

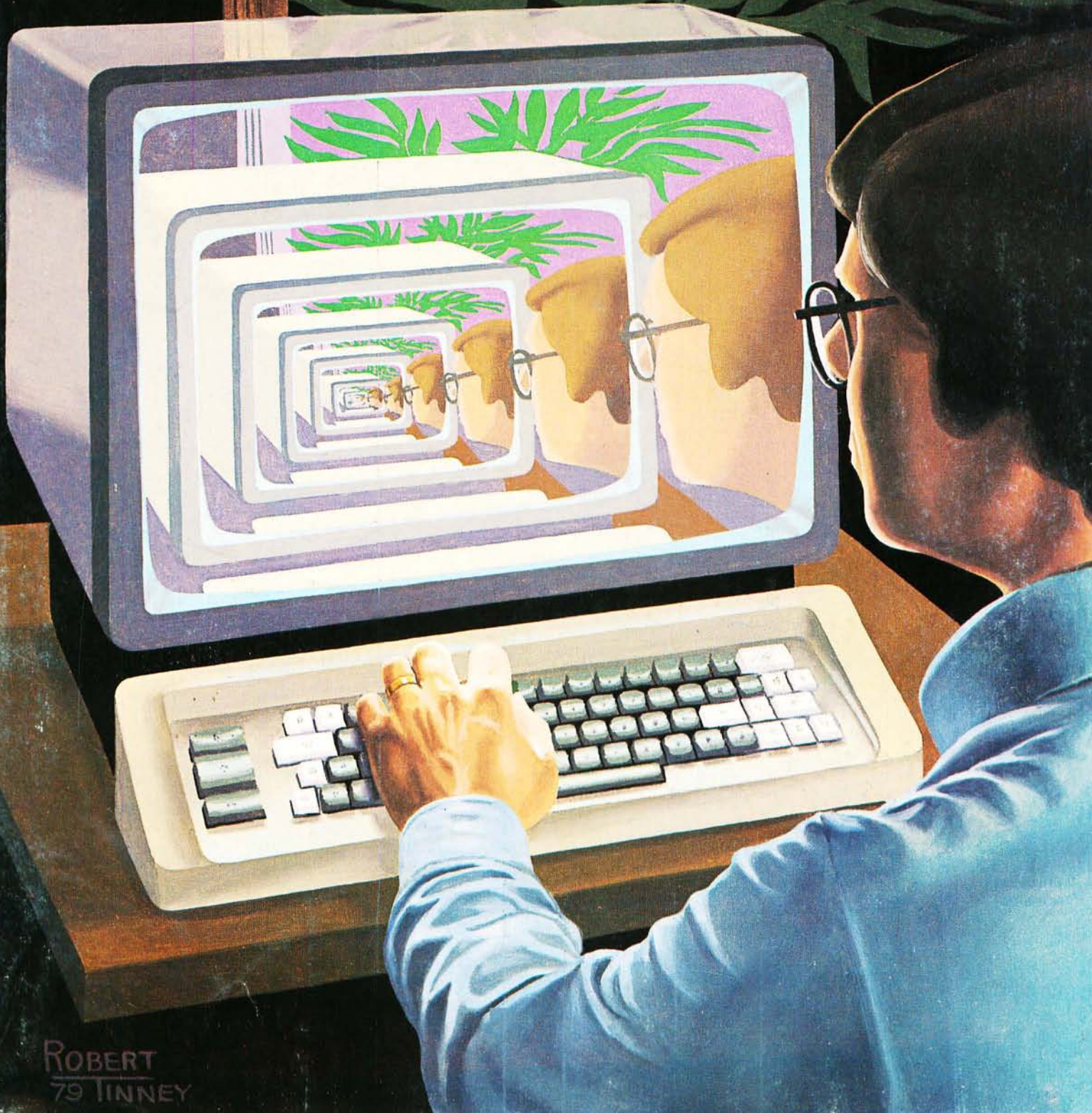
APRIL 1979

Volume 4, Number 4

\$2.00 in USA/\$2.40 in Canada

# BYTE

the small systems journal



ROBERT  
79 TINNEY





## 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.





# 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 ½ 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.

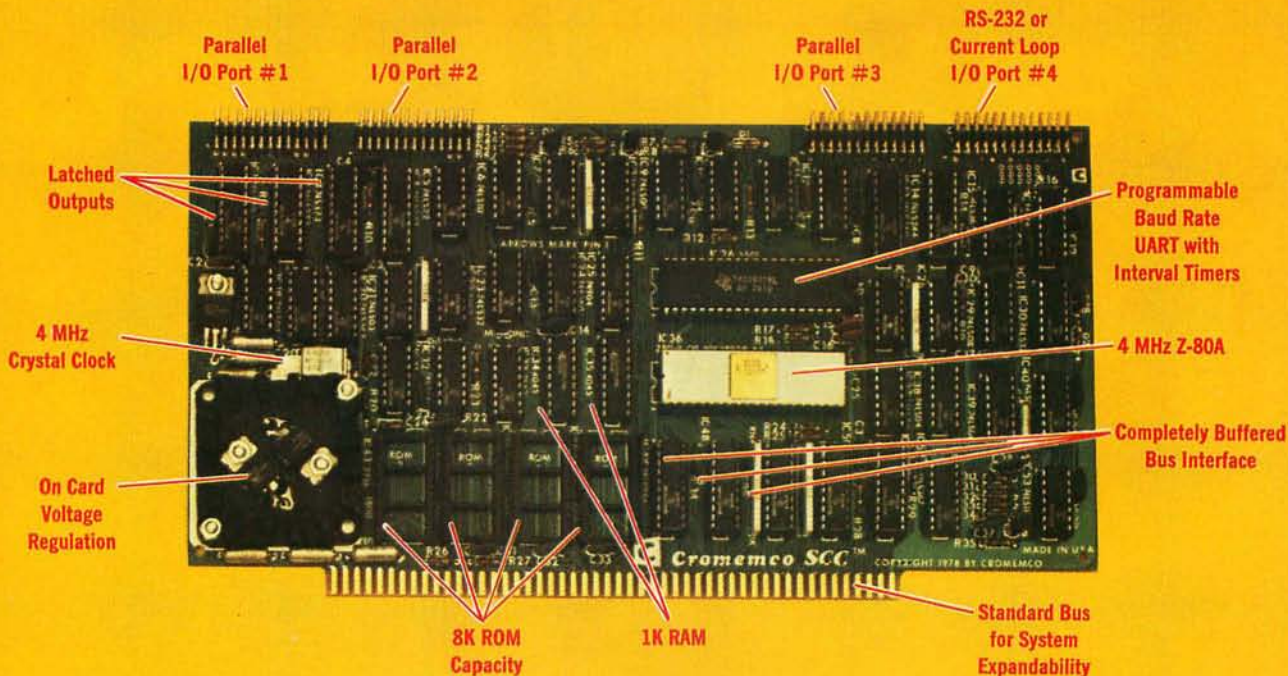


**Cromemco**  
i n c o r p o r a t e d

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.

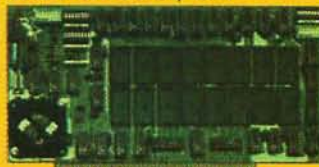
Add to that vectored interrupts.

