outlined in the manual, and proceeded to the next step of assembly.

Front Panel Circuit Board

The H8 front panel control system has many features which make using the H8 a pleasure. One of these is the multifunction console keypad that provides users with direct, easy-to-use commands to operate the H8 without a terminal (see figure 1). Another feature is the 7 segment LED (light emitting diode) display system that displays a variety of system status information in an easy to read format not found on many larger 8 bit systems. We'll take a closer look at this unique system later, but first let's consider its assembly.

The entire assembly procedure is very straightforward. However, it is during the assembly of this board that a second rather tedious subassembly construction activity is encountered. In particular, it is necessary to prepare the cables that run from the board to the first row of plugs on the mother board and between the front panel and processor boards. The instructions and illustrations for this stage of construction are excellent and, if they are followed exactly, you should have no problems. The

work performed on the cables is rather delicate, requiring the same amount of care and patience needed while assembling the mother board. One construction hint: you are instructed to mount four single element LEDs on the upper left side of the board. Make sure that each LED is mounted at exactly the same height as the others (0.25 inches from the board to the base of each LED). This can be easily accomplished by cutting a piece of 0.25 inch wire and using this as a spacer placed underneath each LED between the pairs of LED leads prior to soldering each to the board.

The Processor Board

Another feature of the H8 is the processor board, which comes preassembled. This is a real advantage because many of the problems that computer kit builders encounter are caused by mistakes made during assembly or installation of the processor board (see photo 2).

With assembly of the circuit boards and chassis complete, all that remains is to install the components. Of course, the H8 does not come with other boards that are necessary to have a functioning computer, such as extra memory and an

USA

United Software of America



FREE! New March '79 Catalog

PET ■ TRS-80 ■ APPLE ■
EXIDY ■ IMSAI ■
COMPUCOLOR ■ AND others

- Thousands of programs • Low prices
- Solves all your software requirements
- Fully illustrated • One stop shopping

Here's a very small sample!

PET (P) APPLE II (A) TRS-80 (T)

BUSINESS—FINANCE

Stock Portfolio Analysis	\$24.95	P		
Mortgage Analysis	15.95	P		
Annual Report Analyzer	22.95	P	A	T
Stock Analyzer	34.95	P	A	T
Bonds	12.95	P		
Checkbook/8K, 16K, 32K	15.95	P		
Checkbook	20.00	P	A	
Finance	15.95	P		
Finance/2 tapes	24.95	P	A	
Stockscreen	29.95	P		T
Stock Options	24.95	P		T
Word Processing	45.00	P		
Electric Pencil	99.95	P		T
Library (100 programs)/5 tapes	49.50	P		T

EDUCATION

Basic Basic/2 tapes	\$14.95	P		
Number Builder	9.50	P	A	T
Analogies Builder	9.50	P	A	T
Vocabulary Builder/2 tapes	12.50	P	A	T
Preschool IQ Builder	9.50	P	A	T
Diet Planner/Biorhythm	14.95	P		
6502 Assembler	24.95	P	A	
Step by Step Programming	29.95	P	A	T
Electronics	7.95	P		T
HAM Package	7.95	P		T
Weight Control	7.95	P		
Learn Fractions (Elem.-HS)	7.50	P		
Pilot (Mayday Landing)	10.50	P		

GAMES

Microchess	\$19.95	P	A	T
Checkers	14.95	P		T
Bridge Challenger	14.95	P	A	T
Super Startrek	14.95	P	A	
Swarm 8K	14.95	P		
Swarm 16K	19.95	P		
Galaxy Games	9.95	P		
Spacetrak	9.95	P		
Spacetrak	9.95	P		T
Osero/Reverse	9.95	P		
Target Pong	9.95	P		
Blackjack	9.95	P		
Lunar Lander (plus 3 more)	9.95	P		
Lunar Lander	7.95	P		T
Battle of Midway	9.95	P		
Hostage/Jury	9.95	P		
Blackjack/Slot	7.50	P	A	
Color Math/Hangman	7.50	P	A	
Biorhythm/Mastermind	7.50	P	A	
States and Capitals	7.95	P	A	
Backgammon	7.95	P		
Casino I (blackjack)	7.95	P		
Casino II (craps)	7.95	P		
Golf	7.95	P		T
Library (100 programs)	49.50	P		T
Backgammon	12.95	P	A	T
Space Maze	9.95	P		
Apple II Organ	19.95	P		
Rocket Pilot	9.95	P	A	
Saucer Invasion	9.95	P		A

SORCERER \$14.95 each

Beat the House • Clinic • Outwit • Outwit II • Adventure • The Market • Blockade

IMSAI

General Ledger	\$750
Inventory Control	350/750
Inventory Control (with invoicing)	950
Word Processing	225
Cash Receipts/Disbursement	150 each

COMPUCOLOR II - \$19.95 each disk

MATH TUTOR—with Checkbook, Bio rhythms, Math Dice, and Recipe	PERSONAL FINANCE I
CHESS—with Acey Deucey & Line 5	PERSONAL FINANCE II
STARTREK—with Lunar Lander	EQUITY
OTHELLO—with Dice & Concentration	BONDS AND SECURITIES
HANGMAN—with Math Tutor, 2 on 10	BLACKJACK

TOLL FREE

800-223-7318

Send 30¢ in stamps or coins to cover postage. (Dealer inquiries invited.)

750 Third Avenue New York, N.Y. 10017

American Express
Master Charge and
VISA accepted

The following are \$24.95 each
TEXT EDITOR • ASSEMBLER

I/O (input/output) board. These are options the user purchases when buying an H8 (and most other computers, for that matter).

The Memory Board

If you want to use your H8 without external devices, the H8-1 memory board is the only other board you will need. The H8-1 is a 4 K byte programmable memory board which can be extended to a full 8 K by installing the optional H8-3 memory chip set. This board is easy to assemble, and not much more need be said about it — nothing, that is, except a short story about a mistake I made which also points to another nice feature of the H8.

Briefly, it happened like this: I was assembling the H8's circuit boards with extreme care, paying particular attention to the quality of the instructions and illustrations and making notes in my manuals I might want to use later. On the evening I started putting the memory board together, friends dropped over, and because the board looked so simple to put together, I decided to put part of it together while we relaxed and chatted. As a result of my divided attention, I installed a 14 pin IC socket in a 16 pin socket location.

One of my visitors was just beginning to get interested in computers (which was part of my reason for doing some of the assembly while company was around) and I showed her the partially completed board. She looked at it, asked a few questions, and then said, "What are those holes for by the end of that socket?"

I turned a bit red — I had blundered in the middle of a demonstration. Well, for the next 45 minutes we struggled to remove the socket, clean out the solder that was plugging the holes in the board and refit another socket. The H8 as well as its accessory kits come with sockets for all of the ICs including the 7 segment displays. If you ever need to replace an IC, you won't have to struggle with unsoldering it and cleaning off the board. And you won't have to pay extra for the socket sets when you buy the kits. The finished board is shown in photo 2.

The H8-5 SIO Board

If you want to connect your H8 to a console terminal or use the system software stored on cassette tape, you'll also want the H8-5 serial I/O and cassette interface board. It took quite a while to assemble because of its relatively high component density, but it presented no construction problems.

Testing and Alignment

After assembling the basic H8 system, you are instructed to perform three program-mable test routines as well as an alignment of the cassette interface. The first test routine is a short program entered in machine code through the front panel keypad. The routine performs a general check of the H8 and at its end-of-run displays several messages on the front panel LEDs (ie: YOUR H8... IS UP AND... RUNNING). If the test routine does not execute properly, the reader is directed to an extensive trouble-shooting flowchart that is ten pages in length and very clearly written. I had no trouble at this point and proceeded to the next test routine.

The second of the two routines is a memory test routine. It is also entered in machine code through the front panel keypad. The program performs a thorough test of every memory location on any 4 K or 8 K byte memory board by storing and retrieving consecutive octal values from 000 through 377 in every memory location. If an incorrect value is detected during a compare operation, the program halts, sounds an audio alert, and displays the expected (rather than observed) contents of the location where the test failed. The address where the test fails and the actual (or observed) contents of memory at that location can both be displayed on the LEDs by displaying the contents of the HL register pair and the accumulator, respectively. If no problems are encountered during execution of this routine, it will continue to repeat the test cycle until stopped by the user. Everything worked fine for me as I watched the memory content values go sailing by in the display.

The last task to be performed is the alignment of the cassette interface on the cassette I/O board. The procedure consists of setting the two variable resistors on the board to the correct positions as indicated by the readout on an on board single element LED test lamp. This LED also comes in handy later for troubleshooting the H8's circuitry. The adjustments were quite tricky to make, but after two tries and a number of test loads of software cassette tapes, it worked very well. Had it not worked, I could have referred to another trouble-shooting flowchart to locate the problems.

But everything did work. I proceeded to play around with the keypad commands, becoming familiar with what made my H8 "tick." Finally it was time to install the front panel cover and the louvered metal chassis cover. I connected the serial I/O

Up Your Output.

TEMPOS

MULTI-TASKING!

The TEMPOS Operating System is quickly becoming the standard in Multi-User, Multi-Tasking operating systems for 8080 and Z80 microcomputers. Multi-Tasking means that, even with only one user at one terminal, more than one job can be running on the system *simultaneously*! If you have ever had to go get a cup of coffee while you wait for your computer to print listings, you *know* the advantages of a system that will handle one job while you are working on another. TEMPOS is a true time sharing system, and the maximum number of jobs is limited only by your memory.

MULTI-USER!

Want to share your computer with another user? With TEMPOS all it takes is another terminal... up to seven interactive terminals are allowed! And with Re-Entrant programs, each user does not need a complete copy in memory. We include three Re-Entrant programs (the OPUS/THREE High-Level Language, the TEXTED Text Editor, and FILES, a disc file directory/manipulator) or write your own! In addition, we include an assembler, a linking loader, over a half-dozen other utility programs and over 60 system subroutines, callable by the programmer!

PROVEN!

With TEMPOS, you get a package that has been tested in our facilities for over two years, and in the field at over 50 different installations. We have used this system ourselves for everything from writing high-level languages to developing applications to text editing to games. TEMPOS is undoubtedly the most flexible software tool on the market... and you can have it for much less than you think!

COMPATIBLE!

TEMPOS is available for many different systems; pre-written drivers may include yours. Or, using our interactive System Generation Routine, you can add your own. Call or write *now* for our free catalog and the name of a dealer near you. The TEMPOS Operating System is available for \$787.00, the manual set (price may be credited toward the purchase of the TEMPOS package) for \$21.50 (prices include shipping within the U.S.).

ADMINISTRATIVE
SYSTEMS
INC.

1642 S. Parker Road, Suite 300, Denver, Colorado 80231
(303) 755-9694

TRS-80 Software Exchange

With so many new names on the street, it's good to know that one company has been producing and distributing top quality software for the TRS-80 for almost as long as there has been a TRS-80.

MASTERMIND	Level I or Level II 16K.....	\$7.95
ROBOT	Level II 4K.....	\$4.95
'ROUND THE HORN	Level II 16K.....	\$7.95 *
3-D TIC TAC TOE	Level I or II 16K.....	\$7.95
CONCENTRATION	Level I or II 16K.....	\$7.95
SANTA PARAVIA	Level II 16K.....	\$9.95
WHEEL OF FORTUNE	Level II 4K.....	\$4.95
REMAINDER	Level I or II 4K.....	\$4.95
TIME BOMB	Level I or II 16K.....	\$7.95
CRIBBAGE	Level I or II 16K.....	\$7.95
END ZONE	Level I or II 16K.....	\$7.95
BREAKAWAY	Level I or II 4K.....	\$4.95
TROLL'S GOLD	Level II 16K.....	\$4.95
STAR TREK III	Level II 16K.....	\$14.95
X-WING FIGHTER	Level II 16K.....	\$7.95
PORK BARREL	Level II 16K.....	\$9.95
BRIDGE CHALLENGER	Level II 16K.....	\$14.95
CHECKERS	Level I 4K.....	\$4.95
SARGON	Level II 16K.....	\$19.95
MICROCHESS	Level I or II 4K.....	\$19.95
CASH REGISTER	Level I or II 4K.....	\$10.00
INVENTORY-MOD	Level I or II 16K.....	\$20.00
TEXT EDITOR	Level II 4K or 16K.....	\$9.95
FILE HANDLING	Level II 16K.....	\$9.95
ACCT. RECEIVABLE	Level II 16K.....	\$25.00
INVENTORY MGMT.	Level II 16K.....	\$25.00
SMALL BUS. BOOKKEEPING	Level I 4K or II 16K.....	\$15.00
BIORHYTHMS	Level I or II 4K.....	\$3.95 *
MICRO TAX '78	Level II 16K.....	\$12.95
TAROT	Level I or II 16K.....	\$7.95 *
MORTGAGE CALC.	Level II 4K.....	\$4.95
HOME FINANCE MGMT.	Level II 16K.....	\$9.95
PERSONAL FINANCE	Level II 16K.....	\$9.95
8080-280 CONVERSION	Level II 16K.....	\$12.00 *
RENUMBER	Level II 4K — 48K (specify).....	\$15.00
ZONE HOCKEY	Level I 4K.....	\$4.95
TEN PIN	Level II 16K.....	\$7.95 *
PREFLIGHT	Level II 16K.....	\$20.00
BACKGAMMON	Level II 16K.....	\$7.95
CHESS COMPANION	Level II 16K.....	\$7.95

DISK SOFTWARE

INVENTORY 2.0	.....	\$39.95
INVENTORY 2.2	.....	\$59.95
ACCT. RECEIVABLE	.....	\$59.95
PAYROLL	.....	\$59.95



*Special prices in effect for 30 days

Credit card orders accepted by phone



To order any of the programs listed above, and to receive our complete catalog of TRS-80 software currently available on cassette, disk or in source code listings, call or write:

17 Briar Cliff Drive Milford, New Hampshire 03055

TRS-80 Software Exchange

cable to my H9 video terminal and was ready to do the final test routine for the serial I/O channel on the serial I/O board. It consists of setting up the USART (universal synchronous/asynchronous receive/transmit device) assigned to this channel and transmitting and receiving characters to and from the terminal. I was amazed at how easy it was to do I/O routines from the front panel. The final test was completed, so I left my system for awhile to return to the H8 operating manual and software manual set.

The Benton Harbor Bus

The Benton Harbor Bus represents a departure from the S-100 bus, which has become one of the "standards" of the microcomputer industry. The H8 system bus uses only 50 lines, compared with the 100 lines of the S-100. Since the S-100 was designed early in the history of the microcomputer industry, it incorporates bus lines which are no longer needed or which have been replaced by more recent system control hardware.

Manufacturing costs are kept down by not having to machine an edge connector tongue, not using gold plated edge connectors, and replacing the expensive 100 pin socketing system of the S-100 with much less expensive plug and socket sets which are assembled by the user.

Another feature found on the H8 is its convection cooling system. This system has been designed so that power supply voltage decreases slightly every time a circuit board is added to the mainframe. As more boards are added, the proportional amount of heat dissipation from each circuit board regulator also decreases. It is for this reason that you are instructed to "locate circuit boards in alternating positions for improving ventilation." When the time comes to add boards to the unoccupied alternating rows of plugs on the mother board, the effective heat dissipation will be low enough to position boards adjacent to one another. To improve upon this scheme, all circuit boards are installed on a slant to facilitate the convection cooling process. The end result is a quiet running machine which does not require the added cost of a fan to keep component temperatures down.

Costs are also kept down by the size of the H8's power supply. I saved a lot of money by not buying an 8 bit machine with a large power supply. The fact is that you pay dearly for every extra and often unused ampere that a power supply delivers. In this regard, the H8 delivers a full 10A,

which is sufficient to operate all of the boards that the chassis can hold — up to seven in addition to the front panel and processor boards. It is also switch-selectable for operation on either 110 or 220 VAC, an advantage for European users. It also includes a switch for normal or low level line voltages, which may come in handy in case of a brownout — you'll need a separate generator for a blackout.

Split-Octal Notation

Before going on to discuss the firmware that coordinates many H8 operations, we should first describe the type of machine language code notation used by the H8. The H8 uses a number system called split octal, a modification of straight octal that is well suited to 8 bit computers like the H8. It is also well suited for the H8 display system, as you will see.

Split-octal notation is identical to octal notation except that the two most significant bits of each pair of data bytes are represented by one arabic numeral. In this scheme 377 is the highest value that can be represented by one 8 bit byte (ie: word) of data. Thus:

$$377 = \underbrace{11}_3 \underbrace{11}_7 \underbrace{11}_7$$

And, the highest value that can be represented by two 8 bit bytes of data would be 377.377. The H8 defines 1 K bytes of memory as 003.377 bytes and 8 K bytes of memory as 037.377 bytes. The H8 is designed to reserve certain portions of memory for the system monitor and later system expansion as shown in the H8 memory map (see figure 2).

PAM-8, the Front Panel Monitor

The functions and features discussed above are tied together by another H8 feature — the front panel monitor — which resides in 1 K bytes of read only memory on the processor board. It also controls such activities as initializing the system during power-up, coordinating tape loads and dumps, communication with the Console Driver routine (part of every Heathkit software package), processing restart and clock interrupt vectors, and processing user defined interrupt requests.

H8 Software

Someone once said a computer system is no better than the software that comes with

Here's Your BRAND At Our GREAT PRICE With LIGHTENING FAST DELIVERY.

ITEM CODE	DESCRIPTION	LIST PRICE	CASH* PRICE
MAINFRAMES			
NS-H-1/D	North Star Horizon 1 Doub. Dens Kit	\$1599.	\$1339.
NS-H-1/D/A	North Star Horizon 1 Doub. Dens Assm.	\$1899.	\$1595.
NS-H-2/D	North Star Horizon 2 Doub. Dens Kit	\$1999.	\$1679.
NS-H-2/D/A	North Star Horizon 2 Doub. Dens Assm.	\$2349.	\$1973.
IM-PCS-40	IMSAI PCS-40 180KB Disk	\$2695.	\$2275.
IM-PCS-42	IMSAI PCS-42 400KB Disk	\$2995.	\$2535.
IM-PCS-44	IMSAI PCS-44 780KB Disk	\$3695.	\$3125.
IM-VDP-44	IMSAI VDP-44 780KB Disk System	\$4995.	\$4195.
CR-Z2	Cromemco Z2 Kit	\$ 595.	\$ 536.
CR-Z2/A	Cromemco Z2 Assm.	\$ 995.	\$ 896.
CR-Z2D	Cromemco Z2D Kit	\$1495.	\$1345.
CR-Z2D/A	Cromemco Z2D Assm.	\$2095.	\$1886.

MEMORIES			
NS-16K	North Star 16K 250ns RAM Kit	\$ 399.	\$ 319.
NS-16K/A	North Star 16K 250ns RAM Assm.	\$ 459.	\$ 369.
DY-MS1625	Dynabyte 16K 250ns Static RAM Assm.	\$ 555.	\$ 444.
DY-MS3225	Dynabyte 32K 250ns Static RAM Assm.	\$ 995.	\$ 795.
SE-8KZ	Seals 8K 250ns RAM Assm.	\$ 280.	\$ 175.
CR-BSK-2	Cromemco 8K Bytesaver Kit	\$ 145.	\$ 131.
CR-BSK-2/A	Cromemco 8K Bytesaver Assm.	\$ 245.	\$ 221.
CR-BSK-32	Cromemco 32K Bytesaver Kit	\$ 195.	\$ 176.
CR-BSK-32/A	Cromemco 32K Bytesaver Assm.	\$ 295.	\$ 266.

INPUT/OUTPUT BOARDS			
IM-SIO2-2	IMSAI SIO2-2 Kit	\$ 156.	\$ 133.
IM-VIO-C	IMSAI VIO-C Kit	\$ 325.	\$ 276.
CR-TUART	Cromemco TU-ART Kit	\$ 195.	\$ 176.
CR-TUART/A	Cromemco TU-ART Assm.	\$ 295.	\$ 266.
CR-PIO8	Cromemco 8-Port I/O Kit	\$ 195.	\$ 176.
CR-PIO8/A	Cromemco 8-Port I/O Assm.	\$ 295.	\$ 266.

FLOPPY DISK SYSTEMS			
NS-MDS/D	North Star Doub. Dens. Micro Disk Kit	\$ 699.	\$ 587.
NS-MDS/D/A	North Star Doub. Dens. Micro Disk Assm.	\$ 799.	\$ 671.
MI-1042M1	Micropolis 143K Macrofloppy Assm.	\$ 795.	\$ 675.
MI-1043M2	Micropolis 315K Metafloppy Assm.	\$1145.	\$ 973.

*This price is for payment by check or money order. Credit card prices slightly higher. Prices F.O.B. our warehouse-shipping extra.

• ALL ITEMS COMPLETE AND FACTORY-FRESH WITH FULL MANUFACTURER'S WARRANTY.

TERMS:

Shipping Charges: \$12 for Mainframes, Floppy systems, or large units;
\$1.75 per board.
\$2.25 minimum per order.

Delivery is stock to 30 days on most items. Shipment is immediate for payment by cashiers check, money order or charge card. Allow 3 weeks for personal checks to clear.

N.Y. state residents add appropriate sales tax.

Availability, prices and specs may change without notice.

HOURS:

Monday-Friday 10-5
Eastern Time
Closed Sat. and Sun.

**computer
enterprises**

P.O. Box 71 • Fayetteville, New York 13066 (315) 637-6208

it. This is as true for large computers as it is for microcomputers. The H8 software packages are intended to function as an integrated system. They include TED-8, a line oriented text editor; HASL-8, a machine language assembler; BUG-8, a machine language debugger; and Benton Harbor BASIC, Heathkit's version of the popular interactive programming language created many years ago at Dartmouth College. Let's see what they're all about.

Common Elements

Each of these software packages contains a console driver routine that enables the H8 to communicate with a user's console terminal (Teletype, video display terminal, etc) and a cassette or paper tape transport. It occupies 355 decimal bytes of programmable memory in each software product from locations 040.100 through 041.144. Thus, all of the console driver routines are available to users for special purpose modifications as well as for use in user designed software which would benefit from using the same I/O routines, including I/O port assignment. It is responsible for processing console terminal interrupts, setting up and reading USART (universal synchronous-asynchronous receiver-transmitter) modes, commands and statuses, processing control characters (such as CTL-C, CTL-Q, and CTL-S), reading and writing single characters, and processing character strings in the 28 character type-ahead buffer. During interrupt processing, the console driver interacts with the PAM-8 system monitor. The entire listing of the console driver routine in assembly language is provided in an appendix to the software manuals. As in the case for the monitor, the console driver routine and all

other software for the H8 were developed for Heath by Wintek. The Heath Company cannot (under contract with Wintek) provide any listings other than the partial listings presented in the software manuals, and "cannot provide consultation on user developed programs or modified versions of Heath software products." However, with a homebrew disassembler or memory dump routine and the partial listings provided, you might not have too much difficulty in generating your own unofficial versions of the source codes.

Another common element to all Heath software products is the software configuration procedure that must be performed before any software distribution tape is loaded into the H8. The procedure provides opportunities for the user to adapt each software package to his or her own needs. A list of program configuration parameters is presented to the user, who can then define items such as BKSP, which allows the user to define which key will be used to control the backspace function, HIGH MEMORY, which allows the user to specify that section of high memory that he or she does not want used by the system program, and LOWER CASE, which allows the user to select either upper and lower case or upper case only I/O to the terminal.

A third element common to all Heath software products is command completion. The feature allows the user to enter the first letter(s) of a program command, whereupon the software routine, in conjunction with the console driver, will print out the remainder of the command. For example, a text editor allows the PRINT command to be evoked by typing P, and the system responds with RINT, completing the command. The problem is that, if one is a fast

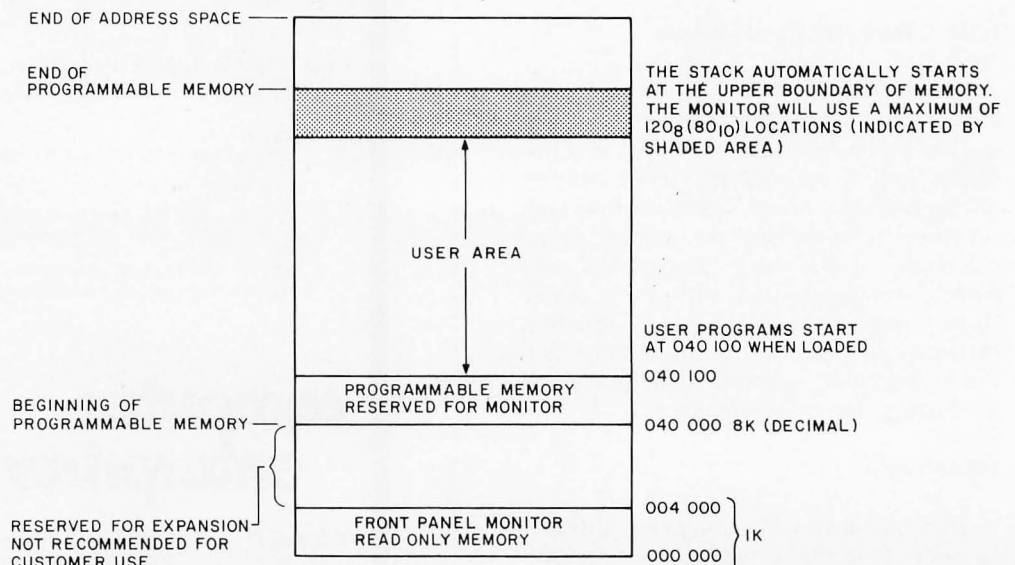


Figure 2: The H8 memory map.

INTRODUCING DUAL DRIVE MINIFLOPPY FOR PET!

A FULL RANGE
OF PERIPHERALS
TO COMPLETELY
SUPPORT YOUR PET



PROFESSIONAL
SOFTWARE
SUPPORT

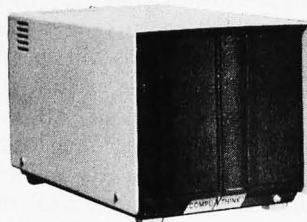


A TOTALLY
INTEGRATED
PET* SYSTEM



DOMESTIC & OVERSEAS DEALER INQUIRIES INVITED ON DISK SYSTEM & MEMORY

NOW THE DISKDRIVER DUAL DRIVE DISK SYSTEM CAN ADD TOTAL SYSTEM CAPABILITIES TO PET!



THE DISKDRIVER,
DOS, AND EXPANDAPET
ARE ALL PRODUCTS OF
COMPUTHINK

- * DUAL MINI FLOPPY DRIVE (5.5") WITH 100K PER DISK SIDE FOR TOTAL 200K ON LINE.
- * EXPANDABLE IN MARCH/APRIL 1979 TO 400K ON LINE VIA DOUBLE DENSITY FORMAT.
- * DISKMON-DISK OPERATING SYSTEM (DOS) IS RESIDENT IN PROM VIA DISK CONTROLLER BOARD THAT PLUGS DIRECTLY INTO THE INTERNAL EXPANDAPET MEMORY BOARD.*
- * DISKMON COMMANDS EXIST SIMULTANEOUSLY WITH THE BASIC LANGUAGE COMMANDS.
- * DISKMON ADDS 16 COMMANDS TO BASIC INCLUDING DISK DATA FILE COMMANDS.
- * DESIGNED FOR COMMERCIAL SPEED REQUIREMENTS — READS AN ENTIRE TRACK AT A TIME.
- * DISK DRIVES ARE AUTOMATICALLY TURNED OFF BETWEEN COMMANDS FOR LESS WEAR.
- * EXCELLENT DOCUMENTATION AND FULL SOFTWARE SUPPORT VIA FUTURE SOFTWARE.
- * DISKMON AUTOMATICALLY SUPPORTS COMMERCIAL TYPE PRINTER (CENTRONICS MODELS) VIA PARALLEL PORT.
- * DISKDRIVER COMES COMPLETE WITH ATTRACTIVE BEIGE CABINET, BUILT IN POWER SUPPLY, DISK CONTROLLER BOARD, ALL PLUG COMPATIBLE WITH YOUR PET (DISKDRIVER REQUIRES THE EXPANDAPET)
- * NOW FOR THE FIRST TIME YOUR PET CAN BE UTILIZED AS A COMPLETE, TOTAL SYSTEM.
- * APPLICATION/DEVELOPMENT SOFTWARE AVAILABLE * BUSINESS PACKAGES IN MARCH/APRIL.
- * FULL PRODUCT (HARDWARE & SOFTWARE) SUPPORT FROM COMPUTHINK AND DEALERS.

HARDWARE/SOFTWARE PRODUCT DIRECTORY

DKH642-1	DISKDRIVER DUAL DRIVE MINIFLOPPY SYSTEM (200K ON LINE STORAGE)	\$1295
EXPMEM	EXPANDAPET MEMORY EXPANSION BOARD (SPECIFY 16K, 24K, 32K) 16K MODEL	\$ 425
PRT200	CENTRONICS COMMERCIAL PRINTER (MODEL 779-1) WITH FRICTION FEED	\$1245
PRT202	CENTRONICS COMMERCIAL PRINTER (MODEL 779-2) WITH TRACTOR FEED	\$1345
PRT100	AXIOM HOBBYIST PRINTER (ELECTROSTATIC 5.5" WIDE PAPER) APPROX.	\$ 450
NPK101	NEECO PERIPHERAL KEYBOARD (TYPEWRITER TYPE) AVAILABLE JAN.	\$ 140
ASG200	PET ASSEMBLER PROGRAMMER'S GUIDE (SHOWS HOW TO TAP INTO BASIC)	\$19.95
ASM789D	PET ASSEMBLER 6502 PROGRAMMING SOFTWARE (ON DISK—WITH MANUAL)	\$49.95
LNK456D	AUTOLINK PROFESSIONAL LINKING LOADER SOFTWARE (ON DISK—WITH MANUAL)	\$49.95
EDT392D	ASSEMBLER-EDITOR, ASSEMBLER SOURCE PROGRAM EDITOR (ON DISK—WITH MANUAL) ..	\$49.95
DUG078	DISKMON USER'S GUIDE (PROVIDED WITH SYSTEM—CAN BE PURCHASED SEPARATELY)	\$ 9.95
DKL067	DISKMON (DOS) ASSEMBLER LISTING IN MANUAL FORM	\$19.95
FOR112	FORTRAN COMPILER FOR DISKDRIVER SYSTEM (AVAILABLE JAN./FEB.)	\$69.95
PLM118	PROFESSIONAL PLM COMPILER FOR DISKDRIVER (AVAILABLE JAN./FEB.)	\$49.95
FUTURE	BUSINESS AND PROFESSIONAL PACKAGES STARTING IN JAN./FEB.	

* NOTE PET IS A TRADEMARK OF COMMODORE AND IS SOLD ONLY BY AUTHORIZED DEALERS.

NEECO

EASTERN U.S. & EUROPEAN
NEW ENGLAND ELECTRONICS
248 BRIDGE ST.
SPRINGFIELD, MASS., 01103
(415) 854-2577

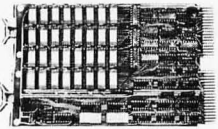
COMPU  **THINK**

WESTERN U.S. & CANADA
COMPUTHINK
3260 ALPINE ROAD
MENLO PARK, CA., 94025

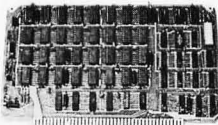
64KB MICROPROCESSOR MEMORIES

- **S-100 - \$695.00**
- **LSI 11 - \$890.00**
- **6800 - \$995.00**

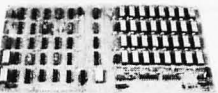
CI-S100 64K x 8



CI-1103 32K x 16



CI-6800 64K x 8



CI-8080 64K x 8

CI-S100 — 64K x 8 on a single board. Plugs directly into the IMSAI, MITS, TDL, SOL and most other S-100 Bus computers. No wait states even with Z80 at 4Mhz. Addressable in 4K increments. Power requirement 6 watts. Price \$695.00.

CI-1103 — 8K words to 32K words in a single option slot. Plugs directly into LSI 11, LSI 11/2, H11 & PDP 1103. Addressable in 2K increments up to 128K. 8K x 16 \$390.00. 32K x 16 \$890.00 qty. one.

CI-6800 — 16KB to 64KB on a single board. Plugs directly into Motorola's EXORcisor and compatible with the evaluation modules. Addressable in 4K increments up to 64K. 16KB \$390.00. 64KB \$995.00.

CI-8080 — 16KB to 64KB on single board. Plugs directly into Intel's MDS 800 and SBC 80/10. Addressable in 4K increments up to 64K. 16KB \$390.00. 64KB \$890.00.

Tested and burned-in. Full year warranty.



Chrislin Industries, Inc.

Computer Products Division

31352 Via Colinas • Westlake Village, CA 91361 • 213-991-2254

Circle 47 on inquiry card.

typist or has used computer terminals before, one tends to enter too many beginning characters and thereby cause an error. For example, I still haven't gotten used to typing just P to evoke the print command. So what happens? I type out the entire command, PRINT, and the result is PRINT RINT. The problem is even more bothersome because the command completion for some of the same commands is different for different software. Using the text editor (the above example), typing just P evokes the RINT completion; using BASIC, a PR evokes the INT completion.

TED-8, the Heath Text Editor

A text editor turns the user's terminal into a typewriter of sorts with the added capability to store what is typed into memory, and to edit the contents once stored. It is essential for writing assembly language programs and for preparing various kinds of texts, such as newsletters and reports, for personal use.

TED-8 is a line oriented text editor that occupies approximately 4.3 K of user memory. It has commands for loading and dumping both files and individual records, searching for character strings, clearing the text buffer, replacing and deleting lines, specifying range statements which control the number of lines upon which commands will operate, creating new text, and editing existing text in the buffer. It also includes a TAB command to facilitate the writing of assembly language programs, a wide variety of range commands, and a USE command that provides the user with a current number-of-lines count and memory usage information.

In my opinion, TED-8 is a reasonably good small system text editor with considerable flexibility. It is, however, somewhat inconvenient to use, especially when one needs to edit a particular line but does not know the exact line number and must therefore either count the lines (an inconvenience if there's a lot of text to cover) or write and execute an often lengthy expression to specify the character string in the line that is to be edited. Some of this could have been avoided if a line numbering system had been included, which could be stripped off at the end of editing.

Another problem is that the text editor and assembler are interdependent in some situations but must each be loaded separately into memory. This makes repeated editing and execution for program testing a real chore. I would have liked to see these programs (TED-8 and HASL-8) put together as one package, or have been provided with a dedicated linking loader as part of the

PAM-8 monitor that would enable me to load both programs into memory. Aside from these two disappointments, I am pleased with the general capabilities of TED-8. For the small amount of memory it occupies, it is relatively powerful.

HASL-8, the Heath Assembly Language

HASL-8 is a 2 pass assembler which effectively means that you must load (play-back) your source program (created by TED-8) twice before the assembly of the source program can be executed. (You can see how often you may have to load and unload, rewind and playback cassette tapes if you are editing and testing even a moderately sized assembly language program.) The output of HASL-8 is object code which is the machine language for the computer. In addition, a source listing of your program is generated, which includes not only the text of your original program but also the addresses which correspond to specific assembly language and machine language instructions (op codes). The Heath assembly language resides in slightly less than 8 K bytes of user memory and supports a complete set of operators, tokens, and pseudo opcodes (assembler directives), including in the latter a large set of pseudo ops for error detection and control of listings.

When a configured version of HASL-8 is started, the user must first answer a series of questions regarding the desired page size, interpage gap size, listing port, whether or not to produce a binary image of the source program in memory, and whether or not to save a binary image on tape. The program then requests input of the source program from tape, makes a second pass after the tape is rewound, assembles the object program, and dumps out a listing at the console terminal. The listing includes single character error codes in the far lefthand margin, and run summary data at the end of the listing (number of statements listed, remaining free bytes in user memory, and the number of errors detected). HASL-8 does not process macros or provide a cross-reference listing of user labels and associated addresses, both of which would be a nice improvement in a subsequent version. It is a fairly average assembler for its size, but should be adequate for most general purpose assembly language programming. Its documentation is very good, as is the documentation for all of the software products from Heath.

BUG-8, the Heath Console Debugger

BUG-8 is one of the best software packages that comes with the H8. Residing in any

MICROPROCESSOR ENGINEERS

EW SOFTWARE ENGINEERS

When Opportunity Knocks... GRAB IT!

Sure, you're a proficient and talented microprocessing engineer or an EW software engineer, and things are going OK professionally, but deep down inside there's a gnawing that says something's missing. Not enough challenge, the same routine, mundane assignments, not much professional growth.

Here at AMECOM, a major Litton Systems division, we're working on major NEW Avionics ESM programs with production follow-on to provide systems operating capability through the year 2000 requiring state-of-the-art development of multifunction distributed microprocessors.

If you are a MICROPROCESSOR DESIGN/DEVELOPMENT ENGINEER or a REAL-TIME ELECTRONIC WARFARE SOFTWARE ENGINEER, we have positions of uncommon potential from Member of the Technical Staff to Senior Scientist with salaries to \$35,000.00.

Don't be bored any longer. Grab the initiative about opportunities with an international leader; call COLLECT or send your resume including salary history in confidence to:

W.L. McAMIS (301) 864-5600

Amecom is located in a pleasant Maryland suburb with your choice of city, country, mountain or waterfront living without onerous taxes.



Amecom Division

**LITTON
SYSTEMS, INC.**

5115 Calvert Road, College Park, Md. 20740

An Equal Opportunity Employer M/F/H

Circle 7 on inquiry card.

3 K bytes of memory, it provides the user with powerful tools for writing, editing and debugging machine language programs from a console terminal in octal, decimal or ASCII format. It interacts with the PAM-8 monitor and uses many of the PAM-8 routines. With BUG-8 running as a full console monitor, you can do any of the following:

- examine the contents of any memory locations;
- change the contents of memory locations;
- examine the contents of any processor register;
- change the contents of any processor register;
- start program execution;
- perform single step execution of a program;
- set program breakpoints;
- clear program breakpoints;
- load and dump programs from OR to tape.

The command format used in BUG-8 is short, which makes using BUG-8 a real pleasure (the same kind of feature would be very desirable as a configuration option for TED-8).

Benton Harbor BASIC and Extended BASIC

When you purchase an H8 kit, you are supplied with Heath's 8 K byte, Benton Harbor BASIC. In addition, Heath has also marketed two versions of Extended BASIC (versions 10.01.02 and 10.02.01) which provide the user with functions for string manipulation and a number of other useful

features. Version 10.02.01 of Extended BASIC also enables the user to load and dump variables, program text, and both text and variables. This latest version is a significant improvement over the earlier version of Extended BASIC in that it allows the user to pass variables from one program to the next.

There has been quite a bit of discussion about the relative execution speed of various versions and brands of BASIC that are on the market. However, the benchmark tests for Heath BASICs that have appeared in the small systems literature have been performed only under somewhat restricted circumstances. In particular, the H8 real time clock was not enabled when Extended BASIC benchmark tests were published, which by omission and implication exaggerates the speed of the 8 K byte version of BASIC. Now, speed isn't the only criterion in evaluating a higher level language's performance, but to provide you with a more balanced perspective on this issue, I give you the following benchmark comparisons between the two versions of Extended BASIC and the 8 K BASIC that comes with the kit.

A modified benchmark algorithm developed by J G Letwin (a software engineer for Heath) was used to conduct all of the tests. All timings were accomplished using the H8 real time clock via the POKE and PEEK commands. Table 1 presents the comparative data for execution time of various functions in milliseconds. The real time clock was enabled for all tests. The algorithm I used is as follows:

```

110 B=1.1:C=1.5 (numeric constants)
120 POKE 8219,0:POKE 8220,0 (set clock = 0)
130 FOR I=1 TO 2000 (2000 iterations)
140 (line for each test function)
150 NEXT I
160 Y=PEEK (8219)+(PEEK (8220)*256)
    (read run time)
170 X=(correction factor for "A=B")
180 T=((Y/500-X)/2000 (time in ms)
190 PRINT "T=";T;"Y=";Y (output)
32767 END

```

Table 1: Comparison of execution times for three Heath BASICs for various common functions, operators, and the FOR/NEXT statement. All times are in milliseconds, with the real time clock enabled.

FUNCTION/ OPERATOR/ STATEMENT	8 K BASIC (Version 05.01.00)	Extended BASIC (Version 10.01.02)	Extended BASIC (Version 10.02.01)
A=B	14.9	15.7	15.8
ABS	1.2	1.2	1.2
+	1.9	2.7	2.5
-	2.2	3.0	2.7
INT	2.3	2.0	2.0
RND	2.4	2.4	2.4
PEEK	3.5	3.3	3.2
*	4.3	3.3	3.1
/	5.2	5.9	5.7
FOR/NEXT	5.4	5.5	5.5
POKE	14.5	13.8	13.7
COS	18.3	15.0	14.6
SIN	19.3	15.7	15.3
EXP	22.1	17.3	17.0
LOG	27.2	21.8	22.0
ATN	29.2	24.9	24.3
SQR	47.8	15.7	15.3

The argument at line 180 computes the time for execution of one operation of the function supplied at line 140 by dividing total time in milliseconds (Y) by 500, subtracting the time for the identity statement A=B, and then dividing by the total number of iterations (2000). Line 140 contains the function being benchmarked across each version of BASIC (for example, 140 A=SIN(B), 140 A=SQR(B)). The POKE and PEEK commands are placed immediately before and after the test routine to be timed, respectively, thus holding any time required to execute these commands constant and to a minimum.

MEMORY SALE! have it your way ...

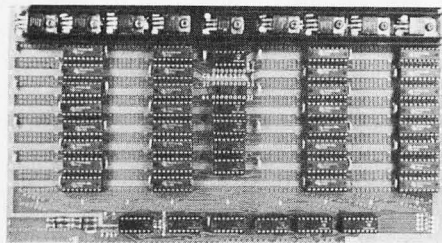
16K \$295.00 !! (450 NS)
\$327.00 !! (250 NS)

32K \$485.00 !! (450 NS)
\$549.00 !! (250 NS)

ASSEMBLED AND TESTED ONLY ! Check features before you buy any other memory

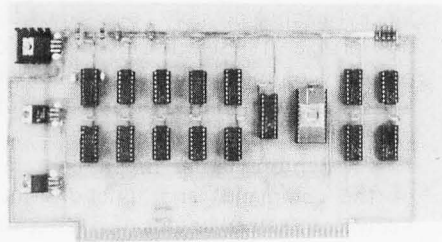
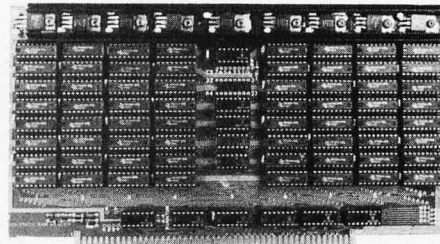
- Extended addressing allows board to exist anywhere in 1 megabyte of memory on standard S-100 bus
- LOW Power, 1.8 Amp per 16K
- 9 Regulators for perfect heat distribution
- Static, of course
- Phantom line
- Each 4K block locateable anywhere
- Fully tested and burned in for 48 hours

ADD-ON MEMORY CHIPS - \$4.95 EACH !! (MM5257 or MM5267) — 8 Chips — Minimum order



16K

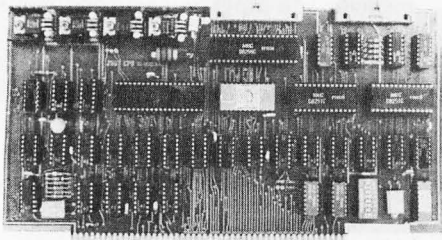
32K



MEMORY MANAGEMENT

\$135.00 !!

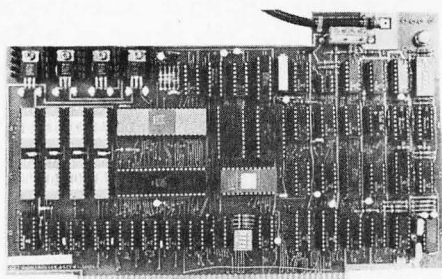
- Turn banks of memory on and off
- "Sensitize" board to 15 CPU instructions (similar to DEC System)
- Extends addressable memory space to 1 megabyte



Z-80 CPU

\$195.00 !!

- 2 Parallel + 2 Serial Ports
- 2 MHz or 4 MHz Switch Selectable
- Baud Rates 150-9600
- Power on Jump to On Board Eprom (2708 or 2716)



VIDEO TERMINAL SIMULATOR

\$295.00 !!

- Plugs into S-100 Bus and simulates all functions of a Soroc or other RS-232 type terminal. A simple video monitor such as a Sanyo or Sony TV will perform as a smart terminal by writing into an IO Port.
- 2K Eprom, 4K Ram (2 video pages)
- Lower Case Descenders (16 x 64 or 24 x 80)
- Tabs, protected fields, home/load cursor, blink, reverse video, underline, page erase, etc.

West Coast:

ORDER NOW !!

East Coast:

DELTA PRODUCTS

1653 E. 28th Street
 Long Beach, Calif. 90806
 Tel. (213) 595-7505



SALES
 &
 SERVICE



NEW LENOX ELECTRONICS

1254 South Cedar Road
 New Lenox, Ill. 60451
 Tel. (815) 485-9072

Personal checks must clear before shipment • 90 day unconditional warranty • B of A, M/C Okay

Write faster in BASIC, FORTRAN, or COBOL

Document & modify more easily, too

Human-engineered to do the job better. Yes, you really can get flawless code faster, using the Stirling/Bekdorf™ system of software development tools with structured programming concepts. The 78F2, 78P4, and 78C1 are human-engineered to reduce initial errors, improve debugging speed, and aid concept communication. First, use the 78F2 Flowchartrix™ to lay out your original concept blocks. Then use it to write a finely detailed flowchart.

54% more logic cells than other flowchart forms, put far more of your program on each page. Each Flowchartrix has a full 77 logic cells, not just 50. This saves paper, and makes your finished flowcharts easier to understand. By seeing up to 27 extra steps of a program on each page, you comprehend program flow more clearly. You save money and storage space, too.

Every matrix cell in the 7 x 11 matrix has a specific label to help you track branch points. When you write program documentation, having a separate reference point for each cell makes your program much easier to describe clearly.

With Flowchartrix, you don't need a shape template to draw remarkably regular logic symbols. Guides for the most-used logic symbols are right in each matrix cell, to help you draw most standard flowchart symbols entirely free-hand.

78P4 Print-Out Designers are next. When you finish flowcharting, lay out the printed reports your program will generate. Then when you write code you blaze through the report generation segments right along with the rest of your program.

Unique 70 x 160 matrix accommodates even proportional-spacing word processor formats. The 160-column width can handle practically any printer format. The 78P4 is big, 14½ x 22 inches, because we've scaled the cell size to human writing comfort, not machine print, giving nearly twice the character-writing area of other printout design sheets.

Special 5-column area records the program line number of the code which creates each printed line. It shows, at a glance, exactly which line of code creates each line of your report, saving hours of needless search time when you must change the report format (and don't you always have to, sooner or later?)

Every sheet of 78C1 gives you 2 form uses for the price of one. Use 78C1's full 28 line x 80 column grid area to code regular program steps. Then for interactive or instructional sections, simply keep your characters within the appropriate CRT indicator lines, and you'll automatically know where every character will show on your CRT screen.

28 line x 80 column coding capacity saves you 14 sheets out of every 100, compared to 24-line forms. 86 sheets hold more program steps than 100 sheets of any 24-line form, yet we offer full-size 6mm x 3mm grid blocks to give you comfortable writing room and visual space between lines.

Works with your CRT display, no matter what brand you own. Equipped for both 16 line x 64 column and 24 line x 80 column display formats.

Available in three versions (one for BASIC languages, one for FORTRAN, another for COBOL), the 78C1 is so powerful we include a 7-page instruction manual with every order.

Every tool in the Stirling/Bekdorf system is surface-engineered to take both pen & pencil without blotching. Our tough, extra-heavy, 22# paper is pure enough to use with critical magnetic ink character readers, and gives you crisp, sharp characters with pencil or plastic-tip pen.

Every part of our system uses eye-comfortable soft blue grids. All grid rulings, tints, and division rules are reproduced in a special shade of blue, easy on your eyes even after hours of continuous programming. If you're a professional programmer, you'll particularly appreciate our improvement over the green lines you've been writing on.

A 3-ring binder is one more of our secrets for your success. All your notes, logic concepts, flowcharts, code, CRT layouts, print-out designs, and documentation can be kept together, in order, in one place. When everything you create stays together, debugging and modification is much simpler.

Order your supply of the world's most advanced software development tools, right now, before you hatch even one more bug.

78F2 Flowchartrix
☐ 2 pads of 50 = \$7.90 + \$2.85 pkg & shpg
☐ 10 pads of 50 = \$34.35 + \$6.45 pkg & shpg

78P4 Print-Out Design Sheets
☐ 1 pad of 50 = \$7.45 + \$3.15 pkg & shpg
☐ 5 pads of 50 = \$32.10 + \$6.75 pkg & shpg

3-hole punched vinyl pockets for 78P4 Design Sheets
☐ set of 5 for \$2.65 + \$1.35 pkg & shpg
☐ set of 12 for \$5.00 + \$1.85 pkg & shpg

☐ Sample of one sheet of each form + associated labels & literature \$2.50

Enclosed is my check for \$_____

Name _____

Address _____

City _____

Charge to: ☐ Master Charge ☐ Visa exp. date _____

Card # _____

Signature _____

Phone _____

State _____ Zip _____

78C1 Combination Coding/CRT Layouts
All are the same price, but please check which language format you want:

☐ for BASIC ☐ for FORTRAN ☐ for COBOL

☐ 2 pads of 50 = \$6.35 + \$1.95 pkg & shpg
☐ 10 pads of 50 = \$26.85 + \$3.35 pkg & shpg

Texas residents please add 5.5% sales tax to base price. We ship UPS so P.O. Box address must give phone number. Prices shown for packing & shipping are U.S.A. only. International shipping rates are higher, write for details.

Stirling/Bekdorf™

4407 Parkwood □ San Antonio, TX 78218 □ (512) 824-5643

b3

© 1978 Stirling/Bekdorf Div. of Blackman Mfg. Co., Inc.

What can we glean from all these timings? For one thing, the 8 K basic BASIC is generally slower than either of the Extended BASICs. The differences in execution times between the three versions is not really significant for the arithmetic functions. On the other hand, the transcendental functions run faster in Extended BASIC. The differences between the versions are most evident when the SQR function timings are compared. It appears that for arithmetic applications, such as those used in most financial accounting, the user can get by very well without using Extended versions. On the other hand, those who plan to do engineering or scientific applications software development should give serious consideration to using only the Extended versions. All of the versions will operate approximately 10 to 15 percent faster if the real time clock is disabled, which might be a further incentive for the scientific programmer to use only the latest version (10.02.01) of Extended BASIC.

Aside from timing benchmarks, there are many other criteria to consider when reviewing a higher level language like BASIC. Since I cannot possibly cover all of them in this article, I'll select the ones which are probably of most interest to many readers. Let's start with the command and function types of the three versions.

8 K Benton Harbor BASIC contains most of the commands and functions found in many commercial brands of BASIC for small systems. It has a set of editing facilities, immediate and program command modes, and a full set of relational operators. It also has additional commands, including PEEK, POKE, SEG (for controlling the H8 LED displays), PAD (for utilizing the H8 control keypad while running BASIC), and several commands for loading and dumping programs. Most 8 K BASIC functions can use variables in addition to constants within their arguments, which makes programming more flexible. This version of BASIC does not provide functions for manipulating string variables.

In contrast to 8 K BASIC, both versions of Extended BASIC have a variety of functions for handling string variables. In addition, such commands as BUILD, DELETE, LINE INPUT and CONTROL make program development easier. Each version makes use of the FREE command, which prints out memory allocation data for the user. The latest version of Extended BASIC also includes commands for differentiated loading and dumping of program text and variable as well as LOCK/UNLOCK commands for file protection. Both versions display the type of data being loaded or dumped on the H8 front panel LED displays. As the data in

table 1 indicates, the latest version is quite fast. Additional refinements, such as incorporating PRINT USING, OCTS and DECS (for octal to decimal, and decimal to octal conversion), and file handling commands that could be executed in program mode (such as PUT and GET), would have been useful. In addition, a special INPUT command that suppresses the carriage return/line feed would also have been useful for formatting the terminal display during INPUT, as would a more flexible RUN command to specify a file/program name for storing and executing one of several programs stored in user memory. This can be accomplished now using a combination of the GOTO and CONTINUE commands. However, this procedure prevents the use of identical variable names in different programs unless such variables are reinitialized before each execution, or the variable values of a previously executed program are to be used as *global* variables in subsequent programs in memory.

A Few Pointers

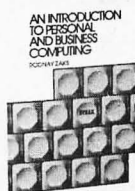
The following section includes some suggestions about using the real time clock for program run timing, displaying output using user defined patterns or character messages on the LEDs, and using the audio feedback system for any number of interesting projects. By combining and augmenting some of the following techniques, you can use your H8 as a daytime clock, alarm clock, device controller timer, and even a (rather crude) music synthesizer.

Among the applications software packages available from Heath for the H8 are a Space War program and a set of games programs. The Space War game, which requires 24 K bytes of memory is a sophisticated version of Star Trek. It has excellent displays, a full range of commands, and some surprises for those of you who dream of cruising the galaxy. Finally, the games set, which comes on one cassette tape, contains a variety of interesting games, including Craps, Nim, Hexapawn, Tic Tac Toe, Orbit, Hamrabi, and Derby, all stored in machine language and executable without first loading the BASIC interpreter into memory.

In addition to the above applications software, the Heath Company is also planning to market some business software in the not too distant future. This source of applications programs will be supplemented by the software that will become available from the Heath user's group (HUG), which is presently reviewing and cataloging hundreds of programs that are being donated to HUG by users. Software from HUG will be available to HUG members at a nominal cost and will

SYBEX

LEADER IN MICROCOMPUTER EDUCATION



AN INTRODUCTION TO PERSONAL AND BUSINESS COMPUTING

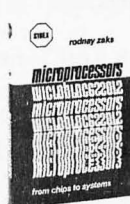
by Rodnay Zaks
250 pp, ref C200 \$6.95

The basic introductory text on microcomputers, with a detailed evaluation of the features and peripherals required for specific applications. No prior computer knowledge required.

MICROPROCESSORS: from Chips to Systems

by Rodnay Zaks
420 pp, ref C201 \$9.95

An educational text, used worldwide at universities and in industry designed to teach all the fundamentals of microprocessors, the assembly of a system, and its use.



MICROPROCESSOR INTERFACING TECHNIQUES

Austin Lesea and Rodnay Zaks
416 pp, ref C207 \$11.95

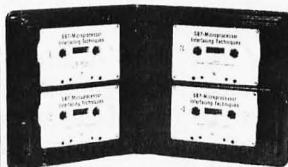
All the basic interfacing techniques, from keyboard to floppy disk, including the standard buses (S100 to 1EEE488).

MICROPROCESSOR LEXICON

120 pp, ref X1 \$2.95
Dictionary and tables. All the definitions of the microprocessor world in a pocket book format.

MICROPROGRAMMED APL IMPLEMENTATION

330 pp, ref Z10 \$25.00
How to design an APL interpreter.



PROGRAMMING THE 6502

by Rodnay Zaks
320 pp, ref C202 \$10.95

An introductory programming text for the 6502. Does not require any prior programming knowledge. From arithmetic to interrupt-driven input-output techniques.

6502 APPLICATIONS BOOK

by Rodnay Zaks
ref D302 \$12.95

Actual application programs to interface the 6502 to the real world, from LED to motor, and analog-digital conversion. *Available Shortly*

SELF STUDY COURSES ON CASSETTES

Ten courses to study at home or in the car. The most time-efficient way to learn. Includes workbook and cassettes.

INTRODUCTORY \$29.95 ea

S1-INTRODUCTION TO MICROPROCESSORS (2.5 hrs)

S2-PROGRAMMING MICROPROCESSORS (2.5 hrs)

COMPREHENSIVE \$59.95 ea
SB1-MICROPROCESSORS (12 hrs)

SB2-MICROPROCESSOR PROGRAMMING (10 hrs)

SPECIALIZED \$49.95

SB7-MICROPROCESSOR INTERFACING (6 hrs)

TO ORDER

By phone: 415 848-8233, Visa, MC, Amer Express

By mail: circle books on ad. Include payment.

Shipping: add 65¢ per book (4th class) or \$1.50 faster shipping (UPS).

Double for cassettes and overseas.

Tax: in California add tax.

FREE DETAILED CATALOGUE

SYBEX

2020 Milvia Street
Berkeley, CA 94704

Tel 415 848-8233 Telex 336311
DEPT. B

be announced in the HUG magazine *REMark* as contributed programs become available.

The H8 Real Time Clock

Every 2 ms the H8 generates a level 1 interrupt which is then used to service the front panel and update the real time clock. The clock or "tick counter" is located in two bytes of user memory at locations 040.034 and 040.033 and is called TICCNT. Both the high order byte (040.034) and low order byte (040.033) of the counter can be displayed on the H8 LEDs using the following short assembly language program which can be executed in memory with the assembler (HASL-8) resident:

```

074.000          ORG 074000A
074.000 041 033 040 LIX H,040033A
                  LOW ORDER BYTE
074.003 116 DISPLAY MOV C,M
                  LOAD LOW BYTE
074.004 054        INR L
                  NEXT BYTE
074.005 106        MOV B,M
                  LOAD HIGH BYTE
074.006 055        DCR L
                  RETURN POINTER
074.007 303 003 074 JMP DISPLAY
                  NEXT BYTES
074.012          END 074000A

```

Be sure to set the front panel to display the BC register pair before running the program.

The BASIC timings described earlier accessed the TICCNT memory locations by using the PEEK function and POKE command. Using these commands, it is possible to create a program run timer for programs that run up to approximately two minutes. Unfortunately, after this time TICCNT will start all over again instead of continuing to increment third and fourth memory locations, which would have provided a very convenient built-in extended range timer. You will need to allocate additional bytes in memory for a higher order counter in order to extend the clock range.

H8 Display Control

As discussed earlier, the H8's front panel is an integral part of the entire system and can be used for many operations even while using a console terminal. One of the advantages of this design is that the LED display can be accessed and controlled by the user either through the front panel or through a program being run from a terminal. Much of this is made possible by accessing the monitor control cells and flags stored in memory.

As an example, the assembly language program in listing 1 provides you with complete control of the display updating. First the display update control bit in the user definable memory flag .MFLAG is set to 002 to disable display update. The displays are then loaded with the desired bit pattern, in this case the pattern "XrunningX" (where X = blank). The user accessible memory cells for each LED bit pattern are in memory locations 040.013 through 040.023. The temporary bytes for storing the pattern for this display are in locations 071.000 through 071.010. Each byte in the temporary area is, in progression, loaded into the corresponding byte in the monitor LED memory bytes. To modify the display, change the bit patterns in the temporary area. Add additional temporary bit pattern tables and a table reference and transfer routine to display more than one front panel message.

The H8 Horn

The audio feedback system that is part of the H8 has other practical uses. The audio tone can be turned on from a running program that stores the octal value 160 in the front panel hardware control cell CTLFLG located at 040.011. If an attempt is made to do this from the front panel without going through a program, the front panel will be disabled before the operation is completed. The tone can be turned off by restoring CTLFLG to its normal octal value of 360.

Here is an interesting BASIC routine to generate an audio beep sequence with timing that follows a sine curve. Change the value of X to vary the timing curve. (Note: line number 3 is written in multiple statement form to structure the program to run as fast as possible.)

```

1  X=1
2  A=8201: B=120: C=208: D=20
3  J=J+X: POKE A,B: POKE A,C:
   FOR I=X TO SIN(J)*D+D: NEXT I: GOTO 3
4  END

```

Split-Octal to Decimal Conversion

It is often useful to be able to quickly convert split octal bytes to their decimal equivalents. The following routine does this. It can be located as a temporary program in BASIC while other programs are being developed or executed. Be sure to use line numbers that do not conflict with those in the program you are using. (Note: input N if done.)

```

010 REM OCTAL TO DECIMAL CONVERSION
020 PRINT: INPUT "A=?";N

```


INTRODUCING

The LOW COST Alternative For Factory, Depot, and Field Board Repair.

PHOENIX DIGITAL's LS-100 Series Digital Signature Analyzer System brings uniform test procedures across your factory, depot and field testing. For the first time, manufacturers and service groups can establish repair facilities on a very cost effective basis. More remarkable, you can utilize inexperienced, unskilled labor to troubleshoot, diagnose, and locate faulty components with positive, predictable results. Gives you the ability to KEEP UP with expanding service needs and shrinking pools of qualified service technicians.

New Opportunity

Get into the highly profitable service business without a major investment or using highly-skilled, expensive test personnel. SINGLE-CARD Signature Analyzer Modules provide system-resident diagnostic and failure isolation power of expensive board testers.

Quick Initial Use

Take existing factory and field board test software and exercise one known-good board, taking digital signature servicing values, and adding the values to your service documentation. To repair boards, merely take measurements, match with service documentation for correct four digit values, and faulty backtrack through the logic to isolate components. Complexity of repair is about that of servicing a TV.

Flexible Family Of Tester Types

Versions are available for resident and plug-in use with S-100 and other bus types. Easily controlled by either hardware or software. Automatically scan a large number of test points using optional 32-input multiplexer attachment. Probe with built-in service-oriented logic-state LEDs.

CUSTOM versions available for your bus type or built-in application.

Call or write, today, for full details on the system best suited to your needs: (602) 991-6360.

PHOENIX DIGITAL CORPORATION

7745 E. Redfield Road, Scottsdale, Arizona 85260



071.000				ORG	071000A	
071.000	377			DB	377A	LED PATTERN 1
071.001	235			DB	235A	LED PATTERN 2
071.002	203			DB	203A	LED PATTERN 3
071.003	221			DB	221A	LED PATTERN 4
071.004	221			DB	221A	LED PATTERN 5
071.005	363			DB	363A	LED PATTERN 6
071.006	221			DB	221A	LED PATTERN 7
071.007	240			DB	240A	LED PATTERN 8
071.010	377			DB	377A	LED PATTERN 9

					*	
					*	
071.011	041	010	040	LXI	H,040010A	POINTER TO .MFLAG
071.014	076	002		MVI	A,002A	(A)=OFF CONSTANT
071.016	167			MOV	M,A	DISABLE LED UPDATE
071.017	041	000	071	LXI	H,071000A	PATTERN TBL POINTER
071.022	021	013	040	LXI	D,040013A	LED TABLE POINTER
071.025	176			MOV	A,M	(A)=BIT PATTERN
071.026	353			XCHG		(H)=LEDPT, (D)=DISPT
071.027	167			MOV	M,A	DISPLAY IT
071.030	353			XCHG		(H)=DISPT, (D)=LEDPT
071.031	043			INX	H	NEXT PATTERN BYTE
071.032	023			INX	D	NEXT LED
071.033	067			STC		SET CARRY=1
071.034	077			CMC		SET CARRY=0
071.035	076	024		MVI	A,024A	(A)=COMPARE CONSTANT
071.037	273			CMP	E	(A)<(E)
071.040	322	025	071	JNC	LOADIT	NEXT PATTERN/LED
071.043	303	011	071	JMP	DISPLAY	REINITIALIZE
071.046				END	071011A	

Listing 1: An 8080 assembly language program to allow the user to control the LED (light emitting diode) readouts on the front panel of the H8 computer.

```

030 IF N > 377 GOTO 100
040 IF N=0 GOTO 110
050 A=INT(N/100): IF A > 3 GOTO 90
060 B=INT ((N/10)-(A*10)): IF B > 7 GOTO 100
070 C=N-((A*100)+(B*10)): IF C > 7 GOTO 100
080 Q=C+(8*((8*A)+B))
090 PRINT: PRINT "A="N;"D="Q: GOTO 20
100 PRINT: PRINT "ERROR! USE ONE
    SPLIT-OCTAL INPUT BYTE!"
110 GOTO 20
120 END

```

Heath Support Services

Regarding the servicing of digital systems like the H8, Heath's present approach is to do most repairs at regional centers or at the factory in Benton Harbor MI until such time as each local store can either provide additional in service training for existing technicians or add on additional technical staff. Some stores that are not regional centers, such as the Heathkit Electronic Center in Peabody MA, have service technicians who are capable of performing most of the necessary digital equipment repair jobs. All Heath products are warranted for a 90 day period from date of delivery. If replacement parts are needed, some parts can be obtained through local stores; the remainder must be ordered from the factory. I have used the replacement parts service and found it to be most adequate.

Another area of support services is the Heath Users Group (HUG). Owners of Heath computers can pay a yearly membership fee to join HUG which is administered in St Joseph MI. HUG supplies users with a variety of services including contributed

software, membership information, and newsletters. HUG is an important component of the overall services provided by Heath and is growing rapidly. HUG members who are interested in forming local or regional users groups should feel free to contact HUG manager Robert Furtaw for additional information and assistance.

A third area of support services is new system products. The design of the H8 lends itself to upgrading and expansion in many ways, which Heath is already taking advantage of. I have also heard they're considering a number of designs for interfacing the H8 to their excellent line of ham radio gear, which should be of considerable interest to ham operators who are also interested in RTTY (radio teletypewriter). Likewise, I wouldn't be surprised if Heath introduces sophisticated video game boards to interface to their television sets, and household controllers to interface with some of their home oriented equipment.

Final Thoughts

Aside from these items, the possibilities are many. Digital to analog/analog to digital converters, video drivers, speech recognition systems, EROM (erasable read only memory) boards, upgraded firmware monitors, firmware versions of existing and future software, printers, modems, intruder entry detection devices, graphics boards, and perhaps even bubble or CCD (charge coupled device) memory boards are just a few of the many possible products that Heath might market. ■

EVERYTHING YOU NEED IN SMALL COMPUTER SYSTEMS

COMPARE PRICE, QUALITY, DELIVERY, SERVICE
AND YOU'LL SEE WHY YOU DON'T HAVE TO LOOK ANYPLACE ELSE!

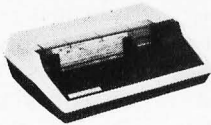
TERMINALS


LEAR-SIEGLER ADM 3A		\$854.95
ADM 31		1450.00
ADM 42		1795.00

HAZELTINE	1500		1149.00
	1400		699.00
Mod 1 Edit			1650.00

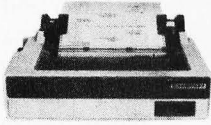
ADDS Regent	100		1095.00
-------------	-----	---	---------

PRINTERS

TEXAS INSTRUMENT			
	810		1799.00
	820		2195.00
	745		1795.00


TELETYPE	43		1199.00
----------	----	---	---------

OKIDATA	SL 125		2449.00
	110		1199.00

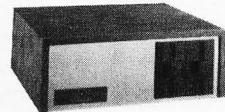
CENTRONICS			
	779		1294.00
	700		1520.00
	761		2025.00
	703		2805.00

We do complete customizing of Hardware
and Software to meet your specific needs

COMPUTERS

IMSAI	VDP 80		\$6995.00
	VDP 40		3995.00
	VDP 42		4195.00
	VDP 44		4495.00
	PCS-80/15		929.00
	PCS-80/10 (Kit)		599.00

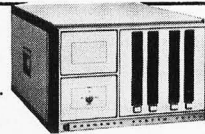
NORTHSTAR

Horizon II (Kit)		1699.00
------------------	---	---------

DIGITAL SYSTEMS

DSC-2		4995.00
Double Density		
Dual Drive Disk		2745.00

CROMEMCO

System 3		5990.00
----------	---	---------

MORE SPECIALS

Decwriter II	1395.00
Qume Sprint 5/45 R0	2795.00
Persci 277 Dble Density	1395.00

SOFTWARE



Includes Oper-
ator's Manual
and Disk

Accounts Receivable	500	250.00
Inventory	500	250.00
Order Entry	1000	500.00
Word Processing	350	195.00
Payroll	2000	1000.00
Sort & Merge		250.00



SYNCHRO-SOUND

The Computer People
193-25 Jamaica Avenue, Jamaica, New York 11423
212/468-7067 TWX 710-582-5886

ENTERPRISES, INC.

Hours 9-4 Daily
and Saturday

Visit our new showroom
Working units on display
BankAmericard Master Charge

A Stepping Motor Primer

Part 2: Interfacing and Other Considerations

Paul Giacomo
51 Farmington Chase
Farmington CT 06032

Interface Circuitry

Part 1 of this article ("A Stepping Motor Primer," February 1979 BYTE, page 90) described the theory of operation of the stepping motor. Part 2 concludes the discussion with a description of how to interface stepping motors to microcomputers. The interface can be accomplished in several different ways. The most common methods are to either decode the control sequence in software, outputting it to a parallel port with buffers and connecting the output of the buffers to the drive transistors, or use the output ports of the computer to feed into an external decoder that will sequence the drive. Since personal preference and individual application dictate how much or how little of this will be in the program, I will first describe a hardware version for a 4-phase, full-step drive, then describe how to transfer it to software.

Let us assume that two control lines from an input/output (IO) port are used to control the stepper. One line is for direction and the other is for a step command. The program can then control the speed of the motor by controlling the frequency of pulses on the control line. Figure 17 shows a simple interface circuit. The control lines coming from an output port are buffered and sent over a cable to this circuit, which is in close proximity to the motor. (Avoid high voltage and current spikes near the processor.) The first thing to be done is to clean up the signals and then feed them into an up-down counter. The counter determines in which of the four excitation stages the motor is to be. The outputs of the counter are fed into a decoder section that activates the driver transistors at the correct time.

Note:

The figure numbering sequences used in this installment continues the sequence begun in part 1. Also, part 1 includes a glossary of terms and a reference list.

There is a 16 pin integrated circuit available (SAA 1027) through North American Philips Corporation that can do all of this, as well as including the drive transistors, for under \$10. The program needed for the system is now fairly simple. What must be done is to select the direction of travel and then pulse the step line the correct number of pulses at the desired stepping speed. *Ramping* the speed of the motor is discussed in the following section.

The software version of this system would use four lines of parallel port interfacing directly with the drive transistors, with the excitation sequence stored in the program. To advance the motor, the program either increments to the next sequence pattern and outputs it for forward, or decrements the pattern and outputs it for reverse. Again, the speed of the motor is determined by how fast the patterns are outputted.

Although not covered in this article, there are drives available that allow one to input to the drive the number of steps to travel and then activate the go line. The drive automatically ramps the motor up in speed and then stops at the number of steps set beforehand. These drives are known as preset indexers. Another type of drive uses a voltage level to control an oscillator for the stepping speed.

Behavior of Motors in Operation

Like any other motor, the stepper cannot instantly start and stop at full speed and maximum load and still be expected to end at the correct position.

When a motor takes a step, it behaves in a manner similar to that of a fiberglass pole with a weight on one end, as shown in

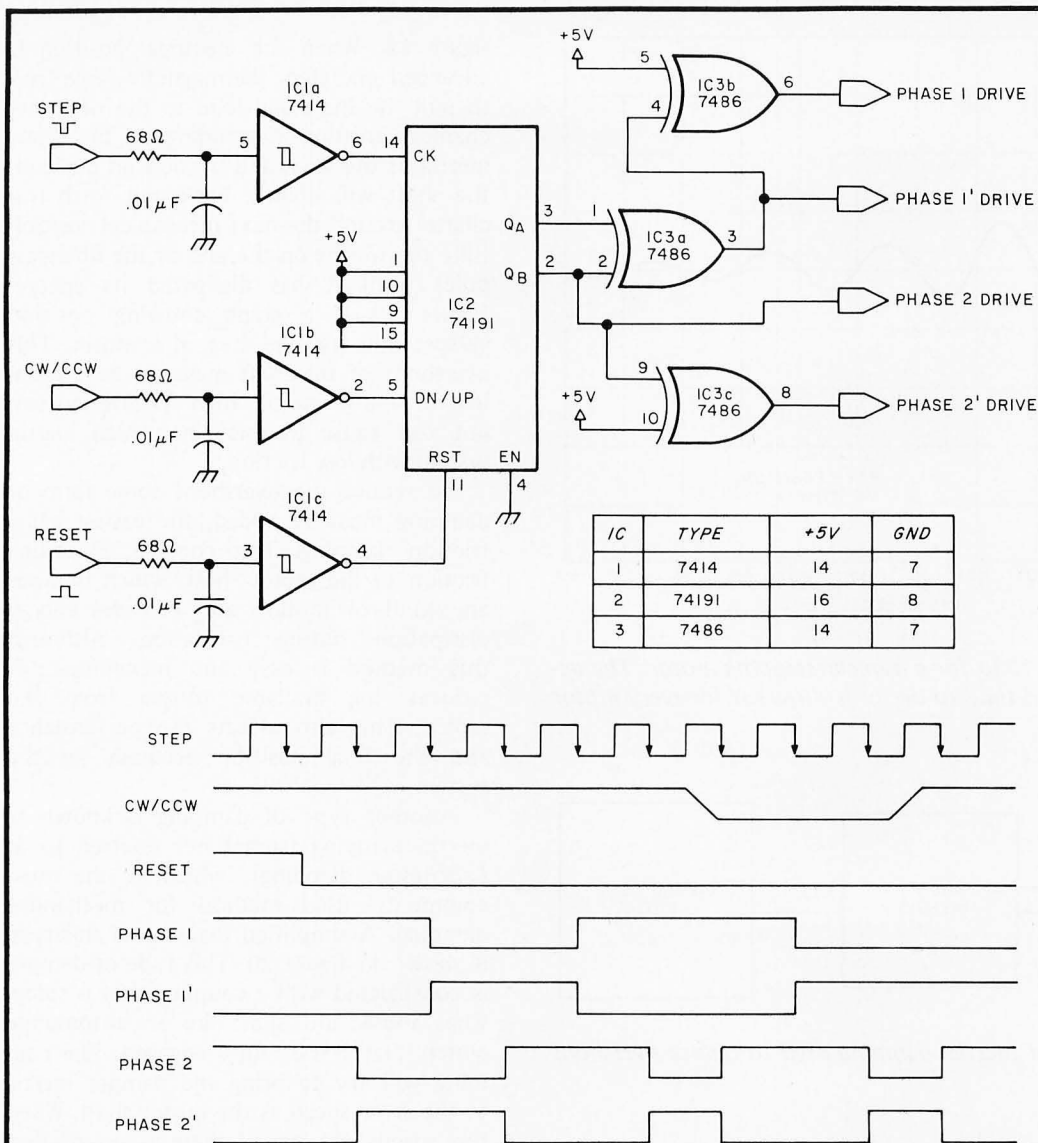


Figure 17: Hardware version of step sequence generation for a 4 phase full stepping motor.

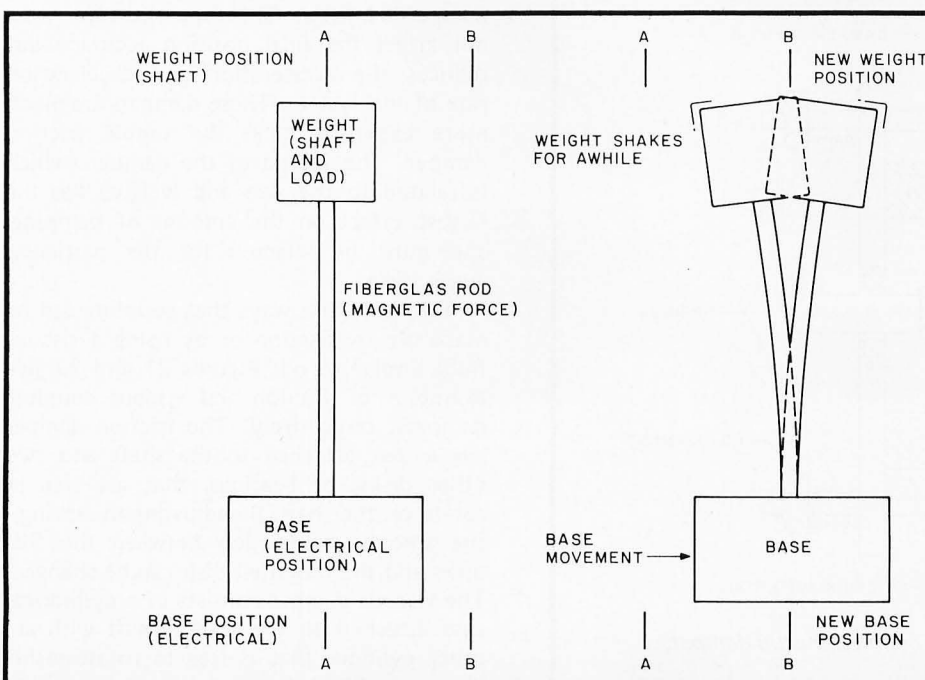


Figure 18: Analogy to single step movement in a stepping motor. When the base (electrical position) is suddenly moved to a new position, the fiberglass rod (magnetic force) pulls the suspended weight (shaft and load) along with the base. Because the fiberglass rod is flexible, the weight causes it to shake for a while before stopping. The inertia of the shaft and load in the stepping motor's case is the mass that makes the weight oscillate for a time.

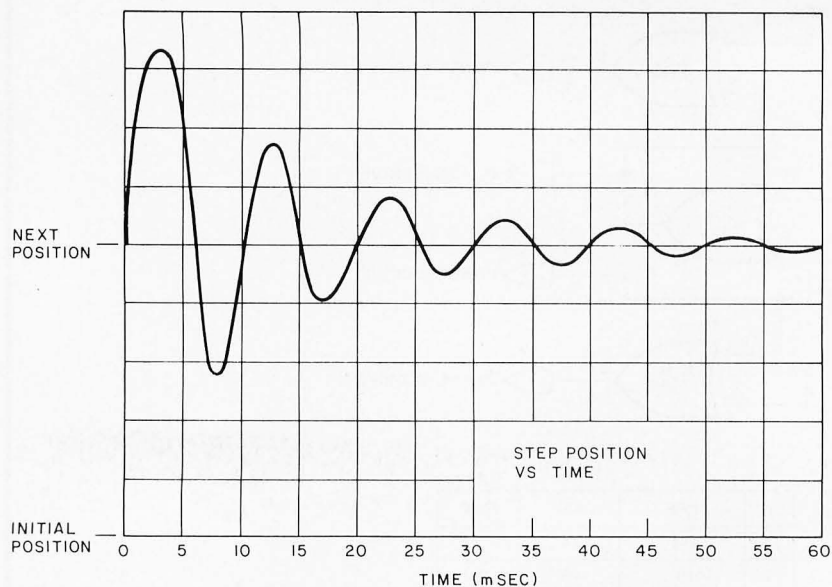


Figure 19: Step position versus time for a typical stepping motor. The actual frequency of oscillations and time to decay is different for every motor and load combination.

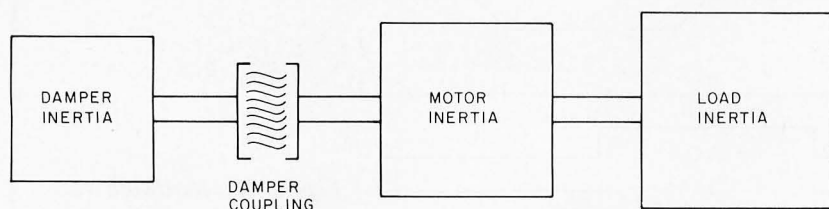


Figure 20: Simplified diagram of inertial damping used to reduce overshoot of a motor.

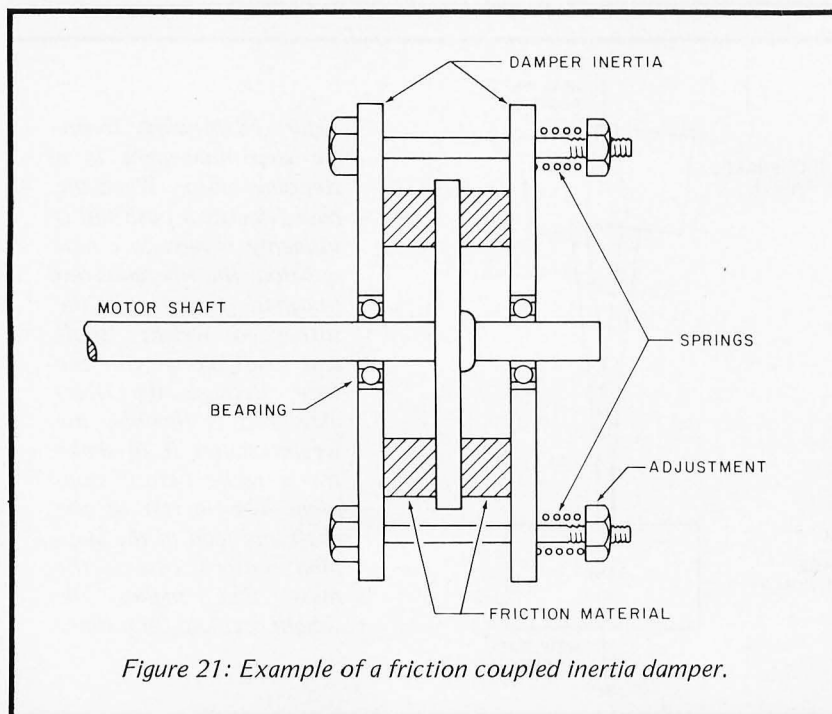


Figure 21: Example of a friction coupled inertia damper.

figure 18. When the electrical position is advanced one step, the magnetic force tries to pull the shaft and load to the next mechanical position. Depending on the drive, inertia of the load, and friction on the load, the shaft will bounce back and forth (oscillate) around the next mechanical position (like the weight on the end of the fiberglass pole) until it has dissipated its energy. Figure 19 is a graph showing position versus time for one step of a motor. This overshoot of the shaft may not be a problem in a low inertia, high friction system, but can cause troubles in a high inertia system with low friction.

To reduce the overshoot some form of damping must be added, the easiest being friction damping. This consists of adding friction to the motor shaft, which opposes any kind of motion and provides energy dissipation during oscillation. Although this method is easy and inexpensive, it reduces the available torque from the motor. This also affects the performance and the final position accuracy of the system.

Another type of damping is known as inertia damping (sometimes referred to as *Lanchester* damping), which is the most commonly used method for mechanical damping. A simplified diagram of this type is shown in figure 20. This type of damper is constructed with a coupling that is somewhat loose and slips like an automobile clutch that is not fully engaged. The coupling will try to bring the damper inertia to the same speed as the motor shaft. When the speeds are equal, there is no friction between the damper and motor, so the damper is inactive. This type of damper does not affect the final position accuracy but reduces the acceleration and deceleration rate of the system. These dampers are much more expensive than the simple friction damper. The inertia of the damper (which is related to the size and weight) has the largest effect on the amount of damping, and must be selected for the particular application.

Two common ways that coupling can be made are by friction or by using a viscous fluid similar to oil. Figures 21 and 22 give examples of friction and viscous coupling dampers, respectively. The friction damper has a disk attached to the shaft and two other disks, or bearings, that are free to rotate on the shaft. By adjusting the springs, the amount of friction between the free disks and the mounted disk can be changed. The viscous damper consists of a cylindrical case attached to the motor shaft with another cylinder that is free to rotate inside the case. Fluid inserted between the two

SOFTWARE HEADACHES?



HERE'S WHAT DEALERS RECOMMEND FOR RELIEF...

Russell F. Roth, President, Roth Computer Processing, Indianapolis, IN: "Bookkeeper and Autoscribe are flexible enough for almost any business application. MicroSource narrows the applications gap between micros and the other guys . . . refreshing for packaged systems."

Chuck Faso, Owner, Computerland of Niles, IL: "You cannot find more for your money anywhere. Autoscribe is the easiest to operate I've seen. It does everything you would want to do with word processing. There's just no competition at this price."

Norm Dinnsen & Dave McDonough, Owners, Computerland of San Diego: "We like to sell systems we can depend on. That's why we sell MicroSource. MicroSource software is more business-oriented, the systems are a lot cleaner and they use good dependable equipment."

"MicroSource has the best documentation we've yet to see. Bar none. We're looking forward to more MicroSource packages."

Autoscribe — The Paperwork Manager™.
Here's the lowest-cost answer to your office paperwork problems. And, the only word processor that's also a small business computer. Less than \$8,000 (under \$200/mo. on a financing lease) with a North Star-based system (sugg. list).

Bookkeeper — The Office Accountant™.
Now you can use the same system used by CPA firms to prepare your monthly statements. What used to take you days now takes just hours. Just \$7595 (under \$200/mo. on a financing lease) with a North Star-based system (sugg. list).

MICRO SOURCE™

1425 W. 12th Place • Tempe, Arizona 85281 • (602) 894-9247 • Cable: MICROAGE
Telex: 165 033

The following are trademarks of The Phoenix Group, Inc.: MicroSource, Autoscribe, Bookkeeper
DEALERSHIPS STILL AVAILABLE

cylinders acts as the coupling. By changing the viscosity of the fluid, the amount of damping can be adjusted.

Another damping method uses the control circuit to electronically damp the mechanical oscillations. This is accomplished by giving the motor a quick reverse, then forward pulse, just as it were about to stop at the final position. Although inexpensive, it requires tuning of the pulses to the load, and the motor will be sensitive to fluctuations in load and friction. For this reason, this type of damping is not suggested for most personal computing applications.

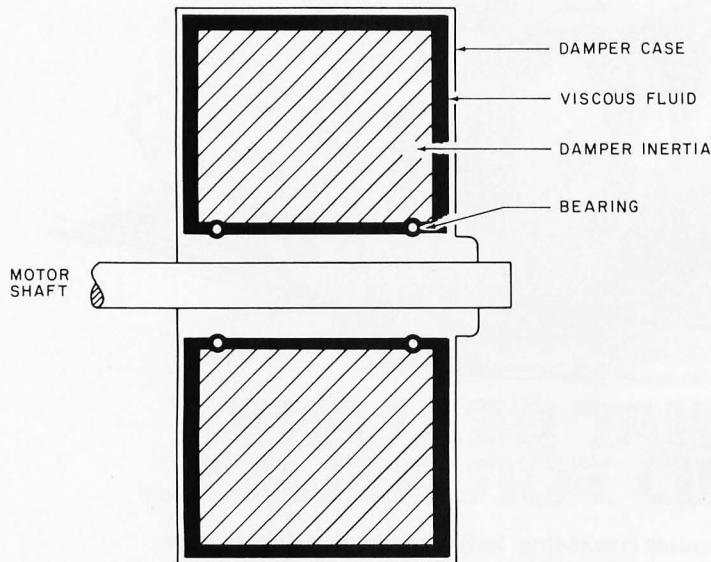


Figure 22: Example of a viscous fluid coupled inertia damper.

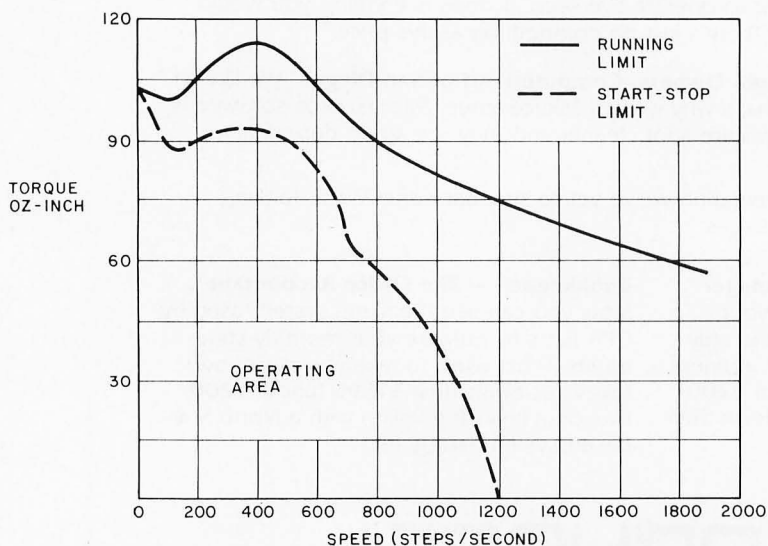


Figure 23: Typical speed versus torque curve for a medium power stepping motor. The solid line represents the maximum speed-torque combination that the particular motor and drive combination is capable of producing. The dotted curve shows the maximum speed-torque combinations that can be achieved and still start and stop without gradual acceleration or deceleration.

Since the motor cannot normally start and stop at high speeds, some form of acceleration and deceleration must be used. This quickly becomes obvious if the inertia is too large for the initial speed attempted. The motor will make noise and the computer will sequence through the steps, but the motor will not run. Fortunately, this will not harm the motor. To correct this situation, provided that the motor and drive combination is capable of that speed, the motor must start at a speed low enough to turn the shaft and then gradually accelerate to the desired speed. If the acceleration is too fast, the motor will lose synchronism and stop running. To stop the motor, it should be decelerated or it will continue to turn even after the pulses have stopped. As a rule, the deceleration rate can be faster than the acceleration rate.

An operating parameter exhibited by all stepping motors that should be noted is resonance. Every motor has a particular speed at which it has difficulty running. This is called its primary resonance, and it is usually located somewhere between 50 and 150 steps per second. An unloaded motor, when run at its resonance, will have very little torque and may sputter, make noise, stop turning or run backwards. This will not hurt the motor, but it will make the system do a lot of strange things.

To lessen the effects of resonance, a number of things may be done. More friction could be provided by damping, or the drive could be made to deliver less power. The best solution, however, would simply be not to run at that particular speed. When ramping up or down in speed, acceleration through resonance is possible as long as it is only for a few pulses.

The characteristics mentioned above can be found for every motor by examining the motor's speed versus torque curve. Figure 23 shows a typical curve. One point to remember about the graphs is that the curve represents a particular motor with a particular drive, so it is only a rough approximation for a motor with a personally designed drive. The bottom of the graph usually represents the speed of the rotor in steps per second. The side scale shows the torque that the motor can produce. The curve usually shows the maximum torque that can be applied and still start and stop without error. Notice the sag in the curves at low speed. This is where the resonance is located. Under certain conditions, the sag can be very sharp, going down to almost no torque and then back up to several hundred ounce-inches of torque in only 20 to 30 steps per second.

It should be kept in mind that if there is less current in the main drive than what is

An **INFO 2000** DISK SYSTEM gives you a lot less than you expected:

Less Cost

The DISCOMEM Controller board costs us less to manufacture. So your complete INFO 2000 Disk System costs you less — at least \$400 less than comparable disk systems.

Less Hardware

Only three S-100 boards are needed to create a complete, high-performance disk-based microcomputer system—the DISCOMEM Controller Board, a 32K memory board, and any 8080, 8085 or Z80 CPU board. You don't need extra interface or EPROM boards since DISCOMEM contains 2 serial ports, 3 parallel ports and provision for 7K of EPROM and 1K of RAM.

Less Time

The INFO 2000 Disk System is incredibly fast! Using the PerSci Drives with voice coil positioning, disk seek times are up to 8 times faster than with other drives. A full disk-to-disk copy and verification takes well under a minute. Formatting and verifying a new diskette takes less than half a minute. Reloading CP/M* from diskette takes a fraction of a second.

Less Space

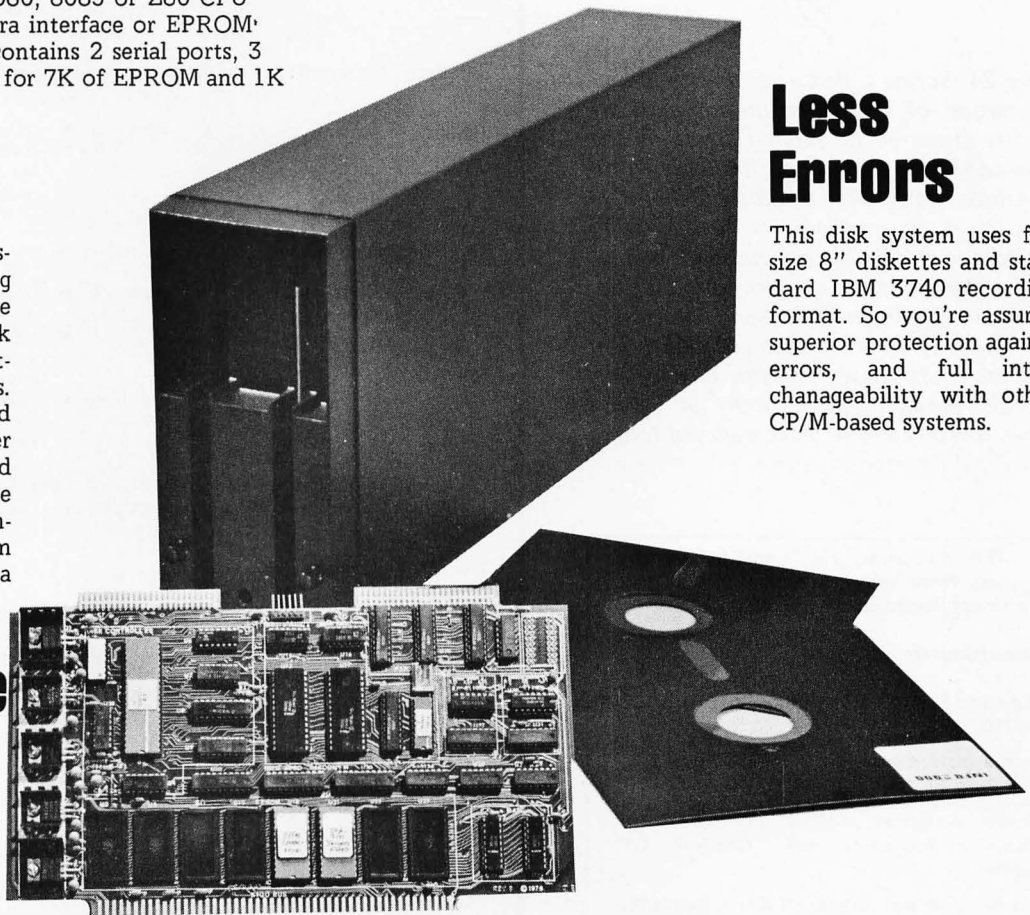
The system is remarkably compact, requiring only 1/2 to 1/3 the space taken by other 2-drive disk systems.

Less Hassle

The INFO 2000 Disk System eliminates the "I/O configuration blues" by incorporating all necessary interface ports. A CP/M Loader and all I/O drivers are contained in EPROM so there is no need for special software customization. Just plug the system into your S-100 microcomputer and begin immediate operation using the CP/M disk operating system. The INFO 2000 Disk System is supported by the most extensive library of software available, including 3 different BASICs, 2 ANSI FORTRAN IVs, several assemblers, text editors, debugging tools, utilities and numerous applications packages.

Less Errors

This disk system uses full size 8" diskettes and standard IBM 3740 recording format. So you're assured superior protection against errors, and full interchangeability with other CP/M-based systems.



It all adds up to more capability for your money.

The complete INFO 2000 Disk System comes completely assembled and tested. It includes dual diskette drives, the DISCOMEM Controller, power supply, cabinet, cables and the CP/M disk operating system—everything you need for immediate plug-in-and-go operation with your microcomputer. This means less time, hassle, hardware, space, errors and less money than for comparable equipment. Now, isn't that a lot less than you'd expected in a dual disk system?

INFO 2000 Disk Systems are also available for Digital Group and Heath H8 microcomputers. Dealer inquiries welcomed.

*CP/M is a registered trademark of Digital Research.

INFO 2000
CORPORATION

20620 South Leapwood Avenue
Carson, California 90746

(213) 532-1702

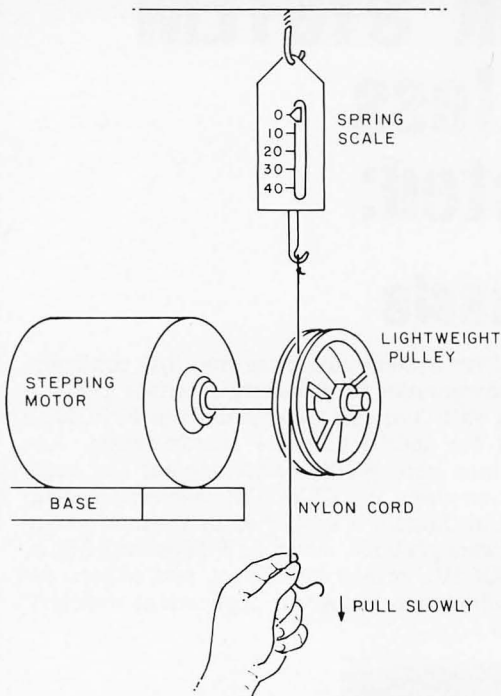


Figure 24: Spring scale torque measurement. The torque of a stepping motor at a set speed is measured by pulling slowly on the nylon cord wrapped around the pulley until the motor stalls. The reading on the scale times the pulley radius gives the maximum load torque the motor can run with at that speed. The amount of turns around the pulley varies with the pulley and cord. For a 3/32 inch (0.25 cm) diameter cord and aluminum pulley, two or three turns works best. By measuring the torque at several speeds, it is possible to make a special torque curve for the motor and drive.

The following list contains various sources from which stepping motors and pertinent literature may be obtained.

Manufacturers:

Superior Electric Co, Middle St, Bristol CT 06010.

Sigma Instruments Inc, Motion Control Div, 170 Pearl St, Braintree MA 02184.

North American Philips Control Corp, Cheshire Industrial Park, Cheshire CT 06410.

Warner Electric Brake, MCS Div, Beloit WI 53511.

Computer Devices of California, 11901 Burke St, Santa Fe Springs CA 90670.

Singer Co, Kearfott Div, 1150 McBride Av, Little Falls NJ 07424.

Berger-Lahr, Jaffrey NH 03452.

Surplus Stepping Motors and Equipment:

AST/Servo Systems Inc, 930 Broadway, Newark NJ 07104.

Some Stepping Motor Calculations

The following formulas are commonly used in stepping motor calculations.

Distance = $s = \frac{1}{2}at^2 + v_0t + c$ where s = distance (inches or cm)
 a = acceleration (inch per second²)
 t = time (seconds)
 v_0 = velocity, initial (feet per second or meter per second)
 c = constant.

Velocity (linear) = $v = at + v_0$ where v = velocity (inch per second or meter per second)
 a = acceleration
 t = time
 v_0 = velocity, initial.

Velocity (angular) = $\omega = v/(r\pi)$ where ω = angular velocity (radians per second)
 v = linear velocity (inch per second or meter per second)
 r = radius (inches or meters)

$\omega = (\text{RPM}) N/60$ where RPM = revolutions per minute
 N = number of steps per revolution
 ω = angular velocity in steps per second.

(Similarly, the speed in revolutions per minute is $\text{RPM} = \omega 60/N$.)

Torque = $T = Fd$, where d = radius from pivot point to force
 F = force applied or restraining force, ie: friction, weight, load (ounces or newtons).

The relationship between torque and rotary motion is:

$T = J (\omega/t)$ where T = torque (ounce-inches or newton-meters)
 J = moment of inertia (ounce-inch-seconds² or newton-meter-seconds²)
 ω = angular velocity (radians per second)
 t = time (seconds)

To use the equation with J in units of ounce-inches², multiply the inertia by 1/384 (ounce being a unit of mass in this case, instead of a unit of force as used above).