## 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



## Foreground

- 10 THE TOY STORE BEGINS AT HOME, *by Steve Ciarcia*  
Build a challenging musical game in BASIC
- 26 SIMULATING PHYSICAL SYSTEMS, The Two-Dimensional Ideal Gas, *by Mark Zimmermann*  
Experiment with physical models on your computer
- 46 SOURCES OF NUMERICAL ERROR, *by Daniel R Buskirk*  
Learn how to control errors from rounding and truncating
- 84 MARSPOUT: The Three-Dimensional Celestial Mechanics Simulation for the HP 67/97, *by D D Hinrichs*  
Pilot a spaceship to a soft landing on the Martian surface
- 110 STANDARD DATA ENCRYPTION ALGORITHM, Part 2: Implementing the Algorithm, *by R V Meushaw*  
The Standard Data Encryption Algorithm on a KIM-1 computer. Part 2 of two parts.
- 132 QUEUING THEORY, Part 1: Queue Representation, *by Len Gorney*  
Waiting lines are so important that an entire area of mathematics is devoted to their study
- 176 THE POWER OF THE HP-67 PROGRAMMABLE CALCULATOR, Part 2, *by Robert C Arp, Jr*  
An example solution of simultaneous equations

## Background

- 20 CROSS-POLLINATING THE APPLE II, *by Richard Campbell*  
Add an Intel 8251 programmable communications interface
- 54 SMART MEMORY, Part 1, *by Randy C Smith*  
The concept of associative ("smart") memory is discussed
- 66 A SIMULATED VIEW OF THE GALAXY, *by Mark Dahmke*  
Viewing constellations from other parts of the galaxy, and related matters
- 144 CRYPTOGRAPHY IN THE FIELD, Part 2: Using the Pocket Calculator, *by John P Costas*  
Using a pocket calculator to implement a field cipher
- 166 LIFE CAN BE EASY, *by Randy Soderstrom*  
A simple implementation of Life
- 170 AN EASY WAY TO CALCULATE SINES AND COSINES, *by Robert Grappel*  
Relative sine and cosine values in one byte
- 210 AN INTRODUCTION TO MICROPROGRAMMING, *by Ben E Cline*  
The fundamental level of control
- 218 A DIGITAL ALPHANUMERIC DISPLAY, *by Daniel Chester*  
A 7 segment display
- 224 MICROCOMPUTER TIMESHARING: A Review of the Techniques, *by Kenneth J Johnson*  
Designing multiuser systems
- 236 A BINARY GUESSING GAME, *by Mark Zimmermann and James Blodgett*  
Calculator pattern recognition

## Nucleus

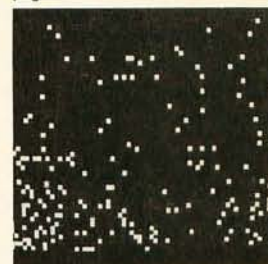
- |              |  |     |  |
|--------------|--|-----|--|
| 4            | In This BYTE                                   | 193 | BYTE News                                    |
| 6            | Editorial: On the Importance of Backups        | 202 | Event Queue                                  |
| 8            | Letters  | 204 | Clubs and Newsletters                        |
| 42           | Book Reviews                                   | 222 | Programming Quickies: Label and File Program |
| 50, 247      | Technical Forum                                | 238 | Languages Forum                              |
| 53, 192, 201 | BYTE's Bugs                                    | 249 | What's New?                                  |
| 64, 175, 221 | BYTE's Bits                                    | 278 | Unclassified Ads                             |
| 172          | Desk Top Wonders: Digital Circuit Simulation   | 280 | BOMB   |
| 190          | Nybbles: BASIC Cross-Reference Table Generator | 280 | Reader Service                               |



page 10



page 20



page 26



page 66

Cover Art:  
INFINITE REGRESSION  
*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 \$18 for one year, \$32 for two years, and \$46 for three years in the USA and its possessions. In Canada and Mexico, \$20 for one year, \$36 for two years, \$52 for three years. \$32 for one year air delivery to Europe. \$32 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.



# In this BYTE

This month's cover painting by Robert Tinney is called "Infinite Regression"—an appropriate way to introduce you to several articles in this issue dealing with computer simulation.

The term "simulation" can have a bewildering variety of meanings; we have restricted ourselves herein to simulations of galaxy projections, digital circuits, celestial mechanics, and an ideal two-dimensional gas — all using your personal computer or programmable calculator.

By adding special controls to a microcomputer, a user can input special information or information in particular forms. The addition of four switches and four colored lights allows your computer to play a memory game such as the ones found in department stores. Steve Ciarcia tells how **The Toy Store Begins at Home.** *page 10*

There is more than one way to peel an Apple, or in this case to interface an Apple II. Richard Campbell gets to the core of the problem in **Cross-Pollinating the Apple II.** *page 20*

One fascinating use of a computer is performing experiments quickly and easily. The experimenter can define properties and change parameters in a program rather than having to rebuild equipment. Mark Zimmermann discusses **Simulation of Physical Systems, specifically The Two-Dimensional Ideal Gas.** *page 26*

An important area of numerical calculations is the control of errors: rounding errors, truncation errors, and so on. Daniel R Buskirk has some comments on this very necessary study in **Sources of Numerical Error.** *page 46*

Wouldn't it be nice to have a type of memory in your computer that would answer questions such as, "Which of my employees are over 35 and make more than \$20,000?" Such a memory is known as an associative memory. Randy Smith introduces us to the world of Smart Memory in part 1 of this 2 part series. *page 54*

Have you ever wondered what our galaxy looks like from one million light years away? Perhaps you want to study the formation of the Andromeda galaxy or incorporate a known star cluster into a space war game. In either case you'll want to have **A Simulated View of the Galaxy** as discussed by Mark Dahmke. *page 66*

Delmer D Hinrichs presents a combination three-dimensional Mars lander and introduction to celestial mechanics in **Marsport Here I Come: The Three-Dimensional Celestial Mechanics Simulation for the HP 67/97.** *page 84*

The Standard Data Encryption Algorithm by Robert V Meushaw discusses its implementation on the basic KIM-1 system. A detailed description of the algorithm and generalized flowcharts are also given. *page 110*

In everyday life we wait in lines before we can do particular things. The same happens with computers. The study of waiting, called **Queueing Theory**, and how computers handle the situation is discussed by Len Gorney. *page 132*

The pocket calculator can be used to encipher and decipher messages. John Costas provides us with working examples of **Cryptography in the Field, Part 2: Using the Pocket Calculator.** *page 144*

Randy Soderstrom provides a quick and simple Life program for the 8080 in his article **Life Can Be Easy.** *page 166*

When working with trigonometric quantities, it is not always necessary to arrive at the precise value. Often a relationship between the desired value and the entire range of allowable values is sufficient. Robert Grappel discusses such an implementation in **An Easy Way to Calculate Sines and Cosines.** *page 170*

In **The Power of the HP-67 Programmable Calculator, Part 2**, Robert C Arp Jr concludes his discussion of the HP-67 with a practical applications program for solving simultaneous equations. *page 176*

The ability to microprogram a processor increases the power and usefulness of that processor to a particular user. Microprogramming allows one machine to appear as several different processors while using the same hardware. Ben E Cline gives us **An Introduction to Microprogramming** and shows how it can be used. *page 210*

Could you use a pocket-size alphanumeric terminal? One of the main problems with this type of device is the size of the video screen used for output. By using 7 segment displays, Daniel Chester has thought of a way to make **A Digital Alphanumeric Display.** *page 218*

Is it practical to use microcomputers for timesharing? In **Microcomputer Timesharing**, Kenneth J Johnson reviews some of the techniques developed for large computers with an eye toward utilizing them on a microcomputer. *page 224*

Artificial intelligence (AI) on a programmable calculator? Why not? **A Binary Guessing Game** shows you how. Authors Mark Zimmermann and James Blodgett describe a pattern recognition algorithm that tries to outguess the operator, often with remarkable success. *page 236*

## 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 Editors

David William Hayward  
Ann Graves  
**Art Director**  
Ellen Bingham  
**Production Art**  
Wai Chiu Li  
Christine Dixon  
**Typographers**  
Cheryl A Hurd  
Stephen Kruse  
Debe L Wheeler

## Advertising Director

Patricia E Burgess  
**Assistant**  
Ruth M Walsh  
**Adv/Prod Coordinator**  
Thomas Harvey  
**Advertising Billing**  
Noreen Bardsley  
Don Bardsley

## Receptionist

Jacqueline Earnshaw

## Circulation Manager

Gregory Spitzfaden  
**Assistants**  
Pamela R Heaslip  
Agnese E Perry  
Melanie Bertoni  
**Dealer Sales**  
Ginnie F Boudrieau  
Anne M Baldwin

## Traffic Department

Rick Fuetta  
Mark Sandagata

## Book Division:

**Publisher**  
Edmond C Kelly Jr  
**Production Editors**  
Patricia Curran  
William Hurlin  
E S Associates

## 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

## Printing

The George Banta Company

## Drafting

Techart Associates

## Typography

Goodway Graphics

## Photography

Ed Crabtree

## Editorial Associate

Daniel Fylstra  
**Associates**  
Walter Banks  
Steve Ciarcia  
David Fylstra  
Ira Rampill

## 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 VOX 1A0



# 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** <sup>T.M.</sup>  
10260 Bandley Dr., Cupertino, CA 95014



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

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

**Apple Computer**  
10260 Bandlely 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

 **Shugart**

# Editorial

## On the Importance of Backups

by Carl Helmers

The other day I had a problem using my computer system which many readers may have had. The lesson to be learned from my experience forms the subject of this essay.

This problem is one of zapping the file structure of a disk. Sooner or later everyone who uses a small computer system will encounter a similar situation. One could be tempted to think, naively, that such problems are limited to large computer systems with large sensitive flying head disk media, but this is by no means the case. Floppy disks can be logically zapped just as easily.

I, like many of our readers with systems, have not been letting my system lie idle in the house. In the years since starting this publication with my associates in 1975, I have been suffering withdrawal symptoms from big computers and associated time sharing software. In my case it was everyone's favorite target of criticism, TSO running on a large IBM 360 system. Well, finally small computers got to the point where they could support my style of language, Pascal. Last summer, I bought the Northwest Microcomputer Systems model 85/P with UCSD Pascal as its operating system, filing system, editor and high level language package.

(An aside: at present, the options are hardly limited to the 85/P as many other small computer manufacturers have begun offering versions of this excellent software; at present one can get it on machines ranging from a dual mini-floppy Apple II or North Star Horizon, to machines with full size floppies like my 85/P, or the Cromemco system we are using at BYTE as an editorial computer, to the most exotic of all Pascal machines, the Western Digital "Pascal Micro Engine" which directly executes the p-code intermediate output of the UCSD compiler. Recent word from Apple has it that the UCSD Pascal system *with* full Turtle graphics will be available in June of this year for approximately \$400 hardware and software cost. The hardware consists of a special 16 K programmable memory card added to a 48 K Apple II with single or dual disks. The software is the complete UCSD system of editor, file system, Pascal compiler and utilities.)

Recently I have been writing my editorials for BYTE using the excellent screen oriented editor program of the UCSD system. I have been learning Pascal so that I can make it my principal software development tool. I have been learning the details of using Pascal as a significant hardware oriented programming aid, a limited function with the 85/P but one which will blossom to full fruition when I get the Pascal microengine sometime in the coming months.

All this is but a prelude. I have also learned anew the opportunities for making foolish mistakes. One of the most foolish is that of not periodically backing up files against possible losses. The losses I refer to can stem from numerous causes.

We all, quite naturally, assume that the systems software is perfect, but there is that nagging 1 percent of doubt that everyone has. So even if we had perfect media, it would be necessary to back up files by copying from one disk to another as insurance against software failure. But that is hardly the major problem.

Continued on page 196.



# "My 8 to 5 minifloppy™ now works nights and weekends!"




"I own a fast-growing business and before I bought my computer system I put in a lot of late hours keeping up with my accounting and inventory control. Now the computer does my number crunching quickly, so I have time after hours to have some fun with the system. My son and I started out playing Star Trek on the system, and now we're learning to play chess.

"When I was shopping around for my system, the guys in the computer stores demonstrated all the unique features of the minifloppy. I've got to admit that at first I didn't really understand all the technical details. But now that I use the system every day, I really appreciate the minifloppy's fast random access and data transfer. I like the reliability, too.

"I'm glad I went with Shugart drives. Look, when you lay out your own money for a system, you want dependable performance and good value. Do what I did. Ask for the system with the minifloppy."

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

 Shugart Associates

435 Oakmead Parkway, Sunnyvale, California 94086

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

™ minifloppy is a registered trademark of Shugart Associates



# Letters

## SUCCESSFUL TRANSFORMATION

I thoroughly enjoyed the article "Fast Fourier Transforms on Your Home Computer," by William D Stanley and Steven J Peterson (December 1978 BYTE, page 14). I have the program running on Radio Shack TRS-80 disk BASIC. I also tried the BASIC code in "Tic-Tac-Toe in BASIC" (December 1978 BYTE, page 174). It would be helpful if Mike Stoddard, the author, had explained the characteristics of his source machine. I spent some time converting the "215" enclosed in backslashes to CHR\$(215) for formatting purposes.

I enjoy your magazine and use it regularly. Keep it up.

Joseph X Brennan  
POB 302  
Upland CA 91786

Another problem with "Tic-Tac-Toe in BASIC" was the accidental omission of program lines 2590 through 3080. The missing lines were printed in the "BYTE's Bugs" section of the February 1979 BYTE, page 43. . . .CH.

## MAKING CENTS

Being an avid reader of BYTE I have received many helpful hints about how to use my computer more efficiently. I have enclosed a simple program that puts dollars and cents into business programs.

A lot of small businesses need calculated results in a print out in the form of at least two digits, complete with 0s after the decimal point (eg: "\$2.00"). Most systems automatically eliminate trailing 0s. The enclosed program can be used as a subroutine to perform this task. The variable must be made equal to X previous to using the subroutine.

As you can see, the program returns even if there is no need to add 0s. Several small businesses are using this simple answer to the zero problem.

```

1000 C=0
1010 LET A$=STR$(X)
1020 LET I=LEN(A$)
1030 LET H=I-1
1040 IF X=INT(X) THEN PRINT
      MID$(A$,1,H); ".00": RETURN
1050 FOR A=1 TO 9
1060 LET B=C+.1
1070 IF X=INT(X)+B THEN PRINT
      MID$(A$,1,H); ".0": RETURN
1080 LET C=B
1090 NEXT A
1100 PRINT A$
1110 RETURN
  
```

James Thebeault, Sr  
Rte 12 POB 94  
Mansfield OH 44903

## DIGICAST DATA

I just read Mr Halsema's article, "The Digicast System: Receiving Data and Information over your FM Radio" (January 1979 BYTE, page 100) and I noted a few technical deficiencies in his description of an FM station's signal spectrum.