$T = J (\omega/t) (1/384)$

The moment of inertia for a rotating disk (pulley, gear, etc) is:

$J = Wr^2/2$ where J = moment of inertia
 r = radius of disk
 W = weight of disk

L/R Time Constant

The ratio of the inductance to resistance of a winding is used to determine the buildup or decay of current in a stepping motor. The basic equation which represents current flowing in a stepping motor is as follows:

$I = I_{ss} \frac{t}{-(L/R)} (1 - e^{-})$ where I = instantaneous current (amps)
 I_{ss} = steady state current in winding (amps)
 e = natural exponent = 2.718
 t = time (seconds)
 L = inductance in winding (henries)
 R = total resistance in the current path (ohms)

By examining the formula closely, it can be seen that the instantaneous current will reach its steady state value much sooner if the ratio of inductance to resistance is decreased. The result is that the motor will react faster to input signals, which will increase system performance.

shown for rated current, the curve will be shifted below the rated curve. A speed versus torque curve of the motor to be used will help to make the design much easier, and without unexpected disasters. By trying to operate safely below the curve, and observing the design rules, no unforeseen problems should be experienced with the system.

Once the motor has been selected and the drive fully completed, the next logical step is to make a speed versus torque curve of the motor and drive combination. This is important for a number of reasons. First, the speed versus torque curve obtained is the actual response of the motor and drive combination rather than a representative curve provided by the manufacturer. Second, it becomes a reference to compare against if any changes in the drive are made to alter its performance. Another reason for obtaining a curve is that it gives the experimenter a hands-on feel of the behavior of the stepping motor. (See text box for a detailed method of finding the torque of a stepping motor.)

I hope the information presented in these two articles will inspire you to use the versatile stepping motor for your own applications.■

Obtaining the Torque Curve: A Practical Technique

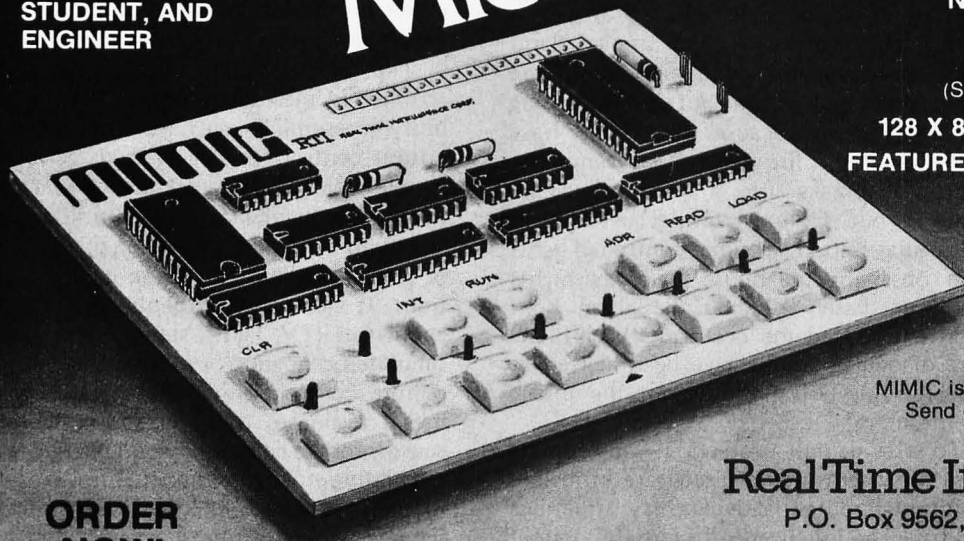
A simple technique for obtaining the curve is through the use of a spring scale (small fishing scale will serve the purpose) and a thin nylon cord. In this system, a cord suspended from a spring scale is wrapped several times around the motor shaft (or a lightweight pulley on the shaft) and is used to apply a frictional torque on the motor (see figure 24). Changing the size of the pulley will provide several ranges of torque. To find the torque, the motor is run at a constant speed and the free end of the cord is pulled very slowly. As friction builds up, the scale will begin to move. At the point where the motor stops turning, the value on the scale times the radius of the shaft (pulley) gives the maximum torque for that speed. This should be repeated several times to get the correct reading. This is repeated for several different speeds. The typical speed points taken start at 50 steps per second and proceed in increments of 50 steps per second up to 250 steps and then every 200 steps per second thereafter. Other points to find are the maximum torque point, maximum speed no torque point and resonance points. When enough points are taken to get an idea of the curve (about 10 to 15), the points are plotted on regular graph paper and a "best fit" curve is drawn through the points.

Warning: Be careful at low speeds, because the motor can run backwards when it is "jerked" out of synchronism and wind the cord around the shaft in the reverse direction (your finger can get wrapped in there in larger motors). A thin nylon cord is preferable because of its strength. A point to remember is that this is a frictional load and that the shaft (pulley) and cord will heat up when trying to dissipate the energy.

MIMIC

**IDEAL FOR THE
BEGINNER, HOBBYIST,
STUDENT, AND
ENGINEER**

The \$50 Microcomputer



**COMPLETELY SELF-CONTAINED
NEEDS ONLY A 6V BATTERY
FOR FULL OPERATION**

FULLY DOCUMENTED
(SAMPLE PROGRAMS INCLUDED)

128 X 8 ONBOARD RAM SUPPLIED

FEATURES 57 INSTRUCTIONS, PLUS:
STOP AND WRITE TO DISPLAY
MANUAL, ELECTRICAL &
SOFTWARE INTERRUPTS

**BUS ACCESSIBLE FOR
PERIPHERAL DEVICES**

MIMIC is available in unassembled KIT form.
Send check or money order for **\$50.00** to:

Real Time Intelligence Corp.
P.O. Box 9562, Rochester, New York 14604

Mass. residents please add 5% Sales Tax. New York residents please add 7% Sales Tax.
Allow 4 - 6 weeks for delivery

**ORDER
NOW!**

Build a Computer Controlled Security System for Your Home: Part 3

Steve Ciarcia
POB 582
Glastonbury CT 06033

Copyright © 1978 by Steven
A Ciarcia. All rights reserved.

There are many security systems on the market. From the simple \$10 door buzzers which signal forced entry to elaborate professionally installed Rollins and ADT systems, their purpose is singular: give the occupant advance warning of an emergency condition. Protection of property is a secondary benefit of the more sophisticated alarms. Ultimately it is the overall complexity of the security system that defines how much coverage is attained in each of these areas.

Forced entry, prowler, and fire detection are but three possible events for which people buy alarms. A \$15 smoke alarm alerts the occupants, who rush out of the house in the nick of time but stand watching the house burn because they didn't have time to call the fire department. Similarly, a prowler breaks into a home when the family is out. He has grown accustomed to the regular pattern of timer controlled lights after observing the house for a few nights and immediately disables the alarm horn upon entry. Had the occupants been home they of course would have been alerted to the break-in, but that was not the thief's intention.

To provide full protection, the ultimate security system should discourage intrusion, monitor all potential emergency situations and have the intelligence to initiate a preset series of actions should the alarming event ever occur. Combining all these elements

into a single computer controlled security system is the subject of this and the two preceding articles (January 1979 BYTE, page 56; February 1979 BYTE, page 162). With the control system proposed and developed in this series, the user will have more of a process control computer than a burglar alarm. Except for the detection of the alarming event itself, a system designed to discourage intrusion and automatically respond to certain situations cannot be configured solely as a passive detection unit. The programs which this computer executes either in response to timed events or sensor inputs amount to a process control situation.

The computer controlled security system outlined in these three articles has the capability (presuming you have wired the same output controls as I have) to detect cars or people approaching a residence and track them by sequentially turning on flood lights aimed to cover the perimeter of the house, or give an audible warning in daylight situations. It can also control the power to AC appliances (TV, lights, stereo, etc) either to simulate occupancy or provide the luxury of remote control. This same software allows preset responses to water and temperature sensors for the control of wood heating, water circulating stoves or simply to turn on a pump in the basement. Should any perpetrator be ignorant enough to break in even after sufficient warning, the system has all the usual bells and whistles, an automatic telephone

dialer, a hidden video tape recorder to obtain evidence, and, finally, a separate communications link to your neighbor.

The first article presented a general outline of the control system, the types of inputs available, and proposed responses. The second article described the hardware modifications to the SDK-85 computer used as the controller and provided an extensive description of the control and data acquisition software. With these three articles, more advanced readers should have enough information to configure a similar control computer using any microprocessor.

The final installment in the series presents examples of discrete input sensors to monitor temperature, moisture, motion, fire, and smoke. To allow the computer to make the proper response to such inputs, designs for flashing lights, strobes, siren, and AC remote control interfaces are also detailed. Finally, just to alleviate any lingering apprehensions over what appears to be a complex software algorithm, we will trace the flow of an alarm input as it is processed by the security system and demonstrate the versatility of table-driven software in this application.

The Alarm System Is Only as Good as Its Input Sensors

The SDK-85 has 38 bits of parallel I/O (input/output). In this application 18 of these bits have been set aside to control outputs, while the remaining 20 are used solely for input. Because the computer is composed of TTL (transistor-transistor logic) circuitry, any input to it must also be TTL compatible. It is a further requirement that all signals be discrete in nature. That is, they change state from a 1 to a 0 or a 0 to a 1 level when the set point is attained. Analog inputs are not beyond the capabilities of the software, but no analog to digital interface has been built into the system.

Analog Input Sensors

Temperature and voltage are important analog parameters which any sophisticated alarm system requires if it is to monitor freezer or furnace room temperature and brownout conditions. The circuit of figure 1 can be used to read temperature setpoints. IC1 is a special integrated circuit having an output voltage proportional to temperature.

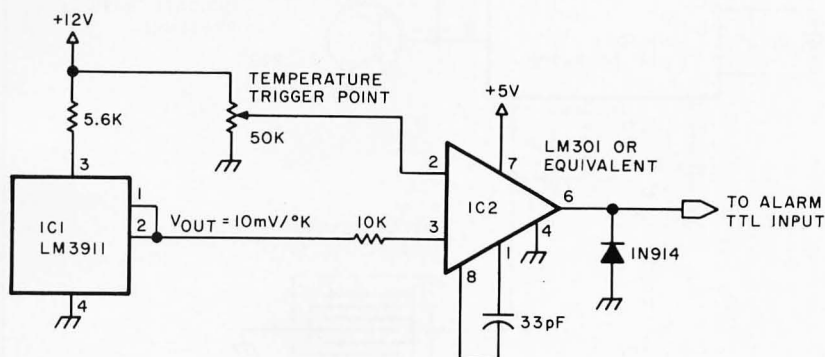
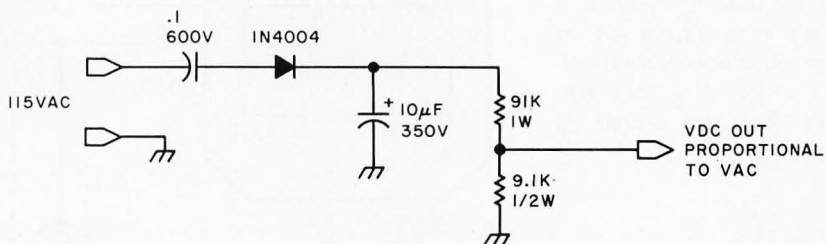
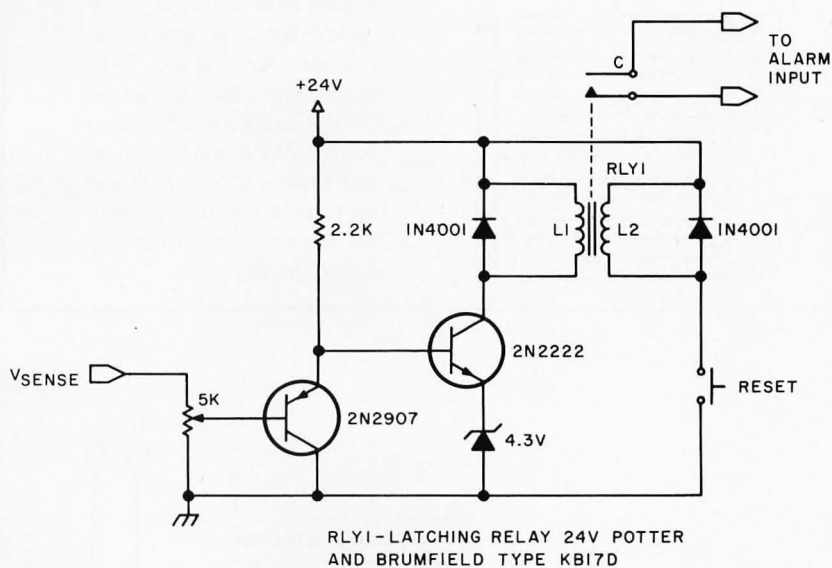


Figure 1: Temperature setpoint indicator circuit. IC1 is a special integrated circuit whose output voltage is proportional to temperature. The circuit feeds into an Intel SDK-85 single board computer, which accepts only TTL (transistor-transistor logic) level inputs. Op amp IC2 is used as a computer to convert the output accordingly.



AC TO DC CONVERTER TO MONITOR POWER FAILURE OR BROWN OUT CONDITION

Figure 2: Circuit which can be used to monitor any DC voltage between 0 and 24 V. A latching relay is used to latch on when a voltage transient occurs.

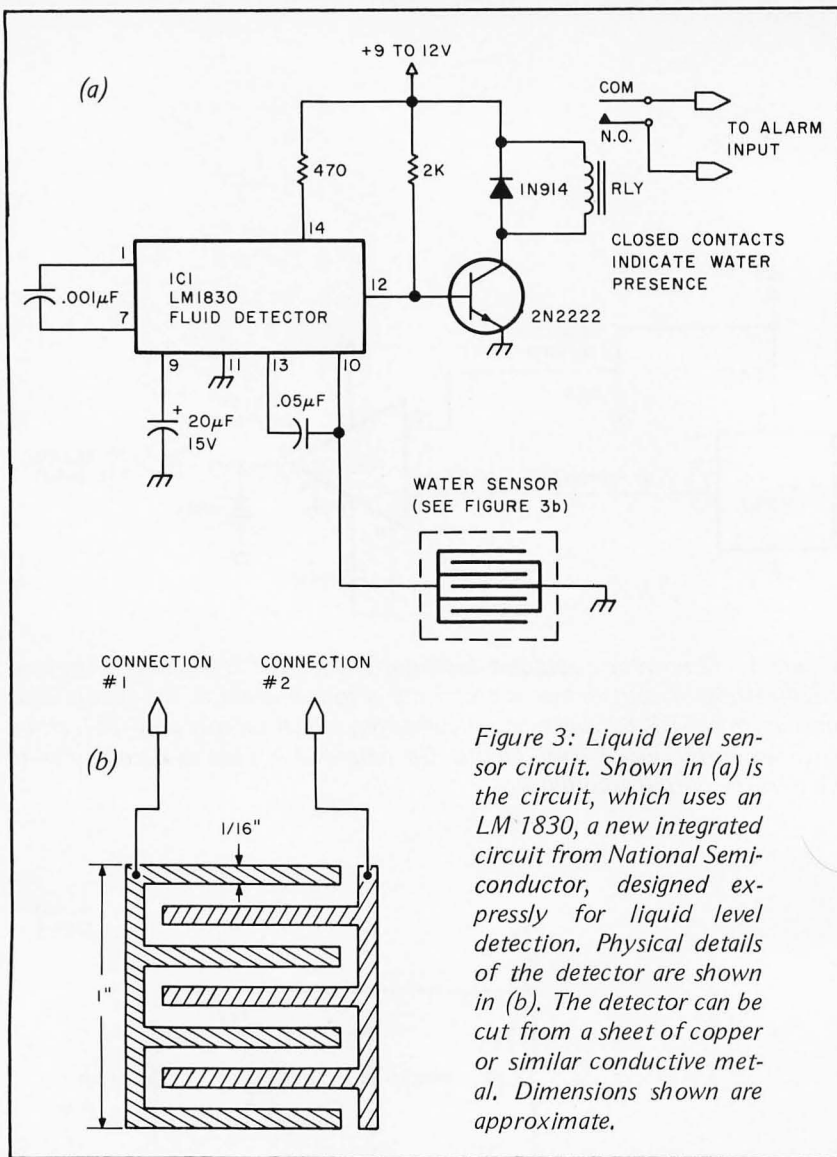


Figure 3: Liquid level sensor circuit. Shown in (a) is the circuit, which uses an LM 1830, a new integrated circuit from National Semiconductor, designed expressly for liquid level detection. Physical details of the detector are shown in (b). The detector can be cut from a sheet of copper or similar conductive metal. Dimensions shown are approximate.

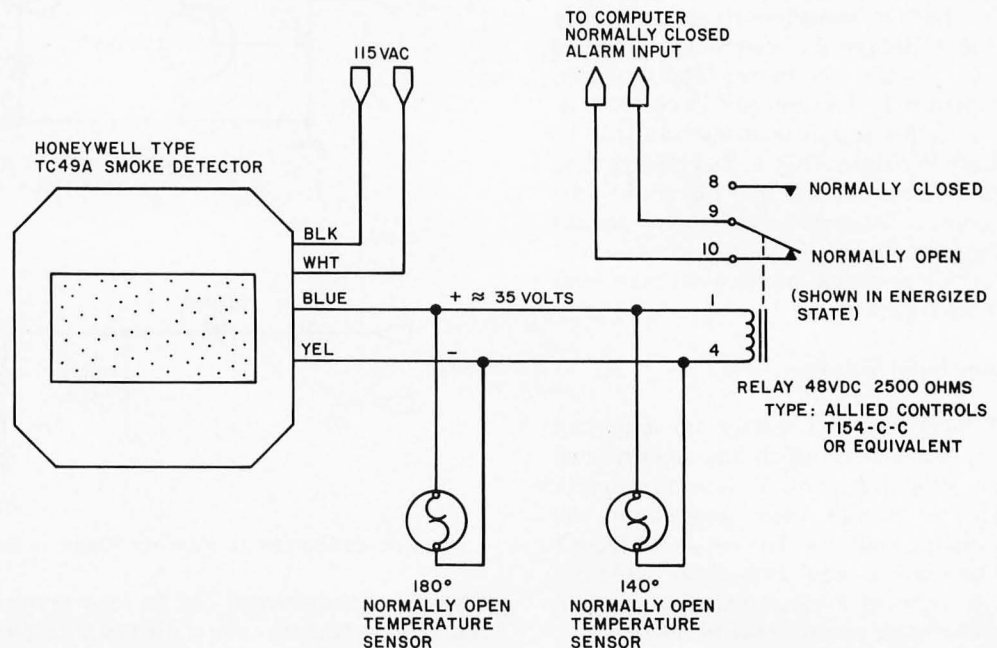
Since the SDK-85 can respond only to TTL inputs, op amp IC2, configured as a comparator, changes logic levels when the output of IC1 equals the setting of the temperature trigger pot. IC2 is powered by a 5 V power supply so that the output is TTL compatible. If a multiple array of temperature transducers is to be constructed, use an LM339 quad comparator instead of four LM301s to reduce wiring complexity. Another analog circuit, shown in figure 2, can be used to monitor any DC voltage between 0 and 24 V. It could be used to monitor the battery back-up supply to the computer or some other important parameter. Since voltage fluctuations are often significant and desirable to catch, the circuit uses a latching relay to keep it in the set condition once triggered. If that is not a desirable feature, then replace RLY1 (relay 1) with a nonlatching type. A relay should continue to be used, however, because it isolates the computer from the monitored voltage sources.

Discrete Input Sensors

Actually, all inputs to the computer are discrete, and this need not be a separate category. The outputs from the sensors are primarily contact closures for a reason I'll explain later. Some of the important ones worth considering are liquid level or moisture, smoke and fire, and ultrasonic and infrared interrupted beam motion detectors.

A liquid level sensor suitable for detecting basement flooding so that a sump pump can be turned on is illustrated in figures 3a and 3b. This circuit uses a new integrated circuit from National Semiconductor specifically

Figure 4: Commercial smoke detector with additional temperature sensors and data acquisition output added. Additional sensors may be added in parallel.



The COMPUTER FACTORY

... when software counts 485 Lexington Avenue 750 Third Avenue New York, N.Y. 10017
(212) 687-5001 (212) PET-2001 Foreign order desk - Telex 640055



COMMODORE "PET"

only \$795 USED

- 14K ROM Operating System \$549
- 8K RAM Memory
- 9" Video Monitor
- Built In Keyboard
- Digitally controlled tape

commodore

Today's best value in personal computers, along with the latest in peripherals, are always in stock at the COMPUTER FACTORY

PERIPHERALS FOR PET

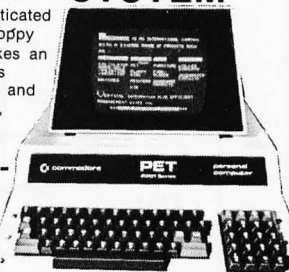
- 24K Memory Expansion ... \$499
- 16K Memory Expansion ... 399
- PET to RS232 Serial ... 169
- 2 Way Serial/Communication 295
- Modern Board for PET ... 375
- PET to S100 (4-slot) ... 160
- Second Cassette Drive ... 95
- Parallel Printer Interface ... 199
- PET Music Box ... 39

CREDIT CARD ORDERS ONLY—
800-223-7318

NEW! PET BUSINESS SYSTEM

The PET is now a truly sophisticated Business System with the Floppy Disk and Printer which makes an ideal cost efficient business system for most professional and specialized fields: medicine, law, research, engineering, education, etc.

PET 2001 -
16K \$995
32K \$1195



- 16 or 32K Bytes Dynamic RAM
- 14K ROM Operating System
- 9" CRT
- Upper/Lower Case and Graphics
- Full Sized Business Keyboard
- Full Screen Editing
- Operating system will support multiple Languages (BASIC resident)
- Machine Language Monitor
- 8K ROM Expansion Sockets

Compucolor II

\$1,495 Complete!
16K Model add \$200
32K Model add \$500

COMPUCOLOR II Disk Based Model 3
Advanced hardware and software technology gives you:

- 13 inch Color Display
- Advanced Color Graphics
- 51K Disk Built In
- 16K ROM Operating System
- 8K RAM User Memory
- 4K RAM Refresh
- 8080A Microcomputer
- RS-232 I/O

Every unit comes with an extended DISK BASIC that has a full file management capability resident in the COMPUCOLOR II in 16K of ROM. Color is fantastic, but COMPUCOLOR II has the power to handle com-

plex tasks and small business applications. An impressive software library supplements your own creativity.

RADIO SHACK • PET • SORCERER • APPLE • COMPUCOLOR • ETC. PRINTERS • PRINTERS • PRINTERS

The COMPUTER FACTORY's extensive inventory and wide selection of computer printers assures you of finding the printer best suited for your needs and specifications. The following printers work well with all known personal computers.

- CENTRONICS 779 \$1045
- AXIOM (Parallel) \$ 395
- AXIOM (Serial) \$ 495
- EXPANDOR (Tractors) \$ 425
- INTEGRAL DATA \$ 795
- DUME or DIABLO \$3400

CENTRONICS 700 (Business) \$1595
PET TO CENTRONICS PRINTER INTERFACE
SWITCH SELECTABLE \$199

ANDERSON JACOBSON



Ideal for word processing and small businesses.

- ASC II Code
- 15 cps Printout
- High Quality Selective Printing
- Use Keyboard for PET
- Reliable heavy duty Mechanism
- Completely Refurbished by A.J.
- Service in 15 Major Cities

Serial - \$1195
Parallel - \$1095

SORCERER



- EXIDY Z-80 Processor
- Keyboard and Numeric Pad
- 8K RAM (up to 32K)
- Serial and Parallel I/O
- Dual Cassette I/O
- 30 x 64 Display
- S100 Compatible
- 64 User Defined Characters
- 240 x 512 Resolution Graphics

Modular design allows use of both cassettes for programs and ROM PAC cartridges for future language introductions like: APL, COBOL, PILOT, FORTRAN, etc. Add monitor and tape or disk for complete computer system.

\$895

\$1095

NEW! FROM PET!

SINGLE DRIVE FLOPPY 2041

- Intelligent mini floppy
- 171.5K net user storage

\$595



DUAL DRIVE FLOPPY DISK 2040

- 360 K Bytes Storage
- High Speed Data Transfer
- Plugs into IEEE Port
- 6504 Microprocessor
- 8K ROM Operating System

- 8K ROM Encoding and Decoding
- 4K RAM
- Uses Single or Dual sided Diskettes

NEW FROM PET!

PET 8 1/2 ELECTROSTATIC PRINTER 2021

- 80 column dot matrix
- Full PET graphics
- 8 1/2 inch paper!

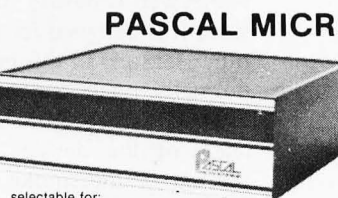
\$549



The Computer of The Future is here Now!

Western Digital's new 16-bit Pascal Computer System is driven by a unique LSI innovation: the 16-bit Pascal MICROENGINE™ designed for direct high-level language execution gives you minicomputer performance at microcomputer prices. Programs written in the block-oriented Pascal language are compiled into P-code and directly executed.

- 64K bytes (32K words) of RAM Memory
- Two RS-232 asynchronous/synchronous ports
- Two 6-bit parallel ports
- Floppy disk controller with direct memory access (DMA), switch



- selectable for:
 - single or double density
 - mini or standard floppy (up to 4 drives)
 - compatible with most standard floppies
- Floating point hardware

PASCAL MICROENGINE™

- Self test microdiagnostics (CPU and memory)
- Memory Mapped I/O
- Enclosed power supply
- Complete UCSD Pascal Operating System (Release 3.0)
 - Pascal compiler
 - BASIC compiler
 - File Manager
 - Screen oriented editor
 - Symbolic Pascal debugger
- System Reference Manuals

INTRODUCTORY SPECIAL OFFER

\$2695 reg. \$2995
offer expires April 15th

FREE \$35 of Software with purchase of any computer on this page

SPECIAL SALE
Buy any computer and take 10% off price of printer of your choice

Word Processing For PET.
With this program in hand, you can create text and add, delete, center, recall lines and move text around on page or between pages. Use either PET or terminal keyboard. \$45.00

Send for FREE Illustrated Software Catalog for PET/APPLE/TRS-80 with hundreds of selections from all over the world.
Min. Credit Card Order \$75
Open Mon.-Fri. 10-6 Sat. 10-4

BUSINESS COMPUTERS



Data General micro NOVA

The ultimate in small business computers when matched with COMPUTER FACTORY's minicomputer: Software - Accounts Receivable/Payable, Inventory Control/Order Entry, General Ledger, Payroll Systems from about \$13,500



IMSAI

The low cost solution for all small business problems. A wide variety of software is available for all your needs. PCS series include dual floppies, 32K RAM, I/O, DDS, BASIC
• PCS-42 (400KB) \$2995 • PCS-44 (780KB) \$3695
VDP-42 series adds video terminal, keyboard, and VIO to above.
VDP-42 - \$4795 • VDP-44 - \$4995
VDP-80 - \$6995



N.Y. residents add 8% sales tax • Same day shipment on prepaid and credit card orders
• Add \$10 shipping for computers, \$3 for boards, \$25 each cassette tape

Toll Free Number for Credit Card Order Desk Only 800-223-7318

The COMPUTER FACTORY 485 Lexington Avenue 750 Third Avenue New York, N.Y. 10017
(212) 687-5001 (212) PET-2001 Foreign order desk - Telex 640055

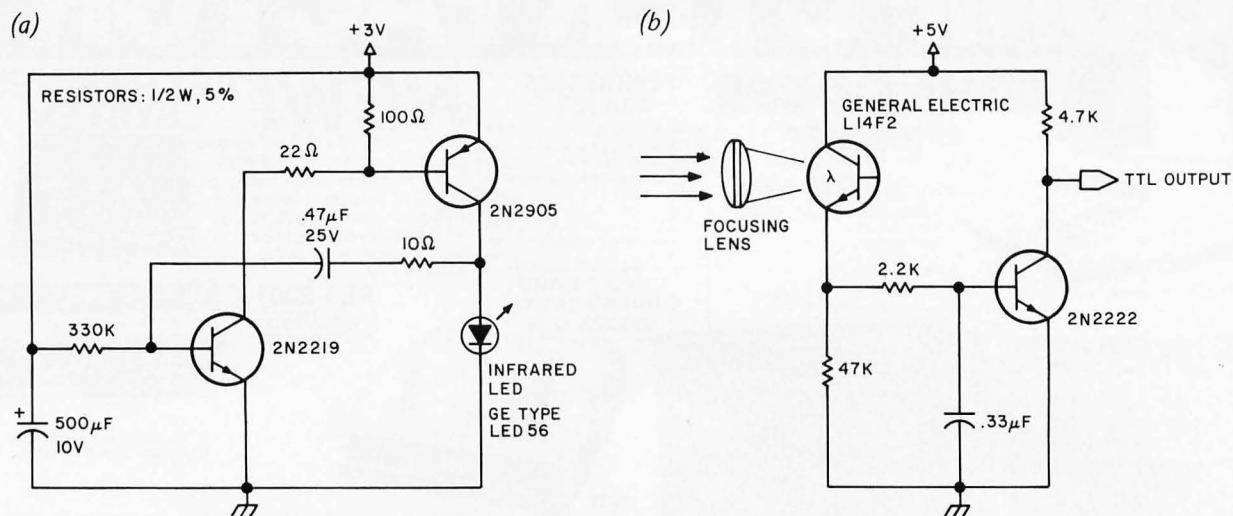


Figure 5: Intrusion alarm infrared transmitter and detector. Shown in (a) is a low voltage pulsed LED (light emitting diode) transmitter; the light beam receiver with optional focusing lens is shown in (b). The lens extends the range of the unit from approximately 10 to 50 feet. Anyone or anything breaking the beam will alert the security system.

designed for this purpose. As configured, the relay contacts will close in the presence of water or condensing moisture. The circuit is extremely sensitive and can be used with practically any conductive liquid.

Probably the most important sensors on the security system are the ones that detect fire and smoke. A commercially available ionization type smoke detector, shown in figure 4, has been configured to interface to the computer. The AC powered TC49A by Honeywell is ideally suited for this purpose, since it is designed for parallel attachment to other sensors. In this instance any number of normally open temperature sensors can be attached between the blue and yellow output leads of the device. Should any of these sensors or the smoke detector itself detect an alarm condition, the 35 V normally present on these wires will drop 2 V. The relay which had previously been in an energized state will open, signaling the event to the computer. Protection must be provided during power failures, however, so that the computer (which has an emergency supply) does not detect a false alarm. If the program which scans the smoke alarm also checks the power failure sensor, positive results should be obtained. In any case it is always a good idea to have a battery powered smoke detector also within the residence.

Note that the majority of sensor designs presented in this article can be used independently. The device normally activated when the sensor signals an alarm condition

can be attached and directly controlled through another parallel set of relay contacts. An example would be the water detector that automatically turns on the sump pump. Requiring the computer to receive the signal, process the control record, and turn on an AC powered pump would be a waste of wire. The computer need know only that the high water mark has been reached to notify the residents on the display panel: it does not have to control it as well. Before you string a mile of wire through the house, consider what functions really need "computer" rather than "local" control.

The two remaining special input sensors are related in purpose. Both are used to detect an object or person passing between two points, and both use interrupted beam sensing techniques. One is an infrared light beam and the other is ultrasonic. The light beam circuit is shown in figure 5 and the ultrasonic circuits are illustrated in figure 6. The range of the infrared unit is about 10 feet without a lens and as much as 50 feet with proper ambient light shielding and a focusing lens. No focusing was tried on the ultrasonic unit, but 25 feet was easily achieved.

Testing and alignment of the ultrasonic transmitter can be tricky, while the infrared is simply a mechanical alignment consideration. First, the transmitter must be tuned to resonance. The nominal frequency of the ultrasonic transducers can be 34 to 42 kHz; they should be bought in pairs. An oscillo-

scope should be put across the transducer in the transmitter circuit when power is applied. Coils T1 and T2 should then be adjusted to produce the greatest amplitude across the transducer. The usual value is about 30 V peak-to-peak and the frequency should be the nominal F_0 listed for the part.

Once the transmitter is tuned, place it about 2 feet in front of the receiver. Adjusting the center frequency adjustment pot should cause the relay to pull in and the LED (light emitting diode) to light. The transmitter and receiver can now be placed across a driveway or large room.

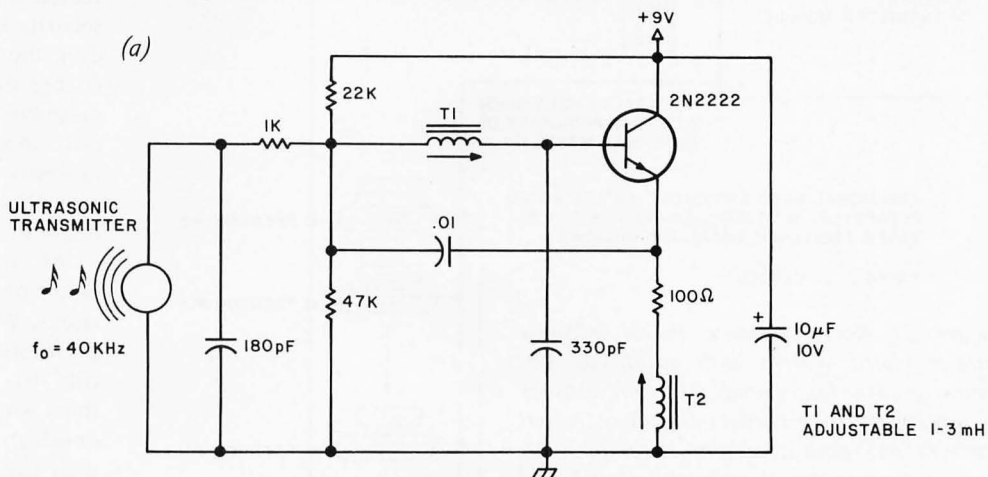
Wireless Inputs

So far we have only discussed input sensors which are directly wired to the

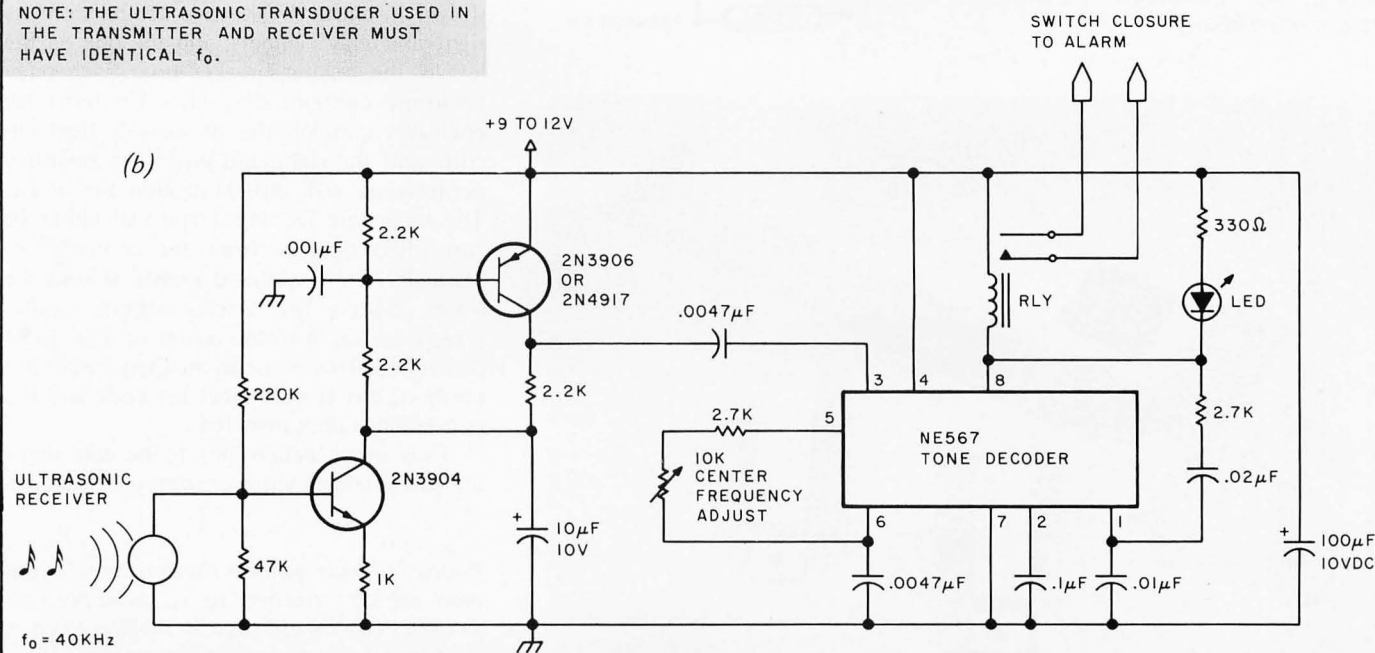
connectors of the SDK-85 computer. If a reed switch were attached to the garage door a wire must be run from it to the computer. In a larger house this can amount to a lot of wire and can extend system construction time. One possible solution is to use a wireless transmitter and receiver between the computer and remote points within the house.

Homebrew wireless transmitters, while cheap, suffer from a lack of reliability. They are not being considered for this application because there is a commercial unit available which is both cost effective and reliable. The particular device is the Norelco Home Patrol wireless burglar alarm system available in most discount stores for about \$200. It consists of a receiver, four contact-closure-activated transmitters, and a smoke

Figure 6: Medium power ultrasonic transmitter (a) and receiver (b). As with the infrared system in figure 5, interruption of the ultrasonic path will alert the security system.



NOTE: THE ULTRASONIC TRANSDUCER USED IN THE TRANSMITTER AND RECEIVER MUST HAVE IDENTICAL f_0 .



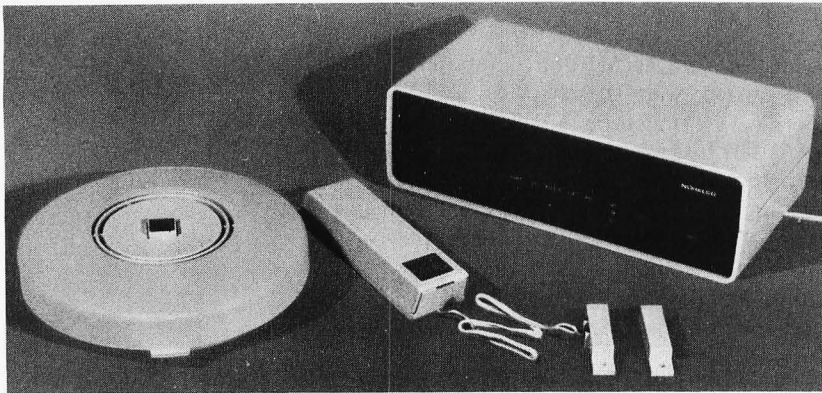


Photo 1: Norelco wireless alarm system. The three components from left to right are: wireless smoke detector, wireless door sensor, and master receiver.

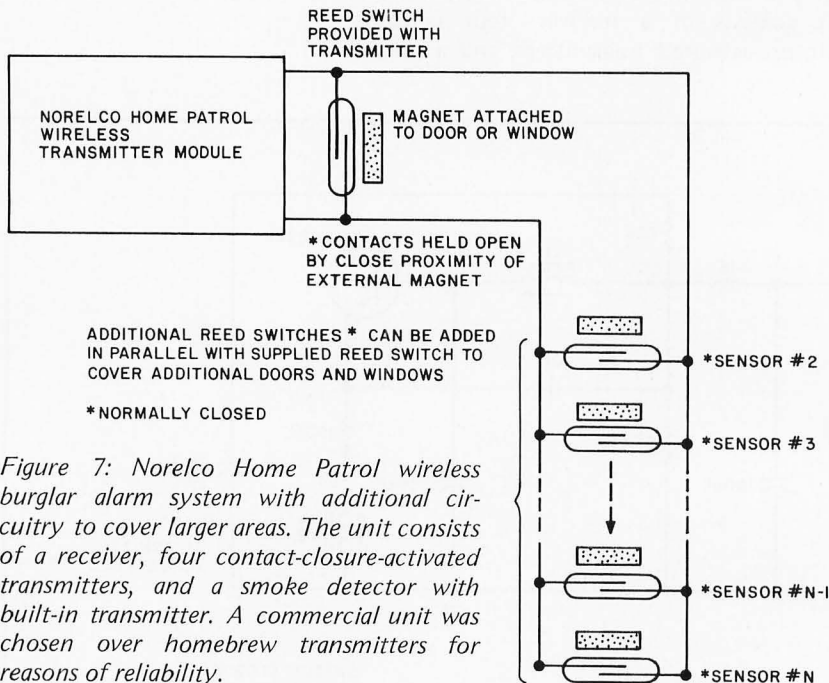
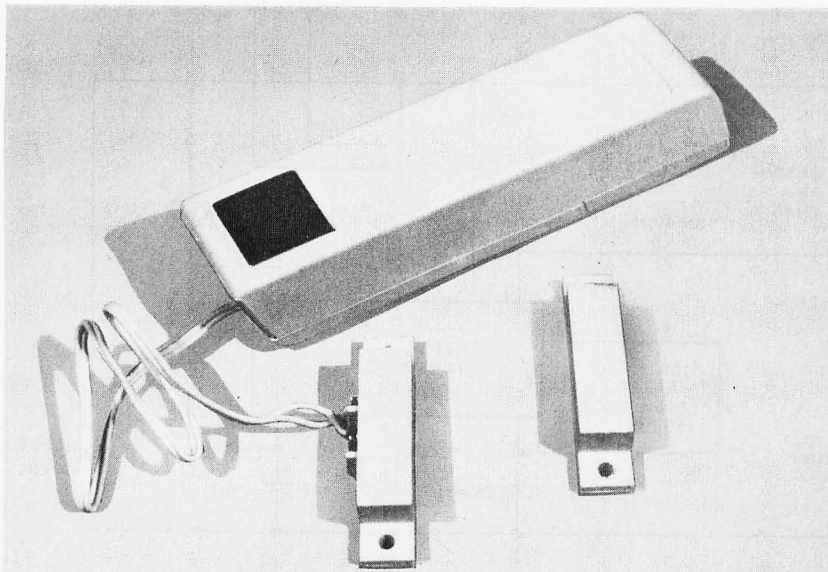


Figure 7: Norelco Home Patrol wireless burglar alarm system with additional circuitry to cover larger areas. The unit consists of a receiver, four contact-closure-activated transmitters, and a smoke detector with built-in transmitter. A commercial unit was chosen over homebrew transmitters for reasons of reliability.



detector with built-in transmitter. Photo 1 shows the components of the system and figure 7 details how each of these separate transmitters can be expanded to cover a wider area.

The Norelco receiver has four separate output channels designated as fire, intrusion, car, and miscellaneous. Transmitters are supplied for intrusion and fire only — transmitters for the other two channels must be purchased separately. Photo 2 shows one of these devices.

Photo 3 shows the output connections of the receiver and figure 8 illustrates the type of interface which must be constructed to convert the 0 and -15 V Norelco receiver outputs to be TTL compatible. Only then can the security system be aware of these remote alarm inputs.

Security System Outputs

Once an alarm condition has been detected or the event processor activated, the security system responds accordingly. Whatever the cause, the output will be a TTL change of state which can be used to drive a mechanical or solid-state relay. Typical output interfaces are warble alarms, high intensity flashers, and strobe lights. They are shown in figures 9, 10 and 11, respectively.

AC output control can be handled in either of two ways: solid-state or mechanical relays. While solid-state relays are definitely the more modern approach, it is very difficult to find control panels incorporating them which are understandable to electricians or which meet local electrical codes. Rather than fight the system it was easier to install a readily available relay control panel as shown in photo 4. The two cabinets on the right are relay cabinets, and the one on the left is the regular breaker box. Each relay enclosure contains six relays. The left relay enclosure controls the six outside light circuits and the righthand enclosure remotely controls six wall outlets around the house. The relays are DC input and can either be controlled directly from the computer or manually from scattered points around the house. Each of the 12 relay outputs requires a separate cable to the outlet or light to be controlled. This is not an inexpensive control method, but it does meet the code and is a convenience once installed.

Two other details left to be considered are the emergency power supply to the com-

Photo 2: Single wireless transmitter with one read switch attached to it. Multiple reed switches can be attached in parallel to cover a wider area, as described in the text.

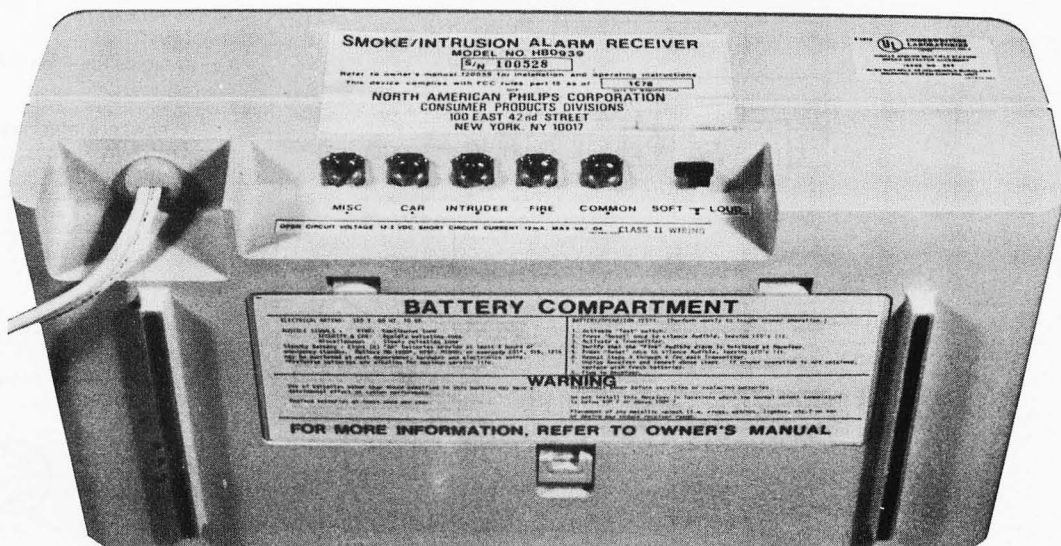


Photo 3: Output connections of the Norelco receiver. Using the circuit described in figure 8, the outputs of the Norelco receiver can be easily interfaced to the computer. There are four distinct output channels of the Norelco unit. As purchased in its basic form it comes with transmitters for fire and intrusion only.

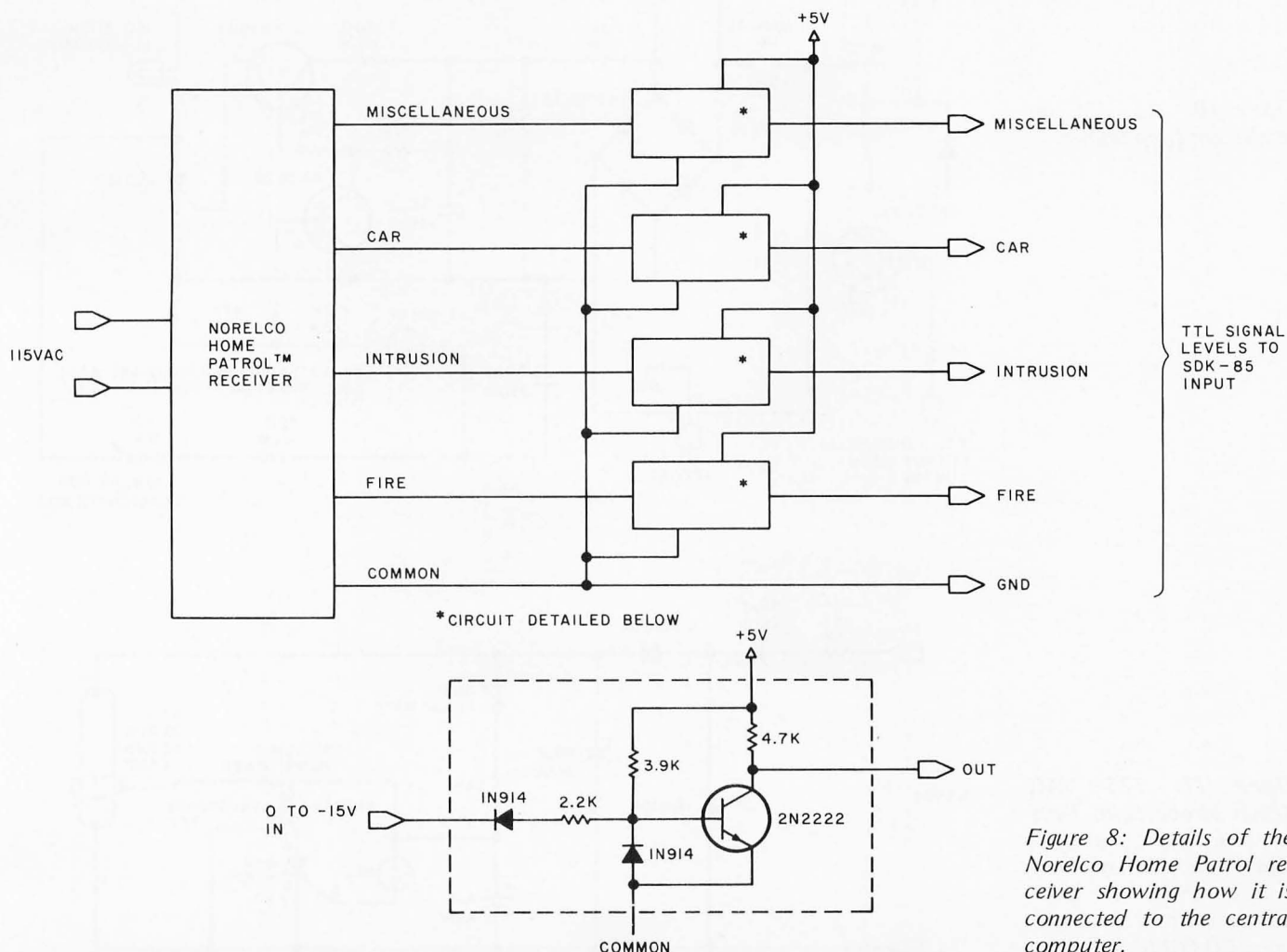


Figure 9: CMOS warble alarm.

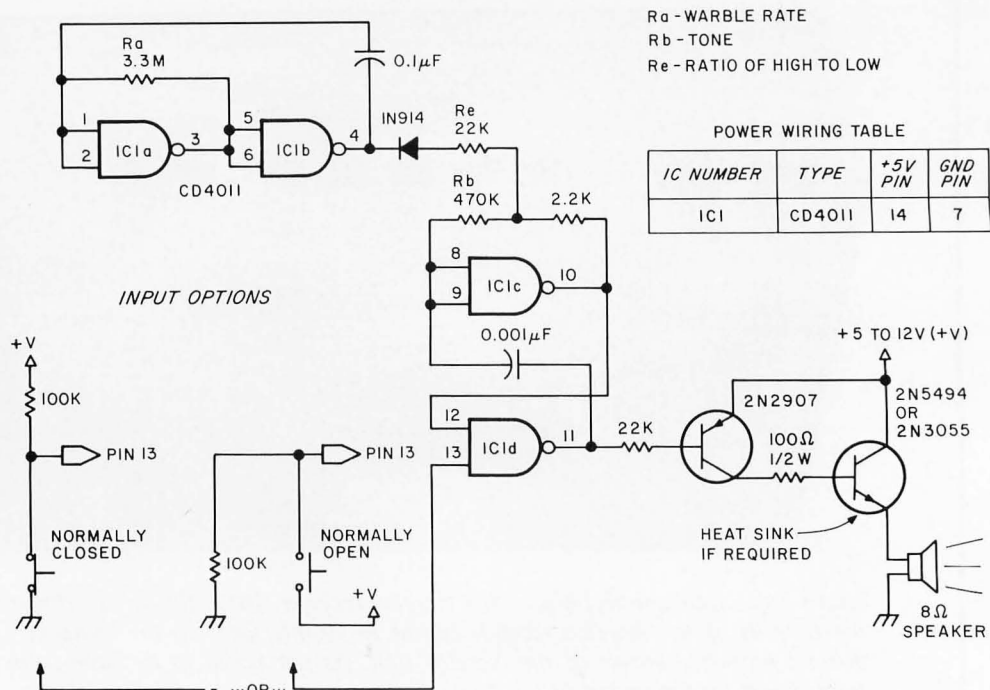


Figure 10: 115 VAC incandescent lamp flasher.

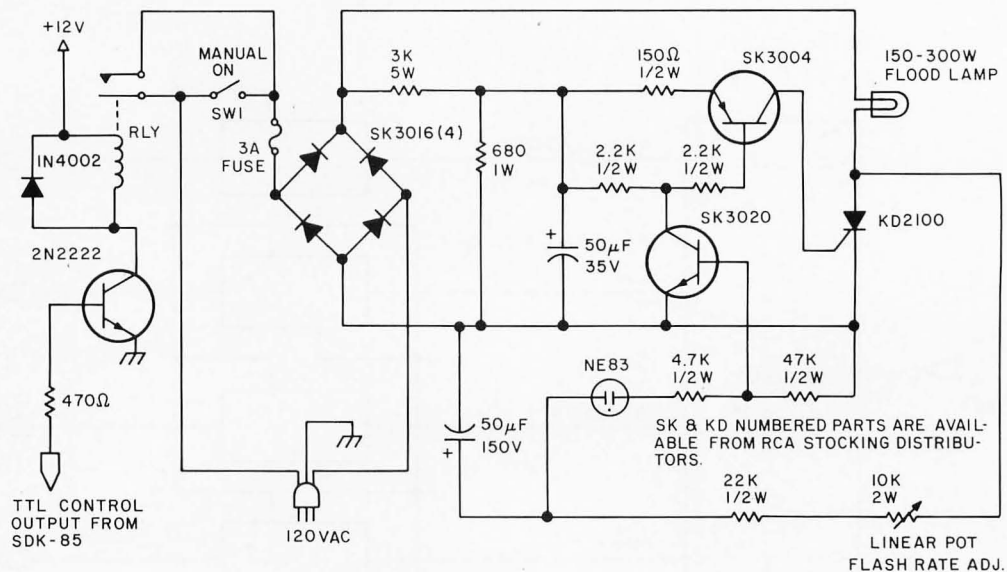
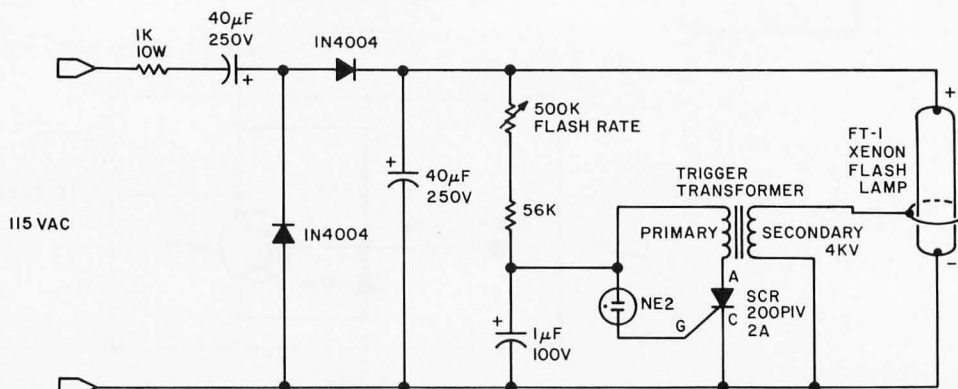
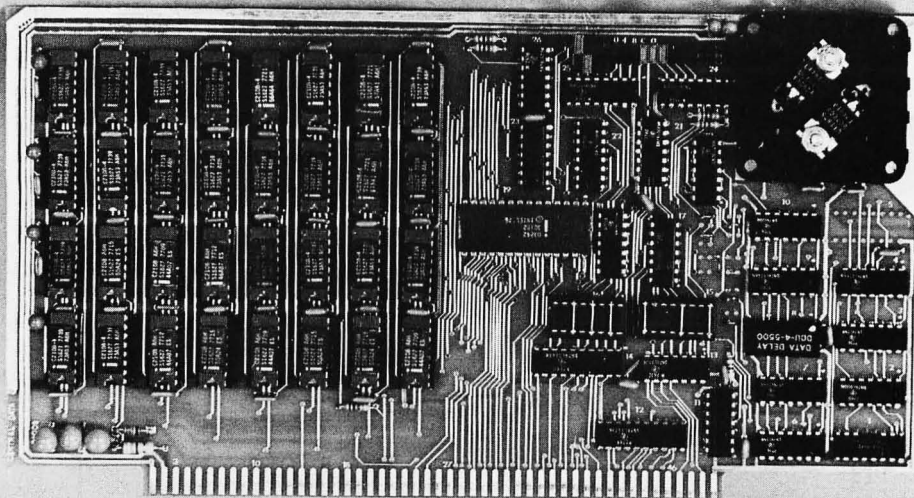


Figure 11: 115 VAC Xenon strobe light. Parts for this circuit are available from Chaney Electronics, 2010 W Dartmouth Unit # 8, Englewood CO 80110.





We Start With A Price That's Hard to Beat.

And We Don't Stop There.

Central Data Corporation has combined the benefits of new technology and high-volume company sales to bring you a RAM board with more features and product options for less money.

Lower Prices

More Memory Capability

To begin with, we've reduced the price of our 16K RAM board by \$40 to \$249. At \$425—a price reduction of \$50—our 32K board costs less, too. Plus, we now offer a full 48K memory board for \$599. These boards are expandable to 64K at a price of \$185 per 16K package. Or you can start right out with a full 64K board for \$775.

Improved Board Design

We've also added improvements to the board design at no extra cost to you.

- **Deselectable in 2K increments.** Our deselect feature enables you to switch off any 2K to avoid overlap with your existing memory.
- **Fully socketed memory.** This feature enables you to expand the memory board yourself.
- **Plug selectable addressing.** Now you can re-address without soldering.

Other Standard Features

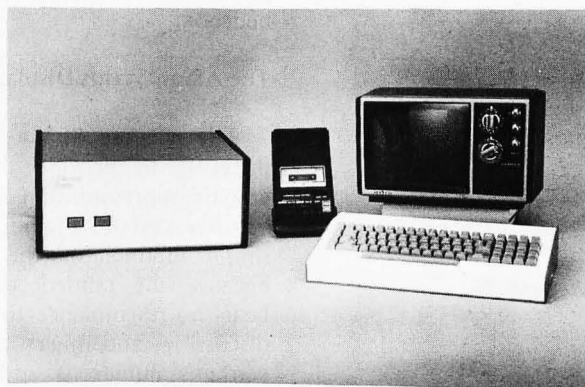
- S-100 and Z-80 compatible
- Fully assembled, tested, and burned-in
- Power-saving dynamic board with on-board invisible refresh
- One-year guarantee on parts and labor

Specifications

Storage capacity	16K, 32K, 48K, or 64K
Addressing	16K boundaries
Max. input load	One LS TTL load
Output buffering	On all data lines
Access time	450ns
Cycle time	480ns
Wait states generated	None
Maximum DMA rate	1 Mhz

Power Consumption (typ)

+16	150ma
+ 8	300ma
-16	20ma



Other Products From Central Data

Central Data also offers, fully-assembled and in kits, a range of other computer products including (pictured above) our 2650 micro-processor, software packages, television monitor, ASCII keyboard, and (not pictured) floppy disk system, to name just a few.

Contact Your Local Dealer

To order our RAM board and for more information, contact your local computer dealer. If unavailable locally, the board and other Central Data products can be ordered directly from us. And, as always, we welcome any questions that you have about our products.

Central Data Corporation

P.O. Box 2530, Station A
1207 N. Hagan
Chamapign, Illinois 61820
(217) 359-8010

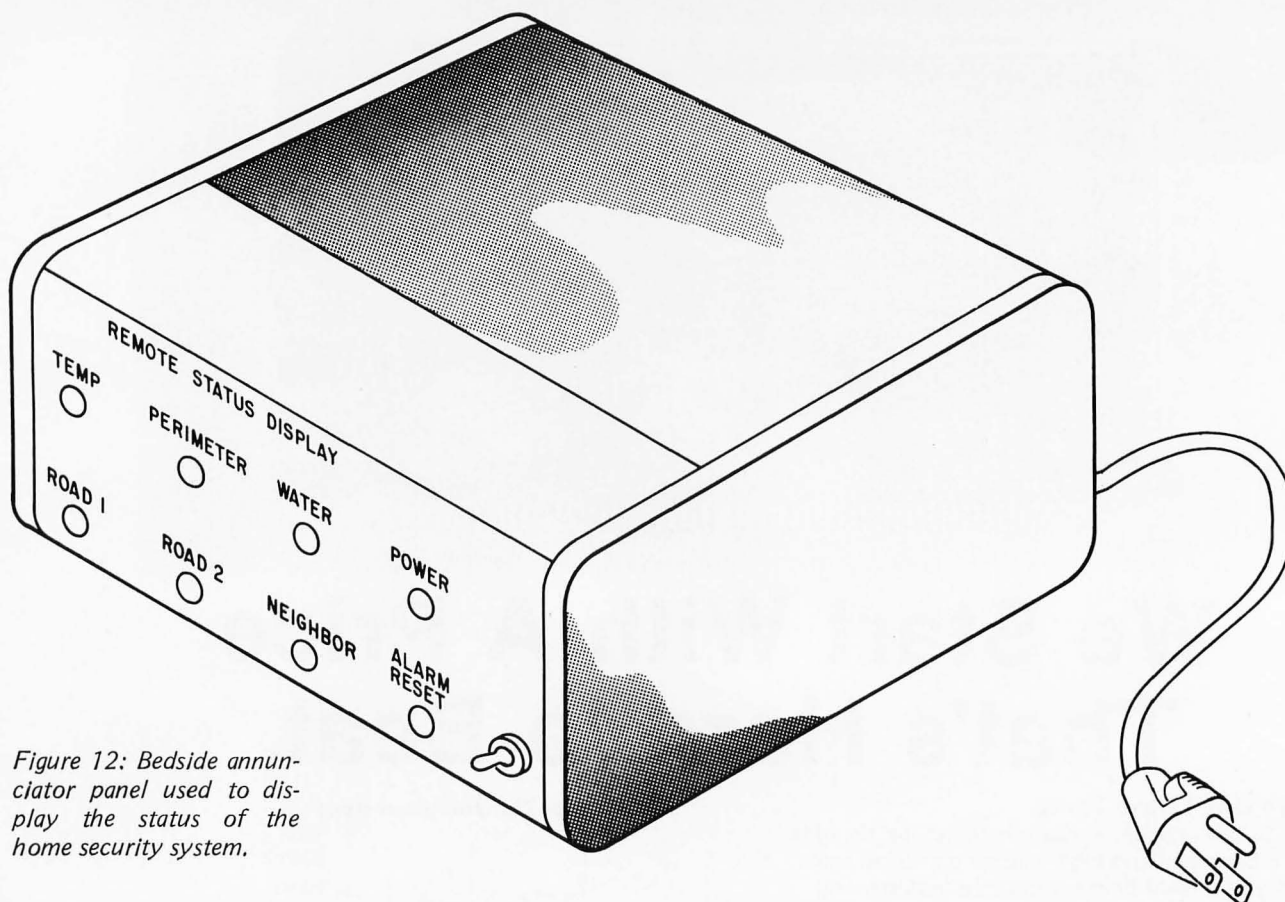


Figure 12: Bedside annunciator panel used to display the status of the home security system.

puter and the display panel located in the bedroom.

The Alarm Status Display Panel

The purpose of the alarm status display panel is to provide the resident with a graphic representation of the status of the security system. Figure 12 is a sketch of a simple annunciator (the picture was omitted because the control panel I finally built bears no resemblance to the purpose we are discussing, and might be confusing since it contains numerous additions to the basic concept).

The circuit (see figure 13) is simply a BCD (binary coded decimal) to decimal decoder driver which is multiplexed by a 3 bit output from the SDK-85. The computer sequentially sends out the codes for the particular lights to be lit. This is done repeatedly and with sufficient speed so that they appear constant. If the annunciator panel is more than 50 feet from the computer, the user may want to consider the addition of the line drivers also described.

Emergency Power Supply

Should power ever be lost in the residence, it is important to maintain the security system in an active mode. To do this a 12 V automobile battery is used to

power the computer *all the time*. The SDK-85 5 V power is derived from the 12 V through a regulator. The EROM (erasable read only memory) can be either a single +5 V unit such as a 2716; or, if using a 2708, the -12 V can be derived using one of the circuits outlined in my article "No Power for Your Interfaces? Build a 5 W DC to DC Converter" (October 1978 BYTE, page 22). The requirements of such a power supply are maintenance of the 12 V on the battery, recharging the battery as it needs it, and also providing standby power to critical sensors and alarms.

Tracing an Activated Alarm Condition: An Example

Part 2 of this series (February 1979 BYTE, page 162) emphasized the software of our computerized home security system. To adequately complete the description of this design, it is necessary to include an example which illustrates the use of table driven software. Included is a listing of the digital scan module and various response modules which should aid in understanding.

Suppose one of the functions of the system is to respond to a smoke and fire detector. First, assume that the sensor in question is wired into the least significant bit (bit 0)

on port 0. Response to this sensor is on a reset-to-set (0 to 1) transition, and that on a set-to-reset (1 to 0) transition no action is to be taken. As detailed in part 2 of this series, the initial state change is detected by DIGSCN (the digital scan module) which uses the information contained in XFVE (the sensor state transfer table) to initiate the processing of a digital event. If you recall, the sensor state transfer table is comprised of four byte records, with one record being required for each digital input:

Sensor State Transfer Record

Bytes 0 and 1: event record address for reset-to-set transition plus active/inactive flag (bit 7);
Bytes 2 and 3: event record address for set-to-reset transition plus active/inactive flag (bit 7).

The smoke and fire detector connected to bit 0 input uses the first record in the sensor state transfer table to initiate the required responses. Since no action is required for a set-to-reset transition, bytes 0 and 1 are set equal to hexadecimal FF. This makes such a transition inactive (active/inactive flag = 1). We do, however, want to process a smoke and fire alarm. Therefore, bytes 2 and 3

must contain the address of the event record associated with the alarm. For this example let us assume that the address of the event record used to process this alarm is at hexadecimal 4214 (therefore byte 2 of the transfer record will equal hexadecimal 14 with byte 3 being equal to 42):

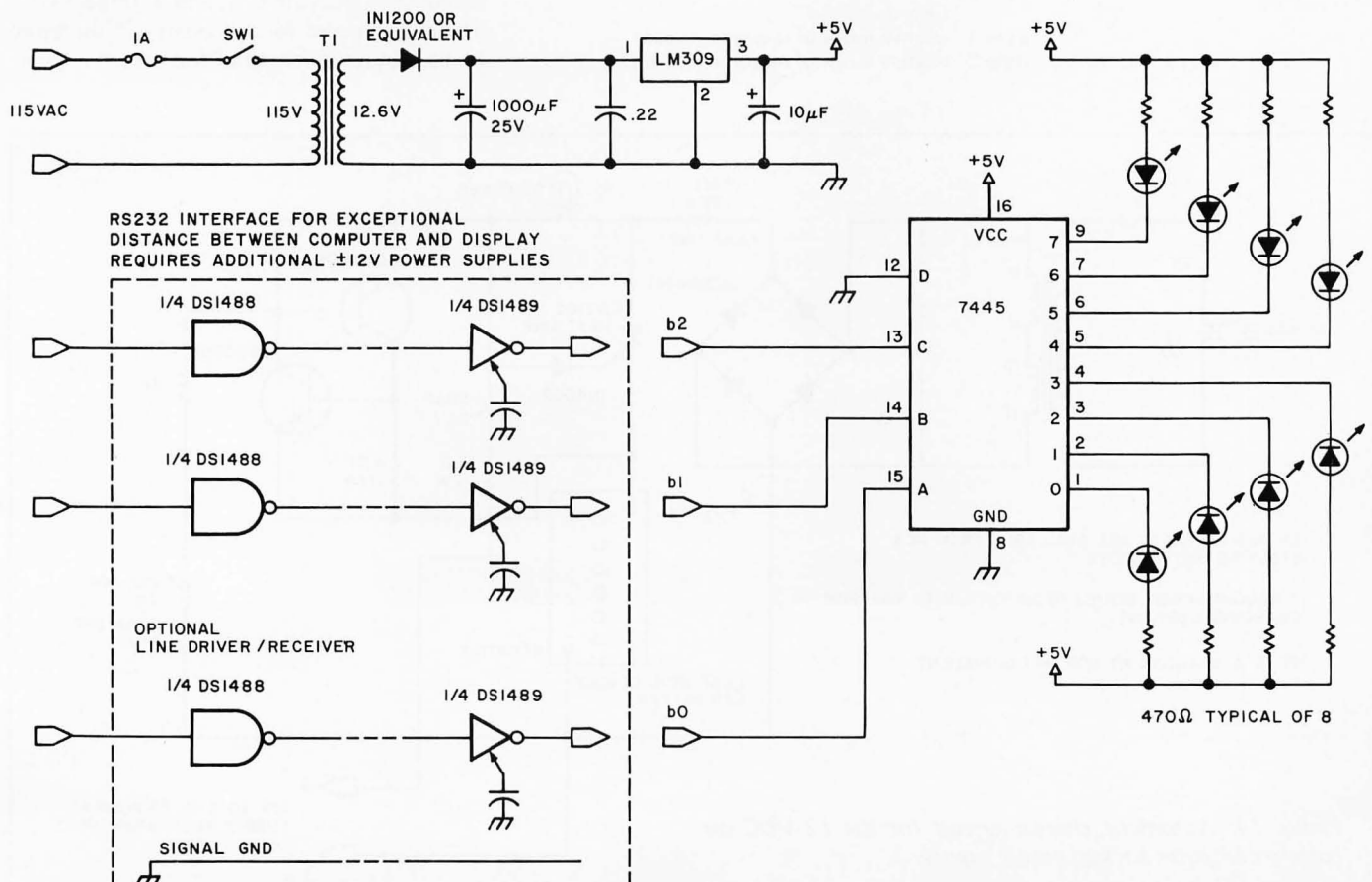
Sensor State Transfer Record for Smoke and Fire Alarm

Byte 0 = FF;
Byte 1 = FF;
Byte 2 = 14;
Byte 3 = 42.

To summarize, the digital scan module detects the transition of the smoke and fire sensor from a reset to a set state. Using the information contained in the sensor state transfer table, the system processes the event by first extracting the address of the event record associated with this alarm and then activating EVPRO (the event processor module).

EVRREC (the event record), which is used by the event record processor, contains the indices to the various response records associated with this alarm. As you may recall, one of the features of this system is its ability to associate several responses to

Figure 13: Driving circuitry for the annunciator panel (see figure 12). A BCD (binary coded decimal) code from the computer is converted to decimal by IC7445 to drive the LEDs on the panel, which are driven sequentially with sufficient speed so they appear to be lit constantly. An optional RS-232 interface for driving the circuit at some distance from the computer plus a 5 V power supply are also shown.



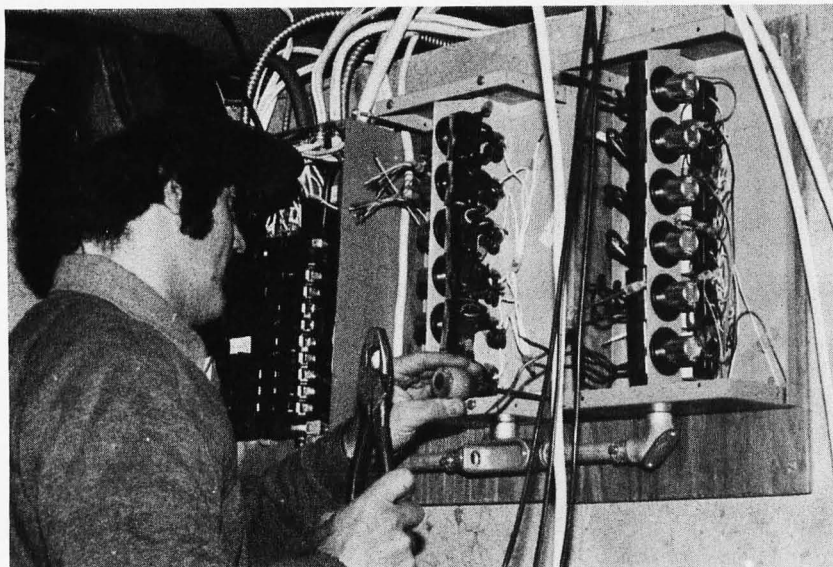


Photo 4: Electrician Vince Sadosky installing "Touch Plate" control system. Each enclosure (of the two on the right) contains six 15 A latching relays. The relay is a pulse on/pulse off type in which the control pulse can come from either a manual pushbutton panel in the kitchen or from the computer.

a single event. The event record is the mechanism which accomplishes this as follows:

Event Record Format

Byte 0: number of responses associated with record;
 Byte 1: relative index of response record i ;
 Byte 2: relative index of response record j ;

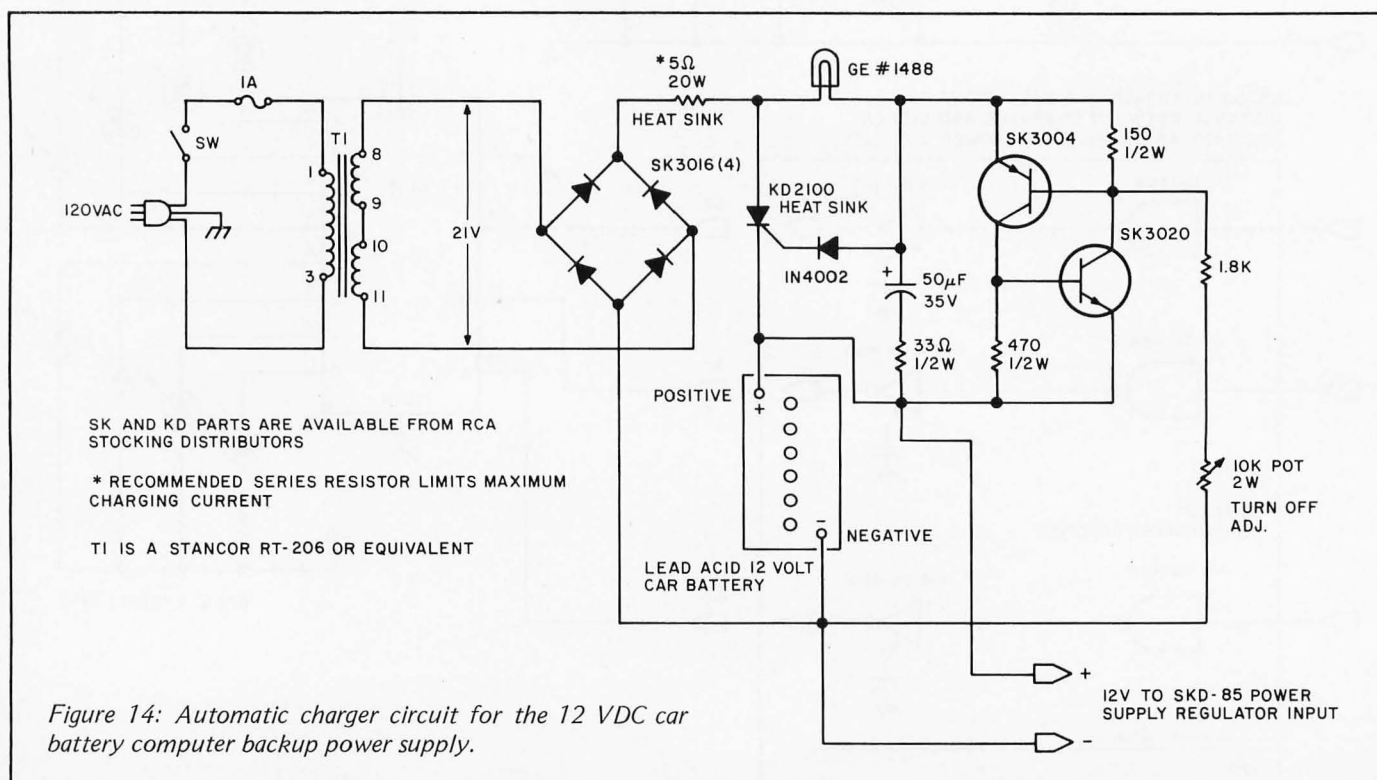
Byte n : relative index of response record z .

Initially the response might be to activate the autodialer notifying the police and fire departments of the predicament. But before doing that, let us take a few seconds to check for a false alarm and, if possible, verify the situation. This can be accomplished with the following responses to the alarm. First we do want to initiate the autodialer. So, our first response will be the initiation of a 60 second delay of the autodialer. Next, since we may be in the bedroom and unable to hear the alarm itself, we will initiate an audible alarm — and, so that we can tell the location of the alarm, we will display the location of the alarm on the annunciator panel.

These functions will require an event record containing the indices of the following responses:

- Delay timer activation for the 60 second delay.
- Application task response for driving the annunciator.
- Digital output response for activating the audible alarm.

In this example it is assumed that the response indices are 0, 1, and 2, respectively. The event record for this event will therefore be four bytes in length as follows:





Please Sir—Could you tell me where I can
Find Software for my Microcomputer?

BUSINESS AND APPLICATION SOFTWARE

AVAILABLE

CALL OR WRITE
FOR DETAILS

SOFTWARE FOR YOUR TRS-80 · PET · APPLE

GALACTIC BLOCKADE RUNNER—an exciting, different and sophisticated space war game with interesting graphic displays. Plays better than many of the Star Treks out there. T1/4 T2/16 P A \$9.95
SCI-FI GAME SAMPLER—includes 3 games—Space Monster, Lunar Lander and Space Battle, all with graphics. T1/4 T2/16 P \$5.95
SOLARIA—a sophisticated fantasy economic simulation—you won't believe the complexity of this one's output. T2/16 P \$9.95

PILOT— The educational language—Ready for your TRS-80! This version comes complete with a built in editor and 3 sample programs. Tape Version \$14.95 Disk Version \$24.95

DIET PLANNING PACKAGE—use your computer to help plan a safe, reliable diet—calculates what your weight should be, your daily calorie allowance—helps plan your menu. T1/4 T2/16 \$14.95
OTHELLO III—A strategy board game—play with the computer, a friend or have the computer play against itself. T1/4 T2/4 P A \$7.95
DAILY BIORHYTHM PROGRAM—has interesting moving line display, gives 30 day graph and more! T1/4 T2/4 \$5.95
MICRO-TEXT EDITOR—non destructable cursor, graphics capability, versital editing options, save & load screen, output to printer. T2/4 \$9.95

GIVE A VOICE AND EARS TO YOUR APPLE COMPUTER!

APPLETALKER—speech synthesis for your APPLE computer! \$15.95
APPLELISTENER—speech recognition for your APPLE computer. A nice companion program to the one above. Just think of the possibilities! \$19.95

MICROCHESS—play chess with your computer. Uses graphic display and provides various levels of difficulty. T1/4 T2/4 P A \$19.95

BRIDGE CHALLENGER—why wait to get 3 other people together to play? Your computer's ready anytime. T2/16 P A \$14.95

AIR RAID—a machine language, real-time, arcade type game. Shoot down planes as they fly by. T1/4 T2/4 \$14.95

RSM-2—a machine language monitor for the TRS-80. Many, many features including a built in disassembler. \$26.95 Disk Version \$29.95

A NEW AND EXCITING VERSION OF STAR TREK IS ON THE WAY! WATCH OUR ADS FOR DETAILS OR SEND FOR FREE CATALOG.

APPLE 21—black jack for your APPLE! \$9.95

STAR WARS/SPACE MAZE—sci-fi games for your APPLE. \$12.95

MICRO-TAX 78—just in time to help you prepare your returns. Does form 1040 and schedules A, B, C, SE, D & 4797. T2/16 \$12.95

RENUMBER—a machine language program for renumbering your BASIC programs, one of your most useful programming tools. T2/4 \$14.95

100'S MORE — SEND FOR FREE CATALOG — GIVE TYPE OF COMPUTER
T TRS-80 Level/Mem P Commodore PET A Apple II

10 % OFF IF YOU BUY 3 OR MORE!



MAD HATTER SOFTWARE

900 SALEM ROAD, DRACUT, MA 01826 (617) 682-8131



IF YOU WOULD LIKE TO HAVE YOUR COMPANY NAME HERE
AS ONE OF OUR RETAIL DISTRIBUTORS CALL

(617) 682-8131

FOR WHOLESALE PRICE INFORMATION


```

ZERO EQU 0
ONE EQU 1
P1 EQU 0 *PORT 1
P2 EQU 1 *PORT 2
P3 EQU 2 *PORT 3
*
* THE FOLLOWING AREAS ARE TO BE LOCATED IN RAM
*
TEMP1 DB 0
TEMP2 DB 0
TEMP3 DB 0
PORT1 DB 0 * CURRENT INPUT DATA FOR PORT 1
PORT2 DB 0 * CURRENT INPUT DATA FOR PORT 2
PORT3 DB 0 * CURRENT INPUT DATA FOR PORT 3
PORT1H DB 0 * PREVIOUS INPUT STATE FOR PORT 1
PORT2H DB 0 * PREVIOUS INPUT STATE FOR PORT 2
PORT3H DB 0 * PREVIOUS INPUT STATE FOR PORT 3
QPORT DS 3 * OUT PUT PORT STATUS
DIGIND DB 0 *DIGITAL INPUT BIT PROCESSING INDEX
XFVE DS 500 *SENSOR STATE TRANSFER TABLE
EVKREC DS 3000 *EVENT RECORD FILE
TODREC DS 1000 *TIME OF DAY RECORD FILE
TIMREC DS 1500 *DELAY TIMER RECORD FILE
RESREC DS 1500 *RESPONSE RECORD FILE
DIGREC DS 3600 *DIGITAL OUTPUT RECORD FILE
*
*THE FOLLOWING MODULES REPRESENT THE MODULES
* REQUIRED FOR PROCESSING THE OCCURRENCE OF
* A DIGITAL EVENT. THESE MODULES WOULD RESIDE IN PROM
*
* THE DIGITAL SCAN MODULE READS THE DIGITAL
* INPUTS, COMPARES THE CURRENT STATE WITH THE PREVIOUS
* STATE AND IF DIFFERENT INITIALIZES THE PROCESSING
* OF THE STATE CHANGE. UPON COMPLETION OF THE DIGITAL
* INPUT PROCESSING THE HISTORY STATE
* OF THE DIGITAL INPUTS IS UPDATED AND THE
* NEXT SCAN INITIATED
*
DIGSCN IN P1 *INPUT PORT 1
STA PORT1
IN P2 *INPUT PORT 2
STA PORT2
IN P3 *INPUT PORT 3
STA PORT3
MVI A,0 *RESET DIGITAL PROCESSING INDEX
STA DIGIND
*
* ISOLATE BIT FROM HISTORY AND CURRENT DIGITAL STATE
*
DIG1 LDA DIGIND *GET PROCESSING INDEX
CPI 80 *INDEX .GT.9
JC DIG4 *JUMP IF INDEX=0-7
CPI 160 *INDEX.LT.16
JC DIG3 *JUMP IF INDEX =08-15
*
* PROCESS THIRD PORT
*
LXI H,PORT3 *HL=PORT3 DATA ADDRESS
LXI D,PORT3H *DE=PORT3 HISTORY ADDRESS
DIG2 CALL COMBIT *GO COMPARE BIT
CPI 0 *IF A=0 NO CHANGE
JNZ DIGPRO *IF A=0 /R 2 GO PROCESS STATE CHANGE
LDA DIGIND *INCREMENT PROCESS INDEX
CPI 255 *ALL INPUTS PROCESSED
JNZ DIG1 *JUMP IF NOT
JMP DIGSCN * GO RESTART SCAN
*
* PROCESS SECOND PORT
*
DIG3 LXI H,PORT2 *HL=PORT 2 DATA ADDRESS
LXI D,PORT2H *DE=PORT 2 HISTROY ADDRESS
JMP DIG2
*
* PROCESS FIRST PORT
*
DIG4 LXI H,PORT1 *HL=PORT 1 DATA ADDRESS
LXI D,PORT1H *DE=PORT1 HISTORY ADDRESS
JMP DIG2
*
* IF A=1 PROCESS A SET STATE
* IF A=2 PROCESS A RESET STATE
* DIGIND CONTAINS THE RELATIVE INDEX INTO
* THE SENSOR STATE TRANSFER VECTOR TABLE
*
DIGPRO STA TEMP1
LXI H,XFVE *HL=BASE ADDRESS
LDA DIGIND
DCR A
RLC *DIGIND*4

```

Event Record for Smoke and Fire Alarm

Hexadecimal
Address

4214 = 3 } number of responses;
4215 = 0 }
4216 = 1 } response record indices for
4217 = 2 } event.

The event processor will process the entries in the event record sequentially, extracting the response record index and activating RESPRO (the response record processor). Using this index the response processor will obtain RESREC (the indicated record from the response file) and direct the activation of the appropriate subprocessors, which contain the following information:

Byte 0 = response type

- 0 = digital output;
- 1 = application module;
- 2 = delay activation;
- 3 = delay deactivation;
- 4 = time-of-day activation;
- 5 = time-of-day deactivation.

Bytes 1 and 2 = module address of record index.

For our example the records will be as follows:

Response File

Record 0 { Byte 0 = 2
Byte 1 = 0 } second delay
Byte 2 = 1 } timer record;

Record 1 { Byte 3 = 1
Byte 4 = 0F } address of annunciator
Byte 5 = 2C } application module;

Record 2 { Byte 6 = 0
Byte 7 = 0 } first digital output
Byte 8 = 0 } record.

The first record processed causes DELINT (the delay module) to activate the second record in TIMREC (the delay timer file). These records contain the delay time (in seconds) and address of the event record to be activated when the directed delay has timed out:

Delay Time Record

Bytes 0 and 1: active flag plus remaining time;
Bytes 2 and 3: number of seconds to delay;
Bytes 4 and 5: address of event record.

In our example this record (prior to activation) will appear as follows:

Bytes 0 and 1: 80, 0 = record inactive;
Bytes 2 and 3: 0, 3C = 60 second delay;
Bytes 4 and 5: 18, 42 = event record at hexadecimal 4218.

After the delay has been initiated, the event processor will notify the response processor to initiate the second response.

Listing 1, continued:

```

      RLC
      MOV     C,A
      MVI     R,ZERO
      DAD     HL,BC
      LDA     TEMP1
      CPI     2
      JZ      DIGP1      *JUMP IF SET TO RESET
      INX     H
      INX     H
DIGP1  LDAX    DE          *DETRANSFER VECTOR
      CPI     80H        *IS HIGH ORDER BIT SET
      JNC     DIGP2      *JUMP IF RECORD INACTIVE
      LDAX    DE
      MOV     L,A
      INX     DE
      LDAX    DE
      MOV     H,A
      CALL    EVPRO      *PROCESS EVENT RECORD
      JMP     DIGP2
*
* COMBIT ISOLATES AND COMPARES THE DATUM BIT
* IN THE CURRENT AND HISTORICAL DIGITAL INPUT
* STATE TABLES
*
* HLECURRENT DATA ADDRESS
* DEEHISTORY DATA ADDRESS
*
COMBIT  LDAX    D          *AEHISTORY DATA
      CMP     M          *COMPARE HISTORY TO CURRENT
      JZ      COM5      *JUMP IF CURRENTEHISTORY
*
* NO COMPARE ISOLATE BIT
*
      MVI     A,1        *SET MASKE1
      JMP     COM42
COM1    CPI     0        *SHIFR COUNTED
      JZ      COM4      *JUMP IF SHIFT COUNTED
      RLC     A          *SHIFT MASK BIT
COM2    STA     TEMP2     *SAVE MASK
*
* GET CURRENT STATE BIT
*
      MOV     R,M        *BECURRENT DATA
      ANA     B          *AECURRENT STATUS BIT
      STA     TEMP3      *TEMP3ECURRENT BIT STATUS
      XCHG
      MOV     R,M
      LDA     TEMP2
      ANA     B
      MOV     R,A        *BEHISTORY BIT
      LDA     TEMP3      *AECURRENT BIT
      CMP     B          *COMPARE BITS
      JZ      COM6      *RETURN IF EQUAL
*
* CURRENT .NF. HISTORY
* UPDATE HISTORY STATE
*
      CPI     0          *IS BIT RESET
      JNZ     COM3      *JUMP IF BIT SET
* RESET HISTROY STATE
      LDA     TEMP2      *GET MASK
      CMA
      XCHG
      ANA     M          *COMPLIMENT MASK
      MOV     M,A        *STORE HISTORY
      INR     A
      STA     DIGIND
      MVI     A,2
      RET
*
* SET HISTORY STATE
*
COM3    LDA     TEMP2      *GET MASK
      ORA     M          *AENEW HISTROY
      MOV     M,A        *STROE NEW HISTORY
      LDA     DIGIND
      INR     A
      STA     DIGIND
      MVI     A,1
      RET
*
COM5    LDA     DIGIND
      ADD     RD
      STA     DIGIND
COM4    MVI     A,0      *A=0
      RET
COM6    XCHG
      LDA     DIGIND
      INR     A
      STA     DIGIND

```

The **Rothenberg**

INTEGRATED FINANCIAL SYSTEM

under
CP/M*

- GENERAL LEDGER
- ACCOUNTS RECEIVABLE
- ACCOUNTS PAYABLE
- PAYROLL
- INVENTORY CONTROL

Easy to use, self-guided.
You don't have to be a CPA!

Price: \$500 each
Complete manuals: \$8 each
Immediate Delivery
Requires only 32K system

Requires CBASIC**

Prepaid or COD only

Send CP/M serial # with each order

Also available:
Complete Legal Billing System
Only \$1995. Manual \$12.

Rothenberg
INFORMATION SYSTEMS, INC.

260 Sheridan Avenue
Palo Alto, CA 94306
(415) 324-8850

*CP/M is a trademark of Digital Research

**Add \$100 if CBASIC is also needed

Circle 329 on inquiry card.

Listing 1, continued:

```

        LDA     TEMP2
        JMP     COM1

*
* THE EVENT RECORD PROCESSOR OBTAINS THE INDEX
* OF THE RESPONSE RECORD FROM THE EVENT RECORD
* CALCULATES ITS ADDRESS
* AND CALLS THE RESPONSE RECORD PROCESSOR
* EVENT RECORD ADDRESS IS IN H/L
EVPRO   MVI     A,ONE      *SET INITIAL INDEX
        PUSH    AF         *SAVE INDEX
        PUSH    HL
EVPR1   INX     HL         *INCREMENT RECORD ADDRESS
        PUSH    HL         *SAVE RECORD ADDRESS
        MOV     A,M        *A=RELATIVE RESPONSE RECORD INDEX
        CALL    RESPRO     *CALL RESPONSE RECORD PROCESSOR
        POP     HL         *GET EVENT RECORD ADDRESS
        POP     DE         *GET INITIAL RECORD ADDRESS
        POP     PSW        *A=GET INDEX
        INR     A          *INCREMENT INDEX
        XCHG    B,M        *HL=INITIAL ADDRESS
        MOV     B,M        *B=NUMBER OF RECORDS TO PROCESS
        XCHG    DE
        PUSH    DE         *SAVE INITIAL RECORD ADDRESS
        CMP     B          *HAVE ALL RESPONSE RECORDS BEEN PROCESSED
        JZ      EVPR2     *JUMP IF MORE TO PROCESS
        POP     HL         *REMOVE BASE ADDRESS OF RECORD FROM STACK
EVPR2   RET
        POP     DE
        INR     A
        PUSH    PSW
        PUSH    DE
        JP      EVPR1     *GO PROCESS NEXT ENTRY IN RECORD

*
* THE RESPONSE RECORD PROCESSOR OBTAINS THE
* RESPONSE TYPE FROM THE RECORD AND TRANSFERS CONTROL
* TO THE APPROPRIATE RESPONSE MODULE
* ON ENTRY A=RESPONSE RECORD INDEX
*
RESPRO  MOV     L,A
        MVI     H,7F0H    *HL=RESPONSE INDEX
        MOV     B,M
        MOV     C,L
        DAD     DE
        DAD     DE
        DAD     DE        *HL=RESPONSE INDEX*3
        XCHG    HL,RESREC
        DAD     DE        *HL=RESPONSE RECORD ADDRESS
        MOV     A,M        *A=RESPONSE TYPE
        ADD     A
        INX     HL        *HL=ADDRESS OF NEXT DATA ITEM IN RECORD
        XCHG    HL,DE      *DE=ADDRESS OF NEXT DATA ITEM IN RECORD
        MOV     C,A
        MVI     B,7F0H
        LXI     HL,RESTAR
        DAD     BC        *HL=TABLE ADDRESS
        MOV     C,HL
        INX     HL
        MOV     B,HL        *BC=ADDRESS OF RESPONSE MODULE
        PUSH    BC
        XCHG    HL
        INX     HL
        MOV     F,M
        RET          *GO TO RESPONSE SUBPROCESSOR
RESTAR  DW      DIGOUT
        DW      APPL
        DW      DELINT
        DW      DELDAC
        DW      TONACT
        DW      TONNAC

*
* THE DIGITAL OUTPUT SUBPROCESSOR EXTRACTS
* THE PORT/MASK/AND DIRECTIVE INFORMATION FROM
* THE INDICATED RECORD AND OUTPUTS THE NEW VALUE
* DE CONTAINS THE RECORD INDEX
*
DIGOUT  LXI     HL,DIGREC  *SET DIGITAL OUTPUT RECORD ADDRESS
        DAD     DE
        DAD     DE
        DAD     DE        *HL=OUTPUT RECORD ADDRESS
        PUSH    HL        *SAVE OUTPUT RECORD ADDRESS
        MOV     A,M        *A=PORT
        DCR     A
        MOV     C,A
        MVI     B,7F0H
        LXI     HL,OPORT   *HL=OUTPUT PORT BASE ADDRESS
        DAD     BC        *HL=ADDRESS OF PORT DATA
        MOV     A,M        *A=OUTPUT PORT CURRENT STATE
        POP     HL
        INX     HL        *HL=MASK ADDRESS

```

This time it determines that the response required from record 1 is to call the application module located at hexadecimal address 2C0F. This information is transmitted to APPL (the application task initiator subprocessor) by the response processor, which transfers control. In our particular example this application module will cause the display panel to flash the location of the sensor giving the alarm. Upon completion of this function the application module returns control to the event record processor.

Next, the event record processor transfers the index of response record 2 to the response processor. Recognizing that a digital output is to be initiated, the processor extracts the index of DIRREC (the digital output record), 0 in this example, and initiates DIGOUT (the digital output subprocessor).

The function of this subprocessor is to activate the audible alarm. A 3 byte record is used to effect the actual output:

Digital Output Record

Byte 0 = output port;
 Byte 1 = bit isolation mask;
 0 for reset (off);
 Byte 2 = 1 for set (on).

In our case let's assume that the audible alarm has been connected to bit 5 on output port 3 and must be set to a logic 1 to sound the alarm. This requires a digital output record as follows:

Audible Alarm Output Record

Byte 0 = 3;
 Byte 1 = 20;
 Byte 2 = 1.

Using this information bit 5 on output port 3 is set and the alarm horn is turned on. Processing this final response causes the event processor to return to the digital scan module, which will continue monitoring the state of all the digital inputs.

The intent of this example is to show how the system works when attached to the real world. While this example does not cover all the functions one might associate with a smoke or fire alarm, it does serve to illustrate how the various tables are structured. What you can do with such a system is limited only by your imagination. As stated earlier in this series, the system can be structured to perform many of the discrete tasks associated with the control and monitoring of the home or office, as well as protecting your property against intruders. So let your imagination take command and have fun. Next month: musical toys.■

Listing 1, continued:

```

ANA      M
PUSH     PSW      *SAVE MASKED STATE
INX      HL
MOV      A,M      *GET SET/RESET DIRECTIVE
DCX      HL
CPI      ONE
JZ       DIGSET   *GO TO SET FUNCTION
POP      BC       *BENEW OUTPUT STATE
DIGOU1   DCX      HL      *HLEPORT ADDRESS
MOV      A,M      *AEOUTPUT PORT
STA      DIGOUT2+1 *SAVE PORT NUMBER IN OUTPUT INSTRUCTION
MOV      A,R      AEOUTPUT DATA
DIGOU2   OUT      THREE
MOV      C,M      *CEPORT
MOV      R,7FH0
LXI      HL,0PORT
DAD      BC
MOV      M,A      *SAVE NEW STATE IN MEMORY
RET
DIGSET   MOV      A,M      *AEMASK
CMA
POP      BC       *CEMASKED VALUE
ORA      B        *AENEW OUTPUT STATE
MOV      P,A
JP       DIGOUT1

```

* VECTORS TO APPLICATION TASK
* DE CONTAINS MODULE ADDRESS

```

*
APPL     PUSH     DE      *SAVE ADDRESS ON STACK
        RET      *EXIT TO APPLICATION MODULE

```

* DELINT ACTIVATES THE DELAY RECORD WHOSE
* RECORD INDEX IS IN DE

```

*
DELINT   LXI      HL,DELREC *SET BASE ADDRESS
        DAD      DE
        DAD      DE
        DAD      DE
        DAD      DE
        DAD      DE
        DAD      DE
        MOV      A,M      *HLEDELAY RECORD ADDRESS
        ANI      80H      *GET ACTIVE FLAG
        RZ           *IS ACTIVE FLAG RESET ,ACTIVE<
        INX      HL      *RETURN IF RECORD IS ACTIVE %RESET<
        INX      HL      *HLETIMER ACTIVATION VALUE
        MOV      A,M      *AETIMER VALUE
        DCX      HL
        DCX      HL
        MOV      M,A      *SET VALUE IN RECORD
        RET

```

* DELDAC DEACTIVATES THE DELAY RECORD
* WHOSE INDEX IS IN DE

```

*
DELDAC   LXI      HL,DELRES *SET BASE ADDRESS
        DAD      DE
        DAD      DE
        DAD      DE
        DAD      DE
        DAD      DE
        DAD      DE
        MVI      A,7EH0
        MOV      M,A      *RESET ACTIVE FLAG
        RET

```

* TODACT ACTIVATES THE TOD RECORD
* WHOSE RECORD INDEX IS IN DE

```

*
TODACT   LXI      HL,TODREC *SET BASE ADDRESS
        DAD      DE
        DAD      DE
        DAD      DE
        DAD      DE
        DAD      DE
        MVI      A,7FH
        ANA      M      *ACTIVATION MASK
        MOV      M,A      *SET RECORD ACTIVE
        RET
TODDAC   LXI      HL,TODREC *SET BASE ADDRESS
        DAD      DE
        DAD      DE
        DAD      DE
        DAD      DE
        MVI      A,70H
        ORA      M      *DEACTIVATION MASK
        MOV      M,A      *SET RECORD INACTIVE
        RET

```

MORE BANG PER BUCK

The PERKIN-ELMER BANTAM



**ALL
NEW**

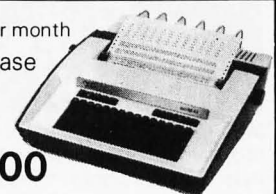
\$799.00

All the Features of the
Hazeltine 1400 & LSI ADM-3A
Plus

Upper/Lower Case
7 x 10 Char. Matrix
White or Black Char.
Transparent Mode

Tab Function
Backspace Key
Shiftlock Key
Print Key
Integrated Numeric
Pad

\$41.61 per month
Lease-Purchase



\$1095.00

**TELETYPE
MODEL 43
KSR**

with RS232
10 or 30 CHAR/SEC
132 COLUMNS
UPPER/LOWER CASE



**USR-310
Originate
Acoustic
Coupler**

0-300 Baud
Crystal Controlled

Stand Alone
RS232

\$149.00



**USR-330
Originate
Auto-Answer
Modem**

\$324.00

FCC Certified for Direct Connection
to Phone Lines

**USR-320 Auto-Answer
Only Modem \$299.00**

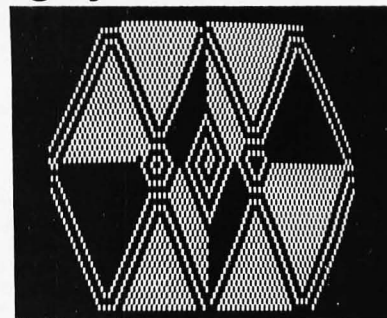
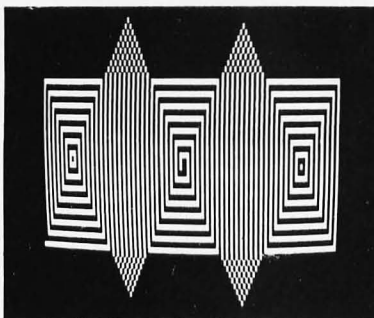
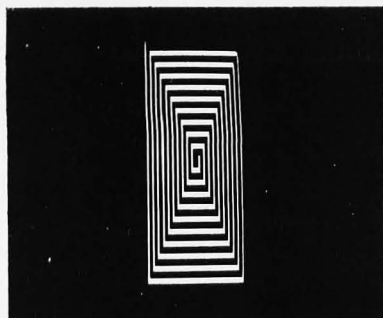
All Units include a 120 day warranty.
Optional Maintenance package available.

**Any Product may be returned
within 10 days for a full refund.**

U.S. ROBOTICS, INC.
1035 W. LAKE ST.
CHICAGO, ILL. 60607

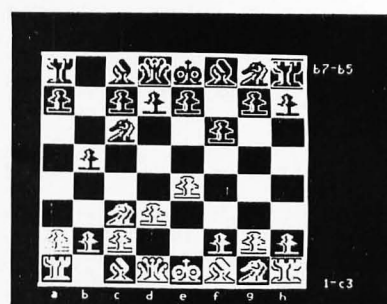
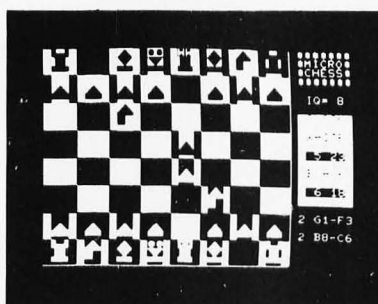
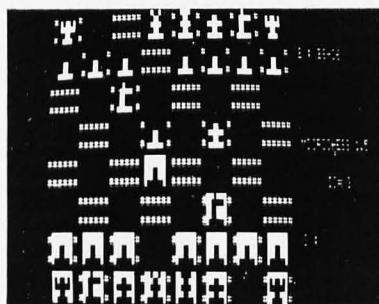
Sales (312) 733-0497
General Offices (312) 733-0498
Service (312) 733-0499

PET / TRS-80 / APPLE: Personal Software brings you the finest!



NEW! THE ELECTRIC PAINTBRUSH by Ken Anderson for 4K Level I and II TRS-80s: Create the most dazzling graphics displays you have ever seen with a minimum of effort. *The Electric Paintbrush* is actually a simple 'language' in which you can write 'programs' directing your paintbrush around the screen—drawing lines, turning corners, changing white to black, etc. Once defined, these programs may be called by other programs or repetitively executed, each time varying the parameters of brush movement.

The machine language interpreter executes your programs almost instantaneously, allowing you to create real-time, animated graphics displays. The screen photos above are actually 'snapshots' of the action of a single one-line program over about thirty seconds. Mesmerize your friends with visual effects they've never seen on a TV screen! There's no limit to the variety of exciting and artistic graphics displays you can create with *The Electric Paintbrush*. And it's available now for only **\$14.95**



MICROCHESS is the culmination of two years of chessplaying program development by Peter Jennings, author of the famous 1K byte chess program for the KIM-1. MICROCHESS 2.0 for 8K PETs and 16K APPLES, in 6502 machine language, offers 8 levels of play to suit everyone from the beginner learning chess to the serious player. It examines positions as many as 6 moves ahead, and includes a chess clock for tournament play. MICROCHESS 1.5 for

4K TRS-80s, in Z-80 machine language, offers 3 levels of play (both Level I and Level II versions are included and can be loaded on any TRS-80 without TBUG). MICROCHESS checks every move for legality and displays the current position on a graphic chessboard. You can play White or Black, set up and play from special board positions, or even watch the computer play against itself! Available now at a special introductory price of only **\$19.95**

BRIDGE CHALLENGER by George Duisman for 8K PETs, Level II 16K TRS-80s, and 16K APPLES: You and the dummy play 4 person Contract Bridge against the computer. The program will deal hands at random or according to your criterion for high card points. You can review tricks, swap sides or replay hands when the cards are known. No longer do you need 4 people to play! **\$14.95**

NEW! TIME TREK by Brad Templeton for 8K PETs is **Personal Software's** answer to the proliferation of Star Trek type games. This is a real time action battle game which requires fast thinking as well as sharp wits. There are no 'turns' in Time Trek: your scanners and ship's status report are constantly updated on the screen, and you can enter commands as fast as you can press the keys. You use your shields, phasers and photon torpedoes against enemy Klingons in a game where you can move, steer and fire at the same time. Star Trek aficionado or not, you'll appreciate the excitement and excellence of this real time game **\$14.95**

WHERE TO GET IT: Look for the **Personal Software™** display rack at your local computer store. Over 240 dealers now carry the **Personal Software™** line—more than any other brand. If your local dealer doesn't already carry **Personal Software™** products, ask him to call us at (617) 782-5932. Or you can order direct from us by check, money order or VISA/Master Charge. If you have questions, please call us at (617) 783-0694. If you know what you want and have your VISA/MC card ready, you can use any phone to

VISA **DIAL TOLL FREE**
1-800-325-6400 **master charge**

24 hrs In Missouri dial 1-800-342-6600 7 days

Or you can mail your order to the address below. To add your name to our mailing list for free literature and announcements of new products, use the reader service card at the back of this magazine.

Personal Software™

P.O. Box 136-B3, Cambridge, MA 02138



Look for Personal Software™ products at the dealer nearest you!

ALABAMA

COMPUTERLAND
Huntsville, AL 35805
THE LOGIC STORE
Opelika, AL 36801

ALASKA

ALPHA ELECTRONICS
Anchorage, AK 99503

ARIZONA

COMPUTERLAND OF PHOENIX
Phoenix, AZ 85016
COMPUTER SHOWROOM
Tucson, AZ 85710

ARKANSAS

DATACOP
Little Rock, AR 72204

CALIFORNIA

JAY-KEN ELECTRONICS
Bakersfield, CA 93305
BYTE SHOP
Burbank, CA 91506
BYTE SHOP OF SACRAMENTO
Citrus Heights, CA 95610
COAST COMPUTER CENTRE
Costa Mesa, CA 92627
COMPUTERLAND OF EL CERRITO
El Cerrito, CA 94530
BUSINESS ENHANCEMENT
COMPUSERVICE
Escondido, CA 92027
CHANNEL DATA SYSTEMS
Goleta, CA 93017
RAINBOW COMPUTING
Granada Hills, CA 91344
JADE COMPUTER PRODUCTS
Hawthorne, CA 90250
BYTE SHOP OF HAYWARD
Hayward, CA 94541
COMPUTERLAND OF HAYWARD
Hayward, CA 94541
COMPUTERLAND OF WEST L.A.
Inglewood, CA 90302
COMPUTERLAND OF SOUTH BAY
Lawndale, CA 90260
A-VIDD ELECTRONICS
Long Beach, CA 90815
COMPUTERLAND
Los Altos, CA 94022
HOBBY WORLD ELECTRONICS
Northridge, CA 91324
COMPUTERS-MADE-EASY
Palmdale, CA 93550
BYTE SHOP OF PLACENTIA
Placentia, CA 92670
CAPITOL COMPUTER SYSTEMS
Sacramento, CA 95616
COMPUTERLAND
San Bernardino, CA 92404
COMPUTERLAND OF SAN DIEGO
San Diego, CA 92111
COMPUTER MERCHANT
San Diego, CA 92115
COMPUTERLAND OF
SAN FRANCISCO
San Francisco, CA 94105
VIDEO GAMES & COMPUTERS
San Francisco, CA 94118
COMPUTERLAND OF SAN JOSE
San Jose, CA 95129
BYTE SHOP
San Louis Obispo, CA 93401
MARIN COMPUTER CENTER
San Rafael, CA 94903
ADVANCED COMPUTER PRODUCTS
Santa Ana, CA 92705
BYTE SHOP
Santa Clara, CA 95051
COMPUTER FORUM
Santa Fe Springs, CA 90670
THE COMPUTER STORE
Santa Monica, CA 90401
SANTA ROSA COMPUTER CENTER
Santa Rosa, CA 95404
BYTE SHOP
Suisun, CA 94585
BYTE SHOP OF TARZANA
Tarzana, CA 91356
COMPUTERLAND OF
THOUSAND OAKS
Thousand Oaks, CA 91360
SMALL SYSTEM SOFTWARE
Thousand Oaks, CA 91360
COMPUTER COMPONENTS
Van Nuys, CA 91411
COMPUTERLAND
Walnut Creek, CA 94598
BYTE SHOP
Westminster, CA 92683
COMPUTER COMPONENTS OF
ORANGE COUNTY
Westminster, CA 92683

COLORADO

AMPTC
Denver, CO 80216
BYTE SHOP
Englewood, CO 80110
COMPUTERLAND
Denver, CO 80222

CONNECTICUT

COMPUTERLAND OF FAIRFIELD
Fairfield, CT 06430

JRV COMPUTER STORE
Hamden, CT 06518
THE COMPUTER STORE
Hartford, CT 06103
THE COMPUTER STORE
Windsor Locks, CT 06096

WASHINGTON D.C.

COMPUTER CABLEVISION
Washington, D.C. 20007

FLORIDA

COMPUTERLAND
Boca Raton, FL 33432
THE COMPUTER STORE
Bradenton, FL 33505
THE COMPUTER STORE
Clearwater, FL 33516
UCATAN
Destin, FL 32541
BYTE SHOP
Fort Lauderdale, FL 33334
COMPUTERLAND
Fort Lauderdale, FL 33308
COMPUTERS FOR YOU
Fort Lauderdale, FL 33312
DATA MOVERS
Fort Meyers, FL 33901
FOCUS SCIENTIFIC ENTERPRISES
Miami, FL 33132
GRICE ELECTRONICS
Pensacola, FL 32589
COMPUTER AGE
Pompano Beach, FL 33062
MICRO COMPUTER SYSTEMS
Tampa, FL 33609
COMPUTER CENTER OF
PALM BEACHES
West Palm Beach, FL 33409

GEORGIA

ADVANCE COMPUTER TECHNOLOGIES
Atlanta, GA 30328
COMPUSHOP
Atlanta, GA 30342
DATAMART
Atlanta, GA 30305
THE LOGIC STORE
Columbus, GA 31906
COMPUTERLAND OF ATLANTA
Smyrna, GA 30080

HAWAII

MICROCOMPUTER SYSTEMS
Honolulu, HI 96813
RADIO SHACK (Dealer)
Lihue, HI 96766

ILLINOIS

COMPUTERLAND OF
ARLINGTON HEIGHTS
Arlington Heights, IL 03904
FARNSWORTH COMPUTER CENTER
Aurora, IL 60505
KAPPEL'S COMPUTER STORE
Belleville, IL 62220
DOW-COM
Carbondale, IL 62901
BYTE SHOP
Champaign, IL 61820
THE ELEKTRIK KEYBOARD
Chicago, IL 60614
EMMANUEL B. GARCIA JR.
AND ASSOCIATES
Chicago, IL 60613
PERSONAL COMPUTER
Chicago, IL 61820
COMPUTERLAND
Downers Grove, IL 60515
COMPUTER STATION
Granite City, IL 62040
COMPUTERLAND OF NILES
Niles, IL 60648
COMPUTERLAND
Oak Lawn, IL 60453
COMPUTERLAND OF PEORIA
Peoria, IL 61614
WALLACE ELECTRONICS
Peoria, IL 61614
DATA DOMAIN
Schaumburg, IL 60195

INDIANA

DATA DOMAIN OF FORT WAYNE
Fort Wayne, IN 46805
HOME COMPUTER CENTER
Indianapolis, IN 46220
PUBLIC COMPUTING
Lafayette, IN 47904

IOWA

THE COMPUTER CENTER
Waterloo, IA 50701

KANSAS

PERSONAL COMPUTER CENTER
Overland Park, KS 66206
COMPUTER SYSTEMS DESIGN
Wichita, KS 67214

LOUISIANA

METAFIRE SHOPPE
Metairie, LA 70002

MARYLAND

COMPUTERLAND
Rockville, MD 20855

COMPUTERS ETC.

Towson, MD 21204
COMPUTERS UNLIMITED
Towson, MD 21204

MASSACHUSETTS

THE COMPUTER STORE
Burlington, MA 01803
THE COMPUTER STORE
Cambridge, MA 02139
MAD HATTER SOFTWARE
Dracut, MA 01826
NEW ENGLAND ELECTRONICS
Springfield, MA 01103

MICHIGAN

NEWMAN COMPUTER EXCHANGE
Ann Arbor, MI 48104
NEW DIMENSIONS IN COMPUTING
East Lansing, MI 48823
COMPUTER HOUSE DIV.
Jackson, MI 49202
COMPUTERLAND OF
GRAND RAPIDS
Kentwood, MI 49508
COMPUTRONIX
Midland, MI 48640
COMPUTER MART OF ROYAL OAK
Royal Oak, MI 48073
TRI CITY COMPUTER MART
Saginaw, MI 48603
COMPUTERLAND
Southfield, MI 48034
LEVEL FOUR PRODUCTIONS
Westland, MI 48185

MINNESOTA

COMPUTERLAND
Bloomington, MN 55431
MINN. MICRO SYSTEMS
Minneapolis, MN 55454

MISSISSIPPI

OXFORD SOFTWARE CO.
Oxford, MS 38655

MISSOURI

COMPUTER COUNTRY
Florissant, MO 63031

NEVADA

HOME COMPUTERS
Las Vegas, NV 89109

NEW HAMPSHIRE

TRS-80 SOFTWARE EXCHANGE
Milford, NH 03055
COMPUTERLAND OF NASHUA
Nashua, NH 03060
BITS, INC.
Peterborough, NH 03458

NEW JERSEY

COMPUTER LAB OF NJ
Budd Lake, NJ 07828
COMPUTER EMPORIUM
Cherry Hill, NJ 08002
COMPUTER MART OF NJ
Iselin, NJ 08830
MSM ELECTRONICS
Medford, NJ 08055
COMPUTERLAND
Morristown, NJ 07960
COMPUTERLAND
Paramus, NJ 07652
COMPUTER NOOK
Pine Brook, NJ 07058
COMPUTER ENCOUNTER
Princeton, NJ 08540
TYPRONIC COMPUTER STORE
Ramsey, NJ 07446

NEW YORK

COMPUTERLAND
Carl Place, NY 11514
COMPUTER SHOP OF SYRACUSE
De Witt, NY 13214
THE COMPUTER TREE
Endwell, NY 13760
LONG ISLAND COMPUTER
GENERAL STORE
Lynbrook, NY 11563
COMPUTER MICROSYSTEMS
Manhasset, NY 11030
THE COMPUTER FACTORY
New York, NY 10017
AUTOMATIC SYSTEMS
Poughkeepsie, NY 12603
COMPUTER HOUSE
Rochester, NY 14609
THE COMPUTER STORE
Rochester, NY 14618
THE COMPUTER CORNER
White Plains, NY 10601

NORTH CAROLINA

BYTE SHOP
Charlotte, NC 28212
COMPUTERLAND
Charlotte, NC 28205
FUTUREWORLD
Durham, NC 27707
BYTE SHOP
Greensboro, NC 27401
MICROCOMPUTER SERVICES
Hickory, NC 28601
BYTE SHOP OF RALEIGH
Raleigh, NC 27605

OHIO

BASIC COMPUTER SHOP
Akron, OH 44314
CINCINNATI COMPUTER STORE
Cincinnati, OH 45246
21ST CENTURY SHOP
Cincinnati, OH 45202
CYBER SHOP
Columbus, OH 43227
MICRO MINI COMPUTER WORLD
Columbus, OH 43213
ASTRO VIDEO ELECTRONICS
Lancaster, OH 43130
COMPUTERLAND OF CLEVELAND
Mayfield Heights, OH 44121
RADIO SHACK (Dealer)
St. Clairsville, OH 43950

OKLAHOMA

BUSINESS MICRO SYSTEMS
Oklahoma City, OK 73108
HIGH TECHNOLOGY
Oklahoma City, OK 73106
MICROLITHICS
Oklahoma City, OK 73127
HIGH TECHNOLOGY
Tulsa, OK 74129

OREGON

THE COMPUTER STORE
Corvallis, OR 97330
CAMERA AND COMPUTER
EMPORIUM
Portland, OR 97205
COMPUTERLAND OF PORTLAND
Tigard, OR 97223

PENNSYLVANIA

BYTE SHOP
Bryn Mawr, PA 19010
PERSONAL COMPUTER CENTER
Frazier, PA 19355
COMPUTER AID
Latrobe, PA 15650
THE COMPUTER WORKSHOP
Murrysville, PA 15668
RADIO SHACK (Dealer)
North Wales, PA 19454
A B COMPUTERS
Perkasie, PA 18944
MICROTRONIX
Philadelphia, PA 19106

SOUTH CAROLINA

DATA MART
Greenville, SC 29607

TENNESSEE

MICROCOMPUTER STORE
Knoxville, TN 37919
COMPUTER LABS OF MEMPHIS
Memphis, TN 38117
DOC'S COMPUTER SHOP
Nashville, TN 37211

TEXAS

COMPUTERLAND OF AUSTIN
Austin, TX 78757
COMPUSHOP
Dallas, TX 75243
COMPUTERLAND
Dallas, TX 75231
KA ELECTRONICS SALES
Dallas, TX 75247
COMPUTER TERMINAL
El Paso, TX 79901
RAM MICRO SYSTEMS
Fort Worth, TX 76116
COMPUTERCRAFT
Houston, TX 77063
NEIGHBORHOOD COMPUTER
Leavitt, TX 79401
COMPUTER PATCH OF SANTA FE
Odessa, TX 79762
COMPUSHOP
Richardson, TX 75080
THE COMPUTER SHOP
San Antonio, TX 78216
COMPUTER SOLUTIONS
San Antonio, TX 78229
WICHITA COMPUTER SYSTEMS
Wichita Falls, TX 76301

UTAH

THE HI-FI SHOP
Salt Lake City, UT 84117

VERMONT

COMPUTERMART
Essex Junction, VT 05452

VIRGINIA

COMPUTER HARDWARE STORE
Alexandria, VA 22314
COMPUTERS PLUS
Alexandria, VA 22304
HOME COMPUTER CENTER
Newport News, VA 23606
COMPUTER TECHNIQUES
Richmond, VA 23235
THE COMPUTER PLACE
Roanoke, VA 24015
COMPUTER WORKSHOP
Springfield, VA 22151
HOME COMPUTER CENTER
Virginia Beach, VA 23452

WASHINGTON

OMEGA NORTHWEST
Bellevue, WA 98004
COMPUTERLAND OF SOUTH
KING COUNTY
Federal Way, WA 98003
YE OLDE COMPUTER SHOPPE
Richland, WA 99352
THE COMPUTER SHOPPE
Seattle, WA 98115
EMPIRE ELECTRONICS
Seattle, WA 98166
COMPUTERLAND
Tacoma, WA 98499

WISCONSIN

BYTE SHOP OF MILWAUKEE
Greenfield, WI 53227
COMPUTERLAND
Madison, WI 53711
MADISON COMPUTER STORE
Madison, WI 53711
FOX VALLEY
COMPUTER STORE
Neehwa, WI 54956

AUSTRALIA

ELECTRONIC CONCEPTS PTY. LTD.
COMPUTERLAND
Sydney, N.S.W.

CANADA

COMPUSHOP
Calgary, Alberta T2N 2A4
THE COMPUTER SHOP
Calgary, Alberta T2T 4T9
TJB MICROSYSTEMS
Edmonton, Alberta T5M 0H9
COMPUTER CITY
Winnipeg, Manitoba R3P 0H8
COMPUTERLAND
Winnipeg, Manitoba R3G 0M8
INTERACTIVE COMPUTER SYSTEMS
Frederickton, New Brunswick
KOBETEK SYSTEMS
Wolville, Nova Scotia B0P 1X0
LYNTRONICS
Downsview, Ontario M2J 2W6
COMPUTER CIRCUITS
London, Ontario N6A 3H2
COMPLUMART
Ottawa, Ontario K2A 1J2
COMPUTER INNOVATIONS
Ottawa, Ontario K1B 4A8
THE COMPUTER CENTRE
Sarnia, Ontario N7T 1B4
HOUSE OF COMPUTERS
Toronto, Ontario
MARKETRON
Toronto, Ontario
MICRO-WARE
Toronto, Ontario M4E 2L2
COMPUCENTRE
Montreal, Quebec H1J 1Z4
FUTUR BYTE
Montreal, Quebec H3B 3C9
CUSTOM COMPUTING SERVICES
Saskatoon, Saskatchewan S7K 2B5
DIGITAL SERVICE
Saskatoon, Saskatchewan S7J 3A9

ENGLAND

BYTE SHOP
Ilford, Essex
INFOGUIDE
London
CYTEK
Manchester M4 3E4
PETSOFT
Newbury, Berkshire RG13 1PB
KEEN COMPUTERS
Nottingham NG7 1FN
PETAELECT
Woking, Surrey
J&J ELECTRONICS
Bexhill-on-Sea, East Sussex
OPTRONICS
Twickenham TW1 4RY

GERMANY

ING. W. HOFACKER
8 Munchen 75

HOLLAND

COMPUTRON
Den Haag 2502 ER

ITALY

HOME MICROCOMPUTERS SRL
20123 Milano

SINGAPORE

THE COMPUTER CENTRE PTE. LTD.
Singapore 7

SWEDEN

MICROFUTURE
Stockholm 10322
SEMIDAKO
Uppsala 75353

SWITZERLAND

INTERFACE TECHNIQUE
Basel
DIALOG COMPUTER
Lucerne
ELBATEX
Wettingen

Common Mistakes

David A Higgins
Langston Kitch and Associates
715 8th St
Topeka KS 66607

Using Warnier-Orr Diagrams

Editorial Note. . .

Since publishing David Higgins' first two articles on Warnier-Orr diagramming techniques, we have received a number of letters from people expressing the message (paraphrased) "if I have this or that self-documenting structured programming language, why should I use Warnier-Orr techniques? After all, if a program in my language is logically equivalent to the Warnier-Orr structure, and it is directly executable, I see no need for an extra layer of documentation."

A very real answer to this objection is that it is correct. There is no point to using Warnier-Orr techniques if you properly use a language such as PASCAL which, having structured programming constructs built in, allows long descriptive names for variables and procedures, and as a result can support self-documenting code.

But most currently used languages in personal computing do not easily support self-documenting code and modern concepts of structured programming. The usefulness of the Warnier-Orr methodology is that it provides a disciplined way of imposing such structure on a language such as BASIC, FORTRAN or assembly language. In effect, the Warnier-Orr discipline is a programming language which is intended for hand translation into one of the existing unstructured languages. . . CH

In my opinion, one of the best program and system design methods is the Warnier-Orr structured systems design approach, which I described previously ("Structured Program Design," page 146, October 1977 BYTE; "Structured Programming with Warnier-Orr Diagrams," page 104, December 1977 and page 122, January 1978 BYTE). This article is being presented because of the interest expressed in this subject, and because a lot of people will be trying these techniques for the first time. Newcomers to this methodology often have many questions about their work, and want to know whether or not what they are doing is correct. The purpose of this article is to outline a few of the more common mistakes that beginners make when using this technique.

Philosophical Errors

Many first time users of the Warnier-Orr diagrams tend to make mistakes which are so similar that they are worth examining. The

biggest and most common mistakes tend to be a direct result of what we can call philosophical errors; not really a misuse of the techniques so much as a misunderstanding of the techniques. The most common error stems from the fact that many computer programmers tend to be obsessed with the desire to write some kind of code at the very beginning of the design process. This problem usually manifests itself in any or all of the following three ways:

- Trying to code the program while designing it (called the design-a-little, code-a-little approach).
- Relying too heavily on language restrictions and considerations while doing logical design.
- Skipping the design phase altogether because:
 - a) the program is "too easy" or
 - b) the programmer is "too smart."

Any of the above practices will destroy most if not all of the effectiveness of the Warnier-Orr methodology [or any other structured programming methodology for that matter. . . CH]. It will certainly cause you to waste a great deal of time.

If you try to use the first technique, the design-a-little, code-a-little approach, you will probably be in for quite a bit of erasing or retyping when you have to change the design because you coded yourself into a corner that you can't design your way out of. Your program will tend to be twice as long as it should have been and half as efficient. You will probably be in for a lot of debugging runs while trying to put back into the code everything that you left out when you changed the design. As you can see, this technique just naturally generates problems.

The second technique described above is a common mistake that veteran programmers almost always seem to make: relying too heavily on the program language they will be using while doing the program design. Consider the two examples of program

The Software Company

Technical Systems Consultants, Inc.

TSC, Technical Systems Consultants, is the software company for all the newest, most innovative ideas in computer software. TSC builds a variety of programs, packages and games so you can get down to business or just some fun.

Text Editing System

The most complete and versatile editor available for the 6800 and 8080 micro. The system is line and content oriented for speed and efficiency and features such commands as block move and copy, append and overlay, as well as string manipulators. The 6800 version requires 5K beginning at 0 hex, the 8080 needs 6K starting at 1000 hex. Both should have additional file space as required.

SL68-24	6800 Text Editing System	\$23.50
SL68-24C	w/cassette	\$30.45
SL68-24P	w/paper tape	\$31.50
SL68-24D	w/mini flex disc	\$31.50
SL68-24F	w/flex disc	\$50.00
SL80-10	8080 Text Editing System	\$28.50
SL80-10P	w/paper tape	\$37.50
SL80-10F	w/ CP/M disc	\$40.00

Space Voyage

SL68-5C	w/cassette	\$18.95
SL68-5P	w/paper tape	\$19.00
SL80-9P	w/paper tape	\$19.00

6800 Disassembler

SL68-27C	w/cassette	\$15.95
SL68-27P	w/paper tape	\$13.00

Micro BASIC Plus for 6800

SL68-19C	w/cassette	\$22.90
SL68-19P	w/paper tape	\$21.95

6800 Floating Point Package

SL-68-4	Floating Point Package	\$6.50
SL68-4P	w/paper tape	\$9.50



Technical Systems Consultants, Inc.

Box 2574 W. Lafayette, IN 47906

Specialists in Software & Hardware for Industry & the Hobbyist

Text Processing System

As a complement to the Editor, the Processor supports over 50 commands for left, right or center justification, titling, paging and general text output formatting. A loop command is available for repeated formatting jobs such as form letters. Also included are capabilities for macro definition to build special formatting commands. The program requires about 8K of RAM and previously edited text.

SL68-29	6800 Text Processor	\$32.00
SL68-29C	w/cassette	\$38.95
SL68-29P	w/paper tape	\$40.00
SL68-29D	w/mini flex disc	\$40.00
SL68-29F	w/flex disc	\$75.00

SL80-11	8080 Text Processor	\$32.00
SL80-11P	w/paper tape	\$41.00
SL80-11F	w/ CP/M disc	\$50.00

Relocator

This self-prompting, easy to use program relocates object code in RAM or from tape. Complete instructions included for making the TSC Editor and Assembler or Editor and Text Processor co-resident. (As sold they reside in the same area.) Just over 1K in length.

SL68-28	6800 Relocator	\$ 8.00
SL68-28C	w/cassette	\$14.95
SL80-13	8080 Relocator	\$ 8.00
SL80-13P	w/paper tape	\$13.00

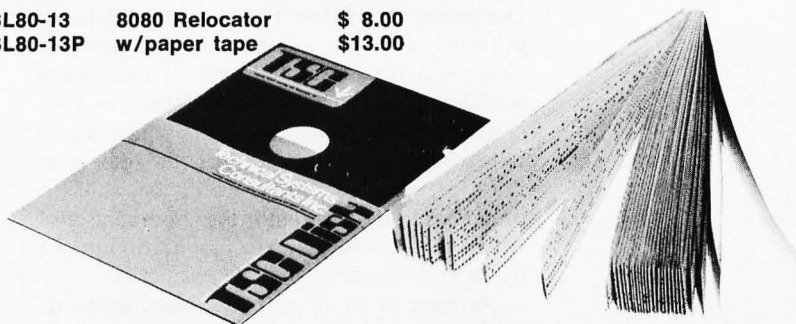
The Mnemonic Assembler

The ideal addition to the Text Editing System, together they form a complete program development center. The Assembler is one of the most versatile available and allows for easy adaptation to most systems. The Assembler is many times faster than other resident assemblers. Requires approximately 5.5K plus file and symbol table space.

SL68-26	6800 Mnemonic Assembler	\$23.50
SL68-26C	w/cassette	\$30.45
SL68-26P	w/paper tape	\$31.50
SL68-26D	w/mini flex disc	\$31.50
SL68-26F	w/flex disc	\$50.00
SL80-12	8080 Mnemonic Assembler	\$25.00
SL80-12P	w/paper tape	\$34.00
SL80-12F	w/ CP/M disc	\$40.00

All programs include complete source listing. Cassettes are in the Kansas City standard format.

All orders should include check or money order. Add 3% for postage and for orders under \$10, please add \$1 for handling. Send 25¢ for a complete software catalog.



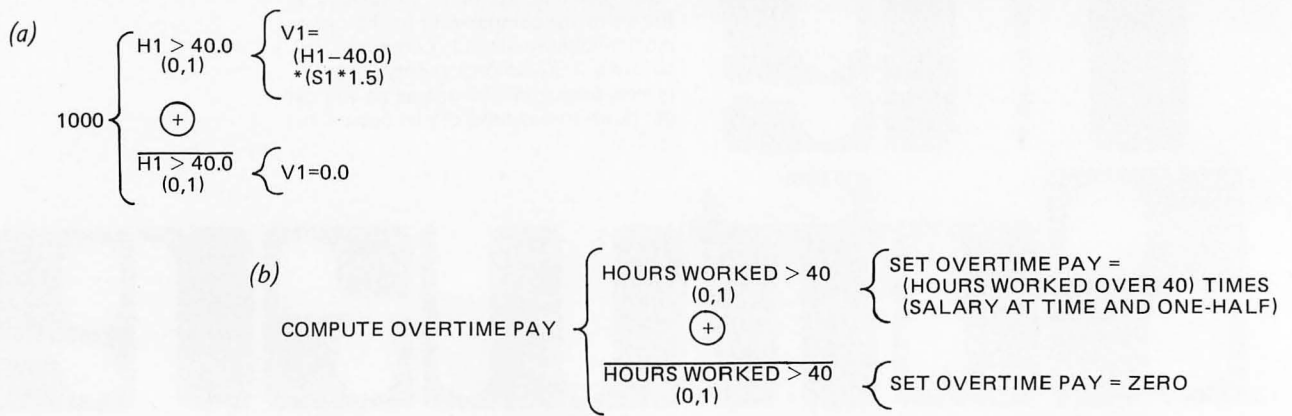


Figure 1: DOs and DON'Ts of Warnier-Orr diagramming. Figure 1a looks like actual program code and should not be used when trying to logically design a program. Figure 1b shows the correct method. The entire diagram contains only logical statements which could be coded into any computer language.

designs shown in figure 1. Both figures 1a and 1b are diagrams of the same process: computation of overtime wages. The diagram in figure 1a however seems to be the type that veteran programmers will almost always try to draw. Note its heavy stress on the language aspect of the function. It almost looks like part of a BASIC program cut out and pasted on a diagram. Contrast that diagram with the one of figure 1b which correctly details the logical process being performed. You can see that if figure 1a was the only documentation for this particular procedure, you would probably not be able to tell what that piece of code was supposed to be doing. You might have some idea because this program seems to have semimeaningful field names from which you might deduce some purpose. All we can tell for sure from figure 1a is that some part of the program is going to crunch a couple of numbers. What numbers it is going to crunch and just what for are anyone's guess. On the other hand, it is impossible to misunderstand what the process diagrammed in figure 1b is doing. It is very easy to read and comprehend because it shows the logical side of the procedure.

This stress of the logical over the physical while designing with the Warnier-Orr diagrams is essential to their correct usage. Designing as in figure 1a serves absolutely no purpose as far as understanding the process that is being described and is essentially worthless as far as documentation is concerned. Even though you might be able to tell what that diagram does the day you draw it, you probably won't be able to understand it in six months. Someone else who wants to use your documentation might never understand it.

As long as we're on the subject of docu-

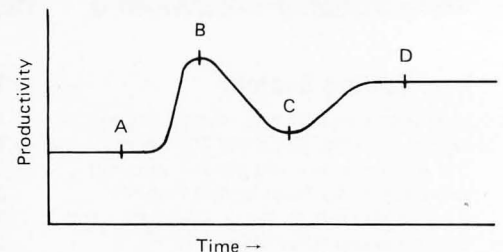


Figure 2: Typical productivity curve of programmer being introduced to Warnier-Orr diagram methodology.

mentation, I might mention that through the development period of this technique, many people were concerned that the diagrams might become too far removed from the actual code, which would render them useless as effective documentation. They worried that since the diagrams depicted the logical side of the problem, they had little or no relevance to the physical (real world) side. Those fears were easily put aside with two diagramming and coding conventions, as follows:

- Physical mileposts on the Warnier-Orr diagrams.
- Logical symbol tables in the programs.

Thus, when we actually wrote code that looked like that of figure 1a, we would tie it to the logical figure 1b by adding the following to the diagram.

COMPUTE OVERTIME PAY

$$\left\{ \begin{array}{l} :STMT\# 1000 \\ . \\ . \\ . \end{array} \right.$$

This would be included in the program itself by using comment statements:

```

1000 REM      COMPUTE OVERTIME PAY
1001 REM      HFLD  = HOURS WORKED
1002 REM      OVTFLD = OVERTIME PAY
1003 REM      SALFLD = SALARY

```

This allows us to have a very clear and concise, one to one mapping between the logical diagram and the physical code. References between the two diagrams are quite easy. If, for instance, you want to know what a particular section of code is supposed to be doing, you need only to look it up on the logical diagram. Similarly, if you want to find out which part of the program is carrying out a particular logical function, you have the location information at your fingertips. This is excellent documentation in the event that you or someone else might someday want to make a modification to your code.

The third common philosophical error, that of skipping the design phase altogether, is a real problem to most newcomers. In fact, if you look at a typical productivity curve for a programmer who is introduced to the Warnier-Orr diagrams, it generally looks something like the curve in figure 2.

A currently productive programmer producing work at a constant rate up until the time the Warnier-Orr techniques are introduced (point A), will typically show an initial burst of very high productivity (point B). This is usually followed by a slump (point C) where the programmer sinks back to or just above his previous level of work. Eventually, he will climb back up to a new, higher level of work (point D), where he will usually stay. This peculiar slump at point C seems to be primarily due to the fact that since the programmer has begun to feel comfortable with the new technique and has had some initial success with it, he begins to feel confident enough to try to do the work without doing the diagrams first. He soon realizes that the quality of his work has dropped off and starts to do the diagrams once again, this time for good, and his work level rises up to a new, higher level that will remain fairly constant.

Apparently, the only way to get new people to avoid this temptation is to forewarn them that it does tend to happen, so that if and when they find themselves on the downhill side of the productivity curve, they can recognize the trap in time to escape the worst of it.

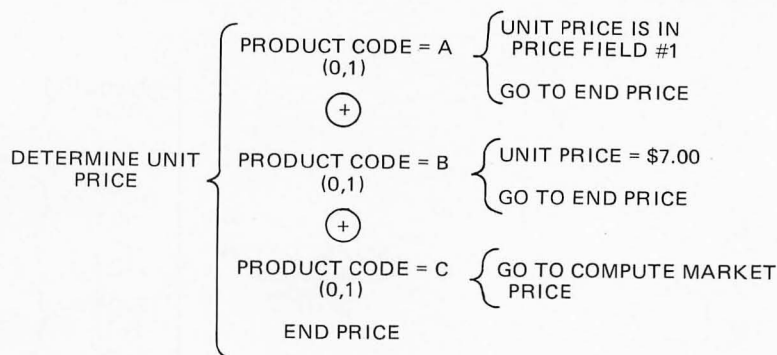


Figure 3: Example case statements making use of logically illegal GOTO statements. When a set of statements is finished the diagram will logically fall through all of the other exclusive ORs, ⊕, and arrive at the END PRICE section. Thus no GOTO need be shown.

So much for the philosophical errors. There are also a few common technical errors that people make, and we'll look at those next.

Technical Errors

For a lot of people who are just starting to program and may be unfamiliar with structured programming techniques, some of the diagramming methods may seem to be a bit uncomfortable. One of the most often seen technical errors is the attempted use of a GOTO statement on the diagram. The case statement shown in figure 3 illustrates this problem.

Two of the occurrences of the GOTOs in figure 3 are incorrect and the other is ambiguous. The GOTOs in "PRODUCT CODE = A" and in "PRODUCT CODE = B" are unnecessary and incorrect. The default logical linkages will see to it that the appropriate steps are executed. The GOTO at "PRODUCT CODE = C" is unclear. If it is supposed to mean that we are to cease execution of this process and jump to the procedure "COMPUTE MARKET PRICE" to begin processing, then its usage is incorrect. If on the other hand it means that "COMPUTE MARKET PRICE" is a common utility routine and is described elsewhere in the system, then the GOTO is misleading. Instead, we should have written:

```

PRODUCT CODE = C { COMPUTE MARKET PRICE
(0,1)             ... SEE PAGE #3,

```

if the process was expanded on a different page of the diagram; or something like the words "...SEE ABOVE" or "...SEE BELOW" if that process appears elsewhere on the same page. The GOTO is a physical entity to be used at execution and is not a logical relationship, so it does not belong on

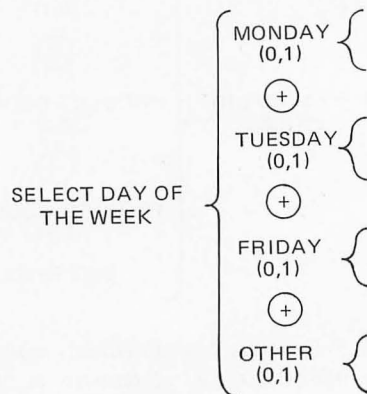


Figure 4: Example of a case statement with processes that are mutually exclusive and mutually independent.

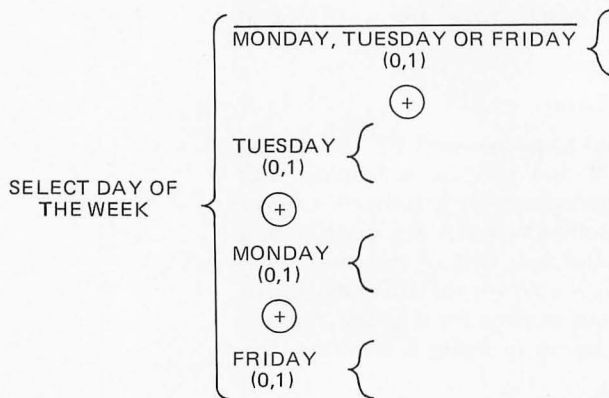


Figure 5: When a case statement has mutually independent and mutually exclusive statements, the statements may be rearranged into any order without changing the logic of the diagram.

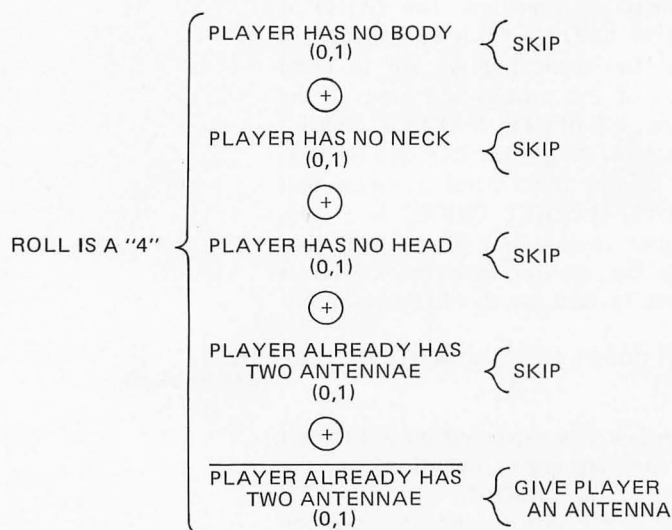


Figure 6: Although this is a working Warnier-Orr diagram, the case statements are not mutually independent.

```

IF 'player has no body'
  THEN ...
ELSE IF 'player has no neck'
  THEN ...
ELSE IF 'player has no head'
  THEN ...
ELSE IF 'player has two antennae'
  THEN ...
ELSE 'give player one antenna'

```

Listing 1: Typical if-then-else structure for Warnier-Orr diagram of figure 6.

a logical Warnier-Orr diagram.

Another common technical mistake is one that is a little harder to catch, and is one that even professionals with this technique will make if they aren't careful. Consider the case statement shown in figure 4.

Note that in this case statement, not only are the processes outlined mutually exclusive (only one of the cases is true), but they are also mutually independent. That is, their order within the case statement does not matter. It would be just as correct for me to have written the diagram as shown in figure 5.

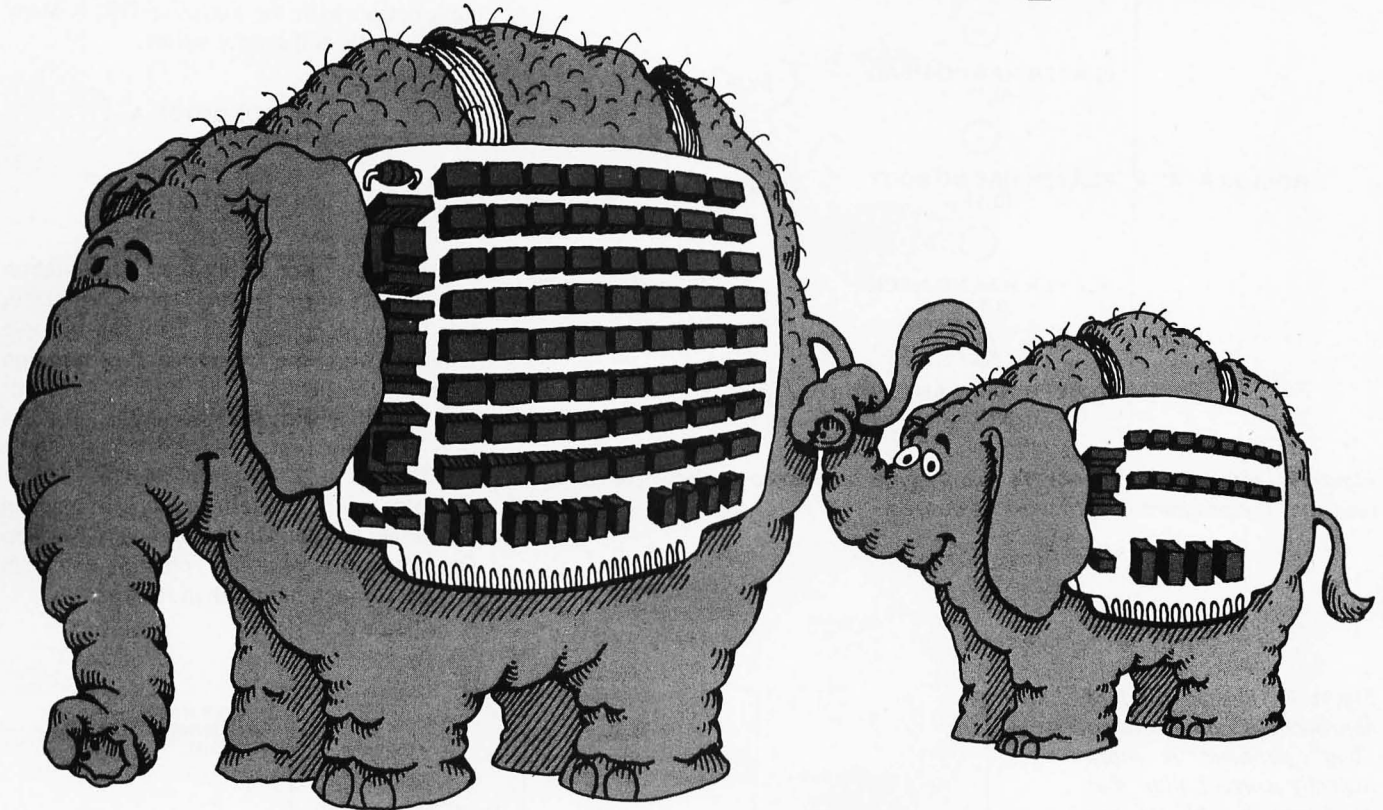
In an earlier article "Structured Program Design" (Oct 77 BYTE), the game of BUG was outlined. In the game, a die is rolled for each player and each number of the die corresponds to a part of the bug's body; the player finishing his bug first wins the game. If a player rolls a 4 for instance, he is entitled to one antenna. But he must have already acquired a body, a neck and a head in that order before he can receive an antenna. He needs a total of two antennae if he is to complete a bug.

Many people would try to code that process as a case statement as in figure 6. The process in figure 6 certainly looks correct, and indeed, if you code it as a case statement, as in listing 1, it will even run correctly.

However, this process is not a case statement. It is more properly called a pseudo-case statement, because each of its cases is mutually dependent. The cases cannot be reordered within the statement without destroying its logic. Notice that rearrangement of the case statement diagram as shown in figure 7 does not work at all. This arrangement will give the player an antenna anytime a four is rolled, until he has two antennae, regardless of whether or not he already has a body, a neck or a head. A more correct logical interpretation of the case structure we want is shown in figure 8.

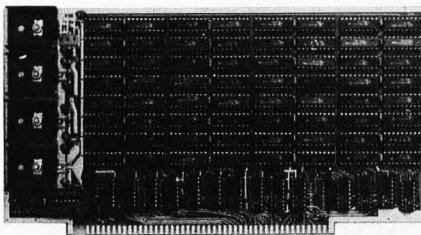
You might also notice that since the bug must have a body before it can have a neck (and a neck before it can have a head) if we

S-100 Memory for peanuts, Artec has slashed its prices!



32K for \$620, 16K for \$315—Assembled.

No matter what your needs, Artec has a memory board for you. You can start with 8K of TI 4044 memory on a 5.3" x 10" card and work your way up to a full 32K in 8K increments. The access time is only 250ns. The memory is addressable in 4K blocks and is perfect for S100 and battery augmented systems. The Artec 32K Expandable Memory has four regulator positions, bank select and plenty of room for all necessary support hardware. It uses less than 1 amp per 8K of memory (3.9 for 32K), and only +8 volts.



BOARD	KIT	ASSEMBLED
8K Memory	\$150	\$175
16K Memory	\$265	\$315
24K Memory	\$400	\$475
32K Memory	\$520	\$620

Add-ons: \$135—Chips alone: \$7.00

GP100—\$20.00

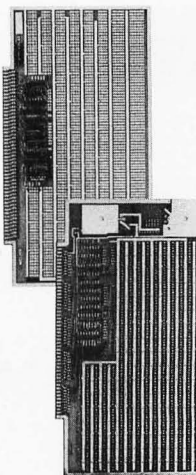
Maximum design versatility along with standard address decoding and buffering for S100 systems. Room for 32 uncommitted 16 pin IC's, 5 bus buffer & decoding chips, 1 DIP address select switch, a 5 volt regulator and more. High quality FR4 epoxy. All holes plated through. Reflowed solder circuitry.

WW100—\$20.00

A wire wrap breadboard, similar to the GP100. Allows wire wrap of all sizes of sockets in any sizes of sockets in any combination. An extra regulator position for multiple voltage applications. Contact finger pads arranged for easy pin insertion.

Buffering Kit—\$12.65

All the necessary components to bootstrap any Artec board into your system. Buffering I/O, DIP switch heat sinks and every support chip you need.



TO ORDER: Use your Mastercharge or BankAmericard. Or just send along a money order. We can accept only U.S. currency. Please include \$3 handling on all orders. California residents add 6.0% sales tax.

FOR MORE INFORMATION: For more information about these or any of Artec's complete line of circuit boards or for either industrial or personal use, please call or write. A catalog will gladly be sent.

Please send me: (Include Quantity)

☐ 32K ☐ GP100 ☐ WW100

☐ I've enclosed a money order.

☐ Mastercharge No. _____ Exp. Date _____

☐ BankAmericard No. _____ Exp. Date _____

Name _____

Address _____

City _____ State _____ Zip _____

Calif. Res. add 6% Sales Tax \$3.00 Handling Encl.

ARTEC ELECTRONICS, INC.

605 Old County Rd., San Carlos, CA 94070

(415) 592-2740

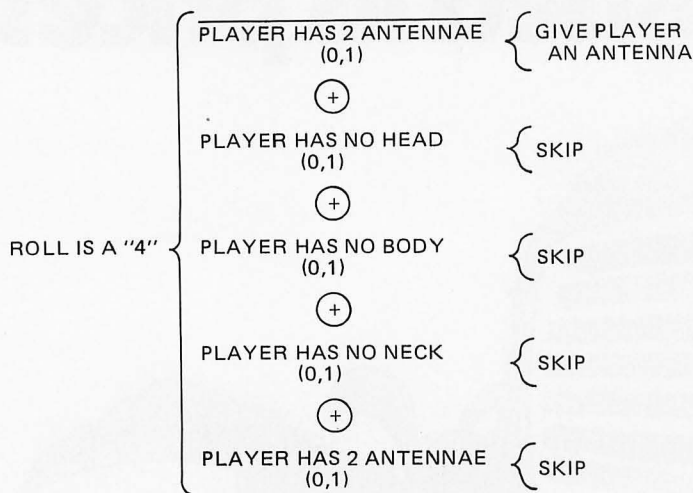


Figure 7: When the statements in figure 6 are rearranged as shown, it can be seen that the program fails to work as desired.

Figure 8: This method of approaching the stated "bug" problem is more logically correct than that of figure 6. All of the statements at each level of the diagram are mutually exclusive and mutually independent.

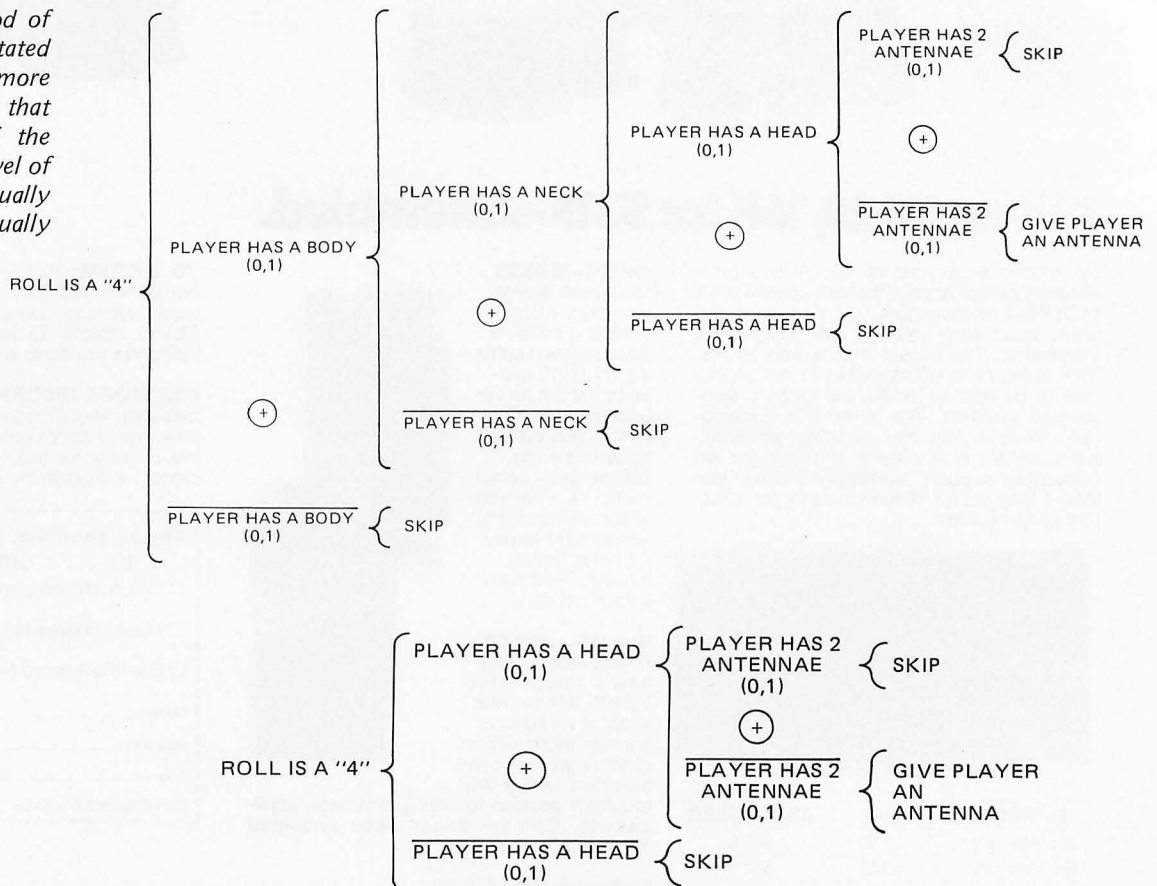
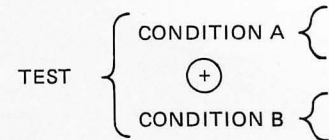


Figure 9: Since a bug must have a head in order to have an antenna, and a body and neck to have a head, the search process can be shortened by just checking for the presence of a head.

merely check for the presence of the head, we will be indirectly checking for the neck and the body, so that figure 9 is an equivalent structure.

Another common technical error is the misuse or lack of use of the (0,1) notation in conjunction with the exclusive OR, \oplus . Many times, people will simply write:



By this they often imply the (0,1) notation with the use of the symbol \oplus alone. Actually, this is not incorrect; in fact, for most people familiar with the diagrams, this notation seems to be just as clear. But for users not quite familiar with the Warnier-Orr diagrams it is probably best to go ahead and include the (0,1).

To conclude, I'll reiterate a point made in an earlier article: Understanding a Warnier-Orr diagram is very easy; creating one from scratch is much harder than it looks. ■

IT'S NOT A TELEPHONE...



THE SUPERPHONE®

The telephone with such sophisticated features it's more than a phone. An indispensable desktop aid or bedside friend, with microprocessor controlled solid state electronics and 14 digit LED readout. Here's what Superphone does for you:

It's a Telephone

- Easily connects to any private or business phone line... and there's no need to switch to Touchtone® service because Superphone works on either Touchtone® or rotary dial lines with ultimate pushbutton convenience.
- Simply lift the hand set and you're in the telephone mode.
- Even if there's a power failure, the rechargeable battery takes super charge of the situation.

It's a Memory-dialer

- Superphone enables you to store the 20 numbers you call most frequently, and these numbers can be up to 14 digits long.
- Just press the MEM DIAL and the location number and your number will be both displayed and dialed automatically.
- For PBX users who need to dial an "access" number (such as "9") for an outside line, it provides a pause before the next digit is dialed.

It's an Auto-redialer

- Automatically stores the last number dialed whether from memory or manually.
- Just press REDIAL and the last dialed number will be displayed and dialed automatically.

It's a Calculator

- Four-function floating decimal point, eight digit calculator: +, -, ×, ÷, and chain calculations are features that count.
- Calculations without interference, even during a conversation.
- Just press CALCULATOR key to start or to terminate calculator functions.

It's a Digital Clock

- Constant display of hour, minute, day, and date keeps you in time with a blinking dot per second.
- Quartz crystal accuracy for super dependability.
- Easy Keyboard programming for the time and date set.

It's an Alarm Clock

- Alarm can be set to the minute to keep you on schedule.
- The buzz will remind you of important appointments or wake you up when you want.
- Easy Keyboard programming for the alarm time set.

It's a Stopwatch

- Enables you to clock your conversations to the second.
- Just press the TIMER key to start the stopwatch function.

It's Guaranteed

- Built-in battery that continues phone function in event of power failure.
- One year warranty.
- FCC approved for direct connection to all phone lines.
- Complete money back guarantee if returned within 30 days.

Available in Ivory (with black faceplate) or Espresso Brown (with chocolate brown faceplate). Each \$229.00 plus \$2.50 insured UPS shipping and handling.

BITS inc

CALL YOUR CHARGE CARD ORDERS ON OUR TOLL-FREE LINE: 1-800-258-5477

POB 428, 25 Route 101 West, Peterborough NH, 03458



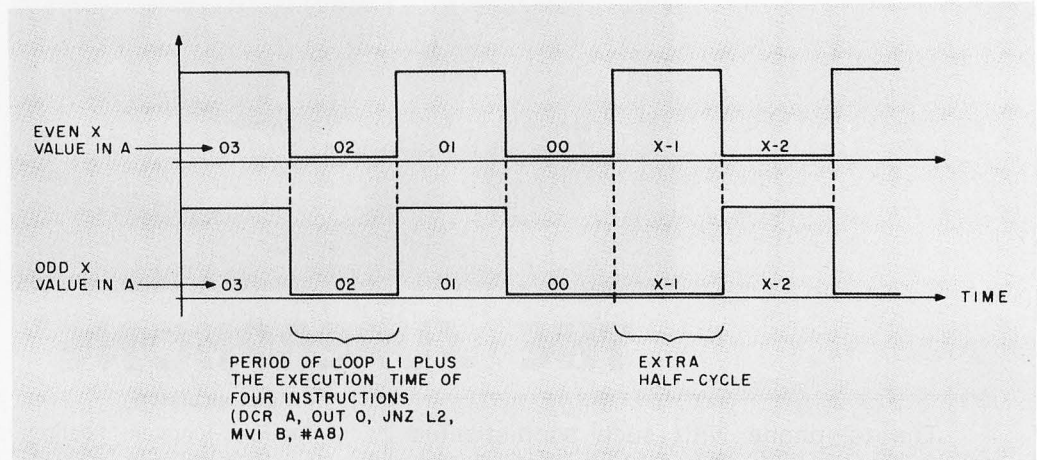
Solution to Machine Language Puzzler (See page 92)

The waveforms shown in figure 1 depict the voltage waveform being applied to the speaker from the least significant bit of port 0 for each case.

When the outer loop constant (in A) is decremented to 00, the accumulator is reinitialized with #X. If X is even, only an imper-

ceptible discontinuity in the waveform results owing to the execution time of 2 more instructions. If #X is odd, however, the waveform contains *one extra* half cycle, and a blip is heard. Every time A is reinitialized with an odd X, the waveform phase is changed by 180°.

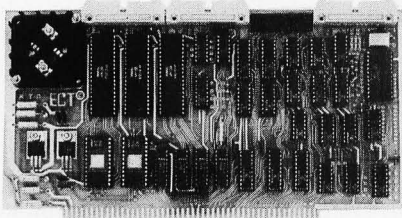
Figure 1: Voltage waveform appearing at the least significant bit (LSB) of port 0 for each case in the problem.



SPECIALIZING IN QUALITY MICROCOMPUTER HARDWARE

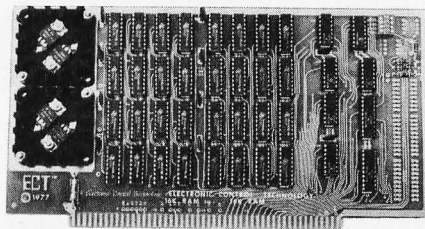
INDUSTRIAL • EDUCATIONAL • SMALL BUSINESS • PERSONAL

BUILDING BLOCKS FOR MICROCOMPUTER SYSTEMS, CONTROL & TEST EQUIPMENT



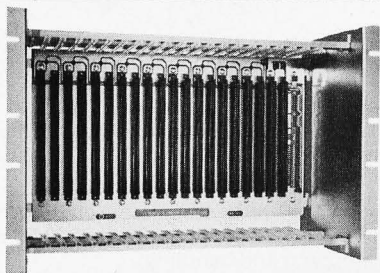
R² I/O

2K ROM
2K RAM
3 Serial Ports
1 Parallel Port



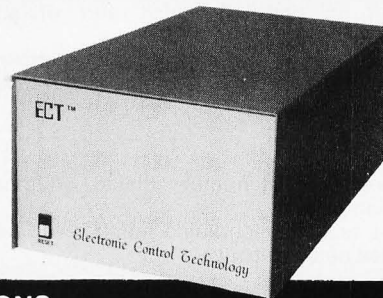
16 K RAM

FULLY STATIC
MEMORY



ECT-100-F

RACKMOUNT
CARD CAGES



TT-10

TABLE TOP
MAINFRAMES

POWER SUPPLIES, CPU's, MEMORY, OEM VARIATIONS

ELECTRONIC CONTROL TECHNOLOGY

763 RAMSEY AVE.
HILLSIDE, N.J. 07205

(201) 686-8080

BITS ^{T.M.} inc
Books to erase the impossible
POB 428, 25 Route 101 West
Peterborough, NH 03458

Offers The Best In Software for your Microcomputer...

MICROCHESS - by Peter Jennings - from Personal Software™

Peter Jennings has been pioneering computer chess programs for the personal microcomputer, and MICROCHESS is the mature fruition of two years of this development. With several levels of play it will sharpen your game and prove to be a challenging opponent.

MICROCHESS 1.5 - for 4K TRS-80's

This is a 4K Z-80 machine language program utilizing every byte of available memory on the TRS-80. It displays a graphic chessboard and even flashes the piece on which the computer narrows its attention prior to making its move. Based on earlier chess programs for the 8080 and 6502 microprocessors, Microchess incorporates the improvements suggested by hundreds of users, and offers three levels of play to challenge all players from beginners to real chess enthusiasts.

Microchess can be fun on any TRS-80 and is easily loaded from cassette with the CLOAD command. Standard algebraic notation is used to describe the moves, and a simple command lets you temporarily number the squares to assist in move entry. Every move is checked for legality, and the program even handles castling and en passant captures. You can play white or black, set up special board situations and play them out against the computer, or even watch the computer play against itself.

MICROCHESS 2.0 - for 8K PET's and 16K Apples

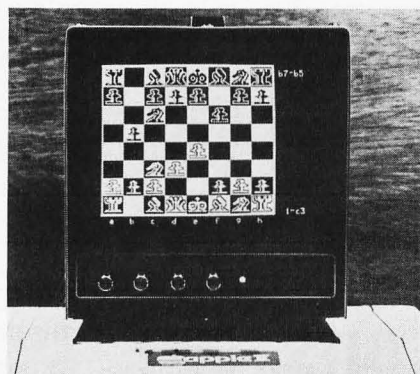
In 6502 machine language, this version of Microchess offers eight levels of play to suit everyone from beginner to the serious player. It examines positions as many as six moves ahead, and includes a chess clock for tournament play. \$19.95 each.

TRS-80 (4K) ☐ PET (8K) ☐ Apple (16K) ☐

BRIDGE CHALLENGER - by George Duisman - from Personal Software™

If you like to play bridge but have trouble getting four people together to play, or if you'd just like to practice a little to improve your play, this program cassette is for you. With Bridge Challenger you and the dummy play against the computer in regular contract bridge. You can let the computer deal, or set up hands for study and practice play and save them on cassette. Created by George Duisman, an expert bridge player and programmer, this program takes full advantage of the PET's BASIC and requires all of the 8K RAM to run. Standard bridge notation, like that found in books and newspaper columns, is used to help you analyze the hands. Complete instructions, including an introduction to bridge for the novice, are included in six pages of documentation. \$14.95 each.

TRS-80 (16K Level II) ☐ Pet (8K) ☐ Apple (16K) ☐



STIMULATING SIMULATIONS - by Dr. C. William Engel - from Personal Software™

This is a set of ten original simulation games written by Dr. Engel. The games are fun, and the 64 page paperback book which accompanies the cassette giving instructions, flowcharts, program listings and suggested modifications makes Stimulating Simulations an educational tool too. The games begin on an elementary level and progress to more complex problem situations, but most can be played by schoolchildren. The program listings in the book are in PET or TRS-80 Level II BASIC but special versions of the programs are provided for Level I BASIC users. \$14.95 each.

TRS-80 ☐

PET ☐

...now!

GRAPHICS PACKAGE - from Personal Software™

This set of four programs provides a quick and easy way for you to use your PET for several of the most common graphics applications: plotting equations or data, drawing pictures, and creating headlines of block letters. These programs, written by Dr. Peter Maggs, make use of the PET's graphic capabilities and can provide another dimension in your personal computing. \$14.95

PET ☐

ASSEMBLER IN BASIC - from Personal Software™

Now you can write programs in assembly language for the 6502 microprocessor and have them translated to machine language for direct execution on your PET. The assembler accepts all standard 6502 mnemonics, pseudo-ops and addressing modes plus a new TEXT pseudo-op, and evaluates binary, octal, decimal, hexadecimal and character constants, symbols and expressions. You can create assembly source programs with the text editor which is supplied, and save

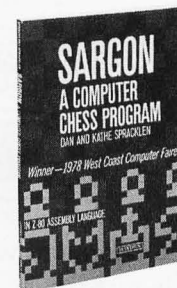
them on cassette. The assembler reads its source code from cassette or from DATA statements, and assembles machine code directly at any location in memory. You can save machine language subroutines in the PET's second cassette, buffer, and execute them immediately with keyboard and display input/output. \$24.95

PET ☐

ASTROLOGY PROGRAMS - by Michael Erlewine - from Personal Software™

You enter the date, time, and place of your birth. The program computes the sidereal time on the equator of your birth and your ascendant or rising sign, midheaven, and vertex angles in degrees / sign of zodiac / minutes of arc format. The helio and geocentric planetary positions are also given, and the program will optionally calculate and display the Local Space positions of the planets, the Local Space chart for a locality shift, give the position and direction in azimuth along the horizon of any city in the world, or display the equatorial coordinates for your natal planets. You can even input the right ascension and declination of any celestial object, and the program will compute its position on the horizon or Local Space chart. This program is loaded with celestial mechanics equations, and will save you or your astrologer hours of calculating time. \$14.95

PET ☐



SARGON - A COMPUTER CHESS PROGRAM - by Dan and Kathe Spracklen - from Hayden

SARGON is the computer chess program that won the 78 West Coast Computer Faire tournament for microcomputers. Now you can run it on your own TRS-80 Level II. It is available in two forms: the book which contains the program listing in Z-80 assembly language and enough documentation to enable you to tailor and run it on your 8K Z-80 machine, and in cassette form ready to run on any TRS-80 Level II. Test your skill in this classic game; the machines are getting better!

Sargon Book with listing ☐ \$14.95
Cassette for TRS-80 Level II
(with brief instruction booklet) ☐ \$19.95

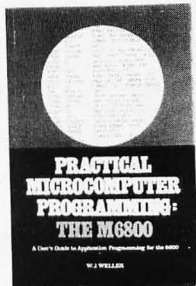
DIAL YOUR BANK CARD ORDERS ON OUR TOLL-FREE HOT LINE: 1-800-258-5477.



You may photocopy this page.
Dealer Inquiries Invited.

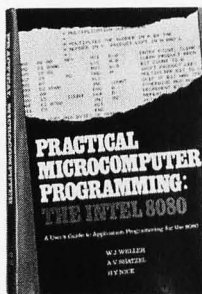
For convenience in ordering, please use this page plus the order form on page 199

Practical Microcomputer Programming



PRACTICAL MICROCOMPUTER PROGRAMMING: THE M6800 by W J Weller.

This second volume of the Practical Microcomputer Programming series addresses the problems of applications programming at assembly level for the M6800. In 16 chapters and more than 100 formal examples, the fundamental techniques of assembly level programming are applied to the solution of specific problems with the 6800. Nowhere theoretical, it is a thorough and detailed methods text for the beginning and intermediate application programmer using the 6800. Hardback. \$21.95.



PRACTICAL MICROCOMPUTER PROGRAMMING: THE INTEL 8080 by W J Weller, A V Shatzel, and H Y Nice.

Here is a comprehensive source of programming information for the present or prospective user of the 8080 microcomputer, including moving data, binary arithmetic operations, multiplication and division, use of the stack pointer, subroutines, arrays and tables, conversions, decimal arithmetic, various IO options, real time clocks and interrupt driven processes, and debugging techniques.

This 306 page hardcover book is well worth its \$21.95 price and should be in every 8080 or Z-80 user's library.

Name _____

Address _____

City _____ State _____ Zip _____

BITS
INC

PRACTICAL
MICROCOMPUTER
PROGRAMMING:

POB 428
25 Route 101 West
Peterborough NH 03458

THE INTEL 8080 @ \$21.95 \$ _____

THE M6800 @ \$21.95 \$ _____

Postage \$.75 ea. \$ _____

Postage outside USA \$ 1.00 \$ _____

Total \$ _____

☐ Check enclosed



☐ Bill MC # _____ / / / Exp. Date _____



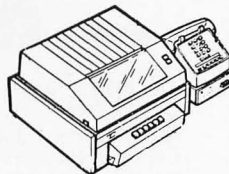
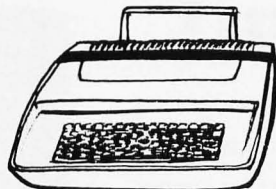
☐ Bill BA # _____ / / / Exp. Date _____



Signature _____

You may photocopy this page if you wish to leave your BYTE intact.

THE TELETYPE MODEL 43 FAMILY.



Naturally, a company whose name has almost become synonymous with data communication in industry can produce exceptionally fine business terminals. These terminals, just as naturally, form the best business end for your personal computer. When you're ready for your computer to start earning its keep, let us put a system together for you. We offer a complete line of Teletype Corporation Products interfaced and tested to Apple II, TRS 80, Commodore Pet, Amsai, Ohio Scientific and others. We stock and distribute this specialized product line and our goal is to provide you with the best service, the best delivery, and the best price available anywhere.

The following printers are available now. Many more soon.

DELUXE BUSINESS MODEL 43, 132 Column Pin Feed	\$1295.00
80 COLUMN MODEL 40, 300 Line Per Minute Work Horse	\$2395.00
132 COLUMN MODEL 40, 300 Line Per Minute Industry Standard	\$3500.00

Order Direct, Check or Purchase Order to:

CABOT COMPUTER SERVICES, INC.

P. O. Box AA

Cabot, AR 72023 (501) 843-5302

INTRODUCING DUAL DRIVE MINIFLOPPY FOR PET!



DEALER
INQUIRIES
INVITED

DKH641 IS A PRODUCT OF COMPUTHINK.

- *DUAL MINI FLOPPY DRIVE WITH 100K PER DISK SIDE FOR TOTAL 200K ON LINE.
- *DESIGNED FOR COMMERCIAL SPEED REQUIREMENTS *FAST LOADING SPEED.
- *DISKMONTM (DOS) AUTOMATICALLY REORGANIZES FREE DISK SPACE AFTER SAVE OR ERASE.
- *DISKMON IS RESIDENT IN ROM VIA DISK CONTROLLER BOARD PLUGGED INTO EXPANDAPET.*
- *DISKMON ADDS 16 COMMANDS TO BASIC INCLUDING DISK DATA FILES.
- *DISKMON COMMANDS SUPPORT COMMERCIAL PRINTER OFF PARALLEL PORT SUCH AS CENTRONICS 779.
- *FULL DISK SOFTWARE SUPPORT * FORTRAN & PLM COMPILERS THIS JANUARY.
- *90 DAY MANUFACTURER'S WARRANTY ON HARDWARE*READY TO USE ON DELIVERY. WITH FULL INSTRUCTIONS AND UTILITY DISKETTE.
- *CALL OR WRITE FOR ADDITIONAL INFORMATION * INITIAL QUANTITIES LIMITED.
- *THIS SYSTEM IS FULLY SUPPORTED BY SOFTWARE FROM THE MANUFACTURER.
- *ORDERS ARE NOW BEING ACCEPTED FOR DECEMBER & JANUARY DELIVERY.

DKH642	—DUAL DRIVE SYSTEM, COMPLETE WITH DISKMON	..... \$1295.00
DKL067	—DISKMON ASSEMBLER LISTING/DOS	..... \$19.95
ASM789T	—PET ASSEMBLER ON CASSETTE	..... \$19.95
ASM789D	—PET ASSEMBLER ON DISKETTE (5.5 inch)	..... \$49.95
LNK456	—AUTOLINK LINKING LOADER ON DISKETTE	..... \$49.95
FOR300	—FORTRAN COMPILER ON DISKETTE (JAN'79)	..... \$69.95
PLM400	—PLM COMPILER ON DISKETTE (JAN'79)	..... \$49.95

*** BUSINESS PACKAGES STARTING IN 1st QUARTER 1979 ***

*THIS SYSTEM REQUIRES EXPANDAPET MEMORY (MINIMUM 16K—SEE BELOW)

PET COMPUTER

If you
haven't
bought
a pet
yet, call
for our
pet info
package!



WHY NOT BUY FROM THE BEST?

8K PET \$ 795

24K PET (8 + 16K) \$1220

32K PET (8 + 24K) \$1320

ALL PRICES INCLUDE 48 HR. PRE-SHIPMENT TESTING & 3 FREE CASSETTE PROGRAMS

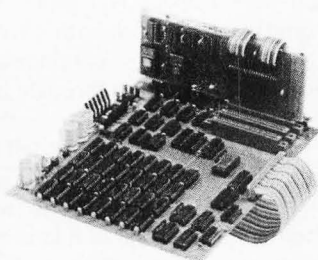
PRICES SHOWN ABOVE INCLUDE EXPANDAPET. PME MEMORIES WILL HAVE HIGHER PRICING.

- * NEECO IS A CUSTOMER ORIENTED, FULL SERVICE COMPANY.
- * PETS RECEIVE 48 HR. 'BURNIN' BY NEECO BEFORE SHIPMENT.
- * FULL CUSTOMER SERVICE AND FULL PRODUCT SUPPORT.
- * 48 HR MAXIMUM 'TURNAROUND' ON PET WARRANTY SERVICE ON PETS PURCHASED FROM NEECO.
- * FULL PRE-PURCHASE INFO AVAILABLE FROM OUR PET INFO PACKAGE — WE ANSWER CUSTOMER QUESTIONS!
- * AUTOMATIC SOFTWARE/HARDWARE UPDATES VIA OUR PET OWNERS MAILING LIST — CALL/WRITE TO BE LISTED!
- * COMMERCIAL QUANTITIES AVAILABLE.
- * WE ALSO MARKET REPLACEMENT RAMS & ROMS, ETC.
- * OFF THE SHELF DELIVERIES (NO DEPOSIT REQUIRED).
- SCHOOL INQUIRIES INVITED!

INTERNAL MEMORY EXPANSION FOR PET!

EXPANDAPET™

INTERNAL MEMORY EXPANSION UNIT



DEALER INQUIRIES
INVITED

- *MOUNTS EASILY INSIDE YOUR PET
- *EASY TO INSTALL (15 MINUTES)
- *NO DEGRADATION OF PET SYSTEM
- *USES LOW POWER DYNAMIC RAMS
- *90 DAY PART&LABOR, 1 YR-RAMS.
- *30 DAY MONEY BACK GUARANTEE.
- *MOUNTING SLOTS FOR 4 BOARDS.
- *CALL/WRITE FOR ADDITIONAL INFO
- *DEALER INQUIRES INVITED.

EXPANDAPET PRICES

16K (+ 8K PET = 24K)	\$425
24K (+ 8K PET = 32K)	\$525
32K (+ 8K PET = 40K)	\$615

OPTIONAL PLUG-IN BOARDS 32K UNIT ALLOWS: 8K OF
SERIAL I/O BOARD.....\$75 ASSEMBLY LANGUAGE
S-100 I/O BOARD.....\$75 SUBROUTINES ACCESSED
4K EPROM BOARD.....\$50 VIA THE USR COMMAND.

EXPANDAPET IS A PRODUCT OF COMPUTHINK.

FULLSIZED TYPEWRITER KEYBOARD FOR PET!



- *COMMERCIAL QUALITY KEYBOARD WITH METAL ENCLOSURE.
- *BASIC TYPEWRITER DESIGN FOR TOUCHTYPISTS.
- *SINGLE KEY FUNCTIONS FOR ALL CURSOR CONTROLS.
- SHIFT/RUN, INSERT, CLEAR SCREEN/HOME CURSOR, MORE.
- *FUNCTIONS SIMULTANEOUSLY WITH PET'S KEYBOARD.
- *PLUGS DIRECTLY INTO PET'S LOGIC BOARD.
- *DOES NOT USE USER OR IEEE-488 PORTS.
- *NPK-101 IS FULLY TESTED & READY TO USE.
- *ATTACHES DIRECTLY TO FRONT OF PET'S FRAME.
- *CAN BE USED AS A REMOTE TERMINAL (SPECIAL ORDER).
- *30 DAYS TRIAL PERIOD * 90 DAY WARRANTY.
- *CALL OR WRITE FOR FULL SPECS-INITIAL QTY LIMITED.

ORDERS ARE NOW BEING
ACCEPTED FOR DEC/JAN
CUSTOMER DELIVERIES.

\$139.95

NPK-101 IS A PRODUCT OF NEW ENGLAND ELECTRONICS.

WE CANNOT LIST ALLOF OUR SOFTWARE AND HARDWARE PRODUCTS
CALL OR WRITE FOR OUR *FREE* SOFTWARE/HARDWARE DIRECTORY

DOMESTIC & OVERSEAS DEALER INQUIRIES INVITED ON * MEMORY * KEYBOARD * FLOPPY

NEECO

NEW ENGLAND ELECTRONICS CO., INC.
248 BRIDGE ST., SPRINGFIELD, MASS. 01103
MON-FRI 9:30-5:30, SAT 10-2, E.S.T.

(415) 854-2577



ACCEPTED, ADD 3%
SERVICE CHARGE.

A Search for Vector Graphics

Mitchell Gilberg
c/o Coles, POB 610
Natchez MS 39120

I am a subscriber and avid reader of BYTE, and I have a problem I hope you can help me solve. I am trying to find some information on a particular type of video graphic display and whether it is currently available on any personal computers. Unfortunately, I don't know a technical name, so I'll have to attempt a cumbersome non-technical description. What I want is to be able to draw one dimensional lines between defined endpoints, and to move the lines continuously across the screen.

Let me give you an example. Suppose an application I want to display is an aircraft instrument panel. The altimeter might look something as shown in figure 1. With the relatively common raster scan grid the altimeter would look as shown in figure 2.

One problem here is that in order to have enough detail to read the instruments, they would have to be too big to get an entire instrument panel on the screen. Another is that "lines" are not continuous. They are approximations that frequently lose their original shape when rotated between horizontal and vertical. Also, small displacements are lost if they aren't large enough to cause a quantum jump between plot grid points.

With high density noncolor graphics, you gain the ability to create a more detailed drawing, but motion becomes impractical. To show increasing altitude on the altimeter above, you must calculate a new location for each point on the rotating indicator and set and reset the corresponding bits in memory. That might represent several hundred calculations for each degree of rotation. Also, the indicator will not move as a unit. That is, it "warps" point by point, as shown in figure 3.

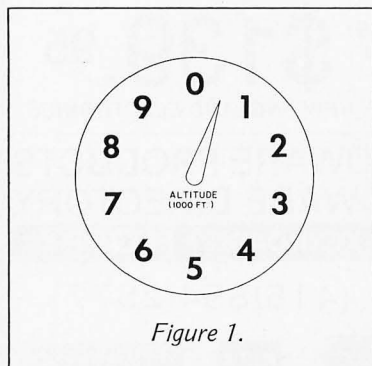


Figure 1.

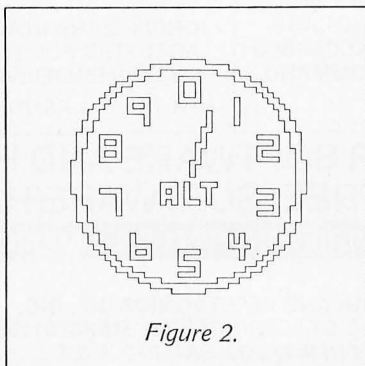


Figure 2.

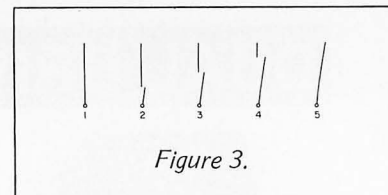


Figure 3.

In the past, I have used a Tektronix 4010 storage tube. This particular device allows plotting graphics as lines between endpoints. That is, your program specifies a starting and ending point for a line segment, and you can then "draw" a line between the points. So, for rotation of the altimeter, you need only calculate the positions of three points, and connect them with line segments. The line segments are always continuous, never warped. However, the Tektronix stores the line until the entire screen is erased, so you can draw detailed diagrams although true motion is impossible. You must erase the entire screen and redraw it at the new position—a process which takes several seconds for complex diagrams.

Let me now try to describe what I need. The display must be able to define lines as the Tektronix does, so that line movements are done by simply recalculating the endpoint locations. But, it must also allow for moving the line without having to recreate the entire drawing—or, if it must recreate the entire drawing, it must recreate it fast enough so that you don't see an erase and redraw action. (I have seen this type of display in only two places, both of which were in 25 cent video arcade games, and both of which were a Space War game. The games were similar in that they both showed spaceships which moved continuously through space, able to turn through any angle.)

If you or any of your readers can tell me who makes this type of display, or how it works, or if it's even feasible to do with personal computers that are available today, I would certainly appreciate it. ■

We cannot help specifically in this reply, but can point you in the right direction: you are looking for a vector display, where an XY oscilloscope with blanking is driven from a list of XYZ coordinate triples. (The Z axis simply indicates an intensity for the line of 0 or 1.) An example of this was found in Steve Ciarci's article, "Make Your Next Peripheral a Real Eye Opener," (November 1976 BYTE, page 78). Steve's design is not, to our knowledge, currently being manufactured, so you will have to build it yourself. . . .CH

C-1000



THE FIRST TV CAMERA DESIGNED FOR COMPUTER INTERFACE

SUPERB RESOLUTION—

Observe minute detail with resolution over 1000 TV lines.

VIRTUALLY DISTORTION-FREE—

Image is accurate, linear from center of screen to outer edge with less than 0.2% distortion.

STABLE—

Less than 0.05% drift per 24 hours, less than 0.2% from 10° C to 40° C.

PLUS ALL LINES NEEDED FOR DIGITAL AND ANALOG COMPUTER INTERFACE

**THIS UNIT IS "INSTRUMENT QUALITY"
—NOT A VIDEO SYSTEM FOR
ENTERTAINMENT VIEWING**

APPLICATIONS:

MEDICAL

Tissue analysis
Blood analysis
Neurological—X-Y movement analysis
Optical Instrument data analysis
Other analysis of visual data

INDUSTRIAL

Aerial photography analysis—crop areas,
insect infestation
IR Analysis—detect forest fires, direct robot
fire fighters
Bottle inspection—using polarized light
Dimension analysis and control, area
measurement, displacement measurement
Printed pattern analysis and control
Missile tracking

UNIVERSITY

Analysis of any visual information that can be
measured through variation in light intensity
Medical research
Physics research
Laser technology

HAMAMATSU

HAMAMATSU CORP. • 420 SOUTH AVENUE • MIDDLESEX, NEW JERSEY 08846 • (201) 469-6640

Robert Jones
Canadian Micronics Research Corp
33383 Lynn Av
Abbotsford BC
CANADA V2S 1E2

Filling 6800 Op Code Holes

Table 1: A table of "holes" in the 6800 op code space. Analyzing the holes involves tabulating the effect of each instruction on the condition code register, computing the number of machine cycles for each instruction, and most importantly, finding suitable applications for these instructions.

Instruction Length	Hex Code	Label	Commentary
1	00	NOP	
1	02	NOP	
1	03	NOP	
1	04	NOP	
1	05	NOP	
1	12	SBA-1	$A \leftarrow A - (B+1)$.
1	13	SBA-1	Same as 12.
1	14	NBA	$A \leftarrow A \text{ AND } B$
1	15	NOP	
1	18	DAA	No effect on carry bit?
1	1A	ABA	No effect on carry bit.
1	1C	ABA+1	$A \leftarrow A + (B+1)$. No effect on carry or half-carry bits.
1	1D	ABA	$A \leftarrow A + B$. No effect on half-carry bit.
1	1E	TBA	Same as 17.
1	1F	TBA	Same as 17, plus carry bit is set to 1.
2	21	BRA r	Same as 20.

When looking at a reference chart for the Motorola 6800 processor, one may notice many nonimplemented op codes. It is possible that these codes, when properly explored, can lead to interesting operations of the processor. I could not resist the challenge to do this and have spent many frustrating hours trying to understand the strange results obtained. By dint of perserverance, I eventually worked my way through every one, producing table 1. I have not yet made a study of the complete effect of each operation on the condition code register, although some were obvious along the way.

It is interesting to note that four of the op codes (hexadecimal 87, 8F, C7 and CF) actually modify the program, conveniently skipping one program step in the process. This jumped over step could contain a branch or jump instruction, so that if the modified part of the program is immediately followed by a branch back to the skipped over instruction we would have the possibility of an approximately 65,536-way branch, depending on the result of some calculation in either of the accumulators or the index register. Of course, any program using this self-modifying feature can only be implemented in programmable memory. Committing it to read only memory would automatically render it unchangeable.

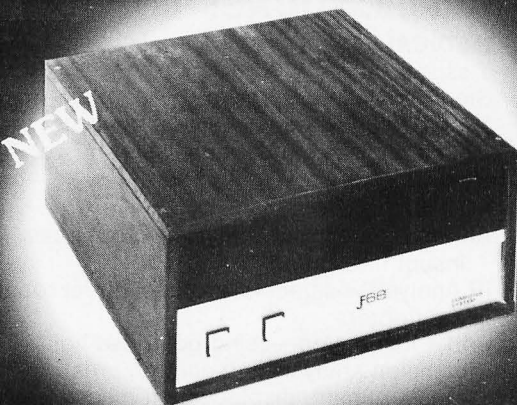
Three codes (hexadecimal 3D, 9D and DD) cause the 6800 to continuously increment the address bus with both the valid memory address (VMA) and read write (RW) lines held high, but the microprocessor does not act on the instructions it reads along its route. Perhaps they can be used in the form of some direct memory access instruction with a hardware halt to the process by activating RESET.

It would be interesting to find out if all 6800s follow the patterns in my table, or if the results are specific to my individual unit. Remember, these instructions worked in my processor but may not necessarily work in yours. The best course of action is to use my table as a base and then double check your own processor.

REFERENCES

1. Jessop, Paul M, "The Motorola 6800 Instruction Set," January 1978 BYTE, page 84.
2. Wheeler, Gerry, "Undocumented M6800 Instructions," December 1977 BYTE, page 46.

ENCOUNTER of the 6800 kind...



The Personal Machine from JF

Introducing the JF68. A Computer System that's both affordable and expandable. The JF68 is finding widespread use in hobbyist, small business, and OEM applications. Its expandability and low cost will make it the affordable solution to your every processing problem. You can order it the way you like it. Either in KIT Form for \$549.95, or fully assembled and tested for \$749.95. At these prices, shouldn't our computer be solving that problem instead of you?

FEATURES

- Woodgrain Cabinet
- SS50 Based System
- Cassette I/O Included
- Serial Communications to 9600 BAUD
- MIKBUG Compatible
- 16 Slot Motherboard
- 2K ROM Monitor on CPU



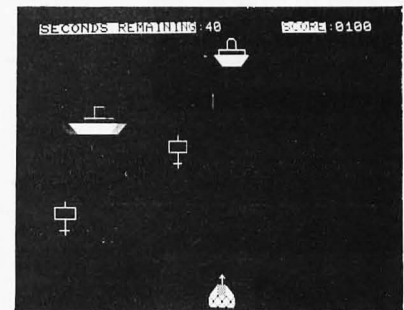
JF PRODUCTS
1441-5 POMONA RD.
CORONA, CA 91720
(714) 734-6900



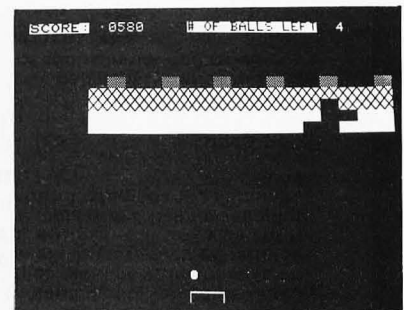
Table 1, continued:

1	38	RTS	Same as 39 followed by 34; ie: RTS followed by reset of stack pointer to original setting plus 1.
1	3A	RTI	Same as 3B followed by 34s; ie: RTI followed by reset of stack pointer to original setting plus 1.
1	3D	DMA	Program counter continuously increments address bus. VMA and RW lines go high.
1	41	CPZ A	Compare register A with zero. Leaves register A unchanged, but sets NZVC according to result of the compare with zero.
1	42	COM A	Same as 43.
1	45	CPY A	Copies least significant bit of register A into carry bit. Leaves register A unchanged. Sets overflow bit (V) according to $V=NC + \bar{N}C$. Sets zero bit (Z) if either register A or B is zero. Could be used (by following with BCS) to branch on register A equal to an odd number.
1	4A	DEC A	Same as 4A.
1	4E	NOP	
1	51	CPZ B	Compare register B with zero. Similar to 41 above.
1	52	COM B	Same as 53.
1	55	CPY B	Copies least significant bit of register B into carry bit. Leaves register B unchanged. Remarks similar to 45 above.
1	5B	DEC B	Same as 5A.
1	5E	NOP	
2	61	NEG X	Same as 60.
2	62	COM X	Same as 63.
2	65	LSR X	Same as 64.
2	6B	DEC X	Same as 6A.
3	71	NEG e	Same as 70.
3	72	COM e	Same as 73.
3	75	LSR e	Same as 74.
3	7B	DEC e	Same as 7A.
2	83	SB1 A#	$A \leftarrow (A) - (\text{immediate}+1)$.
1	87	ST2 A	$PC+2 \leftarrow (A)$. Stores contents of register A at current program counter plus two and advances to program counter plus 3.
1	8F	ST2 S	$PC+2, PC+3 \leftarrow SP$. Stores current value of stack pointer at program counter plus two and three and advances to program counter plus four.
2	93	SB1 A d	$A \leftarrow (A) - [(\text{memory direct})+1]$. Adds one to contents of referenced memory, subtracts result from register A and stores result of subtraction in register A. Leaves memory contents unchanged.
1	9D	DMA	Same as 3D above.
2	A3	SB1 A X	$A \leftarrow (A) - [(\text{memory indexed})+1]$. Similar to 93 above.
3	B3	SB1 A e	$A \leftarrow (A) - [(\text{memory extended})+1]$. Similar to 93 above.
2	C3	SB1 B#	$B \leftarrow (B) - (\text{immediate}+1)$.
1	C7	ST2 B	$PC+2 \leftarrow (B)$. Similar to 87 above.
3	CC	CPX #	Same as 8C.
2	CD	BSR r	Same as 8D.
1	CF	ST2 X	$PC+2, PC+3 \leftarrow IX$. Stores current value of index at program counter plus two and three and advances to program counter plus four.
2	D3	SB1 B d	$B \leftarrow (B) - [(\text{memory direct})+1]$. Similar to 93 above.
2	DC	CPX d	Same as 9C.
1	DD	DMA	Same as 3D above.
2	E3	SB1 B X	$B \leftarrow (B) - [(\text{memory indexed})+1]$. Similar to 93 above.
2	EC	CPX X	Same as AC.
2	ED	JSR X	Same as AD.
3	F3	SB1 B e	$B \leftarrow (B) - [(\text{memory extended})+1]$. Similar to 93 above.
3	FC	CPX e	Same as BC.
3	FD	JSR e	Same as BD.

P.E.T. Food



SEAWOLF - - - \$10.00



BREAKOUT - - \$10.00

You spent the following amounts in each category for the months of JANUARY FEBRUARY

CATEGORY	AMOUNT	CATEGORY	AMOUNT
AUTO	19.46	INCOME	2.75
WRTGE	320.73	TRAVEL	2.10
CLOTHES	448.61	MEDICAL	210
ENTERTAIN	211.65	INSUR	281.55
FOOD	225.28	SAVINGS	36.23
GIFTS	100.44	VACATION	1823.41
HOUSE	539.44	MISC	70.12

Total amount spent was 4358.99
Total income was 2.75
Do you want a spending profile for this period?(Y or N)

HOUSEHOLD FINANCE

PARTS 1&2 - - \$15.00

Dual Joystick Interface
(with two programs) - \$45.00

LIFE - - - - - \$20.00

ORDERS: Send check, money order, or VISA/Mastercharge (include expiration date) and add \$1.50 shipping. Calif. residents add 6% sales tax.

INFORMATION: More information on these and many other currently available programs is available on a free flyer. Write directly to Creative Software.

Creative Software

P.O. BOX 4030, MOUNTAIN VIEW, CA 94040

Some Comments on

BBC Teletext

R G Silson
Near Station
TRING
Herts HP23 5QX
ENGLAND

E John Dehaven (April 1978 BYTE, page 152) is a little out of date regarding British TV standards. In 1936 the world's first high definition television station started regular broadcasts from Alexandra Palace, London ENGLAND. The transmission used 405 lines with AM sound and synchronized to the 50 Hz power lines. After the war the system was extended to cover the whole country on VHF.

With the introduction of color, a new UHF network was set up which now has around 1000 transmitters. The color system uses a 625 line phase alternation line (PAL) system with FM sound. *[In the PAL color system, the subcarrier derived from the color burst is phase inverted from one line to the next to minimize possible transmission hue errors. . . CM]* No new 405 sets have been available for many years. Official policy has been to delete the 405 line system

as soon as practical since all channels are duplicated on UHF. The problem is that many small communities in hilly areas find UHF reception very poor and a local UHF transmitter is not always economic.

In Britain the whole 50 Hz power system is synchronized by high voltage links, but transmitters are no longer tied to it. This change is perhaps unfortunate since some sets show a moving band, at the difference frequency, up or down the screen. This is usually faint but noticeable to the critical.

There is no need to modify the latest British color sets. They include high quality video display unit facilities to receive the new Teletext transmissions. All 625 channels now transmit digital data on unused picture lines giving up to 800 pages on each channel (more with special arrangements as below). A standard format of 24 lines, each with 40 characters, is used, with odd parity 8 bit bytes for each character. Each page is numbered (100 to 899) and the whole series is transmitted in sequence each 15 seconds or so. Some pages (eg: page 100) give general or special indexes to other pages which carry all kinds of information from news to recipes, sports to weather maps, etc. A digital

THE MICRO WORKS

MOTOROLA M6809 EMULATOR

- DS-80 S-100% compatible video digitizer with 256 x 256 resolution & 64 levels of grey scale. **\$349.95**
- DS-68 The same item for the SS50/6800 buss **\$169.95**
- MPRINT 6800 Driver software in 2708 for Malibu 160 printer Wiring diagram included. **\$39.95**
- BIOPIC Complete Biorhythm and Computer Portrait Software in 2708S for Malibu printer, DS-68 and SWTPC 6800 computer. **\$175.00**
- PSB-08 Prom system board with 8K of 2708 and 1K ram for all SS-50 Computers. **\$119.95**

Smoke Signal Disk Users! Run Mixed 5 and 8 Inch Drives

The Disk Mixer is a retrofit kit for Smoke Signal Disk controller boards capable of driving either 5 in. or 8 in. disks that allows the user to mix drive sizes. DM-85 allows any configuration of 5 in. and 8 in. drives to be user defined, and provides the appropriate clock signals for the disk being accessed. This is a kit, and is not recommended for those without hardware experience.

\$39.95

Run 6809 software before the chip is available!

E6809 is a 6800 machine language program that emulates all of the functions of the Motorola 6809 third generation micro-processor. Developed for use on any SS-50 computer system, the program allows software development and debugging prior to 6809 availability. The 3 K byte program is complete with a 6809 mini-monitor for ease of use, and on source listing. Available in Smoke Signal or Flex format disk, or cassette tape. **\$49.95**

*See Byte, Jan., Feb., Mar., 79

P.O. BOX 1110 DEL MAR, CA. 92014 714-756-2687

Master Charge
and
BankAmericard

the electric pencil II™

© 1978 Michael Shrayer

The Electric Pencil II is a Character Oriented Word Processing System. This means that text is entered as a string of continuous characters and is manipulated as such. This allows the user enormous freedom and ease in the movement and handling of text. Since line endings are never delineated, any number of characters, words, lines or paragraphs may be inserted or deleted anywhere in the text. The entirety of the text shifts and opens up or closes as needed in full view of the user. The typing of carriage returns as well as word hyphenation is not required since lines of text are formatted automatically.

As text is typed in and the end of a screen line is reached, a partially completed word is shifted to the beginning of the following line. Whenever text is inserted or deleted, existing text is pushed down or pulled up in a wrap around fashion. Everything appears on the video display screen as it occurs which eliminates any guesswork. Text may be reviewed at will by variable speed scrolling both in the forward and reverse directions. By using the search or the search and replace function, any string of characters may be located and/or replaced with any other string of characters as desired.

When text is printed, The Electric Pencil II automatically inserts carriage returns where they are needed. Numerous combinations of line length, page length, line spacing and page spacing allow for any form to be handled. Character spacing, **BOLD FACE**, multicolumn as well as bidirectional printing are included in the Diablo versions. Right justification gives right-hand margins that are even. Pages may be numbered as well as titled. This entire page (excepting the large titles and logo) was printed by the Diablo version of The Electric Pencil II in one pass.

Now on CP/M

The Electric Pencil II is also compatible with Imsai's **IMDOS**. **HELIOS** versions **SSH** and **DSH** are now ready. The **NEC** print package is now available. A utility program that converts **PENCIL** to **CP/M** to **PENCIL** files is ready. "CONVERT" is only **\$35.00**.