Mr Halsema describes the L-R difference signal centered around 38 KHz as the pilot carrier. In actual practice, the station transmits a 19 KHz ( $\pm 2$  Hz) stereo pilot tone at 8 to 10 percent modulation. This is the synchronizing signal used by the receiver in demodulating the L+R and L-R signals into discrete L and R channels.

In FM broadcasting, the 75 KHz deviation Mr Halsema refers to is the 100 percent modulation point. We could get into modulation index and other parameters, but the BYTE letters column is not the place for this. Suffice it to say that "high fidelity music" transmission is not restricted by the current modulation limits.

Two factors that may limit the growth of digicasting in metropolitan areas are present. Assuming that the 67 KHz SCA (Subsidiary Communications Authorization) signal is used for digicasting, the first factor is the "loudness" game that many stations get caught up in in the quest for larger market shares. The 19 KHz pilot eats up 10 percent of the modulation capability. The 67 KHz SCA signal eats up another 10 percent of the modulation capability. This leaves a maximum of 80 percent modulation capability for your main carrier program material. While this is only a 1 db to 2 db decrease in "loudness" compared to a nonSCA or a mono station, there are many programming and time sales people who believe that they need to be the loudest station on the dial. The second factor is that some major market broadcasters subscribe to music syndication services. Some of these services (notably Jim Schulke's SRP service) have been known to write clauses into their contracts that forbid the subscribing station from using an SCA signal.

As a sidenote, two years ago while I was still in broadcast engineering, I was contacted by an outfit called Cables & Wireless Ltd. They were looking for an SCA signal to use for electronic message (or mail) service. My station was under a "no SCA signal" clause with a music syndicator and I had to turn them down, but recently *Computer Decisions* magazine published an article on electronic mail that briefly discussed the Cables & Wireless Ltd system.

I look forward to digicasting with great anticipation but I fear that it will become mired in the infinite jungle of federal regulations.

Noel M Moss  
UniCard

1034 S Brentwood Blvd  
St Louis MO 63117

Continued on page 206.

## ComputerLand®

ALABAMA	
Huntsville	(205) 539-1200
ARIZONA	
Phoenix	(602) 956-5727
ARKANSAS	
Little Rock	(501) 224-4508
CALIFORNIA	
Belmont	(415) 595-4232
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	(213) 449-3205
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
Wainut Creek	(415) 935-6502
COLORADO	
Colorado Springs	(303) 574-4150
Denver	(303) 759-4685
CONNECTICUT	
Fairfield	(203) 255-9252
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
Mundelein	Call Directory Assistance
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
South West 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.	
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







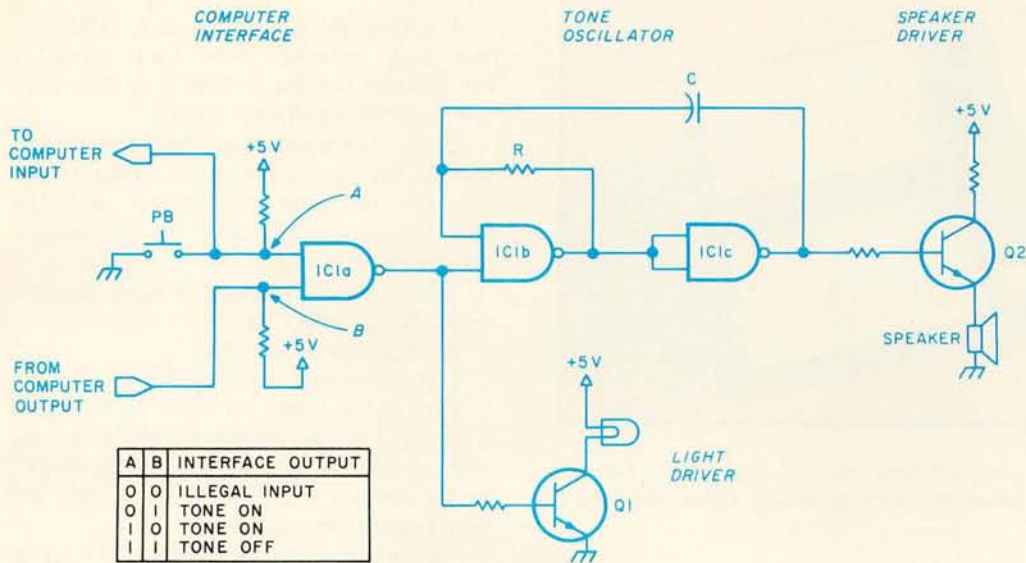


Figure 1b: Details of the circuit in figure 1a, showing one of the four light and sound generating sections.

Steve Ciarcia  
POB 582  
Glastonbury CT 06033

"Mister? Mister?"

A little boy was tugging on my sleeve. It startled me that in today's sophisticated society anyone would attempt to attract my attention by such an obvious, though effective, means. Impatient and undaunted by the scowl I flashed in his direction, he said, "Mister? Do you know where the toy department is?"

I have never acquired what some people call the ability to commune with children. Perplexed therefore as to the presentation of a proper reply, I considered an indignant, wave-of-the-hand dismissal of "Over there, kid." On the other hand, should I consider a character reversal with a Santa Claus imitation and invite the young man to hop up on my shoulder while we looked over the store directory together? The latter seemed hardly my style and the former was much too harsh even considering his still firm attachment to my sleeve.

"Mister? Mister?"

The delay only heightened his fervor.

I looked up and found myself staring straight at the shirt pocket button of a very large man. Instantly I calculated that this male figure dressed in jeans, heavy boots and a woolen shirt was a foot taller than I.

His relationship with the boy was quickly clarified as he said in a deep paternal voice, "Come on Brucie, I think it's over there where that crowd is." I waited for Paul Bunyan and son to be safely on their way before I made my next move.

Stark reality returned, however, when I remembered that I, too, was looking for the toy department. It verges on humiliation actually. Why do they have to categorize everything? Just because an item is manufactured by a toy company doesn't immediately classify it as a toy. I mean, big people have constructive leisure time manipulatives and little people have toys. Department stores should realize the embarrassment of crossing this line and have an "amusements for the sophisticated" department and a "toys for tots" department.

Finding the toy department was no problem. I simply stood where I was and slowly rotated 360°. The noise peaked at about 160° SSE and I cautiously proceeded in that direction. The noise in my immediate vicinity became sharply amplified as two young boys raced by, carrying some unidentifiable toy devices.

I spied my objective ahead — the electronic games counter. I got into line between two youngsters and their parents. Were these PG or R rated games? I saw no parents with the kids playing basketball in the next aisle. Perhaps the cost of computerized games warranted closer parental scrutiny. \$5 for a hockey stick is one thing, but \$50 for a talking plastic robot is another. All the games at this counter incorporated microprocessors as their intelligence. Some simulated war games

Copyright © 1979 by Steven A Ciarcia. All rights reserved.