NEW FEATURES: * **CP/M**, **IMDOS** and **HELIOS** Compatible * Supports Four Disk Drives * Dynamic Print Formatting * **DIABLO** as well as **NEC** printer packages * Multicolumn Printing * Print Value Chaining * Page-at-a-time Scrolling * New Bidirectional Multispeed Scrolling Controls * New Subsystem with Print Value Scoreboard * Automatic Word and Record Number Tally * Cassette backup for additional storage * Full Margin Control * End-of-Page Control * Non-Printing Text Commenting * Line and Paragraph Indentation * Centering * Underlining * **BOLD FACE** *

W I D E S C R E E N V I D E O ! ! !

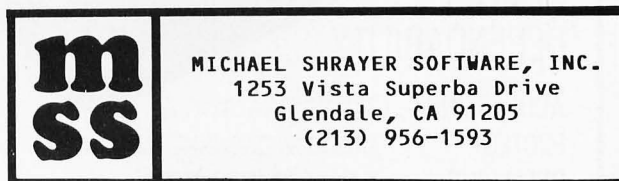
Available to Imsai V10 video users for a huge 80x24 character screen. These versions put almost twice as many characters on the screen !!!

HAVE WE GOT A VERSION FOR YOU ?

The Electric Pencil II operates with any 8080/Z80 based microcomputer that supports a CP/M disk system and uses a Imsai V10, Processor Technology VDM-1, Polymorphic VTI, Solid State Music VB-1B or any similar memory mapped video interface. REX versions now available. Specify when using CP/M that has been modified for Micropolis or North Star disk systems as follows: For North Star add suffix A to version number, for Micropolis add suffix B to version number, e.g. SS-IIA, DV-IIB.

Vers	Video	Printer	Price
SS-II	SOL	TTY or similar	\$225.
SP-II	VTI	TTY or similar	\$225.
SV-II	VDM	TTY or similar	\$225.
SR-II	REX	TTY or similar	\$250.
SI-II	V10	TTY or similar	\$250.
DS-II	SOL	Diablo 1610/20	\$275.
DP-II	VTI	Diablo 1610/20	\$275.
DV-II	VDM	Diablo 1610/20	\$275.
DR-II	REX	Diablo 1610/20	\$300.
DI-II	V10	Diablo 1610/20	\$300.
NS-II	SOL	NEC Spinwriter	\$275.
NP-II	VTI	NEC Spinwriter	\$275.
NV-II	VDM	NEC Spinwriter	\$275.
NR-II	REX	NEC Spinwriter	\$300.
NI-II	V10	NEC Spinwriter	\$300.
SSH	SOL	Helios/TTY	\$250.
DSH	SOL	Helios/Diablo	\$300.

UPGRADING POLICY: Any version of The Electric Pencil may be upgraded at any time by simply returning the original disk or cassette and the price difference between versions plus \$15.00 to MSS. Accept only original media at time of purchase.



MICHAEL SHRAYER SOFTWARE, INC.
1253 Vista Superba Drive
Glendale, CA 91205
(213) 956-1593

Electric Pencil I is still available for non CP/M users:

Vers	Video	Printer	Cassette	Disk Drive	Price
SS	SOL	TTY or similar	CUTS	---	\$100.
SP	VTI	TTY or similar	Tarbell	---	\$100.
SV	VDM	TTY or similar	Tarbell	---	\$100.
SSN	SOL	TTY or similar	CUTS	North Star	\$125.
SPN	VTI	TTY or similar	Tarbell	North Star	\$125.
SVN	VDM	TTY or similar	Tarbell	North Star	\$125.
DS	SOL	Diablo 1610/20	CUTS	---	\$150.
DP	VTI	Diablo 1610/20	Tarbell	---	\$150.
DV	VDM	Diablo 1610/20	Tarbell	---	\$150.
DSN	SOL	Diablo 1610/20	CUTS	North Star	\$175.
DPN	VTI	Diablo 1610/20	Tarbell	North Star	\$175.
DVN	VDM	Diablo 1610/20	Tarbell	North Star	\$175.

Demand a demo from your dealer!

4044 — \$5

450 nsec. — Quantity 64

250 nsec. 450 nsec.

1-31 chips	\$8	\$7
32-63 chips	7	6
64-over	6	5

2716 — \$49

Single 5V Supply — Limited Quantity

Z-80A — \$19

4 Mhz. Version

Other Specials

6810 — \$4.25

8251A — \$7.50

All are Factory Prime Chips — Guaranteed Good



Seattle Computer Products, Inc.

1114 Industry Drive, Seattle, WA. 98188

(206) 575-1830

clock is given on the top line of each page, exact to the second.

A small key pad is provided. Keying a page number selects that page from the stream and stores it in the set for display as required. Normally only one page is stored but this is limited by economics alone. Storage may be for seconds or weeks if necessary. Extra pages above the basic 800 are obtained by using sets of pages with the same page number, and cycling them over several minutes, or even once per day. The keypad has extra buttons that permit normal picture display, Teletext display and combined display. It also has clock time setting switches that allow a page to be selected at a given time and stored to be displayed at leisure.

To use the set as a personal video display unit, one merely needs to input serial bytes in the published standard Teletext format via a spare channel. Superb facilities are available, all controlled by the data. Characters are of a high standard since they are generated as video signals by the Teletext unit with an equivalent bandwidth of about 14 MHz. The whole ISO-7 ASCII set is available with upper and lower case. Additionally, there are 64 graphics characters (permitting maps and other displays). These are in a 3 by 2 rectangle using one of six bits to give all possible on or off combinations. A duplicate upper case permits legends within the graphics.

The Teletext unit has direct control of the three color guns, permitting all characters to be displayed as black, white, red, green, yellow, blue, magenta or cyan in almost any combination, against a background of a chosen color. Any or all of the characters may be flashed on and off to attract attention.

A special control character may be used to open and close a box in the normal picture. The box may be of any size or shape and in any position on the screen. This facility is normally used for subtitles and news flashes, but could allow part of the screen access to the personal computer while the family watches a normal program on the rest of it. The store is continually updated by incoming new or repeat data but, if required, the whole page may be erased before a new page is started.

Overall, this set seems to have a high potential of usefulness. This may increase in the future since several control characters are still spare. In Britain this video display unit is also being standardized for telephone data so that all possible digital information services may use the household television, giving a minimum total cost. One wonders what the limit is going to be. ■

Pacific

DIGITAL

RELIABILITY
QUALITY
DEPENDABILITY

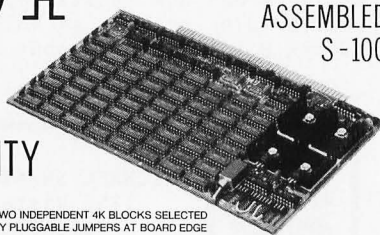
ADDRESSING
PROTECT
BUFFERING
LOW POWER
WAIT STATES
QUALITY
GUARANTEE
DELIVERY
PHANTOM
TESTING

SPECIAL

INTRODUCTORY
PRICE
ASSEMBLED / TESTED

8KRS

8K STATIC RAM
ASSEMBLED
S-100



TWO INDEPENDENT 4K BLOCKS SELECTED BY PLUGGABLE JUMPERS AT BOARD EDGE

ON-BOARD SWITCH WRITE PROTECTS/UNPROTECTS ALL 8K OR EACH 4K BLOCK CAN BE PROTECTED VIA FRONT PANEL

ALL S-100 BUS LINES ARE FULLY BUFFERED ONE LS-TTL LOAD PER LINE

21L02 RAMS - THE 8KRS TYPICALLY REQUIRES 1.5 AMPS AT 8 VOLTS - 4 ON-BOARD 5 VOLT REGULATORS

0, 1, OR 2 WAIT STATES MAY BE SELECTED VIA A PLUGGABLE JUMPER

THE BOARD IS GLASS EPOXY WITH SILK SCREEN LEGEND, FULL SOLDER MASKS ON BOTH SIDES, FLOW SOLDERING, GOLD CONTACTS

IF NOT SATISFIED RETURN THE UNDAMAGED 8KRS WITHIN 10 DAYS FOR FULL REFUND - ALSO 90 DAY LIMITED WARRANTY

STOCK TO 30 DAYS - CALL BETWEEN 8:30 AND 6:00 TO RESERVE YOUR 8KRS OR FOR MORE INFORMATION

MEMORY DISABLE IS IMPLEMENTED VIA PHANTOM (PIN 67)

COMPLETE TESTING NOT ONLY OF ALL MEMORY CELLS BUT ALSO OF ALL SUPPORT CIRCUITRY AND OPTIONS

450 ns 250 ns
\$149⁹⁵ \$189⁹⁵

CALIFORNIA RESIDENTS ADD 6% TAX

Pacific

DIGITAL

(714) 992-5540
2555 E. CHAPMAN AVE.
SUITE 604
FULLERTON, CA 92631

TRS-80 OWNERS

AVAILABLE FOR IMMEDIATE DELIVERY

CASSETTE SOFTWARE DISKETTE

Package # 1036 (Level II)\$495.00

COMPLETE SMALL BUSINESS – This program is a complete small business program that was tailored to work for most small business applications. The program includes such things as Accounts Receivable, Accounts Payable, Invoicing, Inventory Control, Payroll and General Ledger.

Package # 1038 (Level II)\$ 99.95
ACCOUNTS RECEIVABLE

Package # 1039 (Level II)\$ 99.95
ACCOUNTS PAYABLE

Package # 1044 (Level II)\$125.00
INVENTORY CONTROL

Package # 1045 (Level II)\$ 99.95
INVOICING

Package # 1046 (Level II)\$ 99.95
PAYROLL

Package # 1047 (Level II)\$ 99.95
MAILING LIST

Package # 1024
(Level II, DISKETTE)\$24.95
Includes the following:
SPACEWAR I – BANNER – UFO ATTACK – PILE UP –
BIORHYTHM – AUTO RACE and WORDS.

Package # 1026
(Level II, DISKETTE)\$24.95
Includes the following:
SPACEWAR II – CIVIL WAR – TRAP THE TRIBBLE –
LIFE – KNIGHT – CONCENTRATION and LUNAR
LANDER.

OVER 150 EXCITING PROGRAMS

★ MORE EVERY DAY ★

EDUCATION

ELECTRONICS

MARKETING

Also available for PET and APPLE.

All SOFTWARE-80 programs are guaranteed.

Programs available in Level I and Level II Basic.

All of our business programs will operate with printer; custom programs also available.

With certified check or money order, all orders shipped within 24 hours.

Personal checks allow 2 weeks.

Send for our complete catalogue.

SOFTWARE-80

18228 Cabrillo Court
Fountain Valley, CA 92708
(714) 962-3423

ALL PRICES AND PROGRAMS ARE SUBJECT TO CHANGE WITHOUT NOTICE

Technical Forum

Adding Lowercase Display to the ADM-3A

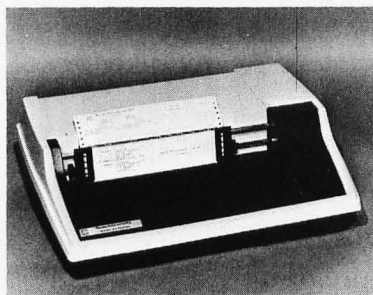
A W Walker
1914 Ridgewood Dr
San Diego CA 92139

The scenario: you wanted a good quality, versatile video display, so you stretched the budget to the limit to buy a "dumb" terminal kit. After it's all together, you're showing off the result of your assembly skills when someone innocently asks "Does it have lowercase?" Well no, it doesn't, actually. You ask around, and find there is a way, but at \$89, the kit from Lear Siegler doesn't quite fit the constraints. So a short expedition into the innards of the ADM-3A should be helpful; after all, one should only need a bit more of a character generator read only memory to do the trick. Lo and behold, the designers at Lear Siegler have even provided the socket, so let's see what fits into it. The

ADM-3A maintenance manual explains nicely on page 6-11 that "the lowercase read only memory is a custom masked part" whose distinguishing attribute is that "all of the address lines. . . are inverted." Well, just how unusual is that custom read only memory? After some experimentation and further delving into the mysteries of the schematics, it appears that all one has to do is turn over the six character address bits, use a readily available lowercase 2513 for about \$9.95 and be on the air. An easy way to invert six bits might be with a 74LS04 transistor-transistor logic (TTL) integrated circuit.

To avoid any modifications to the

AVAILABLE NOW



\$1695 T.I. 810 printer

- 150 cps bi-directional impact printer
- Tractor feed, 3" to 15", up to 6-part
- Programmable forms length
- EIA RS-232 serial, 110-9600 baud

Options:

- Upper/lower case \$90—Stand & paperbasket \$135
- Forms Length Control \$90—Vertical Format Control \$180
- FLC/Compressed Print \$180—VFC/Compressed Print \$270

Need a Texas Instruments portable, ASR or KSR?
Call MICROMAIL



Teletype 43 \$999

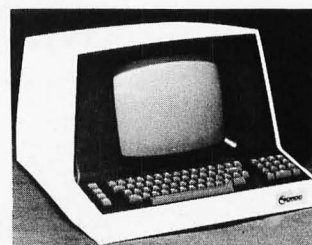
- Upper/lower case, 132 columns
- RS 232 serial, 110 or 300 baud
- 12" X 8½" pin-feed paper



(1620 pictured)

Diablo 1641/3 \$2910

- Letter-quality printing
- HyType II daisywheel printer
- RS 232 serial, 110-1200 baud



SOROC
IQ 120

\$795

- Upper/lower case, 24 X 80 12" display
- Numeric keypad, cursor control keys
- RS-232 interface plus extension port

Need more intelligence?

SOROC IQ 140 **\$1345**

FROM MICROMAIL

To order: Send a certified check or money order. Personal or company checks require two weeks to clear.

Handling: Less than \$2000, add 2%; over \$2000, add 1%.

Tax: California residents add 6% sales tax.

All terminals shipped freight collect in original carton with manufacturer's warranty.

Write for free catalogue

MICROMAIL
MICROMAIL • BOX 3297 • SANTA ANA, CA 92703
(714) 731-4338

**RADIO SHACK
5-STAR EDITION**



**RADIO SHACK
5-STAR EDITION**

TRS-80 TRANSFORMED WITH PROFESSIONAL SOFTWARE PACKAGE

Lifeboat Associates, specialists in microcomputer disk software, is proud to offer the first professional disk-based language and utility package for the Radio Shack TRS-80 computer. Written by Microsoft, creators of Level II BASIC, the package runs on a TRS-80 system with 32K RAM, one or more drives and TRSDOS. The software is supplied on diskettes and consists of:

FORTTRAN a true relocatable machine code compiler for ANSI FORTRAN X3.9 (except COMPLEX variables).

MACRO ASSEMBLER a disk-based macro assembler utilizing Zilog mnemonics and producing relocatable code.

LINKING LOADER to link-edit and load FORTRAN and assembler modules for execution.

SUBROUTINE LIBRARY a complete library of subroutines existing as relocatable linkable modules for FORTRAN or assembler programs — e.g., double precision square root, natural log, transcendentals, etc.

DISK TEXT EDITOR to create and modify FORTRAN and assembler programs as disk files; also can be used as a general purpose text editor for correspondence and other documents.

This high-powered professional software package with full documentation is available at the
DISCOUNT PRICE OF **\$325** PER COMPUTER SYSTEM

Dealer Inquiries invited

LIFEBOAT ASSOCIATES

164 West 83rd Street/New York, NY 10024 (212) 580-0082

Please send me the
TRS-80 FORTRAN
Package @ \$325.00
(plus \$2.00 shipping or
\$5.00 foreign)

- ☐ Check enclosed
☐ C.O.D. (\$1.00 add'l)
☐ Master Charge
☐ VISA

Name _____

Address _____

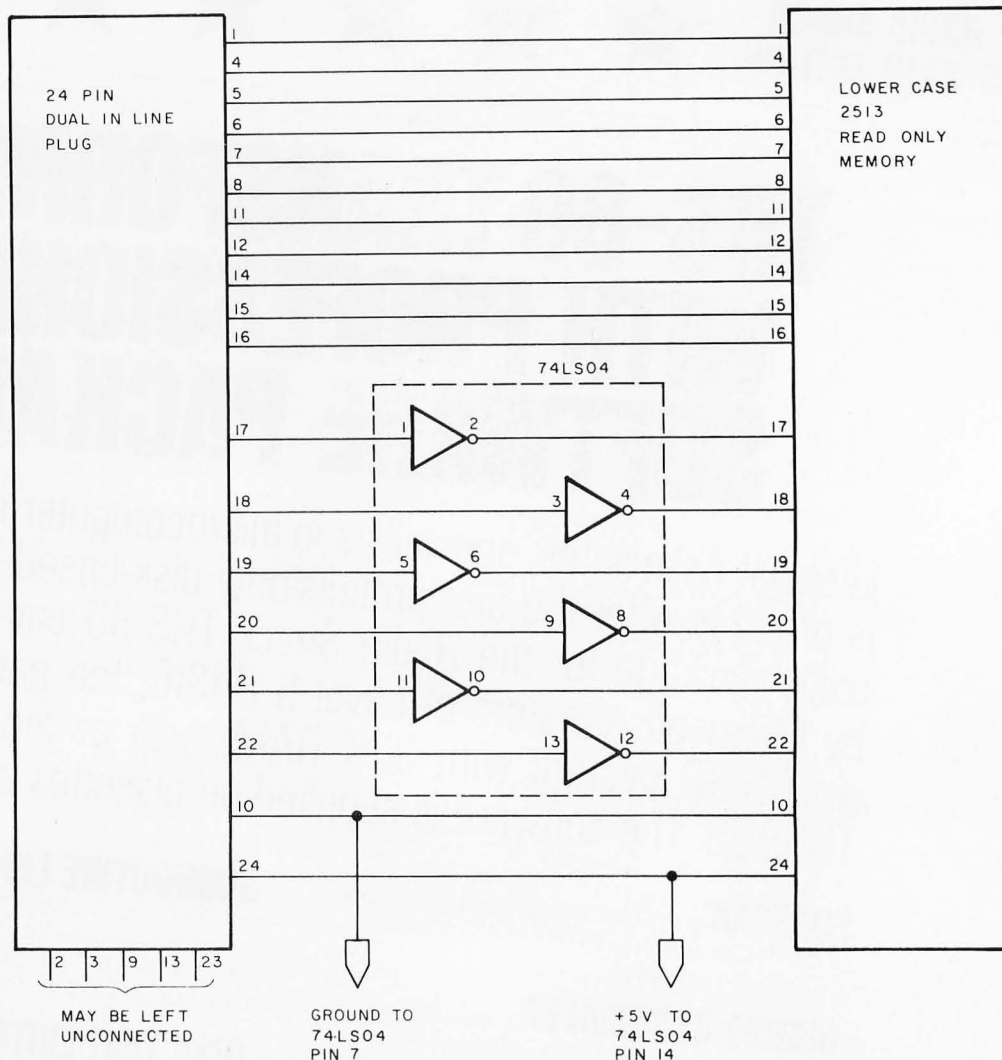
City, State, Zip _____

Acct. No. _____ Expires _____

Signature _____

b

Figure 1: Modifications that must be made to the existing ADM-3A to produce lower case characters.



NEW FROM XITEX

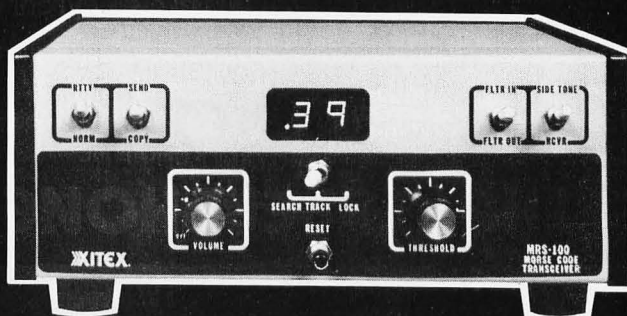
\$95 MORSE TRANSCIEVER

SEND:

- 1 to 150 WPM (set from terminal)
- 32 character FIFO buffer with editing
- Auto Space on word boundaries
- Grid/Cathode key output
- LED Readout for WPM and Buffer space remaining

SERIAL INTERFACE:

- ASCII (110, 300, 600, 1200) or Baudot (45, 50, 57, 74) compatible
- Simplex Hi V Loop or T²L electrical interface
- Interfaces directly with the XITEX® SCT-100 Video Terminal Board; Teletypes® Models 15, 28, 33, etc.; or the equivalent



MRS-100 CONFIGURATIONS:

- \$95 Partial Kit (includes Microcomputer components and circuit boards; less box and analog components)
- \$225 Complete Kit (includes box, power supply, and all other components)
- \$295 Assembled and tested unit (as shown)

Overseas Orders and dealer inquiries welcome

COPY:

- 1 to 150 WPM with Auto-Sync.
- Continuously computes and displays Copy WPM
- 80 HZ Bandpass filter
- Re-keyed Sidetone Osc. with on-board speaker
- Fully compensating to copy any 'fist style'

See your local dealer or contact XITEX® direct.

MC/Visa accepted

XITEX CORP.

13628 Neutron • P. O. Box 402110
Dallas, Texas 75240 • (214) 386-3859

ADM-3A, I built my lowercase adapter on a 24 pin dual-in-line plug that inserts into the existing lowercase read only memory socket (location L14) in the terminal. On top of the plug I mounted a small piece of 0.1 by 0.1 inch (0.254 by 0.254 cm) perforated board with sockets for the added lowercase 2513 and the 74LS04 inverter. Using this assembly method requires fairly careful consideration to avoid interference with the cabinet top or other components. For more compact assembly, the perforated board and sockets might be omitted with the new read only memory mounted directly on the plug and the inverter glued in place upside down on top. Since all but six of the read only memory's pins are connected directly to those of the plug, adequate support is available. The remaining six pins needing inversion can be bent out for appropriate connection to the 74LS04.

Regardless of the final mounting and installation method chosen, the required wiring is given in figure 1. Note that two additional 2102-1 memories are required, which plug into locations J11 and H11 to store the uppercase/lowercase data bit on characters stored in the display memory. The total cost of materials for my unit is \$14.25, and it can be built for less depending upon your junk-box, where you shop for parts, and the method of construction.

Once installed in the ADM-3A, and assuming the UC DISP-U/L DISP at the inside rear of the unit is set to U/L DISP with the LC EN-UC switch at the left of the key-

board set at LC EN, the result is a full 95 character terminal display including the 26 lowercase letters and five additional symbols as shown in table 1. Note that, since the characters are still only generated with a 5 by 7 dot matrix, the lowercase letters with descenders, such as g, j, p, q and y, do not actually display the descenders below the writing line, but instead are elevated so as to allow the characters, including descenders, to be displayed within the 5 by 7 matrix. This technique results in a very acceptable low cost upper and lowercase display. My customized ADM-3A has been in service quite satisfactorily for more than eight months.■

Bits	765	110	111
4321			
0000	,		p
0001	a		q
0010	b		r
0011	c		s
0100	d		t
0101	e		u
0110	f		v
0111	g		w
1000	h		x
1001	i		y
1010	j		z
1011	k		{
1100	l		}
1101	m		~
1110	n		DEL
1111	o		

Table 1: Additional characters added to the ADM-3A by the modification shown in figure 1.



\$95 Stand Alone Video Terminal

aBYG:Bu\pvnIphiRo123°±÷%[]|←→↑↓
 !"#%&'()*+,-./012456789:;<=>?
 @ABCDEFGHIJKLMNPOQRSTUVWXYZ[\]^_
 `abcdefghijklmnopqrstuvwxyz{|}~

SCT-100 FEATURES:

- 64 X 16 line format with 128 displayable characters
- Serial ASCII or BAUDOT with multiple Baud rates
- \$187 Assembled or \$157 Kit (Partial Kit \$95)
- Full cursor control with scrolling and paging
- On board power supply MC/VISA accepted

Call or write today.

XXITEX CORP
 13628 Neutron P. O. Box 402110
 Dallas, Texas 75240 (214) 386-3859

Overseas orders and dealers inquiries welcome

Password Protection for Your Computer

R Jordan Kreindler
USC Eastern Regional Office
5510 Columbia Pike
Arlington VA 22204

Is your computer available via the telephone? Do you plan to leave it in a public area but want to limit its use? Will your system be used in a school environment where access must be controlled?

If the answer to any of the above questions is "yes," this article should interest you.

A Simple Password Procedure

One way to restrict system access is by

Number of characters in password	Number of possible passwords
3	46,656
4	1,679,616
5	60,466,176
6	2,176,782,336

Table 1: Possible password combinations using upper case letters and digits.

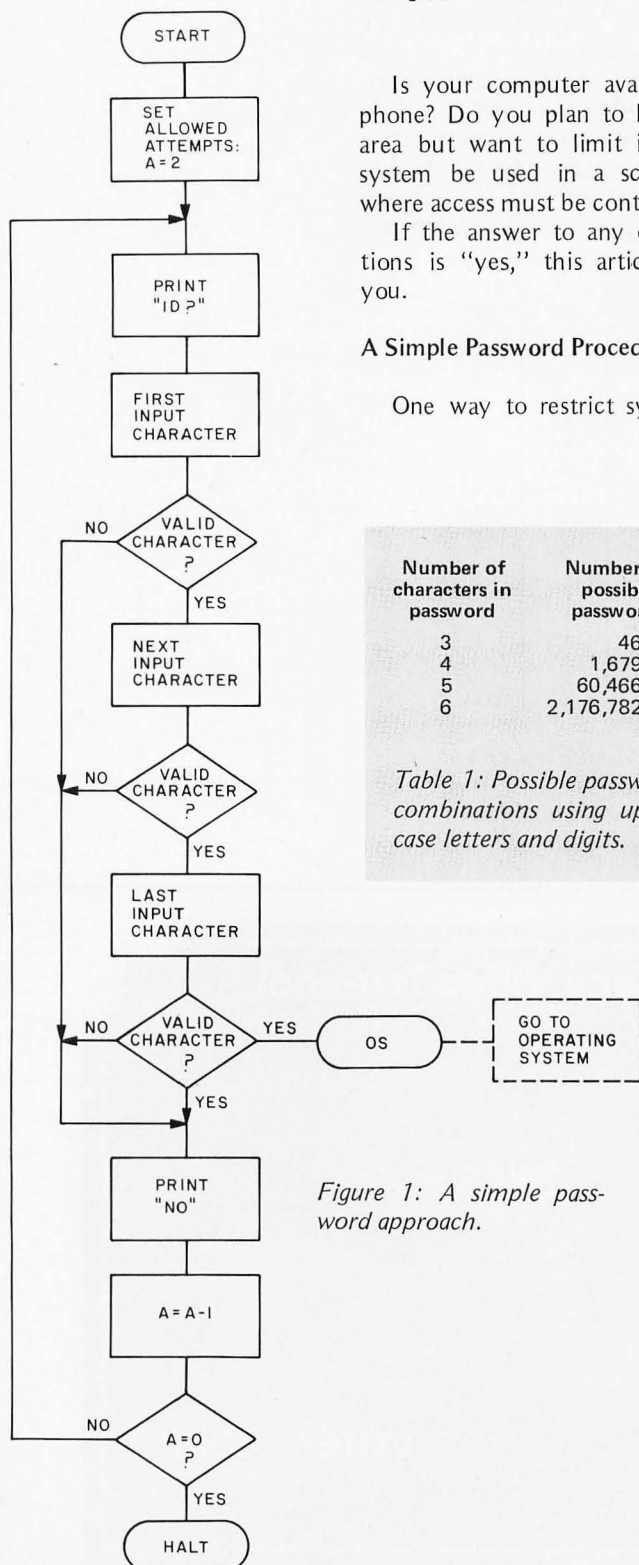


Figure 1: A simple password approach.

lock and key. An easier method is to set up a password requirement. The flowchart in figure 1 is one way of implementing a password subroutine. This figure shows a simple method for checking a 3 character password. Each character of the password is checked immediately after it is entered. Upon detection of an illegal character, "NO" is printed. As shown, the user is allowed two attempts to enter the correct password. If both attempts fail, the system halts.

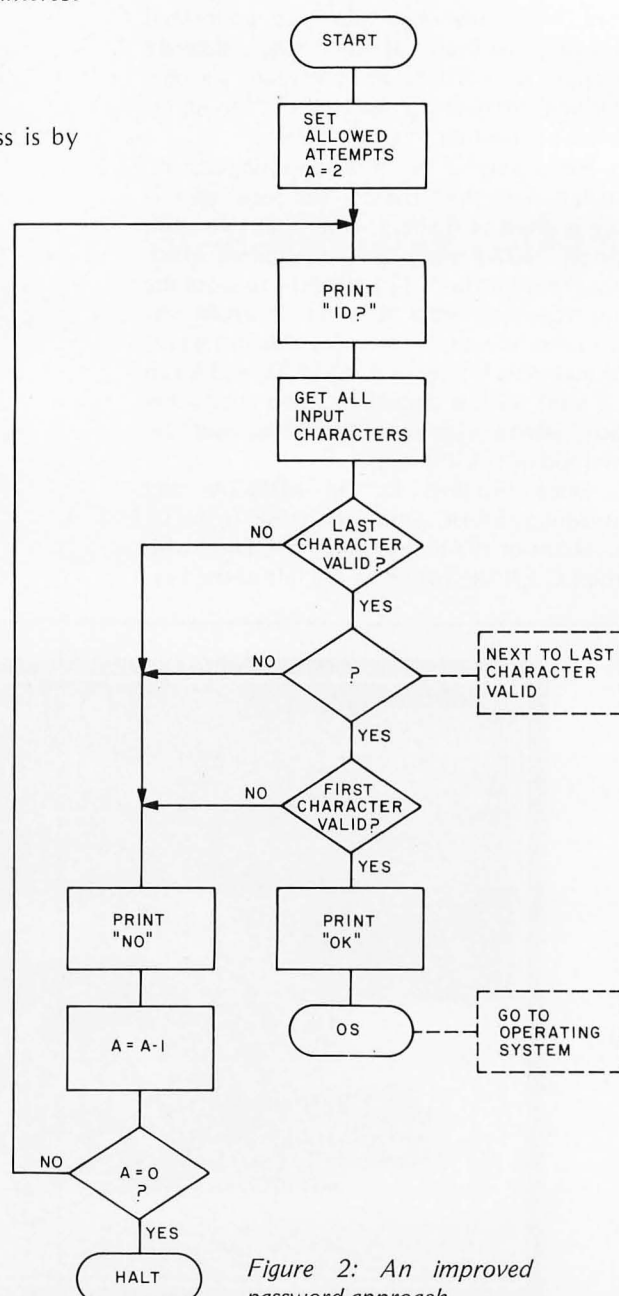


Figure 2: An improved password approach.

Assume that the 26 upper case letters and the 10 digits will be used to establish a password. For the algorithm in figure 1, a user could try, in order, all 36 characters to find the correct first character. After the first character is identified, the user could follow the same procedure to find the second character. Once the second character is found, the procedure could be repeated to find the third.

With this system, there are $36 + 36 + 36 = 108$ different possible passwords. This is too few combinations for adequate security.

An Improved Password Procedure

A better procedure is shown in figure 2. Here, a 3 character password is also used. However, in this method all characters are entered before the password is checked. Thus, a failing password yields little information. The user can't tell which of the characters is incorrect. All that is known is that the combination tried was incorrect.

With this procedure, there are $36 \times 36 \times 36 = 46,656$ possible passwords. This should be an acceptable level of security. If additional security is desired, the password can be expanded beyond three characters. Table 1 shows the number of different possible passwords in these situations. This table was developed with the assumption that only upper case letters and digits would be used in a password.

The program in listing 1 is an 8080/Z-80 coding of the algorithm in figure 2. The program as shown uses the password YES. It has been implemented on a North Star Horizon Computer. The following comments should allow this program to be modified for other systems (all numbers shown are in hexadecimal; DOS stands for disk operating system):

Statement	Comment
CALL 200D	Calls the DOS output routine.
	Outputs the character in the B register.
CALL 2900	Calls the DOS character input subroutine.
JMP 270F	Jumps to the DOS to allow normal system access.
MVI E, 53	Establishes the password as "YES." These three
MVI E, 45	statements are where you
MVI E, 59	establish your own password.

A password subroutine is easy to implement and requires little computer memory. However, it increases the security of your system.■

Listing 1: An 8080/Z-80 assembler listing of the improved algorithm for a 3 character password. This program is written for the password YES.

```

2969          ;*****
2969          ;*
2969          ;*   PROGRAM NAME :ID
2969          ;*   PROGRAMMER  :R. J. KREINDLER
2969          ;*   DESCRIPTION :THIS PROGRAM
2969          ;*   ALLOWS THE USER TO ESTABLISH
2969          ;*   A THREE CHARACTER ID(PASSWORD)
2969          ;*   TO CONTROL SYSTEM ACCESS
2969          ;*
2969          ;*****
2969          ;*
2969          ;DEFINE STORAGE LOCATIONS FOR INPUT CHARS
2969          ;*
2969          LOC1: EQU 29CCH
2969          LOC2: EQU 29CDH
2969          ;*
2969          ;ESTABLISH NUMBER OF TRYs
2969          ;*
2969          ID: MVI D,02H          ;SET ATTEMPTS TO TWO
2969          IDETR: MVI B,0DH       ;PLACE "CR" IN B
2969          CALL 200DH            ;PRINT "CR"
2969          MVI B,0AH            ;PLACE "LF" IN B
2969          CALL 200DH            ;PRINT "LF"
2969          MVI B,49H            ;PLACE "I" IN B
2969          CALL 200DH            ;PRINT "I"
2969          MVI B,44H            ;PLACE "D" IN B
2969          CALL 200DH            ;PRINT "D"
2969          MVI B,3FH            ;PLACE "?" IN B
2969          CALL 200DH            ;PRINT "?"
2969          MVI B,20H            ;PLACE " " IN B
2969          CALL 200DH            ;PRINT " "
2969          ;*
2969          ;OBTAIN THE THREE INPUT CHARACTERS
2969          ;*
2969          CALL 2900H            ;GET INPUT CHAR
2969          STA LOC1              ;STORE CHAR AT ADDRESS LOC1
2969          CALL 2900H            ;GET NEXT INPUT CHAR
2969          STA LOC2              ;STORE IT AT LOC2
2969          CALL 2900H            ;GET LAST INPUT CHAR
2969          ;LEAVE IT IN A
2969          ;COMPARE INPUT TO VALID ID IN REVERSE ORDER
2969          ;*
2969          MVI E,53H            ;PLACE "S" IN E
2969          CMP E                 ;COMPARE WITH LAST CHAR IN
2969          JNZ TRYs              ;NO MATCH GO TO TRYs
2969          LDA LOC2              ;PLACE 2ND CHAR IN A
2969          MVI E,45H            ;PLACE "E" IN E
2969          CMP E                 ;COMPARE WITH 2ND INPUT CHAR
2969          JNZ TRYs              ;NO MATCH GO TO TRYs
2969          LDA LOC1              ;PLACE 1ST INPUT CHAR IN A
2969          MVI E,59H            ;PLACE "Y" IN E
2969          CMP E                 ;COMPARE WITH 1ST INPUT CHAR
2969          JNZ TRYs              ;NO MATCH GO TO TRYs
2969          ;*
2969          ;IF ID VALID PRINT "OK" & GIVE SYSTEM ACCESS
2969          ;*
2969          OK: MVI B,4FH          ;PLACE "O" IN B
2969          CALL 200DH            ;PRINT "O"
2969          MVI B,4BH            ;PLACE "K" IN B
2969          CALL 200DH            ;PRINT "K"
2969          JMP 270FH            ;GIVE ACCESS TO SYSTEM
2969          ;*
2969          ;IF INPUT INVALID PRINT "NO"
2969          ;*
2969          TRYs: MVI B,4EH        ;PLACE "N" IN B
2969          CALL 200DH            ;PRINT "N"
2969          MVI B,4FH            ;PLACE "O" IN B
2969          CALL 200DH            ;PRINT "O"
2969          ;*
2969          ;TEST NUMBER OF INPUT TRYs
2969          ;*
2969          DCR D                  ;REDUCE D BY 1
2969          JNZ IDETR              ;IF D NOT 0 TRY AGAIN
2969          ;*
2969          ;IF ALL ALLOWED TRYs FAIL THEN HALT
2969          ;*
2969          HALT: HLT
2969          ;*

```


The Power of the HP-67 Programmable Calculator, Part 1

Robert C Arp Jr
POB 1268
Minden NV 89423

Introduction

This article is not a simple product review. Rather, it is the presentation of a complex programming example designed to illustrate the exploitation of a computing system composed of the HP-67 and its accessories, and worksheets that reduce the task of programming the calculator to a systematic exercise. The HP-67 is a pocket-sized version of the HP-97. The built-in thermal printer of the HP-97 is the major difference between the calculators. The HP-67 is shown in photo 1.

In addition to the HP-67, there are other sophisticated programmable calculators available at price levels which attracted consumers to the first scientific calculators in 1972 and the years following. I purchased my HP-35 early, and until the introduction of the HP-67 I considered it to be the finest calculator ever manufactured.

I must admit that I was intrigued by the features of the SR-52 when it was introduced. However, three of the Hewlett-Packard features force me to vote for the HP-67: choice of display format (fixed decimal, scientific and engineering; all with number of digits control), reverse Polish notation (RPN), and my previous experience with Hewlett-Packard. (Since 1972 I have experienced zero down time with the HP-35. Therefore, I am properly impressed with HP quality.)

Although I expect to see calculators with more memory capacity and some increase in programming capability in the future, I think the HP-67 represents a plateau of sophistication that will satisfy the needs of a large percentage of users. The HP-67 has 26 data storage registers, 224 steps of program memory (each step can hold as many as three keystrokes), unconditional and conditional branching, three levels of subroutines, four flags, 20 labels, indirect addressing, and, if that isn't enough, it accepts magnetic cards that record data or programs. In addition, each of the 35 keys control up to four separate operations, and, of course, it is completely portable with the rechargeable battery pack.

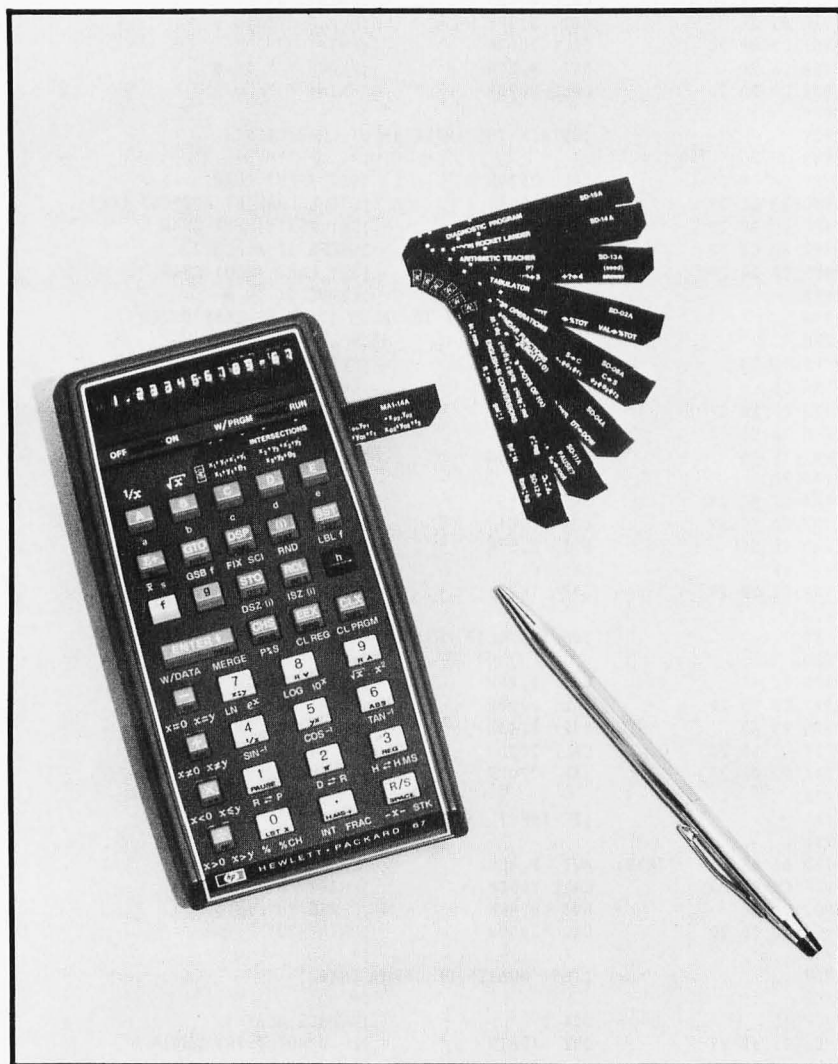


Photo 1: The HP-67, one of the sophisticated pocket calculator products which represent the small end of the personal computing hardware range.

ARE YOU TAKING FULL ADVANTAGE OF YOUR COMPUTER?

☐ **NO**

Then we want you. Assembled at the Personal Computing Festival of the 1979 National Computer Conference will be scores of experts with diverse backgrounds. Your imagination cannot help but be triggered with new uses and applications for your own computer. Over 25 technical sessions will cover such topics as: languages, education, robotics, small business applications, speech synthesis and recognition, and investment analysis. Live demonstrations of applications by individual users will enable you to see the latest personal computing realities in action. Commercial exhibits will bring you up-to-date on industry offerings in microcomputer products, systems, and services. Take full advantage of your computer by attending the NCC Personal Computing Festival at the Americana Hotel in New York City, June 4-7. For continuing information about the complete computing experience at NCC, simply fill out and return the coupon below.

☐ **YES**

Then we need you. You have developed an application to a point where your results are up to your own high personal standards. Speak to us, and the world, at the NCC '79 Personal Computing Festival. You can help your friends and colleagues take full advantage of their own computers by presenting a paper, chairing a session, or demonstrating your application. Valuable prizes will be awarded for outstanding applications demonstrations and for the best papers published in the *NCC '79 Personal Computing Proceedings*. Fill out the coupon below, check the box on conference participation, and we'll send you complete information. Time is short, so you must act promptly. But remember...whether or not you're presently taking full advantage of your computer, there's a world of information on the very latest in personal computing awaiting you at NCC '79 in New York.



NCC '79

PERSONAL COMPUTING FESTIVAL

c/o AFIPS, 210 Summit Avenue, Montvale, N.J. 07645

BYT

- ☐ Please keep me up-to-date on NCC '79 and its Personal Computing Festival.
- ☐ I'm interested in making a presentation and have enclosed a description of my topic.
- ☐ I'm interested in demonstrating my own personal computing application and am enclosing a description of it.
- ☐ My company is interested in exhibiting at the Personal Computing Festival.
- ☐ Please send information on the NCC '79 Travel Service.

Name _____ Title _____

Company _____

Street _____

City _____ State _____ Zip _____

Learning to Use the HP-67

Table 1 is a list of cautions which should be memorized before using the HP-67. These simple rules will allow maximum utility with minimum misery. After memorizing these rules, read Appendix B of the HP-67 handbook before attempting to use the calculator.

The HP-67 is a very powerful computer. One should not expect to memorize the *Owner's Handbook and Programming Guide* with a cursory reading. (The handbook is almost 3/4 inch thick.) Its contents should be digested in two stages: After acquiring your HP-67, read the handbook leisurely for two or three days, performing calculations when necessary. Next, design programs that require as many functions as possible, referring to the handbook often.

In addition to the *Owner's Handbook and Programming Guide*, the HP-67 is accompanied by a "Standard Pac" of programs which includes:

- 15 prerecorded magnetic cards containing programs for problems common to business, science and engineering, a diagnostic program and an abrasive cleaning card.
- 24 blank magnetic cards.
- *Standard Pac Handbook*.

The *Standard Pac Handbook* contains a description of each of the standard programs, instructions for running the programs, example problems, program listings and explanations of important programming techniques. As part of learning to use the HP-67, an owner should be sure to read this handbook. Pay particular attention to any

Table 1: A list of precautions for prospective users of the Hewlett Packard HP-67 and HP-97 programmable calculators.

1. Always have a battery pack installed in calculator.
2. Connect the calculator to the charger using the following steps: a. Turn HP-67 off. b. Connect charger to calculator. c. Plug charger into power outlet. d. Turn HP-67 on.
3. Disconnect the charger from the calculator using the following steps: a. Turn HP-67 off. b. Unplug charger from power outlet. c. Disconnect charger from calculator.
4. Leave the W/PRGM-RUN switch in the RUN position except when programming or recording a program.
5. Check each program of the Standard Pac and your Application Pacs as soon as you receive the Pacs. Don't wait until the need occurs to discover an error.
6. Store partially completed programs on two blank cards. Don't trust yourself with only one copy.
7. If any difficulty is experienced when removing a program card from the window slot, press down on the card with a pencil's eraser and slide the card out of the slot.
8. If the motor begins to sound as if it is laboring, a pass or two of the abrasive cleaning card may clear up the problem. Remember, also, that a fully discharged battery pack must be charged for five minutes before a card can be read.

programming techniques you might be able to utilize.

Application pacs (which include business decisions, statistics, mathematics, electrical engineering, clinical lab, nuclear medicine, mechanical engineering, and surveying) contain about 20 prerecorded program cards apiece and a handbook containing a description of the programs with relevant equations, instructions for running the programs, example problems and program listings.

All prerecorded cards in the pacs have printed mnemonics which substitute for the instructions after a few familiarization runs. The mnemonics include input variables, keys to be pressed and outputs to be expected. A full explanation of the mnemonic symbols for the magnetic cards may be found on page vi of the *Standard Pac Handbook* and in each *Application Pac Handbook*.

Key Functions

All of the HP-67 Key Functions are discussed briefly on pages 8 thru 13 of the *Owner's Handbook and Programming Guide*. The mathematical key functions are discussed in detail in the first 120 pages of the guide. Following this is a complete description of the programming key functions. Card reader operations and the appendices take up the rest of the guide.

Many of the mathematical and programming functions are self-explanatory by their designations. Examples of these, which would be familiar even to those people unfamiliar with Hewlett-Packard calculators, are \div , \times , $+$, $-$, π and \sqrt{x} . Experienced users should recognize ENTER, CHS, EEX and CLX. After brief explanations, it is easy to remember the function of most unfamiliar keys by their abbreviations: STK = stack review, ABS = absolute value, INT = integer portion, FRAC = fractional portion, RND = round off, STO = store, and RCL = recall.

32 of the keys may be used as a single stroke function, or they may be preceded by one of three prefix keys (two stroke function) and, occasionally, they may be followed by another function key (three stroke function). These 32 keys are used to provide 116 functions (five are redundant), but because the key designations closely describe the functions performed, they are easily memorized. I also found the mathematical functions listed in table 2 to be especially useful.

Functions I Would have Appreciated

The programming functions of the HP-67

FUNDAMENTALS OF COMPUTER ALGORITHMS

by E. Horowitz and S. Sahni

☐ The concept of computer algorithms is fundamental to any study of computer programming. Horowitz and Sahni present the subject completely, covering the underlying strategies, design techniques, analysis, and testing of algorithms. Problems and exercises are included, using an ALGOL/PASCAL-like language. Twelve chapters; an essential text. 626 pp. \$19.95 hardcover.

FUNDAMENTALS OF DATA STRUCTURES

by E. Horowitz and S. Sahni

☐ This text covers the other half of computer programming; data structures, their specification, design, evaluation, and realization in a programming language. Chapters include: arrays, stacks and queues, linked lists, trees, graphs, internal sorting, external sorting, symbol tables, and files. Many examples and exercises are provided, using an ALGOL/PASCAL-like language. 564 pp. \$18.95 hardcover.

A COLLECTION OF PROGRAMMING PROBLEMS AND TECHNIQUES

by H.A. Maurer and M.R. Williams

☐ Here is a book that presents you with problems — nearly 400 of them: problems and games like chess, bridge, NIM; practical problems such as applications of the law of science, Kramer's rule of solving simultaneous equations, and applications of Latin squares, to problems of probability. The most valuable feature of the book is its careful and thorough explanation of the use of algorithms to solve problems. No dyed-in-the-wool programmer or experimenter will be able to read this book for very long before trying to solve the tantalizing and well presented problems. 256 pp. \$15.00

THE ART OF COMPUTER PROGRAMMING

by D.E. Knuth

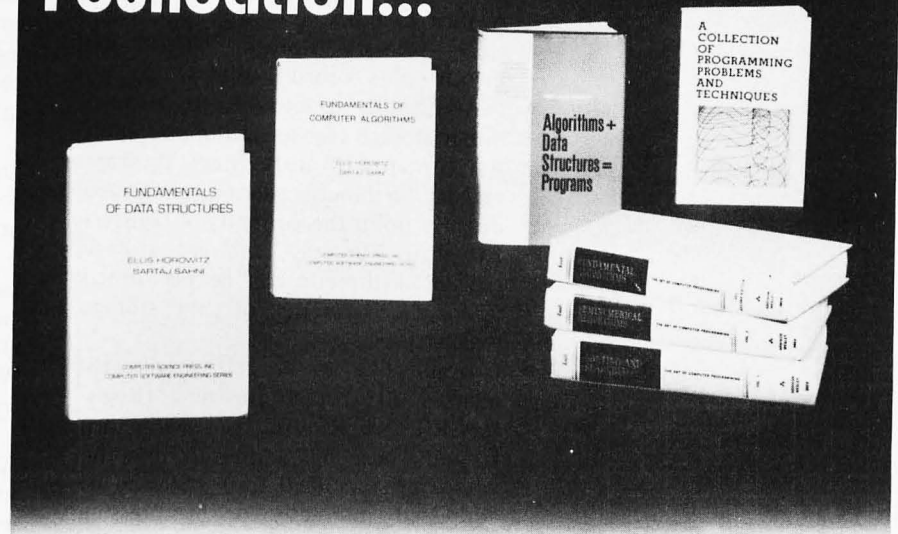
☐ **Volume I, Fundamental Algorithms**, Second Edition, begins with a thorough discussion of the mathematics used in computer programming, followed by a treatment of information structures, stacks, arrays, linked lists, dynamic storage allocation, and trees. 634 pp. \$22.50 hardcover.

☐ **Volume II, Seminumerical Algorithms**, Second Edition, is concerned with random numbers, statistical tests, random sequences, as well as arithmetic (floating point and multiple precision), polynomials, and rational arithmetic. 624 pp. \$22.50 hardcover.

☐ **Volume III**, deals with **Searching and Sorting**, as the name implies, the emphasis is on algorithms for sorting, including combinatorial properties of permutations, internal sorting, optimum sorting, and external sorting. Also included is a section on sequential searching, hashing, digital searching, and more. 722 pp. \$22.50 hardcover.

A hypothetical assembly language called MIX has been developed by the author to illustrate programming examples throughout the series. MIX is easily convertible to other assembly languages.

Building Your Programming Foundation...



ALGORITHMS + DATA STRUCTURES = PROGRAMS

by Niklaus Wirth

☐ "Programs, after all, are concrete formulations of abstract algorithms based on particular representations and structures of data". Niklaus Wirth here presents the fundamental concepts of algorithms and data structures and their interdependence. In his lucid treatment he covers fundamental data structures, sorting, recursive algorithms, dynamic information structures, language structures and compilers, using PASCAL in the examples and exercises. An important text. 366 pp. \$19.95 hardcover.

BITSTM

Books to erase the impossible

25 Route 101 West, PO Box 428, Peterborough, NH 03458

Name _____

Address _____

City _____

State _____ ZIP _____

Number of Books _____ \$ _____

Postage: \$.75 per Book
or \$ 1.00 outside U.S. \$ _____

Grand Total \$ _____

☐ Check Enclosed
☐ Credit Card

Expires _____



**DIAL YOUR BANK CARD ORDER
ON OUR TOLL-FREE HOT LINE:
1-800-258-5477**



Prices
subject to
change without notice
Dealer Inquiries Invited
You may photocopy this page

certainly allow the writing of complex programs. Yet, I would ask for the following additional features:

- I would like to be able to clear registers R0 thru R9 with one or two keystrokes, without clearing registers A thru E and I. (Pressing f CL REC clears primary storage registers R0 thru R9 plus A thru E and I.)
- I would like to be able to perform direct storage register arithmetic upon the contents of all registers. (Storage register arithmetic can be performed directly upon the contents of registers R0 thru R9 only. *Indirect* storage register arithmetic can be performed upon the contents of any storage register.)
- I would like to be able to directly address all storage registers. (Registers R0 thru R9 and registers A thru E and I can be addressed directly, while registers RS0 thru RS9 can be addressed indirectly or by pressing f P \geq S.)

Most Appreciated Features

Personally, I think the most powerful HP-67 functions are the five program editing and manipulation functions. These five functions are nonrecordable operations that assist you in altering and correcting your programs.

The SST (single step) function may be used while either programming or running a program. When SST is pressed (with the W/PRGM-RUN switch set to W/PRGM) the calculator moves to and displays the next step of program memory. This allows you to view each step of the program without execution. If SST is pressed while the W/PRGM-RUN switch is set to RUN, the calculator displays the next step of program memory, and, when you release the SST key, the calculator executes the instruction loaded in that step. This operation is especially useful when debugging a program.

Table 2: Some useful mathematical functions available on the HP-67 and HP-97 programmable calculators.

Function Name	Definition
P	Rectangular to polar coordinates conversion
R	Polar to rectangular coordinates conversion
LSTx	Recalls number displayed before the previous operation
R	Converts degrees to radians
D	Converts radians to degrees
DEG	Sets decimal degrees mode for trigonometric functions
RAD	Sets radians mode for trigonometric functions
GRD	Sets grads mode for trigonometric functions
H.MS	Converts decimal hours or degrees to hours, minutes and seconds, or degrees, minutes and seconds
H.MS+	Adds hours, minutes and seconds (or degrees, minutes and seconds) in the Y register to those in the X register

When the W/PRGM-RUN switch is set to W/PRGM, the h BST operation causes the calculator to move to and display the previous step of program memory. If the W/PRGM-RUN switch is set to RUN, pressing BST, after h has been pressed and released, causes the calculator to display the contents of the previous step of program memory. When BST is released, the original contents of the X register are displayed, the calculator having executed no instructions.

The GTO.nnn operation permits you to jump to any location in program memory for editing, additions or corrections to a program. When GTO. is pressed, followed by a three digit step number, the calculator transfers execution so that the next operation or instruction will begin at that step number (this happens whether the W/PRGM-RUN switch is set to W/PRGM or to RUN). No instructions are executed.

When the W/PRGM-RUN switch is set to W/PRGM, a press of h DEL will erase the instruction at the current step of program memory, and all subsequent instructions in program memory move upward one step. (Note: Any time an instruction is inserted between existing instructions in a program, all subsequent instructions in program memory move downward one step. Thus the HP-67 has a true insertion capability.)

Programming the HP-67

A program for the HP-67 is nothing more than a listing of the keystrokes necessary to perform the desired calculations manually, plus the labels to define the beginning and ending of the program, loops and subroutines. The listing may be prepared using a worksheet such as that shown in figure 1. The form shown is page 1 of a set of five with preprinted program steps from 1 thru 224.

When creating programs, remember that any solution that gives the correct outputs may be a suitable program. There is no *one* correct program for any problem. Emphasis, when programming, must only be placed on *time*. The *time* spent in programming must be compared to the *time* involved in running the program and the number of *times* the program will be used. It would be silly to spend days modifying a program with a running time of 30 minutes so that it could be run in 20 minutes if the program is to be used only two or three times.

In addition, programming is a personal art. Spend enough time creating your programs to satisfy your own artistic fastidiousness. Of course, you are limited to the available memory. However, the example to be discussed illustrates that very complex

BYTE March 1979 201

problems can be handled with 224 steps of program memory. Furthermore, don't forget that data may be stored on the magnetic cards, and this memory is limited only by the number of blank cards you purchase.

The guide (and probably every other publication which discusses programming) suggests that a flowchart be drawn for each program. A flowchart breaks down a program into small groups of instructions which can be handled more easily than the entire program. In addition, flowcharts can be used as documentation for the program. I cannot argue with this reasoning because it seems logical. I can only say that I personally find flowcharts worthless when they are drawn, and I can, within the limits of my capabilities, write a program while another pro-

grammer is fooling around with the flowchart.

I certainly do suggest, however, that you try the flowchart approach to programming, but don't be surprised if you find it easier to tackle the program directly. For documentation, I believe that comments with the program and the run instructions are more valuable than any flowchart, especially a year or two after the program is written.

While creating a program, a review of the "Function Key Index" every now and then will keep the full repertoire of the HP-67 fresh in your mind. This is important if you want to take advantage of the many mathematical, branching and looping functions available. Also, since there are usually many ways to accomplish a desired series of steps, spend a moment or two thinking of the various possibilities. For example, if a conditional test must be executed, would $g X=Y$, $f X=0$, $f DSZ$, $f ISZ$, $g DSZ(i)$ or $g ISZ(i)$ fit best in your program? Each of these functions are designed to be used in slightly different ways, yet all of them may be used to test for zero.

When $g X=Y$ and $f X=0$ are used, the calculator branches around the next instruction if the question asked by the conditional is not true; $f DSZ$ and $f ISZ$ decrement or increment the contents of the I register unless its contents are zero, and, if the number in the I register has become zero, program execution skips the next step just like a false conditional instruction; $g DSZ(i)$ and $g ISZ(i)$ decrement or increment the contents of the storage register addressed by the current number in the I register unless the contents of the addressed register are zero, and, if the number in the addressed register has become zero, one program step is skipped.

These functions, as well as the many other programming functions, are fully explained in the guide. Since it is not my desire to reprint the guide, I will not dwell upon these explanations. I would, however, like to mention two other types of choices that must often be made.

One of these choices is whether to branch forward or to branch backward. A backward branch, which is usually executed faster, becomes necessary when all labels have been used for other purposes. But any correction to the program after the backward branch has been added may necessitate a correction to the number stored in the I register. (It is the number stored in the I register which causes the jump.)

The other choice is whether or not a subroutine should be used to accomplish the functions performed by a group of keystrokes used more than once during program

PROGRAM TITLE:										PAGE		OF	
APPLICATION:													
PROGRAMMER:										DATE:			
REGISTERS													
0	1	2	3	4	5	6	7	8	9				
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9				
A		B		C		D		E		F		I	
LABELS													
A		B		C		D		E		0	FLAGS		TRIG
a		b		c		d		e		1	ON	OFF	DISP
0		1		2		3		4		2	DEG		FIX
5		6		7		8		9		3	GRA		SCI
											RAD		ENG
DEFINITIONS AND REMARKS													
NUM	PROGRAM CODES												
ADD	NUMERIC						SYMBOLIC						
001													
002													
003													
004													
005													
006													
007													
008													
009													
010													
011													
012													
013													
014													
015													
016													
017													
018													
019													
020													
021													
022													
023													
024													
025													
026													
027													
028													
029													
030													
031													
032													

CALCULATOR PROGRAM WORKSHEET

TREBOR ENGINEERING

Figure 1: An example of the author's calculator program sheet used to write a program for the HP-67 which solves up to nine equations in nine unknowns.



INTRODUCING G2 LEVEL III BASIC.

Now do more than ever before with the most powerful Basic you can buy for the TRS-80.

Open the manual and load the cassette. Then get ready to work with the most powerful Basic interpreter you've ever had your hands on...Level III Basic for Radio Shack Computers. It loads right on top of the Level II ROM, and in just 5K of space, opens up your capability to new dimensions. For starters, this new cassette-based interpreter gives you the whole catalog of disk programming power. Plus graphics commands. Plus powerful editing commands. Plus long error messages, hex and octal constants and conversions, user defined functions and a number of commands never before available on either cassette or disk interpreters!

Easier Loading, Fewer Keyboard Errors. G2 Level III Basic eliminates aggravations you've had, including keyboard "bounce" and those super-sensitive tape deck settings. Programs will load easier, and you'll have far less trouble with input errors.

Basic Access to RS-232. Until now, if you wanted to access your RS-232 interface, you had to work in assembly language. G2 Level III Basic does the work for you, letting you use your interface with Basic statements.

Have You Wished for More Power? This new interpreter gives you 10 machine language user calls for subroutines, long error messages, a new TIME\$ call for your real time accessory, plus measure or limit input timing that lets you put a time limit on responses when you're playing games or giving exams. And the list doesn't stop here.

Easier and More Powerful Graphics. This new Basic includes three simple commands that can eliminate dozens of program steps. PUT transfers information from a designated array to your screen; GET reverses the process. LINE makes your computer do the work when you input beginning and end points. Give it two diagonally opposite corner locations, and it'll outline the rectangle you're looking for.

Only Microsoft Could Do It. G2 Level III Basic was created by Microsoft, the same company that wrote Level II Basic for Radio Shack. And it actually uses Level II as a foundation for this enhanced add-on. By the time you've mastered all it can do, calling up the flexibility of the graphics commands, and even enjoying the convenience of renumbering, you'll wonder how it was all possible. It's like getting a whole new computer for your computer.

Available Now for Only \$49.95. You get the power that might otherwise cost you hundreds of dollars in additional equipment for only \$49.95. Price includes the User Manual, a Quick-Reference Card, and a preprogrammed cassette tape. Load the tape, open the manual, and get ready to work with the most powerful Basic Interpreter you've ever had your hands on. G2 Level III Basic for the TRS-80. Another member of the growing G2 Personal Computer Program Library.

For the name of the G2 dealer nearest you, call us toll-free at 800/538-8540 or 800/538-8541. In California, please call 800/672-8691.

**THE REASON
YOU BOUGHT
YOUR COMPUTER.**



A Product of GRT Corporation
Consumer Computer Group
1286 North Lawrence Station Road, Sunnyvale, California 94086, 408/734-2910

execution. Because of the run time needed to search for the subroutine and the discontinuity in the program which results, I recommend not using subroutines unless it is absolutely necessary to save space in memory to accommodate a program which would otherwise have more than 224 steps.

I have seen commercial programs so riddled with subroutines that the programs had to be completely rewritten at enormous expense after the programmers were replaced. Of course, you would not want to punish yourself this way. When you own the calculator, you don't pay for computer time or memory. It costs you the same to run a 224 step program as it does a five step program.

As I have stated above, the guide covers all programming operations thoroughly. There is one operation I found difficult to implement. I am referring to the g MERGE function, but now that I have performed the function successfully, I can't imagine the cause of the difficulty I experienced.

The g MERGE function allows data or programs from magnetic cards to be merged with data or programs in the calculator. When a program from a card is merged with one in the calculator, steps 000 thru nnn of

the original program are preserved. This function permits you to add to or alter a program that is already loaded in the calculator.

In fact it is possible to include the g MERGE instruction immediately preceding the h PAUSE instruction in a program and to load a program or data from a magnetic card into the calculator while a program is running. Not mentioned in the guide is the fact that when a program is loaded during a pause in a running program an h RTN immediately following the h PAUSE will be overwritten by the first step of the merging program and execution of the new program will begin immediately after it is loaded.

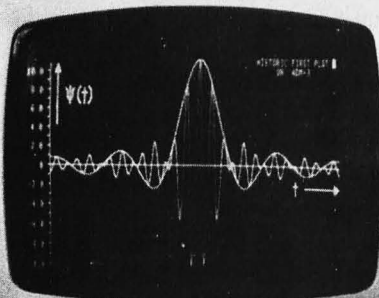
Card Reader Operations

One of the primary reasons the HP-67 is such a versatile calculator is its ability to store information on magnetic cards and to retrieve this information at a later time. Therefore, I would like to stress the following points concerning this operation:

- When storing the contents of the registers on a data card, always pass side 1 of the card through the card reader first, then side 2, if necessary. This insures that any nonzero data in the secondary registers will always be stored on side 2 of the card.
- When it is necessary to restore data from only one side of a magnetic card into the calculator, pass the side of the card which contains the data through the card reader. Then, when crd is displayed, press CLX.
- Accidents may occur that will destroy the program or data on a card, therefore, if the information to be stored is important or extensive, do yourself a favor and store it on two cards.
- Identify the information on your magnetic cards with a #2 pencil. When necessary, the cards can be easily erased.
- When inserting the leading edge of a card to be read into the card reader automatically during a pause, remember that the program must actually be running when you insert the leading edge. Be sure to insert the tip of the card far enough into the card reader. ■

Next month's concluding installment of this article features an example program showing how the HP-67 can be used to solve simultaneous network equations for an electrical network.

Retro-Graphics™



For your Dumb Terminal. The Retro-Graphics PC card mounts easily in the Lear Siegler ADM-3A to provide you with an affordable graphics computer terminal.

Features:

- Z-80 Based
- 512 by 250 Dot Matrix
- Simple Plug-in Interconnect
- Point Plotting
- Automatic Vector Generation
- Optional TEKTRONIX Software Compatibility

You will be impressed with the packaging, performance and price of the Retro-Graphics card. Write or phone today for complete specifications.

DIGITAL ENGINEERING, INC.

1787 Tribute Road, Suite K
Sacramento, CA 95815
(916) 920-5600

First Time Offer for the Micro Market



MODEL 501

DATA-SCREEN® TERMINAL

A NEW LOW COST, MICROPROCESSOR CONTROLLED CRT TERMINAL

**QUALITY — APPEARANCE
ECONOMY**

ONLY \$995.⁰⁰ (QTY 1)

DELIVERED CONT. USA

**90 DAY WARRANTY GUARANTEES YOU
YOUR EQUIPMENT WORKS PROPERLY**

1 YEAR EXTENDED WARRANTY
AT SPECIAL RATES

Go First Class

✓ Our Specifications Before You Buy

DISPLAY

SCREEN CAPACITY, CHARACTERS	2000
CHARACTERS PER LINE	80
NUMBER OF LINES	25
SCREEN	P4 phosphor (white)
TUBE SIZE(DIAGONAL)	12 inches (30.4 cm)
VIEWING AREA	54 square inches (137.1 cm)
CHARACTER SIZE	0.20" high x .08" wide (5.08 mm high x 2.03 mm wide)
REFRESH RATE	60 Hz (50 Hz available)
SCAN METHOD	Raster
CHARACTER GENERATION	5 x 7 character in an 8 x 10 dot matrix
CURSOR	Blinking block

MEMORY

TYPE	Random Access Memory
CAPACITY	2000 characters

OPERATOR CONTROLS

POWER ON/OFF SWITCH On rear of unit
BRIGHTNESS CONTROL On rear of unit

POWER REQUIREMENTS

Model 501 – 115 volts, 60 Hz, 100 watts nominal
Model 502 – 230 volts, 50 Hz, 100 watts nominal

SPECIFICATIONS

INTERFACE

DATA FORMAT

DATA BITS	7 serial, asynchronous
DATA BIT 8	1, 0 or deleted
PARITY	Odd, even or deleted with error displayed as DLE
STOP BITS	1 or 2
DATA TRANSFER RATE	50, 75, 110, 134.5, 150, 300, 600, 1200, 1800, 2000, 2400, 3600, 4800, 7200, 9600 BAUD

STANDARD FEATURES

INVERSE VIDEO	Operator or software selectable
TRANSMIT MODES	Half or full duplex (switch selectable)
DATA ENTRY	Top or bottom line
END OF LINE BELL	Switch selectable
CURSOR POSITIONING	X—Y
CURSOR ADDRESS	Load and read
DISPLAYABLE CHARACTERS	126 (including space)
CURSOR CONTROLS	Up, down, left, right, home, return
AUTOMATIC ROLL—UP	Switch selectable
AUTO CARRIAGE RETURN AND LINE FEED	Switch selectable
MONITOR MODE	Special "Monitor" Mode allows display of control codes (first two columns) of ASCII Code Chart).

NATIONAL DISTRIBUTOR FOR

DEALER NETWORK IS NOW BEING SET UP – YOUR
INQUIRY IS INVITED



**OLDEST INDEPENDENT
COMMERCIAL CRT TERMINAL
MANUFACTURER**

3S SALES, INC.

P.O. Box 45944

Tulsa, OK 74145

918 - 622-1058

CPAids

microcomputer software
for professionals

The people who brought you the
revolutionary tax software — now offer their

GENERAL LEDGER PACKAGE

- Over one year in development and use in a CPA's practice
- Screen formatted with cursor positioning for efficient input and editing
- Transaction history file maintained
- Comparative financial statements
- User defined output format
- Interactive with tax software and payroll programs

Runs on North Star Basic and CP/M. Requires 6 K Free Memory, Dual Disk.

For Free Brochure Describing All of Our programs, write:

CPAids

1640 Franklin Avenue Kent, Ohio 44240
216-678-9015

A Division of Computer Tax Service Inc.



Titus Purdin
5901 JFK #101

N Little Rock AR 72116

Computer Assisted

Flight Planning

The production of flight plans is a task that lends itself well to computer solution. It is a time-consuming and repetitious job involving numeric manipulation and output formatting, just the sort of thing that computers do accurately and quickly. The drawback has been, of course, that computer facilities have not been made available to pilots in a way that allows timely production of flight plans. To be useful, flight plans must reflect accurate route and weather data, and so cannot be produced too far in advance. The solution, of course, is that the increased availability of computing facilities made possible by the microprocessor makes automated flight planning practical even for private pilots.

The heart of any flight planning system consists of three calculations. Indeed, anything else the system may provide is really the option of the system's designer. The first necessity is a true air speed calculation. Without going into too much detail, airplanes fly with "indicated" air speeds, but flight plans need "true" air speeds for their calculations. The formula used in my program is:

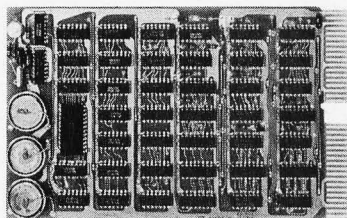
$$\begin{aligned} \text{true air speed} = & \text{indicated air speed} \\ & \times [.971 + \text{temp} \times (.017 + \text{INT} \\ & (\text{altitude} / 50.1) \times .002) / 10] \\ & + \text{altitude} / 10 \times (.02 + \text{INT} \\ & (\text{altitude} / 50.1 \times .00035))]. \end{aligned}$$

This formula provides accuracy within 1 knot up to altitudes of 15,000 feet. The error is somewhat greater than that above 15,000 feet, but might be considered acceptable up to 20,000 feet. For private sector flying this formula should provide excellent accuracy and reasonable simplicity. Another simpler formula is usable up to altitudes of 8,000 feet:

$$\text{true air speed} = \text{indicated air speed} \times (\text{temp} \times .002 + \text{altitude} / 10 \times .018 + .971).$$

There are formulae which purport to give absolute accuracy at all altitudes, but those that I am familiar with are extremely cumbersome and time-consuming.

LSI-11 TIME



It's **TIME** you brought your LSI-11 up to **DATE**. **TIME** and **DATE**, two important parameters in the computer world, are available to your LSI-11 on one **DUAL SIZE BOARD**. When requested, the TCU-50D will present you with the date (month and day), time (hour and minutes), and seconds. Turn your computer off and forget about the time — your battery supported TCU-50D won't, not for 3 months anyway. The correct date and time will be there when you power up.

The TCU-50D is shipped preset to your local time, but can be set to any time you want by a simple software routine.

AT \$295

YOU CAN'T AFFORD TO IGNORE TIME

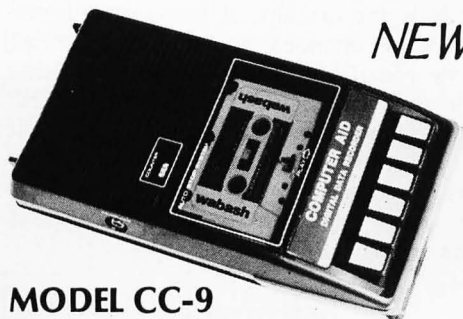
Time is only one way we can help you upgrade your LSI-11 or PDP-11 system. We'd also like to tell you about the others. So contact Digital Pathways if you're into -11's. **We are too.**



DIGITAL PATHWAYS INC.

4151 Middlefield Road • Palo Alto,
California 94306 • Telephone (415) 493-5544

The LATEST in Tape Systems



NEW!

9600 BAUD CASSETTE RECORDER

An ASYNCHRONOUS NRZ type Recorder with remote motor start/stop. Error rate 10^8 at 4800 BAUD. Can be used from 110 to 9600 BAUD into a UART — no clocking required. This is not an audio recorder. It takes RS232 or TTL signals from the terminal or computer and gives back the same signals. No audio interface is used. Motor start/stop is manual or through TTL or RS232 signals.

Tape speeds are 1.6" / 3.0" and 6.0" per second. 110 volt, 60 Hz, 5 watts. (220 Volts on special order). Can use high quality audio cassettes (Philips Type) or certified data cassettes.

Recommended for DATA LOGGING, WORD PROCESSING, COMPUTER PROGRAM RELOADING and DATA STORAGE. Manual control except for motor start/stop. 6800, 8080 or Z80 software for file or record searching available on request with order. Used by major computer manufacturers, Bell Telephone and U.S. Government for program reloading and field servicing.

MODEL CC-9

\$200.00 (4800 Baud)

\$220.00 (9600 Baud and 220V/50 Hz)

AVAILABILITY — Off the shelf.

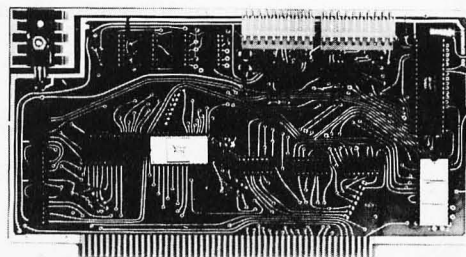
PROVIDES MONITOR AND TAPE SOFTWARE in ROM. TERMINAL and TAPE PORTS on SAME BOARD. CONTROLS ONE or TWO TAPE UNITS (CC-8 or 3M3B).

This is a complete 8080, 8085, or Z80 system controller. It provides the terminal I/O (RS232, 20 mA or TTL) and the data cartridge I/O, plus the motor controlling parallel I/O latches. Two kilobytes of on board ROM provide turn on and go control of your Altair or IMSAI. NO MORE BOOTSTRAPPING. Loads and Dumps memory in hex on the terminal, formats tape cartridge files, has word processing and paper tape routines. Best of all, it has the search routines to locate files and records by means of six, five, and four letter strings. Just type in the file name and the recorder and software do the rest. Can be used in the BiSync (IBM), BiPhase (Phase encoded) or NRZ modes with suitable recorders, interfaces and software.

This is Revision 8 of this controller. This version features 2708 type EPROM's so that you can write your own software or relocate it as desired. One 2708 preprogrammed is supplied with the board. A socket is available for the second ROM allowing up to a full 2K of monitor programs.

Fits all S100 bus computers using 8080 or Z80 MPU's. Requires 2 MHz clock from bus. Cannot be used with audio cassettes without an interface. Cassette or cartridge inputs are TTL or RS232 level.

AVAILABILITY — Off the shelf.



2SIO (R) CONTROLLER \$190.00, Tested & Assmb.

NEW!

→ DOUBLE DENSITY FLOPPY DISK CONTROLLER

A new floppy controller for 5" and 8" drives utilizing the new 1791 chip to provide single or double density recording. Flip the switch to use one or the other mode. Can load memory from single density and re-record it double density on the same drive so you can transfer or re-record your programs and files. Comes with new format program for double density on disk to replace your old single density format program. (Soft Sector IBM format). \$320. Assembled and tested.

SHIPPING STARTED OCTOBER '78.

NEW!

→ PEGASUS DOUBLE DISK ENCLOSURE and POWER SUPPLY

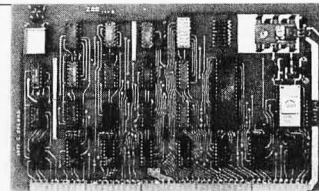
Holds one or two drives, has two drive power supply. 110 or 220V. Comes empty or filled with Shugart drives. Variations preclude listing prices. Call or write for full details.

SHIPPING STARTED OCTOBER '78.

Z 80 BOARD for SWTP COMPUTER

Now you can use the 8080/Z80 software programs in your SWTP 6800 machine. Replaces your MPU board with a Z80 and ROM so that you are up and running with your present SWTP memory and MPS card. 1 K ROM on board replaces MIKBUG and enables you to use XITAN Z80 software which we can supply.

AVAILABILITY — Off the shelf.



\$190.00, Tested & Assmb.

For U.P.S. delivery, add \$3.00. Overseas and air shipments charges collect, N.J. Residents add 5% Sales Tax. WRITE or CALL for further information. Phone Orders on Master Charge and BankAmericard accepted.

National Multiplex Corporation

3474 Rand Avenue, South Plainfield NJ 07080 Box 288 Phone (201) 561-3600 TWX 710-997-9530

If you need Business Reports with fancy frills you have the wrong company. We don't put these in our Software or our Ads. Both cost ***** You *** Money.**

But if you need solid, Down-To-Earth Software for your North Star, Imsai, or other low cost Data Processing System written in Microsoft Basic or Cbasic including GL, AR, AP, Inventory, Payroll, Mailing List and Fixed Asset Accounting then you ***** Do ***** have the right company.

GIVE US A TRY — WE KNOW YOU'LL BE GLAD YOU DID

We honor **Visa** and **Mastercharge**

Aaron Associates

102 Avenida Dela Estrella
Suite 208
San Clemente, CA 92672
(714) 492-7633

CATCH THE S-100 INC. BUS!



	LIST PRICE	OUR SPECIAL CASH PRICE
S.D. Systems Floppy Disk Interface Kit	159.00	135.00
Imsai S102-1 Serial Port Interface Kit	125.00	106.00
Imsai M10 Multiple I/O Interface Kit	195.00	166.00
ECT 10 Slot Main Frame Kit	325.00	277.00
Godbout 24K Memory Unkit	445.00	380.00
SSM 104 2P + 2SI/O Kit	149.95	128.00
North Star Horizon I Dual Density Kit	1599.00	1339.00

Call for Our Prices on:
Cromemco, IMSAI, Vector Graphic,
North Star, Sanyo, Hazeltine, IMC
Plus Most Other Major Lines.

Subject to Available Quantities. • Prices Quoted Include Cash Discounts.
Shipping & Insurance Extra.

Bus. . . **S-100, inc.**
Address. . . **7 White Place**
Clark, N.J. 07066
Interface. . . **201-382-1318**

The second necessary calculation is drift. Drift is the measure of how many degrees off your intended course the wind will blow you if you let it. My program uses a one pass wind solution that gives the drift and ground speed after going through the formula just once. This particular solution has the disadvantage of requiring the use of an inverse sine (\sin^{-1}) in the calculation. The one pass drift formula is:

$$\text{drift} = \sin^{-1} \left[\frac{\text{wind velocity} \times \sin(\text{course} - \text{wind direction} - 180)}{\text{true air speed}} \right]$$

It is possible to substitute an inverse tangent calculation for the inverse sine. This substitution is:

$$\sin^{-1}(Y) = \tan^{-1}(Y/\text{SQRT}(1 - Y^2)).$$

The one pass ground speed formula is the third of the three necessary calculations. This formula will not work for direct head winds or tail winds. These conditions must be handled separately. In this program, I detected these situations prior to the drift calculation to save the extra step. The one pass ground speed formula is:

$$\text{ground speed} = \frac{\sin(180 - \text{course} + (\text{wind direction} + 180) - \text{drift}) \times \text{true air speed}}{\sin(\text{course} - (\text{wind direction} + 180))}$$

The special cases of direct head or tail winds are easy to handle. In either case the drift is 0. For head winds ($\text{course} - \text{wind direction} = 0$), the ground speed will be equal to true air speed minus wind velocity. For tail winds, ground speed will be equal to true air speed plus wind velocity.

An alternative to the one pass system is a *two pass* system. In this case the course is applied to the formula initially to obtain an estimate of the drift. This in turn is applied to the course to get a heading. The heading is then used in the formula to obtain the actual drift and ground speed. This routine is equally accurate and has the advantage that it requires no functions more sophisticated than sine and cosine. In an extreme case the sine and cosine functions could be obtained by reading a table.

As I said earlier, any output beyond these three basic pieces of information is at the discretion of the system's designer. I use a similar system to produce flight plans for low altitude and high-speed routes, which I fly as a C-130 instructor navigator. That system uses fixed route data stored on disk and produces precise ETAs (estimated times of arrival) and includes a lot of ancillary output information concerning altitudes,

APPLE II - TRS 80 - PET

& MANY OTHER PROGRAMS
ON CASSETTE & DISK
FOR SALE

WE PROMOTE, ADVERTISE AND SELL SOFTWARE FOR FREE LANCE COMPUTER SPECIALISTS ALL OVER THE FREE WORLD.

OUR PUBLIC DOMAIN SOFTWARE MAY BE REPRODUCED OR SOLD AT YOUR DISCRETION

SOME SAMPLES

AIRCRAFT INSTRUMENT TRAINING SIMULATOR
FOR APPLE II. YOUR APPLE TEACHES BASIC
INSTRUMENT FLYING (CASSETTE OR DISK) . \$19.95

PUBLIC DOMAIN PACKAGE INCLUDES OVER 100
PROGRAMS FOR APPLE II. CONTENTS CHANGE
EACH QUARTER. BEST AVAILABLE \$49.95

TRS 80 PUBLIC DOMAIN PACKAGE OF
25 PROGRAMS. \$29.95

GET A WHOLE YEAR'S MEMBERSHIP &
SUBSCRIPTION TO OUR CATALOG.
WE'LL SELL YOUR PROGRAMS, TOO! \$5.00

SAMPLE COPY OF PUBLICATION \$1.00

Programmers Software Exchange
2110 North 2nd Street
Cabot, Arkansas 72023

C/PM® SOFTWARE TOOLS

ED-80 TEXT EDITOR

THE PROGRAMMER'S MOST IMPORTANT SOFTWARE TOOL
— WHY NOT MAKE IT YOUR BEST?

ED-80 encompasses the features found on large mainframe and minicomputer editors, such as the IBM 370, CDC 170, UNIVAC 1100, and the DEC PDP-11 series computers, plus additional features designed for floppy disk based operating systems. It is a context editor which is compatible with C/PM and its derivatives, including IMDOS, DOS-A, CDOS, etc.

Over 50 commands are provided, including forward or backward LOCATE, CHANGE, and FIND commands; INSERT, DELETE, REPLACE, APPEND, PRINT, LIST, MACRO, upper and lower CASE, SCALE, TABSET, and WINDOW commands; and GET and PUT commands for repositioning, duplicating, concatenating, and managing text files and libraries. Sophisticated search and change techniques are provided for managing BASIC, FORTRAN, COBOL, PL/I, ALGOL, APL, PASCAL, ASSEMBLER, TEXT FORMATTED, and other file types.

The WINDOW command allows instantaneous full screen displays of both the current and surrounding lines for further editing, and provides for forward and backward scrolling in the full screen mode. Designed for today's high speed CRT's and video monitors, the WINDOW command separates ED-80 from all other available editors, and is not hardware dependent.

Up to three MACRO commands may be defined for iterative execution of concatenated editor commands. Once defined, they may be subsequently executed, or recalled for observation. A MACRO may also be defined and executed in a single operation.

Configurable parameters for tailoring the editor to the user's keyboard and environment are provided through the use of the C/PM Dynamic Debus Tool (DDT). The WINDOW, WINDOW NEXT, WINDOW PREVIOUS, NEXT LINE, and PREVIOUS LINE commands fall in this category. These commands are considered so important to text editing that only one key has to be depressed to cause any one of them to execute.

A CURRENT LINE NUMBER is internally maintained by the editor for displaying when prompting for input and with certain other commands. Line numbers are dynamically adjusted as the result of line inserts and deletes, and may be used for positioning within the file. They are not stored or associated with the text in any manner.

ED-80 is thoroughly documented with a User's Manual of over 35 pages describing each command and feature, and includes numerous examples. It is 9.5K bytes in size, and a minimum C/PM operating system of 20K is recommended. A User's Manual and standard size single density diskette are \$69.00. A User's Manual is \$7.50, refundable with purchase. COD and money orders shipped next day. COD orders require 10% deposit. Personal checks must clear before shipment. Include \$2.00 shipping/handling per order.

SOFTWARE DEVELOPMENT AND TRAINING, INC.
P.O. Box 4511 — Huntsville, Alabama 35802
C/PM® is a trademark of Digital Research

ANNOUNCING

PILOT

THE EDUCATIONAL LANGUAGE
NOW READY FOR YOUR TRS-80

THIS VERSION FEATURES A BUILT IN EDITOR (THE ONLY ONE WITH ONE ON THE MARKET THAT WE KNOW OF) AND COMES WITH THREE SAMPLE PROGRAMS.

THIS IS A PROGRAMMING LANGUAGE SO SIMPLE A YOUNG CHILD CAN USE IT.

ALONG WITH YOUR ORDER YOU WILL RECEIVE THE LATEST LIST OF PILOT PROGRAM PACKAGES, WHICH SELL FOR \$7.95 EA.

AND—YOU WILL BECOME A MEMBER OF THE PILOT USERS GROUP, WITH A NEWSLETTER SENT TO YOU FREE FOR THE NEXT YEAR!

ORDER NOW!!

TAPE \$14.95

DISK \$24.95

(OTHER VERSIONS WILL BE AVAILABLE SOON)

MAD HATTER SOFTWARE

900E SALEM ROAD • DRACUT, MA 01826

• PHONE: (617) 682-8131



NO FRILLS! NO GIMMICKS! JUST GREAT DISCOUNTS MAIL ORDER ONLY

HAZELTINE

1400 \$ 650.00
1500 995.00
Mod 1 1495.00

CENTRONICS

779 985.00
779 tractor 1040.00
700 tractor 1185.00
761 KSR tractor 1595.00
703 tractor 2195.00

NORTHSTAR

Horizon I assembled . . 1629.00
kit 1339.00
Horizon II assembled . . 1999.00
kit 1599.00
Disk System 589.00

TELETYPE

Mod 43 1095.00

IMS

16K Static Memory . . . 459.95

DIGITAL SYSTEMS

Computer \$4345.00
Double Density
Dual Drive 2433.00

IMSAI

VDP 80/1000 \$5895.00
VDP 40 3795.00
VDP 42 3895.00
VDP 44 4195.00
16K Memory assem. . . . 399.00
PCS 80/15 679.00

15% off on all other IMSAI products

CROMEMCO

System III \$1000 off . . 4990.00

10% off on all other Cromemco products

TEXAS INSTRUMENT

810 Printer 1625.00

ADDS

Regent 100 1095.00

Most items in stock for immediate delivery. Factory-fresh, sealed cartons.

DATA DISCOUNT CENTER

135-53 Northern Blvd., Flushing, New York 11354, 212/465-6609

N.Y.S. residents add appropriate Sales Tax. Shipping FOB N.Y.
BankAmericard, Master Charge add 3%. COD orders require 25% deposit.



And here's three more reasons why . . .

SARGON: A Computer Chess Program (Spracklen) offers the chess program that won first prize at the 1978 West Coast Computer Faire Chess Tournament! In book form (#5155-7, \$14.95) or on computer program tapes (#00603, TRS-80 Level II, \$19.95; #00604, Apple II, \$19.95).

BASIC MICROPROCESSORS AND THE 6800 (Bishop) gives you two books in one: a basic guide to microprocessors for the beginner, and a complete description of the M6800 system for the engineer. (#0758-2, \$11.95).

SIXTY CHALLENGING PROBLEMS WITH BASIC SOLUTIONS (Spencer) will sharpen your programming skills through games, puzzles, science problems, business problems, and mathematical recreations.

These three books add luster to Hayden's reputation as being #1 in personal computing books! Check them out at your local computer store!

Hayden Book Company, Inc.
50 Essex Street,
Rochelle Park, NJ 07662



high obstructions along each leg, and detailed descriptions of each turn point.

This program, however, is intended to fit the most general case; readers can tailor it to their own needs more easily if what they start with is not too cluttered. The program accepts basic header data and then information concerning each leg of the

Listing 1: Sample program of the flight program. The typical output from the program is also shown.

DATE (YY,MM,DD): 78,06,20

THIS FLIGHT PLAN GOES FROM: LITTLE ROCK
TO: NEW ORLEANS

PILOT'S NAME: TITUS PURDIN

ACFT TYPE:

PROPOSED TAKE-OFF TIME: 1200

LEG # 1

THIS LEG GOES FROM LITTLE ROCK TO [MEMPHIS]
[]

MAG COURSE: 072

LEG DIST: 111

ALTITUDE (X100): 50

TEMP AT ALT (C): 22

IND AIR SPEED: 120

WIND (DDD,VV): 210,15

DO YOU HAVE ANOTHER LEG TO ENTER? YES

LEG # 2

THIS LEG GOES FROM MEMPHIS TO [GRNWOOD]
[]

MAG COURSE: 186

LEG DIST: 97

ALTITUDE (X100): 50

TEMP AT ALT (C): 22

IND AIR SPEED: 120

WIND (DDD,VV): 230,10

DO YOU HAVE ANOTHER LEG TO ENTER? YES

LEG # 3

THIS LEG GOES FROM GRNWOOD TO [JACKSON]
[]

MAG COURSE: 177

LEG DIST: 50

ALTITUDE (X100): 50

TEMP AT ALT (C): 22

IND AIR SPEED: 120

WIND (DDD,VV): 230,10

DO YOU HAVE ANOTHER LEG TO ENTER? YES

LEG # 4

THIS LEG GOES FROM JACKSON TO [MCCOMB]
[]

MAG COURSE: 177

LEG DIST: 79

ALTITUDE (X100): 50

TEMP AT ALT (C): 22

IND AIR SPEED: 120

WIND (DDD,VV): 230,10

route. It allows 25 individual legs, and prints a formatted flight plan of fairly simple design.

The program is based on magnetic information (magnetic courses and magnetic winds). This is simple and direct because

the end product is supposed to be a magnetic (compass) heading. A more formal solution can be made based on true information (true courses and true winds) by applying magnetic variation. A typical program run is shown in listing 1.■

The Nybbles Library is an inexpensive means for BYTE readers to share some interesting but specialized forms of software. These programs are written by readers with small computers and printer facilities, and are therefore designed for particular systems. The algorithms and programming techniques in these programs can be directly used by readers with similar equipment, or can serve as an inspiration for improvisation on computers of different characteristics.

Potential authors of such programs should send us a self-addressed stamped envelope, with a request for a copy of our "Guidelines for Nybbles Authors." Payment

for Nybbles items is based on sales and length of the item. Rates are set at the time of acceptance.

Nybbles Library programs are sent in listing form, printed on 8.5 by 11 inch paper on both sides. The Nybbles Library programs are 3 hole punched for collection in loose leaf binders, and come in an attractive folder which serves as a cover.

This month the "Computer Assisted Flight Planning" (document #104) has been added to the Nybbles Library. Use the coupon below to order your personal copy, at \$1.25 (US and Canada), \$1.85 (foreign air-mail) postpaid.

Please send _____ copies of BYTE Nybble # _____ at \$ _____ postpaid.

Please remit in US funds only.

_____ Check Enclosed

Bill my BAC # _____ Exp Date _____

Bill my MC # _____ Exp Date _____

Name _____

Street _____

City _____ State _____ Zip Code _____



BYTE Nybbles Library, 70 Main St, Peterborough NH 03458

You may photocopy this page if you wish to keep your BYTE intact.

NEW TRS-80

CASH	CHARGE	PAID OUT	
FOOD	BEVERAGE	TAX	TOTAL
17.00	3.50	.92	21.42
AMT. TENDERED			30.00
CUSTOMER CHANGE			8.56

PET

MIKE 2500				PAT 1600			
1	2	3	4	1	2	3	4
1	2	6	9	2	0	1	2
2	1	6	9	0	2	1	2
1	2	3	8	3	0	7	2
1	2	3	0	3	0	7	8
1	2	3	4	4	7	9	0
				UNCLE			

APPLE

A									
B									
C									
D									
E									
F									
G									
H									
I									
J									

STACI [10]

BABE [8]

HELEN [7]

ERIN [8]

BULLS•HITS™... Hitch up your horse sense, wind up your wits, load the Computer and get ready to play **BULLS•HITS™**. A **NEW** game of logic and luck developed by Michael O'Toole. It means spellbinding, sophisticated, stimulating fun for the entire family. One, two players or partners will be at odds trying to beat each other or the Computer. Score—that's the object—SCORE, and the higher the better. Completely interactive... ENJOY... Only \$14.95

BLACK•STARS™... If you enjoyed Microchess you'll love **BLACK•STARS™**, another **NEW** strategy game by Michael O'Toole. The action is fast and furious. Two, three, four or more players utilize the strategic locations of the **BLACK•STARS™**, to capture and recapture areas on the space grid. Every game different. SURE TO BE A CLASSIC... Only \$14.95

INSTANT•CASH•REGISTER™... For the TRS-80 Level I and II, Pet and Apple soon. Register Sales, Paid Outs, Charge, Cash, Tax, Amt. Tendered, Customer Change, Daily Read Out on Totals, and more. Easily Customized Cash Register by day, game player at night?... Only \$19.95

ORDERS: SEND CHECK OR MONEY ORDER TO:

the COMPUTER BUS™

P.O. BOX 397D GRAND RIVER, OHIO 44045

At last... the mechanical interface!

Turn your electric typewriter into a low cost,
high quality hard copy printer.



The all new
I/O Pak from
Rochester Data,
Inc. interfaces the keyboard
of any commercially available
electric typewriter with any
computer. The result: low cost, high
quality hard copy.

User list

\$395⁰⁰

Write today for more information.

ROCHESTER DATA
Incorporated

3100 Monroe Avenue, Rochester, New York 14618

ONLY PROGRAMMERS SHOULD BE ALLOWED TO MANAGE FILES!

Isn't that ridiculous? They're your files, your information and your needs. Take control of them now with

FMS-80

available separately (for only \$95.00)—FMS-80, the only fully integrated microcomputer File Management System. From initial file definition through selective report generation, FMS-80 takes you every step of the way *interactively*.

Written entirely in assembly language, FMS-80 is both efficient, fast and will run under any CP/M-based program (IMDOS, CDOS, etc).

Also ask about REMOTE-80 Intelligent Terminal Software; SCREEN DESIGNER—interactively create and utilize video forms; and MLU—the complete Mailing List Utility.

DEALERS: Liberal discounts and painless evaluation packages available. Contact us on your letterhead for additional information.

COMPUTERS PLUS, INC.
678 S. Pickett St.
Alexandria, VA 22304. (703) 751-5656

The plus makes the difference.

Continued from page 6

paste, until the document is finished or the author is exhausted. To me, that is inefficiency! Of course, many computer text editors are not well suited to creative composition, being little more than teletypewriter editors. Even with many display editors one still has to resort to hard copy for effective editing. That is the nub of our problem: most display editors are line oriented and run on "glass teletypewriters." The latter were derived from hard copy terminals, which were in turn derivatives of keypunches—certainly an old way of thinking about text production. If the display media are truly utilized, however, a quantum improvement in editing facilities can result: information can be presented as in a "video book," complete with rapid random access paging and on screen cutting and pasting.

Given such a tool, creative composition becomes a joy. Freedom of expression is improved; the ideas flow freely from mind to screen. A phenomenon of egoless composition results; the author does not have to measure the content of a passage against the agony involved in its creation. As a result, the author is more willing to modify and polish the document, even experimenting with major revisions in order to present the topic in its best light. What is truly exciting is that the technology for such editing systems is now of modest cost; one need only break with the past ways of thinking about editors.

What does this have to do with our subject? There is a strong analogy between the editing task and the programming task. We must examine the programming task the same way we looked at editors. Alas, most of us still program on "virtual keypunches." We may even use one of these excellent display editors to create our card deck, but we create a linear string of characters and throw the completed program at a compiler; given that there are no syntax errors, we try to run the program, probably debugging with dumps, print statements, or debuggers which give us information in terms of the compiled code. If an error is found, we return to the editor to modify the source, recompile, and try again. Given these conditions, sloppy work habits are inevitable. In fact, the *conditions* are sloppy.

Editing Programs

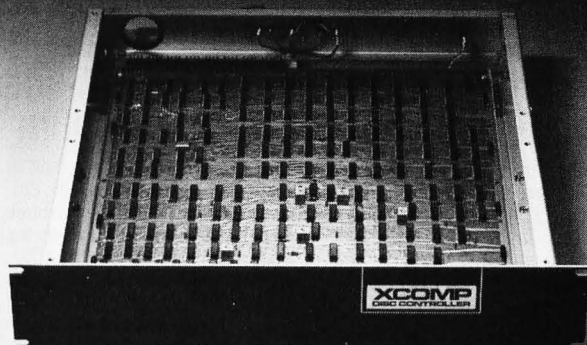
Now we are at a critical point in programming: do we build a better "programming keypunch," or do we look for a programmer's tool analogous to the display editor? I would opt for the latter, and would

claim that the paradigm of LISP programming is the appropriate model from which we should begin.

First, let's examine the conservative "key-punch" approach. The traditional edit-compile-debug cycle is improved by a display editor, operating with a compiler that can return the user to the editor upon indication of a syntax error, pointing at the source statement that caused the error. A quick edit, and the syntax check cycle begins again. However, once the program is compiled, we are still at the mercy of primitive debugging techniques. One solution is to require that the user specify more information about the program, indicating expected behavior of program modules with the assumption that the compiling phase can be made more knowledgeable, and check the consistency of the expectations against the realities present in the user's encoded algorithms. This reassures us that the code which gets to the debug portion of the cycle does operate as expected. In general these user expectations are difficult to express, and checking their consistency is even more problematic. Syntactic consistency checks based on simple properties of the programmer's variables can be checked in a reasonably straightforward manner. Such properties are called

HARD DISC FOR S100 MICROS

The XCOMP DCF-10 Disc Controller provides the OEM with a high performance, low cost interface for fixed and removable (2315 or 5440) cartridge disc drives. The DCF-10 is currently supported by two operating systems. For information or manuals, contact XCOMP.



XCOMP
INCORPORATED

9915-A Businesspark Ave., San Diego, CA 92131 • (714) 271-8730

BYTE IS COMPLETELY INDEXED!

Relax...you no longer have to do a sequential search to order reprint articles. In addition to the 1975-1976 index, the 1977 and 1978 indices are now available.

To receive your BYTE INDEX/REPRINT CATALOG(S) send 50¢ for postage and handling to BYTE INDEX, 70 MAIN STREET, PETERBOROUGH NH 03458.

An order form is included in the index package for convenient ordering of reprint articles. Just fill it in, enclose payment and return it to BYTE.

A FEW OF THE BEST

1977

Making Hash with Tables	T Dollhoff
An Inexpensive Joystick Interface	T Buschbach
Newt: A Mobile Cognitive Robot	R Hollis
How to Pick Up a Dropped Bit	D Maurer
An APL Interpreter for Microcomputers	M Wimble
Control the World	S Ciarcia
How to Implement Space War	D Kruglinski
Kompuatar	D Brader
Building a Computer from Scratch	H Jones
The Computers of Star Trek	K Schmucker
The Digital Cassette Subsystem	Rampil & Breimier
Give Your Micro a Megabyte	R Grappel
Structured Program Design	D Higgins
Floating Point Arithmetic	B Hashizume

1978

Brains of Men and Machines	E Kent
Program Your Next EROM in BASIC	S Ciarcia
A Programmable Character Generator	L Weinstein
Give an Ear to Your Computer	B Georgiou
How to Choose a Microprocessor	L Frenzel
Who's Afraid of Dynamic Memories	L Hauck
Let Your Fingers do the Talking	S Ciarcia
A Tiny Pascal Compiler	Chung & Yuen
WADUZITDO	L Kheriaty
Computer Chess Programming	the Spracklens
Tune in & Turn On	S Ciarcia
Three Dimensional Plotting	M Gottlieb
Add a Voice to Your Computer	S Ciarcia
Designing Structured Programs	C Weems

SURPLUS PRINTER FOR TRS80* OKIDATA CP110 LINE PRINTER WITH INTERFACE BOARD.

*T.M. - RADIO SHACK



NO SOFTWARE OR HARDWARE CHANGES REQUIRED. JUST PLUG IN AND RUN!

- 5x7 Impact Dot Matrix
- 80 Char/Line
- 64 Char ASCII (Upper Case)
- 110 Char/Sec.
- 66 Lines/Min.
- Accepts 8-1/2" TTY Roll paper

PRINTER **\$650.00**

INTERFACE: BUILT \$100.00

KIT \$ 60.00

INFOR & SCHEMATIC \$ 5.00

Shipped Freight collect. Send check, M.O.;



INCLUDES - Power Supply, Built in Selftest, Parallel Interface, Line Buffer and Cables. Housed in a three piece plastic cabinet with all control electronics. Retail for over \$1,100. PRINTER BRAND NEW NEVER USED IN FACTORY SEALED CARTON.

Operating Manual Included. *Supplies Limited*

Guaranteed to be in good working order at time of delivery.

Write for Interface Info on Heath, Apple, Imsai, Sol, Northstar

**INTERNATIONAL ELECTRONICS
EQUIPMENT CORP.**

P.O. Box 522542, Miami, Florida 33152

type structures. The compiler checks each occurrence of an identifier to ensure that it always has the same type; with simple variables, this involves checking such things as "Is it an integer?", "Is it a Boolean operator?" with procedures the compiler checks to make sure that the programmer's calls are consistent in the number of arguments supplied and the types of the parameters. Such consistency is important, but it usually requires that the programmer supply declarations throughout the program segments, specifying the type structure information of each and every identifier. This approach offers a short-term payoff in an increased probability that the generated code will perform as expected. But then, there's still the strong possibility that the programmer's errors are not so transparent that type checking can detect them. One approach is to improve the consistency phase, strengthening the compiler's ability to detect inconsistencies between expectations and reality. This requires that programmers express more and more of their expectations along with their algorithms; a program verification system results. Such a system would guarantee that the expectations expressed were consistent with the written algorithm. The debugging problem vanishes, but is replaced with a specification task that may be as difficult to accomplish as the debugging.

AI and Programming Expectations

What about programs whose expectations are not easily formulated? The primary example is artificial intelligence programming: often it is only the final algorithm itself which expresses the expectation. The creative programming process is driven by a partially understood phenomenon; the programming effort is to capture as much of that phenomenon as possible. We program in a world of great uncertainty, much like driving a car. We may have a reasonably detailed roadmap, but the path may involve traffic lights, accidents, and detours. We do not return home and restart every time we encounter an unexpected situation; we correct on the fly and continue. I feel that much of modern computation has this exploratory character of artificial intelligence.

What about programs which contain issues involving more than correctness? For example, it would be difficult to express the specifications of a text editor in terms of static conditions. To be sure, certain aspects of editors involve correctness, but usability is equally important. An experimental process is involved which requires modification and iteration. In fact the editor

HAVE YOU HEARD JAMES MARTIN LATELY?



A COMPLETELY RESTRUCTURED 5 DAY PRESENTATION ON

**DISTRIBUTED PROCESSING
TELEPROCESSING
DATA BASE
NETWORKS**

New York	March 19-23, 1979
Miami Beach	March 26-30, 1979
Toronto	April 23-27, 1979
San Francisco	April 30-May 4, 1979

Don't miss this intensive, challenging seminar
Seminar Fee: \$975

(213) 476-1331

Call or write today:



P.O. BOX 49765, LOS ANGELES, CA 90049 (213) 476-1331

exists for modification. If we made no typing errors we would not need an editor. For example, when we discover an error in a text file, we don't erase the whole file and retype it—we edit the error and keep the result. However in the traditional debugging paradigm, when we discover a runtime error, we throw away all the computation, edit the file, and restart. If that computation has taken several hours (or even minutes) to elicit the bug, it will be most painful to restart.

Most programming involves a deeper issue than debugging: it involves modifiability. Programs are always being modified because we change our expectations. Debugging is only a very minor component of the problem of program modification. Therefore, as we progress to more and more complex programming tasks, programming modification will take on a more fundamental role. Don't try to stamp out program modification as a manifestation of human frailty and error; it is a fundamental ingredient of our field. Cater to modification at the innermost levels of our programming systems. Assembly language continues to dominate systems design not because of innate masochism, but because of modifiability. There is a close (but low level) match between the language, the debugger, and the execution device. Any language that expects to dethrone machine language must offer an equally compelling environment.

"Modifying a Blank Screen"

One artificial intelligence researcher has characterized programming as "debugging a blank piece of paper." To that I would add: *programming is modifying a blank screen*. Get the machine into the programming process as soon as possible, but it must be done right. In that context we will see a rise in productivity comparable to that experienced in the editing task when a true display editor is used. We can expect egoless programming and good work habits to evolve naturally. With such tools the promise of structured programming can become a reality. That is, it is the *activity* of programming that involves the structuring. One should not expect to find structure in a program anymore than one can look at the final board positions of a chess game and tell whether that game was played by Masters or amateurs. Imagine programming systems whose "moves" involve stepwise refinement of partially elaborated programs; imagine the transcript of those keystrokes as comparable to the recording of moves in the chess game. The transcript of the program development would be available for analysis by programming students



CYBERNETIC MICRO SYSTEMS PRESENTS:
THE CY-480 CONTROLLER.
IT CONTROLS ALL THE LRC-7848 SERIES PRINTERS.
HERE IS THE MODEL.

The world's only single-chip LSI Universal Printer Controller is here!

The very low-cost 40-pin CY-480 printer with print speeds up to 200 cps! The Controller from Cybernetic Micro Systems is the first—and only—40-pin LSI device which will control and interface any standard 5" x 7" dot matrix printer (including those from Victor, LRC, Practical Automation and Amperex) having a print speed up to 200 cps. It operates from a single +5V power supply and will interface a printer with any microcomputer or minicomputer system through standard 8-bit ports. The CY-480 accepts either serial (RS232C) or parallel ASCII input from the host system's data channel.

The CY-480 replaces bulky, expensive dedicated controllers. The small, single LSI package offers a 5 x 7 dot matrix character generator, full upper and lower case ASCII 96-character font, and a 48-character (expandable by daisy-chaining) internal line buffer storage. Standard are a 10, 12 or 16 characters/inch variable character density command, 2-color selectable print command, forward/backward printing command, and horizontal and vertical independently expanded print command. The CY-480 provides graphics capability and includes a "flip-print" operating mode for 180° viewing. Ready lines provide full asynchronous communications with handshaking.

Low price! \$35 a single unit!
CYBERNETIC MICRO SYSTEMS
2378-B Walsh Ave. • Santa Clara, Calif. 95050
Phone (408) 249-9255

PET WORD PROCESSOR



This program permits composing and printing letters, flyers, advertisements, manuscripts, etc., using the COMMODORE PET and a printer.

Script directives include line length, left margin, centering, and skip. Edit commands allow the user to insert lines, delete lines, move lines and paragraphs, change strings, save onto cassette, load from cassette, move up, move down, print and type.

The CmC Word Processor Program addresses an RS-232 printer through a CmC printer adapter.

The CmC Word Processor program is available for \$29.50. Add \$1.00 for postage and handling per order.

Order direct or contact your local computer store.



CONNECTICUT microCOMPUTER
150 POCONO ROAD
BROOKFIELD, CONNECTICUT 06804
(203) 775-9659



**BET,
YOU DIDN'T KNOW!**

OAE'S new **PP-2708/16** PROM Programmer is the *only* programmer with all these features:

- Converts a PROM memory socket to a table top programmer: No complex interfacing to wire—just plug it into a 2708 memory socket*
- A short subroutine sends data over the address lines to program the PROM
- Programs 2 PROMS for less than the cost of a personality module. (2708s and TMS 2716s)
- Connect 2 or more in parallel — super for production programming
- Complete with DC to DC switching inverter and 10

turn cermet trimmers (for precision pulse width and amplitude alignment)

- All packaged in a handsome aluminum case

PP-2708/16 ... A & T \$295.

PP-2716 (Programs Intel's 2716) A & T \$295.

OAE

Oliver Advanced Engineering, Inc.
676 West Wilson Avenue
Glendale, Calif. 91203
(213) 240-0080

*Pat's Pending



That's right. The famous Computalker CT-1 Speech Synthesizer that produces highly-intelligible natural sounding speech can now be installed on your TRS-80.

Completely self-contained, the Model CT-1T comes with its own chassis and power supply, on-board audio amplifier (2 Watts), CSR1 software, and interconnect cable. The CT-1T comes with complete documentation and is avail-

able on either 5 1/4 inch diskette or cassette. TRS-80 Level II and 16K words memory required, 32K words recommended.

**SAVE \$100
SPECIAL INTRODUCTORY PRICE
\$495**

Suggested retail price is \$595
Calif. residents add 6% sales tax.



**COMPUTALKER
CONSULTANTS**

1730 21st St., Suite A
Santa Monica, CA 90404
(213) 392-5230

and teachers. Such a system would truly support structured programming. Current practice does not support such activity. We are forced to submit character strings to our language systems, even though our methodology tells us to compose in terms of structure. Until that disparity is resolved we should expect little improvement in the software problem.

Most programming languages do very little to reinforce the creative process of algorithm discovery and creation. They are more concerned with the *execution* of already constructed algorithms. This is a natural outgrowth of their ancestry: a numerical computation era in which the emphasis was placed on minimizing computer time at the expense of programmer time. Also, the programming problems of that day involved the transcription of well-specified numerical algorithms into an equally precise programming language. Times and economics have changed. The problems are more complex and no longer as well-specified as those of numerical analysis. Now computers are cheap and programmers are expensive; we need techniques to speed the development of correct programs. Certainly the verification efforts are aimed in this direction, but verification typically is an after-the-fact reconciliation of a completed algorithm with some descriptive specification of its behavior. We need languages that support the creative and exploratory phases of program development. Of course, one may question this. In the Computing Surveys, Wirth writes:

... It is therefore entirely possible that in the future a more interactive mode of operation between compiler and programmer will emerge, at least for the very sophisticated professional. The purpose of this interaction would not, however, be the development of an algorithm or the debugging of a program, but rather its improvement under invariance of correctness. [Wirth's emphasis].

I most definitely agree with the emphatic phrase; we must develop such program transformation systems. However, it is equally important to improve the program development phase.

Exploratory programming, which is the hallmark of artificial intelligence and which, to a very large extent, occurs in the creative stages of any programming task, is best done with an untyped interactive language like LISP. Strong typed languages like Pascal only confuse and obfuscate the formulative stages.

LISP's basic unit is an expression, meaning

that every LISP construct computes a value. LISP tends to emphasize the applicative nature of algorithms, using "function application" as its basic computational notation and using recursion to express the control aspects of the process; recent research has indicated that many common recursive schemes can be *executed* in an iterative fashion. That is, the evaluation mechanism need not involve the usual stack oriented overhead. One should not confuse the recursive notation with the evaluation mechanism.

The basic unit of Pascal is a statement, rather than an expression. That is, Pascal's units tend to be executed for *effect* rather than *value*. It is interesting that John Backus, the "father" of FORTRAN, has spent considerable time in recent years studying and advocating applicative languages, turning from the more traditional imperative, statement oriented languages like FORTRAN, ALGOL, and Pascal. In his Turing lecture, Backus writes:

This world of statements is a disorderly one, with few useful mathematical properties. Structured programming can be seen as a modest effort to introduce some order into this chaotic world, but it accomplishes little in attacking the fundamental problems created by the word-at-a-time von Neumann style of programming, with its primitive use of loops, subscripts, and branching flow of control.

Of course things are not all that black and white. Pascal has applicative aspects and LISP has imperative aspects. The difference is again one of emphasis and philosophy: the expression versus the statement. The difference has a mighty influence on the language design: expressions lead to calculator-like interactions; statements lead to computer-like programs. Wirth, in the Computing Surveys, writes:

We must recognize the strong and undeniable influence that our language exerts on our way of thinking, and in fact defines and delimits the abstract space in which we can formulate—give form to—our thoughts.

Computing Attitudes

That is a critical point, true in natural language as well as in programming languages. In fact, the problem goes deeper than programming language. One's attitude about computation is deeply connected with the human interface problem. Those who

Circle 72 on inquiry card.

NOBODY SELLS THE BEST FOR LESS

	LIST PRICE	SPECIAL PRICE
Electronic Control Technology		
16K RAM Kit	279.00	235.00
Assembled	310.00	265.00
MECA Alpha-1 Dual Drive Cassette System	845.00	725.00
Thinker Toys - Discus One	995.00	850.00
SSM Music Synthesizer Board Kit	149.95	125.00
Mountain Hardware		
100,000 Day Clock	219.00	185.00
Micropolis Model 1042		
Double Density Disk System	799.00	675.00
Godbout 8K Unkit	139.00	118.00

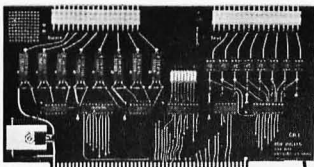
Call for our prices on:

North Star, IMSAI, Sanyo, Integral Data Systems, Cromemco, Teletek, IMC, Problem Solver, SSM, Polymorphic, Vector Graphic
Subject to Available Quantities • Shipping FREE on prepaid orders

Computer Lab of New Jersey

141 Route 46
Budd Lake, New Jersey 07828
Phone (201) 691-1984

OUR BOARDS WON'T LEAVE YOU BORED.




By and large, computer boards aren't the most exciting things in the world... but Mullen boards are an exception.

The **Extender Board Kit** has a logic probe that lets you know what's going on in your circuit. And if you get bored with that, there's a general purpose kluge board area where you can implement custom testing jigs. Still not enough? Hook a 'scope probe on to the specially designed edge connectors and check out the logic patterns. And if all that fails, maybe the low price will get you excited: **\$39 per kit.**

The **Controller Board Kit** is an intelligent switching system that listens to the world through 8 opto-isolator inputs, confers with the computer, and then issues open/close instructions to 8 reed relays. If you get tired of low power applications, high power AC modules are available. Each kit includes applications notes and an onboard self-tester. **\$99 per kit.**

For some people, the fun stops once you've put a board in your computer. With a Mullen board, the fun's just beginning.

MULLEN Computer Products
BOX 6214, HAYWARD, CA 94545
Mullen boards are available at computer stores nation-wide or by direct mail (Californians add sales tax).

Circle 267 on inquiry card.

March 1979 © BYTE Publications Inc

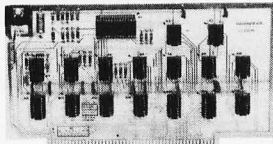
217

cañada

systems, inc.

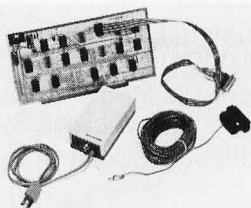
Boards DO Something

If your system needs to know what time it is, our CL2400 is the board for you. The present time in hours, minutes, and seconds is always available for input, and is continuously updated by the highly accurate 60 Hz power line frequency. Need periodic interrupts? The CL2400 can do that, too, at any of 6 rates. Reference manual with BASIC and assembly language software examples included.



CL2400 Real Time Clock
\$98/ Kit \$135/ Assembled

If your system needs on/off control of lights, motors, appliances, etc., our PC3200 System components are for you. Control boards allow one I/O port to control 32 (PC3232) or 16 (PC3216) external Power Control Units, such as the PC3202 which controls 120 VAC loads to 400 Watts. Optically isolated, low voltage, current-limited control lines are standard in this growing product line.



PC3200
Power Control System
PC3232 \$299/Kit \$360/Asm.
PC3216 \$189/Kit \$240/Asm.
PC3203 \$39.50/Kit \$ 52/Asm.

P.O. Box 516
La Canada, CA 91011
(213) 790-7957

(formerly comptek)

Mike's

YOUR

NORTH STAR ★ COMPUTERS PROGRAMMING SPECIALISTS!

You can look to us for innovative and imaginative programs

**** Intertec Intertubes now available ****

Thinker Toys 8" Disk Drives Many different and diversified for North Star Computers **\$995⁰⁰** computers systems available. All Additional Drives **\$795⁰⁰** include full access to Program Library. Systems start at **\$4,995⁰⁰**

DOSCHG

Patches to connect Thinker Toys 8" Disk Drives to North Star DOS & Basic. Fully supports all North Star Functions on 8" disk.

\$49.95

CSUB

A set of Functions defined in North Star Basic that handle all disc accessing (Sequential, Random, & Keyed Access) and all CRT display, formatting & Input. A SUPERB APPLICATION PROGRAM DEVELOPMENT PACKAGE.

\$49.95

TIMESHARE

Patches to North Star DOS & BASIC that take advantage of the versatility of the Horizon computer to implement an interrupt driven bank-switching time sharing system. Requires additional memory & terminals.

\$49.95

Micro Mike's

905 Buchanan, Amarillo, Texas 79101
806-372-3633

grew up with batch oriented computation have a quite different frame of reference from that of a person who has experienced truly interactive access.

These attitudes permeate the whole computing approach. If one is to interact with a calculator, then we must expect to present expressions and receive values; that implies an immediacy which is antithetical to type structures. So too is interactive design; the interactive creation and running of partially specified programs is difficult to reconcile with language processors that expect total information about all program segments and identifiers.

By now many of you are sure that I am preaching total heresy, advocating a return to the old days of hack and patch programming. I am definitely not. Rather, I am advocating the development of programming systems that incorporate the ideas of structured stepwise development of programs—systems in which the interactive *development* is as flexibly supported as the interactive *debugging* of modern LISP systems. We must do for programming what the page oriented display has done for editing. But such systems are only half the software problem. We must dramatically improve the way people think about programming. Computer programming is probably the most difficult and challenging enterprise mankind has ever undertaken. Until programming methodologies are supported by the programming tools, and until programmers are expected to spend as much time perfecting their craft as professional engineers and poets, we should expect little improvement in software quality.

We must put a stronger emphasis on the education of programmers, rather than restrict the expressive powers of the languages. Consider the tools of a more traditional craftsman: in the hands of an amateur those tools can be deadly, whereas the craftsman can develop exquisite objects. We do not propose that all tools be dulled appropriately so that the amateurs cannot do themselves injury! We educate them in the proper use of, and respect for, the instruments and expect that the craftsman's tool remain sharp. The emphasis is properly placed on the individual. Do not confuse education with the mass-merchandizing of armies of programmers whose competence is sealed in a cautious, uncreative world of dull tools. The artificial intelligence community is the craft of the tool builder; their tools are the sharpest and most incisive of the computer field. It is this kind of tool which should appeal to the personal computer person. It is not the elegance of BASIC which has made it the standard personal

computer language; it is BASIC's interactive nature, allowing quick experimentation with programming ideas, that accounts for its longevity. This interactive flavor can be grafted onto a Pascal-like language, but it is much more difficult to do this successfully. In the process one either compromises the tenets of the language (extensions) or compromises the resulting system.

"Wild West" Computing

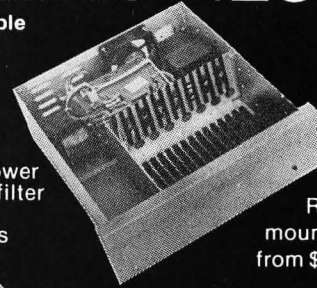
The essence of personalized computing has been sort of the "wild west" attitude: open, undisciplined, but creative and lusty as hell. You are a very healthy sign; today, a modest personal computer has more power and flexibility than that available in a professional installation 20 years ago. Each of you has molded your system according to your desires and economic constraints. But freedom is expensive; systems and programs become one of a kind. Enter compatibility and, unless you are careful, exit individuality. Clearly these problems are not solely the province of personal computing; the manufacturers feel the same pressures. So the real question is: can we bring discipline and order to programming without curtailing the creativity?

Personal computer users need not give up the interactiveness of BASIC to gain the structure and portability which Pascal is advertising; LISP offers both. BASIC's longevity, indeed strength, lies in its "friendliness." That is a critical ingredient of an interactive programming language. I guarantee that if BASIC were available only in the traditional batch oriented environment, its popularity as a personal computer language would not have occurred. Similarly with LISP or Pascal. That is, it is the total environment in which a language is situated that is important. The UCSD experience with Pascal illustrates this point well. The real question then is: can we do better?

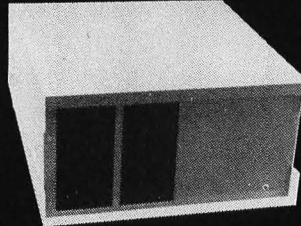
LISP is *not* a special purpose list processing language. A modern LISP system has more flexible data handling facilities than other more recent languages. For example, MACLISP's data types include arbitrary precision numbers, very flexible record structures (called property lists), strings, arrays, list structure, and even procedures. One attribute which leads to LISP's elegance and economy of expression is that all of these data types are available as values of programming constructs. Thus LISP procedures may take procedures as values, return procedures as values, or create arrays which are returned as value.

Main/Frames from \$200

- 14 Basic Models Available
- Assembled & Tested
- Power Supply:
8v@15A, $\pm 16v@3A$
- 15 Slot Motherboard
(connectors optional)
- Card cage & guides
- Fan, line cord, fuse, power
& reset switches, EMI filter
- 8v@30A, $\pm 16v@10A$
option on some models



Rack
mounted
from \$200



8" Floppy Main/Frame
Single & Dual from \$335
(includes power for
drives and mainframe)

Write or call for our
brochure which includes our
application note:
'Building Cheap Computers'

INTEGRAND

8474 Ave. 296 • Visalia, CA 93277 • (209) 733-9288
We accept BankAmericard/Visa and MasterCard



A UNIQUE NEW PRODUCT

... protects your hardware and your investment. Saves maintenance, downtime and looks great. Our Dust Covers come in hundreds of sizes each custom designed to fit a particular model of terminal, CPU, Line Printer, Floppy Disk. They're a proven way to help eliminate dust and dirt accumulation, improve system reliability and save many times the cost in reduced maintenance and downtime. What's more, your **satisfaction is 100% guaranteed.**

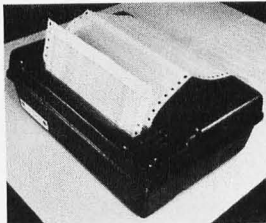
Cover Craft Dust Covers are available from your local computer retailer or contact Cover Craft.

Can you afford to wait any longer?

COVER CRAFT
P.O. Box 555, Amherst, NH 03031
Telephone (603) 673-8592

PET™ EXPANDOR PRINTER**FROM PETSHACK Software House****P.O. Box 966****Mishawaka, IN 46544****Tel: (219) 255 3408****PRINTER PRICE WITH PET INTERFACE \$525**

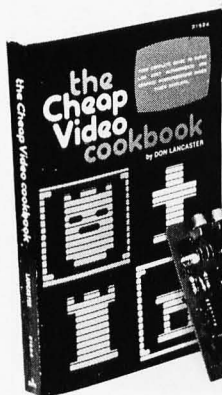
- Small size of 4.5"H x 12 1/2"W x 9 1/2"D
- Impact printing - 3 copies
- Prints 80 columns wide
- Print Cylinder - not a matrix
- Uses 8 1/2" paper, pressure or pin feed
- Easy to maintain yourself, or return to us
- Regular Paper - Coated paper not required
- Lightweight, 11 1/2 lbs. with cover
- Prints 10 characters per second
- 64 Character ASCII Character Set
- Full Documentation Included



This is the ideal, low cost, reliable, self maintained printer with which to complete your PET system.

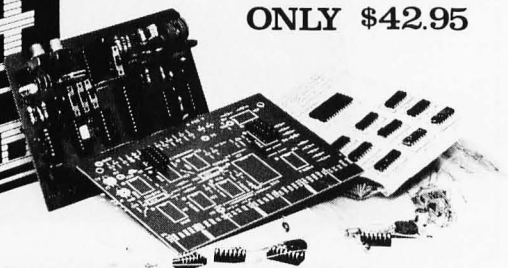
PET ROM LISTINGS	\$19.95
PET SCHEMATICS	\$24.95
PET TO PARALLEL INTERFACE with 5V .8A power supply	\$74.95
PET TO 2nd CASSETTE INTERFACE	\$49.95
BUDGET - NEW - Keep track of Bills and Checks. Update as needed	\$14.95
NUMBERAMA - Number Guessing Game based on 'MASTERMIND'	\$5.95
STATES - Help the kids with their geography. Match States & Capitals	\$5.95
MATH TUTOR - Help youngsters learn math in an enjoyable way	\$5.95
6502 DISASSEMBLER	\$12.95
MAD LIBS - PARTY FAVORITE! Hilarious stories created	\$5.95
WORLD CONQUEST - Advanced game of Strategy	\$5.95
STARTREK - All-time favorite written for the PET's special Graphics	\$5.95
MORTAR - Advanced game with X-Y coordinates & angles	\$5.95
PSYCHO ANNIE - Tell your problems to Psycho Annie	\$5.95
COMPUTER DERBY - Up to 4 people can play the horses	\$5.95
MAILING LIST - For personal or business applications.	\$9.95
HOME UTILITIES - Loans, Savings, Electricity, & miles per gallon	\$9.95
MACHINE LANGUAGE MONITOR - Write Machine Code. Save on tape	\$9.95

PET is a trademark of Commodore Business Machines



the ULTIMATE in CHEAP VIDEO

**BOOK & KIT
ONLY \$42.95**



Don Lancaster's "Cheap Video" concept allows almost unlimited options, including:

- * **Scrolling** - Full performance cursor.
- * **Line/Character formats** of 16/32, 24/80, 32/64 or almost anything.
- * **Graphics** - up to 256 X 256 B&W; 96 X 128 COLOR (requires low-cost option modules)
- * **Works with 6502, 6800 and other micros.**

SPECIAL OFFER: Buy the Kit (upper case alpha-numeric option included) & get the Book at 1/2 price.

BIA ELECTRONICS, DEPT. 3-B, 1020 W. WILSHIRE BLVD., OKLAHOMA CITY, OK 73116

I'm Sold, PLEASE RUSH..... ☐ SEND FREE CATALOG

☐ TVT-658 Kit & Cheap Video Cookbook - \$42.95 (enclosed)

☐ TVT-658 Kit only (book required for assembly) - \$39.95

name: _____

address: _____

city: _____ state: _____ zip: _____

BIA ELECTRONICS DEPT. 3-B, 1020 W. WILSHIRE BLVD., OKLAHOMA CITY, OK 73116

Lest you suspect that such generality implies inefficiency, note that LISP has been used as the systems programming language for the MIT LISP machine. All system software is written in LISP even to the level of the algorithms that place the characters on the screen. Even the micro-code is written in LISP. LISP compilers can be as good as those of any other language. In one experiment, the MACLISP compiler was tested against a FORTRAN compiler on some purely numerical examples. The LISP compiler's code was better both in terms of space and time.

Might not such generality lead to sloppy programming techniques? Note again that a language is a tool, and is only as effective as its user. I would rather sharpen the user than dull the tool. In terms of user aids, LISP excels. A modern LISP system is an integrated programming environment incorporating editors, debuggers, and compilers. Some LISP packages include sophisticated error recovery modules, allowing the user to undo computations or explore alternative computations. The integration of these "programmer's assistants" with modern display techniques has begun. The results are quite impressive. The flexibility of these systems is due in large part to LISP's unique representation of programs as data structures. As a result, it is easy to write programs which manipulate programs. Note that language editors, debuggers, compilers, and program transformations systems like those advocated by Wirth (above) all fall into this category.

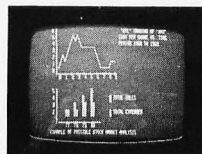
One also hears dreadful rumors about LISP's syntax (Lots of Irritating Single Parentheses). First, the regularity of the notation and the simple syntax more than make up for any initial inconvenience. However, these syntactic difficulties can also be stifled directly. It is quite simple to supply LISP with an ALGOL like sugared input and output. Such parsers and unparsers are simple LISP programs.

The above discussion has hinted at a very important aspect of LISP: LISP is a machine language. In the traditional machine, instructions reside in memory locations just as data does. It is the access path of the processor that determines how the contents of a location are to be interpreted. Access by the program counter implies an instruction fetch; other access implies a data fetch—so too in LISP. Data and program are stored identically; both are presented to the machine in a simple syntax of lists. The LISP CPU (central processing unit), called *eval*, accesses LISP memory either to fetch code or data. Instead of the linear sequential representation of traditional ma-

CONVERT ANY TV TO A HIGH QUALITY MONITOR



- Hot Chassis or Transformer sets
 - 64-80 characters per line
 - By-passes tuner & I.F.
 - Normal viewing unaffected
 - Safe—Easy installation
- ACVM Hi-Resolution \$24.95 ppd

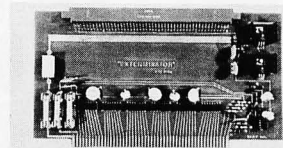


"POLYGRAFIX"

A completely self-contained, high density graphics system for S-100 buss users of Polymorphic VTI-64 video board. —512H by 128V resolution. Total software control. Assembled & tested. . . \$245.00
Write for details and avail. options.

VAMP Inc. Box 29315
Los Angeles, Calif. 90029

The "EXTERMINATOR"



All New Dual Function Board: Serves as an extender card & also terminates S-100 buss. Eliminates crosstalk, overshoots & noise which can scramble data. Occupies only a single slot. Fully fused.

VTE-100-K (Kit) \$49.95
VTE-100-A (Asmb.) 74.95
Extender Card (w/conn.). . 24.95
Add \$2 shipping & handling
Calif. Residents add 6% Sales Tax

chines, LISP has a tree-like storage scheme. One very exciting area of investigation involves architectures for LISP-like machines.

Finally, it is often assumed that LISP demands large expensive computers for its implementation. That, too, is not true: there are versions of LISP for the Z-80, 8080, 6800, F8, LSI-11, and even a version in BASIC. Certainly the machine size will limit the range of feasible applications; but that is true of any language. The new class of microcomputers is particularly exciting. They will open up many new areas—including artificial intelligence study—for the personal machine. The new machines will support very substantial implementations of LISP.

It is particularly important to influence the personal computer advocate now, given the growth in computing power and the cries for compatibility, discipline, and standardization. The DOD-1 language effort is but the latest manifestation of this attitude. I do not believe that this legislative approach is healthy. I believe that LISP offers a healthy alternative to the current choices of programming languages for personal computation. ■

REFERENCES

ACM Computing Surveys, volume 6, number 4 (December 1974): Wirth, N, "On the Composition of Well-Structured Programs," page 247, and Knuth, D, "Structured Programming with GOTO Statements," page 261.

Jensen, K, and N Wirth, *Pascal User Manual and Report*, Springer-Verlag, 1974.

J Backus Turing Lecture: "Can Programming Be Liberated from the von Neumann Style? A Functional Style and Its Algebra of Programs," CACM, volume 21, number 8, page 613.

Allen, J, *Anatomy of LISP*, McGraw-Hill, 1978.

Steele, G, and G Sussman, "The Revised Report on Scheme," MIT AI memo 452, Cambridge, January 1978.

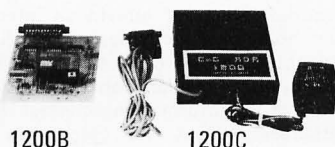
Steele, G, and G Sussman, "The Art of the Interpreter or, the Modularity Complex," MIT AI memo 453, Cambridge, May 1978.

Teitelman, W, "A Display Oriented Programmer's Assistant," Xerox Palo Alto Research Center, Report CSL 77-3.

Sandewall, E, "Programming in an Interactive Environment: The 'LISP' Experience," ACM Computing Surveys, volume 10, number 1, March 1978, pages 33-71.

PET PRINTER ADAPTER

GET HARD COPY FROM YOUR
COMMODORE PET USING A
STANDARD RS-232 PRINTER



The CmC ADA 1200 drives an RS-232 printer from the PET IEEE-488 bus. Now, the PET owner can obtain hard copy listings and can type letters, manuscripts, mailing labels, tables of data, pictures, invoices, graphs, checks, needle-point patterns, etc., using a standard RS-232 printer or terminal.

\$98.50 ADA 1200B
Assembled and tested

\$169.00 ADA 1200C
With case, power supply
and RS-232 connector



Order direct or contact your local computer store.
Add \$3.00 for postage and handling per order.



CONNECTICUT microCOMPUTER
150 POCONO RD, BROOKFIELD, CT 06804
(203) 775-9659

Clubs and Newsletters

Southeastern Michigan Computer Organization Sponsors TRS-80 Group

SEMCO (the Southeastern Michigan Computer Organization) sponsors a TRS-80 special interest group for Radio Shack TRS-80 enthusiasts. Meetings are for the beginning hobbyist and computer expert alike. The main objective is to share ideas on programming, troubleshooting and new or compatible TRS-80 products. This group meets the first Saturday of every month from 6 to 9 PM. The location is the Bryant Branch Library, Michigan Av and Mason St, Dearborn MI 48124.

Northwest Computer Society

The Seattle chapter of the Northwest Computer Society meets at the Pacific Science Center on the first and third Thursday of each month at 7:30 PM. The first meeting of the month is normally held in room 200 on the east side of Science Center Court. This meeting usually features a formal presentation by a speaker or speakers. The second meeting of the month is normally held in the math room at the southeast corner of Science Center Court. This meeting is usually more informal with freewheeling discussion and problem

solving. Call the recorded information line at (206) 284-6109 or write to POB 4193, Seattle WA 98104.

South Florida Computer Group

The South Florida Computer Group has two chapters, one in Miami and the other in Ft Lauderdale. Members can attend meetings at both chapters and visitors are welcome. The Miami chapter meets the first Monday of every month at the Papanicolaou Cancer Research Institute, 1155 NW 14 St, Miami. The Ft Lauderdale chapter meets the second Tuesday of every month at the Social Annex Building, Holiday Park (behind the Parker Playhouse). Both chapters have a \$5 a year membership fee which includes their monthly newsletter, *I/O*. For more information about this group, write to Robert Lief, Papanicolaou Cancer Research Institute, 1155 NW 14 St, Miami FL 33136.

Australian 9900 Users Group

The Australian 9900 Users Group is a relatively new club concerned with the 9900 family of devices and applications for process control and business data processing. They have both Texas Instruments and Technico equipped members and would welcome contact with overseas correspondents. Presently, they do not have meetings but operate by direct contact or by correspondence between members. Contact Barry Day, 43a Osborne Rd, Lane Cv, NSW 2066, AUSTRALIA.

Melbourne Australia Computer Club

We have heard from Andrew Stewart, correspondence secretary of MICOM (the Microcomputer Club of Melbourne). The club meets the third Saturday of every month at Railway Modellers' Hall, Wills St, Glen Iris, Victoria. The dues are \$7.50 per year, which includes a monthly newsletter and quarterly magazine. MICOM can be contacted at POB 60, Cantebury, Victoria 3126, AUSTRALIA.

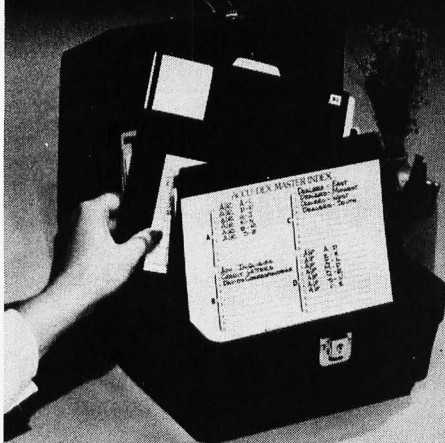
North London Hobby Computer Club

A press release has come our way informing us of a recent meeting of the North London Hobby Computer Club. At this particular meeting, held at the Polytechnic of North London, over 200 members and guests listened to a talk given on the present situation in personal computing. After the talk, three user groups were formed: a PET user group; a business user group; and another group of individuals interested in homebrew activities. The club is planning a series of lectures, and hopes to publish a regular monthly newsletter. For more information, contact Robin Bradbeer, Dept of Electronics and Communications Engineering, Polytechnic of North London, Holloway Rd, London N7 8DB, ENGLAND.

Health Insurance for Your Floppies!

Problem: Dust, Smoke, and Warpage will Ruin Your Floppy Disks.

Solution: The Flex 80 System will Protect, Index, and File Your Floppy Disks Quickly and Easily.



FLEX 80 SYSTEM

For Further Information
and a
Free Copy of Our "Policy"
CALL TOLL FREE
800 323-0254



ADVANCE ACCESS GROUP

10526 W. Cermak Westchester, IL 60153 312 562-5210

"Manufacturers of Information Processing Supplies"

Attention: TDL Users

An exchange of information among users of TDL (Technical Design Labs) equipment and software is being started by Dr John R Cameron, POB 1517, Palo Alto CA 94301. If you would like to correspond with others who have similar interests, send descriptions of any and all Z-80/TDL related hardware and software to Dr Cameron. He asks that you enclose a brief summary (typed, single spaced) of your offerings and wishes, with your return address. Whatever material you wish to disseminate may be enclosed, or give prices and availability for commercial offerings. A users survey is also being compiled, so you may wish to describe your system and its applications. For copies of other users' summaries and information of general interest, send \$3 to Dr Cameron at the above address.

New Computer Group in Battle Creek MI Area

Called the Battle Creek Area Microcomputer Club, this group consists largely, but not exclusively, of TRS-80 owners. Meetings are on alternate Thursdays at 7 PM and include software swapping, hardware topics, tutorials, etc. Both professionals and beginners are welcome. For detailed information, contact Jeff Stanton, 8587 Q Dr N, Battle Creek MI 49017.

Pittsburgh Area Computer Club Members Compete for Monthly Babbage Award

PACC (the Pittsburgh Area Computer Club) is currently meeting every third Sunday at 11 AM in the community room of the Northway Mall. They normally have a 2 hour general session, followed by a formal meeting with a speaker. This in turn is followed by another general session in which the various user groups meet. During the formal meeting the monthly Babbage is awarded to the "best in its class." Members and guests are invited to bring their systems, share their ideas and vie for the Babbage prize. Contact PACC, 400 Smithfield St, Pittsburgh PA 15222.

Space Coast Microcomputer Club Celebrates Second Birthday

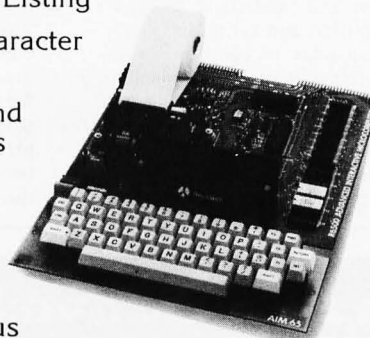
Ray Lockwood, president of the Space Coast Microcomputer Club, called us with information about his computer group. The club recently celebrated its second birthday and boasts a membership of approximately 100. They meet every fourth Thursday at 7:30 PM at the Merritt Island Public Library, 315 Inlet Av, Merritt Island FL. The membership fee of \$5 includes the club's newsletter. Ray tells us there is club interest, but not exclusively, in 8080 and Z-80 systems. If you wish further information, he can be reached at (305) 452-2159.■

AIM 65. Only \$375.

Get a head start with computers the easy, inexpensive way with Rockwell's AIM 65.

For learning, designing, work or just fun, the R6500 Advanced Interactive Microcomputer (AIM 65) offers features you won't find on other comparably priced systems.

- Alphanumeric 20-Column Thermal Printer for Hard Copy Listing
- Alphanumeric 20-Character Display
- Dual Cassette, TTY and General-Purpose I/Os
- R6502 NMOS Microprocessor
- Read/Write 1K Byte RAM Memory
- System Expansion Bus Connector
- PROM/ROM and RAM Expansion Sockets
- Advanced Interactive Monitor Firmware
- Big, Terminal-Style Keyboard
- Optional Two-Pass, Symbolic Assembler and BASIC Interpreter



AIM 65 is available from your local Hamilton/Avnet distributor or send the coupon below to:
Microelectronic Devices, Rockwell International,
P.O. Box 3669, Anaheim, CA 92803 or phone
(714) 632-3729.

GET ME STARTED!

- ☐ Send me more information on AIM 65.
- ☐ Have someone phone me at _____

Name _____

Address _____



Rockwell International

...where science gets down to business

BYTE's Bits

Call for Papers

The 17th annual meeting of the Association of Computational Linguistics will be held August 11 thru 12, 1979, on the campus of the University of California, San Diego, at La Jolla CA. Papers are being solicited on linguistically and computationally significant topics, including theoretical and methodological problems of computational linguistics (eg: mathematical foundations, software tools); computational semantics (eg: linguistic semantics, deductive logic, artificial intelligence); automatic syntactic parsing and synthesis of natural languages; computational lexicography and stylistics (eg: concordances and statistical studies); speech recognition and synthesis, graphemics (ie: character recognition); automated terminology dictionaries, machine translation and machine aided translation. Authors wishing to present a paper should submit five copies of an extended abstract (not to exceed 1000 words) by April 1 1979 to: Dr Norman

Sondheimer, Sperry Univac, POB 500, M S 2G3, Blue Bell PA 19424, (215) 542-5896.■

Boston is Having a Huge Small Computer Show

Hynes Auditorium in Boston is the site of the Northeast Computer Show. The show originally scheduled to be held April 6, 7 and 8, 1979 has been changed to September 28, 29 and 30, 1979. The Northeast Computer Show will be a total spectrum presentation for the trade and public. There will be two separate sections to the show: a small business system section and a personal computing section.

The personal computing section will feature microcomputers, small computer systems, business opportunities, electronic and video games, career and employment opportunities, education exhibits, free seminars and lectures. Exhibitors will display the latest in personal computing hardware and software, computerized music synthesizers, computer amusements, computer generated art, graphics, and animation. Dozens of free lectures and seminars will be given by internationally recognized speakers for all categories and levels of enthusiasts including introductory classes.

The admission fees to the show are \$5 for adults, \$4 for college and high school students. For more information write or call: Northeast Exposition, POB 678, Brookline Village MA 02147, (617) 522-4467.■

Tektronix Microprocessor Design and Development Lab Workshops

Tektronix Inc is offering a series of microprocessor design and development lab workshops. Two different types of workshops are available: one lasts five days for those who want exposure to basic microprocessor design and organization, as well as experience in design development and testing. The other is a 3 day workshop for those already experienced in microprocessor design who wish more intensive training in developing and testing a design using the Tektronix 8002 Microprocessor Development Lab. Both workshops will provide a practical, hands-on, results oriented learning experience. The purpose of the workshop is to help the attendee grow as a professional designer. For a complete listing of dates and locations, write to Tektronix Inc, POB 500, Beaverton OR 97077.■

International Date Standard

Software system writers may be interested in the international standard for writing numeric dates. In 1971 the International Organization for Standardization adopted Recommendation 2014, which provides for a system of descending order when writing numeric dates on any letter or document. If numbers only are used, the first day of July in the year 1979 should be written 1979-07-01. The hyphen is preferred as a separator, rather than the period, slant, or space.

If the month is given in alphabetic form, one can write the date in any order (eg: 1 July 1979, July 1 1979, or 1979 July 1). No ambiguity results when a 4 character year field is used.

A related document, Recommendation 2015, sets up a standard for the numbering of weeks. It is recommended that for business and commercial purposes, Monday be regarded as the first day of the week. Furthermore, the week should always be seven days in length. A week which is divided by the turn of the year should be attached to the year containing a majority of days in that week.

ANSI (the American National Standards Institute) is the member organization representing the United States. Correspondence should be directed to ANSI, 1430 Broadway, New York NY 10018.■

Sargon Reproduced

We have been informed by Matt Mihovich of the Hayden Book Company

Add-In Associative Memory for the S-100 bus

Discussed and dreamed about by computer scientists for years, Content-Addressable Memory (CAM) is now here at an affordable price. CAMs have been so costly to build that few have actually been produced. Now Semionics has developed a simplified design, lowering the cost by two orders of magnitude. This new memory is called Recognition Memory (REM), since (like the human brain) it can recognize words, patterns, etc.

Adding a REM board to an ordinary microcomputer converts it into a very powerful machine known as a Content-Addressable Parallel Processor (CAPP).

Features:

- 4K bytes per board
- Static—no refresh needed
- Can be used as ordinary RAM or as CAM
- RAM access time: 200 ns
- CAM access time: 4 μ s
- Multiwrite—writing into multiple locations with one instruction
- Masking—for individual bit access
- Multiple REM boards accessed in parallel

Adds 17 associative memory functions to instruction set of Z-80 or 8080.

Applications:

- Pattern Recognition
- Information Retrieval
- Compiling & Interpreting
- Natural Language Processing
- Code Compression
- Artificial Intelligence

Price: \$325

4K firmware package of REM routines: \$80

SEMIONICS

41 Tunnel Road • Berkeley • CA 94705
(415) 548-2400



that the Sargon chess program described in recent issues of BYTE is no longer directly available from the authors. It is now marketed by the Hayden Book Company in book and tape (TRS-80, Level II) formats. The book retails for \$14.95 and the tape for \$19.95. Contact Hayden at 50 Essex St, Rochelle Park NJ 07662.■

New Computer Chess Champion

At the Computer Chess Championship held at the 1978 ACM (Association for Computing Machinery) meeting this past December, a new champion emerged from the Swiss system tournament. The program *Belle*, developed at Bell Laboratories, edged out defender Chess 4.7, the program developed by Slate and Atkin at Northwestern University. The Belle program runs on a Digital Equipment Corp PDP-11 with special hardware to generate moves, and a new device to evaluate positions using high speed hardware.

Of interest to microcomputer users is the relatively good performance of the Sargon program, written by Dan and Kathe Spracklen. It managed a good enough performance for a tie for third place, although the Swiss system leaves controversy concerning its exact ability.

Still waiting in the wings is Slate and Atkin's newest effort, Chess 5.0. At this writing, this version is not ready for competition. The rewritten program uses the venerable FORTRAN language.■

Association for Women in Computing

It has been announced that the AWC (Association for Women in Computing) was founded on December 5 1978 in Washington DC. The purposes of AWC are:

- to promote communication among women in computing;
- to further the professional development and advancement of women in computing;
- to promote the education of women and girls in computing.

Membership in AWC is open to all persons interested in the purposes of the association regardless of sex, race, religion, or national origin. To obtain further information and/or a membership application, contact Anita Cochran, 5A137 Bell Laboratories, Murray Hill NJ 07974.■

Automatic Shopping List

During the past Christmas season, an interesting computer application was demonstrated at the Mall of New Hampshire in Manchester. The Digital Equipment Corp retail store there set up three DECstation 78 computer systems for use by shoppers. Each system executed a

program for an automated shopping list. Each user answered four questions about a gift recipient, and the computer selected appropriate gifts from a data base contained on floppy disks. The selections were printed out in the form of a list of 20 suggestions.

The data base was created from gift selections submitted by the various stores in the mall in each of the several categories. An exemplar of a gift suggestion list is reproduced here. The list is specified as being appropriate for a

female, 18 years of age or older, in the price range of \$20 to \$50, in the category of general presents.

It is estimated that over 1000 people per day used the system. The DEC store has received many inquiries about the system, and no doubt many such systems will appear in other locations. The program used in the system was written in the DIBOL language. The processor unit in the DECstation 78 is a microcomputer version of the venerable PDP-8.■

MERRY CHRISTMAS FROM THE DIGITAL STORE!
OUR COMPUTER HAS PROCESSED YOUR DATA AND SUGGESTS THE FOLLOWING GIFTS:

STORE	DESCRIPTION OF GIFT	PRICE
WEATHERVANE	PLAYGIRL SHOULDER BAG	23.00
FILENE'S	E LAUDER PVT COLLECTION 1/2 OZ	45.00
KARTEN'S	PORCELAIN FIGURINES	50.00
BRAZIL CONTEMPO	LIMITED PRINTS	50.00
GREAT EXPECTATIONS	GIFT CERTIFICATE FOR PERMANENT	25.00
LONDON HARNESS COMPANY	AUTHENTIC SCRIMSHAW	25.00
THE GREAT INDOORS	TEA SET	23.50
SCANDINAVIAN DESIGN	IMPORTED BASKETS	25.00
PHOTO CORRAL	800G SLIK TRIPOD	26.95
JOY OF COOKING	COPCO COOKWARE	22.95
TARRANT'S CUTLERY SHOWCASE	KING'S ARMS 2PC CARVING SET	37.50
SEARS ROEBUCK AND CO.	DIGITAL CLOCK RADIO	44.95
LAMP AND SHADE WORLD	STAINED GLASS TIFFANY LAMP	49.99
C.B. PERKIN'S TOBACCO SHOP	PARKER CUBE TABLE LIGHTER	29.95
QUALITY PETS	COMPLETE DOG GROOMING KIT	26.99
FABRIC GALLERY	STUFFED CHILDREN TOYS	25.00
BROOKSTONE	BRASS FIRST MATE'S LAMP	37.50
ABUNDANT LIFE WOODSTOVES	CAST IRON TEA KETTLE	29.95
LECHMERE SALES	GE DIGITAL SCALE	39.88
BREWSTER GLASSMITH	HANDMADE GLASS SEWING MACHINE	22.50

THANK YOU FOR SHOPPING AT THE MALL OF NEW HAMPSHIRE



ELF II by
NETRONICS
As featured
in POPULAR
ELECTRONICS

Shown with
optional 4k Memory Boards.
GIANT BOARD™ & Kluge Board.

HOBBYISTS! ENGINEERS! TECHNICIANS! STUDENTS!

Write and run machine language programs at home, display video graphics on your TV set and design microprocessor circuits—the very first night—even if you've never used a computer before!

ELF II featuring RCA COSMAC microprocessor/mini-COMPUTER \$9995

Stop reading about computers and get your hands on one! With a \$99.95 ELF II and our *Short Course* by Tom Pittman, you master computers in no time at all! ELF II demonstrates all 91 commands an RCA 1802 can execute and the *Short Course* quickly teaches you to use each of the 1802's capabilities. ELF II also displays graphics on any TV set, including an exciting new target/missile gun game! Add-ons are among the most advanced available anywhere. You get massive computing potential. No wonder IEEE chapters, universities and major corporations all use ELF II to train engineers and students! Kit is easily assembled in a single evening and you may still have time to run your first programs before going to bed!

SEND TODAY!

NOW AVAILABLE FOR ELF II—

- Tom Pittman's *Short Course On Microprocessor & Computer Programming* teaches you just about everything there is to know about ELF II or any RCA 1802 computer. Written in non-technical language, it's a learning breakthrough for engineers and laymen alike. **\$5.00** postpaid!
- Deluxe metal cabinet with plexiglas dust cover for ELF II, **\$29.95** plus \$2.50 p&h.
- ELF II connects to the video input of your TV set. If you prefer to use your antenna terminals, order **RF Modulator**, **\$8.95** postpaid.
- **GIANT BOARD™** kit with cassette I/O, RS 232-C/TTY I/O, 8-bit P/I/O, decoders for 14 separate I/O instructions and a system monitor/editor, **\$39.95** plus \$2 p&h.
- **Kluge** (Prototype) Board accepts up to 36 IC's. **\$17.00** plus \$1 p&h.
- **4k Static RAM** kit. Addressable to any 4k page to 64k. **\$89.95** plus \$3 p&h.
- Gold plated **86-pin connectors** (one required for each plug-in board). **\$5.70** postpaid.
- Professional **ASCII Keyboard** kit with 128 ASCII upper/lower case set, 96 printable characters, onboard regulator, parity, logic selection and choice of 4 handshaking signals to mate with almost any computer. **\$64.95** plus \$2 p&h.
- Deluxe metal cabinet for ASCII Keyboard, **\$19.95** plus \$2.50 p&h.
- ELF II **Tiny BASIC** on cassette tape. Commands include SAVE, LOAD, \times , \div , \cdot , \cdot , 26 variables A-Z, LET, IF/THEN, INPUT, PRINT, GO TO, GO SUB, RETURN, END, REM, CLEAR, LIST, RUN, PLOT, PEEK, POKE. Comes fully documented and includes alphanumeric generator required to display alphanumeric characters directly on your TV screen without additional hardware. Also plays tick-tack-toe plus a drawing game that uses ELF II's hex keypad as a joystick. 4k memory required. **\$14.95** postpaid.
- Tom Pittman's *Short Course on Tiny BASIC* for ELF II, **\$5** postpaid.
- **Expansion Power Supply** (required when adding 4k RAM). **\$34.95** plus \$2 p&h.
- **ELF-BUG™ Deluxe System Monitor** on cassette tape. Allows displaying the contents of all registers on your TV at any point in your program. Also displays 24 bytes of memory with full addresses, blinking cursor and auto scrolling. A must for the serious programmer! **\$14.95** postpaid.
- Coming Soon:** A-D, D-A Converter, Light Pen, Controller Board, Color Graphics & Music System...and more!

Call or write for wired prices!

Netronics R&D Ltd., Dept. BY-3
333 Litchfield Road, Phone
New Milford, CT 06776 (203) 354-9375

Yes! I want to run programs at home and have enclosed: ☐ \$99.95 plus \$3 postage & handling for **RCA COSMAC ELF II** kit, ☐ \$4.95 for power supply (required), ☐ \$5 for RCA 1802 User's Manual, ☐ \$5 for *Short Course on Microprocessor & Computer Programming*.

☐ I want mine wired and tested with power supply, RCA 1802 User's Manual and *Short Course* included for just **\$149.95** plus \$3 p&h!

☐ I am also enclosing payment (including postage & handling) for the items checked at the left.

Total Enclosed (Conn. res. add tax) \$
☐ Check here if you are enclosing Money Order or Cashier's Check to expedite shipment.

USE YOUR ☐ VISA ☐ Master Charge (Interbank # _____)

Account # _____
Signature _____ Exp. Date _____

PHONE ORDERS ACCEPTED (203) 354-9375

Print Name _____

Address _____

City _____

State _____ Zip _____

DEALER INQUIRIES INVITED.

Continued from page 10

I am just reaching the point where I can remember that TH is a search mode and ZA is the number of characters in a word. This is particularly regrettable in a program with avowedly pedagogical purposes. I shall refrain from belaboring the similar confusion caused by the program's use of GOTOS.

Finally, I am sorry that the authors did not comment generally on the memory requirements for the program, its performance, and the question of high versus low level languages for competitive chess programs. Still, it is an exciting series and I look forward to adapting the program when my Western Digital Microengine arrives.

David A Mundie
104-B Oakhurst Cir
Charlottesville VA 22903

ATTENTION ATARI EXPERTS

I am getting started in home computing. I have an Atari video computer with interchangeable game cartridges and controls. Is it possible to modify this so that I can write small programs on it? If anyone has done this, I would appreciate being sent some directions on how to do it. (I have some experience in putting electronic kits together.)

If these modifications are not feasible, does there exist a plug-in cartridge for playing chess? It seems to me that the 12 key keyboard or the 10 pin connector could be made to handle chess functions. I would appreciate help and advice from your readers.

Paul Rensink
POB 247
Ashton IA 51232■

DIGICAST: A CORRECTION AND AN OPINION

I would like to make a couple of corrections to the otherwise fine article by A I Halsema regarding "The Digicast System" in January 1979 BYTE, page 100.

- The explanation offered for the functioning of the standard FM Multiplex transmission and reception system needs clarification. What is commonly referred to as the stereo pilot signal is a signal sent to the FM tuner at 19 kHz from center frequency, which acts as an *on-off* switch for the tuner's demultiplexing section. In the presence of the 19 kHz pilot, the tuner will attempt to combine the difference signal being sent in the 38 kHz band with the

summary monaural signal to derive two channels [algebraically, $(L + R) \times (L - R) = (L^2 - R^2)$]; in the absence of the pilot, the monaural signal is fed to both preamplifier channels.

- I highly doubt that, in practice, one could realize a full 6 M bit data rate on a UHF television channel where the full channel bandwidth is only 6 MHz total. The realities of broadcast transmission and reception would probably yield a service operating at less than half this frequency (I would guess 2.0-2.5 M bps tops).

Neil D Weiser
81 Horton St
Stamford CT 06902

CAN OUR READERS HELP?

I would appreciate information concerning any suppliers of an IBM compatible Magnetic Card II reader which may be interfaced to a microcomputer which uses the S-100 bus.

Ray Menzies
3/545 St Kilda Rd
Melbourne 3004
AUSTRALIA

Any BYTE reader with appropriate information is requested to correspond with Mr Menzies.

TEXT EDITOR

Your editorial "On the Virtues of Writing Editors" (November 1978 BYTE, page 6) prompted this letter to the editor. It seems that we have been reinventing the same wheel. I began writing my text editor about nine months ago—after becoming sufficiently frustrated with the Teletype-oriented editor purchased when I first got my system running. I have actually intended to write this letter since I read your earlier editorial asking for a better text processing system. However, I have been busy completing my doctorate during the period when the program was being developed so other things have also occupied my time. Many of your ideas were incorporated into my program. Here is a description of my editor.

Videowriter is a video display oriented text editor. I wrote it for the most common hobbyist systems (16 lines of 64 characters) but it is easily modified for other page lengths, and can be modified for other page widths (it is very easily modified for the Sorcerer size screen). It is an expandable program designed to have extra features added on as desired by the user. A complex split screen video driver for a memory mapped video display and a keyboard input routine using three flashing cursors are incorporated into Videowriter so that support software external to the program is not needed.

The screen is divided into a text display area and a command and message

6800 PERFORMANCE PRODUCTS FROM MICROWARE

A/BASIC COMPILER Unmatched for speed, versatility and efficiency, generates pure 6800 machine language from BASIC source. Fast integer math, strings, logical and array operations. Output is ROMable and requires no run-time package. Cassette version requires RT/68 and 8K RAM. Disk versions require 12K and have complete disk I/O statements plus other extensions.

Cassette Version — A/BASIC V1.0C \$ 65.00
SWTPC Miniflex — A/BASIC V2.1F \$150.00
SSB DOS-68 — A/BASIC V2.1S \$150.00

RT/68 OPERATING SYSTEM Compatible MIKBUG replacement ROM with expanded, improved monitor plus real-time multiprogramming executive. 1000's in use since 1976.

RT/68 MX on 6830 ROM (Mikbug pin compatible) \$ 55.00
RT/68 MXP on 2708 ROM (EPROM pin compatible) \$ 55.00

6800 CHESS challenging chess program, two difficulty levels. Runs in 8K RAM. Mikbug-compatible object plus A/BASIC source. Specify cassette, SSB or SWTPC minidisk.
CHESS V1.0 \$ 50.00

DR. ELIZA 6800 version of famous MIT artificial intelligence program. Computer as psychoanalyst communicates in plain English dialog. Mikbug compatible object plus A/BASIC source. Specify cassette, SSB or SWTPC minidisk.
ELIZA 1.0 \$ 30.00

AS-1 A/D INTERFACE. Eight channel, 8-bit high speed A/D system for SS-50 I/O buss. Assembled. \$115.00

AS-4 D/A INTERFACE Four channel 8-bit ultra fast D/A system for SS-50 I/O buss. Independent isolated Z-axis strobe output for oscilloscope or plotter graphics. Assembled. \$195.00

U.S. orders add \$2 for shipping. VISA and MASTERCHARGE welcome. Call or write for free 6800/6809 catalog.

**MICROWARE
SYSTEMS CORPORATION**

2035 East Ovid Ave.
Des Moines, IA 50317
(515) 265-6121



SOFTWARE FOR BUSINESS

includes:

- * Mailing List
- * General Ledger
- * Payroll
- * Phone Directory
- * Customer Information
- * Invoice Writer
- * Inventory
- * Check Writer
- * Complete Business System
- * Master Business System

Available Soon Word Processor

video world

2224 N. University, Peoria, IL 61604
Phone 309/686-9352

*Trademark of Apple Computer Co. Inc.

TRS-80 CORNER

ANNOUNCING...ONE-STOP SHOPPING FOR YOUR TRS-80 MICROCOMPUTER

SOFTWARE (State of the Art)

- Disc-based business software
- FORTRAN for the TRS-80
- Functional, cassette-based programs
- Of course, some games
- And much more

HARDWARE

- 16 K RAM kits with instructions
- 5¼" Minidiskettes — only the very best — Scotch
- C-10 Data-settes — blank cassettes for programs
- Isolation Filters — the insurance you need!
- All Radio Shack equipment at 10% off
- And much more

BOOKS

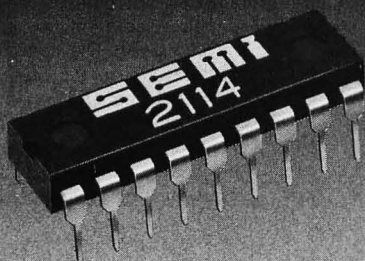
- David Lien's — "The BASIC Handbook" — A must for every programmer
- Coming Soon — David Lien's — "The LEVEL II Handbook" A must for every Level II owner
- The Adam Osborne Series on Microcomputers
- Robert E. Purser's — "Computer Cassettes" — A compilation of all TRS-80 Software on the market

CONSULTING SERVICES

- Including installation and hands-on training with the TRS-80 Business System, for those end-users who are not computer hobbyists
- and much more

FOR MORE INFORMATION WRITE
CIRCLE ENTERPRISES, INC.
POST OFFICE BOX 546
GROTON, CONNECTICUT 06340

The experienced 2114 4K static RAM



From EMM — the industry's largest supplier of 4K static RAMs — a 2114 with a year and a half of delivery behind it. Not a new part. Just a new pin-out of a proven part. 1K x 4 organization. 5V only. Standard 18-pin DIP. It draws only 300 mw, has all the speed you need for microprocessor applications.

EMM SEMI, INC.

A division of Electronic Memories & Magnetics Corporation
3883 North 28th Avenue, Phoenix, Arizona 85017 (602) 263-0202

INCOME TAX PROGRAMS FOR TRS-80™

FOR INDIVIDUALS (LINE PRINTER OR
DISK NOT REQUIRED)

1040A	4K	7.95
1040 (with Schedule A & C thru F Routine)	4K	14.95
TC&G (Income Averaging)	4K	14.95

★ ★ ★ STATE LEVEL I OR II ★ ★ ★

BUSINESS & PROFESSIONAL:

Full systems with line printer
output start at..... 189.95

**FREE 7-PAGE CATALOG
AND DESCRIPTION**

CONTRACT SERVICES ASSOCIATES
1846 W. Broadway Anaheim, CA 92804

display area. The text area is the bottom 13 lines of the screen. A flashing cursor indicates the position at which the next operation in the text buffer will occur. This cursor changes to different figures for either the text input mode or the command mode so the operator can tell at a glance which mode is in effect. The cursor can always be moved at will—left, right, up, and down. Left and right movement stop at the end of the line, and the cursor can move to any of the 13 text lines displayed. If the operator attempts to move the cursor off the top or bottom of the screen, text is scrolled onto the screen (scroll down or scroll up) from the text buffer. A direct one-to-one correspondence is always maintained between the screen text cursor position and the text buffer pointer position. To illustrate the use of the cursor, imagine that you are entering text and notice a misspelled word several lines up on the page. Without changing operating modes, move the cursor up to the line containing the error and then over to the wrong letter, positioning the flashing cursor over the error. Touching the delete key (or any other key so defined at assembly) removes the letter and the line beyond the cursor moves back one place. Now simply type in the letter or letters desired. The line moves to the right to make room. If the line becomes too long for the screen

width it is split into two parts at the cursor position, and you continue entering on the same line. If you come to the end of the screen line an automatic carriage return and line feed is executed. If you were part way through a word at the end of the line the entire word will be entered on the next text line, and you simply keep typing. When a letter is entered in the last position on the screen line the cursor wraps around to the start of the next line to signify that that is where the next letter will go. A cursor-left from this "65th" position will move back up to the last line entered just as if the cursor was actually on the same line (in the text buffer it is). The cursor *always* indicates where the next insertion or deletion will occur. The operator does not need to enter a carriage return at the end of the line—this is done automatically.

Text lines in the text buffer are terminated by a single carriage return character. Actual line length varies from the single carriage return up to 64 text characters and a carriage return. This buffer arrangement is the most memory conservative arrangement that I could easily implement. Any byte (hexadecimal 00 to FF) can be entered into the text buffer.

Videowriter features user set, variable tab stops that work exactly like tab stops on a typewriter. 16 tab stops are

allowed—and they can be set at any line position.

The top line of the screen is used for messages from the editor to the operator. If more tabs are entered into a line than there are tab stops set in the tab stop buffer the message TAB STOP NOT SET appears in the upper left corner of the screen and the system's bell is sounded. Similar messages announce other user errors and undefined conditions.

The command mode of operation allows the operator to manipulate the text through the execution of command strings. Commands are all single letter entries (upper or lower case) made on the third line of the screen. Command characters do not have to be separated by a delimiter, but a delimiter \$ is used to separate groups of commands. Each group delimited by a \$ will be repeated as a loop according to the number preceding the group on the command line. For example:

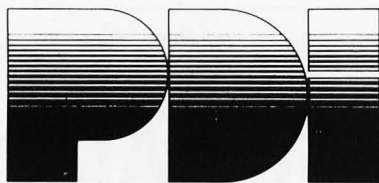
```
9999asdf$23ERT$h$121K$$
```

will be interpreted in the following way.

1. Execute the commands A, S, D, and F; and repeat 9999 times.
2. Do E, R, T 23 times.
3. Do one H; execute L and K commands.
4. Stop.

After the command string is entered on line 3, the two dollar signs \$\$ signal the start of execution. The line is first moved up to line 2, and then the commands are actually read from the video memory and executed. If the operator makes an error another command string can be entered on line 3 with the previous string still visible on line 2. Existing line 2 command strings can be repeated, and line 3 command entries can be deleted singly or the entire line can be erased. The command line cursor indicates where the next command line entry will go. A text cursor indicates where the next command will have effect in the text buffer. For example, the delete command will delete characters starting at the current text cursor position.

There are two types of commands. The 26 single letter commands are reserved for use on the command line as described above. These commands are decoded in sequence and a vector is found in a table. The user can place any vector in this table and the editor will then call the user's routine. A number of immediate commands are implemented using the set of ASCII control characters. A control E initiates the text enter mode. A control C halts execution of any command mode string (if the user has written it into the routine!) and returns to the command mode with a *BREAK* message and a bell. Control R deletes the entire line 3 command string entry. A control X returns to the monitor or operating system. The control Z command causes the next character



HAVING TROUBLE LEARNING BASIC?

STEP BY STEP is an interactive computer course in BASIC that's easy even for beginners. Program Design has developed a logical, structured approach that really works. At the end of STEP BY STEP, you'll be writing programs using all important BASIC commands.

AVAILABLE FOR TRS-80 LEVELS I & II, PET, AND APPLE II

STEP BY STEP:

- presents material in small steps
- provides guided programming practice in each lesson
- tests your progress after each lesson
- teaches actual program writing, not just terms
- is suitable for anyone from junior high up, regardless of math background

10 lessons with quizzes, plus final test 3 cassettes
64 page Workbook \$39.95 plus \$2.00 shipping

P.D.I. has many other educational programs too. Available at your computer store. Or order directly from us.

VISA & Master Charge accepted (include number, exp. date, MC include digits above name)

Department 201
Program Design, Inc., 11 Idar Court, Greenwich, Conn. 06830

DEALERS

AMPTEC, Inc.
Denver, CO

Computerland
Lawndale, CA

Computer Components
Westminster, CA

Computer Craft
Houston, TX

Computer Shop
San Antonio, TX

Grice Electronics
Pensacola, FL

Newman Computers
Ann Arbor, MI

Computerland
Niles, IL

Computer Factory
New York City

Computer Mart
New York City

Computer Corner
White Plains, NY

Computer Nook
Pine Brook, NJ

Computer Encounter
Princeton, NJ

Computer Mart
Iselin, NJ

Kobetek Systems
Wolfville, Nova Scotia

AND OTHER COMPUTER STORES

entered from the keyboard to be entered into the text buffer, regardless of any assigned function of the character.

Videowriter is constructed in two parts. The core program does the house-keeping for the features described above (except for the delete command). None of the 26 single letter commands is used by the core program. (Control T initiates the tab set or clear routine.) All of the immediate commands are processed by the core program. Text buffer entry or delete, cursor positioning, screen scrolling, and keyboard entry are managed by the core. Decoding of the 26 single letter commands, command line execution and loop control is done by the core, and control is passed to the vector in the command vector lookup table. Undefined commands return control to the command processing routine.

The other half of Videowriter is a user expandable set of extension routines vectored to by the core program. The user's routine does not need to save any registers or the stack pointer position, but the address on the stack when the extension routine is called must be saved. This is the return address to the command processor. Input and output routines are obvious candidates for the extension routines, since these routines must be tailored to the user's individual disk or tape system. The normal editor functions to search for strings, substitute strings, delete text blocks, copy blocks, move blocks, etc., are implemented in the extension routines.

The character delete routine is a good example. The single letter D or d causes one character to be deleted from the text buffer. D100 will delete a block of 100 characters. 100D will delete 100 characters one at a time, with the results displayed on the screen after each deletion. 30D100 will delete 30 blocks of 100 characters each. The D\ command simply searches from the current pointer position toward the end of the text, looking for a special stop character in the text buffer. Text is then deleted from the cursor to the stop flag, or to the end of text if no flag is set.

The O\ command outputs from the buffer from the cursor to the stop flag or end of text, and the O command saves the entire buffer. The move command moves a block, from the cursor to the stop flag, to a position marked in the buffer by a special flag. The function requires only one byte more than the original buffer size, regardless of the size of the block moved. Copy works similarly except that the original block is not destroyed. It appears that there will be about ten unused command vector positions left in the command vector table for the addition of user functions. These could be used to implement text output processing extensions.

It is my intention that Videowriter be used by simply pointing the cursor and then performing the function doing it without having to count lines or places, etc. All changes to the text buffer are displayed. It has always seemed obvious to me that this is an absolute

requirement for a text editor, but I have never seen another program that does as much for the operator as Videowriter. Since no one else had what I considered to be a "decent" editor, I wrote it myself!

Of course, the current implementation of Videowriter doesn't satisfy me completely. It has one major drawback which must be fixed—the more text between the cursor position and the end of text the slower it runs (block transfers are slow). If text is being entered with 16 K bytes of text following the cursor, a fast typist can enter characters faster than Videowriter can put them into the buffer. This will be fixed by using a line input buffer so that no more than 64 characters will be moved at each entry until the line is full. Nested command loops will be added, probably before you receive this letter. This will allow true macrocommand loops to be entered and executed.

Only two simple routines are needed to allow nested command loops, with no changes to the current command processing scheme. Currently, only 9999 iterations of each loop are allowed, but this will be changed to allow 65535 passes. That should be enough to satisfy anyone! I want to add a display at the upper right corner of the screen to show the workspace remaining. The tab set and clear routine must be modified to

display the position number of each tab stop. And, finally, I eventually want to add a separate command buffer so that huge macrooperation can be executed. The command buffer contents will be saved and loaded just like the text buffer. These are all changes to the core program, and should take another month or two at the most.

Do you like it? Do you have any suggestions for further additions or modifications? If you do I would certainly appreciate your opinions. Of course it isn't complete (as I would like it) now, but it works—and, of course, I am using Videowriter to write this letter! Virtually all of the extensions need rewriting to speed them up. I forgot to mention one point: Videowriter was assembled in TDL's pseudo-8080-like, Z-80 mnemonics. Since most of the op codes are 8080 op codes, rewriting for the 8080 will be simplified. I have machine reproducible flow diagrams for all of Videowriter which are fairly compact—more so than flowcharts.

I will appreciate any comments. Videowriter will soon be running on several other systems so I can get other opinions.

Phillip Hays
Apt 46
825 NW 23rd St
Corvallis OR 97330

Now available! Text Editor, Assembler, Disassembler and a new Video Display Board for ELF II!

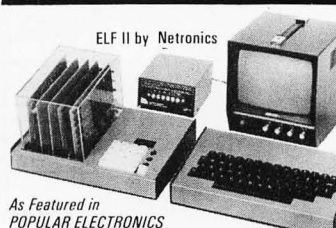
The TEXT EDITOR gives you word processing ability and the ability to edit assembly language programs while displayed on your video monitor. Lines and characters may be quickly inserted, deleted or changed. (Add a printer and ELF II can type letters for you—error free—plus insert names and addresses from your mailing list!)

ELF II's ASSEMBLER translates assembly language programs into hexadecimal machine code for ELF II use. The Assembler features mnemonic abbreviations for instructions (rather than numerics) so your programs are easier to read and debug. ELF II's DISASSEMBLER takes machine code programs and produces assembly language source listings. This helps you better understand the programs you are working with, so they become a lot easier to improve.

The new ELF II Video Display Board lets you generate a sharp, professional 32 or 64 character by 16 line upper and lower case display on your tv screen or video monitor—dramatically improving your unexpanded \$99.95 ELF II. When you get into longer programs, the Video Display Board is really a blessing!

Now Available • Text Editor, Assembler & Disassembler!

ELF II by Netronics



As Featured in
POPULAR ELECTRONICS

Featuring 1802
RCA COSMAC
microprocessor/mini-
COMPUTER
INCLUDES VIDEO
INTERFACE ONLY **\$99.95**

So stop reading about ELF II and get your hands on one! Starting with a \$99.95 ELF II and our super simple *Short Course on Microprocessor & Computer Programming*, you can master ELF II in no time at all! Then, as your understanding grows, you can expand ELF II with advanced add-ons that offer you a lot more power to solve "real world" problems than you would get from "famous name" computers selling for many times ELF II's low price. No wonder IEEE chapters, universities and major corporations are all ordering ELF II to train their personnel! Now you can order your ELF II, direct from the factory, with the coupon below—

Netronics R&D Ltd., Dept BY-3
333 Litchfield Road, New Milford, CT 06776

Yes! I want my own computer! Please rush me—

☐ RCA COSMAC ELF II kit at \$99.95 plus \$3 postage and handling (requires 6.3 to 8 volt AC power supply)

☐ Power Supply (required), \$4.95 postpaid

☐ RCA 1802 User's Manual, \$5 postpaid

☐ Tom Pittman's *Short Course on Microprocessor & Computer Programming* teaches you just about everything there is to know about ELF II or any RCA 1802 computer. Written in non-technical language, it's a learning breakthrough for engineers and laymen alike. \$5 postpaid

☐ Deluxe Metal Cabinet with plexiglas dust cover for ELF II, \$29.95 plus \$2.50 p&h

☐ I am also enclosing payment (including postage & handling) for the items checked below!

☐ I want my ELF II wired and tested with power supply, RCA 1802 User's Manual and Short Course—all for just \$149.95 plus \$3 p&h.

ALSO AVAILABLE FOR ELF II

☐ **GIANT BOARD™** kit with cassette I/O, RS 232-C/TTY I/O, 8-bit P/I/O decoders for 14 separate I/O instructions and a system monitor/editor. **\$39.95** plus \$2 p&h

☐ **Kluge (Prototype) Board** accepts up to 36 IC's, \$17.00 plus \$1 p&h

☐ **4k Static RAM** kit. Addressable to any 4k page to 64k. **\$89.95** plus \$3 p&h

☐ Gold plated 86-pin connectors (one required for each plug-in board). **\$5.70** ea. postpaid

☐ **Expansion Power Supply** (required when adding 4k RAM). **\$34.95** plus \$2 p&h

☐ **Professional ASCII Keyboard** kit with 128 ASCII upper/lower case set, 96 printable characters, onboard regulator, parity, logic selection and choice of 4 hand-shaking signals to mate with almost any computer. **\$84.95** plus \$2 p&h

☐ **Deluxe metal cabinet for ASCII Keyboard**, **\$19.95** plus \$2.50 p&h

☐ **Video Display Board** kit lets you generate a sharp, professional 32 or 64 character by 16 line upper and lower case display on your tv screen or video monitor—dramatically improving your unexpanded \$99.95 ELF II. (Fits inside ASCII Keyboard cabinet.) **\$89.95** plus \$2 p&h

☐ **ELF II Tiny BASIC** on cassette tape. Commands include SAVE, LOAD, ±, ×, ÷, (,).

PHONE ORDERS ACCEPTED!
Call (203) 354-9375

Total Enclosed \$ _____
(Conn. res. add. tax)

CHARGE IT! Exp. Date _____
☐ Visa ☐ Master Charge
(Bank # _____)

Account # _____

programs and produces assembly language source listings to help you understand and improve your programs. **\$19.95** on cassette tape.

SAVE \$9.90—Text Editor, Assembler & Disassembler purchased together, only \$49.95! (Require Video Display Board plus 4k memory.)

☐ **ELF II Light Pen**, assembled & tested. **\$7.95** plus \$1 p&h

☐ **ELF II Color Graphics & Music System Board** kit. **\$49.95** plus \$2 p&h

☐ ELF II connects directly to the video input of your tv set without additional hardware. To connect ELF II to your antenna terminals instead, order **RF Modulator**, **\$8.95** postpaid.

Coming Soon: A-D, D-A Converter, Controller Board and more!

Print Name _____

Address _____

City _____

State _____ Zip _____

DEALER INQUIRY INVITED

What Is an Interrupt?

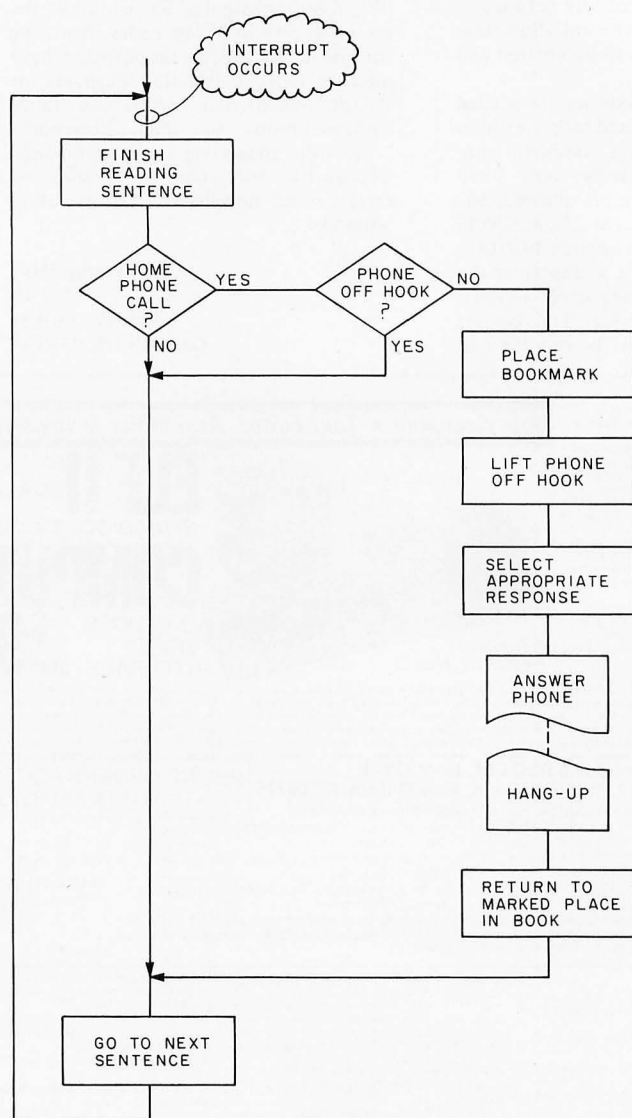


Figure 1: One example of a way to handle a human being's interrupt processing in response to a ringing bell. The ringing bell is like a signal on a multiple source interrupt line of a computer. The first object is to identify the source of the interrupt. If processing is done, the state of the interrupted process (reading a book here) is saved (with a bookmark) while the phone is answered. After the phone call, the reading of the book may be resumed at the place of the bookmark, restoring the original process.

Busy work! It's a terrible thing to inflict on people or computers. Wait loops in input or output operations are busy work for computers, and unless you learn how to tap your computer on the shoulder when you need it, it will probably spend most of its time doing busy work.

As hobbyists, we are always concerned about squeezing the greatest value out of our investments. We want our computers to run as efficiently as possible. Since it is likely that we will be involved in designing and building some of our own IO devices, we should develop an understanding of the concept of interrupts. To efficiently program peripherals for IO purposes it is often necessary to use interrupts.

This article introduces the basic concepts of interrupts, defines the terminology that applies to interrupt mechanisms, and describes the processing events that must occur during the time from the receipt of an interrupt to the return from that interrupt.

Concepts

An excellent example of interrupt processing is the system used in telephones. Let's see why.

We know when someone is trying to call us because the telephone rings. But consider how much time would be wasted if we had to periodically pick up the receiver to see if anyone was on the telephone if the phone had no bell. This periodic method is called *polling*; it works well for telethons and radio talk shows. However, it's not the best method for normal home telephone installations. Assume you receive an average of one or two phone calls a day at home. Imagine yourself as a processor and the callers as the IO requests from a keyboard. The order of magnitude differences in this example are about the same as with your processor and its IO. The bell on your telephone is, of course, an *interrupt*. It is an

BAS

BUSINESS APPLICATION SOFTWARE

**ACCOUNTS PAYABLE
ACCOUNTS RECEIVABLE
GENERAL LEDGER**

* COMPATIBLE MODULES
* ALSO INDEPENDENTLY INSTALLABLE
* PROGRAMS IN EACH MODULE ALLOW:

All File Maintenance
Utility File Listing
Individual Account Inquiries
Original Journals
Automatic Master File updating
Fast Accurate Keyboard input

A/R : CUSTOMER STATEMENTS
AGEING & TRIAL BALANCE
SALES/ C/R JOURNALS
A/P : CHECK WRITING
AGEING & TRIAL BALANCE
ACCT. # VERIFICATION
G/L : DETAIL HISTORY INQUIRY
TRIAL BALANCE
P&L & BALANCE SHEET

BUSINESS APPLICATION SOFTWARE

Division of ELP Development Co., Inc.
16755 Littlefield Lane, Los Gatos, CA 95030

ITEM	A/R	A/P	G/L
System Manual	\$ 8.00 <input type="checkbox"/>	\$51.00 <input type="checkbox"/>	\$ 19.00 <input type="checkbox"/>
Program Listings	58.00 <input type="checkbox"/>	51.00 <input type="checkbox"/>	160.00 <input type="checkbox"/>
Programs on Disk *	89.00 <input type="checkbox"/>	81.00 <input type="checkbox"/>	250.00 <input type="checkbox"/>

AR, AP, GL on disk with manual \$390.00 COD orders accepted
Immediate shipment upon receipt of certified check or money order
*CP/M CBASIC Compatible source & Object code Single ☐ or Dual Density ☐

NAME _____
Address _____
City _____ State _____ Zip _____

ATTENTION SWTPC DISC SYSTEM USERS

All Ed Smith's M6800 SOFTWARE TOOLS

are now available in mini-FLEX format as well as Smoke Signal Broadcasting format. See July BYTE for diskette media prices. Disc users specify SSB OR SWTPCO.

- M6800 RELOCATING ASSEMBLER AND LINKING LOADER software for rapid program development and debugging. Some of its features are RELOCATABLE CODE—FULL ALPHABETIZED CROSS REFERENCE LISTING—BOTH GLOBAL AND LOCAL LABELS—LISTING OF EXECUTION TIME—RELATIVE BRANCH TARGET ADDRESS—ES-8 CHARACTER LABELS—CORESIDENT EDITOR—ENGLISH ERROR MESSAGES—80 COLUMN LISTING USING PR-40—etc.
- M6BAS .cassette \$50.00
M6BAS-D .minifloppy \$55.95
- M6800 RELOCATABLE DISASSEMBLER AND SEGMENTED SOURCE TEXT GENERATOR. This software tool enables you to modify and adapt those large sized object programs and re-assemble them on your system without requiring enormous memory. This program will produce segmented source text files with all the external linkage information required for re-assembly using the above Relocating Assembler.
- M68RS .cassette \$35.00
M68RS-D .minifloppy \$40.95
- M68ASPK Above two programs on single diskette \$85.00
- The above two programs are furnished in relocatable formatted code with instruction manuals and commented assembly listings. The loader is also supplied in standard MIKBUG format on cassette or as a binary file on disc to initially load the linking loader at any desired address.
- The linking loader is also available in EPROM on two 2708's for \$45.00. Specify desired address and version, i.e. cassette, FLEX or SSB.

S-M-I-T-H-B-U-G

FIRMWARE from Ed Smith's SOFTWARE WORKS

A 2k Monitor Disassembler-Trace Debugging Tool in EPROM. Use as stand-alone monitor or as an adjunct to your Smartbug or Swtbug. Requires ACIA as control port. Provides all the monitor commands (23) you could ever ask for, plus the convenience of a mnemonic disassembler and single stepping disassembler-trace display. Interactive use of single or dual breakpoint with trace pickup at breakpoint, plus many new monitor functions and sub-routines, makes this a super tool you will love to work with. Uses location \$F800 to \$FFFF. Furnished on two 2708's or one 2716. Includes Manual and commented assembly listing. Specify ACIA location and present monitor in order to keep \$A000 RAM compatibility.

SMITHBUG ON 2708's \$60.00
SMITHBUG USER SUPPLY \$40.00

Get under Ed Smith's Software RUG (Relocating assembler Users Group). All RUG members will have use of a building software support library in relocatable format. Upcoming items are a Floating Point package and a Trig package.

Order direct by check. Specify system configuration if other than SwTPCo. California residents add 6% sales tax.

Ed Smith's SOFTWARE WORKS

P.O. Box 339, Redondo Beach, CA 90277, (213) 373-3350

BYTE

Back Issues for sale



The following issues available:

- November 1976
- December 1976
- February-December 1977
- February-December 1978

Cover price for all issues thru August 1977 is \$1.50 plus \$.25 postage and handling (\$3.50 total foreign). September '77 thru '78 issues are \$2.00 plus \$.50 postage and handling (\$4.00 total foreign).

Send requests with payment to: **BYTE Magazine**
70 Main Street
Peterborough
NH 03458
Attn: Back Issues

Radio Shack Computer Users

TRS-80

monthly newsletter

The largest publication devoted to the TRS-80 System

- Business
- Personal Finance
- Practical Applications
- Gambling—Games
- Latest RADIO SHACK Developments
- Software Exchange
- Market Place
- Questions and Answers
- Program Printouts

• . . . and more

MAJOR PROGRAMS PUBLISHED MONTHLY • INCOME TAX PROGRAM — LONG AND SHORT FORMS • INVENTORY CONTROL • EXTENSIVE MAILING LIST AND FILE PROGRAM • PAYROLL • STOCK SELECTION • PICKING WINNING HORSES • RENUMBER PROGRAM LINES • CHESS • CHECKERS • FINANCIAL APPLICATIONS PACKAGE • PERSONAL FINANCE PACKAGE • GRAPHICS • STATISTICS • MATHEMATICS • EDUCATION . . . AND MORE

\$24. Per Year



H & E COMPUTRONICS INC.

MATHEMATICAL APPLICATIONS SERVICE™

Box 149RB, New City, New York 10956 (914) 425-1535

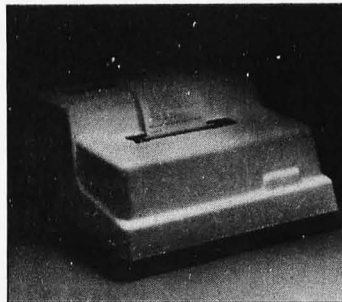
Send for FREE Software Catalogue (Including listings of hundreds of TRS programs available on cassette and diskette).

Why Pay More?

Why pay for more printer than you need? Our series 40 printers offer more features for less bucks than any other commercial quality printer on the market today. A complete stand-alone 40 column impact dot matrix printer with a 64 character ASCII set. Includes power supply, casework and interface electronics. Single quantity price for the parallel ASCII interface model is \$425. Serial RS232/current loop interface models start at \$575. OEM discounts available.

For more information write to:

MPI 2099 West
2200 South, Salt
Lake City, Utah
84119 or call (801)
973-6053.



SHOULD it be a Heathkit® ?

Whether you are considering the purchase of an additional peripheral or your first computer you should know more about Heath® computer products. Heathkit® has a continuing commitment to selling well-documented computer kits and software. Are they for you? How can you find out?

Read Buss: The Independent Newsletter of Heath Co. Computers, where information on new products is printed as it leaks out of Benton Harbor, not held back to suit a marketing plan. Buss is not a company-controlled publication, so it can deal with weaknesses of Heathkit® products as well as their strengths. It features news of compatible hardware and software from other vendors. Every Buss issue has candid accounts of experiences of Heathkit® owners. Results of their discoveries, which often include hardware modifications, save subscribers headaches--and money. That's proven by two years' experience. So Buss can guarantee a full refund any time you're not satisfied.

Buss is mailed first class (by airmail outside North America). The 24-issue subscription gives you the choice of starting with the latest issue or with available back issues (about 8 are still in stock). Send \$ 8.00 for 12 issues or \$ 15.25 for 24 (overseas, \$10.00/12; \$19.25/24 US funds) to: Buss

325-B Pennsylvania Ave., S.E.
Washington, DC 20003

**The Independent Newsletter
of Heath Co. Computers**

excellent way to resolve the asynchronism and speed differentials of the telephone communications system. Interrupts can resolve the same fundamental mismatches for computers as well.

Terminology

Let's carry this analogy a little further to introduce the terminology that refers to variations of the basic interrupt concept.

If your phone is ringing, and you are about to process an interrupt, what are your reactions? How does your interrupt processing work?

More than likely, you will perform a sequence of actions precisely analogous to those your microprocessor performs when it receives an interrupt. Figure 1 is a flowchart of the typical procedure we would run through for a telephone interruption. It consists of both the *housekeeping* chores of switching from the background task you were doing, reading, to the interrupt task, answering the phone, and back again in an orderly and complete fashion, as well as the interrupt handler itself.

In the computer an interrupt is a special control signal that is sent to your microprocessor when a given asynchronous event, such as a switch closure, or an IO ready signal, is detected by your system. It is the mechanism by which your processor is forced to take note of that exceptional event.

The interrupt causes your processor to transfer control to a set of instructions known as the *interrupt handler*. The interrupt handler is nothing more than a pre-coded contingency plan in the form of a subroutine that may be called at any time in response to an interrupt signal. What you do in this subroutine is limited only by the software capabilities of your processor.

In microprocessors, interrupt processing is basically a software technique with varying degrees of hardware support depending on your particular processor and system. The term *vectored interrupt* refers to a simple method of reacting to an interrupt. The processor is sent to the interrupt handler which will lead the processor through steps to determine the source of the interrupt, initiate appropriate actions and return to the point of interruption. The *vector* is simply the starting address of the interrupt handler, and is supplied either externally or internally, depending upon your particular processor's hardware.

Microprocessor integrated circuit designers who seek to minimize the hardware requirements in their processors often

assign a fixed location or set of locations in the processor's address space to hold the vector(s). The 6800 processor uses this approach, as does the Texas Instruments TMS-9900. Other processors such as the 8080 receive their vectors directly from external sources, a method which usually involves more system hardware.

The built-in process that occurs in your microprocessor chip is usually limited to saving the program counter and the processor's status register, masking subsequent interrupts, and then *transferring control* to your interrupt handler (loading the program counter with the interrupt handler's starting address). The task of determining where the interrupt came from is left to the interrupt handler itself. In the simplest case, where you have only one device tied to an interrupt line, the origin of the interrupt is implied. Since we may at some time have more devices than we have separate interrupt lines, we should also know how to make a more sophisticated system capable of handling many devices.

To see how multiple interrupts are handled, consider another analogy. Assume you had just settled back into your easy chair after finishing with the telephone interruption, when suddenly a pair of hands covers your eyes and a voice says, "Guess who?" You've been interrupted again, and you don't know which of your 12 children it is, so you will have to save your place again, and begin by saying, "Is that you Olen?". . . "No.". . . "Is it you Travis?". . . "No.". . . "Is it you Mary Ellen?". . . etc, until you get a positive response. In much the same way, several devices can use a single common interrupt line to your processor so that, once the interrupt handler is initiated, it can interrogate all the devices to see which one sent the interrupt signal. To accomplish this, it is customary to have a *device status register* in the microprocessor's address space for each individual device. The data in this location indicates the device's current status: busy or ready.

Now suppose this game of guess-who is very popular with your children, and they are all playing it on you, some much more often than others. Your best strategy would probably be to adopt an ordering scheme to *optimize* the handling of these many interruptions. This simply means that you would guess the names of the children who were the most frequent players first, and check the least likely ones last. Similarly, in interrupt processing you should arrange the order of checking the device status registers of your IO units from the most frequent source of interrupts to the least

The **8100** by **HUH ELECTRONICS**

An S-100 Bus Adapter/Motherboard for the TRS-80
plus a whole lot more!!!



- S-100 BUS INTERFACE
- 6 SLOT MOTHERBOARD

- SERIAL RS232/20ma I/O
- PARALLEL INPUT AND OUTPUT
- SPACE FOR 16K DYNAMIC RAM
- CAN USE LEFT OVER 4K CHIPS
- LOW COST—PRICES START AT \$185*
- AVAILABLE IMMEDIATELY

The 8100 allows a Radio Shack TRS-80 computer to be interfaced to the popular S-100 Bus for memory expansion and extended I/O capabilities. For example, you can now easily add more memory, floppy disc systems, PROM boards, printer interfaces, multi-purpose I/O boards, AC device controllers, and a whole host of other varied peripherals.

The 8100 has its own built-in 6 slot motherboard which includes our unique card guide system which keeps the boards in their places.

The 8100 has support circuitry and sockets for eight 16K dynamic RAM chips allowing you to expand the memory of your TRS-80 by 16K without having to buy any S-100 RAM boards.

If you purchased an expansion memory kit for TRS-80 you could be left with eight 4K RAM chips and nowhere to put them! Well, they can go in the RAM sockets instead! That's right, you can use either 4K or 16K chips and address them anywhere you like.

The 8100 has a full RS232/20 ma serial interface who's features include: RS232 and 20 ma current loop interface, software programmable baud rate from DC to 56K baud, software programmable modem control lines, on board DTR-DS connector and much more.

The 8100 also has an 8 bit parallel input port and an 8 bit parallel output port. Both are latched, have both positive and negative strobe inputs and outputs and have plenty of drive capability.

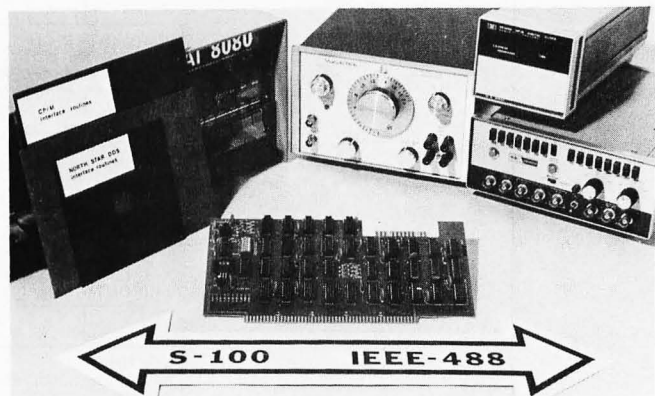
PRICES START AS LOW AS \$185* (S-100 BUS INTERFACE ONLY)



1429 Maple St.
San Mateo, CA
94402
(415) 573-7359

CALL OR WRITE FOR COMPLETE PRICING
INFORMATION AND MORE DETAILS.
THE 8100 IS AVAILABLE FROM LEADING
COMPUTER DEALERS OR FACTORY DIRECT
DEALER INQUIRIES INVITED
*Extra S-100 connectors, RAM support,
I/O circuitry optional.
USA DOMESTIC PRICE ONLY.

Need Intelligence in your 488 Instrumentation System ???



Get it with your favorite S-100 computer and the P&T-488 Interface Board.

The P&T-488 Interface Board gives your S-100 computer the ability to be a talker, listener, or controller on the IEEE-488 instrumentation bus. Three software packages are available: 1) Driver for **North Star DOS/BASIC** 2) Driver for **CP/M** which can be used by **MBASIC** or **CBASIC** 3) Driver for direct assembly level programming (for generating customized systems.) Price of the P&T-488, assembled and tested with any one of the software packages, is \$400.



PICKLES & TROUT
P.O. BOX 1206, GOLETA, CA 93017, (805) 967-9563

frequent. By ordering your interrupt servicing this way, you can add significantly to the efficiency of your system.

By now you've probably realized that the idea of letting multiple devices share one interrupt line is problematical: two devices may want to interrupt the processor at the same time. In terms of our analogy, all 12 of your children may want to play the guess-who game with you at the same time. The way to handle this

situation is to say, "Hold it! I will play the game with each of you. . .but only one at a time." By doing this you act on one interrupt while you *mask out* the rest.

The concept of *maskable interrupts* is incorporated in many of today's processors. There is usually a mask bit or bits used to block or *mask* the interrupt signal from the processor. This masking is frequently part of the built-in process on your microprocessor chip to protect the function of saving critical information, such as the program counter and status register, from subsequent interrupts. Once masked out, your system's design will determine if a subsequent interrupt will be held pending or lost. Interrupts that are kept pending are often referred to as *queued interrupts*. Sometimes circuitry external to the processor chip itself is used to give the pending interrupts an order of priority in much the same way as you might tell your children to line up in the order of youngest to oldest to play the guess-who game. The *N level priority* interrupt capabilities that are mentioned as features of microprocessor systems refer to this type of interrupt queuing. A higher priority interrupt that arrives after several low priority ones will usually bump the lower priority interrupts down in the queue.

For those cases where an interrupt must get the processor's attention right away, a *nonmaskable interrupt* is usually also provided in the chip's structure. This control line is for a very high priority function of your choice, which can override the maskable interrupts even if they are in progress. This is valuable for very high speed IO, such as a floppy disk unit, and for hardware emergencies such as fire or power loss routines. Your system reset is usually a non-maskable interrupt.