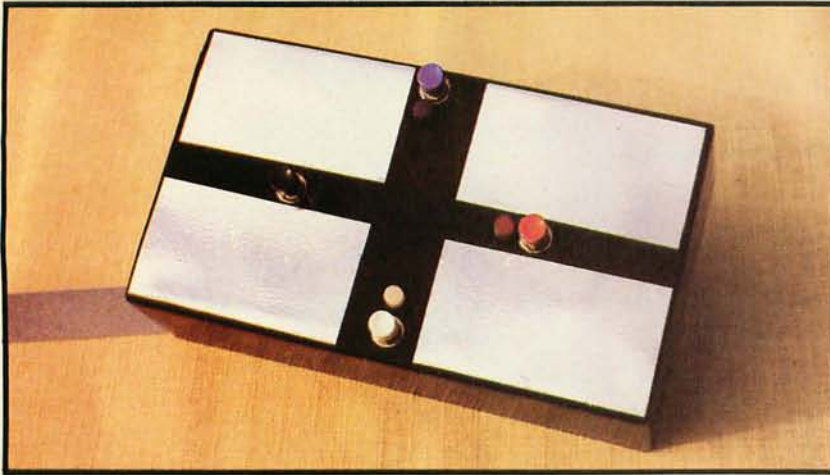


Photo 1: Player console for the computerized musical tone game. Players attempt to repeat a sequence of tones and corresponding lights chosen by the computer at random.

and produced authentic battle sounds while others proved to be formidable challengers in games of chance.

I looked through the products in the case, hoping to spot the one I so desperately wanted. Would this be another store that was completely sold out? Would I never get my Simon?

"Sir? Can I help you?" the salesman asked. His attitude was surprisingly pleasant considering that he worked in the store's combat zone.

"I don't see it!"

"See what, sir?"

Still vaguely pleasant, his tone changed to "I've had a long day, buddy. Let's not play 20 questions."

"Simon of course!" I replied. "But I know you don't have any. No one does."

"You're in luck, sir. I believe we re-

ceived a back ordered shipment yesterday. I'll check."

A young girl behind me said, "Did you hear that, mommy? They have Simon! I can practice for the competition after all."

I said, "Competition? Simon?"

"Sure. Everybody's got one. Except me, that is. We have contests in school to see who can remember the longest tune. It's fun. Oh, I can't wait!" she responded, tugging on my sleeve.

"That sounds exciting. I hope you do well in the contest," I said.

The salesman returned.

"I have one left. You're in luck."

I hardly had time to smile as he passed it to me. I heard a whimper from behind me and sensed the little girl's disappointment. Saying nothing I turned to look at her. She tried to hide her anguish.

"What is your name, little girl?" I asked, stooping down a bit to be more at her level.

"Brenda," she said wistfully.

"That's a coincidence. I have a little . . . er, girl named Brenda too." I had to catch myself — as I have a female Scottish Terrier named Brenda. Parents might get upset if you compare their children to dogs. "She's a little smaller than you are."

"Is Simon for her, Mister?"

"No, she likes playing with tennis balls. But no matter. I've only been *looking* at this game. I'm not sure I really want to buy it just yet. Would you like it?"

She offered several relieved thank-yous as I bolted for the door. I was in a hurry to get to the department store two blocks up the street before they closed. . . .

### Musical Games Are Addicting

Some time ago I was in a stuffy business meeting. When it became apparent to the chairman that most of the attendees were asleep, he pulled out a saucer shaped object with four colored areas on it and slid it along the table. It stopped in front of me and went "beep" and lit a red light. Instructed to respond in kind, I pressed the red area which turned out to be an oversized lighted push-button. The saucer replied "beep-boop" and lit the red and green lights sequentially. It became immediately apparent that the plastic saucer was a game and the object was to duplicate the sequential tones it played. The task became increasingly difficult as it added another note each time around. If missed, it made a sound like a "raspberry" before starting a new game.

This "game" turned out to be Simon, from Milton Bradley Corporation. It uses a microprocessor to synthesize the tones, light the lights, and generate the sequence.

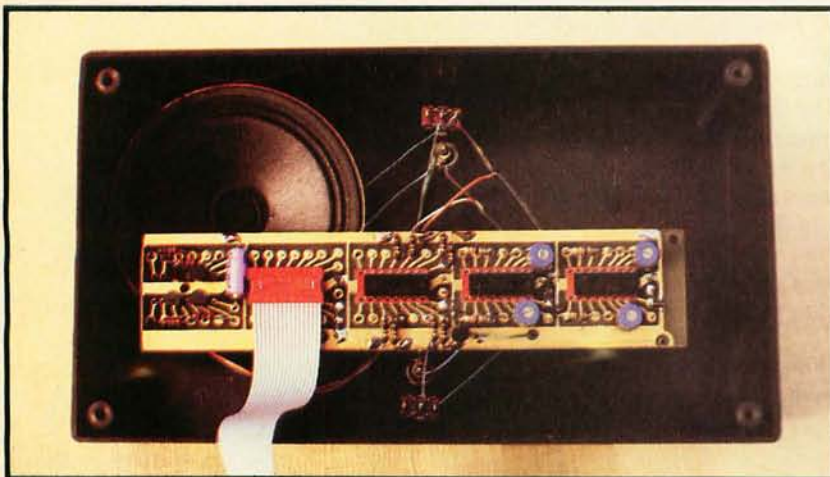


Photo 2: Bottom view of the player's console. The ribbon connector attaches to the user's personal computer.



# "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

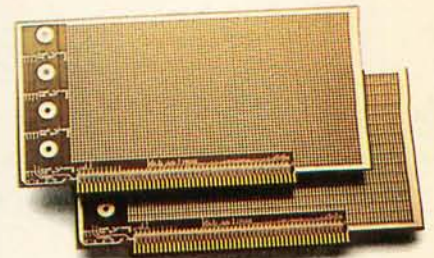


The place was alive with "mad doctors" 40 years ago. For good reasons. They couldn't get what they wanted. Labs were piled high with incomplete kits, defective gear, and undecipherable support documentation.

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.

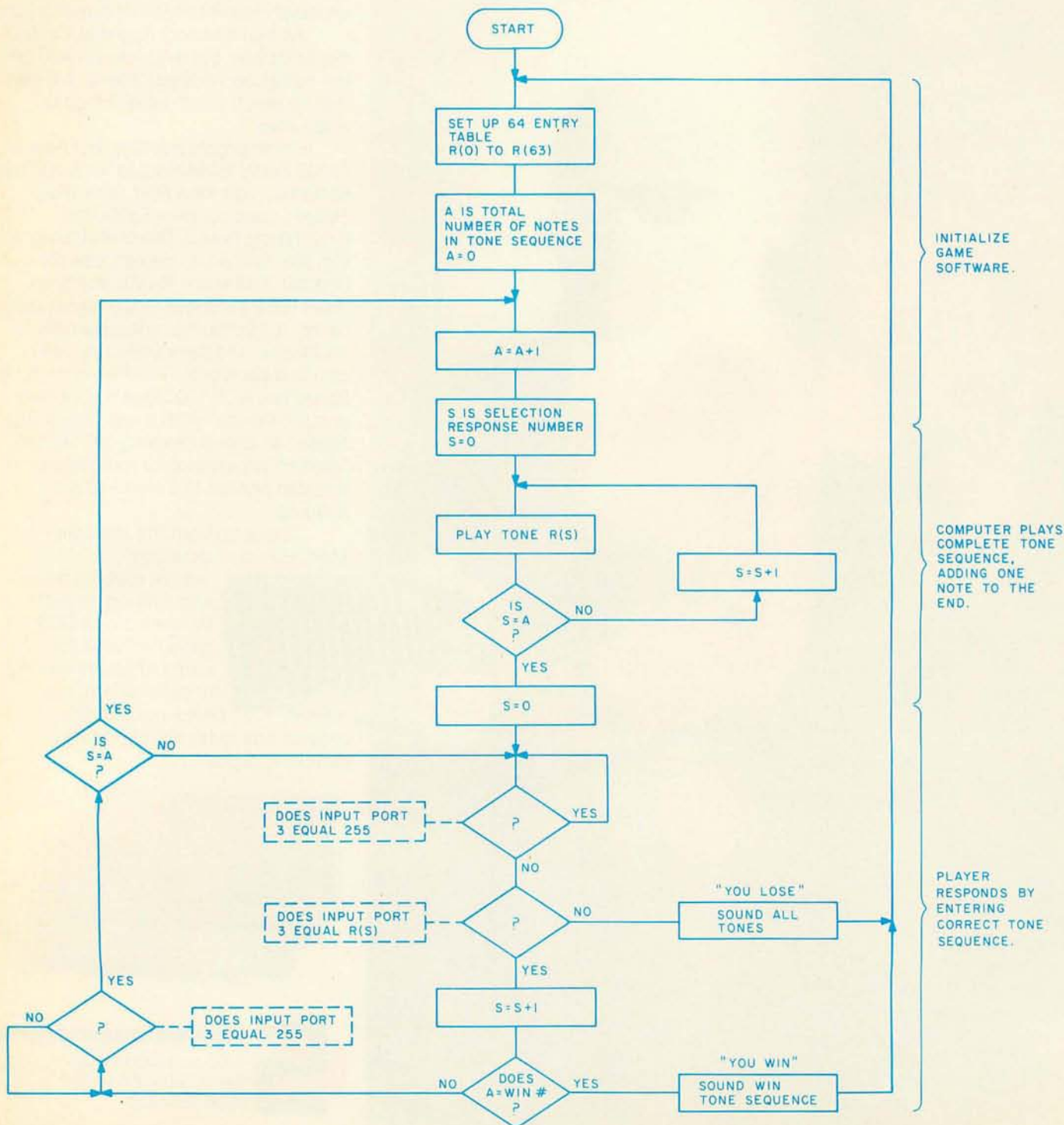


## Build Your Own Musical Game

It is only logical that any of the \$30 to \$50 electronic toys in department stores can be simulated with the average \$6000 personal computer. (This is why critics frequently call computers illogical.) The distinguishing feature between a toy built around a microprocessor and the average

home computer is the packaging and I/O (input/output) interface. With the exception of addressable memory, the microprocessor in a battleship game has a processing capability comparable to the more general purpose processors like the 8080 and 6800. The major difference is that single chip computers incorporate limited quantities of programmable memory, read only memory, and I/O in one package. This is the most cost-effective approach for a dedicated task like a game. The most popular single chip com-

Figure 2: Flowchart for the computerized musical game.





# 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



puter in the computer games market is the Texas Instruments TMS 1000. Customized versions of this integrated circuit are used in the majority of electronic games.

Presuming that we can write a program on our large computer that accomplishes the same logical objective as the dedicated game, the only real difference becomes I/O. Most personal computers incorporate ASCII keyboards, video displays, and tape cassette interfaces for I/O. Electronic board games use a few switch inputs (constant closures) and lights or buzzers for output and, because there is little operating system overhead, sound effects are directly synthesized by program timing loops. Theoretically, if we attach these switches and lights to a convenient I/O port on our computer we should be able to program a similar or even more challenging game.

Building a musical game that tests the players' ability to memorize a string of tones is a simple task. Input to the computer consists of four switches, one for each of four tones. Output from the computer is likewise four signals which light four colored lights on the player console. Each light corresponds to a distinctive tone.

The game is simple to play. The computer plays a tone and the player responds by

pressing the button for that same tone. Next, the computer plays two notes and the player replies accordingly. Each correct exchange results in adding one more note to the string. Eventually either the player misses by being unable to replay the exact tone sequence, or wins by attaining some preset number of notes without failure. The former is signified by an ungracious combination of tones and the latter by a distinctive tune played by the computer in celebration.

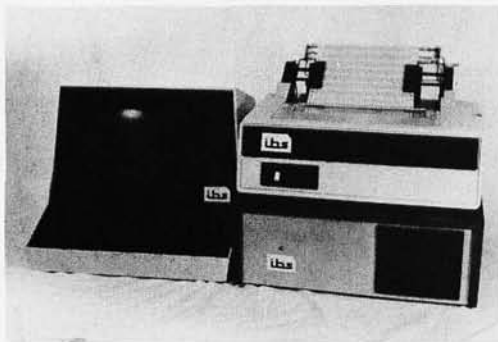
There are two possible design approaches. One is to use machine language and a "bare bones" interface consisting of four switches and four lights directly connected to a parallel input and output port. Timing loops written into the software produce the tones. This method uses the least hardware but requires considerably more software.

The second alternative is to use a high level language such as BASIC and use an external hardware interface for tone generation. This is the approach I have taken. Experimenters wishing to use another approach can easily follow the logic flow of BASIC and in this way I am not confining the reader to a particular microprocessor. Also, on-the-spot program variations to accommodate individual players are more easily implemented in a high level language.

## OVERBYTES AND UNDERPRICES THE COMPETITION

Introducing  
the

**ibs** **betasystem**



**\$5885.**

**Complete with the  
fantastic UCSD Pascal  
Operating System**

**PASCAL OPERATING SYSTEM:** The smoothest, most convenient operating system available, featuring a powerful screen oriented text editor, the fast PASCAL compiler, file and library handling system, linker, library, BASIC compiler, and more.

**Z-80 MICROCOMPUTER:** Northstar based 4 MHz S-100 microcomputer with 64k RAM, serial and parallel ports, dual Micropolis quad density (630 kbytes formatted) disk drives.

**60 cps DOT MATRIX PRINTER:** Centronics model 779 with tractor feed and paper stacker.

**FULL FUNCTION INTELLIGENT TERMINAL:** Microterm ACT-V, with addressable cursor, protected fields, erase to eol, erase to eos, reduced intensity, protected fields, much more.

	RETAIL	ibs PRICE
Microcomputer/Dual Drive/64k/Pascal	\$4695	\$3995
Printer/tractor feed/paper stacker	\$1250	\$1095
Terminal	<u>\$880</u>	<u>\$795</u>
	\$6825	\$5885

Buy complete system and receive all cables and box of disks free.

**ibs**

independent business systems, inc. • 5476 Cleo Ct. • Livermore, CA 94550 • (415) 443-3131





## Heathkit Personal Computers are "System Designed" - Read about them in the

# FREE!

## HEATHKIT CATALOG



*Complete descriptions of the best in  
personal computers - now available in  
kit and assembled versions*

In the world of personal computing, compatibility of design and operation is an important consideration. The computer hobbyist or small business user of today doesn't have time to iron out hardware and software problems that can arise from a "shot-gun" approach to system design.

Heathkit Personal Computer Systems are just that—systems. They were designed around each other for total complementary performance. Expansion within the computer itself and with our peripheral devices is always a trouble-free transition.

You can start with our low-cost 8-bit H8 Computer and just 4K of memory as an introduction to computing. Its easy to use octal data entry and 9-digit octal read-out make learning a simple matter. As your abilities grow, so can your computer. Add more memory and one or more peripherals



WH27  
Controller

like the H9 Video Terminal with its ASCII keyboard for convenient entry and display of your programs. And you can store your programs in one of three ways too! Choose our new WH17 Floppy Disk System (single and dual drives available) for the ultimate storage mode. Its expanded 40-track hard sectored diskette has 102K Bytes of available storage so you can store hundreds of programs on one disk. If paper tape storage is your preference, choose our H10 Paper Tape Reader/Punch. For the most in economy, we offer a cassette player/recorder too. The H8 is indeed a complete system.