Mechanisms

Now that you have a feel for the terminology, let's take a look at the mechanisms and processing that are common to all interrupt routines. Figure 2 is a typical flowchart of the functions necessary to accomplish the transfer of control from the background processing to the interrupt handler and return. You may think of this as putting the background process "on hold" while the interrupt is processed and recommencing the background process when it returns. The background process is not affected by what has happened; thus the interrupt processing is completely transparent to the background process and may be executed at any time without fear of disturbing it. The only definite change is

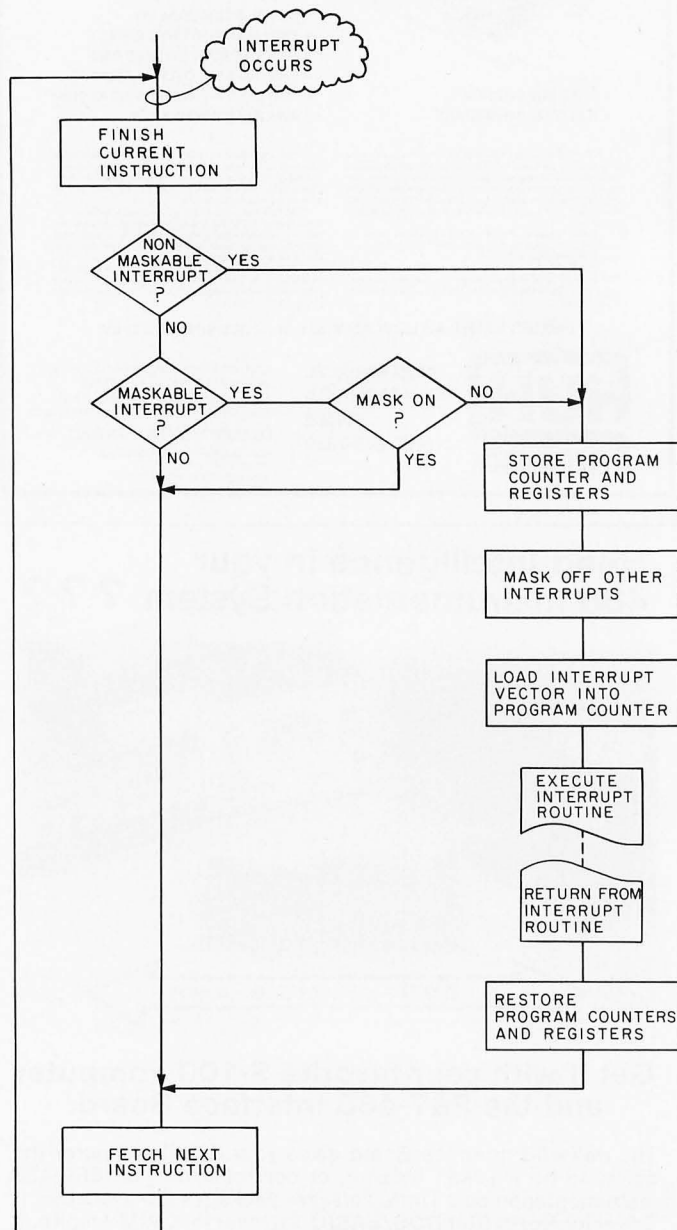


Figure 2: Analogous to the human interrupt processing of figure 1, the typical computer's interrupt processing activities are shown by this chart. The differences between the two figures (1 and 2) are largely in the activities described in each box; the form of the processing logic in this particular set of examples is nearly identical.



READY-TO-RUN SOFTWARE FOR YOUR NORTH STAR COMPUTER

NEW! LANGUAGE TRANSLATOR PKG. \$60.00
ENGLISH TO JAPANESE - Teaches rudimentary conversational Japanese - easy to use, easy to learn.

TUTORIAL III \$40.00
Release version 4, covers many new commands plus customizing program for BASIC.

INTEGRATED BUSINESS SYSTEM \$175.00
Designed for dual floppy drive system - contains A/P; A/R; Pay; Gen. Ledger; Letter Generator; Bus Stat; Inventory; Sales/Sales Analysis.

MEDICAL/PROFESSIONAL BILLING \$35.00
Doctors, Lawyers and Dentists - use this to issue statements, track receivables, age accounts, etc.

MAILING LABEL PROGRAM \$35.00
Lots of help for your direct mail program. Add, delete, maintain mailing list and print labels.

ALL SOFTWARE PACKAGES ARE WRITTEN IN BASIC ON DISKETTE ONLY

Send for Free Catalog

Packages containing Program Listings only are available.

(714) 774-1270



AJA SOFTWARE

P.O. Box 2528 • Orange, CA 92669

22 START-AT-HOME COMPUTER BUSINESSES

In "The Datasearch Guide to Low Capital, Startup Computer Businesses"

CONSULTING • PROGRAMMING • SOFTWARE PACKAGES • COM • FREELANCE WRITING • SEMINARS • TAPE/DISC CLEANING • FIELD SERVICE • SYSTEMS HOUSES • LEASING • SUPPLIES • PUBLISHING • TIME BROKERS • HARDWARE DISTRIBUTORS • SALES AGENCIES • HEADHUNTING • TEMPORARY SERVICES • USED COMPUTERS • FINDER'S FEES • SCRAP COMPONENTS • COMPUTER PRODUCTS AND SERVICES FOR THE HOME.

Plus - Loads of ideas on moonlighting, going full-time, image building, revenue building, bidding, contracts, marketing, professionalism, and more. No career planning tool like it. Order now. If not completely satisfied, return within 30 days for full immediate refund.

• 8½ x 11 ringbound • 156 pp. • \$20.00

Phone Orders **901-382-0172**



DATASEARCH

incorporated

5694 Shelby Oaks Dr., Suite 105, Dept. B, Memphis, TN 38134

Rush _____ copies of "Low Capital Startup Computer Businesses" at \$20 per copy to me right away.

NAME/COMPANY _____

ADDRESS _____

CITY/STATE/ZIP _____

☐ Check Enclosed ☐ Bankamericard ☐ Master Charge



is serious about **CAI**

MICROPI introduces **COMMON PILOT**, the only computer-assisted instruction language that makes a micro-based system comparable to the most expensive CAI system in the world! Features include floating point, matrices, scientific functions, string manipulation, pattern matching, dynamic indirect execution of strings, graphics (on certain terminals), and program modules of virtually any length, limited only by disk capacity. Completely compatible implementations are available for a wide variety of computers including 8080/Z80 for North Star DOS or CP/M (\$275), Helios II (\$295), TRS-80 (\$195), SwTPC 6800 (multi-user version from SwTPC), TERA 8510, ODELL-85, Alpha Microsystems and more, including the possibility of implementation on any system with interactive **PASCAL**. Don't confuse **COMMON PILOT** with less powerful versions of **PILOT**.

Also available, a cassette-based subset of **COMMON PILOT** written in Microsoft BASIC for TRS-80, Apple and others (\$85).

MICROPI also offers quality CAI courses written in **COMMON PILOT**. **MICROPI** will pay author royalties for quality CAI materials accepted into our catalog.

If you are serious about CAI, send \$6 for the **COMMON PILOT AUTHOR'S GUIDE** and see what a state-of-the-art CAI system is all about.

2445 N. Nugent

Lummi Is., WA. 98262

DATAFACS

Software now for:
Micropolis and NorthStar

Good Software is Essential for an Efficient Business. Now, the finest in software at a price you can afford. We are definitely the affordables!

PROGRAMS CURRENTLY AVAILABLE:

INVENTORY PROGRAM PACKAGE

- Inventory Addition • Update
- Analysis (Current month) • Analysis (Year to date)
- Search • Vendor File

Also generates 7 additional user reports and much, much more.

— **Cost \$175.00** —

MAILING LIST PROGRAM (Single Drive)

*Print formatting in 80 or 132 columns.

— **Cost \$20.00** —

The above programs are designed to run under the following:

- *CP/M in CBASIC } Micropolis and NorthStar
- 2 drives required
- *CP/M in BASIC E } also IMSAI IMDOS
- (2) 8" disc IBM 3740 Format required

EXTENSIVE CONTRACTORS ESTIMATING PROGRAM

Literature available upon receipt of your letterhead

Currently Under Development:

- Billing } Available
- Payroll } early in '79
- General ledger } in new CBASIC-2

Specializing in custom software for the AM-100**

Datafacs System Inc. Eastern Division
2440 W. Catalpa, Chicago, Ill. 60625

Phone (312) 784-0300

*CP/M is a Trademark of Digital Research Corp.

**AM-100 is a Trademark of Alpha Microsystems.

Table 1: The following list of responsibilities must be jointly met by both the programmer and the system being programmed, if interrupts are to be properly handled. The key item to remember is that when the interrupt occurs, the critical data values which determine the state of the machine must be saved so that at the end of the interrupt process, the original process can be resumed "as if the interrupt never happened."

- Sensing an interrupt signal and determining appropriate response.
- Setting the mask to protect the processor from subsequent interrupts.
- Note where you are by saving the program counter and status register.
- Transferring processor control by loading the program counter with the interrupt vector address.
- Executing the interrupt handler which may:
 - save accumulator(s).
 - save index register(s).
 - save pointers(s).
 - search for interrupt source.
 - satisfy device request.
 - restore pointer(s).
 - restore index register(s).
 - restore accumulator(s).
 - clear the interrupt mask.
- Resume normal processing by restoring the program counter and the processor status register.

that the background processing will slow down somewhat because the processor has to take extra time to service the interrupt(s). As a result, any real time clocking in the system will be offset by that interrupt processing time.

The joint responsibility of the processor and you, the interrupt routine programmer, is to insure that the background process is not disturbed. These responsibilities are simply stated in table 1.

Within the interrupt handler it is not always necessary to save all of the working registers for every interrupt, but you must at least save and restore every register used in your routine.

Deciding when to remove the interrupt

protection (clear the mask) is your responsibility. The key is to pick a point which comes after the saving of the critical registers. The mask shouldn't be removed in the middle of your interrupt routine unless the routine is *reenterable*. Reenterancy is a term that refers to software routines that find new memory locations to store their working data each time that they are re-entered before they have been exited. The significance of this is that if you clear the mask and a subsequent interrupt arrives, stops your current interrupt processing, and begins to use the same interrupt routine you were just using, you must ensure that it doesn't destroy your current working data. The safest procedure is to stay masked throughout the interrupt processing until you become experienced with the reentry software techniques. Figure 3 shows the division of these interrupt processing duties for a typical micro-computer system.

If your processor's monitor was supplied by the manufacturer, there is much to be learned from studying its interrupt handler section. Look for the methods used to accomplish the basic steps we have outlined above, then write your own simple interrupt handler, modify the interrupt vector to point to your routine instead of theirs, and execute your interrupt handler.

Once you have done this successfully, you will have developed an appreciation of how the modern digital computer, large or small, services the requests of so many peripheral devices seemingly simultaneously. Understanding interrupt driven processing, which is the central concept of computer operating systems, will help you to grasp the awesome power that lies within your own personal computing system. ■

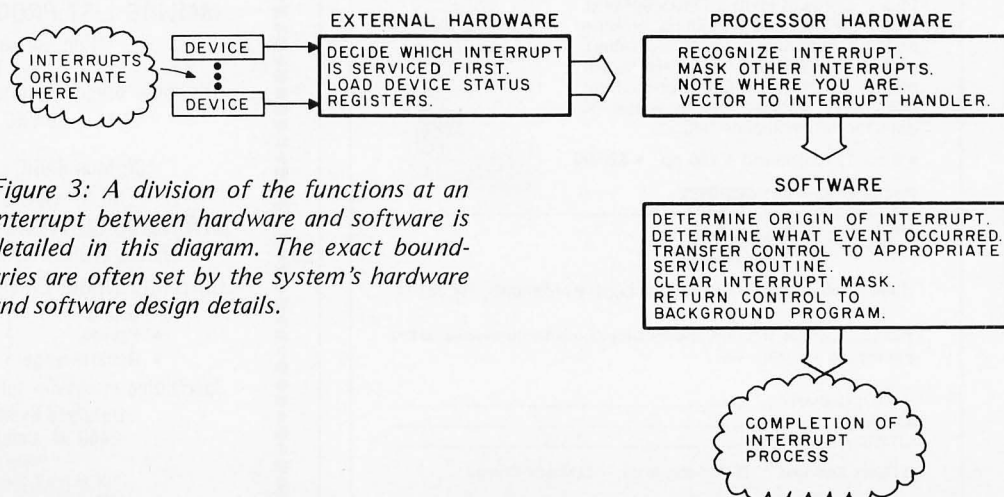
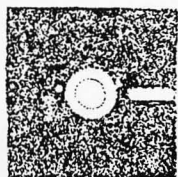


Figure 3: A division of the functions at an interrupt between hardware and software is detailed in this diagram. The exact boundaries are often set by the system's hardware and software design details.



CP/M™ LOW-COST MICROCOMPUTER SOFTWARE

CP/M™ OPERATING SYSTEM:

- Includes Editor, Assembler, Debugger and Utilities.
- For 8080, Z80, or Intel MDS.
- For IBM-compatible floppy discs.
- **\$100**-Diskette and Documentation.
- **\$25**-Documentation (Set of 6 manuals) only.

MAC™ MACRO ASSEMBLER:

- Compatible with new Intel macro standard.
- Complete guide to macro applications.
- **\$90**-Diskette and Manual.

SID™ SYMBOLIC DEBUGGER:

- Symbolic memory reference.
- Built-in assembler/disassembler.
- **\$75**-Diskette and Manual.

TEX™ TEXT FORMATTER:

- Powerful text formatting capabilities.
- Text prepared using CP/M Editor.
- **\$75** Diskette and Manual.



DIGITAL RESEARCH

P.O. Box 579 • Pacific Grove, California 93950
(408) 649-3896



APPLE II USERS WE'VE GOT SOFTWARE!

We have the best disk file management system in the market. Use it for your mailing list, accounts receivable, payables, personnel records, etc.

In addition, we offer not only the most fascinating basic programming course for people with little or no programming experience, but also commercial software for North Star Horizon Computers and Ohio Scientific Computers, and over one hundred programs for Apple II Computers.

The file management system is available for \$60.00 and the programming course for \$30.00.

Please specify tape or disk version.

*Check, money orders and credit cards accepted.
Florida residents add 4% tax.*

TRANS-DATA CORPORATION

161 Almeria Avenue
Coral Gables, FL 33134
(305) 576-7666

Send \$1.00 for software catalog or call our toll free number
(800) 327-8455.



A Message to our Subscribers

From time to time we make the BYTE subscriber list available to other companies who wish to send our subscribers promotional material about their products. We take great care to screen these companies, choosing only those who are reputable, and whose products, services, or information we feel would be of interest to you. Direct mail is an efficient medium for presenting the latest personal computer goods and services to our subscribers.

Many BYTE subscribers appreciate this controlled use of our mailing list, and look forward to finding

information of interest to them in the mail. Used are our subscribers' names and addresses only (no other information we may have is ever given).

While we believe the distribution of this information is of benefit to our subscribers, we firmly respect the wishes of any subscriber who does not want to receive such promotional literature. Should you wish to restrict the use of your name, simply send your request to BYTE Publications Inc, Attn: Circulation Department, 70 Main St, Peterborough NH 03458. Thank you.

OMSI PASCAL™



Reliable, efficient, production Pascal compiler for the DEC PDP-11 family, including the LSI-11.

Full Language

All elements of Standard Pascal, including the capabilities not found in student Pascals. Extensions for complete low-level control with direct memory access, embedded assembler code, FORTRAN procedure interface.

Production

Integrated with DEC operating systems (RSTS/E, RT11, RSX, IAS). Compatible with existing file structures, editors, and utilities. Interactive symbolic Debugger with breakpoints and full trace.

Performance

Fast one-pass compiler runs in 16K words (32KB), translates thousands of lines per minute. Produces compact PDP-11 code that runs circles around interpretive or threaded languages.

Proof

In production use since 1975 — now at more than 300 customer sites. Warranted for 1 year after purchase.

Write for information, demonstration, manuals, and benchmark.

Oregon
minicomputer
Software inc.

2340 SW Canyon Road
Portland, Oregon 97201
(503) 226-7760
TWX 910-464-4779

DEC, PDP, RSTS/E, RT-11, RSX, and LSI-11 are trademarks of Digital Eq. Corp.

History of Computers

Keith S Reid-Green
Technical Staff
David Sarnoff Research Ctr
Princeton NJ 08540

The 650 was the most popular IBM computer during the 1950s until it was supplanted by the 1401 at the end of the decade. The machine was used widely by small banking, accounting and insurance companies which did not require the capabilities of the relatively powerful 705, and it is safe to say that IBM's current share of the commercial data processing market got its initial impetus from the successful marketing of the 650. However, the sophisticated personal computer user of today wouldn't give a passing glance to a machine of its capabilities.

The original 650 consisted of three units: the power supply, console and card reader/punch. Later modifications allowed for the addition of an on line printer and magnetic tape units, but the original 650 was strictly cards in and cards out. A tabulating machine such as the 407 was therefore required to produce printout, but this system was not satisfactory from financial and ecological points of view, since punching cards as an intermediate step to a printed page is very wasteful. The really bad news, however, was storage. Either 1000 or 2000 10 digit deci-

mal words could be stored on a magnetic drum in bands of 50 words, each band having its own read head. Since the drum rotated at 12,500 revolutions per minute, average access time (half a revolution) was a little less than one hundredth of a second, or in modern terms 9,600,000 ns.

The problem of rotational delay could have been a serious detriment to processing speed except for a very clever assembly program. Modern computers using random access memory are programmed on the assumption that, in the normal course of execution, instructions are stored in consecutive locations. Had this been the case on the 650 it would have reduced processing speed to roughly one instruction per drum revolution, or 12,500 program steps per minute, because the processor was not fast enough to process an instruction in less time than it took for the next instruction to pass under the drum's read heads. However, instructions consisted of an operation code and two addresses; a data address and a next instruction address. Theoretically, the programmer could organize an optimum way to store the finished program so that the completion of each instruction coincided with the arrival of the next instruction under a read head. Since execution times varied from one instruction type to another, it was very difficult to optimize a program by hand.



Photo 1: The basic IBM 650, consisting of power unit, processor and card reader/punch.

The IBM 650

Fortunately, the SOAP assembler (SHARE optimum assembly program) did a pretty good job of optimizing the object programs it produced.

The instruction execution process was accomplished through a minimal number of registers (see figure 1). An instruction was brought from the drum to the program register, where the operation code and data addresses were passed on to the 2 digit operation register and 4 digit address register. If necessary, the data word specified by the address register was brought to the distributor, where it may have been used in conjunction with the lower or upper accumulators (the accumulators were logically considered as a

20 digit number separated into upper and lower halves). Then the instruction address was moved from the program register to the address register in order to process the following instruction.

Validity checking of numbers took place whenever they were transferred among registers or to the drum. Digits were stored in bi-quinary form, requiring seven binary bits per digit, in which one of two bits represented either 0 or 5 and one of the remaining five bits represented 0, 1, 2, 3 or 4. The sum of the two "on" bits could therefore represent the digits 0 thru 9 and the validity check ensured that exactly one bit of the pair and one of the group of five was "on."

Given the other constraints of the 650, the instruction set was reasonably complete, including read and punch, branching, add, subtract, multiply and divide, shifting and even a table lookup instruction. Routines

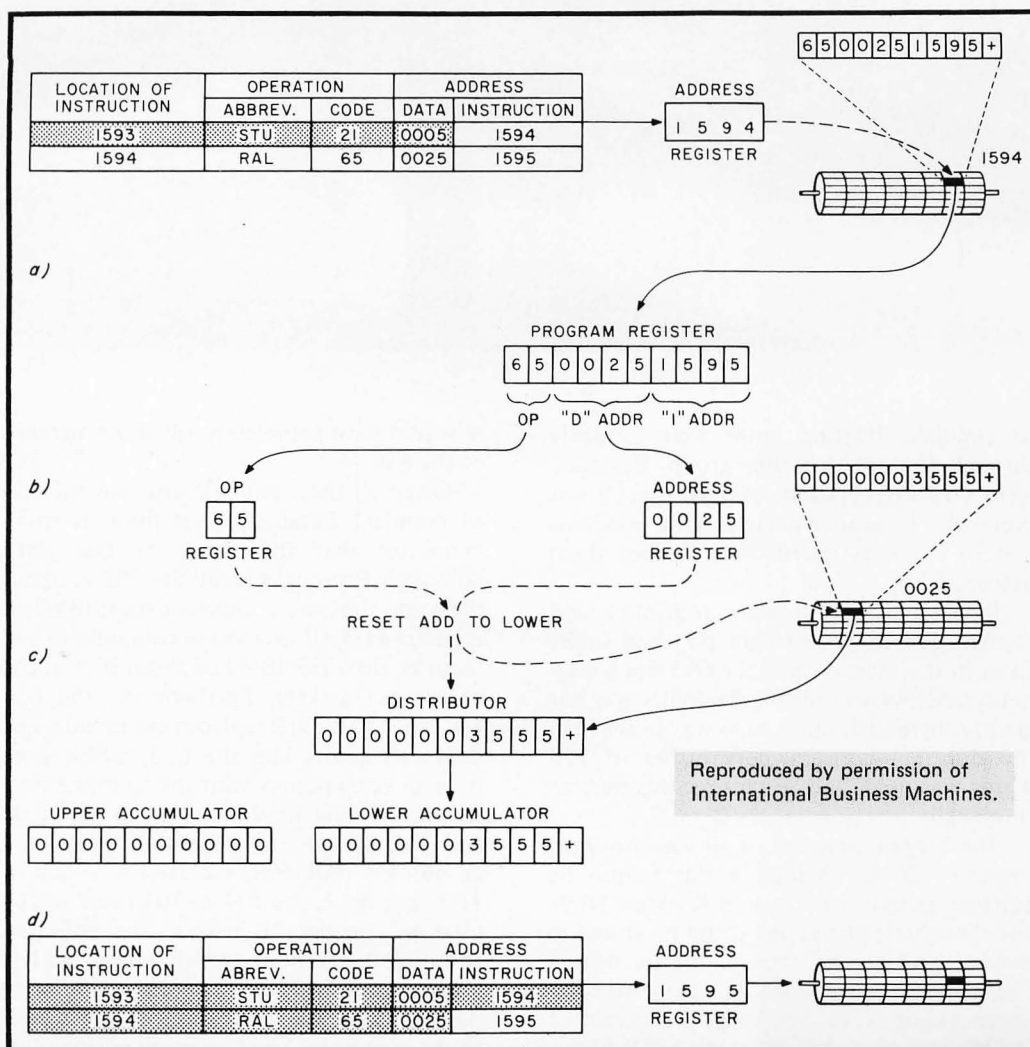


Figure 1: The instruction execution cycle of the IBM 650.

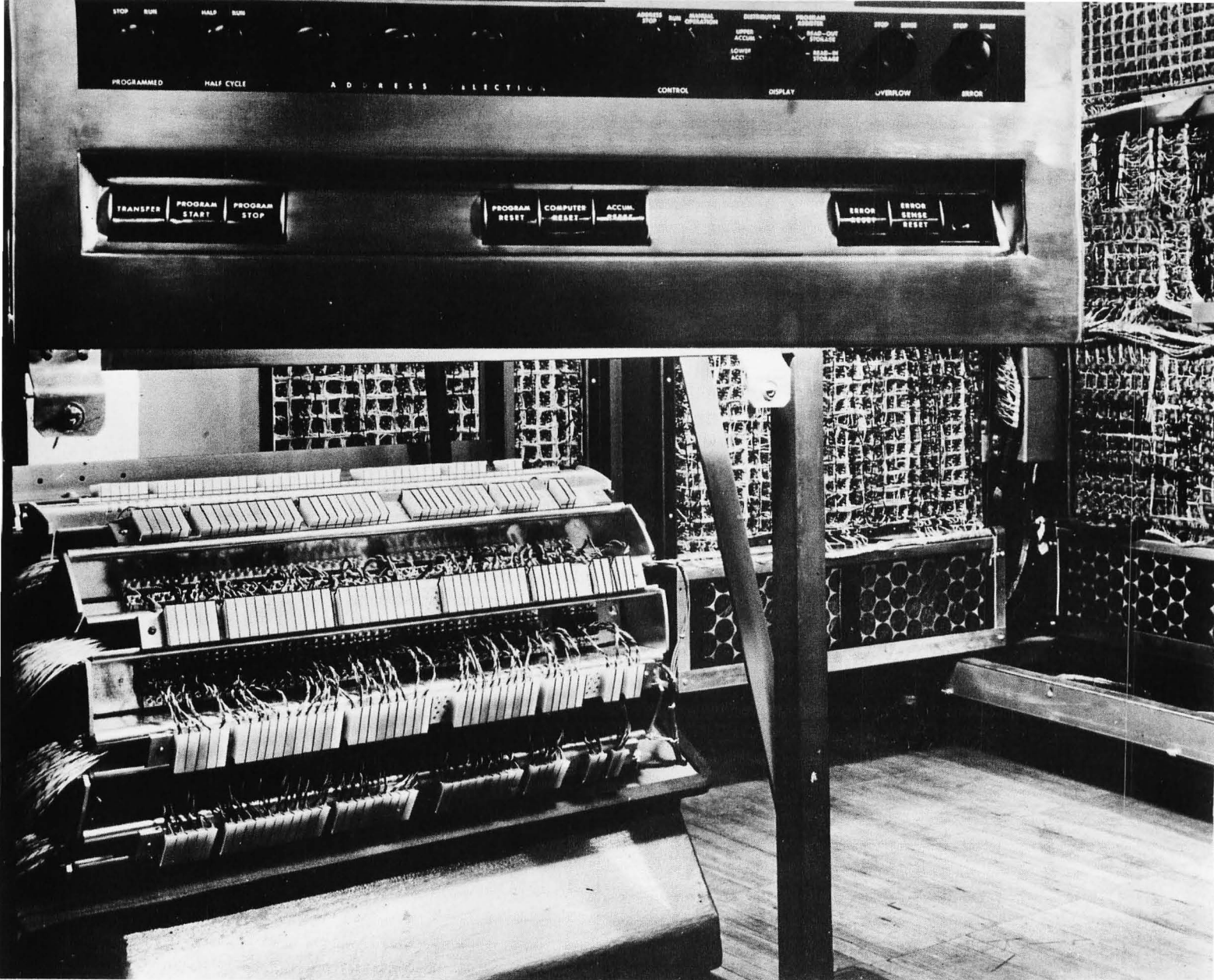


Photo 2: The magnetic drum memory showing positioning of the read heads.

to simulate floating point were available through the SHARE user group, but they were slow in operation. In most cases it was preferable to assume decimal point positions and to use shift instructions to align them before adding.

Input and output were restrictive and clumsy due to reliance on punched cards. Even in the later days of the 650 when magnetic tapes were available, flexibility was not greatly increased. Since tape was faster than the drum, a core memory buffer of 120 words was used, and all tape records were of this length.

The biggest problem of all was the small memory. 2000 10 digit words cannot be equated exactly with, say, 8 K bytes. While five alphabetic characters could be stored in one 650 word, each number and each instruction took up a full word. In a personal computer having a 16 bit word, a program of 2000 instructions takes less than 4 K bytes.

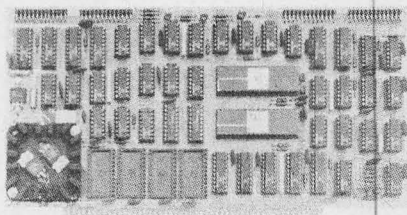
It would have completely filled the memory of the 650.

Given all these failings, why was the 650 so popular? Because it was the only mini-computer that IBM made at that time. Although Burroughs built the 205 at about the same time, no company except IBM had established itself as a viable computer manufacturer (in 1959 IBM had about 90% of the computer market). Furthermore, the 650 was seen as a natural replacement for punched card calculators like the 602, which were used in conjunction with the so-called electric accounting machines, sorters, collators and tabulators, to handle payroll and accounting problems. Clearly, at a rate of \$600 per hour, the 704 or 705 could not be used by smaller businesses. The 650 cost about \$50 per hour, which nowadays is a preposterous rate for such low computing power, but in the 1950s was the only answer to the computing needs of small businesses. ■

What's New?

4 MHz Single Card Computer

Cromemco's Single Card computer features the Z-80 processor and S-100 bus architecture. The card offers 4 MHz operation, 8 K bytes of on board 2716 programmable read only memory and 1 K bytes of static programmable memory. It also provides an RS-232 (or 20 mA current loop) serial interface with programmable transmission rates up to 76,800 bps, 24 bits of bidirectional parallel input and output (I/O), five programmable timers and vectored interrupts. Only a power supply and programmable read only memory software are required for operation. The Single Card



computer can also be the core of an expandable S-100 bus system that can include additional memory, I/O, or even floppy disk drives as required.

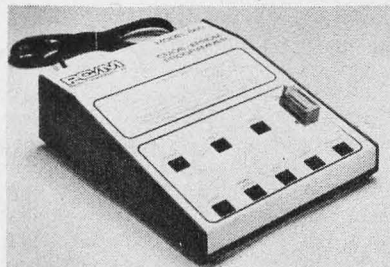
Cromemco's Z-80 Monitor and 3 K byte Control BASIC are available in 2716 read only memory for use with the Single

Card computer. With these two memories, the computer can be used immediately without any additional memory or I/O. The Monitor has 12 comments to aid in program development. The 3 K byte Control BASIC has 36 commands and functions and can directly access I/O ports and memory locations, and call machine language subroutines.

The Single Card computer is available in kit form for \$395 and assembled and tested for \$450. The Monitor and Control BASIC are available in two read only memories for \$90. For additional information contact Cromemco Inc, 280 Bernardo Av, Mountain View CA 94040.■

Circle 548 on inquiry card.

Intelligent Programmer for Intersil Ultraviolet Memory Chips



Pacific Cyber/Metrix Inc has announced availability of its new Model 660 programmer for the 6603 and 6604 4 K bit CMOS ultraviolet erasable read only memory integrated circuits from Intersil Inc.

The Model 660 programmer has been designed specifically for programming the 6603 and 6604 devices. The programmer contains a microprocessor and 4096 bit programmable memory and can be operated stand alone from its front panel or interactively with a video or Teletype terminal through the programmer's built-in RS-232 or 20 mA current loop interfaces. The Model 660 can also communicate with a computer for automated on line programmable read only memory programming.

Built-in features include a full complement of editing capabilities for loading and checking the programmable memory buffer or 660X erasable read only memory, ability to accept all popular paper tape formats, firmware for programmable read only memory copying and verifying, and a front panel erase check capability. Programming time is typically half of that required for similar

N channel device programmers.

The Model 660 is priced at \$645. Contact Pacific Cyber/Metrix Inc, 3120 Crow Canyon Rd, San Ramon CA 94583. ■

Circle 549 on inquiry card.

Attention Readers and Vendors...

Where Do New Products Items Come From?

The information printed in the new products pages of BYTE is obtained from "new product" or "press release" copy sent by the promoters of new products. If in our judgment the information might be of interest to the personal computing experimenters and homebrewers who read BYTE, we print it in some form. We openly solicit releases and photos from manufacturers and suppliers to this marketplace. The information is printed more or less as a first in first out queue, subject to occasional priority modifications. While we would not knowingly print untrue or inaccurate data, or data from unreliable companies, our capacity to evaluate the products and companies appearing in the "What's New?" feature is necessarily limited. We therefore cannot be responsible for product quality or company performance.

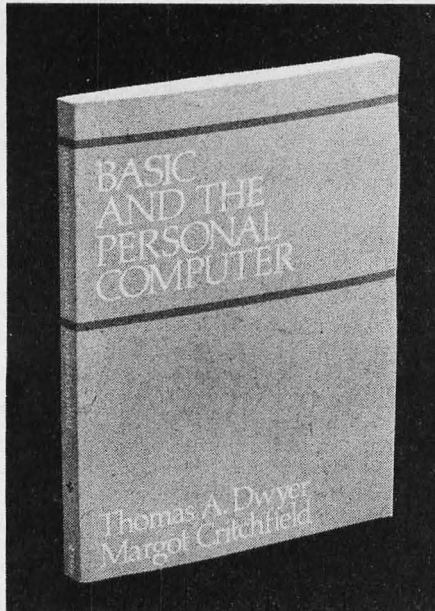
Custom Built Computer Desk



This custom built, all wood desk for your computer system features a split level 55 by 26 inch top with walnut grain Formica. Upper level is 26 by 26 inches (66.04 by 66.04 cm) and is a perfect surface for a printer. The lower level is 30 by 26 inches (76.2 by 66.04 cm) which places the keyboard at elbow height for minimum fatigue. Under the printer area is a 23 by 23 by 24 inch (58.42 by 58.42 by 60.96 cm) compartment with two fully adjustable shelves. There is room for a processor and disk memory. The door opening is 21 by 23 inches (53.34 by 58.42 cm). The standard finish is walnut. Options available are righthand or lefthand design, other finishes and top and minor variations in dimension sizes. Desks are built to customers' requirements and a 50 percent deposit should accompany the order. The price is \$295 from Stephen Moe Company, POB 595, Springfield OR 97477. ■

Circle 550 on inquiry card.

New Book Explores Varied Facets of Personal Computing



BASIC and the Personal Computer by Dwyer and Critchfield describes the uses of personal computers, then explains how to make these ideas become a reality by using the power of interactive computer programming. It features examples that cover a wide range of applications possible with personal computers.

Topics include microcomputer hardware, programming in BASIC and extended BASIC, computer graphics, word processing, data structures, sorting algorithms, computer games, computer art, simulations, business applications, color graphics and the use of special interface devices.

The book requires no previous experience with computing. The text is integrated with a large number of original illustrations that clarify both beginning and advanced concepts.

This 438 page softbound book is published by Addison-Wesley Publishing Co Inc, Reading MA 01867 for \$12.95. ■

Circle 630 on inquiry card.

Software Package for the North Star Disk System

The Program Utility Package (PUP) includes assembler and BASIC programs to enhance the usability of the North Star BASIC language. These programs use the input and output routines provided by the North Star disk operating system and the user. The package includes: CREF which is an assembler program producing a sorted cross reference of variable and function usage by line number; SMAP is an assembler program which produces a sorted map of line reference by GOSUB and GOTO; FLIST is an assembler program to produce a formatted BASIC program listing; MEMTEST is an assembler

program which performs multiple memory diagnostics on user specified memory ranges; HEXMON is a BASIC program to load or list memory in hexadecimal. Each displayed line of 16 bytes of hexadecimal data also has the ASCII equivalents printed.

This package consists of six programs on a library diskette, 16 pages of documentation, and a diskette folder. The price of PUP is \$25, with program listing available for an additional \$7. For further information, contact Business Computer Systems, 216 Collier Dr, Springfield IL 62704. ■

Circle 631 on inquiry card.

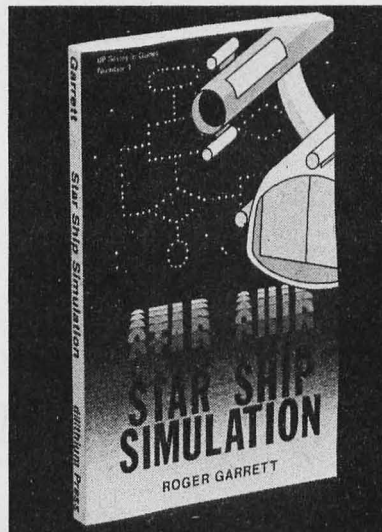
The Complete Star Ship: A Simulation Project

Star Ship Simulation by Roger Garrett explains the methods used in approaching the design of a software simulation. Readers become familiar with the techniques by which any large programming task can be implemented and learn how to attack a program in a straightforward, structured manner.

The first half of the book gives the reader a working knowledge of system design and program structure, and the last half deals with the actual development and implementation of the Star Ship simulation project. Details are given for every major function aboard a star ship as well as the intelligence of enemy and friendly space craft.

The 122 page book is priced at \$6.95 and is available from Dilithium Press, 30 NW 23rd Pl, Portland OR 97210. ■

Circle 632 on inquiry card.



Assembly Language Development System for 8080 or Z-80

PDS is an assembly language development system for 8080 or Z-80 microcomputers with at least one disk drive. PDS includes a unified assembler and editor, a macro-assembler combining the features of a relocating linking loader, a string-oriented text editor, and a trace debugger and disassembler.

The assemblers favor the Intel instruction mnemonics, treating the Z-80 superset as a logical and syntactical extension. The debug module features breakpoint or single step execution of programs with trace display of all register contents, flag status, a memory window, and the mnemonics of the instruction just executed and the next instruction to be executed.

Source modules are available for floating point arithmetic, floating point IO, trigonometric functions, numerical and alphabetic sorting, matrix inversion, fast Fourier transform and a full function expression evaluator.

The price is \$99. For further information, contact Allen Ashley, 395 Sierra Madre Villa, Pasadena CA 91107. ■

Circle 633 on inquiry card.

Micropolis CP/M System Upgrade

The Micropolis CP/M System Upgrade gives the Micropolis disk owner the full capacities of the CP/M disk operating system while retaining full access to Micropolis' operating system.

The CP/M System Upgrade allows the Micropolis disk owner to directly load and start CP/M and automatically execute a program at system start-up. Other features include dynamic disk space allocation and reclamation, random access on all files, high speed disk read and write and full compatibility with all other CP/M systems and software.

For further details, contact the Computer Mart of New Jersey, 501 Rt 27, Iselin NJ 08830. ■

Circle 634 on inquiry card.

Word Processor for the Commodore PET

Connecticut microComputer has announced a word processor program for the Commodore PET. This program permits composing and printing of letters, flyers, advertisements, manuscripts, articles, etc, using the PET and an RS-232 printer.

Script directives include line length, left margin, centering and skip. Edit commands allow the user to insert lines, delete lines, move lines, change strings, save onto cassette, load from cassette, move up, move down, print and type.

The word processor program addresses an RS-232 printer through a Connecticut microComputer printer adapter. The program can be purchased for \$29.50 from Connecticut microComputer, 150 Pocono Rd, Brookfield CT 06804. ■

Circle 635 on inquiry card.

ITHACA AUDIO

THE OEM MARKETPLACE

© 1978 ITHACA AUDIO

IA Expands S-100 Line

Video Display Board

Featuring a full 128 upper/lower case ASCII character set stored in a 1K buffer memory. Easy to read 16 line x 64 character format can be displayed on an inexpensive video monitor or a modified TV set. Includes a TTY software driver. Add our powerful K 2 FDOS to create a versatile operator console.

\$25.00

Disk Controller Board

Controls up to 4 single or double sided drives. Data protect features include automatic disable of write-gate during power-down for data integrity. Supported by a reliable software package, K 2 FDOS and complete diagnostic documentation.

\$35.00

K2 Operating System

Power full disk software in the DEC tradition. Includes Text Editor (TED), File Package (PIP), Debugger (HDT), Assembler (ASMBLE), HEXBIN, 1 COPY, System Generator (SYSGEN). Command syntax follows Digital's OS-8, RT/11 format. First in a family of high level software. Soon to be released, FORTRAN & Pascal Compilers.

\$75.00

Field-proven reliable engineering

Over 10,000 boards worldwide prove Ithaca Audio provides the quality and reliability you demand.

Ithaca Audio Boards are fully S-100 compatible, featuring gold edge connectors and plated-through holes. All boards (except the Protoboard) have fully buffered data and address lines, DIP switch addressing, solder mask and parts legend.

Z-80 CPU Board Most powerful 8 bit central processor available. Featuring power-on-jump, provision for on-board 2708. Accepts most 8080 software.

\$35.00

8K Static RAM Board High speed static memory at the lowest cost per bit. Includes memory protect/unprotect and selectable wait states.

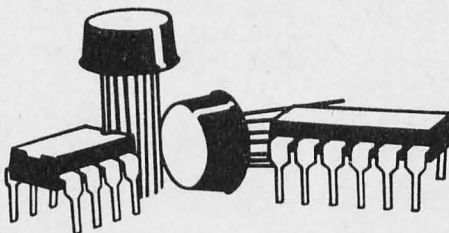
\$25.00

2708/2716 EPROM Board Indispensable for storing dedicated programs and often used software. Accepts up to 16K of 2708's or 32K of 2716's.

\$25.00

Protoboard Universal wire-wrap board for developing custom circuitry. Accepts any size DIP socket.

\$25.00



RAM! 32K for \$359.

Ithaca Audio is now stocking the Mostek 4115 add-on RAM for S.D.'s Expandoram. Buy their basic board, 32K of RAM from us and SAVE.

S.D. SALES Expandoram board \$199
Ithaca Audio 32 4115's @ \$5.00 ea. 160
32K Only \$359

Mass Storage at Incomparable Prices.

Ithaca Audio Floppy Disk

- Up to 250K bytes, single sided
- Up to 500K bytes, double sided
- Data protect
- Powerful software operating system includes 8 utility programs, text editor.

Add the capacity of full size disk to your S-100 microcomputer. Controller, Disk Drive, and Software available separately.

Memorex single sided
550 Flexible Disk Drive \$456.
Memorex double sided
552 Flexible Disk Drive \$630.
Disk Controller Board \$35.
K2 FDOS Available on 8" floppy disk w. manual \$75.

Quality Components

ZILOG Z-80	\$19.00
ZILOG Z-80A	23.00
INTEL 2708	11.00
FAIRCHILD 2102 LHPC	1.60
FAIRCHILD 2102 LIPC	1.35

IMSAI 8080 Kit with 22 Slot M.B.
\$560.00

plus \$10.00 shipping.

HOW TO ORDER

Send check or money order, include \$2.00 shipping per order. N.Y.S. Residents include tax.

For technical assistance call or write to:

**ITHACA
AUDIO**

P.O. Box 91
Ithaca, New York 14850
Phone: 607/273-3271

7400 TTL

SN7400N	16	SN7472N	29	SN74160N	89
SN7401N	18	SN7473N	35	SN74161N	89
SN7402N	18	SN7474N	35	SN74162N	1.65
SN7403N	18	SN7475N	35	SN74163N	89
SN7404N	18	SN7476N	35	SN74164N	89
SN7405N	20	SN7477N	5.00	SN74165N	89
SN7406N	29	SN7478N	5.00	SN74166N	1.25
SN7407N	29	SN7479N	5.00	SN74167N	1.95
SN7408N	20	SN7480N	5.00	SN74168N	1.95
SN7409N	20	SN7481N	5.00	SN74169N	1.95
SN7410N	20	SN7482N	5.00	SN74170N	1.95
SN7411N	20	SN7483N	5.00	SN74171N	1.95
SN7412N	20	SN7484N	5.00	SN74172N	6.00
SN7413N	20	SN7485N	5.00	SN74173N	1.25
SN7414N	20	SN7486N	5.00	SN74174N	89
SN7415N	20	SN7487N	5.00	SN74175N	7.9
SN7416N	20	SN7488N	5.00	SN74176N	7.9
SN7417N	20	SN7489N	5.00	SN74177N	7.9
SN7418N	20	SN7490N	5.00	SN74178N	1.95
SN7419N	20	SN7491N	5.00	SN74179N	1.95
SN7420N	20	SN7492N	5.00	SN74180N	1.95
SN7421N	20	SN7493N	5.00	SN74181N	1.95
SN7422N	20	SN7494N	5.00	SN74182N	7.9
SN7423N	20	SN7495N	5.00	SN74183N	1.95
SN7424N	20	SN7496N	5.00	SN74184N	1.95
SN7425N	20	SN7497N	3.00	SN74185N	1.95
SN7426N	20	SN7498N	3.00	SN74186N	9.95
SN7427N	20	SN7499N	3.00	SN74187N	3.95
SN7428N	20	SN7500N	3.00	SN74188N	3.95
SN7429N	20	SN7501N	3.00	SN74189N	1.25
SN7430N	20	SN7502N	3.00	SN74190N	1.25
SN7431N	20	SN7503N	3.00	SN74191N	1.25
SN7432N	20	SN7504N	3.00	SN74192N	7.9
SN7433N	20	SN7505N	3.00	SN74193N	7.9
SN7434N	20	SN7506N	3.00	SN74194N	89
SN7435N	20	SN7507N	3.00	SN74195N	89
SN7436N	20	SN7508N	3.00	SN74196N	89
SN7437N	20	SN7509N	3.00	SN74197N	89
SN7438N	20	SN7510N	3.00	SN74198N	1.49
SN7439N	20	SN7511N	3.00	SN74199N	1.49
SN7440N	20	SN7512N	3.00	SN74200N	4.95
SN7441N	20	SN7513N	3.00	SN74201N	1.79
SN7442N	20	SN7514N	3.00	SN74202N	7.9
SN7443N	20	SN7515N	3.00	SN74203N	7.9
SN7444N	20	SN7516N	3.00	SN74204N	3.95
SN7445N	20	SN7517N	3.00	SN74205N	3.95
SN7446N	20	SN7518N	3.00	SN74206N	3.95
SN7447N	20	SN7519N	3.00	SN74207N	3.95
SN7448N	20	SN7520N	3.00	SN74208N	3.95
SN7449N	20	SN7521N	3.00	SN74209N	3.95
SN7450N	20	SN7522N	3.00	SN74210N	3.95
SN7451N	20	SN7523N	3.00	SN74211N	3.95
SN7452N	20	SN7524N	3.00	SN74212N	3.95
SN7453N	20	SN7525N	3.00	SN74213N	3.95
SN7454N	20	SN7526N	3.00	SN74214N	3.95
SN7455N	20	SN7527N	3.00	SN74215N	3.95
SN7456N	20	SN7528N	3.00	SN74216N	3.95
SN7457N	20	SN7529N	3.00	SN74217N	3.95
SN7458N	20	SN7530N	3.00	SN74218N	3.95
SN7459N	20	SN7531N	3.00	SN74219N	3.95
SN7460N	20	SN7532N	3.00	SN74220N	3.95

20% Discount 100 pcs combined order - 25% - 1000 pcs combined order

CD4000	23	C/MOS	CD4070	55
CD4001	23		CD4071	23
CD4002	23		CD4072	23
CD4006	1.19		CD4076	23
CD4007	23		CD4077	23
CD4009	49		CD4082	23
CD4010	49		CD4093	23
CD4011	23		CD4098	2.25
CD4012	23		MC14009	14
CD4013	31		MC14410	14
CD4014	39	MC14411	14	
CD4015	1.19	MC14419	4.5	
CD4016	49	MC14433	19	
CD4017	1.19	MC14506	3	
CD4018	99	MC14507	3	
CD4019	49	MC14562	14	
CD4020	1.19	MC14583	3	
CD4021	1.39	CD40508	3	
CD4022	1.19	CD40510	2	
CD4023	23	CD40511	2	
CD4024	79	CD40515	2	
CD4025	23	CD40518	1	
CD4026	2.25	CD40520	1	
CD4027	69	CD40566	2	

74C00	39	74C00	74C163	2.49
74C01	39	74C01	74C164	2.49
74C02	39	74C02	74C165	2.49
74C03	39	74C03	74C166	2.49
74C04	39	74C04	74C167	2.49
74C05	39	74C05	74C168	2.49
74C06	39	74C06	74C169	2.49
74C07	39	74C07	74C170	2.49
74C08	39	74C08	74C171	2.49
74C09	39	74C09	74C172	2.49
74C10	39	74C10	74C173	2.49
74C11	39	74C11	74C174	2.49
74C12	39	74C12	74C175	2.49
74C13	39	74C13	74C176	2.49
74C14	39	74C14	74C177	2.49
74C15	39	74C15	74C178	2.49
74C16	39	74C16	74C179	2.49
74C17	39	74C17	74C180	2.49
74C18	39	74C18	74C181	2.49
74C19	39	74C19	74C182	2.49
74C20	39	74C20	74C183	2.49
74C21	39	74C21	74C184	2.49
74C22	39	74C22	74C185	2.49
74C23	39	74C23	74C186	2.49
74C24	39	74C24	74C187	2.49
74C25	39	74C25	74C188	2.49
74C26	39	74C26	74C189	2.49
74C27	39	74C27	74C190	2.49

74C28	39	74C28	74C191	2.49
74C29	39	74C29	74C192	2.49
74C30	39	74C30	74C193	2.49
74C31	39	74C31	74C194	2.49
74C32	39	74C32	74C195	2.49
74C33	39	74C33	74C196	2.49
74C34	39	74C34	74C197	2.49
74C35	39	74C35	74C198	2.49
74C36	39	74C36	74C199	2.49
74C37	39	74C37	74C200	2.49
74C38	39	74C38	74C201	2.49
74C39	39	74C39	74C202	2.49
74C40	39	74C40	74C203	2.49
74C41	39	74C41	74C204	2.49
74C42	39	74C42	74C205	2.49
74C43	39	74C43	74C206	2.49
74C44	39	74C44	74C207	2.49
74C45	39	74C45	74C208	2.49
74C46	39	74C46	74C209	2.49
74C47	39	74C47	74C210	2.49
74C48	39	74C48	74C211	2.49
74C49	39	74C49	74C212	2.49
74C50	39	74C50	74C213	2.49

74C51	39	74C51	74C214	2.49
74C52	39	74C52	74C215	2.49
74C53	39	74C53	74C216	2.49
74C54	39	74C54	74C217	2.49
74C55	39	74C55	74C218	2.49
74C56	39	74C56	74C219	2.49
74C57	39	74C57	74C220	2.49
74C58	39	74C58	74C221	2.49
74C59	39	74C59	74C222	2.49
74C60	39	74C60	74C223	2.49
74C61	39	74C61	74C224	2.49
74C62	39	74C62	74C225	2.49
74C63	39	74C63	74C226	2.49
74C64	39	74C64	74C227	2.49
74C65	39	74C65	74C228	2.49
74C66	39	74C66	74C229	2.49
74C67	39	74C67	74C230	2.49
74C68	39	74C68	74C231	2.49
74C69	39	74C69	74C232	2.49
74C70	39	74C70	74C233	2.49
74C71	39	74C71	74C234	2.49
74C72	39	74C72	74C235	2.49
74C73	39	74C73	74C236	2.49
74C74	39	74C74	74C237	2.49
74C75	39	74C75	74C238	2.49

74C76	39	74C76	74C239	2.49
74C77	39	74C77	74C240	2.49
74C78	39	74C78	74C241	2.49
74C79	39	74C79	74C242	2.49
74C80	39	74C80	74C243	2.49
74C81	39	74C81	74C244	2.49
74C82	39	74C82	74C245	2.49
74C83	39	74C83	74C246	2.49
74C84	39	74C84	74C247	2.49
74C85	39	74C85	74C248	2.49
74C86	39	74C86	74C249	2.49
74C87	39	74C87	74C250	2.49
74C88	39	74C88	74C251	2.49
74C89	39	74C89	74C252	2.49
74C90	39	74C90	74C253	2.49
74C91	39	74C91	74C254	2.49
74C92	39	74C92	74C255	2.49
74C93	39	74C93	74C256	2.49
74C94	39	74C94	74C257	2.49
74C95	39	74C95	74C258	2.49
74C96	39	74C96	74C259	2.49
74C97	39	74C97	74C260	2.49
74C98	39	74C98	74C261	2.49
74C99	39	74C99	74C262	2.49

LM340K-8	1.35	NE570N	6.95	RC4151	5.
LM340K-12	1.35	LM7030CN/H	49	RC4194	5.
LM340K-15	1.35	LM709N/H	29	RC4195	4.
74LS00	23	74LS00TL		74LS138	
74LS01	23			74LS139	
74LS02	23	74LS47	.69	74LS151	
74LS03	23	74LS51	.23	74LS155	
74LS04	29	74LS54	.23	74LS157	
74LS05	29	74LS55	.23	74LS160	
74LS08	23	74LS73	.35	74LS161	
74LS09	29	74LS74	.35	74LS162	

Transistor Checker



— Completely Assembled —
— Battery Operated —

The ASI Transistor Checker is capable of checking a wide range of transistor types, either "in circuit" or out of circuit. To operate, simply plug the transistor to be checked into the front panel socket, or connect it with the alligator clip test leads provided. The unit safely and automatically identifies low, medium and high-power PNP and NPN transistors. Size: 3 1/2" x 6 1/2" x 2". "C" cell battery not included.

Trans-Check \$29.95 ea.

Custom Cables & Jumpers



DB 25 Series Cables

Part No.	Cable Length	Connectors	Price
DB25P-4-P	4 ft.	2-DB25P	\$15.95 ea.
DB25P-4-S	4 ft.	1-DB25P/1-25S	\$16.95 ea.
DB25S-4-S	4 ft.	2-DB25S	\$17.95 ea.

Dip Jumpers

Part No.	Cable Length	Connectors	Price
DJ14-1	1 ft.	1-14 Pin	\$1.59 ea.
DJ16-1	1 ft.	1-16 Pin	1.79 ea.
DJ24-1	1 ft.	1-24 Pin	2.79 ea.
DJ14-1-14	1 ft.	2-14 Pin	2.79 ea.
DJ16-1-16	1 ft.	2-16 Pin	3.19 ea.
DJ24-1-24	1 ft.	2-24 Pin	4.95 ea.

For Custom Cables & Jumpers, See JAMECO 1979 Catalog for Pricing

CONNECTORS



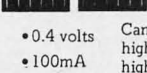
25 Pin-D Subminiature

DB25P (as pictured)	PLUG (Meets RS232)	\$2.95
DB25S	SOCKET (Meets RS232)	\$3.50
DB51226-1	Cable Cover for DB25P or DB25S	\$1.75

PRINTED CIRCUIT EDGE-CARD

.156 Spacing-Tin-Double Read-Out — Bilateral Contacts — Fits .054 to .070 P.C. Cards		
15/30	PINS (Solder Eyelet)	\$1.95
18/36	PINS (Solder Eyelet)	\$2.49
22/44	PINS (Solder Eyelet)	\$2.95
50/100 (.100 Spacing)	PINS (Wire Wrap)	\$6.95
50/100 (.125 Spacing)	PINS (Wire Wrap)	R681-1 \$6.95

Solar Cells

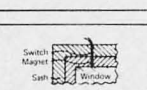


- 0.4 volts
- 100mA
- 41 MW

Can be added in series for higher voltage or parallel for higher current.

#SC 2x2 \$1.95 ea. or 3/\$5.00

Magnetically Activated Switch



The 9250-0002 is a single pole normally closed switch. When the magnet is engaged, the circuit is open. This switch is only suitable for use in non-magnetic doors and windows.

#9250-0002 2/\$1.00

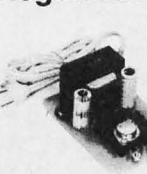
AC Wall Transformer



Ideal for use with clocks, power supplies or any other type of AC application.

Part No.	Input	Output	Price
AC 250	117V/60Hz	12 VAC 250mA	\$3.95
AC 500	117V/60Hz	12 VAC 500mA	\$4.95

Regulated Power Supply



- Uses LM 309K
- Heat sink provided
- P.C. board construction
- Provides a solid 1 amp @ 5V
- Includes components, hardware and instructions
- Sizes: 3-1/2" x 5" x 2" high

JE200 \$14.95

INSTRUMENT/CLOCK CASE



This case is an injection molded unit that is ideal for uses such as DVM, COUNTER, or CLOCK cases. It has dimensions of 4 1/2" in length by 4" in width by 1-9/16" in height. It comes complete with a red bezel.

PART NO: IN-CC \$3.49 each

MICROPROCESSOR COMPONENTS

8080A/8080A SUPPORT DEVICES			MICROPROCESSOR MANUALS			
8080A	CPU	\$ 9.95	M-280	User Manual	\$7.50	
8212	8-Bit Input/Output	3.25	M-CDP1802	User Manual	7.50	
8214	Priority Interrupt Control	5.95	M-2650	User Manual	5.00	
8216	Bi-Directional Bus Driver	3.49				
8224	Clock Generator/Driver	3.99				
8226	Bus Driver	3.49	2513(2140)	Character Generator(upper case)	\$9.95	
8228	System Controller/Bus Driver	5.95	2513(3021)	Character Generator(lower case)	9.95	
8238	System Controller	5.95	2516	Character Generator	10.95	
8251	Prog. Comm. I/O (USART)	7.95	MM5230N	2048-Bit Read Only Memory	1.95	
8253	Prog. Interval Timer	14.95				
8255	Prog. Periph. I/O (PPI)	14.95				
8257	Prog. DMA Control	19.95	1101	256K1	Static	\$1.49
8259	Prog. Interrupt Control	19.95	1103	1024X1	Dynamic	.99
6800/6800 SUPPORT DEVICES			2101(8101)	256K4	Static	3.95
MC6800	MPU	\$14.95	2102	1024X1	Static	1.75
MC6800CP	MPU with Clock and Ram	24.95	2102	1024X1	Static	1.95
MC6810API	128X8 Static Ram	5.95	2111(8111)	256K4	Static	3.95
MC6821	Periph. Inter. Adapt (MC6820)	7.49	2112	256K4	Static MOS	4.95
MC6828	Priority Interrupt Controller	12.95	2114	1024X4	Static 450ns	9.95
MC6830LR	1024X8 Bit ROM (MC6830-8)	14.95	2114L	1024X4	Static 450ns low power	10.95
MC6850	Asynchronous Comm. Adapter	7.95	2114-3	1024X4	Static 300ns	10.95
MC6852	Synchronous Serial Data Adapt.	9.95	2114-3	1024X4	Static 300ns low power	10.95
MC6860	0-600 bps Digital MODEM	12.95	5101	256K4	Static	7.95
MC6862	2400 bps Modem	14.95	5280/2107	4096X1	Dynamic	4.95
MC6880A	Quad 3-State Bus Trans. (MC6876)	2.25	7489	16K4	Static	1.75
MICROPROCESSOR CHIPS—MISCELLANEOUS			745200	256K1	Static Tristate	4.95
Z80(780C)	CPU	\$19.95	93421	256K1	Static	2.95
Z80A(780-1)	CPU	24.95	UPD414	4K	Dynamic 16 pin	4.95
CDP1802	CPU	19.95	(MK4027)	4K	Dynamic 16 pin	14.95
2650	MPU	19.95	UPD416	4K	Dynamic 16 pin	14.95
8035	8-Bit MPU w/clock, RAM, I/O lines	19.95	(MK4116)	4K	Static	14.95
P8085	CPU	19.95	TMS4044	4K	Static	14.95
TMS990JUL	16-Bit MPU w/hardware, multiply & divide	49.95	45N1	45N1	Static	14.95
SHIFT REGISTERS			TMS4045	1024X4	Static	14.95
MM500H	Dual 25 Bit Dynamic	\$ 5.50	2117	16,384X1	Dynamic 350ns (house marked)	9.95
MM503H	Dual 50 Bit Dynamic	5.50				
MM504H	Dual 16 Bit Static	5.50	MM5262	2KX1	Dynamic	41/00
MM505H	Dual 100 Bit Static	5.50				
MM510H	Dual 64 Bit Accumulator	5.50				
MM5016H	500 512 Bit Dynamic	89				
2504T	1024 Dynamic	3.95				
2518	Hex 32 Bit Static	4.95				
2522	Dual 132 Bit Static	2.95				
2524	512 Static	2.95				
2525	1024 Dynamic	2.95				
2527	Dual 256 Bit Static	2.95				
2528	Dual 256 Bit Static	4.00				
2529	Dual 240 Bit Static	4.00				
2532	Quad 80 Bit Static	2.95				
2533	1024 Static	2.95				
3341	Fifo	6.95				
74LS670	4K4 Register File (TriState)	1.95				
UART'S			7102A	2048	FAMOS	\$5.95
A-Y-5-1013	30K BAUD	5.95	TMS2516	16K*	EPROM(Intel 2716)	49.95
			(2716)	*Requires single +5V power supply		
			TMS2532	4KX8	EPROM	89.95
			2708	8K	EPROM	10.95
			2716 T1	16K*	EPROM	29.95
				*Requires 3 voltages, -5V, +5V, +12V		
			5203	2048	FAMOS	14.95
			6301-17611	1024	Tristate Bipolar	3.49
			5330-17602	256	Open C. Bipolar	2.95
			63523	32X8	Open Collector	3.95
			825115	4096	Bipolar	19.95
			825123	32X8	Tristate	3.95
			74186	512	TTL Open Collector	9.95
			74188	256	TTL Open Collector	3.95
			745287	1024	Static	2.95

NEW!! IN STOCK... POWERACE ALL-CIRCUIT EVALUATORS WITH POWER

- 1680 solderless, plug-in tie points... will hold up to 18 14-pin DIP's
- Breadboard elements accept all DIP sizes, including RTL, DTL, TTL and CMOS devices. TO-5's and discrete leads up to .032" dia.
- All connections to/from switches, indicators, power supplies and meters are made via solderless, plug-in, tie-point blocks on control panels.
- Interconnect with any solid 20 to 30 AWG wire.
- Breadboard elements are mounted on ground plane... ideal for high-frequency and high-speed/low-noise circuits
- Short-circuit-proof tested power supplies
- Operate on 110 to 130 VAC at 60 Hz.
- Space-age compact styling and high-grade components permit convenient, organized and quick prototyping.
- All models are 7.5" wide 11.5" deep and 4.0" high (rear 0.75" high front) and weigh approx. 2.5 lbs.

BK PRECISION		100 MHz 8-Digit Counter	
3 1/2-Digit Portable DMM	<ul style="list-style-type: none"> • Overload Protected • 3" High LED Display • Battery or AC operation • Auto Zeroing • 1mu, 10u, 0.1 ohm resolution • Overrange reading • 10 meg input impedance • DC Accuracy 1% typical 	<ul style="list-style-type: none"> • Four power sources, i.e. batteries, 110 or 220V with charger, 12V with auto lighter adapter and external self-contained • Size — 1.75" x 7.38" x 5.63" 	MAX-100 \$134.95
Model 2800 \$99.95	Accessories: AC Adapter BC-28 \$9.00 Rechargeable Batteries BP-26 20.00 Carrying Case LC-28 7.50	ACCESSORIES FOR MAX 100: Mobile Charger Eliminator use power from car battery \$5.95 Charger/Eliminator use 110 V AC Model 100 — CLA \$9.95	

NEW Mini-Max 6 Digit 50MHz Frequency Counter

- Guaranteed frequency range of 100 Hz to 50 MHz
- Full 6 digit display with anti-glare window
- Fully automatic—range, polarity, slope, trigger, input level switching not required.
- Lead-zero blanking—All zeros to the left of the first non-zero digit are blanked. Kilo Hertz and Mega Hertz decimal points automatically light up when the unit is turned on.
- Built in input overvoltage protection.
- Use 9V Battery or 110/220V power.
- Complete with mini antenna.
- Lightweight — Only 8oz.

MINI-MAX \$89.95

Part No.	Description	Price
MM-A4	Antenna	\$ 3.95
MM-C5	Carrying case	5.95
MM-IPC	Input cable with clip leads	3.95
MM-AC2	110V adapter	9.95
MM-AC3	220V adapter	9.95

\$5.00 Minimum Order — U.S. Funds Only
California Residents — Add 6% Sales Tax

Spec Sheets — 25¢
1979 Catalog Available—Send 41¢ stamp

The Incredible

"Pennywhistle 103"



\$139.95 Kit Only

The Pennywhistle 103 is capable of recording data to and from audio tape without critical speed requirements for the recorder and it is able to communicate directly with another modern and terminal for telephone "hamming" and communications. In addition, it is free of critical adjustments and is built with non-precision, readily available parts.

- Data Transmission Method... Frequency-Shift Keying, full-duplex (half-duplex selectable).
- Maximum Data Rate... 300 Baud.
- Data Format... Asynchronous Serial (return to mark level required between each character).
- Receive Channel Frequencies... 2025 Hz for space; 2225 Hz for mark.
- Transmit Channel Frequencies... Switch selectable: Low (normal) — 1070 space, 1270 mark, High — 025 space, 2225 mark.
- Receive Sensitivity... —46 dbm acoustically coupled.
- Transmit Level... —15 dbm nominal. Adjustable from —6 dbm to —20 dbm.
- Receive Frequency Tolerance... Frequency reference automatically adjusts to allow for operation between 1800 Hz and 2400 Hz.
- Digital Data Interface... EIA RS-232C or 20 mA current loop (receiver is optoisolated and non-polar).
- Power Requirements... 120 VAC, single phase, 10 Watts.
- Physical... All components mount on a single 5" by 9" printed circuit board. All components included.

Requires a VOM, Audio Oscillator, Frequency Counter and/or Oscilloscope to align

TRS-80 16K Conversion Kit

Expand your 4K TRS-80 System to 16K. Kit comes complete with:

- * 8 each UPD416 (16K Dynamic Rams)
- * Documentation for conversion

TRS-16K \$115.00

Special Offer - Order both your TRS-16K and the Sup'R' MOD II Interface kit together (retail value \$144.95) for only \$139.95

COMPUTER CASSETTES

- 6 EACH 15 MINUTE HIGH QUALITY C-15 CASSETTES
- PLASTIC CASE INCLUDED
- 12 CASSETTE CAPACITY
- ADDITIONAL CASSETTES AVAILABLE #C-15-\$2.50 ea

CAS-6 \$14.95

SUP 'R' MOD II

- UHF Channel 33 TV Interface Unit Kit
- Wide Band B/W or Color System
- * Converts TV to Video Display for home computers, CCTV camera, Apple II, works with Cromeco Dazler, SOL-20, IRS-80, Challenger, etc.
- * MOD II is pretuned to Channel 33 (UHF).
- * Includes coaxial cable and antenna transformer.

MOD II \$29.95 Kit

RS-232 CONTROL CENTER

Plug in your modem, computer prom programmer, terminal, printer, etc. and selectively control data flow.

- Same Contour as "Pennywhistle 103"
- Totally self-contained
- Includes 2 master ports and 3 slave ports.

PART NO. RS-232CC \$89.95 kit only

Ideal for use with the TRS 80 and others.

*Plug/Jack interface to any computer system requiring remote control of cassette functions

The CC-100 controls cassette motor functions, monitors tape location with its internal speaker and requires no power. Eliminates the plugging and unplugging of cables during computer loading operation from cassette.

63-Key Unencoded Keyboard

This is a 63-key, terminal keyboard newly manufactured by a large computer manufacturer. It is unencoded with SPST keys, unattached to any kind of PC board. A very solid molded plastic 13 x 4" base suits most application. IN STOCK

Hexadecimal Unencoded Keypad

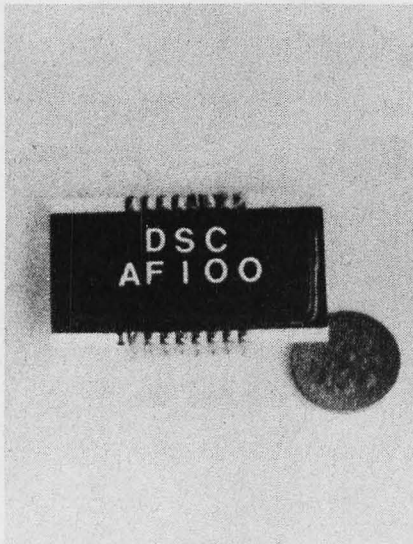
19-key pad includes 1-10 keys, ABCDEF and 2 optional keys and a shift key.

\$10.95/each

What's New?

SILICON

Speech Synthesis Integrated Circuit from TI



A significant new speech synthesis monolithic integrated circuit has been developed by Texas Instruments Inc, POB 5012, Dallas TX 75222. The circuit, along with two 128 K byte dynamic read only memories, each with

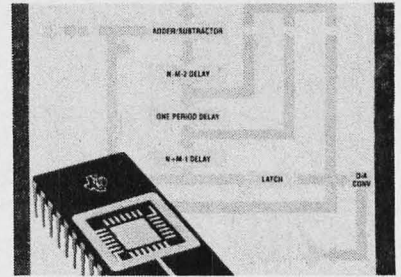
the capacity to store over 100 seconds of speech, and a special version of the TMS1000 microcomputer, serve as the main electronics for a new talking learning aid called Speak and Spell, for ages seven and up.

Speech encoding is achieved through pitch-excited linear predictive coding (LPC). LPC is a technique of analyzing and synthesizing human speech by determining from original speech a description of a time varying digital filter modeling the vocal tract. This filter is then excited by other periodic or random inputs. An 8 bit digital to analog converter on the chip transforms digital information processed through the filter into synthetic speech.

Codes for 12 synthesis parameters (ten filter coefficients, pitch, and energy) serve as inputs to the synthesizer chip. These codes are stored in read only memory and, once decoded by on chip circuitry, represent the time varying description of the LPC synthesis model. The LPC speech synthesizer is an advanced design 10 stage lattice filter which has an integrated array multiplier, an adder coupler to the multiplier output and various delay circuits coupled to the adder output.■

Circle 568 on inquiry card.

Dual Tone Separation Filter Integrated Circuit



The Model AF-100 dual tone separation filter integrated circuit provides channel isolation between the low frequency group tone (DTMF) frequencies 697 Hz thru 941 Hz and the high frequency group tone frequencies 1209 Hz thru 1633 Hz. It is intended for applications in which dual tone separation is required, eg: touch tone decoders, transceivers, modem interfaces, etc.

Contained in a 16 pin dual-in-line package, the dual resistance capacitance active filter chip features 30 dB minimum separation between high and low group tones, 1.5 dB maximum in-band deviation, dual and single power supply operation ± 12 VDC at 2.5 mA each.

The Model AF-100 is priced at \$32. For further information write to Data Signal Corp, 40-44 Hunt St, Watertown MA 02172.■

Circle 569 on inquiry card.

TRS-80™ SOFTWARE

Cat No.	Level	Description	Price
1041	2	Star Trek III	\$14.95
1036	1/2	Sci-Fi Game Sampler	5.95
1061	1/2	Hamurabi	6.00
1040	1/2	Galactic Blockade Runner	9.95
1053	1/2	Slot Machine	6.00
1042	1/2	Tarot	5.95
1038	1/2	Modular Inventory	19.95
1039	1/2	Renumber	14.95
1042	1/2	Bingo	5.95
1173	2	Bridge	14.95
1174	2	Sargon Chess	19.95
1048	1/2	Mach. Lang. Monitor	23.95
1051	1/2	Biorhythm	5.95
1171	1/2	Space Trek II	7.95
1172	1/2	Lunar Lander	7.95

VERBATIM DISKETTES

Soft Sector (TRS-80)
Cat No. 1147
10 Hole hard sector
Cat No. 1148
16 Hole hard sector
Cat No. 1149

box of 10
\$31.50

CALIFORNIA COMPUTER SYSTEMS® TRS-80™ & APPLE 16K MEMORY EXPANSION KIT

Easy to install, requires no special tools! Includes factory fresh prime rams, jumpers, and complete instructions.
Cat No. 1156

\$95

DATA CASSETTES

Perfect for recorders operating under KC or Tarbell standards, (TRS-80, etc). With positive tape path control.

Cat No. 1142

\$2.00 each

16K STATIC RAM KIT

5-100 compatible, true static operation. Requires only +5 volts. Fully buffered, 450 ns, bank switching capability, addressable in 4K blocks. Easy to assemble!
Cat No. 1151

\$265 kit

VISIT OUR RETAIL STORE!
Mon-Fri 8-6, Sat 9-5

WE SELL ONLY PRIME, QUALITY COMPONENTS

© Copyright 1978 Hobby World Electronics

ELECTRONICS

6-BB NORTHBRIDGE, CA 91324
(in Calif (213) 886-9200)

SHUGART SA-400 MINIFLOPPY \$275 DRIVE

Same unit as used in TRS-80 minifloppy. Offers hard and soft sectoring, single density, 35 track. Random access storage, cassette drive size. Superior data integrity, faster data throughput. Equipped with interface which allows upward expansion. Requires power supply.
Cat No. 1154

WRITE FOR OUR FREE SPRING 1979 CATALOG Featuring FACTORY FRESH PRIME IC's, LEDS, READOUTS, RECTIFIERS, ZENERS, TTL, CMOS, LOW POWER SCHOTTKY, MEMORY, BRIDGES, RIBBON CABLE, TOOLS, DISKETTES, FLOPPIES, LINEAR IC's, VOLTAGE REGULATORS, TRS-80 ACCESSORIES, EDGE CONNECTORS, TEST EQUIPMENT, SPEECHLAB, CHASSIS BOXES, RESISTORS, CAPACITORS, MOS-LSI CIRCUITS, SOLDERING AIDS, PC AIDS, FANS, COMPUTACRUISE, INTROL, MUSIC BOARDS, SSM BLUEBOARDS, CCS BOARDS, WIREWRAP AIDS, AND MORE!

NEW
IN STOCK

The EW-2001 A "Smart" VIDEO BOARD KIT At A "Dumb" Price!

A VIDEO BOARD + A MEMORY BOARD + AN I/O BOARD — ALL IN ONE!

- STATE OF THE ART TECHNOLOGY USING DEDICATED MICROPROCESSOR I.C.
- NUMBER OF I.C.s REDUCED BY 50% FOR HIGHER RELIABILITY ■ MASTER PIECE OF ENGINEERING ■ FULLY SOFTWARE CONTROLLED

\$199.95

Priced at ONLY Basic Software Included

SPECIAL FEATURES:

- S-100 bus compatible
- Parallel keyboard port
- On board 4K screen memory (optional)* relocatable to main computer memory
- Text editing capabilities (software optional)
- Scrolling: up and down through video memory
- Blinking characters
- Reversed video
- Provision for on board ROM
- CRT and video controls fully programmable (European TV)

- Programmable no. of scan lines
- Underline blinking cursor
- Cursor controls: up, down, left, right, home, carriage return
- Composite video

*Min. 2K required for operation of this board.

DISPLAY FEATURES:

- 128 displayable ASCII characters (upper and lower case alphanumeric, controls)
- 64 or 32 characters per line (jumper selectable)
- 32 or 16 lines (jumper selectable)
- Screen capacity 2048 or 512
- Character generation: 7 x 11 dot matrix

OPTIONS:

Sockets	\$10.00
2K Static Memory (with Sockets)	\$45.00
4K Static Memory (with Sockets)	\$90.00
Complete unit, assembled and tested with 4K Memory	\$335.00
Basic software on ROM	\$20.00
Text editor on ROM	\$75.00

DEALER

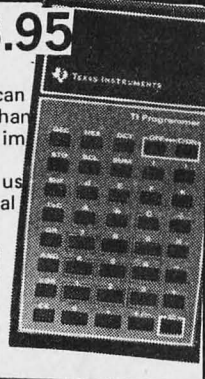
INQUIRIES WELCOMED

TI PROGRAMMER \$53.95

Hexadecimal. Octal. Decimal.

Enter a number in base 8, 10, or 16. TI Programmer can quickly convert to either of the other bases. Rapidly handle arithmetic in all three bases giving you more time for important programming or troubleshooting tasks.

Ideal for use with any size computer. TI Programmer uses integer "two's complement" arithmetic in hexadecimal and octal bases.



\$44.95
DATA CHROM

Large, easy-to-read 8-digit liquid crystal display. Clock mode displays time, day, date, and AM/PM. Stopwatch mode displays hours, minutes, seconds and tenths of seconds up to 9:59:59.9. Economical—you'll get typically 12 months normal operation on a single set of batteries. Attractive—comes in brown vinyl wallet folder with insert pockets for business cards. Makes a neat addition to your personal or business accessories. 24-hour alarm. Stopwatch records and displays lap and total elapsed times. Up to one-tenth of a second accuracy.

SHIPPING: \$3.50

California residents add 6% sales tax

ELECTRONICS WAREHOUSE Inc.

1603 AVIATION BLVD. Dept.

REDONDO BEACH, CA. 90278

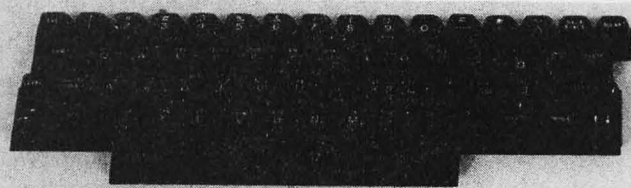
TEL. (213) 376-8005

WRITE FOR FREE CATALOG

Minimum Order: \$10



ASCII KEYBOARD KIT \$74.00



Additional Improvements: Double Size Return Key
Control Characters Molded on Key Caps

- Power: +5V 275mA
- Upper and Lower Case
- Full ASCII Set
- 7 or 8 Bits Parallel Data
- Optional Serial Output
- Selectable Positive or Negative Strobe, and Strobe Pulse Width
- 2 Key Roll-Over
- 3 User DEfineable Keys
- P.C. Board Size: 17-3/16" x 5"

OPTIONS:

■ Metal Enclosure Painted Blue and White	\$27.50
■ 18 Pin Edge Con.	\$ 2.00
■ I.C. Sockets	\$ 4.00
■ Serial Output Provision (Shift Register)	\$ 2.00
■ Upper Case Lock Switch for Capital Letters and Nos.	\$ 2.00
Assembled (on Sockets) and Tested	\$90.00

APPLE II I/O BOARD KIT

Plugs Into Slot of Apple II Mother Board

18 Bit Parallel Output Port (Expandable to 3 Ports)

1 Input Port

15mA Output Current Sink or Source

Can be used for peripheral equipment such as printers, floppy discs, cassettes, paper tapes, etc.

1 free software listing for SWTP PR40 or IBM selectric

PRICE:

1 Input and 1 Output Port for \$49.00

1 Input and 3 Output Ports for \$64.00

Dealer Inquiries Invited

JADE Computer Products

★ DISK DRIVES ★

B51 5 1/4" \$295.00
by Micro Peripherals, Inc. Operates in either, single density (125KB, unformatted) or double density (250KB, unformatted) modes, up to 40 tracks, with a track-to-track access time of only 5 ms.

SA801R \$495.00
by Shugart Single-sided 8" floppy disk drive.

FD8-100 \$395.00
GSI/Siemens. Runs cooler and quieter than 801 (8")

DM2700-S \$750.00
Includes SA801R. 10"x10"x16" cabinet, power supply, data cable, fan, AC line filter.

1791 B01
Dual Density Controller Chip
\$49.95

- TWO SIEMENS/GSI 8" FLOPPY DRIVES
- POWER SUPPLY FOR ABOVE
- JADE/TARBELL DISK CONTROL KIT (\$100)
- CP/M OPERATING SYSTEM WITH BASIC-E
- PACKAGE OF 10 BLANK 8" DISKETTES

Price if purchased separately:

\$1192.50

JADE SPECIAL PACKAGE DEAL:
\$1050.00

↔ VERBATIM™.M. FLOPPY DISKS

5 1/4 in. Minidiskettes
Soft sector, 10 sector, or 16 sector
\$4.40 each or
box of 10 for **\$40.00**

8 in. Standard Floppy Disks
Soft Sector
\$4.75 each—10 for \$42.50

FLOPPY DISK INTERFACE

JADE FLOPPY DISK (Tarbell board)
Kit **\$175.00**
Assembled & Tested **\$250.00**

S.D. Computer Products VERSA-FLOPPY

Kit **\$159.95**
Assembled & Tested **\$239.00**

EXPANDOR'S BLACK BOX PRINTER

This 64-character ASCII impact printer with 80-column capability is portable and uses standard 8 1/2" paper and regular typewriter ribbon. Base, cover and parallel interface are included. Assembled and complete with manual and documentation.

only \$470.00

(90 day manufacturer's warranty)

TRS-80 Interface Cable for Black Box Printer
with mating connectors: **\$48.00**
(must be used with expansion module, 18v/1 amp power supply required.)

Power Supply for TRS-80/Black Box Printer

\$49.00

MINISCOPES



- 15 megahertz bandwidth.
 - External and internal trigger.
 - Time Base — 0.1 microseconds to 0.5 Sec/div — 21 settings.
 - Battery or line operation.
 - Automatic and line sync modes.
 - Power consumption less than 15W.
 - Vertical Gain — 0.01 to 50 volts/div — 12 settings.
 - Weight is only 3 pounds.
- MS-15** **\$318**
MS-215 Dual Trace Version **\$435**
- With Rechargeable Batteries & Charger Unit
- 10 to 1, 10 meg probe **\$27**
Leather carrying case **\$45**

LOGIC PROBES



Model LP-1
Hand-held logic probe provides instant reading of logic levels for TTL, DTL, HTL, or CMOS. Input Impedance: 100,000 ohms. Minimum Detectable Pulse: 50 ns. Maximum Input Signal (Frequency): 10 MHz. Pulse Detector (LED): High speed train or single event. Pulse Memory: Pulse or level transition detected and stored.

CSC Model LP-1 Logic Probe—Net Each: **\$4.95**

MODEL LP-3
High speed logic probe. Captures pulses as short as 10 ns. Input Impedance: 500,000 ohms. Minimum Detectable Pulse: 10 ns. Maximum Input Signal (Frequency): 50 MHz. Pulse Detector (LED): High speed train or single event. Pulse Memory: Pulse or level transition detected and stored.

CSC Model LP-3 Logic Probe—Net Each: **\$69.95**

3-LEVEL GOLD WIRE WRAP SOCKETS

14 PIN 39¢ each
16 PIN 43¢ each
100 for \$30.00

Sockets are end and side stackable, closed entry.

GOLD PLATED S-100 EDGE CONNECTORS

Solder tail \$3.25 each
10 for \$30.00

Wire Wrap \$4.50 each
10 for \$40.00

S-100 MOTHER BOARDS

JADE 6-SLOT
Kit **\$41.95**
Assembled & Tested **\$56.95**
Bare Board **\$24.95**

9-SLOT "LITTLE MOTHER"

Kit **\$85.00**
Assembled & Tested **\$99.00**
Bare Board **\$35.00**

13-SLOT "QUIET MOTHER"

Kit **\$95.00**
Asm. & Tested **\$110.00**
Bare Board **\$40.00**

22-SLOT "STREAKER"

Asm. & Tested **\$149.00**

JADE

VIDEO INTERFACE

S-100 Compatible Serial Interface with Sockets Included.
Kit **\$117.95**
Assembled & Tested **\$159.95**
Bare Board w/manual **\$ 35.00**

Z80A SPECIAL

4MHz Zilog CPU Chip

★ **\$14.95** ★

TU-1

Convert your T.V. set into a Video Monitor
Kit **\$8.95**

JADE

PARALLEL/SERIAL INTERFACE

S-100 compatible, 2 serial I/O ports, 1 parallel I/O.
Kit **JG-P/S** **\$124.95**

Assembled & Tested: **JG-P/SA** **\$179.95**
Bare Board w/Manual **\$ 30.00**

ELECTRONIC SYSTEMS

"KANSAS CITY STANDARD" TAPE INTERFACE

Part No. 111
Board \$7.60; with parts \$27.50

RS-232/TTL INTERFACE

Part No. 232
Converts TTL to RS-232 and RS-232 to TTL
Board only \$4.50; with parts \$7.00

RS-232/TTY INTERFACE

Part No. 600
Converts RS-232 to 20mA current loop, and 20mA current loop to RS-232
Board only \$4.50; with parts \$7.00

LIQUID CRYSTAL DIGITAL CLOCK-CALENDAR

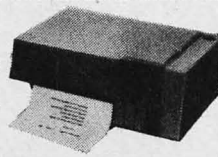


- For Auto, Home, Office.
- Small in size (2x2 1/2"x3 1/2").
- Push button for seconds release for date.
- Clocks mount anywhere with either 3M double-sided tape or VELCRO, included.
- 2 MODELS AVAILABLE.
- LCD-101, portable model runs on self-contained batteries for better than a year.
- LCD-102, runs on 12 Volt system and is back lighted.
- LCD-101 or LCD-102 your choice **\$34.95 ea.**
- Clear desk stand for **\$2.00**

Integral Data Systems



Check the impressive features on Integral's **IP-125 Impact Printer**
only \$799



LOADED WITH EXTRAS AT NO EXTRA COST

• Microprocessor controller • Serial RS232C interface • Parallel TTL level interface • Full upper and lower case ASCII character set (96 characters) • Full 8 1/2" inch wide paper • Line length of 80 columns at 10 characters per inch • Impact printing • 7x7 dot matrix • Ordinary paper—roll, fanfold, or sheet • Serial baud rate to 1200 bits per second • Multiple line buffer of 256 characters • Instantaneous print rate to 100 characters per second • Multiple copies without adjustment • Reinking ribbon mechanism • Front panel operator controls • Attractive table top console

IP-125 Integral Data System IP-125 Friction Feed Printer

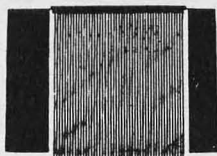
- 96 upper & lower case ASCII character set
- Enhanced character control
- Serial RS232C Interface (std. factory wiring)
- Parallel TTL Interface (factory wired on req.)
- 80 column line
- 256 byte multiline buffer

\$799

IP-225 Integral Data System IP-225 Tractor Feed Printer

- All standard features of IP-125
- Tractor feed paper drive
- Forms Control Option (P1250)

\$949



3690-12 CARD EXTENDER

Card Extender has 100 contacts. 50 per side on .125 centers. Attached connector is compatible with S-100 Bus Systems **\$25.00**
3690 6.5" 22/4 pin. 158 ctrs.
Extenders **\$12.00**



Gen. Purpose D.I.P. Boards with Bus Pattern for Solder or Wire Wrap. Epoxy Glass 1/16" 44 pin con. spaced .156.

3677 9.6" x 4.5" \$10.90
3677-2 6.5" x 4.5" \$9.74

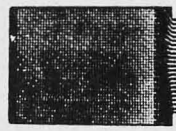
Vector Plugboards 8800V

Universal Microcomputer/processor plugboard. Use with S-100 bus. Complete with heat sink & hardware. 5.3" x 10" x 1/16"

8801-1

Same as 8800V except plain; less power buses & heat sink.

	1-4	5-9	10-24
8800V	19.95	17.95	15.95
8801-1	14.95	13.45	11.95



P pattern plugboards for IC's
Epoxy Glass 1/16" 44 pin con. spaced .156.

3662 6.5" x 4.5" \$7.65
3662-2 9.6" x 4.5" \$11.45



Hi-Density Dual-in-Line Plugboard for Wire Wrap with Power & Grd. Bus Epoxy Glass 1/16" 44 pin con. spaced .156.

3682 9.6" x 4.5" \$10.97
3682-2 6.5" x 4.5" \$9.81

PLACE ORDERS TOLL FREE:

800/421-5809 Continental U.S.
800/262-1710 Inside California

LEEDEX MONITOR

- 12" Black and White
- 12MHZ Bandwidth
- Handsome Plastic Case

\$140.00

THE KIM-1
\$179

Low price includes KIM-1 Module, monitor programs stored in 2048 ROM Bytes. User Manual, wall size Schematic, Hardware Manual, Programming Manual, Programmers Reference Card, Keyboard/Display

THE SYM-1 \$245

6502 — based single board computer with keyboard/display, KIM-1 hardware compatible, complete documentation.

SYM-1 CASE \$29.95

MICROPROCESSORS

F8	\$16.95
Z80 (2MHz)	\$20.00
Z80A (4MHz)	\$14.95
CDP1802CD	\$17.95
6502	\$11.95
6800	\$16.95
6802	\$25.00
8008-1	\$12.95
8035	\$20.00
8035-8	\$21.00
8080A	\$10.00
8085	\$23.00
TMS9900TL	\$49.95

8080A SUPPORT DEVICES

8212	\$ 2.90
8214	\$ 4.65
8216	\$ 8.25
8224 (2MHz)	\$ 4.30
8224-4 (4MHz)	\$ 9.95
8226	\$ 2.75
8228	\$ 6.40
8238	\$ 6.40
8243	\$ 8.00
8251	\$ 7.50
8253	\$20.00
8255	\$ 6.45
8257	\$20.00
8259	\$20.00
8275	\$75.00
8279	\$18.50

USRT

S2350	\$10.95
-------	---------

UARTS

AY5-1013A	\$ 5.25
AY5-1014A	\$ 8.25
TR1602B	\$ 5.25
TMS6011	\$ 5.95
IM6403	\$ 9.00

BAUD RATE GENERATORS

MC14411	\$10.00
14411 Crystal	\$ 4.95

6800 PRODUCT

6810P	\$ 4.00
6820P	\$ 6.60
6821P	\$ 6.60
6828P	\$11.25
6834P	\$16.95
6850P	\$ 8.65
6852P	\$11.00
6860P	\$ 9.25
6862P	\$12.00
6871P	\$28.75
6875P	\$ 8.75
6880P	\$ 2.50

CHARACTER GENERATORS

2513 Upper (-12+5)	\$ 6.75
2513 Lower (-12+5)	\$ 6.75
2513 Upper (5 volt)	\$ 9.75
2513 Lower (5 volt)	\$10.95
MCM6571 up scan	\$10.95
MCM6571A down scan	\$10.95

PROMS

1702A	\$ 8.00
2708	\$ 9.95
2716 (5+12) T1	\$60.00
2716 (5v) INTEL	\$60.00
2758 (5v)	\$23.40

DYNAMIC RAMS

4160/4116 (250ns)	\$12.50
2104/4096	\$ 4.00
2107B-4	\$ 3.95
TMS4027/4096 (300ns)	\$ 4.00

STATIC RAMS

21L02 (450ns)	\$ 1.50
21L02 (250ns)	\$ 1.75
2101-1	\$ 2.95
2111-1	\$ 3.25
2112-1	\$ 2.65

FLOPPY DISK CONTROLLERS

1771B01	\$39.95
1791	\$49.95

KEYBOARD CHIPS

AY5-2376	\$13.75
AY5-3600	\$13.75
MM5740	\$18.00

DYNABYTE

Naked Terminal

FEATURES & BENEFITS

- Industry standard 80 character by 24 line format (Model 57)
- Completely self contained terminal electronics, just add CCTV monitor and keyboard.
- No support software required.
- Switch selectable modes: Half Duplex, Full Duplex, Block mode.
- Block mode allows editing before transmit.
- Keyboard interface provided, including regulated +5 volts and -12 volts.
- Video is switch selectable as "Black-on-White" or "White-on-Black".
- Fully assembled, socketed, tested, burned in, and guaranteed for a full year from date of purchase.

\$350.00
with cables

NEW!

JADE Z80 BOARD

IMPROVED DESIGN AND FEATURES

- ON BOARD 2708 or 2716 EPROM
- VERY RELIABLE AT 4 MHZ OR 2 MHZ
- POWER ON JUMP AND RESET
- ON BOARD USART (8251)

2MHz	
Kit	\$135.00
Assembled & Tested	\$185.00
4 MHz	
Kit	\$149.95
Assembled & Tested	\$199.95
Bare Board	\$ 35.00

JADE 8080A

with full documentation

Kit	\$100.00
Assembled & Tested	\$149.95
Bare Board	\$ 30.00

EPROM BOARD KITS

JG8/16 (uses 2708 or 2716) \$69.95

Rockwell AIM-65: The Head-Start in Microcomputers

A KIM-1 compatible machine with on-board printer and a real keyboard!

\$375.00 w/1K RAM
\$450.00 w/4K RAM

4K assembler/editor in ROM: **\$ 80.00**
8K BASIC in ROM: **\$100.00**
Power supply: **\$ 59.95**
Case for AIM-65: **\$ 49.95**

Special Package Price: \$599.00

AIM-65 (4K), Power Supply, Case, and 8K BASIC ROM



KIMSI

INTERFACE/MOTHERBOARD

Makes S-100 cards plug-in compatible with KIM!

Kit	\$125.00
Assembled & Tested	\$165.00

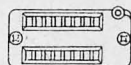
BETSI

INTERFACE/MOTHERBOARD

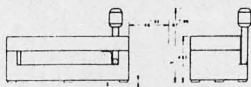
Makes S-100 cards plug-in compatible with PET!

Kit	\$119.00
Assembled & Tested	\$159.00

TEXTOL ZIP* DIP® II Sockets



***ZERO INSERTION FORCE sockets**



PRICES:

16 pin Zip Dip II	\$5.50
24 pin Zip Dip II	\$7.50
40 pin Zip Dip II	\$10.25

JADE

Computer Products

4901 W. ROSECRANS AVENUE
Department "B"
HAWTHORNE, CALIF. 90250
U.S.A.



Cash, checks, money orders, and credit cards accepted. Add freight charge of \$2.50 for orders under 10 lbs. and \$1.00 service charge for orders under \$10.00. Add 6% sales tax on all parts delivered in California. Discounts available at OEM quantities.

WRITE FOR OUR FREE CATALOG

All prices subject to change without notice.

TRS-80 Apple II

MEMORY EXPANSION KITS

4116's
8 for \$69.96
(16K x 1, 200ns)

includes dip plugs and instructions

★ TRS-80 Kit ★
(16K x 1, 300ns)

includes connectors and instructions

\$75.00

Call for discounts on larger quantities

"IMSAI"-TYPE CARD GUIDE SPECIAL!

Regular Price 30¢ each

SPECIAL: 10 for \$1.00!

New Prices

DYNAMIC RAM BOARDS EXPANDABLE TO 64K

32K VERSION • KITS

Uses 4115 (8Kx1, 250ns) Dynamic RAM's, can be expanded in 8K increments up to 32K:

8K	\$159.00	24K	\$249.00
16K	\$199.00	24K	\$299.00

4115 SALE
8 for \$39.95

64K VERSION • KITS

Uses 4116 (16Kx1, 200ns) Dynamic RAM's, can be expanded in 16K increments up to 64K:

16K	\$249.00	48K	\$469.00
32K	\$369.00	64K	\$569.00

★ STATIC RAM SPECIALS ★

2114's, low power (1024x4)

	1-15	16-99	100 +
450ns	8.00	6.95	5.50
300ns	9.00	8.00	6.50

TMS4044/MM5257, low power

450ns	8.00	7.50	6.50
300ns	9.95	8.75	8.00

4200A (4Kx1, 200ns)

	9.95	8.50	8.00
--	------	------	------

410D (4K x 1, 200 ns)

	8.25	7.00	6.75
--	------	------	------

STATIC RAM BOARDS

JADE 8K

Kits:	450ns	\$125.95
	250ns	\$149.75

Assembled & Tested:

	450ns	\$139.75
	250ns	\$169.75

Bare Board:

		\$ 25.00
--	--	----------

16K — Uses 2114's (low power)

Assembled & Tested:

RAM 16 (250ns)	\$375.00
RAM 16B (450ns)	\$325.00

16K with memory management

Assembled & Tested:

RAM 65 (250ns)	\$390.00
RAM 65B (450ns)	\$350.00

32K Static

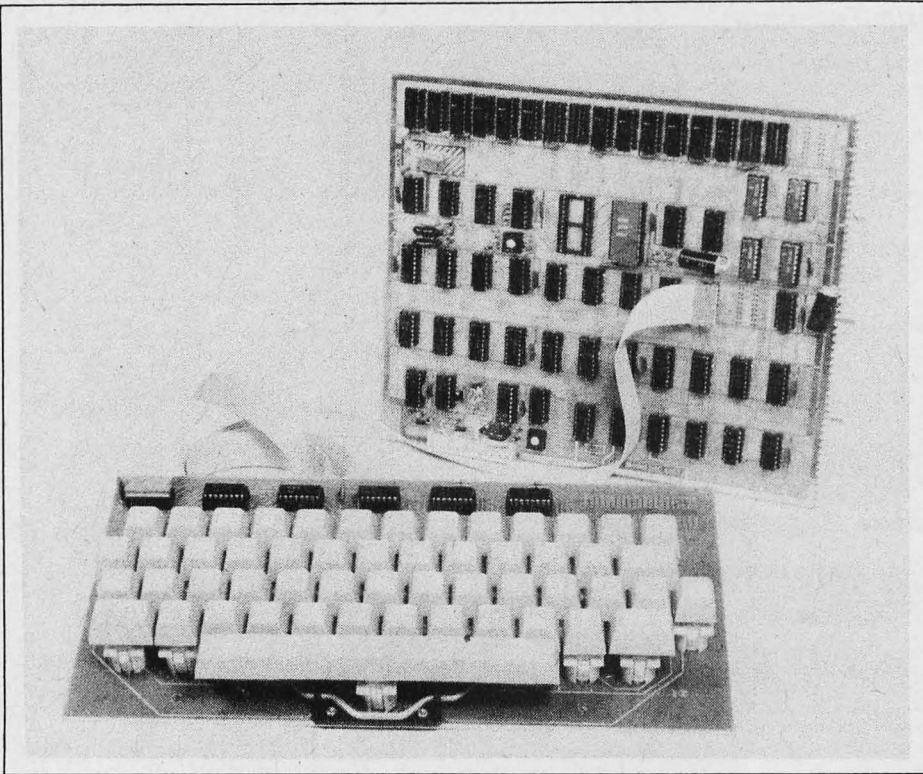
Assembled & Tested:

250ns	\$795.00
450ns	\$725.00
250ns Kit	\$575.00

What's New?

PERIPHERALS

Fully Assembled Video Display Interface for Ohio Scientific Systems



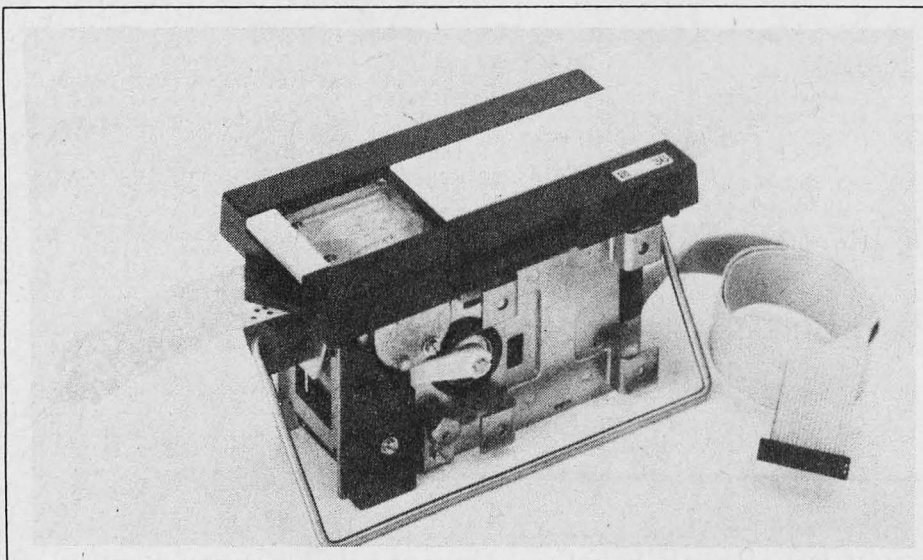
Ohio Scientific is offering the video display interface from its Challenger IIP as a fully assembled accessory for any OSI system. The 540 video display features a 32 row by 64 column display of the standard 64 character ASCII font in 5 by 7 dot matrix form. Standard features include programmable formatting of the display for 32 by 32 or 32 by 64. The 32 by 32 mode is useful for video animation since it provides square character cells. The video board also features a keyboard port which can be used with a standard ASCII keyboard of OSI's new programmable keyboard. The 540 optionally supports a graphics character generator which features lower case and about 170 special characters for plotting and gaming.

All systems using the 540 incorporate OSI's new 542 programmed keyboard. This fully programmable keyboard system is capable of upper and lower case and auto repeat on all characters. The keyboard also features up to five levels of shifting to allow many special single keystroke commands and direct single keystroke graphics. The keyboard has provisions for character editing and supports special formats for video games.

The Model 540 video board is available as an add-on option for any OSI system as a CA-11 for \$249. The graphics character generator option retails for \$29. Contact Ohio Scientific, 1333 S Chillicothe Rd, Aurora OH 44202. ■

Circle 559 on inquiry card.

Tape Punch Handles Paper and Mylar Tapes



This low cost tape punch, which handles paper or Mylar tape, has been introduced by GNT Automatic Inc, 440 Totten Pond Rd, Waltham MA 02154. The GNT 36 tape punch is designed to handle oiled and dry paper tape and all types of Mylar and Mylar foil tapes without adjustment. Easily integrated into a wide variety of equipment, the unit measures 2.4 by 4.7 by 3 inches (6.10 by 11.94 by 7.62 cm).

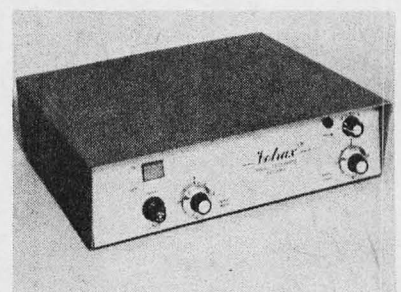
Providing a die block life of 150 mil-

lion characters, the GNT 36 punches up to 50 characters per second. With an allowable back tension of about 5 ounces, the bidirectional unit accommodates 5, 6, or 8 hole tape widths, selectable by the user. A second version of the GNT 36 punches up to 75 characters per second.

The GNT 36 tape punch is priced at \$495. Contact GNT Automatic Inc, 440 Totten Pond Rd, Waltham MA 02154. ■

Circle 560 on inquiry card.

Interface This Electronic Voice System to Your Computer



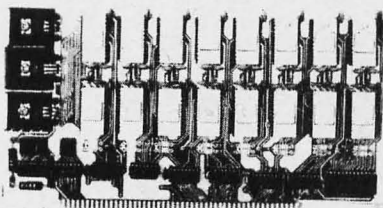
The Votrax VS-6.4 is an improved model of the VS-6 which produces electronically synthesized human speech from digital data. In the VS-6.4 two circuit boards have been changed to obtain improved voice quality. For those who wish to convert their VS-6 equipment, retrofit boards are available. Software is unaffected by the change.

The Votrax VS-6.4 electronic voice system is flexible and operationally simple. A complete range of interface types and options make it compatible with most conventional computer and communications equipment, and it can be used over telephone lines or paging systems.

For further information contact Votrax, 500 Stephenson Hwy, Troy MI 48084. ■

Circle 561 on inquiry card.

16K EPROM CARD-S 100 BUSS



\$59.95
KIT

OUR
BEST
SELLING
KIT!

USES 2708's!

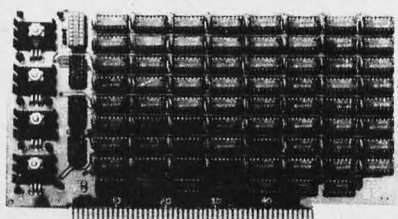
Thousands of personal and business systems around the world use this board with complete satisfaction. Puts 16K of software on line at **ALL TIMES!** Kit features a top quality soldermasked and silk-screened PC board and first run parts and sockets. All parts (except 2708's) are included. Any number of EPROM locations may be disabled to avoid any memory conflicts. Fully buffered and has WAIT STATE capabilities.

OUR 450NS 2708'S
ARE \$8.95 EA. WITH
PURCHASE OF KIT

ASSEMBLED
AND FULLY TESTED
ADD \$25

8K LOW POWER RAM KIT-S 100 BUSS

250 NS SALE!



ADD \$5
FOR
250NS!

\$129 KIT

Use 21L02
450 NS RAMS!

Thousands of computer systems rely on this rugged, work horse, RAM board. Designed for error-free, NO HASSLE, systems use.

KIT FEATURES:

1. Doubled sided PC Board with solder mask and silk screen layout. Gold plated contact fingers.
2. All sockets included.
3. Fully buffered on all address and data lines.
4. Phantom is jumper selectable to pin 67.
5. FOUR 7805 regulators are provided on card.

Blank PC Board w/Documentation
\$29.95

Low Profile Socket Set...**13.50**
Support IC's (TTL & Regulators)
\$9.75

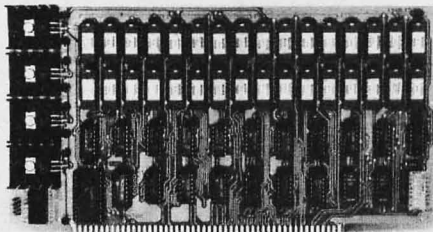
Bypass CAP's (Disc & Tantalums)
\$4.50

ASSEMBLED AND FULLY
BURNED IN ADD \$30

16K STATIC RAM KIT-S 100 BUSS

\$295 KIT

FULLY
STATIC, AT
DYNAMIC PRICES



WHY THE 2114 RAM CHIP?

We feel the 2114 will be the next industry standard RAM chip (like the 2102 was). This means price, availability, and quality will all be good! Next, the 2114 is FULLY STATIC! We feel this is the **ONLY** way to go on the S-100 Bus! We've all heard the HORROR stories about some Dynamic RAM Boards having trouble with DMA and FLOPPY DISC DRIVES. Who needs these kinds of problems? And finally, even among other 4K Static RAM's the 2114 stands out! Not all 4K static Rams are created equal! Some of the other 4K's have clocked chip enable lines and various timing windows just as critical as Dynamic RAM's. Some of our competitor's 16K boards use these "tricky" devices. But not us! The 2114 is the **ONLY** logical choice for a trouble-free, straightforward design.

KIT FEATURES:

1. Addressable as four separate 4K Blocks.
2. ON BOARD BANK SELECT circuitry. (Cromemco Standard!). Allows up to 512K on line!
3. Uses 2114 (450NS) 4K Static Rams.
4. ON BOARD SELECTABLE WAIT STATES.
5. Double sided PC Board, with solder mask and silk screened layout. Gold plated contact fingers.
6. All address and data lines fully buffered.
7. Kit includes ALL parts and sockets.
8. PHANTOM is jumpered to PIN 67.
9. LOW POWER: under 2 amps TYPICAL from the +8 Volt Buss.
10. Blank PC Board can be populated as any multiple of 4K's.

BLANK PC BOARD W/DATA—\$33

LOW PROFILE SOCKET SET—\$12 ASSEMBLED & TESTED—ADD \$30
SUPPORT IC'S & CAPS—\$19.95 2114 RAM'S—8 FOR \$69.95

60 HZ CRYSTAL TIME BASE

\$4.95

(Complete Kit)

Uses MM5369 CMOS divider IC with high accuracy 3.579545 MHZ Crystal. Use with all MOS Clock Chips or Modules. Draws only 15 MA. All parts, data, and PC Board included

100 HZ CRYSTAL TIME BASE

\$5.95

(Complete Kit)

Same as above, except it uses a special MM5369. Perfect for frequency counter time bases, etc. Also use with MOSTEK MK50397 timer chip.

16K DYNAMIC RAM CHIP

16K X 1 Bits. 16 Pin Package. Same as Mostek 4116-4. 250 NS access. 410 NS cycle time. Our best price yet for this state of the art RAM. 32K and 64K RAM boards using this chip are readily available. These are new, fully guaranteed devices by a major mfg.

8 FOR \$89.95

VERY LIMITED STOCK!

NOT ASSOCIATED
WITH
DIGITAL RESEARCH
OF CALIFORNIA,
THE SUPPLIERS OF
CPM SOFTWARE.

450 NS! 2708 EPROMS

Now full speed! Prime new units from a major U.S. Mfg. 450 N.S. Access time. 1K x 8. Equiv. to 4-1702 A's in one package.

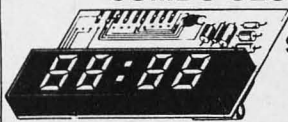
~~\$15.75 ea.~~

\$9.95

~~4 FOR \$50.00~~

PRICE CUT

NATIONAL SEMICONDUCTOR JUMBO CLOCK MODULE



\$6.95

2 FOR \$13

(AC XFMR \$1.95)

ASSEMBLED! NOT A KIT!
ZULU VERSION!
We have a limited number of the 24 HR Real time version of this module in stock.
#MA1008D — \$9.95

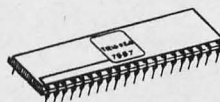
PERFECT FOR USE
WITH A TIMEBASE.

MA1008A BRAND NEW!
FEATURES:
• FOUR JUMBO 3/4 INCH LED DISPLAYS
• 12 HR REAL TIME FORMAT
• 24 HR ALARM SIGNAL OUTPUT
• 50 OR 60 HZ OPERATION
• LED BRIGHTNESS CONTROL
• POWER FAILURE INDICATOR
• SLEEP & SNOOZE TIMERS
• DIRECT LED DRIVE (LOW RFI)
• COMES WITH FULL DATA
COMPARE AT UP TO TWICE
OUR PRICE!
MANUFACTURER'S CLOSEOUT!

WESTERN DIGITAL UART

TR1602A. PIN FOR PIN SUB FOR
AY5-1013 AND TMS6011.

FOR SERIAL I/O



\$2.99

EACH

SURPLUS SPECIAL

SALE!

1N4148 DIODES, SILICON.
Same as 1N914. New,
factory prime, Full Leads.
100 FOR \$2
1000 FOR \$17.50

New! REAL TIME
Computer Clock Chip

N.S. MM5313. Features
BOTH 7 segment and
BCD outputs. 28 Pin
DIP. \$4.95 with Data

Z-80 PROGRAMMING MANUAL

By MOSTEK, or ZILOG. The most detailed explanation ever on the working of the Z-80 CPU CHIPS. At least one full page on each of the 158 Z-80 instructions. A MUST reference manual for any user of the Z-80. 300 pages. Just off the press.

\$12.95

COMPUTER PARTS

Z-80 - 19.95
Z-80A - 24.95
8080A - 6.95
8080A-2 - 8.95

8212 - 2.25
8255 - 6.95
2111AL-4 - 2.25
2708 - 9.95

"THE COLOSSUS"

FAIRCHILD SUPER JUMBO LED READOUT

A full 80 inch character. The biggest readout we have ever sold! Super efficient. Compare at up to \$2.95 each from others!

FND 843 Common Anode
FND 850 Common Cathode

YOUR CHOICE
\$1.49 ea (6 for \$6.95)

Digital Research Corporation

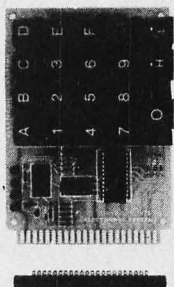
(OF TEXAS)

P.O. BOX 401247Y GARLAND, TEXAS 75040 • (214) 271-2461

TERMS: Add 30¢ postage, we pay balance. Orders under \$15 add 75¢ handling. No C.O.D. We accept Visa, MasterCard, and American Express cards. Tex. Res. add 5% Tax. Foreign orders (except Canada add 20% P & H. 90 Day Money Back Guarantee on all items.

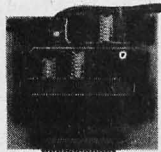
HEX ENCODED KEYBOARD

E.S.
This HEX keyboard has 19 keys, 16 encoded with 3 user definable. The encoded TTL outputs, 8-4-2-1 and STROBE are debounced and available in true and complement form. Four onboard LEDs indicate the HEX code generated for each key depression. The board requires a single +5 volt supply. Board only \$15.00 Part No. HEX-3, with parts \$49.95 Part No. HEX-3A. 44 pin edge connector \$4.00 Part No. 44P.



TRS-80 SERIAL I/O

● RS-232 compatible ● Can be used with or without the expansion bus ● On board switch selectable baud rates of 110, 150, 300, 600, 1200, 2400, parity or no parity odd or even, 5 to 8 data bits, and 1 or 2 stop bits. D.T.R. line. Board only \$19.95 Part No. 8010, with parts \$59.95 Part No. 8010A, assembled \$79.95 Part No. 8010C. No connectors provided, see below.



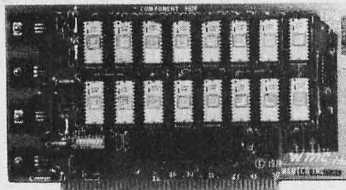
EIA/RS-232 connector Part No. DB25P \$8.00, with 9' 8 conductor cable \$10.95 Part No. DB25PS.

3' ribbon cable with attached connectors to fit TRS-80 and our serial board \$19.95 Part No. 3CAB40.



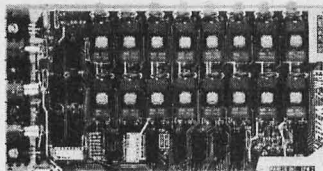
4K EPROM WMC inc.

This board is designed to operate with any speed or power 1702A. Addressable in 4K byte increments and can be configured to occupy either 2K or 4K segments. It can be populated one memory chip at a time. Bare board \$30, board with parts \$200, assembled \$230. Part No. EPM-1



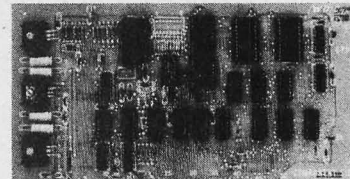
16K OR 32K EPROM WMC inc.

Designed to operate with any speed or power 2708 or single voltage (+5V) 2716. Addressable in 4K increments and can occupy multiples of 4K. It can be populated one memory chip at a time. Has bank addressing and Phantom Disable. The board comes with an exclusive software program that can be placed in a 2708 or 2716 that will, when used in conjunction with a RAM memory board, check out every line on the EPM-2. Bare board \$30, board with parts with 2708 \$455, assembled \$485. Board with parts with 2716 \$1,225, assembled \$1,255. Part No. EPM-2



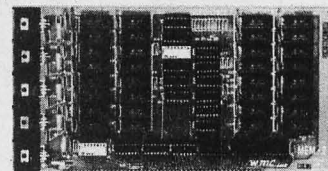
8080A CPU (With Eight Level Victor Interrupt Capability) WMC inc.

Uses the 8080A and the 8224 clock chip. The crystal frequency used is 18 MHz and the vector interrupt chip is the 8214. The board will function normally without the interrupt circuitry. When the interrupt circuitry is built up, the board will respond to eight levels of interrupts. Designed to be a plug-in replacement for the IMSAI CPU board and will work in other computers with the appropriate modifications made to the ribbon cable connector pin out from the front panel. The board will work in systems without a front panel if the system has a PROM board that simulates the functions of the front panel. Bare board \$30, with parts \$185, assembled \$220. Part No. CPU-1



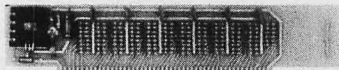
16K STATIC RAM WMC inc.

Operates with any speed or power 2114. All input and output lines are fully buffered. Addressable in 4K byte increments. If the system has a front panel, the board will allow itself to be protected. If there is no front panel, the board will not allow itself to be protected. The board has Bank Address capability, Phantom Disable, MWRITE, and selectable wait states. Bare board \$30, board with parts \$665. Part No. MEM2



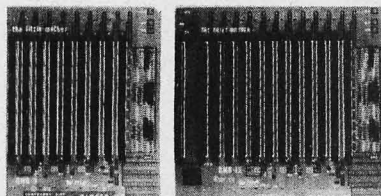
S-100 BUS ACTIVE TERMINATOR *

Board only \$14.95 Part No. 900, with parts \$24.95 Part No. 900A



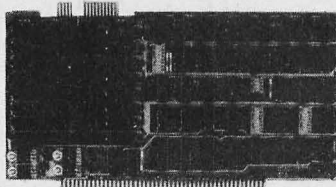
9 AND 13 SLOT MOTHER BOARDS WMC inc.

All traces are reflow solder covered and both sides are solder masked. The connectors used on these boards are the IMSAI™ type (.125" between pins, .250" between rows). Spacing between connectors is .750". All lines, except power and ground, have a passive RC network termination available. There is a kluge area available that will accept two 40 pin sockets and one 36 pin socket. The circuitry for supplying three separate regulated voltages to the kluge area is contained on the board. Part No. GMB-12 \$40 bare, \$105 kit, \$120 assembled. Part No. GMB-9 \$35 bare, \$90 kit, \$105 assembled.



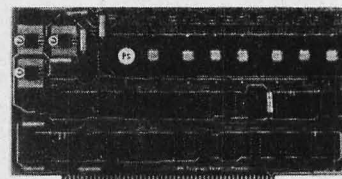
PICEON 65K DYNAMIC RAM

Main memory for microcomputers, intelligent terminals, business systems, medical systems, and OEM systems. ● High density random access memory 48K bytes or 64K bytes ● Fully buffered ● S-100 bus compatible ● Low power (dynamic memory) ● Transparent refresh ● Digital delay line techniques for reliable operation ● Multiple boards allowed using hardware or software controlled bank select ● "Phantom" signal for RAM/ROM overlap ● All boards are fully tested prior to shipment. Operating System test and extensive bit pattern testing. ● Works directly in 8080A processors or Z-80 environment at 2MHz ● Currently used by industry ● 1 year warranty. Only available assembled and tested with 48K \$1,250 Part No. 48K, or with 65K \$1,475 Part No. 65K



8K EPROM PICEON

Saves programs on PROM permanently (until erased via UV light) up to 8K bytes. Programs may be directly run from the program saver such as fixed routines or assemblers. ● S-100 bus compatible ● Room for 8K bytes of EPROM non-volatile memory (2708's). ● On-board PROM programming ● Address relocation of each 4K or memory to any 4K boundary within 64K ● Power on jump and reset jump option for "turnkey" systems and computers without a front panel ● Program saver software available ● Solder mask both sides ● Full silkscreen for easy assembly. Program saver software in 1 2708 EPROM \$25. Bare board \$35 including custom coil, board with parts but no EPROMS \$139, with 4 EPROMS \$179, with 8 EPROMS \$219.



To Order:

Mention part number, description, and price. In USA, shipping paid for orders accompanied by check, money order, or Master Charge, BankAmericard, or VISA number, expiration date and signature. Shipping charges added to C.O.D. orders. California residents add 6.5% for tax. Outside USA add 10% for air mail postage and handling, no C.O.D.'s. Checks and money orders must be payable in US dollars. Parts kits include sockets for all ICs, components, and circuit board. Documentation is included with all products. Prices are in US dollars. No open accounts. To eliminate tariff in Canada boxes are marked "Computer Parts." Dealer inquiries invited. 24 Hour Order Line: (408) 226-4064



* Circuits designed by John Bell

For free catalog including parts lists and schematics, send a self-addressed stamped envelope.

ELECTRONIC SYSTEMS Dept. B, P. O. Box 21638, San Jose, CA USA 95151

The DATA-TRANS 1000

A completely refurbished
IBM Selectric Terminal
with built-in ASCII Interface.

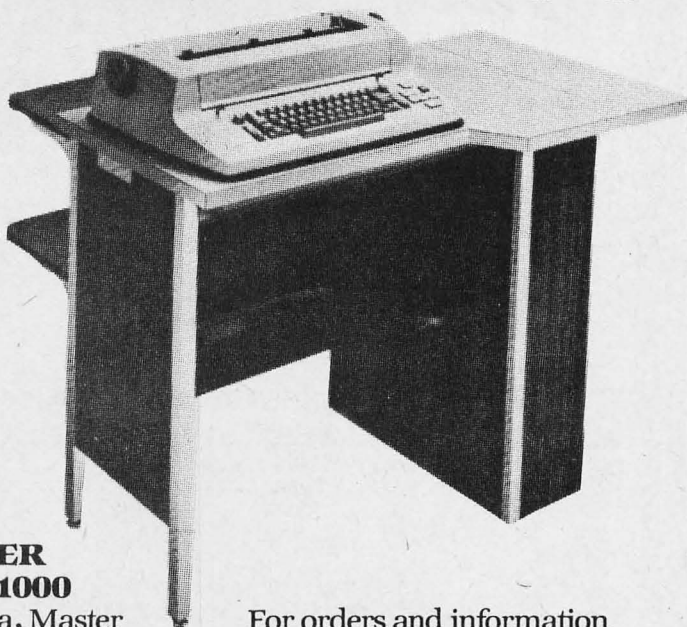
\$1495.00. For a limited time
save **\$100.00** on each unit ordered.

Now, until April 30, 1979

Only \$1395.00

Features:

- 300 Baud
- 14.9 characters per second printout
- Reliable heavy duty Selectric mechanism
- RS-232C Interface (requires RS-232C port for I/O transmission)
- Documentation included
- 60 day warranty - parts and labor
- High quality Selectric printing
- Off-line use as typewriter



HOW TO ORDER DATA-TRANS 1000

1. We accept Visa, Master Charge. Make cashiers checks or personal check payable to:

DATA-TRANS

2. All orders are shipped F.O.B. San Jose, CA
3. Deliveries are immediate

For orders and information

DATA-TRANS

2154 O'Toole St.

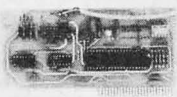
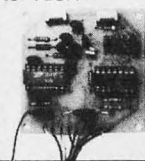
Unit E

San Jose, CA 95131

Phone: (408) 263-9246

MODEM*

- Type 103 • Full or half duplex • Works up to 300 baud • Originate or Answer • No coils, only low cost components • TTL input and output - serial • Connect 8 Ω speaker and crystal mic, directly to board • Uses XR FSK demodulator • Requires +5 volts • Board only \$7.60 Part No. 109, with parts \$27.50 Part No. 109A



APPLE II* SERIAL I/O INTERFACE

Baud rate is continuously adjustable from 0 to 30,000 • Plugs into any peripheral connector • Low current drain. RS-232 input and output • On board switch selectable 5 to 8 data bits, 1 or 2 stop bits, and parity or no parity either odd or even • Jumper selectable address • SOFTWARE • Input and Output routine from monitor or BASIC to teletype or other serial printer • Program for using an Apple II for a video or an intelligent terminal. Also can output in correspondence code to interface with some selectrics. • Board only \$15.00 Part No. 2, with parts \$42.00 Part No. 2A, assembled \$62.00 Part No. 2C

UART & BAUD RATE GENERATOR*

- Converts serial to parallel and parallel to serial • Low cost on board baud rate generator • Baud rates: 110, 150, 300, 600, 1200, and 2400 • Low power drain +5 volts and -12 volts required • TTL compatible • All characters contain a start bit, 5 to 8 data bits, 1 or 2 stop bits, and either odd or even parity. • All connections go to a 44 pin gold plated edge connector • Board only \$12.00 Part No. 101, with parts \$35.00 Part No. 101A, 44 pin edge connector \$4.00 Part No. 44P



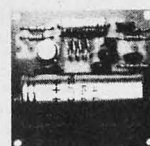
T.V. TYPEWRITER

- Stand alone TVT • 32 char/line, 16 lines, modifications for 64 char/line included • Parallel ASCII (TTL) input • Video output • 1K on board memory • Output for computer controlled cursor • Auto scroll • Non-destructive cursor • Cursor inputs: up, down, left, right, home, EOL, EOS • Scroll up, down • Requires +5 volts at 1.5 amps, and -12 volts at 30 mA • All 7400, TTL chips • Char. gen. 2513 • Upper case only • Board only \$39.00 Part No. 106, with parts \$145.00 Part No. 106A



T.V. INTERFACE

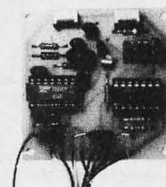
- Converts video to AM modulated RF. Channels 2 or 3. So powerful almost no tuning is required. On board regulated power supply makes this extremely stable. Rated very highly in Doctor Dobbs' Journal. Recommended by Apple • Power required is 12 volts AC C.T., or +5 volts DC • Board only \$7.60 part No. 107, with parts \$13.50 Part No. 107A



(Illegal where prohibited by law.)

TAPE* INTERFACE

- Play and record Kansas City Standard tapes • Converts a low cost tape recorder to a digital recorder • Works up to 1200 baud • Digital in and out are TTL - serial • Output of board connects to mic. in of recorder • Earphone of recorder connects to input on board • No coils • Requires +5 volts, low power drain • Board only \$7.60 Part No. 109, with parts \$27.50 Part No. 109A



To Order:

Mention part number, description, and price. In USA, shipping paid for orders accompanied by check, money order, or Master Charge, BankAmericard, or VISA number, expiration date and signature. Shipping charges added to C.O.D. orders. California residents add 6.5% for tax. Outside USA add 10% for air mail postage and handling, no C.O.D.'s. Checks and money orders must be payable in US dollars. Parts kits include sockets for all ICs, components, and circuit board. Documentation is included with all products. Prices are in US dollars. No open accounts. To eliminate tariff in Canada boxes are marked "Computer Parts." Dealer inquiries invited. 24 Hour Order Line: (408) 226-4064

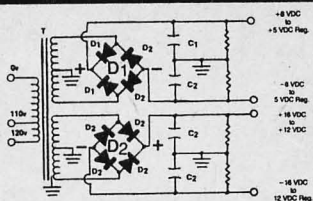


* Circuits designed by John Bell

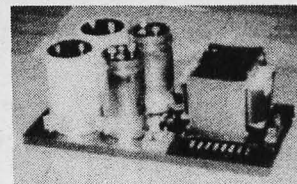
For free catalog including parts lists and schematics, send a self-addressed stamped envelope.

ELECTRONIC SYSTEMS

Dept. B, P. O. Box 21638, San Jose, CA USA 95151



BUILD YOUR OWN LOW COST MICRO-COMPUTER POWER SUPPLIES FOR S-100 BUS, FLOPPY DISCS, ETC.



POWER TRANSFORMERS (WITH MOUNTING BRACKETS)

ITEM NO.	USED IN KIT NO.	PRI. WINDING TAPS	SECONDARY WINDING OUTPUTS			SIZE W x D x H	UNIT PRICE
			2x8.5 Vac	2x14.5 Vac	2x25 Vac		
T ₁	1	0V, 110V, 120V	2x9A	2x2.5A	—	3 3/8" x 4 1/8" x 2 3/16"	19.95
T ₂	2	0V, 110V, 120V	2x13.5A	2x3.5A	—	3 3/4" x 4 3/8" x 3 1/8"	25.95
T ₃	3	0V, 110V, 120V	2x10A	2x2.5A	2x2.5A	3 3/4" x 4 3/8" x 3 1/8"	27.95
T ₄	4	0V, 110V, 120V	2x4.5A	—	2x4.5A	3 3/8" x 4 1/8" x 2 3/16"	19.95

POWER SUPPLY KITS (OPEN FRAME WITH BASE PLATE, 3 HRS. ASSY. TIME)

ITEM	USED FOR	@+8 Vdc	@-8 Vdc	@+16 Vdc	@-16 Vdc	@+28 Vdc	SIZE WxDxH	UNIT PRICE
KIT 1	18 CARDS SOURCE	18A	—	2.5A	2.5A	—	12" x 6" x 4 7/8"	46.95
KIT 2	SYSTEM SOURCE	25A	—	3A	3A	—	12" x 6" x 4 7/8"	54.95
KIT 3	DISC SYSTEM	20A	1A	2A	2A	4A	14" x 6" x 4 7/8"	62.95
KIT 4	DISC SOURCE	8A	1A	—	—	8A	10" x 6" x 4 7/8"	44.95

EACH KIT INCLUDES: TRANSFORMER, CAPACITORS, RESIS., BRIDGE RECTIFIERS, FUSE & HOLDER, TERMINAL BLOCK, ALUM. CHASSIS PLATE, ALL NECE. MTG. PARTS AND INSTRUCTIONS.

SHIPPING: FOR EACH TRANSFORMER: \$4.75. FOR EACH KIT: \$5.00 IN CALIF., \$7.00 IN OTHER STATES. CALIF. RESIDENTS ADD 6% SALES TAX. MASTER CHARGE, VISA & OEM WELCOME.



MAIL ORDER:
P.O. Box 4296
Torrance, Ca. 90510

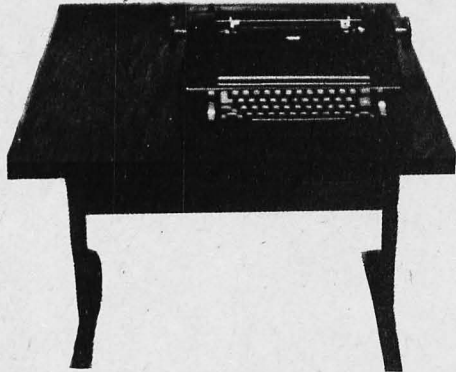
SUNNY INTERNATIONAL
(TRANSFORMERS MANUFACTURER)
Telephone: (213) 633-8327

STORE:
7245 E. Alondra Blvd.
Paramount, Ca. 90723
STORE HOURS: 9 AM-6 PM



ATTENTION TRS-80 & APPLE USERS

A PRINTER FOR YOUR COMPUTER



\$995⁰⁰

MODEL 3S-80 for TRS-80

Ready to plug into your expansion interface.

MODEL 3S-PP

for computers with 8 bit serial port.

MODEL 3S-SS

for computers with RS-232 port.

\$1095⁰⁰ for

MODEL 3S-AA

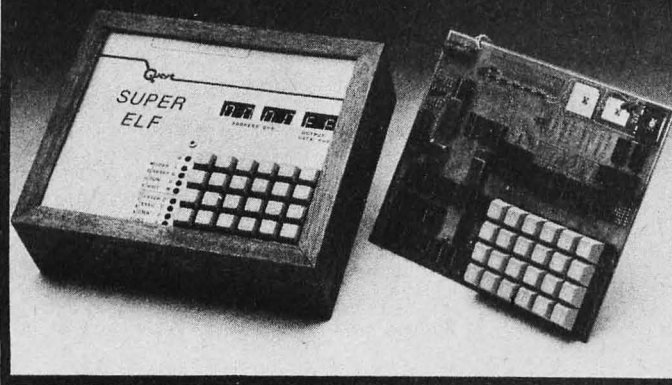
Includes RS-232 card for Apple II
Specify model number on order.

- Ready to plug into your computer
- Very high quality print
- Completely refurbished IBM 731 I/O Selectric terminal in a new table
- Upper & lower case removable type ball
- Special I/O interface
- Heavy duty re-mfg. IBM power supply

TERMS: VISA, MASTERCARD, Cashier Check or Money Order. C.O.D. with 10% down. Shipping Via Air or Truck collect.

3 S SALES

P.O. BOX 45944
TULSA, OK 74145
918/622-1058



QUEST Cosmac Super Elf Computer \$106.95

Compare features before you decide to buy any other computer. There is no other computer on the market today that has all the desirable benefits of the **Super Elf** for so little money. The **Super Elf** is a small single board computer that does many big things. It is an excellent computer for training and for learning programming with its machine language and yet it is easily expanded with additional memory, **Tiny Basic**, ASCII Keyboards, video character generation, etc.

The **Super Elf** includes a ROM monitor for program loading, editing and execution with **SINGLE STEP** for program debugging which is not included in others at the same price. With **SINGLE STEP** you can see the microprocessor chip operating with the unique **Quest** address and data bus displays before, during and after executing instructions. Also, CPU mode and instruction cycle are shown on several LED indicator lamps.

An RCA 1861 video graphics chip allows you to connect to your own TV with an inexpensive video modulator to do graphics and games. There is a **speaker system** included for writing your own music or using many music programs already written. The speaker amplifier may also be used to drive relays for control purposes.

A 24 key **HEX keyboard** includes 16 HEX keys plus load, reset, run, input, memory protect,

memory select, monitor select and single step. Large, on board displays provide output and optional high and low address. There is a 44 pin standard connector for PC cards and a 50 pin connector for the **Quest Super Expansion Board**. Power supply and sockets for all IC's are included in the price plus a detailed 90 page instruction manual.

Many schools and universities are using the **Super Elf** as a course of study. OEM's use it for training and research and development.

Remember, other computers only offer **Super Elf** features at additional cost or not at all. **Compare before you buy. Super Elf Kit \$106.95, High address option \$8.95, Low address option \$9.95, Custom Hardwood Cabinet with drilled and labelled front panel \$24.95, NiCad Battery Backup Kit \$4.95.** All kits and options also come completely assembled and tested.

Questdata, a 12 page monthly software publication for 1802 computer users is available by subscription for \$12.00 per year. New 100 page software manual Vol.1 \$4.95.

Tiny Basic for ANY 1802 System Cassette \$10.00. On ROM Monitor \$38.00. **Super Elf** owners, 30% off. Object code listing or paper tape with manual \$5.95. **Original ELF Kit Board \$14.95.**

Super Expansion Board with Cassette Interface \$89.95

This is truly an astounding value! This board has been designed to allow you to decide how you want it optioned. The **Super Expansion Board** comes with 4K of low power RAM fully addressable anywhere in 64K with built-in memory protect and a **cassette interface**. Provisions have been made for all other options on the same board and it fits neatly into the hardware cabinet alongside the **Super Elf**. The board includes slots for up to 6K of EPROM (2708, 2758, 2716 or TI 2716) and is fully socketed (\$12.00 value). EPROM can be used for the monitor and **Tiny Basic** or other purposes.

A **IK Super ROM Monitor \$19.95** is available as an on board option in 2708 EPROM which has been preprogrammed with a program loader/editor and error checking multi file cassette read/write software, (relocatable cassette file) another exclusive from **Quest**. It includes register save and readout, block move capability, and video graphics driver with blinking cursor. The **Super Monitor** is written with subroutines allowing users to take advantage of monitor functions

simply by calling them up. Improvements and revisions are easily done with the monitor. If you have the **Super Expansion Board** and **Super Monitor** the monitor is up and running at the push of a button.

Other on board options include **Parallel Input and Output Ports** with full handshake. They allow easy connection of an ASCII keyboard to the input port. **RS 232 and 20 mA Current Loop** for teletype or other device are on board and if you need more memory there are 2 S-100 slots for static RAM or video boards. A Godbout 8K RAM board is available for \$135.00. **Parallel I/O Ports \$9.95, RS 232 \$4.50, TTY 20 mA I/F \$1.95, S-100 \$4.50.** A 50 pin connector set with ribbon cable is available at \$12.50 for easy connection between the **Super Elf** and the **Super Expansion Board**.

The **Power Supply** for the **Super Expansion Board** is a 5 amp supply with +8v ± 18v + 12v - 5v. Regulated voltages are ±5v & +12v \$29.95. -12 volt optional. Deluxe version includes the case at \$39.95.

Auto Clock Kit \$15.95

DC clock with 4-50" displays. Uses National MA-1012 module with alarm option. Includes light dimmer, crystal timebase PC boards. Fully regulated, comp. instrs. Add \$3.95 for beautiful dark gray case. Best value anywhere.

RCA Cosmac VIP Kit \$229.00

Video computer with games and graphics. Fully assem. and test. \$249.00

Not a Cheap Clock Kit \$14.95

Includes everything except case. 2-PC boards. 6-50" LED Displays. 5314 clock chip, transformer, all components and full instrs. Green and orange displays also avail. Same kit w/ 80" displays. Red only \$21.95 Case \$11.75

60 Hz Crystal Time Base Kit \$4.40

Converts digital clocks from AC line frequency to crystal time base. Outstanding accuracy. Kit includes: PC board, IC, crystal, resistors, capacitors and trimmer.

Digital Temperature Meter Kit

Indoor and outdoor. Switches back and forth. Beautiful. 50" LED readouts. Nothing like it available. Needs no additional parts for complete, full operation. Will measure -100° to +200°F, tenths of a degree, air or liquid. Very accurate. \$39.95. Beautiful woodgrain case w/bezel \$11.75

NiCad Battery Fixer/Charger Kit

Opens shorted cells that won't hold a charge and then charges them up, all in one kit w/full parts and instructions. \$7.25

PROM Eraser

Ultraviolet, assembled \$34.50

Clock Calendar Kit \$23.95

CT7015 direct drive chip displays date and time on 6" LEDs with AM-PM indicator. Alarm/doze feature includes buzzer. Complete with all parts, power supply and instructions, less case.

Same day shipment. First line parts only. Factory tested. Guaranteed money back. Quality IC's and other components at factory prices.

INTEGRATED CIRCUITS

7400TTL	17	LM340T-18	1.10	CD4511	94	8212	2.90
7400N	17	LM340T-24	1.10	CD4515	2.52	8214	8.00
7402N	43	LM345H	4.30	CD4516	1.50	8216	2.90
7404N	19	LM370	1.15	CD4518	1.02	8224	2.90
7405N	23	LM377	1.15	CD4520	1.02	8226	5.35
7410N	17	LM379	5.00	CD4522	1.51	8231	8.50
7414N	83	LM380N	1.00	CD4528	7.75	8253	10.00
7418N	17	LM380N	1.60	CD4533	1.51	8257	8.25
7422N	139	LM382	1.60	CD4556	5.75	8259	19.50
7424N	20	LM709H	28	CD4585	2.25	8259	19.50
7430N	20	LM703H	40	CD4583	4.50	8259	19.50
7442N	55	LM709H	28	CD4585	2.25	8259	19.50
7445N	69	LM723H/N	50	CD40132	3.00	8259	19.50
7447N	60	LM733N	67	74C00	28	8259	19.50
7448N	69	LM7414H	35	74C04	5.33	8259	19.50
7450N	17	LM741N	25	74C10	2.10	8259	19.50
7474N	29	LM7474H/N	62	74C14	2.10	8259	19.50
7475N	49	LM748N	35	74C20	2.80	8259	19.50
7485N	88	LM1303N	82	74C30	2.80	8259	19.50
7488N	200	LM1304	1.10	74C43	1.95	8259	19.50
7489N	43	LM1305	1.27	74C74	7.75	8259	19.50
7492N	43	LM1307	2.00	74C76	1.40	8259	19.50
7493N	43	LM1310	2.75	74C90	1.15	8259	19.50
7495N	69	LM1458	47	74C93	1.40	8259	19.50
74100N	90	LM1800	1.75	74C154	3.00	8259	19.50
74107N	29	LM1812	7.50	74C160	1.40	8259	19.50
74108N	34	LM1885	1.00	74C175	1.35	8259	19.50
74123N	59	LM2111	1.75	74C192	1.65	8259	19.50
74125N	39	LM2902	1.50	74C221	2.80	8259	19.50
74150N	69	LM3900N	60	74C265	3.00	8259	19.50
74150N	95	LM3905	1.75	74C906	1.95	8259	19.50
74151N	35	LM3909	67	74C914	7.75	8259	19.50
74151N	100	MC1455B	50	74C922	2.50	8259	19.50
74157N	69	NE540L	2.89	74C923	5.95	8259	19.50
74158N	87	NE500N	6.75	74C925	6.95	8259	19.50
74162N	87	NE555V	4.33	74C926	6.95	8259	19.50
74163N	87	NE556A	7.79	74C927	6.95	8259	19.50
74174N	96	NE565A	1.00	74C928	6.95	8259	19.50
74175N	90	NE566V	1.50	74C929	6.95	8259	19.50
74180N	115	NE567V	1.20	74C930	6.95	8259	19.50
74180N	115	NE567V	1.20	74C931	6.95	8259	19.50
74180N	115	NE567V	1.20	74C932	6.95	8259	19.50
74180N	115	NE567V	1.20	74C933	6.95	8259	19.50
74180N	115	NE567V	1.20	74C934	6.95	8259	19.50
74180N	115	NE567V	1.20	74C935	6.95	8259	19.50
74180N	115	NE567V	1.20	74C936	6.95	8259	19.50
74180N	115	NE567V	1.20	74C937	6.95	8259	19.50
74180N	115	NE567V	1.20	74C938	6.95	8259	19.50
74180N	115	NE567V	1.20	74C939	6.95	8259	19.50
74180N	115	NE567V	1.20	74C940	6.95	8259	19.50
74180N	115	NE567V	1.20	74C941	6.95	8259	19.50
74180N	115	NE567V	1.20	74C942	6.95	8259	19.50
74180N	115	NE567V	1.20	74C943	6.95	8259	19.50
74180N	115	NE567V	1.20	74C944	6.95	8259	19.50
74180N	115	NE567V	1.20	74C945	6.95	8259	19.50
74180N	115	NE567V	1.20	74C946	6.95	8259	19.50
74180N	115	NE567V	1.20	74C947	6.95	8259	19.50
74180N	115	NE567V	1.20	74C948	6.95	8259	19.50
74180N	115	NE567V	1.20	74C949	6.95	8259	19.50
74180N	115	NE567V	1.20	74C950	6.95	8259	19.50
74180N	115	NE567V	1.20	74C951	6.95	8259	19.50
74180N	115	NE567V	1.20	74C952	6.95	8259	19.50
74180N	115	NE567V	1.20	74C953	6.95	8259	19.50
74180N	115	NE567V	1.20	74C954	6.95	8259	19.50
74180N	115	NE567V	1.20	74C955	6.95	8259	19.50
74180N	115	NE567V	1.20	74C956	6.95	8259	19.50
74180N	115	NE567V	1.20	74C957	6.95	8259	19.50
74180N	115	NE567V	1.20	74C958	6.95	8259	19.50
74180N	115	NE567V	1.20	74C959	6.95	8259	19.50
74180N	115	NE567V	1.20	74C960	6.95	8259	19.50
74180N	115	NE567V	1.20	74C961	6.95	8259	19.50
74180N	115	NE567V	1.20	74C962	6.95	8259	19.50
74180N	115	NE567V	1.20	74C963	6.95	8259	19.50
74180N	115	NE567V	1.20	74C964	6.95	8259	19.50
74180N	115	NE567V	1.20	74C965	6.95	8259	19.50
74180N	115	NE567V	1.20	74C966	6.95	8259	19.50
74180N	115	NE567V	1.20	74C967	6.95	8259	19.50
74180N	115	NE567V	1.20	74C968	6.95	8259	19.50
74180N	115	NE567V	1.20	74C969	6.95	8259	19.50
74180N	115	NE567V	1.20	74C970	6.95	8259	19.50
74180N	115	NE567V	1.20	74C971	6.95	8259	19.50
74180N	115	NE567V	1.20	74C972	6.95	8259	19.50
74180N	115	NE567V	1.20	74C973	6.95	8259	19.50
74180N	115	NE567V	1.20	74C974	6.95	8259	19.50
74180N	115	NE567V	1.20	74C975	6.95	8259	19.50
74180N	115	NE567V	1.20	74C976	6.95	8259	19.50
74180N	115	NE567V	1.20	74C977	6.95	8259	19.50
74180N	115	NE567V	1.20	74C978	6.95	8259	19.50
74180N	115	NE567V	1.20	74C979	6.95	8259	19.50
74180N	115	NE567V	1.20	74C980	6.95	8259	19.50
74180N	115	NE567V	1.20	74C981	6.95	8259	19.50
74180N	115	NE567V	1.20	74C982	6.95	8259	19.50
74180N	115	NE567V	1.20	74C983	6.95	8259	19.50
74180N	115	NE567V	1.20	74C984	6.95	8259	19.50
74180N	115	NE567V	1.20	74C985	6.95	8259	19.50
74180N	115	NE567V	1.20	74C986	6.95	8259	19.50
74180N	115	NE567V	1.20	74C987	6.95	8259	19.50
74180N	115	NE567V	1.20	74C988	6.95	8259	19.50
74180N	115	NE567V	1.20	74C989	6.95	8259	19.50
74180N	115	NE567V	1.20	74C990	6.95	8259	19.50
74180N	115	NE567V	1.20	74C991	6.95	8259	19.50
74180N	115	NE567V	1.20	74C992	6.95	8259	19.50
74180N	115	NE567V	1.20	74C993	6.95	8259	19.50
74180N	115	NE567V	1.20	74C994	6.95	8259	19.50
74180N	115	NE567V	1.20	74C995	6.95	8259	19.50
74180N	115	NE567V	1.20	74C996	6.95	8259	19.50
74180N	115	NE567V	1.20	74C997	6.95	8259	19.50
74180N	115	NE567V	1.20	74C998	6.95	8259	19.50
74180N	115	NE567V	1.20	74C999	6.95	8259	19.50

P.O. Box 4430X Santa Clara, CA 95054

For will call only: (408) 988-1640

2322 Walsh Ave.

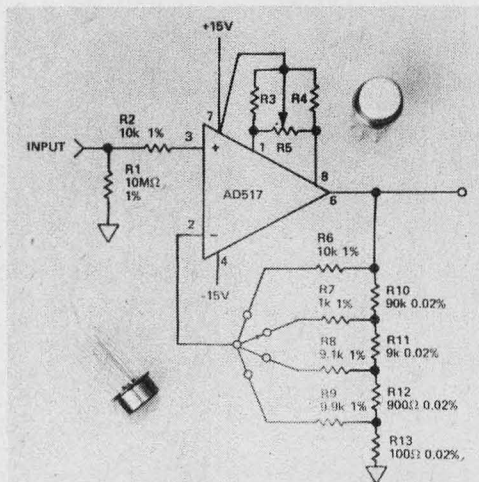
Quest

ELECTRONICS

CLOCK MODULES Complete alarm clocks ready to hook up with transformer and switches. Very compact with 50" and 84" digits.

MA1002A, C or

Free 32 Page Short Form Guide from Analog Devices



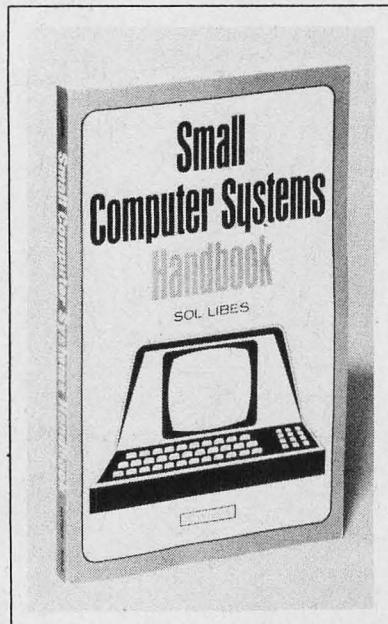
This new *Short Form Guide* contains a complete listing of Analog Devices' line of more than 400 products for precision measurement and control, including digital to analog, analog to digital, voltage to frequency and frequency to voltage converters; sample and hold amplifiers; multiplexers, switches and references; operational amplifiers, instrumentation amplifiers and isolation amplifiers; com-



putational circuits; root mean square to DC converters; analog input and output subsystems for microcomputers; data acquisition subsystems; temperature transducers; digital panel instruments; and power supplies. Products are listed with basic specifications and prices. Contact Analog Devices, Rt 1 Industrial Park, POB 280, Norwood MA 02062. ■

Circle 562 on inquiry card.

Small Computer Systems Handbook by Sol Libes



Small Computer Systems Handbook by Sol Libes is written for those new to the field of personal computers. The emphasis throughout is on important practical knowledge that the small computer user should have to be able to intelligently purchase, assemble and interconnect components, and to program the microcomputer.

This guide provides background in digital logic fundamentals, number systems, and computer hardware and software basics. Only a minimal amount of electronics is required. The book offers an introduction to programming on the machine level, and with higher level languages such as BASIC.

The various applications of small computers are described, such as maintaining financial records, storing records, controlling appliances, typewriting, sales analysis and inventory control.

This 197 page book is priced at \$8.45 and is published by Hayden Book Company Inc, Rochelle Park NJ 07662. ■

Circle 564 on inquiry card.

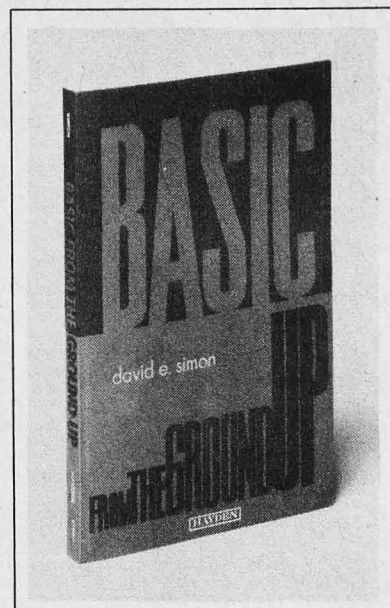
PET Magazine on Cassette

Program is a new monthly magazine recorded on cassette and intended for use by 8 K byte Commodore PET computer owners. Subscribers will receive a standard magazine format for video display on side 1 of the cassette, with pages of articles, applications, sources of hardware and software, avail-

ability of peripherals, programming hints, etc. The reverse side contains three or more games, household and business programs, etc. The subscription rate is \$27 per year. For further information contact *Program*, POB 461, Philipsburg PA 16866. ■

Circle 566 on inquiry card.

For Newcomers to the Computer Field



BASIC From the Ground Up by David E Simon assumes the reader knows nothing about computers. All the statements of BASIC are detailed as well as what goes on inside the computer when programming. The book covers at least one version of each of the BASIC statements along with some of their variations. *BASIC From the Ground Up* is 232 pages long and is priced at \$8.95. Contact Hayden Book Company Inc, 50 Essex St, Rochelle Park NJ 07662. ■

Circle 563 on inquiry card.

Free Information on Commodore PET

Are you having difficulty locating information on the Commodore PET computer? New England Electronics Company, 248 Bridge St, Springfield MA 01103, has available free of charge a PET information package as well as a software and hardware products directory. The information package includes specifications on the PET 2020 printer, PET service and warranty information and other pertinent data concerning the PET. ■

Circle 565 on inquiry card.

Catalog Features Personal Computing

Introduction to Personal Computing is a composite of companies providing personal computing hardware and software to the marketplace. Included are profiles of 69 companies and an overview of their product offerings. It also includes the names and addresses of various computer related publications. This 72 page catalog is available for \$25 (\$5 handling charge if payment does not accompany the order). New Jersey residents should include 5% sales tax. For further information contact Alltech Publishing Company, 212 Cooper Center, N Park Dr and Browning Rd, Pennsauken NJ 08109. ■

Circle 567 on inquiry card.

BUY FROM THE BIGGEST

NCE/CompuMart

1250 North Main Street, Department KB49
P.O. Box 8610 Ann Arbor, Michigan 48107



PET
\$795

THE PET CONNECTION



Networks Bidirectional RS-232C Interface

Single Port \$240.00
Dual Port \$280.00
Cabinet \$35.00

Networks Modem for PET

Attaches to DAA \$320.00
Cabinet \$35.00

PET with 8K user memory

Second Cassette drive \$795.00
RS-232 Printer Adapter — assembled board \$99.95

With power supply, case & connector

\$169.00

Beeper — PET controlled beep

\$24.95

Video Buffer — add a conventional monitor

\$29.95

EXPANDAPET — Economical 16K memory expansion for the PET (incl 1 daughter bd) \$485
Without daughter board \$435

Hams! Add a PET to your rig.

Computerize your station with Microtronics M-65 Ham Interface and included software. You simply plug the unit into your PET and you're ready to display, transmit and receive either CW or RTTY at rates up to 100 WPM.

ASSEMBLED KITS
\$99.95

SECOND CASSETTE FOR PET-\$99.95

This peripheral from Commodore gives you the ability to use one tape deck for input and one for output, copy files, etc.

SELECTRIC-BASED TERMINAL FOR PET

\$895

We have interfaced our TC-71 to the PET. Use with the IEEE-488 bus as a printer or with the VIA User Port for bidirectional I/O. Ideal for Word Processing applications.

Sale price if bought with PET \$795

LOW-COST PRINTER FOR PET

This is a completely refurbished Teletype KSR-33 terminal ready to attach to your PET's interface to use as a printer.

INTRODUCTORY PRICE \$395

apple II



The most powerful computer you can attach to your TV. NCE/CompuMart now carries the popular Apple II microcomputer system. It easily attaches to any TV and can be used for either business or games. To see why the Apple II continues to be the leader in TV-display computers, write for more information.

16K Apple II Computer \$1195
48K Apple II Computer \$1795
Disk Drive & Controller \$595
Second Disk Drive only \$495

EXIDY SORCERER \$895

- 2.80 Processor
- Full-size ASCII keyboard
- User definable characters
- Up to 32K on-board RAM
- Interchangeable ROM PACs
- 20 x 84 display
- Resident 4K Monitor ROM
- Dual Cassette I/O
- Serial and Parallel I/O
- Complete Operators Manual
- Only \$895

Top value in our catalog, simply add a monitor and tape decks to complete the system. Can be used as a terminal. Later ROM PACs will offer 2.80 Assembly Language, APL, PILOT, Word Processing and a DOS PAC for disk-based FORTRAN and COBOL. What a system for \$895!

Sorcerer 8K \$895
Sorcerer 16K \$1150
Sorcerer 32K \$1395
16K Expansion \$299

Single board VIDEO TERMINAL by XITEX

16 Ln x 64 chr display, 128 printable characters, software UART (ASCII or Baudot), 3 serial interfaces & cassette I/O, true composite video, TTL compatible, easy power connection.

Assembled & tested NOW \$187

Hazeltine 1400

IN STOCK NOW Only \$749.00

Now a 5th Generation in Terminals:

Introductory Sale Price — Immediate Delivery

- 24 x 80 display
- RS-232C interface
- 110 to 9600 Baud
- 12" CRT Monitor
- Remote screen control
- Uses 8048 microprocessor
- State-of-the-art design

A full capability terminal completely assembled with a 90 day warranty for less than you'd pay for a kit.

KIM-1

The original fully expandable single board computer. Assembled

\$179.95

with power supply

\$214.95

EXPAND YOUR KIM SYSTEM:

KIM SI
KIM to S-100 Board
Assembled \$169
Connector Set 15
KIM 4
Expansion board 89.95
MICRO TECH. POWER SUPPLY Assembled \$34.95
KIM ENCLOSURE
Give your KIM a professional appearance. No alterations required. sturdy Kydex 100 Black \$23.50

WE WANT TO BUY USED MICROCOMPUTERS

Any Quantity

Urgently needed:

- Peripherals
- Manufacturers surplus
- Closed stores stock



CASH AVAILABLE

Call Today: (313) 994-3200



CompuColor II

Model 3 8K RAM \$1,495.
Model 4 16K RAM \$1,795.
Model 5 32K RAM \$1,995.

- Beautiful 128 x 128 color graphics
- 4K Graphics RAM
- 16K ROM with Disk BASIC
- Built-in 51K mini floppy
- RS-232 interface
- Full size keyboard
- Preprogrammed diskettes avail.

TC-71 SELECTRIC TERMINALS

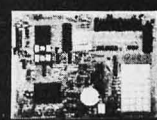
Top-quality printing terminal with RS-232C PTT/C code. Includes desk, 130 character ASCII version employs 6802 for code conversion. See our catalog for details.

ASCII \$864
Refurbished \$695
Working \$495
As-is \$339

SALE ASCII INTERFACE FOR TC-71 45 Day delivery Normally \$199 NOW \$169 Acoustic Coupler for use with ASCII TC-71 \$159



- 28 Double-function keys including up to 24 Special functions
- Extra view 6 digit hex led display
- KIM-1 hardware compatibility
- 6802 based system
- 4K byte ROM resident monitor and operating system
- Single 5 volt power
- 1K bytes of 2174 static RAM on chassis provided for immediate expansion to 4K bytes
- Enhanced software



SYM-1

From Synertek

- Standard interfaces include: Audio Cassette, Hex, code interface with Remote Control
- Full Duplex 2.0MA Teletype Interface
- System Expansion Bus Interface
- TV Controller Board Interface
- CRT Compatible Interface
- 50 I/O Lines in the basic system

\$269.00

SALE
\$285
SANYO MONITOR
VM4209 9" quality monitor \$149

New Acoustic Coupler

\$159

NCE/CompuMart Inc. breaks the price barrier with a new 300 baud RS-232C acoustic coupler. For only \$159 you get an assembled, tested stand alone unit which accepts the standard telephone handset for full or half duplex operation. Complete with power supply and carrier detect light, the unit is housed in an attractive case for desk top use.

TI PROGRAMMER
Hexadecimal, octal, decimal calculator/converter
Reg. \$59.95 NOW \$49.95

A Home Computer & A Video Game in a Single Unit!

INTERACT Model One 14 FREE CASSETTES Worth \$294.

8K-\$499 16K-\$599

- Color graphics on your TV
 - Music and sound synthesizer
 - Built-in cassette tape drive
 - Large 53-key keyboard
 - Two joysticks included
 - Edit-BASIC cassette included
 - 8080 Microprocessor
 - 8K RAM, 2K ROM
- If you can't decide between a sophisticated telephone game and a home computer then the Interact Model One is for you. Hook it to your color TV and you've got both! You can play one of the games which are included free or you can load EDU-BASIC and write your own games. Best of all you get over \$294 worth of free cassettes including:
- Edu-BASIC — Write programs
 - Concentration — The memory game
 - Dognight — Aerial battles
 - Add-Em Up — A math game
 - Biorhythm — Plot your own
 - Blackjack — Wager video bucks
 - Compute-A-Color — Easy graphics
 - Hangman — The word game
 - Knockdown — A dice game
 - Maze — Computer maze
 - Regatta — Race your ship
 - Showdown — Gunfight
 - Trailblazer — Cut off your opponent
 - Blank — Save programs here

Rockwell

AIM65

- Fully assembled, tested, and warranted
- Addressing to 65K bytes (1K RAM on board)
- Includes onboard:
 - Powerful 4K ROM Debug Monitor
 - Sockets for additional 4K RAM 16K ROM
 - 20 Col. ASCII Thermal printer (90 lines/min.)
 - Full size (54 key) alphanumeric keyboard
 - 20 char ASCII alphanumeric display
 - Application Conn. for TTY, 2 cassettes, 2 x 8 pin I/O ports
 - Expansion Conn. (try our KIMS! S-100 board)
 - Both connectors totally KIM-1 compatible
- Easy Power connections \$375

Options — 4K ROM Assembler/Text Editor 8K Basic ROM

10 DAY RETURN PRIVILEGE

- 90 day limited warranty
- Newest, most exciting products in personal computing
- Outstanding values
- All items fully assembled and tested unless otherwise stated.
- Send for our catalog for more detailed product information.

(313)
994-3200

• Michigan residents add 4% sales tax • Foreign order (except Canada) add 10% additional handling (U.S. currency only) • P.O.'s accepted from D&B rated companies — shipment contingent upon receipt of signed purchase order • Phones open from 9:00 a.m.-7:00 p.m. EST Monday-Friday, 10:00 a.m.-5:00 p.m. Saturdays • Open accounts

invited—call for credit application • Most items in stock for immediate shipment—call for delivery quotation • Sorry—no C.O.D.'s • All prices subject to change without notice. • In the Ann Arbor area? Retail store open 11:00 a.m.-7:00 p.m. Tuesday-Friday, 10:00 a.m.-5:00 p.m. Saturdays (closed Sunday & Monday)

Just say charge it! Which card?



Visit our new retail location!



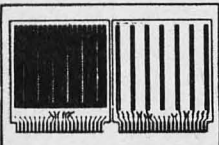
HOBBY WRAP TOOL

STRIP WRAP UNWRAP



Wire-wrapping, stripping, unwrapping tool for AWG 30 on .025 (0.63mm) Square Post.

Regular Wrap	WSU-30	\$6.95
Modified Wrap	WSU-30M	\$7.95



P.C. BOARD

The 4 x 4.5 x 1/16 inch board is made of glass coated EPOXY Laminate and features solder coated 1 oz. copper pads. The board has provision for a 22/44 two sided edge connector, with contacts on standard .156 spacing. Edge contacts are non-dedicated for maximum flexibility. The board contains a matrix of .040 in. diameter holes on .100 inch centers. The component side contains 76 two-hole pads that can accommodate any DIP size from 6-40 pins, as well as discrete components. Typical density is 18 of 14-Pin or 16-Pin DIP's. Components may be soldered directly to the board or intermediate sockets may be used for soldering or wire-wrapping.

Two independent bus systems are provided for voltage and ground on both sides of the board. In addition, the component side contains 14 individual buses running the full length of the board for complete wiring flexibility. These buses enable access from edge contacts to distant components. These buses can also serve to augment the voltage or ground buses, and may be cut to length for particular applications.

Hobby Board H-PCB-1 \$4.99

PRECUT WIRE

Fast • Reliable • Economical

- No more cutting & stripping by hand
- Good, clean, uniform strip
- Cheaper than using bulk wire

PRECUT WIRE #30 Kynar stripped 1" on each end. Lengths are overall. Colors: Red, Blue, Green, Yellow.

	100	500		100	500
2 1/2 in.	.78	2.40	6 1/2 in.	1.15	4.05
3 in.	.82	2.60	7 in.	1.20	4.25
3 1/2 in.	.86	2.80	7 1/2 in.	1.25	4.45
4 in.	.90	3.00	8 in.	1.29	4.65
4 1/2 in.	.94	3.21	8 1/2 in.	1.32	4.85
5 in.	.98	3.42	9 in.	1.36	5.05
5 1/2 in.	1.02	3.65	9 1/2 in.	1.40	5.25
6 in.	1.06	3.85	10 in.	1.45	5.51

WIRE KITS

#1 \$6.95 (2.2 ft.)	#2 \$19.95 (1.8 ft.)
250 3" 100 4 1/2"	250 2 1/2" 250 5"
250 3 1/2" 100 5"	500 3" 100 5 1/2"
100 4" 100 6"	500 3 1/2" 250 6"
	500 4" 100 6 1/2"
	250 4 1/2" 100 7"
	1-250 ft. Roll

WIRE DISPENSER

- With 50 ft. Roll of AWG 30 KYNAR® wire-wrapping wire.
- Cuts the wire to length.
- Strips 1" of insulation.
- Refillable

Blue Wire	WD-30-B	\$3.95
Yellow Wire	WD-30-Y	\$3.95
White Wire	WD-30-W	\$3.95
Red Wire	WD-30-R	\$3.95



ISO-Tip Cordless Soldering Irons

- Up to 125-150 Joints per charge
- 5-10 Seconds average soldering heat time
- Tip performance up to 50 watts and over 700 °F tip temperature
- Built-in work light
- "Lock off" switch
- Rechargeable battery & charger included
- Cannot over charge

7800 \$34.95

Fastest recharging iron on the market. Recharges fully in one hour

7740 \$24.95

"Quick Charge" Recharges completely in 3 to 4 1/2 hours

7540 \$19.95

"The Original" Recharges completely in 12 to 16 hours.

6500 \$10.95

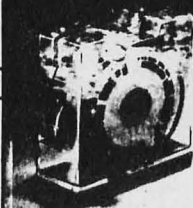
P.C. Drill attachment with No. 56 Bit.

REFILL ROLL OF WIRE

Wire for wire-wrapping AWG-30 (0.25mm) KYNAR® wire, 50 ft. roll, silver plated, solid conductor, easy stripping.



30-AWG Blue Wire, 50ft. Roll	R 30B-0050	\$1.98
30-AWG Yellow Wire, 50ft. Roll	R 30Y-0050	\$1.98
30-AWG White Wire, 50ft. Roll	R 30W-0050	\$1.98
30-AWG Red Wire, 50ft. Roll	R 30R-0050	\$1.98

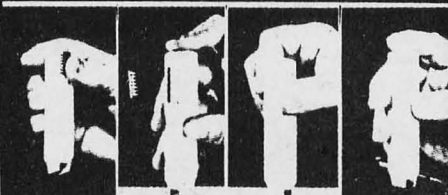


TRI-COLOR WIRE DISPENSER

WD - 30 - TRI \$5.95
R - 30 - TRI 3 color refill \$3.95

- With 50 ft. ea. of RED, WHITE, BLUE wire
- Cuts the wire to length
- Strips 1" of insulation
- Refillable

DIP/IC INSERTION TOOL WITH PIN STRAIGHTENER



14-16 Pin Dip IC Insertor INS-1416 \$3.49

1 TOLL FREE 1-800-423-5633

PRIORITY ONE ELECTRONICS®

16723B Roscoe Blvd. Sepulveda, CA 91343

Terms: VISA, MC, BAC, check, Money Order, C.O.D. U.S. Funds Only CA residents add 6% sales tax. Minimum order \$10.00 Orders less than \$75.00 include 10% shipping and handling; excess refunded. Just in case please include your phone no.

Good Thru March 1979

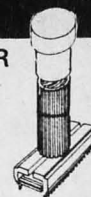
OEM and Institutional inquiries invited.

phone orders welcome (213) 894-8171

Send for our latest brochure.

MOS LSI INSERTER

Tool is chrome plated ABS for excellent static dissipation. Tool has ground lug for connection to grounding strap.



MOS - 40 \$7.95



UP DATE YOUR LIBRARY

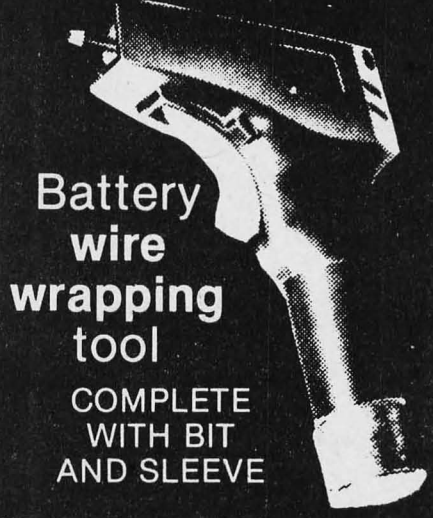
and SAVE with SAMS BOOKS

buy 3 and save 10% buy 5 and save 15%

21188-8. Active-Filter Cookbook	14.95
21388-2. CMOS Cookbook	10.50
21416-4. IC Timer Cookbook	9.95
21447-4. The 8080A Bugbook®: Microcomputer Interfacing & Programming (Bugbook® is a registered trademark of E & L Instruments, Inc. of Derby, CT, 06418).	10.50
21459-8. How to Program Microcomputers	8.95
21500-4. The Z-80 Micro-computer Handbook	8.95
21512-8. Using the 6800 Microprocessor	8.95
21524-1. The Cheap Video Cookbook	5.95
21527-4. IC Converter Cookbook	13.95
21534-8. Fundamentals of Digital Computers (2nd Ed.)	9.95
21536-8. DBUG: An 8080 Interpretive Debugger	4.95
21538-1. The 555 Timer Applications Sourcebook, With Experiments	5.95
21539-X. Design of Active Filters, With Experiments	7.95
21540-3. Microcomputer-Analog Converter Software & Hardware Interfacing	9.50
21541-1. 8080/8085 Software Design	9.50
21542-X. Logic & Memory Experiments Using TTL Integrated Circuits, Book 1	9.95
21545-4. The Design of Phase-Locked Loop Circuits, With Experiments	8.95
21550-0. Introductory Experiments in Digital Electronics and 8080A Microcomputer Programming & Interfacing—Book 1	12.95
21551-8. Introductory Experiments in Digital Electronics and 8080A Microcomputer Programming & Interfacing—Book 2	12.95
20989-1. IC Op-Amp Cookbook	12.95
21035-5. TTL Cookbook	9.50
21586-1. BASIC Primer	8.95

NEW

HOBBY WRAP Model BW-630



Battery wire wrapping tool

COMPLETE WITH BIT AND SLEEVE

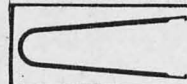
WIRE-WRAPPING TOOL

For .025" (0.63mm) sq. post "MODIFIED" wrap, positive indexing, anti-overwrapping device.

For AWG 30	BW-630	\$34.95*
For AWG 26-28	BW-2628	\$39.95*
Bit for AWG 30	BT-30	\$3.95
Bit for AWG 26-28	BT-2628	\$7.95

Free!! with Kit #1 with BW-630 \$6.95 Value

USE "C" SIZE NI-CAD BATTERIES (NOT INCLUDED)



DIP/IC EXTRACTOR TOOL

The EX-1 Extractor is ideally suited for hobbyist or lab engineer. Featuring one piece spring steel construction. It will extract all LSI, MSI and SSI devices of from 8 to 24 pins.

Extractor Tool EX-1 \$1.49

Visit our new retail location!

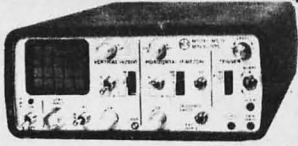
Visit our new retail location!

Visit our new retail location!

Visit our new retail location!

Visit our new retail location!

Visit our new retail location!



\$318.
MS-15
MINISCOPE

With Rechargeable Batteries & Charger Unit

- 15 megahertz bandwidth.
- External and internal trigger.
- Time base — 1 microsec. to 0.5 Sec/div - 21 settings, $\pm 3\%$.
- Battery or line operation.
- Automatic & line sync modes.
- Power consumption < 15 watts.
- Vertical Gain — 0.1 to 50 Volts - 12 settings $\pm 3\%$.
- Viewing area 1.1" x 1.35".
- Case size 2.7"H x 6.4"W x 7.5"D, 3 pounds.
- Parts & labor guaranteed 1 year.
- 10 to 1, 10 mag probe
- Leather carrying case



PROBE 1¢
PROBE 1¢ with the purchase of SCOPE and the MENTION of this MAGAZINE

• MS-215 Dual Trace Version of MS-15 \$435.

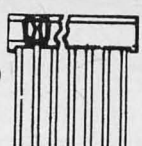
SALE \$-100 BUS EDGE CONNECTORS SALE

\$100-WWG 50/100 Cont. 125 ctrs. 3 LEVEL WIRE WRAP 025 sq. posts on 250 spaced rows. GOLD plated	\$100-STG 50/100 Cont. 125 ctrs. DIP SOLDER TAIL on 250 spaced rows for VECTOR and MASI motherboards. GOLD plated
1-4 5-9 10-24 \$4.00 \$3.75 \$3.50	1-4 5-9 10-24 \$3.50 \$3.25 \$3.00
RG810 50/100 Cont. 125 ctrs. DIP SOLDER TAIL on 140 spaced rows for ALTAIR motherboards. GOLD plated	R681-3 50/100 Cont. 125 ctrs. PIERCED SOLDER EYELET tails for ALTAIR motherboards. GOLD
1-4 5-9 10-24 \$5.00 \$4.75 \$4.50	1-4 5-9 10-24 \$7.53

Other Popular Edge Connectors

R644-G 22/44 Cont. 156 ctrs. PIERCED SOLDER EYELET tails. GOLD plated	R644-3 22/44 Cont. 156 ctrs. WIRE WRAP tails. GOLD
1-4 5-9 10-24 \$3.00 \$2.75 \$2.50	1-4 5-9 10-24 \$4.00 \$3.75 \$3.50
CG-1 IMSAI Style Card Guides 5/51/00	ATTN: OEM's and Dealers, many other connectors available call or quotation

3 LEVEL GOLD WIRE WRAP SOCKETS

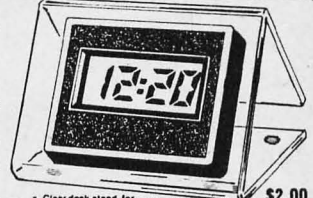


Sockets purchased in multiples of 50 per type may be combined for best price.

	1-24	25-49	50-99	100-249	250-999	1K-5K
8 pin*	.41	.38	.35	.31	.27	.23
14 pin*	.39	.38	.36	.32	.29	.27
16 pin*	.43	.42	.39	.35	.32	.30
18 pin	.63	.58	.54	.47	.42	.36
20 pin	.80	.75	.70	.63	.58	.53
22 pin*	.90	.85	.80	.70	.61	.57
24 pin	.90	.84	.78	.68	.63	.58
28 pin	1.10	1.00	.90	.84	.76	.71
40 pin	1.50	1.40	1.30	1.20	1.04	.89

All sockets are GOLD 3 level closed entry *End and side stackable. 2 level, Solder Tail, Low Profile, Tin Sockets and Dip Plugs available. CALL FOR QUOTATION

LIQUID CRYSTAL DIGITAL CLOCK-CALENDAR



- For Auto, Home, Office
- Small in size (2x2 1/2 x 1/2)
- Push button for seconds release for date.
- Clocks mount anywhere with either 3M double-sided tape or VELCRO, included.
- 2 MODELS AVAILABLE:
LCD-101, portable model runs on self-contained batteries for better than a year.
LCD-102, runs on 12 Volt system and is back-lighted.
- LCD-101 or LCD-102 your choice.

\$34.95

* Clear desk stand for \$2.00

8803 MOTHER BOARD FOR \$100 BUS MICRO-COMPUTERS

- Kit includes 12 tantalum capacitors for $\pm 5\%$ $\pm 12\%$ — 12 buses and insulated mounting spacers
- Wiring code shown. Component side bare epoxy glass with white markings for component locations
- 016 epoxy glass board with 2 ounce copper, solder plated and .038 diameter for leads
- Solder mask with solder windows on etched circuits to avoid accidental short circuits
- Mounts 11 receptacles with 100 contacts (12 rows) on 125 centers with 250 row spacing. Vector part number R681-2, or mounts 10 receptacles plus interconnections to smaller mother board for expansion
- Includes etched circuit and instructions for option of active, pull-up, or floating terminations
- Large buses: $\pm 5V$ and GND (10 AMPS), $\pm 12V$ or $\pm 16V$ (7 AMPS). Current ratings are per MIL-STD-275 with 10°C rise
- Fits in Vector-pak enclosures
- Fits in IMSAI 8080 microcomputer as expander board.

Price: \$29.50

Vector Plugboards

8800V
Universal Microcomputer/processor plugboard, use with S-100 bus. Complete with heat sink & hardware. 5.3" x 10" x 1/16"

1-4	5-9	10-24
\$19.95	\$17.95	\$15.95

8801-1
Same as 8800V except plain, less power buses & heat sink

1-4	5-9	10-24
\$14.95	\$13.45	\$11.95

3677 9.6" x 4.5"
\$10.90

3677-2 6.5" x 4.5"
\$9.74

3682 9.6" x 4.5"
\$10.97

3682-2 6.5" x 4.5"
\$9.81

3692 6.5" x 4.5"
\$7.65

3692-2 9.6" x 4.5"
\$11.45

Gen. Purpose D.I.P. Boards with Bus Pattern for Solder or Wire Wrap. Epoxy Glass 1/16" 44 pin con. spaced .156

Gen. Purpose D.I.P. Boards with Bus Pattern for Solder or Wire Wrap. Epoxy Glass 1/16" 44 pin con. spaced .156

Gen. Purpose D.I.P. Boards with Bus Pattern for Solder or Wire Wrap. Epoxy Glass 1/16" 44 pin con. spaced .156

CARD EXTENDER
Card Extender has 100 contacts 50 per side on 125 centers-Attached connector is compatible with S-100 Bus Systems. \$25.83
3690 6.5" 22/44 pin .156 ctrs. Extenders \$13.17

1/16 Vector BOARD
0.042 dia holes on 0.1 spacing for IC's

Phenolic	SIZE	PRICE
PART NO.		
64P44XXXP	4.5x6.5"	\$1.56 \$1.40
169P44XXXP	4.5x17"	\$3.69 \$3.32

Epoxy Glass	SIZE	PRICE
PART NO.		
64P44	4.5x6.5"	\$1.79 \$1.61
84P44	4.5x8.5"	\$2.21 \$1.99
169P44	4.5x17"	\$4.52 \$4.07
169P84	8.5x17"	\$8.03 \$7.23

TRS-80 MEMORY EXPANSION KITS

4116's RAMS (16Kx1 200ns)

8 for \$69.00

2708 8K 450 ns

EPROM FACTORY PRIME

\$12.00 EA.

25 + Call For Price

14 & 16 PIN GOLD 3 LEVEL WIRE WRAP SOCKETS

14 - G3 100 for \$30.00

16-G3 100 for \$30.00

50 of each for \$32.00

Sockets are End & Side stackable, closed entry

P.C. BOARD HOLDER
315
PRICE: \$16.95

315-S same as 315 but with 14" box to accommodate "S100" boards.
PRICE: \$17.95

HORIZONTAL JAW VISE HEAD
304
PRICE: \$12.95

STANDARD VISE HEAD
303
PRICE: \$12.95

WIDE OPENING VISE HEAD
366
PRICE: \$12.95

PANAVISE TILTS, TURNS, AND ROTATES TO ANY POSITION. IT HOLDS YOUR WORK EXACTLY WHERE YOU WANT IT.

PANAVISE

LOW-PROFILE BASE
305
PRICE: \$11.95

STANDARD BASE
300
PRICE: \$11.95

VACUUM BASE
380
PRICE: \$11.95

LEDU

IM-10A List \$85.00 SPECIAL \$54.95 with tube

Perfectly balanced fluorescent lighting with precision magnifier lens. Tough thermoplastic shade. Easy lens removal. New wire clip design permits easy installation and removal of fluorescent tube. Comes with plastic shield to protect tube from soiling and damage.

Colors: Gray, Black, and Chocolate Brown. Comes with one 22 watt T-9 Circline fluorescent tube. 3 diopter lens.

ORDER TOLL FREE

1-800-423-5633

except CA., AK., HI., Call (213) 894-8171

Vector WRAP POST
(all boards on this page)
T44/c pkg. 100 .. \$2.34
T44/M pkg. 1000 .. \$14.35
A-13 hand installing tool .. \$2.94

PRIORITY ONE ELECTRONICS

16723B Roscoe Blvd Sepulveda, CA 91343

Terms: VISA, MC, BAC, check, Money Order, C.O.D., U.S. Funds Only. CA residents add 6% sales tax. Minimum order \$10.00. Orders less than \$75.00 include 10% shipping and handling; excess refunded. Just in case please include your phone no.

Good Thru March 1979

phone orders welcome (213) 894-8171

OEM and Institutional inquiries invited.

FND 503
Common Cathode

FND 510
Common Anode
1/2" 7 seg LED
59¢
10/5450

24 PIN DIP PLUGS WITH COVERS

3 / \$1.00
40 / \$10.00

Circle 312 on inquiry card. Visit our new retail location!

BECKIAN ENTERPRISES



All Prime Quality — New Parts Only
Satisfaction Guaranteed

EDGE CARD CONNECTORS: GOLD PLATED.

BODY: Non brittle, solvent resistant, high temp, G.E. Valox. The finest you can buy.
CONTACTS: Bifurcated Phos./Bronze; Gold/Nickel.

ALTAIR S-100: Cont./Ctrs. .125" Row Spacing, .140"

50/100 Dip Sold.	\$3.95 ea.	5 pcs.	\$3.75 ea.
50/100 Sold. Eye.	6.95 ea.	5 pcs.	6.50 ea.

IMSAI S-100: Cont./Ctrs. .125" Row Spacing, .250"

50/100 Dip Sold.	\$4.20 ea.	5 pcs.	\$3.95 ea.
50/100 W/Wrap 3	3.75 ea.	5 pcs.	3.50 ea.
IMSAI CARD GUIDES:	0.19 ea.	5 pcs.	0.16 ea.

CROMEMCO S-100: Cont./Ctrs. .125" Row Spacing, .250"

50/100 Dip Sold.	\$6.50 ea.	5 pcs.	\$6.00 ea.
(Or short W/Wrap)			

OTHER CONNECTORS AVAILABLE

.100" Contact Ctrs., .140" Row Spacing.

22/44 Dip Sold.	\$2.30 ea.	5 pcs.	\$2.10 ea.
25/50 Sold. Eye.	2.95 ea.	5 pcs.	2.75 ea.
40/80 Sold. Eye.	4.80 ea.	5 pcs.	4.50 ea.
43/86 Dip Sold.	4.90 ea.	5 pcs.	4.70 ea.
43/86 Sold. Eye.	4.90 ea.	5 pcs.	4.70 ea.

.156" Contact Ctrs., .140" Row Spacing.

6/- Sgle. Row (PET)	\$1.00 ea.	5 pcs.	\$0.90 ea.
22/44 Sold. Eye. (KIM)	1.90 ea.	5 pcs.	1.80 ea.
22/44 Dip Sold. (KIM)	1.90 ea.	5 pcs.	1.80 ea.
43/86 Dip Sold.	4.90 ea.	5 pcs.	4.70 ea.

.156" Contact Ctrs., .200" Row Spacing.

15/30 W/Wrap 3	\$1.05 ea.	5 pcs.	\$0.95 ea.
22/44 W/Wrap 3	2.30 ea.	5 pcs.	2.10 ea.
36/72 Sold. Eye.	3.45 ea.	5 pcs.	3.30 ea.
36/72 W/Wrap 3	3.85 ea.	5 pcs.	3.70 ea.
43/86 W/Wrap 3	5.50 ea.	5 pcs.	5.00 ea.

POLARIZING KEYS FOR ALL OF THE ABOVE:

Specify: IN Contact or BETWEEN Contact:
1 to 49 pcs. \$0.10 ea. 50 pcs./Up \$0.08 ea.

SPECIAL

12/24 Pin .156" Cont./Ctrs. .200" Row Spacing.
TIN PLATED CONTACTS.
IDEAL FOR PET INTERFACE & PARALLEL USER PORT.
\$1.25 ea. 5 pcs. \$1.10 ea.

SUBMINIATURE CONNECTORS: (DB 25 SERIES, RS 232.)

DB 25P Male Plug	\$2.50 ea.	5 pcs.	\$2.20 ea.
DB 25S Female Socket	3.60 ea.	5 pcs.	3.40 ea.
DB 51212-1 Grey Hood	1.20 ea.	5 pcs.	1.10 ea.
DB 51226-1A Black Hood	1.30 ea.	5 pcs.	1.20 ea.
D 20418-2 Hardware Set	0.75 ea.	5 pcs.	0.70 ea.

SAVE: BUY A SET: (1 DB25P, 1 DB25S, Any Hood.)

1 Set: \$6.35 ea. 5 sets: \$6.15 ea.
NOTE: For Hardware, (D20418-2) Add \$.65/Set.

WHISPER FANS

Excellent for computer cabinet cooling. This is the most quiet fan you will find. Only measures 4 3/4" square by 1 1/2" deep. U. L. Listed.
\$21.00 ea. 5 pcs. \$19.00 ea.

I.C. SOCKETS, GOLD.

WIRE WRAP 3 TURN.

14 pin	\$0.36 ea.
16 pin	0.38 ea.

2708 EPROMS PRIME

\$14.00 ea.

I.C. SOCKETS.

Dip Solder, Tin.

14 pin	\$0.15 ea.
16 pin	0.17 ea.

8080 PRIME

\$9.00 ea.

WRITE FOR LARGER QUANTITY DISCOUNTS. DEALER INQUIRIES ARE WELCOME.

WE ARE CONNECTOR (EDGE CARD) SPECIALISTS. IF YOU DO NOT SEE WHAT YOU NEED IN THIS ADVERTISEMENT, PLEASE WRITE US. WE WILL REPLY.

TERMS: Minimum Order \$10.00; Add \$1.25 for handling and shipping. All orders over \$25.00 in USA and Canada: WE PAY THE SHIPPING.

NOTE: CA residents please add 6% sales tax.
NO C.O.D. SHIPMENTS OR ORDERS ACCEPTED.

MAIL ORDERS TO: **Beckian Enterprises**

P.O. Box 3089

Simi Valley, CA 93063



FORMERLY CYBERCOM/SOLID STATE MUSIC.

CB-1 8080 Processor Board. 2K of PROM 256 BYTE RAM power on/rest Vector Jump Parallel port with status. Kit. \$125.95 PCBD \$28.95

MB-6A Basic 8KX8 ram uses 2102 type rams, S-100 buss. Kit 450 NSEC \$123.95. PCBD \$24.95

MB-7 16KX8, Static RAM uses μ P410 Protection, fully buffered KIT \$299.95

MB-8A 2708 EROM Board, S-100, 8KX8 or 16KX8 kit without PROMS \$75.00 PCBD \$28.95

MB-9 4KX8 RAM/PROM Board uses 2112 RAMS or 82S129 PROM kit without RAMS or PROMS \$72.00

IO-2 S-100 8 bit parallel /IO port. 2/3 of boards is for kludging. Kit \$46.00 PCBD \$26.95

IO-4 Two serial I/O ports with full handshaking 20/60 ma current loop: Two parallel I/O ports. Kit \$130.00 PCBD \$26.95

VB-1B 64 x 16 video board, upper lower case Greek, composite and parallel video with software, S-100. Kit \$125.00 PCBD \$26.95

Altair Compatible Mother Board. 11 x 11 1/2 x 1/8" Board only \$39.95. With 15 connectors \$94.95

Extended Board full size. Board only \$ 9.49 With connector \$13.45

SP-1 Synthesizer Board S-100
PCBD \$42.95 KIT \$135.95

82S23	1.50	PRIME SUPPORT	
82S123	1.50	8080A	\$ 9.95
82S126	1.95	8212	3.25
82S129	1.95	8214	6.50
82S130	3.95	8224	3.49
82S131	3.95	L2114 (450 NSEC)	7.25
MMI6330	1.50	L2114 (250 NSEC)	7.99
IM5600	1.50	2102A-2L	1.60
IM5603	1.95	2102A-4L	1.25
IM5604	3.95	2708 450 NSEC	8.95
IM5610	1.50	1702A-6	3.50
IM5623	1.95	4116 (Apple RAM)	12.95
IM5624	3.95		8/89.95



WAMECO INC.

FDC-1 FLOPPY CONTROLLER BOARD will drive shugart, pertek, remic 5" & 8" drives up to 8 drives, on board PROM with power boot up, will operate with CPM (not included).
PCBD \$42.95

FPB-1 Front Panel. (Finnally) AMSAI size hex displays. Byte or instruction single step.
PCBD \$42.95

MEM-1 8KX8 fully buffered, S-100, uses 2102 type rams PCBD \$24.95

QM-12 MOTHER BOARD. 13 slot, terminated, S-100 board only \$34.95

CPU-1 8080A Processor board S-100 with 8 level vector interrupt PCBD \$25.95

RTC-1 Realtime clock board. Two independent interrupts. Software programmable. PCBD \$25.95

EPM-1 1702A 4K Eprom card PCBD \$25.95

EPM-2 2708/2716 16K/32K EPROM CARD PCBD \$24.95

QM-9 MOTHER BOARD. Short Version of QM-12. 9 Slots PCBD \$30.95

MEM-2 16K x 8 Fully Buffered 2114 Board PCBD \$25.95

16K RAM BOARD by HWE fully buffered, bank select standard to IEEE buss gold fingers, solder mask, plated thru holes, silk screened PCBD \$25.95

KLUDGE BOARD by HWE for S-100 glass epoxy over 2600 plated through holes. 4 regulators with CAPS all S-100 functions labeled, gold fingers. PCBD \$29.95

MIKOS

419 Portofino Drive
San Carlos, California 94070

Please send for IC, Xistor
and Computer parts list

MAR. SPECIAL SALE ON PREPAID ORDERS

(charge cards not included on this offer)

WAMECO REAL TIME CLOCK BOARD. Kit with all factory marked parts \$54.95
PCBD \$23.95
4K x 8 EPROM. Fully buffered with Intel 1702A. Kit \$74.86

MIKOS PARTS ASSORTMENT WITH WAMECO AND CYBERCOM PCBDs

MEM-2 with MIKOS #7 16K ram with L2114 450 NSEC \$235.95

MEM-2 with MIKOS #13 16K ram with L2114 250 NSEC \$269.95

MEM-1 with MIKOS #1 450 NSEC 8K RAM \$123.95

CPU-1 with MIKOS #2 8080A CPU 89.95

MEM-1 with MIKOS #3 250 NSEC 8K RAM 144.95

QM-12 with MIKOS #4 13 slot mother board 89.95

RTC-1 with MIKOS #5 real time clock 60.95

VB-1B with MIKOS #6 video board less molex connectors 99.95

EMP-1 with MIKOS #10 4K 1702 less EPROMS 49.95

EPM-2 with MIKOS #11 16-32K EPROMS less EPROMS 59.95

QM-9 with MIKOS #12 9 slot mother board 75.00

MIKOS PARTS ASSORTMENTS ARE ALL FACTORY PRIME PARTS KITS INCLUDE ALL PARTS LISTED AS REQUIRED FOR THE COMPLETE KIT LESS PARTS LISTED ALL SOCKETS INCLUDED.

VISA or MASTERCARD: Send account number, interbank number, expiration date and sign your order. Approx. postage will be added. Check or money order will be sent post paid in U.S. If you are not a regular customer, please use charge, cashier's check or postal money order. Otherwise there will be a two-week delay for checks to clear. Calif. residents add 6% tax. Money back 30 day guarantee. We cannot accept returned IC's that have been soldered to. Prices subject to change without notice. \$10 minimum order. \$1.50 service charge on orders less than \$10.00.

Memory Madness Memory Madness Memory Madness



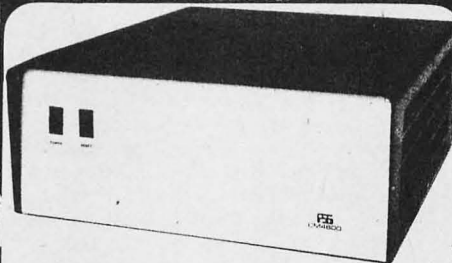
CM5000 COMPUTER MAINFRAME

Includes cabinet, 18 amp power supply, S-100 compatible STREAKER-12® (12-slot motherboard), and dual-disk provision with disk power supply. The CM5000 is fan-cooled, has AC line filter to eliminate EMI, and is fully-assembled and factory-tested. Power and reset switches are located on front panel.

~~\$549.00~~ * **\$495.00**



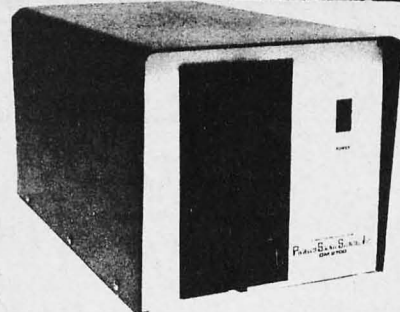
PROBLEM SOLVER SYSTEMS, INC.



CM4800 COMPUTER MAINFRAME

Includes cabinet, 30 amp power supply, and the S-100 compatible STREAKER-22® (22-slot motherboard). The CM4800 is fan-cooled, has AC line filter to eliminate EMI, and is fully-assembled and factory-tested. Power and reset switches are located on front panel. OPTION: Model CM4800D—includes provision for floppy disk power supply. Also available: Model CM4900—with 18 amp power supply and STREAKER-12® (12-slot motherboard)

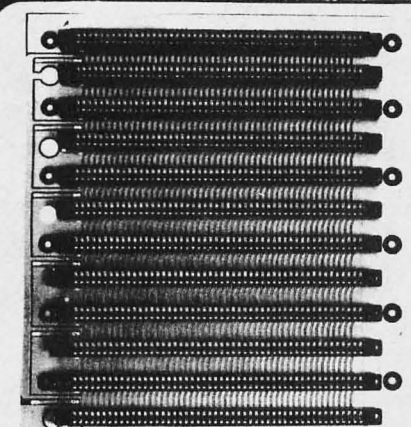
~~\$549.00~~ * **\$495.00**



DM2700 DISK CABINET WITH POWER SUPPLY

Accepts either PerSci or Shugart mini-floppy disks. Includes data cable and AC line filter to eliminate EMI. Operates from 100 to 125 volts or 200 to 250 volts, 50 or 60Hz. Fully assembled and tested at factory. (Disk drive not included). OPTION: Model DM2700S—Includes Shugart Series 800 minifloppy disk.

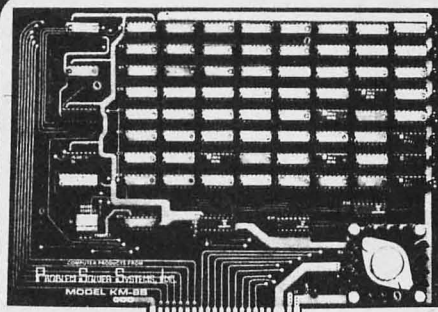
~~\$249.00~~ * **\$225.00**



STREAKER® MOTHERBOARDS

- In 7, 12, and 22-slot versions • S-100 compatible
- Connectors have bifurcated, gold-plated contacts
- Ground plane surrounding each signal
- Compatible with Imsai chassis
- Power connections compatible with power supplies in PSS' CM4800, CM5000, and CM5200 Computer mainframes.
- Fully-assembled and tested at factory
- No isolation hardware required for mounting.

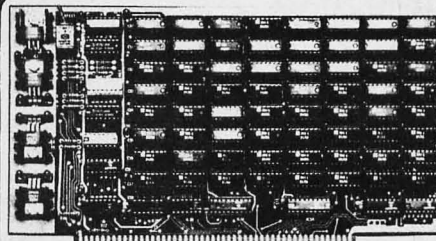
Streaker 12 ~~\$39.00~~ **\$89.00**
Streaker 22 ~~\$159.00~~ **\$147.00**



KIM8B / KIM-4® COMPATIBLE

- KIM® compatible, 8K x 8 bit static RAM
- Can be connected directly to KIM-1®
- Plugs directly into KIM-4® motherboard • 2MHz
- Addressable in 8K steps
- Allows expansion of KIM® computer up to 65K of memory
- Memory protection activated / deactivated by DIP Switch
- Buffered address and data lines
- Operates from either an unregulated 8 volt or a regulated 5 volt power supply
- All IC's mounted in low-profile sockets
- Assembled, tested, burned-in at factory.

~~\$179.00~~ **\$162.00**



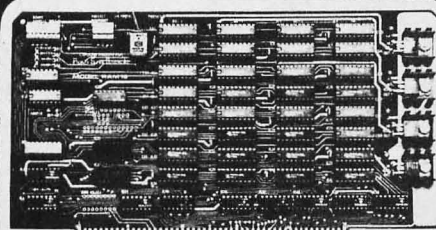
RAM 8 ~~\$199.00~~

\$179.00

- S-100, 8K x 8 bit static RAM
- 4MHz
- Addressable in 8K steps
- Memory protection in 1K increments, from bottom board address up or top down
- Memory protection activated / deactivated by large, easily accessible switch
- May deactivate up to six 1K segments of board by use of jumpers to create "holes" for other devices
- DIP switch selectable wait states
- Phantom line jumper
- Schmitt trigger-buffered I/O lines
- All IC's mounted in low-profile sockets
- Assembled, tested, burned-in at factory.

\$162.00

OPTION: RAM8B—2MHz ~~\$179.00~~



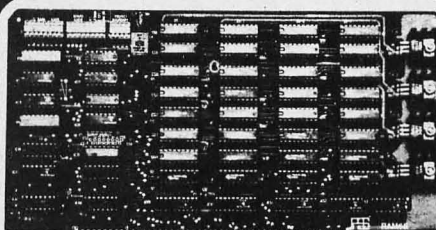
RAM 16 ~~\$449.00~~

~~\$372.00~~ **\$339.00**

- S-100, 16K x 8 bit static RAM • 4MHz
- Addressable in 4K steps
- Memory protection in 1K increments, from bottom board address up or top down
- Memory protection activated / deactivated by large, easily accessible switch
- May deactivate up to six 1K segments of board by use of jumpers to create "holes" for other devices
- DIP switch selectable wait states
- Phantom line DIP switch
- Bank-select for expansion beyond 65K of memory
- Schmitt trigger-buffered I/O lines
- All IC's mounted in low-profile sockets
- Assembled, tested, burned-in at factory

OPTION: RAM16B—2MHz

~~\$429.00~~ **\$339.00**



RAM 65 ~~\$495.00~~

~~\$395.00~~ **BANK SELECTABLE**

- S-100, 16K x 8 bit static RAM • 4MHz
- Addressable in 4K steps
- Memory protection in 1K increments, from bottom board address up or top down
- Memory protection activated / deactivated by large, easily accessible switch
- May deactivate up to six 1K segments of board by use of jumpers to create "holes" for other devices
- DIP switch selectable wait states
- Phantom line DIP switch
- Features bank selection by I/O instruction using any one of 256 DIP switch-selectable codes—allows up to 256 software-controlled memory banks.
- Schmitt trigger-buffered I/O lines • All IC's mounted in low-profile sockets
- Assembled, tested, burned-in at factory

OPTION: RAM65B—2MHz

~~\$459.00~~ **\$389.00**

*Please include sufficient funds to cover cost of shipping of Mainframes.

Send for our latest brochure

Terms VISA MC BAC check Money Order C.O.D. U.S. Funds Only CA residents add 6% sales tax Minimum order \$10.00. Orders less than \$75.00 include 10% shipping and handling, excess refunded. Just in case please include your phone no

phone orders welcome (213) 894-8171

OEM and Institutional inquiries invited

Good Thru March 1979

TOLL FREE
1-800-423-5633

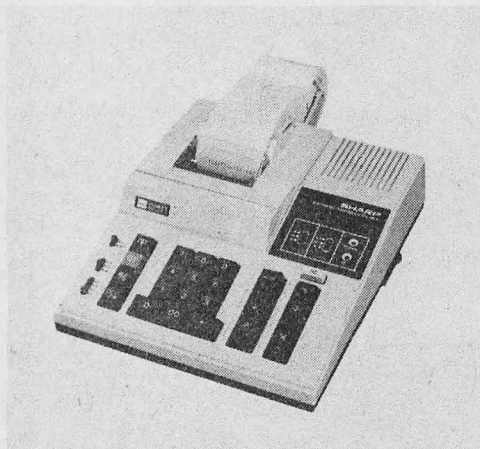
PRIORITY ONE ELECTRONICS®

16723B Roscoe Blvd. Sepulveda, CA 91343

What's New?

CALCULATORS

New 10 Digit Desktop Calculator from Sharp

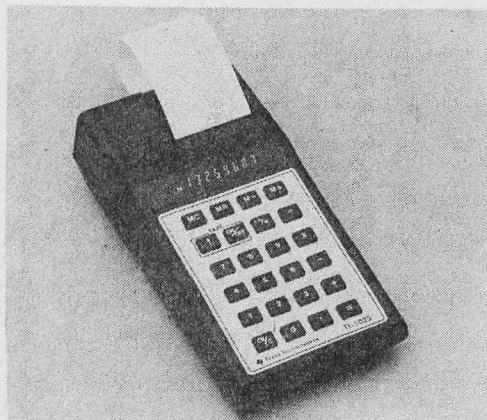


This new desktop, 10 digit business calculator featuring an item counter and grand total key has been introduced by Sharp Electronics Corp, 10 Keystone Pl, Paramus NJ 07652.

The new 4½ pound QS-1702 offers calculating and printing on standard roll paper. A 1 touch grand total key accumulates individual calculations. Specially designed minus equal and plus equal keys make the QS-1702 ideal for applications that require fast calculation. A constant add mode selector facilitates dollars and cents calculations. A 1 touch percent key, non-add and subtract total key for printing dates and codes, an item counter switch with a plus and minus and plus/only calculation and a fixed and floating decimal point selector are other major features of the QS-1702 calculator. ■

Circle 532 on inquiry card.

Handheld Printer and Display Calculator

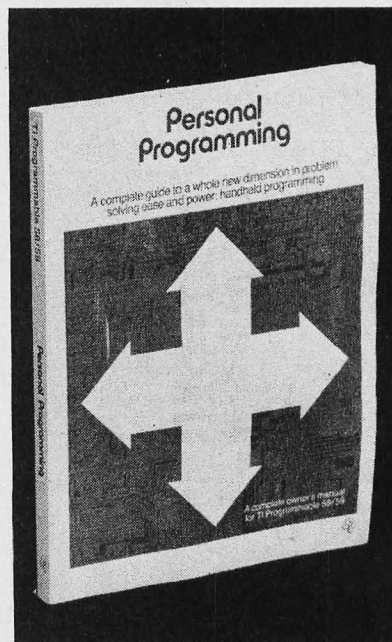


This rechargeable handheld printer and display calculator has been introduced by Texas Instruments Inc, POB 53, Lubbock TX 79408. The TI-5025 features a thermal printer and a large vacuum fluorescent display that can be used without the printer to conserve paper. The unit provides four basic functions as well as percent and 4 key memory. The TI-5025 operates with the same number entry system used in other TI handheld calculators. The thermal printer has fewer parts than impact printers, providing reliable, quiet, ribbonless operation.

The unit is priced at \$80 and comes with a charger and adapter, thermal paper and carrying case. Thermal paper rolls are available in packages of three for \$0.99. ■

Circle 533 on inquiry card.

Operator's Manual for Texas Instruments Programmable 58 and 59 Calculators



Personal Programming is written for owners of the Texas Instruments programmable 58 and 59 calculators. This manual gives a guided tour of keyboard basics, display control, algebraic functions, conversions, and statistical function on keys; a step by step discussion of programming as well as advanced programming; and a detailed analysis of all calculator keys showing the full operating limits of the machines in various calculating situations.