The ultimate personal computer is our 16-bit H11A. Very few people will ever need more computing power than our H11A has to offer. Based on the world-famous DEC® PDP-11/03, it has enough capability for virtually any program—small business or hobby. The H11A offers unequalled software, too, so the number of useful applications is virtually unlimited. The H11A has its own

Heath Co., Dept. 334-520, Benton Harbor, MI 49022

Floppy Disk System, the WH27. And what a floppy it is! Fully-compatible with the DEC RX01® floppy for the PDP-11/03, the WH27 lets you take advantage of all existing PDP-11/03 software in addition to those you develop on your own. Dual drives give you 512K Bytes of program and data storage. The WH27's Z80 microprocessor-based controller permits a head motion of only 6 mS (versus DEC's 10 mS) for data access times that are considerably faster. Other features include built-in self test on power-up; mechanical interlock to prevent disk damage; write protect function that precludes written-over disks; complete HT11 disk operating system software that includes extended BASIC with files and virtual arrays, utilities (with macro-assembler), text editor and more. An extended FORTRAN which supports the ANSI standard (1966 FORTRAN IV) will be optionally available soon.

Read more about Heath system-designed computers and other outstanding kits (nearly 400 in all) in the latest Heathkit Catalog. It's FREE.

### Send for your FREE copy today!

Or bring this coupon to your nearby Heathkit Electronic Center (Units of Schlumberger Products Corporation) where Heathkit products are displayed, sold and serviced.



HEATH	
Schlumberger	
Heath Company Dept. 334-520 Benton Harbor, Michigan 49022	
Please send me my FREE Heathkit Catalog. I am not on your mailing list.	
Name _____	
Address _____	
City _____	State _____
CP-162	Zip _____
Specifications subject to change without notice.	



Photo 3: Corner of the circuit cellar showing the 64 K dual floppy disk Z-80 system used by the author to drive the musical tone game.



Listing 1: Program for the musical tone game, written in 8 K Zapple BASIC.

```

90 REM
92 REM ** CIARCIA'S CIRCUIT CELLAR COPYRIGHT 1979 **
94 REM
100 PRINT "THIS IS A MUSICAL GAME TO TEST YOUR MEMORY"
105 REM
110 REM
115 REM FIRST THING WE DO IS SET UP A TABLE OF 64
120 REM RANDOM NUMBERS WITHIN THE CHOICES OF 1,2,4, OR 8.
125 REM THESE NUMBERS ARE SINGLE BITS WHICH INDICATE A
130 REM PARTICULAR TONE AND COLORED LIGHT.
135 REM THE COMPUTER INTERFACE IS BITS 0 THRU 3 OF I/O PORT 3
140 REM
200 DIM R(64) : DIM S(64) : DIM A(64)
205 A=0
210 FOR S=0 TO 63
220 R=INT(RND(1)*10)
230 IF R>3 THEN 220
240 R(S)=255-2*AR : REM THE INPUT TO THE INTERFACE IS LOW TRUE LOGIC
245 REM TO TURN ON A TONE ALL BITS ARE HIGH EXCEPT THE
247 REM ONE WHICH IS TO BE COMMUNICATED
250 NEXT S
260 REM
270 REM
400 S=0 : A=A+1
410 OUT 3,R(S) : GOSUB 2000 : REM TURN ON TONE
420 OUT 3,255 : REM TURN OFF TONE
425 S=S+1
430 IF S=A THEN 450 ELSE 410
450 S=0
460 W=INP(3)
465 IF W<>255 THEN 470 ELSE 460 : REM HAS A BUTTON BEEN PUSHED?
470 IF W=R(S) THEN 480 ELSE 600
480 S=S+1
481 REM A IS PRESET TO EQUAL WIN NUMBER. THIS CAN BE 1 TO 64 TONES
482 IF A=16 THEN PRINT "YOU WIN" : GOTO 700
490 W=INP(3)
495 IF W<>255 THEN 490 : REM HAS THE PLAYER RELEASED THE BUTTON?
500 IF S=A THEN 580
510 GOTO 460
520 REM
530 REM
580 REM RETRY DELAY
585 FOR T=0 TO 3 : GOSUB 2000 : NEXT T
590 GOTO 400
600 PRINT "SORRY, YOU MISSED IT . . . . YOU HAD ";A;" NOTES IN THE
SEQUENCE"
605 PRINT "TRY AGAIN"
610 OUT 3,0 : REM TURN ON ALL TONES
620 FOR T=0 TO 3 : GOSUB 2000 : NEXT T
625 OUT 3,255
630 GOTO 205
700 FOR T=0 TO 6 : REM PLAY TUNE TO INDICATE A WINNER
705 OUT 3,254 : GOSUB 2050 : OUT 3,253 : GOSUB 2050
710 OUT 3,251 : GOSUB 2050 : OUT 3,247 : GOSUB 2050
715 OUT 3,255 : NEXT T
720 GOTO 205
1980 REM
1990 REM THE VALUE OF T1 SETS THE TONE DURATION
2000 FOR T1=0 TO 250 : NEXT T1 : RETURN
2050 REM WIN DELAY TIMER
2060 FOR Q1=0 TO 80 : NEXT Q1 : RETURN

```

Figure 1a illustrates the hardware interface of this musical game; photos 1 and 2 demonstrate typical layouts. A more detailed description of an individual tone generating section is given in figure 1b. Normally, both signal points A and B are at a high logic level and the tone is off. The tone and light can be turned on by either a low output signal from the computer or the pushbutton being pressed. The resulting high level output of IC1b turns on the oscillator formed from IC1b and IC1c and drives the light through transistor Q<sub>1</sub>.

A flowchart of the software as written in BASIC is shown in figure 2. When the game is initialized, a random number generator sets up a tone sequence of 64 notes. After playing the first note it waits for the player's response and then repeats the action adding another note. The software is written so that the speed of player response is not important. Player frustration is strictly limited to remembering the tone sequence. The BASIC program which plays this game is shown in listing 1.

I have found that this game is a good way to demonstrate my computer to people totally unfamiliar with them. Some of my more computer oriented friends jokingly suggest that I may be doing things the hard way using a 64 K byte dual disk Z-80 system for the game.

If you have any questions, good ideas or comments on this or previous articles, please write to me, enclosing a self-addressed, stamped envelope. Eventually I answer them all.