The price of this manual is \$12.95 plus tax and \$1 for shipping. For further information contact Texas Instruments Inc, POB 2500, Lubbock TX 79408. ■

Circle 534 on inquiry card.

North Star Utilities Package

With these programs the user can:

Read a basic program directly from a disc and list all variables appearing in the program (Listings can be made of variables versus line numbers or line numbers versus variables.)

Selectively print out any statement, function or command versus the line numbers that it appears in

Print out a "flow chart" of the basic program

This package is essential for examining and modifying basic programs. It is provided on a North Star Diskette for \$15.00.

Potter's Programs
22444 Lakeland
St. Clair Shores, MI 48081
(313) 573-8000

Circle 308 on inquiry card.

PROGRAMMING CONTEST !

MICRO-PUZZLE NO. 2

1st PRIZE- FLOPPY DISK SYSTEM OR \$1000 CASH
2nd PRIZE- FLOATING POINT BOARD OR \$400 CASH
3rd PRIZE- AUDIO INTERFACE OR \$200 CASH

M	I	C	R	O		16
O	N	L	A	P		11
O	L	I	V	E		14 = 61
N	E	V	E	N		9
S	T	E	D	S		11

WHY CAN THE HUMAN MIND SOLVE THIS PUZZLE EASIER THAN THE MACHINE MIND? SOMEWHERE ON EARTH THERE MUST BE A COMPUTER THAT CAN BEAT THE HUMANS WHO ENTER THIS CONTEST. THIS IS A TOTALLY OBJECTIVE PUZZLE. PERFECT FOR COMPUTER SOLUTION. WINNERS ARE DETERMINED SOLELY ON THEIR ABILITY TO GET THE HIGHEST SCORE IN ABOUT 1 MONTHS TIME. 4th & 5th PRIZE ARE NOW \$100.

For entry form and official rules send a self addressed stamped envelope to:
MICRO-PUZZLES Dept. A 7858 Cantaloupe Ave.
Van Nuys, California 91402

Circle 227 on inquiry card.

TRS - 80

SPECIAL PROMOTION SALE

SAVE 10%, 15% or more on ALL Computers, Peripherals, Software, and ALL other fine Radio Shack® products.

NO TAXES on out-of-state shipments.

FREE Surface delivery in U.S.
WARRANTIES will be honored by your local Radio Shack® store.

Offered exclusively by
Radio Shack®
Authorized Sales Center
1117 Conway
Mission, Texas 78572
(512) 585-2765



Circle 314 on inquiry card.

wirewrap

PRECUT WIRE

#30 WIRE KITS

#1 \$7.95

#2 \$19.95

250	3"	100	4 1/2"
250	3 1/2"	100	5"
100	4"	100	6"

250	2 1/2"	250	5"
500	3"	100	5 1/2"
500	3 1/2"	250	6"
500	4"	100	6 1/2"
250	4 1/2"	100	7"

#3 \$24.95

#4 \$44.95

500	2 1/2"	500	4 1/2"
500	3"	500	5"
500	3 1/2"	500	5 1/2"
500	4"	500	6"

1000	2 1/2"	1000	4 1/2"
1000	3"	1000	5"
1000	3 1/2"	1000	5 1/2"
1000	4"	1000	6"

Choose One Color or Random Assortment:
Red, Blue, Green, Yellow, White, Orange, Black.

* #26 Prices on Request

#30 Kynar stripped 1" on each end. Lengths are overall.
Colors: Red, Blue, Green, Yellow, Black, Orange, White.
Wire packaged in plastic bags. Add 25¢/length for tubes.

In.	100	500	1000	5000
2 1/2	1.04	2.98	5.16/K	4.67/K
3	1.08	3.22	5.65/K	5.06/K
3 1/2	1.13	3.46	6.14/K	5.46/K
4	1.18	3.20	6.62/K	5.87/K
4 1/2	1.23	3.95	7.12/K	6.25/K
5	1.28	4.20	7.61/K	6.62/K
5 1/2	1.32	4.48	8.10/K	7.03/K
6	1.37	4.72	8.59/K	7.43/K
6 1/2	1.60	5.37	9.84/K	8.48/K
7	1.66	5.63	10.37/K	8.91/K
7 1/2	1.73	5.89	10.91/K	9.33/K
8	1.78	6.15	11.44/K	9.79/K
8 1/2	1.82	6.41	11.97/K	10.19/K
9	1.87	6.76	12.51/K	10.62/K
9 1/2	1.92	6.93	13.04/K	11.05/K
10	1.99	7.26	13.57/K	11.48/K
Addl. In.	.15	.60	1.20/K	1.00/K

EDGE CARD CONNECTORS

44 pin Solder Tail	\$1.95	\$17.50/10	ALL are Gold
100 pin Solder Tail	\$3.95	\$35.00/10	100 pin are IMSAI
100 pin Wire Wrap	\$3.95	\$35.00/10	spacing.

SOLDERLESS BREADBOARDS

SK 10 \$16.50

2.2" x 6.5"



MB10 \$18.95

SK10 mounted on board
W74 Binding Posts &
Rubber Feet

WIRE WRAP SOCKETS

	1-9	10-24	25-99	100-249	250-999
8 pin*	.40	.36	.34	.31	.27
14 pin*	—	.39	.37	.34	.32
16 pin*	—	.42	.40	.36	.34
18 pin*	.70	.60	.55	.50	.45
20 pin	.90	.80	.75	.65	.62
22 pin*	.95	.85	.80	.70	.65
24 pin	.95	.85	.80	.70	.65
25 pin strip	1.25	1.15	1.00	.95	.90
28 pin	1.25	1.15	1.00	.95	.90
40 pin	1.65	1.45	1.35	1.20	1.10

Gold 3-Level Closed Entry Design

2-Level Sockets Available

*End & Side Stackable

PAGE DIGITAL ELECTRONICS

135 E. Chestnut St. #5 Monrovia, CA 91016 (213) 357-5005

Ordering Information:

- Orders under \$25 and COD's add \$2
- All others, shipped Ppd in U.S. via UPS
- For Blue Label (Air) or 1st Class, add \$1
- We accept Visa & Mastercharge

Catalog available on request.

Dealer Inquiries Invited

WIRE WRAP TOOLS

HOBBY WIRE WRAP TOOL

BW 630 (Back Force) \$34.95

BT 30 Extra Bit 2.95

BT 2628 #26 Bit 7.95

Batteries & Charger 11.00



INDUSTRIAL WIRE WRAP TOOL

BW 928

\$49.95*

BW 928BF (Back Force) 52.95*

#30 Bit & Sleeve 29.50

#26 Bit & Sleeve 29.50

Batteries & Charger 11.00



ELECTRICAL INDUSTRIAL WIRE WRAP TOOL

EW 7D

\$85.00*

EW 7D BF (Back Force) 92.90*

#30 Bit & Sleeve 29.50

#26 Bit & Sleeve 29.50

*Industrial Tools do not include Bit & Sleeve
Spring Loaded bit on Back Force models.



INTERCONNECT CABLES

Ribbon cable connectors for connecting boards to front panels, or board to board.

	SINGLE ENDED			DOUBLE ENDED		
	14 pin	16 pin	24 pin	14 pin	16 pin	24 pin
6"	1.24	1.34	2.05	2.24	2.45	3.37
12"	1.33	1.44	2.24	2.33	2.55	3.92
24"	1.52	1.65	2.63	2.52	2.76	4.31
48"	1.91	2.06	3.40	2.91	3.17	5.08

OK PRODUCTS

WD 30	50 ft. Wire Dispenser	Red, White, Blue, or Yellow	\$3.75
WD-30-TRI	TRI Color Dispenser		5.50
R-30-TRI	Refill for TRI Color		3.75
INS 1416	14 & 16 pin Insertion Tool		3.25
MOS 40	40 pin Insertion Tool		7.50
EX-1	IC Extractor Tool		1.49
H-PCB-1	Hobby PC Board		4.99
WSU 30	Hand Wrap/Unwrap/Strip Tool		6.25
WSU 30M	Same as WSU30 with Modified Wrap		7.50

LOGIC PROBE

PRB-1

\$34.95



- Compatible with all Logic Families
- 10 Nsec pulse response

Electrolabs

PO Box 6721 Stanford

CA. 94305
415-321-5601

**USED SYLVANIA
12" MONITORS**
Working: \$69.95
Cold Chassis, 25 lbs.
With New P39 (GR)
or New P4 (WH)
Tube — \$99.00



CRT Only \$39.00

★ TI Sockets!
1 cent per pin.

ANNOUNCING! SUPER DISK!

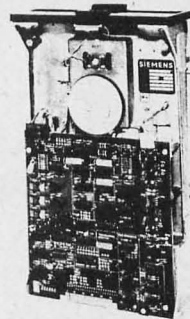
- 10 MB
- Removable Cartridge Disk
- S-100, CP-M Compatible
- Winchester Technology
- Servo Track Seat
(includes controller)

The Cherry "Pro" fully encoded
ASCII KEYBOARD. Auto REPEAT
feature, 5 special function keys. 300
mA/5V. (Shown as mounted in 'The
Case,' below) \$119.99, 3/99.00,
10+/89.00.



"The Case" Beautiful and sturdy
anodized aluminum case in deep black designed to contain the
ESAT 200A, and with a bezel cut out for the Cherry 'Pro' keyboard.
(installed as shown above) Choose deep brown, light yellow, or crim-
son to accent or color code your installation. The only choice for
hard-use institutional and educational applications. \$69.00

GSi-
Siemens
FDD 120-B



TLX 345567
800-227-8266
24 hour service

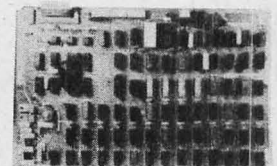
- * Hard and Soft Sectoring
- * Single and Dual Density
- * 110/220V, 50/60Hz
- * Pin for pin compatible with
Shugart 800,801
(50 pin edge connector)

* PRICE BREAKTHROUGH!
\$425 each
ALL OPTIONS INCLUDED

LATEST REVISION: ESAT 200B (BILINGUAL)

Stand Alone Single Board Communicating Terminal
80X24 Standard Format \$329.00 Absolutely Complete

Split Speed 110 to 19,200 Baud
Two Fonts, 128 Char. ea. in 2708 EPROM
Full Feature Cursor, Page Xmit., Scrolling
5V@3A, 8"X14" Board, Requires only a
keyboard and almost any monitor for the
best terminal for the money anywhere!
Supplied with U&LC ASCII in one
font, you may easily program the
other one.



* NEW ITEMS! TRS-80, APPLE Ad-on Set eight and a spare
4116 Type Rams \$89.00. * Hene Laser Tubes .05-2.0 mW - metal
\$49.00, glass \$39.00. * Our new catalog is now out!

Shipping and Handling: Surface: \$0.40/lb., Air: \$0.75/lb.,
\$1.00 minimum. CA Tax: 6.5% Insurance: \$0.50 per \$100.00

WAMECO

THE COMPLETE PC BOARD HOUSE EVERYTHING FOR THE S-100 BUSS

- * **FPB-1** FRONT PANEL BOARD
Hex Displays, IMSAI Replaceable\$50.00
- * **FDC-1** FLOPPY DISC CONTROLLER BOARD
Controls up to 8 Discs\$45.00
- * **MEM-1A** 8K BYTE 2102 RAM Board\$30.00
- * **MEM-2** 16K BYTE 2114 RAM Board\$30.00
- * **CPU-1** 8080A CPU Board
With Vector Interrupt\$30.00
- * **EPM-1** 4K BYTE 1702A EPROM\$30.00

- * **EPM-2** 16K or 32K BYTE EPROM
2708 or 2176 interchangeable\$30.00
- * **QMB-9** 9 SLOT MOTHER BOARD
Terminated\$35.00
- * **QMB-12** 12 SLOT MOTHER BOARD
Terminated\$40.00
- * **RTC** REALTIME CLOCK
Programmable Interrupts\$30.00

FUTURE PRODUCTS: 80 CHARACTER VIDEO BOARD,
IO BOARD WITH CASSETTE INTERFACE.

DEALER INQUIRIES INVITED, UNIVERSITY DISCOUNTS AVAILABLE
AT YOUR LOCAL DEALER



WAMECO INC. 3107 LANEVIEW DR., SAN JOSE, CA 95137

California Digital

Post Office Box 3097 B • Torrance, California 90503



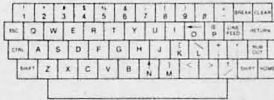
Hazeltine 1400

cost effective
CRT TERMINAL

\$735 plus shipping

The Hazeltine 1400 Video Display Terminal is designed to optimize interactive real-time operations. The interface is capable of either local or remote connection through an EIA RS232-C interface at baud rates that are switch selectable up to 9600 baud.

- All 128 ASCII Codes
- 64 Displayable Characters
- 24 Lines; 12 inch Screen
- 80 Characters per Line
- Self Diagnostic Test

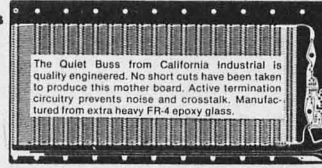


Immediate Delivery

S-100 Mother Board

Quiet Buss

\$29.95
8803-18
18 slot
IMSAI



Shugart Associates

SA800-R Floppy Disk Drive

The most cost effective way to store data processing information, when random recall is a prime factor. The SA800 is fully compatible with the IBM 3740 format. Write protect circuitry, low maintenance & Shugart quality.

\$449.50

TELETYPE MODEL 43

Even if we have to give them away, we're going to ship more 43's in 1979 than the aggregate of all our competitors.

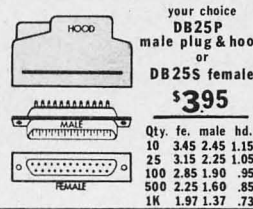


Model 43AAA (TTL)

EACH 3 10 25
\$925. 875. 850. 825.
RS-232 Interface "K" Add \$7500 plus shipping

\$29.95
BOX of 10
DISKETTES
Verbatim APPLE/TRS-80 Mini-Soft sector

CONNECTORS



your choice

DB25P male plug & hood

or

DB25S female

\$3.95

Qty. fe. male hd.

10 3.45 2.45 1.15

25 3.15 2.25 1.05

100 2.85 1.90 .95

500 2.25 1.50 .85

1K 1.97 1.37 .73

Edge Connectors



GOLD 100 PIN

IMSAI/ALTAIR

Imesai solder .125 x .250 \$4.95 3/\$10.00

Imesai w/w .125 centers \$4.95 3/\$13.00

Altair soldertail .140 row \$5.95 3/\$15.00

SPECIALS

22/44 Kim eyelet .156" \$1.95 3/\$5.00

25/50 solder tab .156" \$1.09 3/\$2.00

36/72 wide post w/w .156" \$1.95 3/\$5.00



\$24.88

UNIVAC KEYBOARD

The famous Sperry Univac 1730 Hollerith keyboard assembly is now available from California Industrial for only \$24.88. The ideal computer input device for accountants and mathematicians. The numeric keys are placed on the lower three rows to resemble a ten key adding machine. This format allows one handed numeric data entry. Original cost was \$385. Used but guaranteed in excellent condition. Complete with documentation.

World Power TRS-80 Interface

MSIOA I/O Modular..... \$129.95
MCCA master control... \$149.95
RSBa S-100 interface... \$289.95
EPR80a Eprom prog... \$159.95
EPR100a Eprom prog... \$159.95
Data sheet available upon request

SPECIAL

APPLE II

16K MEMORY

COLOR • GRAPHICS • SOUND

\$1024

PLUS SHIPPING

Mfg. Sug. Retail... \$1195

TEN for \$41 50+385

Scotch CASSETTES

Certified Digital
Won't drop a BIT!



DISKETTES \$5.50
8inch Soft (IBM)
8inch 32 sector
Mini Soft sec.
Mini 10 sector
Mini 16 sector



APPLE RS-232

Serial Interface \$59.95

Apple II to Teletype or other serial printer.

ELECTRONIC SYSTEMS

DigiCAST A/V-100

R.F. MODULATOR

\$29.95 Broadcast both audio and video on your existing color television. Recommended for the Apple II.

Extender Board

Mullen \$34.95

Facilitates design and troubleshooting of all S-100 microsystems. Includes logic probe along with high-low and pulse LED display. Also available, the Mullen CB-1 controller board \$88.

S-100 PROTOTYPE BOARD

\$19.98

GP100-Maximum design versatility along with standard address decoding and buffering for S100 systems. Room for 32 uncommitted 16 pin IC's. 5 bus buffers & decoding chips. 1 DIP address select switch, a 5 volt regulator and more.
WW100-Wide wrap breadboard, similar to the GP100. Allows wire wrap of all sizes of sockets in any combination. An extra regulator position for multiple voltage applications.

MEMORY

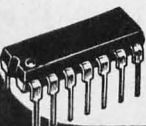
TRS-80 \$65
APPLE II 65
16k memory (8) 4116's

* As you may be aware, publishers require advertisers to submit their ad copy 60 to 90 days prior to "press" date. That much lead time in a volatile market place, such as memory circuits, makes it extremely difficult to project future cost and availability. To obtain the best pricing on memory we have made volume commitments to our suppliers, which in turn affords us the opportunity to sell these circuits at the most competitive prices. Please contact us if you if you have a demand for volume state of the art memory products.

STATIC	1-31	32-99	100-5C	-999	1K+
21L02 450nS.	1.49	1.19	1.05	.95	.89
21L02 250nS.	1.69	1.49	1.45	*	*
2114 1Kx4 450	6.95	6.50	6.25	6.00	5.75
2114 1Kx4 300	8.95	8.50	8.00	*	*
4044 4Kx1 450	5.95	5.50	5.00	*	*
4044 4Kx1 250	9.95	9.50	9.00	*	*
4045 1Kx4 450	8.95	8.50	8.00	*	*
4045 1Kx4 250	9.95	9.50	9.00	*	*
5257 low pow.	7.95	7.50	7.05	6.75	6.45

SPECIAL CIRCUITS

Z80A 4MHz.	24.95	AY5-1013A UART	4.95
8080A CPU	9.95	Floppy Disc Controllers	
8085	22.50	WD 1771 single D.	39.95
8086 Intel 16 bits	*	WD 1781 Double D	65.00
TMS9900 16 bits	49.95	WD 1791 D/D 3740	*



E PROMS	1-15	16-63	64+
1702A 2K	4.95	4.50	4.00
2708 8K	9.95	9.50	9.00
2716 16K	19.95	*	*
2532 32K	*	*	*



Attention TRS-80 Owners

\$650

WORD PROCESSING TERMINAL

LAWYERS, BUSINESSMEN, ... This terminal, when properly interfaced to your computer, allows you the flexibility of generating computerized error free correspondence. Gives your clients and business associates the impression that each letter was personally typed for the recipient. Compose your correspondence and "Fill-in" forms on your computer, edit on your screen and when your text is letter perfect instruct your computer to print an error free copy on your terminal.

The heart of this terminal is the durable IBM Selectric Typewriter. If maintenance is ever required, the World Wide network of IBM service centers is at your disposal. The terminal is functional as a regular office typewriter when not performing computer work. Over the next several months 150 of these terminals will be removed from service, returned to the manufacturer, inspected and brought into perfect condition. Last Spring we offered for sale two-hundred Diable printers. Within three weeks every unit was sold. Don't pass this opportunity to purchase a word processing terminal at an excellent price. Selectric Terminal \$650 (FOB Los Angeles). Shipping to the East coast approx. \$35. Combined TRS-80 interface and power supply available. Documentation will be supplied to those individuals who want to do their own custom interfacing. Sorry, but credit cards will not be accepted on this purchase.

(213)679-9001

All merchandise sold by California Digital is premium grade. Sorry, no COD's. Orders are shipped the same day received. California residents add 6%. Foreign orders add 10%. Orders over \$25, when accompanied by payment, are shipped at our expense. Otherwise, please add \$2.

Thumbwheel switch

Ten position
BCD \$139 ea.
10 50
\$1.19 .89

CAPACITORS

ELECTROLYTICS

ea. 10 50

80,000/10v. 3.95 349 295

4500/50v. \$149 135 119

1000/15v. \$55 49 45

axial

.1 disc \$12 .09 .07

.01 disc .06 .05 .04

450

10 50

\$1.19 .89

SPST

DISCOUNT

Wire Wrap Center

IC SOCKETS

wire wrap low profile

pin ea. 25 50 ea. 25 50

8 17-16 15

14 37-36 35 18 17 16

16 38 37 36 19 18 17

24 99 93 85 36 35 34

40 169 155 139 63 60 58

50ft. **KYNAR WIRE WRAP**

\$98 500 1,000 11,000

\$9. \$15. \$105.

MINIATURE SWITCHES

your choice
10 50 100 1k
\$.98 \$.88 .81 .73 .66

SPDT Miniature Toggles

7101 C&K ON-NONE-ON

7107 1st ON-OFF (mnt. ON)

7108 CK ON-(moment. ON)

Rocker 1BT DPDT

Rotary 3P-4-Pos.

Rotary 3P-6-Pos.

Push B (N.O.) \$39ea. 4/\$1

DIP Switch

10 25 100 1K

\$1.49 \$1.29 \$1.15 .97 .83

specify for 8 pos.

SPST

DISCOUNT

Wire Wrap Center

IC SOCKETS

wire wrap low profile

pin ea. 25 50 ea. 25 50

8 17-16 15

14 37-36 35 18 17 16

16 38 37 36 19 18 17

24 99 93 85 36 35 34

40 169 155 139 63 60 58

50ft. **KYNAR WIRE WRAP**

\$98 500 1,000 11,000

\$9. \$15. \$105.

OK HOBBY WRAP-30

wire wrap & strip tool

\$545

Ham Interface for the PET Microcomputer

The M-65 is a complete Morse code and radioteletypewriter (RTTY) system for the PET microcomputer. The hardware consists of a printed circuit board which plugs into a jack on the radio equipment and the PET user port. No external power is required. Both input and output circuits are optically isolated from the PET, minimizing radio frequency interference and spurious voltages. The board has a built-in side tone oscillator which connects to the speaker or headphone.

The software consists of two computer programs: Morse and RTTY, which are supplied on one audio cassette. Both programs are written in BASIC with machine language subprograms, and each requires 8 K bytes of programmable memory.

The M-65 is available in kit form for \$69.95 or fully assembled and tested for \$99.95. Contact Microtronics, 5943 Pioneer Rd, Hughson CA 95326. ■

Circle 653 on inquiry card.

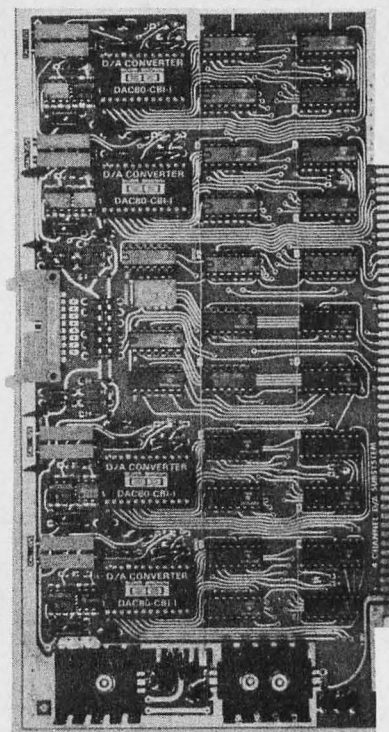
S-100 Bus Compatible 4 Channel Digital to Analog Converter

This 4 channel digital to analog converter is available for use with Z-80 or 8080/8085 processors. The S-100 bus compatible digital to analog board has 12 bit resolution and uses plug-in hybrid digital to analog converters with ± 0.5 least significant bit accuracy. Power requirements are compatible with S-100 bus voltages: +8 V at 338 mA, +18 V at 122 mA, and -18 V at 156 mA.

The output is 10 V or 20 V full scale (strap selectable). The output range may be ± 5 V, ± 10 V, 0 to +10 V, or 0 to -10 V. An inversion strap is also provided for decreasing output with increasing input. Output current is 10 mA. Independent gain and offset adjustments are provided. Input coding may be either binary or 2's complement. Conversion speed is 3 μ s typical, and the converter slew rate is 20 V per μ s typical.

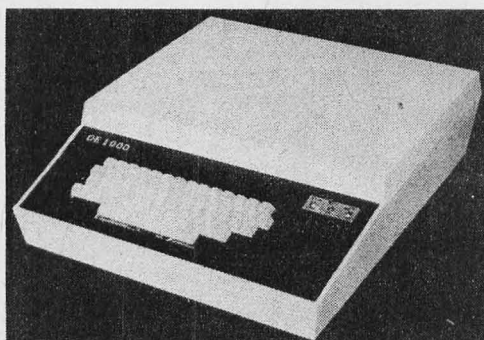
The price is \$495. Contact California Data Corp, 3475 Old Conejo Rd, Suite C10, Newbury Park CA 91320. ■

Circle 654 on inquiry card.



New Terminal Outputs Composite Video

The OE 1000 terminal is designed to interface to any microcomputer that has



a 300 bps serial data output port. It operates in the full duplex mode with either 20 mA current loop or RS-232 voltage swing. The OE 1000 outputs composite video for use with a modified television or a video monitor. The screen format is 16 lines by 64 characters. It has an upper and lower case mode or Teletype mode keyboard and will display 96 ASCII characters and 32 special characters. The OE 1000 has full cursor control, automatic scroll, erase to end of line, erase to end of screen, and clear screen.

The terminal is available as a kit for \$275 or assembled for \$350. Contact Otto Electronics, POB 3066, Princeton NJ 08540. ■

Circle 655 on inquiry card.

PerSci's New 4 Headed Voice Coil Floppy

A 4 headed flexible disk drive has been introduced by PerSci Inc, 12210 Nebraska Av, W Los Angeles CA 90025. The Model 299 diskette drive interfaces to 8080, 6800 and Z-80 systems, as well as minicomputers.

The Model 299 is a dual-headed, dual diskette drive, reading and writing both sides of two 8 inch diskettes. Data can be encoded in single or double density in IBM compatible soft sector formats or expanded hard and soft sector formats on IBM Diskette I, II, IID or equivalent media. The drive will store up to 1 M byte of data in IBM type format, 1.6 M bytes unformatted single density and up to 3.2 M bytes in unformatted double density encoding.

The operational tolerances required to achieve dual head, dual drive double density data handling are provided by PerSci's voice coil positioning system for an average seek time of 33 ms (including 0 settle time), five to seven times faster than stepper motor positioned drives. A full stroke 76 track seek is performed in 100 ms. The speed and the capacity of the drive are achieved while maintaining industry standard data reliability figures of 1 in 10^9 soft errors and 1 in 10^{12} hard errors.

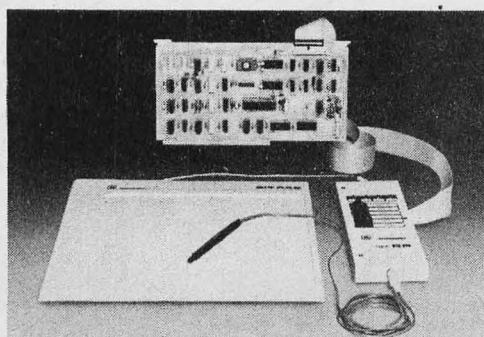
The Model 299 features electric autoloader and can be unloaded by remote software control. Optical write protect secures the file.

The price is \$1595 in single unit quantities. ■

Circle 657 on inquiry card.

Digitizer for Small Computer Systems

Summagraphics has announced a new version of its Bit Pad, the digitizer for



small computer systems. The new Bit Pad configuration is Intel Multibus compatible. The Bit Pad can now be plugged into the Multibus along with Single Board Computers (SBC), memory and input/output (I/O) boards, peripherals and controllers.

All electronics are located on one SBC card. Operational control and status indication is provided from a small handheld console. The system also includes an 11 by 11 inch (27.94 by 27.94 cm) Bit Pad tablet and a date input stylus.

The basic Multibus Bit Pad configuration is priced at \$625. For further information contact Summagraphics, 32 Brentwood Av, POB 781, Fairfield CT 06430. ■

Circle 656 on inquiry card.

SOLID STATE SALES... Announces a Breakthrough in Computer Technology

A PICTURE MAY BE TAKEN BY OUR CAMERA,
STORED IN A COMPUTER IN REAL TIME AND THEN
DISPLAYED ON A CRT AT AN AFFORDABLE PRICE

VIDEO COMPUTER PROCESSING SYSTEM

GRAY LEVELS

THIS REMARKABLE VP-1 COMPUTER/
INTERFACE KIT HAS THE FOLLOWING:

FEATURES

- IT PRODUCES COMPOSITE VIDEO OUTPUT IN A 128 x 128 MATRIX FROM A DIRECT MONITOR CONNECTION USING 8K OF MEMORY
- THE SYSTEM USES A STANDARD S 100 BUSS
- WILL NOT TIE UP COMPUTER SOFTWARE WHEN NOT ADDRESSED
- IT DISPLAYS CONTINUOUSLY WHEN NOT ADDRESSED
- IT MAY PRODUCE PSEUDO COLOR AND/OR GRAPHICS (UP TO 16 GREY LEVELS, 4 BIT BINARY)

THE CAMERA WILL TAKE BETWEEN 15 AND 100 FRAMES/SECOND. THE CAMERA CONNECTS TO THE PROCESSOR WITH SEVEN LINES. THIS INCLUDES VIDEO AND TIMING SIGNALS

APPLICATIONS

- CONTINUOUS SURVEILLANCE
- INSPECTION OF MOVING PARTS WITH PROPER STROBING
- VISUAL GRAPHIC INPUT TO A COMPUTER
- CHARACTER OR PATTERN RECOGNITION
- PICTURES MAY BE TAKEN DIRECTLY FROM A TV WITHOUT ELECTRICAL CONNECTIONS
- THE INTERFACE KIT MAY BE USED SEPARATELY AS A 128 x 128 16 LEVEL GRAPHIC DISPLAY

OUR VP1 VIDEO SYSTEM CONSISTS
OF THE FOLLOWING KITS:

- CCD 202C SOLID STATE VIDEO CAMERA KIT (CASE INCLUDED) . \$399⁰⁰
- VP-1 COMPUTER/VIDEO INTERFACE KIT (3 BOARDS) \$599⁰⁰
- ASSEMBLED 8K MEMORY BOARD (OPTIONAL) \$235⁰⁰

THIS VIDEO COMPUTER KIT
CAN WORK WITH THE GE,
REDICON, OR ANY OTHER
128 x 128 SENSOR CAMERA

REGULATED POWER SUPPLIES

POWER SYSTEMS # PS1111
115-230V 50/60 cy. in 5V DC at 35A out.
6"x 16 1/2"x 15 1/2" 26 lbs. shipping weight \$85.00

POWER SYSTEMS # PS1106
115-230V 50/60 cy. in 12V DC at 15A out.
5"x 16 1/2"x 5" 19 lbs. shipping weight. \$75.00
(OV PROTECT)

C/MOS (DIODE CLAMPED)

4001	-18	4019	-37	4049	-35	74C74	-45
4002	-18	4020	-90	4050	-35	74C83	-115
4006	-95	4021	-90	4053	-110	74C86	-40
4007	-18	4022	-90	4055	-125	74C93	-75
4009	-37	4023	-18	4066	-70	74C151	140
4010	-37	4024	-75	4071	-18	74C160	105
4011	-18	4025	-18	4076	-97	74C161	105
4012	-18	4027	-37	4500	-22	74C175	105
4013	-29	4028	-80	74C00	-22	74C192	120
4014	-75	4029	-95	74C02	-22	74C196	120
4015	-75	4030	-33	74C04	-24	74C193	120
4016	-29	4035	-97	74C08	-22	74C901	48
4017	-90	4042	-65	74C10	-27	74C902	48
4018	-90	4046	-135	74C17	-65	74C914	170

PRINTED CIRCUIT BOARD

4-1/2"x 6-1/2" SINGLE SIDED EPOXY
BOARD 1/16" thick, unetched 5/\$2.60
\$60 ea.

7 WATT LD-65 LASER DIODE IR \$8.95

2N 3820 P FET \$.45
2N 5457 N FET \$.45
2N2646 UJT \$.45
ER 900 TRIGGER DIODES 4 \$1.00
2N 6028 PROG. UJT \$.65

MINIATURE MULTI-TURN TRIM POTS
100, 1K, 2K, 5K, 10K, 20K, 50K,
200K, 1Meg, 2Meg, \$.75 each 3/\$2.00

CHARGED COUPLE DEVICES

CCD 201C 100x100 Image Sensor \$95.00
CCD 202C 100x100 Image Sensor \$145.00

VERIPAX PC BOARD \$4.00

This board is a 1/16" single sided paper epoxy board, 4 1/2"x 6 1/2" DRILLED and ETCHED which will hold up to 21 single 14 pin IC's or 8, 16 or LSI DIP IC's with busses for power supply connection.

FP 100 PHOTO TRANS \$.50
RED, YELLOW, GREEN OR AMBER
LARGE LED'S 2" 6/\$1.00
TIL-118 OPTO-ISOLATOR \$.75
MCT-6 OPTO ISOLATOR \$.80
1 WATT ZENERS: 3.3, 4.7, 5.1, 5.6, 9.1, 10,
12, 15, 18, or 22V 6/\$1.00
MCM 6571A 7 x 9 character gen . . . \$10.75

Silicon Power Rectifiers

PRV	1A	3A	12A	50A	125A	240A
100	.06	.14	.30	.80	3.70	5.00
200	.07	.20	.35	1.15	4.25	6.50
400	.09	.25	.50	1.40	6.50	9.50
600	.11	.30	.70	1.80	8.50	12.50
800	.15	.35	.90	2.30	10.50	16.50
1000	.20	.45	1.10	2.75	12.50	20.00

SAD 1024 a REDICON 1024 stage analog "Bucket Brigade" shift register. \$14.95
IN 4148 (IN914) 15/\$1.00

RS232 DB 25P male \$2.25
DB 25S female \$2.95
HOODS \$1.00

REGULATORS

309K \$1.10	340K 12-15
723 \$.50	or 24V . . . \$1.10
LM 378 \$.60	340T-5, 6, 8, 12
320T \$.15	or 24V \$1.35
5, 12, 15	78 MG \$1.35
or 24 \$1.10	79 MG \$1.35

TRANSISTOR SPECIALS

2N6233-NPN SWITCHING POWER	\$.95
MRP-8004 a CB RF Transistor NPN	\$.75
2N3772 NPN Si TO 3	\$ 1.00
2N1546 PNP GE TO-3	\$.75
2N4006 PNP Si TO 3	\$ 1.00
2N5086 PNP Si TO 92	\$ 4.00
2N3137 NPN Si RF	\$.55
2N3919 NPN Si TO 3 RF	\$ 1.50
2N1420 NPN Si TO 5	\$ 3.00
2N3767 NPN Si TO 66	\$.70
2N2222 NPN Si TO 18	\$ 5.00
2N3055 NPN Si TO 3	\$.50
2N3904 NPN Si TO 32	\$ 6.00
2N3906 PNP Si TO 92	\$ 6.00
2N5296 NPN Si TO 220	\$.55
2N6109 PNP Si TO 220	\$.50
2N3638 PNP Si TO 5	\$ 5.00
MP5A 13 NPN Si	\$ 4.00

TTL IC SERIES

7400	-15	7448	-68	74153	-61
7401	-15	7449	-68	74154	-58
7402	-15	7450	-68	74157	-55
7403	-15	7451	-28	74158	-65
7404	-18	7452	-25	74159	-65
7405	-18	7453	-28	74161	-55
7406	-18	7454	-31	74162	-80
7407	-24	7455	-30	74163	-55
7408	-18	7456	-67	74164	-85
7409	-18	7457	-65	74165	-95
7410	-15	7458	-26	74174	-95
7411	-18	7459	-125	74175	-85
7412	-18	7460	-42	74176	-75
7413	-36	7461	-58	74177	-75
7414	-60	7462	-43	74180	-65
7415	-22	7463	-43	74181	-100
7416	-25	7464	-67	74190	-100
7417	-25	7465	-65	74191	-85
7418	-25	7466	-65	74192	-79
7419	-22	7467	-90	74193	-79
7420	-18	7468	-65	74194	-80
7421	-18	7469	-65	74195	-50
7422	-22	7470	-40	74196	-86
7423	-22	7471	-40	74198	-86
7424	-22	7472	-45	74199	-80
7425	-22	7473	-45	74279	-55
7426	-22	7474	-40	74280	-90
7427	-22	7475	-110	74281	-62
7428	-45	7476	-110	74282	-62
7429	-45	7477	-110	74283	-62
7430	-45	7478	-61	74284	-62

DATA CASSETTES 1/2 HR \$.95

14 pin headers 3/\$1.00

MM 5387AA new clock chip which will directly drive LED's 12/24 hrs., 1 supply & alarm \$5.95

NO. 30 WIRE WRAP WIRE SINGLE STRAND 100' \$1.40

ALCO MINIATURE TOGGLE SWITCHES
MTA 106 SPDT \$.95
MTA 206 DPDT \$ 1.70

MTA 206 PDPDT CENTER OFF \$ 1.85
MSD 206 PDPDT CENTER OFF \$ 1.85
LEVER SWITCH \$ 1.85

Full Wave Bridges

PRV	2A	6A	25A
100	.75	1.25	2.00
200	.95	1.50	3.00
600	1.20	1.75	4.00

DIP SOCKETS

PRV	2A	6A	25A
100			1.30
200	.75	1.25	2.00
400	.95	1.50	3.00
600	1.20	1.75	4.00

SANKEN AUDIO POWER AMPS

Si 1010 G 10 WATTS	\$ 7.80
Si 1020 G 20 WATTS	\$ 15.70
Si 1050 G 50 WATTS	\$ 28.50

TANTALUM CAPACITORS

22UF 35V 5 S1 00	68UF 35V 4 S1 00
47UF 35V 5 S1 00	10UF 10V
68UF 35V 5 S1 00	22UF 25V
1UF 35V 5 S1 00	15UF 35V 3 S1 00
2.2 UF 20V 5 S1 00	30UF 6V 5 S1 00
3.3UF 20V 4 S1 00	47UF 20V
4.7UF 15V 5 S1 00	68 UF 15V

74LS SERIES

74LS00	-23	74LS132	-70
74LS02	-23	74LS138	-70
74LS03	-23	74LS139	-70
74LS04	-25	74LS151	-65
74LS05	-23	74LS153	-65
74LS06	-25	74LS155	-65
74LS08	-23	74LS156	-65
74LS09	-25	74LS157	-65
74LS10	-23	74LS158	-65
74LS11	-23	74LS159	-65
74LS12	-23	74LS160	-65
74LS13	-23	74LS161	-65
74LS14	-80	74LS162	-65
74LS15	-23	74LS163	-65
74LS16	-23	74LS164	-65
74LS17	-23	74LS165	-65
74LS18	-23	74LS166	-65
74LS19	-23	74LS167	-65
74LS20	-23	74LS168	-65
74LS21	-23	74LS169	-65
74LS22	-23	74LS170	-65
74LS23	-23	74LS171	-65
74LS24	-23	74LS172	-65
74LS25	-23	74LS173	-65
74LS26	-23	74LS174	-65
74LS27	-23	74LS175	-65
74LS28	-23	74LS176	-65
74LS29	-23	74LS177	-65
74LS30	-23	74LS178	-65
74LS31	-23	74LS179	-65
74LS32	-23	74LS180	-65
74LS33	-23	74LS181	-65
74LS34	-23	74LS182	-65
74LS35	-23	74LS183	-65
74LS36	-23	74LS184	-65
74LS37	-23	74LS185	-65
74LS38	-23	74LS186	-65
74LS39	-23	74LS187	-65
74LS40	-23	74LS188	-65
74LS41	-23	74LS189	-65
74LS42	-23	74LS190	-65
74LS43	-23	74LS191	-65
74LS44	-23	74LS192	-65
74LS45	-23	74LS193	-65
74LS46	-23	74LS194	-65
74LS47	-23	74LS195	-65
74LS48	-23	74LS196	-65
74LS49	-23	74LS197	-65
74LS50	-23	74LS198	-65
74LS51	-23	74LS199	-65
74LS52	-23	74LS200	-65
74LS53	-23	74LS201	-65
74LS54	-23	74LS202	-65
74LS55	-23	74LS203	-65
74LS56	-23	74LS204	-65
74LS57	-23	74LS205	-65
74LS58	-23	74LS206	-65
74LS59	-23	74LS207	-65
74LS60	-23	74LS208	-65
74LS61	-23	74LS209	-65
74LS62	-23	74LS210	-65
74LS63	-23	74LS211	-65
74LS64	-23	74LS212	-65
74LS65	-23	74LS213	-65
74LS66	-23	74LS214	-65
74LS67	-23	74LS215	-65
74LS68	-23	74LS216	-65
74LS69	-23	74LS217	-65
74LS70	-23	74LS218	-65
74LS71	-23	74LS219	-65
74LS72	-23	74LS220	-65
74LS73	-23	74LS221	-65
74LS74	-23	74LS222	-65
74LS75	-23	74LS223	-65
74LS76	-23	74LS224	-65
74LS77	-23	74LS225	-65
74LS78	-23	74LS226	-65
74LS79	-23	74LS227	-65
74LS80	-23	74LS228	-65
74LS81	-23	74LS229	-65
74LS82	-23	74LS230	-65
74LS83	-23	74LS231	-65
74LS84	-23	74LS232	-65
74LS85	-23	74LS233	-65
74LS86	-23	74LS234	-65
74LS87	-23	74LS235	-65
74LS88	-23	74LS236	-65
74LS89	-23	74LS237	-65
74LS90	-23	74LS238	-65
74LS91	-23	74LS239	-65
74LS92	-23	74LS240	-65
74LS93	-23	74LS241	-65
74LS94	-23	74LS242	-65
74LS95	-23	74LS243	-65
74LS96	-23	74LS244	-65
74LS97	-23	74LS245	-65
74LS98	-23	74LS246	-65
74LS99	-23	74LS247	-65

LINEAR CIRCUITS

LM3001	-	7415132	-	LM 101	-	75
LM3002	-	7415133	-	LM 10174B	-	30
LM3003	-	7415134	-	LM307	-	70
LM3004	-	7415135	-	LM 308	-	75
LM3005	-	7415136	-	LM 309	-	75
LM3006	-	7415137	-	LM 310	-	75
LM3007	-	7415138	-	LM 311	-	75
LM3008	-	7415139	-	LM 312	-	75
LM3009	-	7415140	-	LM 313	-	75
LM3010	-	7415141	-	LM 324	-	70
LM3011	-	7415142	-	LM 329	-	110
LM3012	-	7415143	-	LM 330	-	110
LM3013	-	7415144	-	LM 370	-	115
LM3014	-	7415145	-	LM 371	-	160
LM3015	-	7415146	-	LM 380	-	95
LM3016	-	7415147	-	LM 381	-	95
LM3017	-	7415148	-	LM 386	-	80
LM3018	-	7415149	-	LM 387	-	125
LM3019	-	7415150	-	LM 388	-	250
LM3020	-	7415151	-	LM 553	-	250
LM3021	-	7415152	-	LM 555	-	39
LM3022	-	7415153	-	LM 556	-	110
LM3023	-	7415154	-	LM 557	-	110
LM3024	-	7415155	-	LM 558	-	110
LM3025	-	7415156	-	LM 559	-	110
LM3026	-	7415157	-	LM 560	-	110
LM3027	-	7415158	-	LM 561	-	110
LM3028	-	7415159	-	LM 562	-	110
LM3029	-	7415160	-	LM 563	-	110
LM3030	-	7415161	-	LM 564	-	110
LM3031	-	7415162	-	LM 565	-	110
LM3032	-	7415163	-	LM 566	-	110
LM3033	-	7415164	-	LM 567	-	110
LM3034	-	7415165	-	LM 568	-	110
LM3035	-	7415166	-	LM 569	-	110
LM3036	-	7415167	-	LM 570	-	110
LM3037	-	7415168	-	LM 571	-	110
LM3038	-	7415169	-	LM 572	-	110
LM3039	-	7415170	-	LM 573	-	110
LM3040	-	7415171	-	LM 574	-	110
LM3041	-	7415172	-	LM 575	-	110
LM3042	-	7415173	-	LM 576	-	110
LM3043	-	7415174	-	LM 577	-	110
LM3044	-	7415175	-	LM 578	-	110
LM3045	-	7415176	-	LM 579	-	110
LM3046	-	7415177	-	LM 580	-	110
LM3047	-	7415178	-	LM 581	-	110
LM3048	-	7415179	-	LM 582	-	110
LM3049	-	7415180	-	LM 583	-	110
LM3050	-	7415181	-	LM 584	-	110
LM3051	-	7415182	-	LM 585	-	110
LM3052	-	7415183	-	LM 586	-	110
LM3053	-	7415184	-	LM 587	-	110
LM3054	-	7415185	-	LM 588	-	110
LM3055	-	7415186	-	LM 589	-	110
LM3056	-	7415187	-	LM 590	-	110
LM3057	-	7415188	-	LM 591	-	110
LM3058	-	7415189	-	LM 592	-	110
LM3059	-	7415190	-	LM 593	-	110
LM3060	-	7415191	-	LM 594	-	110
LM3061	-	7415192	-	LM 595	-	110
LM3062	-	7415193	-	LM 596	-	110
LM3063	-	7415194	-	LM 597	-	110
LM3064	-	7415195	-	LM 598	-	110
LM3065	-	7415196	-	LM 599	-	110
LM3066	-	7415197	-	LM 600	-	110
LM3067	-	7415198	-	LM 601	-	110
LM3068	-	7415199	-	LM 602	-	110
LM3069	-	7415200	-	LM 603	-	110
LM3070	-	7415201	-	LM 604	-	110
LM3071	-	7415202	-	LM 605	-	110
LM3072	-	7415203	-	LM 606	-	110
LM3073	-	7415204	-	LM 607	-	110
LM3074	-	7415205	-	LM 608	-	110
LM3075	-	7415206	-	LM 609	-	110
LM3076	-	7415207	-	LM 610	-	110
LM3077	-	7415208	-	LM 611	-	110
LM3078	-	7415209	-	LM 612	-	110
LM3079	-	7415210	-	LM 613	-	110
LM3080	-	7415211	-	LM 614	-	110
LM3081	-	7415212	-	LM 615	-	110
LM3082	-	7415213	-	LM 616	-	110
LM3083	-	7415214	-	LM 617	-	110
LM3084	-	7415215	-	LM 618	-	110
LM3085	-	7415216	-	LM 619	-	110
LM3086	-	7415217	-	LM 620	-	110
LM3087	-	7415218	-	LM 621	-	110
LM3088	-	7415219	-	LM 622	-	110
LM3089	-	7415220	-	LM 623	-	110
LM3090	-	7415221	-	LM 624	-	110
LM3091	-	7415222	-	LM 625	-	110
LM3092	-	7415223	-	LM 626	-	110
LM3093	-	7415224	-	LM 627	-	110
LM3094	-	7415225	-	LM 628	-	110
LM3095	-	7415226	-	LM 629	-	110
LM3096	-	7415227	-	LM 630	-	110
LM3097	-	7415228	-	LM 631	-	110
LM3098	-	7415229	-	LM 632	-	110
LM3099	-	7415230	-	LM 633	-	110
LM3100	-	7415231	-	LM 634	-	110
LM3101	-	7415232	-	LM 635	-	110
LM3102	-	7415233	-	LM 636	-	110
LM3103	-	7415234	-	LM 637	-	110
LM3104	-	7415235	-	LM 638	-	110
LM3105	-	7415236	-	LM 639	-	110
LM3106	-	7415237	-	LM 640	-	110
LM3107	-	7415238	-	LM 641	-	110
LM3108	-	7415239	-	LM 642	-	110
LM3109	-	7415240	-	LM 643	-	110
LM3110	-	7415241	-	LM 644	-	110
LM3111	-	7415242	-	LM 645	-	110
LM3112	-	7415243	-	LM 646	-	110
LM3113	-	7415244	-	LM 647	-	110
LM3114	-	7415245	-	LM 648	-	110
LM3115	-	7415246	-	LM 649	-	110
LM3116	-	7415247	-	LM 650	-	110
LM3117	-	7415248	-	LM 651	-	110
LM3118	-	7415249	-	LM 652	-	110
LM3119	-	7415250	-	LM 653	-	110
LM3120	-	7415251	-	LM 654	-	110
LM3121	-	7415252	-	LM 655	-	110
LM3122	-	7415253	-	LM 656	-	110
LM3123	-	7415254	-	LM 657	-	110
LM3124	-	7415255	-	LM 658	-	110
LM3125	-	7415256	-	LM 659	-	110
LM3126	-	7415257	-	LM 660	-	110
LM3127	-	7415258	-	LM 661	-	110
LM3128	-	7415259	-	LM 662	-	110
LM3129	-	7415260	-	LM 663	-	110
LM3130	-	7415261	-	LM 664	-	110
LM3131	-	7415262	-	LM 665	-	110
LM3132	-	7415263	-	LM 666	-	110
LM3133	-	7415264	-	LM 667	-	110
LM3134	-	7415265	-	LM 668	-	110
LM3135	-	7415266	-	LM 669	-	110
LM3136	-	7415267	-	LM 670	-	110
LM3137	-	7415268	-	LM 671	-	110
LM3138	-	7415269	-	LM 672	-	110
LM3139	-	7415270	-	LM 673	-	110
LM3140	-	7415271	-	LM 674	-	110
LM3141	-	7415272	-	LM 675	-	110
LM3142	-	7415273	-	LM 676	-	110
LM3143	-	7415274	-	LM 677	-	110
LM3144	-	7415275	-	LM 678	-	110
LM3145	-	7415276	-	LM 679	-	110
LM3146	-	7415277	-	LM 680	-	110
LM3147	-	7415278	-	LM 681	-	110
LM3148	-	7415279	-	LM 682	-	110
LM3149	-	7415280	-	LM 683	-	110
LM3150	-	7415281	-	LM 684	-	110
LM3151	-	7415282	-	LM 685	-	110
LM3152	-	7415283	-	LM 686	-	110
LM3153	-	7415284	-	LM 687	-	110
LM3154	-	7415285	-	LM 688	-	110
LM3155	-	7415286	-	LM 689	-	110
LM3156	-	7415287	-	LM 690	-	110
LM3157	-	7415288	-	LM 691	-	110
LM3158	-	7415289	-	LM 692	-	110
LM3159	-	7415290	-	LM 693	-	110
LM3160	-	7415291	-	LM 694	-	110
LM3161	-	7415292	-	LM 695	-	110
LM3162	-	7415293	-	LM 696	-	110
LM3163	-	7415294	-	LM 697	-	110
LM3164	-	7415295	-	LM 698	-	110
LM3165	-	7415296	-	LM 699	-	110
LM3166	-	7415297	-	LM 700	-	110
LM3167	-	7415298	-	LM 701	-	110
LM3168	-	7415299	-	LM 702	-	110
LM3169	-	7415300	-	LM 703	-	110
LM3170	-	7415301	-	LM 704	-	110
LM3171	-	7415302	-	LM 705	-	110
LM3172	-	7415303	-	LM 706	-	110
LM3173	-	7415304	-	LM 707	-	110
LM3174	-	7415305	-	LM 708	-	110
LM3175	-	7415306	-	LM 709	-	110
LM3176	-	7415307	-	LM 710	-	110
LM3177	-	7415308	-	LM 711	-	110
LM3178	-	7415309	-	LM 712	-	110
LM3179	-	7415310	-	LM 713	-	110
LM3180	-	7415311	-	LM 714	-	110
LM3181	-	7415312	-	LM 715	-	110
LM3182	-	7415313	-	LM 716	-	110
LM3183	-	7415314	-	LM 717	-	110
LM3184	-	7415315	-	LM 718	-	110
LM3185	-	7415316	-	LM 719	-	110
LM3186	-	7415317	-	LM 720	-	110
LM3187	-	7415318	-	LM 721	-	110
LM3188	-	7415319	-	LM 722	-	110
LM3189	-	7415320	-	LM 723	-	110
LM3190	-	7415321	-	LM 724	-	110
LM3191	-	7415322	-	LM 725	-	110
LM3192	-	7415323	-	LM 726	-	110
LM3193	-	7415324	-	LM 727	-	110
LM3194	-	7415325	-	LM 728	-	110
LM3195	-	7415326	-	LM 729	-	110
LM3196	-	7415327	-	LM 730	-	110
LM3197	-	7415328	-	LM 731	-	110
LM3198	-	7415329	-	LM 732	-	110
LM3199	-	7415330	-	LM 733	-	110
LM3200	-	7415331	-	LM 734	-	110
LM3201	-	7415332	-	LM 735	-	110
LM3202	-	7415333	-	LM 736	-	110
LM3203	-	7415334	-	LM 737	-	110
LM3204	-	7415335	-	LM 738	-	110
LM3205	-	7415336	-	LM 739	-	110
LM3206	-	7415337	-	LM 740	-	110
LM3207	-	7415338	-	LM 741	-	110
LM3208	-	7415339	-	LM 742	-	110
LM3209	-	7415340	-	LM 743	-	110
LM3210	-	7415341	-	LM 744	-	110

Early-bird Specials...

Circle 296 on inquiry card.

Daisy Wheel Printers

• **SELECTRIC I/O TERMINALS** (by GTE/Information Systems). Both ASCII & IBM code versions with microcomputer interface software & hardware (RS-232 connector.) Cassette drive models permit up to 2400 baud data transfer rate as well as off-line data storage, use as memory typewriter, & use as data entry device for office personnel familiar with Selectric typewriters but not computers. Wide-carriage, interchangeable type spheres; optional built-in modem. All units cleaned, adjusted & warranted.

Model 5541 (IBM Correspondence code) \$695.00
Model 5550 (corres. code, built-in cassette drive) \$1195.00
Model 5560 (ASCII code, built-in cassette drive) \$1295.00

• **IBM SELECTRIC 725 TYPEWRITER I/O** w/solenoids switches & magnet driver PCB (from GTE/IS terminal) plus instructions for 8080 printer-driver interface hardware & software.

a) Typewriter mechanism complete, cleaned & adjusted . . . \$375.00
b) Case from terminal & power supply (+24V, ±12V, +5V @5A). . . \$ 75.00
c) a & b plus output ASCII interface to mCPU 8-bit parallel port . . \$600.00

• **POS 103/202 "MIX or MATCH" MODEM:** BELL 103 and/or BELL 202 FREQUENCIES: Unique POS control design permits use in one housing of both Bell-compatible 103 (0 - 300 baud) and 202 (0 - 1200 baud) modem modules originally made by VADIC Corp. for a telephone company subsidiary. FEATURES: RS-232 serial interface, auto-answer, auto-dial, LED display, telephone line interface via acoustic coupler, manual DAA, or auto-answer DAA (sold separately.) FULLY ADJUSTED; no special tools required. 3,000 mile range over standard dial-up telephone lines.

-POS 103 MODEM (with Auto Answer, Auto Dial). \$179.95
-POS 202 MODEM (Half-Duplex with Reverse Channel). \$249.95
-POS 202 MODEM (Half-Duplex w/Rev. Ch., Auto-Answer) \$279.95
-POS 103/202 MODEM (Auto-Answer, Auto-Dial). \$399.95


NO RISK! 15 DAY APPROVAL ON ALL MAIL-ORDERS

Full documentation included PLUS interface instructions where indicated. All equipment is shipped insured FOB Palo Alto within 14 days after check clears or COD order is received. Prices may change without notice.

PACIFIC OFFICE SYSTEMS, INC.

2600 El Camino Real, Suite 502
Palo Alto, Calif. 94306
(415) 321-3866

Call or write for details, quantity prices, catalog. 15 day return privilege PLUS 90 day no charge replacement of defective parts. All orders shipped from stock. No back orders, no substitutions. M/C & VISA accepted.



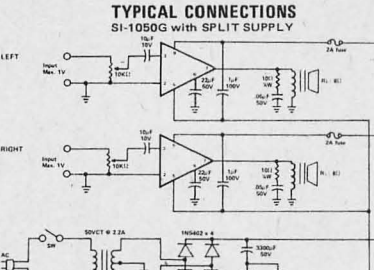
HYBRID AUDIO

10 Watt - 20 Watt - 30 Watt - 50 Watt

POWER AMPLIFIERS

- Multi-purpose linear amplifiers for commercial and industrial applications.
- Less than 0.5% harmonic distortion at full power level.
- 1/2 dB response from 20 to 100,000 Hz.
- Single or split (dual) power supply.
- Rugged, compact and lightweight packages.
- Built-in current limiting for SI-1050G and efficient heat radiating construction.

TYPICAL CONNECTIONS
SI-1050G with SPLIT SUPPLY



Power Amplifier	* Matching Transformer
P/N Power Price	P/N Price
SI-1010G(10W) \$ 6.95	TR10 \$ 7.90
SI-1020G(20W) \$13.95	TR20 \$10.90
SI-A18 (Socket for above)	.95
SI-1030G(30W) \$19.00	TR30 \$12.90
SI-1050G(50W) \$27.80	TR50 \$17.90
SI-A110 (Socket for above)	.95

*Note: One Transformer can power two Sanken audio amplifier modules.

Data Sheet with application Notes - \$.50

SUPERKIM . . \$395.00

Economical expansion into more RAM, user EPROM and prototype area on one modern, compact fully assembled and integrated board. Total compatibility with KIM-1 software. On board 5V, 3A regulator and TTY, RS232 and Audio Tape Interfaces.



FLUKE Model 8020A

\$169



Intersil LED or LCD 3 1/2 DIGIT PANEL METER KITS

BUILD A WORKING DPM IN 1/2 HOUR WITH THESE COMPLETE EVALUATION KITS

Test these new parts for yourself with Intersil's low cost prototyping kits, complete with A/D converter and LCD display (for the 7106) or LED display (for the 7107). Kits provide all materials, including PC board, for a functioning panel meter.

ICL7106(LED) \$29.95 ICL7107(LED) \$24.95

MICROPOWER Timing Circuit

XR-L55BCP Directly interchangeable with popular 555 Timer. Dissipates 1/15th power. \$1.50 each

Intersil's Universal Counter System

EVALUATION KIT ICM7226EV \$59.95

XR-2206KB FUNCTION GENERATOR KIT

Includes all components, PC board and instructions. \$19.95

15 Megahertz PORTABLE MINI-SCOPES

DUAL TRACE MS-215 \$4350
SINGLE TRACE MS-15 \$31800

with RECHARGEABLE BATTERIES & CHARGER

AVAILABLE OPTIONS - usable on both the MS-215 and the MS-15
41-140 Leather Carrying Case \$45.00 - 41-141 10 to 1 Probe \$24.50

Ballantine Model 1010A

Dual Channel X-Y Scope

A professional oscilloscope to fit your basic needs.



\$695

PET 2001 PERSONAL COMPUTER

Quite portable, very affordable and unbelievably versatile, the PET computer may very well be a lifetime investment.

Model	Description	Price
2001	Computer w/8K	\$795.00
2020	PET Printer	\$695.00
C2N	External Cassette	\$9.95

KIM-1 MICROCOMPUTER

Fully Assembled & Tested



\$179.00
Including Documentation

HICKOK LX 303 DIGITAL MULTIMETER

Compact. Accurate. Dependable. With easy-to-read 3 1/2 liquid crystal display for convenient use in any kind of light. Weighs only 8 ounces. Operates up to 200 hrs on a single 9 volt battery. Nineteen ranges including 200mV to 1000VDC, 100 to 10 Megohms, 100 and 1000 VAC ranges, 10uA and 10mA ranges. Excellent overload protection, color coordinated case and color coded panel.

\$74.95

ANCRONA HAS THE SOURCERER™ COMPUTER

\$895.00

STANDARD FEATURES: Z80-4K ROM - 8K RAM - Dual Cassette I/O - 30 Lines of 64 Characters - 64 Defined Characters and 64 User Defined Characters - 512 x 240 Graphic Resolution - Edge Card Connection to S100 Bus - Serial and Parallel I/O

OPTIONS: Expandable to 32K RAM - 8 Slot S100 Bus - Printer - Disk Storage - Telephone - Voice - Home Controller

5% CARBON FILM RESISTORS

1/4W \$1.69
1/2W \$1.79

All values from 10Ω to 10 MΩ - Only in multiples of 100 pcs per value

The Instructor 50

Desktop Computer from SIGNETICS

Complete, Ready-To-Use Microprocessor Learning Package

Includes everything you need to write, run and debug machine language programs. Housed in one compact package.

\$35000

ANCRONA

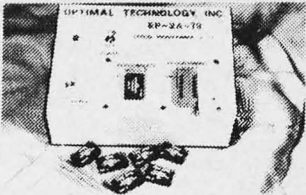
Send Check or Money Order to:
P.O. Box 2208Y, Culver City, CA 90230. California residents add 6% sales tax. Minimum Order: \$10.00. Add \$1.00 to cover postage and handling. Master Charge and Visa welcomed. Please include your charge card number, Interbank number and expiration date.

PHONE ORDERS (213) 641-4064

ARIZONA	CALIFORNIA	CALIFORNIA	OREGON
ANCRONA	ANCRONA	ANCRONA	ANCRONA
4518 E. Broadway Tucson, AZ 85711 (602) 881-2348	11080 Jefferson Blvd. Culver City, CA 90230 (213) 390-3595	1300 E. Edinger Ave. Santa Ana, CA 92705 (714) 547-8424	1125 N.E. 82nd Ave. Portland, OR 97220 (503) 254-5641

CANADA, B.C.	CALIFORNIA	GEORGIA	TEXAS
ANCRONA	ANCRONA	ANCRONA	ANCRONA
5656 Fraser St. Vancouver, B.C. V6M 2K2 (604) 324-0707	1054 E. El Camino Real Sunnyvale, CA 94087 (408) 243-4211	3330 Piedmont Rd. N.E. Atlanta, GA 30305 (404) 261-7100	2648 Richmond Houston, TX 77098 (713) 529-3488

EPROM PROGRAMMER



Software available for F-8, 6800, 8080, 8085, Z-80, 6502, KIM-1, 1802.

The EP-2A-79 will program the 2704, 2708, TMS 2708, 2758, 2716, TMS 2516, TMS 2716, TMS 2532, and 2732. PROM type is selected by a personality module which plugs into the front of the programmer. Power requirements are 115 VAC, 50/60 HZ at 15 watts. It is supplied with a 36-inch ribbon cable (14 pin plus) for connecting to microcomputer. Requires 1 1/2 I/O ports.

Assembled and tested \$145, Plus \$15-25 for each personality module. Specify software.

OPTIMAL TECHNOLOGY, INC.

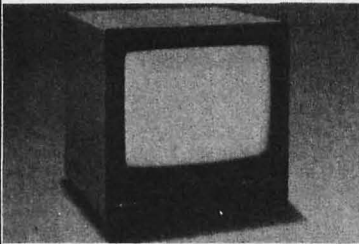
Blue Wood 127, Earlysville, Va. 22936
Phone 804-973-5482

Circle 289 on inquiry card.

-- CRT INTERFACES --

black - white/color

Monitors * Combination Rcvr/monitor sets
* Modulator kits * B-W Cameras * Color
Cameras * Audio Subcarrier kits * Parts



WRITE or PHONE for DETAILS & PRICING.

DIAL: 402-987-3771

Dealers welcomed. Well established program.

13-B
Broadway

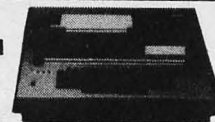
ATV Research

Dakota City,
NE. 68731

Circle 19 on inquiry card.

SURPLUS ELECTRONICS

ASCII



ASCII

IBM SELECTRIC[®]
BASED I/O TERMINAL
WITH ASCII CONVERSION
INSTALLED \$645.00

- Tape Drives • Cable
- Cassette Drives • Wire
- Power Supplies 12V15A, 12V25A, 5V35A Others, • Displays
- Cabinets • XFMRs • Heat Sinks • Printers • Components

Many other items
Write for free catalog
WORLDWIDE ELECT. INC.
130 NORTHEASTERN BLVD.
NASHUA, N.H. 03060
Phone orders accepted using VISA
or MC. Toll Free 1-800-258-1036
In N.H. 603-889-7661

Circle 395 on inquiry card.

RECYCLE(D) COMPUTERS

BUY ☆ SELL ☆ SWAP

Hardware & Software

NEW PRODUCT ANNOUNCEMENTS

22 pages

Mailed 1st Class every 3 Weeks

1 yr. (18 issues) ☆ \$3.75

ON_LINE



David Verette, Publisher Established 1973

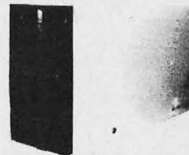
24695 Santa Cruz Hwy. • Los Gatos, CA 95030

THE BEST WAY TO DETERMINE IF ON LINE CAN BE OF VALUE TO YOU IS TO TRY A...

FREE SAMPLE ISSUE

Circle 288 on inquiry card.

TRS-80



TRS-80 Add-ons

- Floppy Drives
- Single Shugart or Pertec system
- \$ 395
- Dual Sided Floppy System..... 695
- RAM Memory 9.75
- 32K Expansion Interface 599
- RS232 Serial I/O (simplex) 79
- RS232 Serial I/O (duplex) 95

PERIPHERAL PRODUCTS

- Floppy Kit for SA801 (8") Floppy (S-100) 599
- Add-on Floppy Drives
- SA800 or Pertec (8") unused ... 469
- SA400 or Pertec (5") unused ... 285
- Centronics 779 w/Tractors 1179

Ask for Free Product Line Catalog
(714) 979-9923

MICROCOMPUTER TECHNOLOGY INC

2098 S. Grand Ave., Santa Ana, CA 92705

Circle 219 on inquiry card.

APPLE

SUPER SALE

16K Apple II \$1039.95

Apple Disk II
w/controller \$495.00
Apple Soft Cards \$149.95
Carrying Case \$29.95
Super Mod \$29.95

UCATAN CORP.
P.O. Box 1000
Destin, Fla. 32541

904-837-2022

Credit Cards Accepted

Circle 378 on inquiry card.

HAZELTINE 1400

only

\$649.95!



- Verbatim Mini Diskettes \$3.70 each (boxes of 10)
- Two-tier walnut formica enclosure for SA-400 Shugart... \$39.95
- Typewriter Ribbons (many makes such as Diablo, Centronics, DEC and print wheels)
- North Star check balancing program... \$50.00
- Centronics 779 tractor — \$1150.00
- Horizon II ass. — \$1999.00

Mail
Order
Only.

TORA SYSTEM INC.
29-02 23rd Avenue
Astoria NY 11105
(212) 932-3533

Circle 371 on inquiry card.

BYTE's New
Toll-free
Subscriber
W.A.T.S. Line
(800) 258-5485

To further improve service to our customers we have installed a toll-free WATS line in our Peterborough, New Hampshire office. If you would like to order a subscription to BYTE, or if you have a question related to a BYTE subscription, you are invited to call (800) 258-5485 between 8:30 AM and 4:30 PM Eastern Time. This applies to calls from within the continental US only.

We thank you and look forward to serving you.

SHORT CASSETTES



777 Palomar Ave. • Sunnyvale, CA 94086

Duplication Services

Microsette also offers professional duplication services for Commodore PET and Radio Shack TRS-80 Level I and Level II cassettes. Our service provides mastering, quality control, all material including two-piece box, affixing of your labels or supplying our blank labels and shipping. Prices start at \$2.00 each in 100 quantity.

MICROSETTE CO.
777 Palomar Ave. • Sunnyvale, CA 94086

Circle 229 on inquiry card.

Unclassified Ads

FOR SALE OR TRADE: Interdata Model 1 minicomputers. One complete and working, another lacking one board. 10 K core memory. \$400 or best offer. Gary Sawyer, 3952 Ash St, Irvine CA 92714, (714) 559-0243.

HELP: We have a SwTPC terminal (TV II) and would like to use it as a character generator for our TV studio. To do this, the terminal has to be synchronized externally. Can anyone send plans or ideas to do this by either stripping the present sync and adding the new, or by rebuilding portions of the terminal to accept external synchronization? Ken Pavlicek, Lyons Township High School, 4900 Willow Springs Rd, Western Springs IL 60558.

FOR SALE: TRS-80, LEVEL I, 4 K complete with video, power pack, cassette recorder, keyboard, original carton, manuals, and software. Perfect condition. I pay the freight. \$490. Mark Baiada, 271 Winding Ln, Cinnaminson NJ 08077. Call collect (609) 829-9310 after 6 PM.

FOR SALE: One Anderson Jacobsen 841 Terminal with 6 bit EBCO code 10 CPS. IBM Selectric keyboard. Good Condition. \$1000 FOB truck. Alan C Page, Green Diamond Forestry Service Inc, Blue Meadow Road, Belchertown MA 01007.

FOR SALE: 64 22 pin 3 level tin wire wrap sockets, \$8 per 16. 58 TMS-4060 4 K programmable memory chips, \$15 per 29 (bought surplus from Honeywell; never used but not guaranteed). Money order or cashier's check. James Phillips, 3435 N 75th Dr, Phoenix AZ 85033, (602) 849-6937.

FOR SALE: Heathkit H11 large scale integration computer with 4 K memory; serial and parallel interface, plus extended arithmetic chip. H10 paper reader/punch up and running and factory tested. Asking \$1900 and I will ship. Jim Thebeault, Rt 12 Box 94, Mansfield OH 44903, (419) 468-4700.

FOR SALE: Viatron Cassette decks, dual heads and motors, excellent foundation unit for mass storage system. Good documentation with all schematics. \$70 for pair or \$38 single units. Money order or certified check. Shipped post paid. V Caggia, 15 Lovell Dr, Wanaque NJ 07465, (201) 835-2477.

FOR SALE: SYM-1; new single board computer in original box with warranty. \$220. Carr, 13624 Neutron Rd, Dallas TX 75240.

FREE: Software and blank diskettes with the purchase of the minifloppy with the best cost/performance ratio available, the Micropolis Macrofloppy. Normally \$835 for drive, S-100 controller, cables, and blank diskettes new; the first check or money order over \$750 takes a factory assembled and tested system (only two months old and working beautifully, with the software and blanks added as a bonus). Contact David or Robert Mason, 503 Timber Ter, Houston TX 77024, (713) 681-3427 after 7 PM.

NEW UNCLASSIFIED POLICY

Readers who have equipment, software or other items to buy, sell or swap should send in a clearly typed notice to that effect. To be considered for publication, an advertisement must be clearly non-commercial, typed double spaced on plain white paper, contain 75 words or less, and include complete name and address information.

These notices are free of charge and will be printed one time only on a space available basis. Notices can be accepted from individuals or bona fide computer users clubs only. We can engage in no correspondence on these and your confirmation of placement is appearance in an issue of BYTE.

Please note that it may take three or four months for an ad to appear in the magazine. ■

FOR SALE: September 1975 thru September 1976 BYTE. Best offer over \$75, all other BYTES to date. Make offer, C Ernst, 215 E Costilla Av, Littleton CO 80122, (303) 794-5667.

FOR SALE: High quality terminal priced to sell, QUME (300Q), rebuilt and reconditioned ASCII, RS232, 55 characters per second, over 70 software commands, super graphics, still in warranty. \$2250. Pat Reynolds, 4903 Hirsch, Houston TX 77026, (713) 674-8367.

FOR SALE: IMSAI 4 K static, \$80. MITS 4 K dynamic, \$50. Tarbell cassette board, \$90. MITS ACR, \$70. MITS Disk drive with BASIC and FORTRAN, \$1300. MITS-Okidata printer with controller, \$1500. All boards fully socketed and factory checked out. Make an offer. K R Roberts, 10560 Main St, Suite 515, Fairfax VA 22030.

FOR SALE: Heath H8, 16 K memory, two H8-5s, cassette, extended BASIC; up and running. \$900 or best offer. Ten new 8 inch disks, make offer. Andy Thornburg, RR2, Thompsonville IL 62890, (618) 627-2166.

FOR SALE: 4 K programmable memory set (eight chips). I converted my 4 K Level II TRS-80 to 16 K. Make me an offer. Ron Urbassik, 13519 Carter Rd, Painesville OH 44077, (216) 254-4238.

CLEANING MY BASEMENT — Electronic components, computer, ham, and test equipment must go. Send stamped envelope for complete list. S V Sanislo, 42 Briarcliffe Rd, Glenolden PA 19036.

FOR TRADE: Famous 8080 FORTRAN MITS disk version for 8080 COBOL or MITS timesharing BASIC. Manuals available. K R Roberts, 10560 Main St, Suite 515, Fairfax VA 22030.

FOR SALE: Video display terminals; industrial quality display terminals with ASCII keyboard; 12.5 MHz display bandwidth; pictures available. Comes complete ready to plug in at \$215 plus shipping. Works great with S-100, Digital Group and other boards. Also available with other options such as 16 by 64 character generation logic, composite (TV) video input, or customized to your specifications. S Stoddard, 12 Kathy Dr, Poquoson VA 23662, (804) 868-7682.

FOR SALE: Technico TMS-9900 processor, 16 bit, with 2 K programmable memory, 2 K read only memory (monitor and Assembler), 2 K erasable programmable memory and programmer. Documentation, manuals and cables. Factory tested, never used. \$275. S J Huber, 318 Steven Ct, Benicia CA 94510, (707) 745-8089.

FOR SALE: 8 K PET commodore with second tape cassette unit, games, manuals, as new. \$695. John Clarke, 13609 Luscomb, Dunlap IL 61525, (309) 243-7584.

SACRIFICE: New Univac type 079 incremental printer. Still in packing crate. Adjustable 132 column tractor feed. 30 characters per second. Hinged top with glass window enclosure and stand. Mechanism alone cost \$1800. Three cases fanfold paper. \$575 plus shipping. Do not phone. Write for details and picture. David Krivoshik, 18 Newcomb Pl, Elizabeth NJ 07202.

FOR SALE: Issues number 1 through number 16 of BYTE magazine. Send offer; will reply to the best. R L Erickson 658B Mapleview Dr, Old Bridge NJ 08857.

DIGITAL USERS: Repair, trade, buy, and assemble Digital Group equipment. For more information, write: Michelle, POB 3009B, Boulder CO 80307.

FOR SALE: Heath H9 terminal fully assembled, checked out (by Heath), and operational, \$500. I will deliver to eastern MA or southern NH. Otherwise add shipping. Lawrence Woods, 12 Patten St, Watertown MA 02172.

FOR SALE: Two Shugart SA-400 Minifloppy disk drives; includes manual. \$275 each or both for \$500. J Lightsey, 339 Deer Trail Rd, Boulder CO 80302, (303) 443-7888.

FOR SALE: Two SSM 450 ns 8 K programmable memory boards, assembled and running, (S-100), \$80 each. One SSM 450 ns 4 K programmable memory board, assembled and running, (S-100), \$60. First money order or cashier's check takes it, all others returned. I pay shipping. Vance Navarette, 2057 S W Leewood Ln, Aloha OR 97005.

XITAN USERS: Information exchange group formed to facilitate finding each other and sharing our work. Send a short description of your applications and any hardware tips or software you wish to exchange or sell to Dr John R Cameron, POB 1517, Palo Alto CA 94301. Enclose \$3 if you wish to receive copies of others' offerings.

FOR SALE: Used computer equipment — three General Automation 16/220 computers, controllers; three GE Terminet 310 line printers; three Hazeltine 1500 video terminals; six Diablo Hy-Term Printers 1620-3. Relate best offer to Mr Ralph P Price, Sun Information Services, 656 E Swedesford Road, Wayne PA 19087, (215) 293-8242.

FOR SALE: PET 8 K. Reasonable offer considered. R White, 5752 N Milwaukee Av, Chicago IL 60646.

FOR SALE: New Noval 765 microcomputer system in a desk including dual Shugart 400 minifloppy drives, controller, Z-80 processor with 32 K programmable memory and 16 K read only memory, built-in 12 inch high resolution (256 by 256) graphics videoterminal, keyboard, and built-in 32 column dot matrix printer. System cost \$5990, asking \$3990. Included are seven programmed minifloppy diskettes plus operator's manuals with diskette operating system on read only memory, and Extended BASIC on diskette. Esther Robinson, 16689 Mt Cachuma Cir, Fountain Valley CA 92708, (714) 554-3914.

FOR SALE: Heathkit H-11 16 bit computer with 12 K memory and serial and parallel interfaces. Heathkit H-9 video terminal. Both fully assembled and tested. Needs only paper tape or floppy disk unit to complete system. Cannot complete — need money for graduate school tuition. Will sell at kit price. Fred Graefe, 309 Harrison Av, Roselle NJ 07203, (201) 245-4930.

FOR SALE: Complete KIM-1 System; BASIC board; 3 K programmable memory, 1 K erasable programmable memory, PIA I/O (input/output), video I/O, Hefty power supply, chassis, mother board, plug-in 44 connector boards, ASCII keyboard, cables. Extra 6502, PIA's available. \$225 or best offer. Bill Carlquist, 6253 Hollywood Blvd, Suite 202, Hollywood CA 90028, (213) 461-4643.

WANTED: TRS-80 computers wanted. Any condition, any quantity. Immediate cash. Also for sale: DEC PDP8 e, f, m; also all peripherals. K2DCY. POB 632; W Caldwell NJ 07006, (201) 226-9185.

FOR SALE: Processor Technology VDM-1, \$130 plus postage. KIM-4 mother board, \$85 plus postage. Bruce McIntire, 807 Bejay Pl, San Pedro CA 90731, (213) 831-1844.

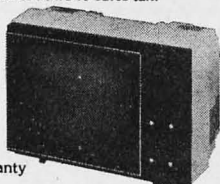
TRADE: Star Trek program, TRS-80 BASIC I or II, source code. Well tested and documented. Send your program to Daniel Napoli, 112 N Walnut St, Beacon NY 12508.

FOR SALE: Processor Technology (GPM) general purpose memory module with ALS-8, SIM-1 and TXT-2 read only memories. All in good working condition. Complete with hardware and ALS-8 manuals. \$275 or best offer. Joe Hartnett, 2323 N Woodlawn, Wichita KS 67220. ■

12" BLACK & WHITE LOW COST VIDEO TERMINAL

\$139.00 LIST

Add \$5 for shipping and handling
Texas residents add 5% sales tax.



One year
limited warranty

• Ideal for home, personal and business computer systems; surveillance monitors • 12" diagonal video monitor • Composite video input • Compatible with many computer systems • Solid-state circuitry for a stable & sharp picture • Video bandwidth—12 MHz \pm 3 dB • Input impedance—75 Ohms • Resolution—650 lines Minimum 1H Central 80% of CRT; 550 Lines Minimum beyond central 80% of CRT ref EIA RS-375 • Dimensions—11.375" high; 16.250" wide; 11.250" deep (exclude video input connector) • Weight—6.5 KG (14.3 lbs) net

Use Master Charge/Visa or send money order.

Micro Products Unlimited

P.O. Box 1525, Arlington, TX 76010
817/461-8043

Dealer inquiries welcome

Circle 224 on inquiry card.

Pascal Micro Engine \$2695.00

Discounts on

Xitan, Cromemco, SD Systems, Vector, TEI, North Star, Apple, Hytype II, Qume, Axiom, TI, Centronics, Integral Data Systems, Soroc, Lear Siegler, Intertec, Micromation, PerSci, Micropolis, SSM, Computalk, Heuristics, Mountain Hardware, Summagraphics,

MICRO MART

Microcomputers, Peripherals
and Software

1015 NAVARRO SAN ANTONIO, TEXAS 78205
512/222-1427

Circle 351 on inquiry card.

TRS-80 16K MEMORY EXPANSION KIT

INCLUDES 8 TESTED & GUARANTEED MSK 4116 3 16K RAMS.
PROGRAMMING PLUGS & EASY-TO-FOLLOW INSTRUCTIONS.

\$72.00 PER KIT

6800 64K BYTE RAM SET AND CONTROLLER CHIP SET

MAKE 64K BYTES OF MEMORY FOR YOUR
6800. THE CHIP SETS INCLUDE:

\$295.00
32 MSK 4116-3 16K RAMS.
1 MC3480L MEMORY CONTROLLER.
PER COMPLETE SET. 1 MC3242AP MEMORY ADDRESS
MULTIPLEXER/COUNTER.
DATA & APPLICATION SHEETS.
PARTS TESTED & GUARANTEED.

16K DYNAMIC RAMS
MSK 4116-3 200NSEC
ACCESS TIME/375NSEC
CYCLE TIME. TESTED &
BURNED-IN.
\$850 EACH/MIN. QTY. 8

4K STATIC RAMS
EQUIV. TO TMS4044-30
300NSEC ACCESS TIME/
CYCLE TIME FOR 4MHZ
Z-80 OPERATION.
\$750 EACH/MIN. QTY. 8
TESTED & GUARANTEED

QUANTITY DISCOUNTS AVAILABLE

ALL ORDERS POSTPAID. U.S. FUNDS. CHECK OR MONEY
ORDER. VISA, BA, MASTERCHARGE — SEND ACCOUNT NO.,
EXPIRATION DATE, INTERBANK NO., & SIGNED ORDER.
PHONE ORDERS: 714/633-4460

MEASUREMENT SYSTEMS & CONTROLS, INC.
MEMORY DEVICES DIVISION, DEPT. B3
867 NORTH MAIN ST., ORANGE, CA 92668

Circle 217 on inquiry card.

ROTATE - MANIPULATE CONTROL - MOVE - LIFT — ANIMATE ACTION GAMES —

Digital (STEP) Motors can be pro-
grammed any rate to 4 turns/sec.
at 7.5°/STEP

FEATURING THE IEEE 488 BUSS
DATA INTERFACE

Can you control 4 bits out? If so
use the DIRECT interface, save \$\$

THE
small Interface board 6" X 7" can
go inside your computer

variable rate manual over-ride
control buttons



DIRECT ASSEMBLED - TESTED \$ 95., WITH 488 \$149.

WRITE FOR DETAILS TO

X AND Y ENTERPRISES P.O. BOX 796
HUNTSVILLE, ALA. 35804

Circle 404 on inquiry card.

MICRO SOFTWARE DEVELOPMENT

THE COMPANY: Leader in auto-
matic test systems. Projected 1979
sales in excess of \$100 million.

RESPONSIBILITIES: Design/de-
velop assembly level test and diag-
nostic software using VLSI micro
hardware. Openings at entry and
senior levels. Higher level fluency,
hardware ability or degree a plus.

COMPENSATION: 17 - 27K. Excel-
lent benefits, flexible hours and
informal atmosphere.

CONTACT: Dave Adams, (617) 246-
2815. N.E. Recruiters, 6 Lakeside
Office Park, Wakefield, MA 01880.

Collect calls accepted. All fees,
interviewing and relocation expenses
assumed by the company.

WE SHIP FROM STOCK

TELETYPE MODEL 43	..... \$985.00
with RS 232	..... \$1,045.00
HAZELTINE 1500	..... \$945.00
M9900 MARINCHIP CPU	
Kit:	\$55.00 Assembled: \$700.00
PROM/RAM/SIO	
Kit:	\$275.00 Assembled: \$350.00
M9900 SYSTEM	
Assembled and Tested including: Tarbell Disk	
Controller, PerSci 277 Disk Drive & cabinet, IMS	
Static Ram 64 K, all in a TEI S-100 Bus	..... \$5,800.00
DEC LA-34 discount price	..... \$1,159.00
Further discount of 5% for early bird, pre-paid	
orders. Available for shipment in April.	
PASCAL MICROENGINE from Western Digital.	
List price \$2,995. 10% discount for early bird,	
pre-paid orders. Available for shipment in April.	
To Order: \$10 shipping for terminals. 24 hr.	
shipping upon receipt of certified check or	
money order. Personal checks: allow 10 days.	
Credit cards: 4% charge. NY residents add tax.	
— We Export —	
We have no reader inquiry number.	
Please call or write.	
John D. OWENS ASSOCIATES, Inc.	
147 NORWOOD AVENUE	
STATEN ISLAND, NEW YORK 10304	
Day, Evening, Weekend,	
Holiday Calls Welcome!	
(212)448-6283	(212)448-6298

VANGUARD 16K STATIC RAM

- Designed for IEEE S100 Bus Standards.
- Fully static and fully buffered.
- Configured as four 4K blocks within a 64K address space.
- Each block separately addressable and write-protectable.
- Components and assembly fully burned-in and tested.
- One year guarantee.

Assembled Kit Board

250 nsec chips \$340. \$300. \$35.
450 nsec chips \$300. \$260

Order direct by check, Visa or
Master Charge. California resi-
dents please add 6 1/2% tax.



Advanced Memory Technology
480 Mercury Drive, Sunnyvale, CA
(408) 736-3864 94086

Circle 4 on inquiry card.

Terminal Systems

is

Dealing /

ADM 3A



FOR THE BEST DEAL

Call!



TERMINAL SYSTEMS INC.

1000 HAYLAND STREET, NORTH HOLLYWOOD, CALIFORNIA 91605

(213) 769-6772

(714) 738-4444

(415) 537-7723

(800) 423-2449

Rely on US

Circle 367 on inquiry card.

NOW AVAILABLE PET AND SOL SOFTWARE IN BASIC

STATISTICS: Distribution \$ 5.95
Linear Correlation and Regression 5.95
Contingency Table Analysis 5.95
Mean and Deviation 5.95
all four for only 18.95

FINANCIAL: Depreciation 5.95
Loans 5.95
Investment 5.95
all three for only 12.95

GENERAL: Tic Tac Toe 4.95
Complete Metric Conversion 5.95
Checkbook Balancer 4.95
all three for only 10.95

FOR THE KIM-1

A real-time PROCESS CONTROL OPERATING SYSTEM
including a process language interpreter (operates in the 1k
KIM-1 RAM).
Assembly listing \$24.95
Cassette tape with users manual 14.95
Schematic for relay control board 9.95

All programs on high-quality cassette tape.
Send self-addressed, stamped envelope for complete software
catalogue.

Send check or money order to:

H. GELLER COMPUTER SYSTEMS

Dept. B, P. O. Box 350
NEW YORK, NEW YORK 10040

(New York State residents add 8% sales tax)

Circle 154 on inquiry card.

Reader Service

To get further information on the products advertised in BYTE, fill out the reader service card with your name and address. Then circle the appropriate numbers for the advertisers you select from the list. Add a 15 cent stamp to the card, then drop it in the mail. Not only do you gain information, but our advertisers are encouraged to use the marketplace provided by BYTE. This helps us bring you a bigger BYTE.

Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.
10	Aaron Associates 208	85	Cutting Edge of Technology 78	224	Micro Products Unltd 271	322	RCA 59
2	Administrative Systems 127	82	Cybernetic Micro Systems Inc 215	*	Micro Pro International 51	315	RNB Enterprises 89
1	Advanced Access Group 222	91	Data Discount Center 209	227	Micro-Puzzles 262	317	Real Time Intelligence 149
4	Advanced Memory Corp 271	81	Datafac System Inc 235	229	Microsette 269	374	Rochester Data 212
3	AJA Software 235	93	DataSearch 235	228	Micro Soft 101	318	Rockwell International 223
5	Aladdin Automation 35	89	Delta Products 135	225	Micro Source 145	329	Rothenberg Information Sys 165
6	Altos 29	88	Digital Engineering Inc 204	226	Microtronix 74	316	S-100 Inc 208
7	Amecom (Div of Litton) 133	86	Digital Pathways 206	211	Microware 226	*	Scientific Research 79
11	Ancrona 268	95	DRC (CA) 237	231	Micro Works 186	324	Seattle Computer Products 188
8	Ancrona 45	100	DRC (TX) 251	230	Mikos 260	323	Semionics 224
15	Apple Computer 5	110	Dynabyte 23	255	Morrow/Thinker Toys CIII, 19	319	Michael Shrayder Software 187
9	AP Products 53	115	Electrolabs 264	265	mpi 232	320	Shugart 6, 7
17	Artec Electronics 175	120	Electronic Control Tech 178	267	Mullen Computer Boards 217	327	Ed Smith's Software Works 231
19	ATV Research 269	125	Electronic Systems 252, 253	279	National Multiplex 207	328	Smoke Signal Broadcasting 64
30	Beckian Enterprises 260	130	Electronics Warehouse 247	*	NCC 79 197	321	Software 80, 189
33	BITS Inc 177	137	EMM/Semi Inc 227	281	NEECO 181	339	Software Development & Training Inc 209
35	BITS Inc 179, 180, 199	154	H Geller 271	282	NEECO 131	335	SSM 52
31	Business Application Services 231	150	Godbout Electronics 113	280	Netronics 225, 229	340	Solid State Sales 267
32	Buss/Charles Floto 232	151	GRT 203	*	N E Recruiters 271	342	Soroc Technology Inc 37
*	BYTE Back Issues 231	156	H & E Computronics 231	283	Newman Computer Exchange 257	350	Southwest Technical Products Corp CII
36	BYTE Books 109, 110, 111, 112, 213	157	Hamamatsu 183	285	North Star Computer 21, 31	352	Stirling Bekdorf 136
*	BYTE Subscribers 237	*	Hayden Book Publishers 210	284	NRI Schools/Elec Div 65	353	Structured Systems Group 106
*	BYTE WATS Line 269	160	Heath Company 61	286	OK Machine & Tool 87	358	Summagraphics 63
38	Cabot Computer Services Inc 180	170	Hobby World 246	287	Oliver Advanced Eng 216	354	Sunny International 254
37	California Computer Systems 24, 25, 27	172	HUH Electronics 233	288	On Line 269	356	Sybox Inc 137
39	California Digital 265	171	Industrial Micro Systems 121	289	Optimal Technology Inc 269	355	Synchro Sound 141
43	Canada Systems 218	178	Info 2000 147	291	Oregon Software 237	357	Talos Systems Inc 39
45	Central Data 159	173	Integral Data Systems 92, 93	292	Osborne & Associates 201	360	Tarbell Electronics 97
47	Chrislin Industries 132	179	Integrand 219	290	OSI CIV, 8, 9, 83	363	Technical Systems Consultants 171
49	Circle Enterprises 227	177	International Elec Equip 214	*	Owens Associates 271	366	Technology Transfer Inc 214
51	Computalk 216	174	Intertec Data Sys Corp 49	294	Pacific Digital 188	367	Terminal Systems 271
67	Computer Bus 211	190	Ithaca Audio 243	296	Pacific Office Systems 268	368	3/M Company 15
69	Computer Data Directory 71	*	Ithaca Audio 76, 77	297	PAIA Electronics Inc 220	364	3 S Sales Inc 205, 254
70	Computer Enterprises 129	197	J F Products 184	298	Page Digital 263	371	Tora System Limited 269
68	Computer Factory 126	195	Jade Co 248, 249	301	Per Com Data 54, 55	372	Trans Data 237
*	Computer Factory (NY) 153	200	Jameco Electronics 244, 245	302	Personal Software 168, 169	326	TRS-80 Software Exchange 128
72	Computer Lab of NJ 217	*	Lifboat Assoc 104, 105, 191	303	Pet Shack Software House 220	378	Ucatan 269
75	Computerland 42, 43	203	Mad Hatter Software 163, 209	304	Phoenix Digital 139	382	US Robotics 167
66	Computer Mart of NJ & PA 70	216	Measurement Sys & Controls 85	306	Pickles & Trout 233	383	Vamp 221
*	Computer Plus 212	217	Measurement Sys & Controls 271	307	Potomac Micro-Magic Inc 99	384	Verbatim Corp 17
73	Computer Tax Service 206	219	MicroComputer Technology 269	308	Potters Programs 262	386	*Video World 227
78	CT Micro Computer 215	222	Micro-Mail 190	312	Priority I 258, 259, 261	387	Wameco 264
79	CT Micro Computer 221	351	Micro Mart 271	305	Processor Technology 10, 11, 117	395	Worldwide Electronics 269
83	Contract Services 227	223	Micromation 40, 41	*	Program Design Inc 228	404	X & Y Enterprises 271
87	Control Systems Inc 75	204	Micro Mike's 218	313	Programmers Software Exchange 209	397	X Comp 213
76	Cover Craft 219	218	Micropi 235	309	PRS 103	400	Xitex 192
77	Creative Software 185	220	Micropolis 124	311	Quest Electronics 255	401	Xitex 193
80	Cromemco 1, 2	221	Micropolis 125	314	Radio Shack Authorized Sales Ctr 262		

*Correspond directly with Company

BOMB— BYTE's Ongoing Monitor Box

Article No.	ARTICLE	PAGE
1	Poduska: Building the Heath H8 Computer	12
2	Melton: A Map of the TMS-9900 Instruction Space	14
3	Klein: Files on Parade	32
4	Ritter, Boney: A Microprocessor for the Revolution	46
5	Costas: Cryptography in the Field	56
6	Meushaw: The Standard Data Encryption Algorithm	66
7	Rampil: Preview of the Z-8000	80
8	Lamkins: Designing with Double Sided Printed Circuit Boards	94
9	Filo: Designing a Robot from Nature	114
10	Giacomo: A Stepping Motor Primer	142
11	Ciarcia: Build a Computer Controlled Security System for Your Home	150
12	Higgins: Common Mistakes Using Warnier-Orr Diagrams	170
13	Kreindler: Password Protection for Your Computer	194
14	Arp: The Power of the HP-67 Programmable Calculator	196
15	Atkins: What Is an Interrupt?	230
16	Reid-Green: History of Computers	238

A Lively Bomb Response

The first and second place winners of the December 1978 BOMB were "Some Facts of Life" by David J Buckingham (page 54) and "Life With Your Computer" by Justin Millium, Judy Reardon, and Peter Smart (page 45). These articles placed 2.17 and 1.21 standard deviations above the mean. First and second prizes of \$100 and \$50 will be sent to the authors.

Third place went to "Fast Fourier Transforms on Your Home Computer" by William D Stanley and Steven J Peterson (page 14), followed by "Chess 4.7 versus David Levy" by J R Douglas (page 84).■

DOUBLE DENSITY



SOLID SAVINGS!

Now you can put your S-100 system solidly into a full-size, single/double density, 600K bytes/side disk memory for just \$1149 complete.

DISCUS/2D™ single/double density disk memory from Thinker Toys™ is fully equipped, fully assembled, and fully guaranteed to perform perfectly.

DISCUS/2D™ is a second generation disk memory system that's compatible with the new IBM System 34 format. The disk drive is a full-size Shugart 800R, the standard of reliability and performance in disk drives. It's delivered in a handsome cabinet with built-in power supply.

The S-100 controller utilizes the amazing Western Digital 1791 dual-density controller chip . . . plus power-on jump circuitry, 1K of RAM, 1K of ROM with built-in monitor, and a hardware UART to make I/O interfacing a snap.

The DISCUS/2D™ system is fully integrated with innovations by designer/inventor George Morrow. Software includes BASIC-V™ virtual disk BASIC,

DOS, and DISK-ATE™ assembler/editor. Patches for CP/M* are also included. CP/M*; MicroSoft Disk BASIC and FORTRAN are also available at extra cost.

DISCUS/2D™ is the really solid single/double density disk system you've been waiting for. We can deliver it now for just \$1149. And for just \$795 apiece, you can add up to 3 additional Shugart drives to your system. Both the hardware and software are ready when you are.

Ask your local computer store to order the DISCUS/2D™ for you. Or, if unavailable locally, write Thinker Toys™ 1201 10th St., Berkeley CA 94710. Or call (415) 524-2101 weekdays, 10-5 Pacific Time. (FOB Berkeley. Cal. res. add tax.)

*CP/M is a trademark of Digital Research.

Circle 255 on inquiry card.



Morrow makes disk memory for

Thinker Toys™

The Microcomputers you should take seriously.

The C3 Series is the microcomputer family with the hardware features, high level software and application programs that serious users in business and industry demand from a computer system, no matter what its size.

Since its introduction in August, 1977, the C3 has become one of the most successful microcomputer systems in small business, educational and industrial development applications. Thousands of C3's have been delivered and today hundreds of demonstrator units are set up at systems dealers around the country.

Now the C3 systems offer features which make their performance comparable with today's most powerful mini-base systems. Some of these features are:

Three processors today, more tomorrow.

The C3 Series is the only computer system with the three most popular processors — the 6502A, 68B00 and Z-80. This allows you to take maximum advantage of the Ohio Scientific software library and the tremendous number of programs offered by independent suppliers and publishers. And all C3's have provisions for the next generation of 16 bit micros via their 16 bit data BUS, 20 address bits, and unused processor select codes. This means you'll be able to plug a CPU expander card with two or more 16 bit micros right in to your existing C3 computer.

Systems Software for three processors.

Five DOS options including development, end user, and virtual data file single user systems, real time, time share, and networkable multi-user systems.

The three most popular computer languages including three types of BASIC

plus FORTRAN and COBOL with more languages on the way. And, of course, complete assembler, editor, debugger and run time packages for each of the system's microprocessors.

Applications Software for Small Business Users.

Ready made factory supported small business software including Accounts Receivable, Payables, Cash Receipts, Disbursements, General Ledger, Balance Sheet, P & L Statements, Payroll, Personnel files, Inventory and Order Entry as stand alone packages or integrated systems. A complete word processor system with full editing and output formatting including justification, proportional spacing and hyphenation that can compete directly with dedicated word processor systems.

There are specialized applications packages for specific businesses, plus the vast general library of standard BASIC, FORTRAN and COBOL software.

OS-DMS, the new software star.

Ohio Scientific has developed a remarkable new Information Management system which provides end user

intelligence far beyond what you would expect from even the most powerful mini-systems. Basically, it allows end users to store any collection of information under a Data Base Manager and then instantly obtain information, lists, reports, statistical analysis and even answers to conventional "English" questions pertinent to information in the Data Base. OS-DMS allows many applications to be computerized without any programming!

The new "GT" option heralds the new era of sub-microsecond microcomputers.

Ohio Scientific now offers the 6502C microprocessor with 150 nanosecond main memory as the GT option on all C3 Series products. This system performs a memory to register ADD in 600 nanoseconds and a JUMP (65K byte range) in 900 nanoseconds. The system performs an average of 1.5 million instructions per second executing typical end user applications software (and that's a mix of 8, 16 and 24 bit instructions!).

Mini-system Expansion Ability.

C3 systems offer the greatest expansion capability in the microcomputer industry, including a full line of over 40 expansion accessories. The maximum configuration is 768K bytes RAM, four 80 million byte Winchester hard disks, 16 communications ports, real time clock, line printer, word processing printer and numerous control interfaces.

Prices you have to take seriously.

The C3 systems have phenomenal performance-to-cost ratios. The C3-S1 with 32K static RAM, dual 8" floppies, RS-232 port, BASIC and DOS has a suggested retail price of under \$3600. 80 megabyte disk based systems start at under \$12,000. Our OS-CP/M software package with BASIC, FORTRAN and COBOL is only \$600. The OS-DMS nucleus package has a suggested retail price of only \$300, and other options are comparably priced.

To get the full story on the C3 systems and what they can do for you, contact your local Ohio Scientific dealer or call the factory at (216) 562-3101.

C3-B wins Award of Merit at WESCON '78 as the outstanding microcomputer application for Small Business.

The C3 Series from Ohio Scientific.

Circle 290 on inquiry card.

C3-B

C3-S1

C3-OEM

OHIO SCIENTIFIC
1333 S. Chillicothe Road • Aurora, Ohio 44202