Next month, the "Circuit Cellar" topic will be communication on a laser light beam. ■





## 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.

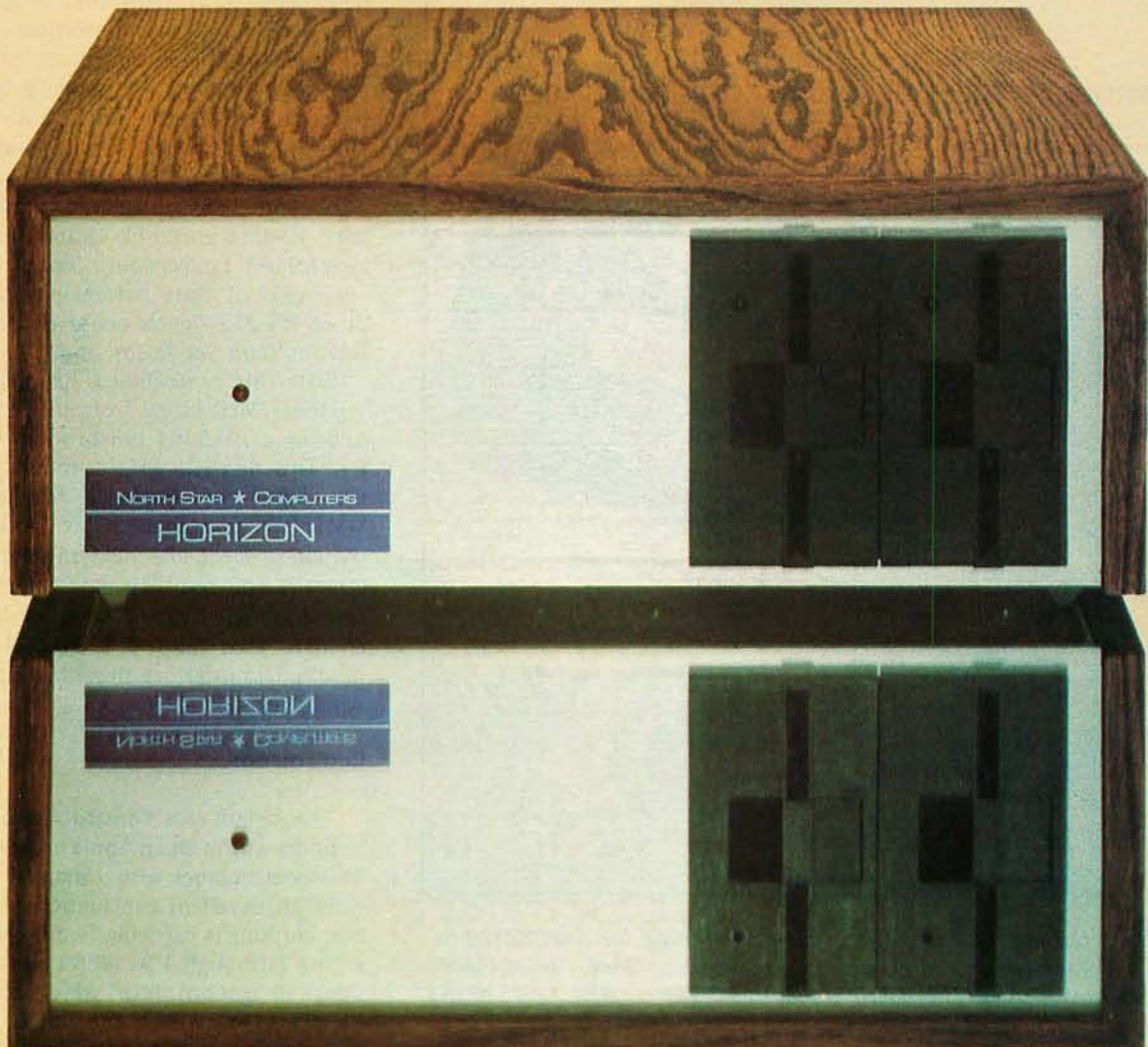
MICRO DISK SYSTEM with one double density SA-400 minifloppy, controller board and power regulation: \$699 kit, \$799 assembled. (Cabinet and power supply \$39 extra each.)

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

### 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.





# Cross-Pollinating the Apple II

## About the Author

Richard Campbell is a software engineer working for Lexitron Corporation, a manufacturer of 8080 based text processors. His hobbies include computing, flying and photography.

Richard Campbell  
7032 Quakertown  
Canoga Park CA 91306

I have an Apple II personal computer, which I like a great deal. I have noticed that most construction articles dealing with custom interfaces for the Apple assume that one must use Motorola or MOS Technology

peripheral integrated circuits. Since I use the Intel 8080 family of devices in my work, and want to add a serial interface to my Apple, I've decided to try a little crossbreeding. The interface was designed to be RS-232 compatible and to allow receiving and transmitting with the ability to add modem control signals easily in the future.

## Circuit Design

The heart of the interface is the Intel 8251 programmable communications interface. The 8251 performs serial-to-parallel and parallel-to-serial conversion. The operating characteristics and mode of the 8251 are programmable by sending the proper bytes to it from the Apple bus. The interface is set up to handle asynchronous communications. National Semiconductor's 1488 and 1489 integrated circuits handle the RS-232 and TTL (transistor-transistor logic) level conversions. Since I am using only one of four buffers per chip, many other RS-232 signals could easily be added such as *Data Set Ready* and *Clear To Send*.

Data rate generation is handled by dividing the 7 MHz signal from the Apple bus by 8, using a 74LS161 synchronous 4 bit counter. This 895.125 kHz output is applied to the input of National Semiconductor's MM5307AA programmable divider. Four switches select the data rate as shown in table 2. The resulting data rates are 3 percent low, but in actual practice this is close enough. Two gates of a 74LS04 device are required to interface the 8251 circuit to the Apple bus.

## Construction

The circuit was constructed using point-to-point wiring on an Apple prototype board. This board comes with a manual which provides an excellent explanation of the Apple bus. Nothing is particularly critical about the wiring (although I wouldn't run the 7 MHz signal all around). A 0.1  $\mu$ F capacitor should be placed near each integrated circuit be-

**intel** Silicon Gate MOS 8251

**PROGRAMMABLE COMMUNICATION INTERFACE**

- Synchronous and Asynchronous Operation
  - Synchronous:
    - 5-8 Bit Characters
    - Internal or External Character Synchronization
    - Automatic Sync Inhibit
- Baud Rate — DC to 56k Baud (Synchronous) DC to 96k Baud (Asynchronous)
- Full Duplex

**PIN CONFIGURATION**

D <sub>7</sub>	1	27	D <sub>0</sub>
D <sub>6</sub>	2	28	NC
Wd <sub>7</sub>	3	29	NC
Wd <sub>6</sub>	4	30	NC
D <sub>5</sub>	5	31	DTM
D <sub>4</sub>	6	32	DTL
D <sub>3</sub>	7	33	DTS
D <sub>2</sub>	8	34	DSR
D <sub>1</sub>	9	35	RESET
D <sub>0</sub>	10	36	CLK
PC	11	37	F <sub>0</sub>
WR	12	38	F <sub>1</sub> EMPTY
CS	13	39	ETS
RD	14	40	SYNDET
RD <sub>0</sub>	15	41	F <sub>0</sub> RDY

**BLOCK DIAGRAM**

The block diagram shows the internal structure of the 8251, including a DATA BUS BUFFER, TRANSMIT BUFFER, RECEIVE BUFFER, and TRANSMIT CONTROL. It also shows the connection to the APPLE BUS and the 74LS04 gates.

Photo 1: The serial interface circuit as constructed using the Intel 8251 programmable communications interface. Point-to-point wiring on an Apple prototype board was used. The board is pictured lying on page 12-46 of the Intel Component Data Catalog.



# "Our reputation rests on digits, decimal points, and details. We wouldn't trust them to anything less than Scotch® Brand Data Cartridges."



Bill Birkett, Vice President,  
Trade Graphics, Inc.,  
Livonia, Michigan

The unique design of a data cartridge provides great reliability, high storage capacity and long tape life. And where could you possibly get better data cartridges than Scotch Brand, made by 3M, the people who invented the data cartridge system itself?

3M controls every step in manufacturing. Top quality magnetic tape and precision components are part of every Scotch Data Cartridge. Over twenty-five years of service to the computer industry assure you of the utmost reliability.

Scotch Data Cartridges are available in miniature DC 100A, the standard-size DC 300A and now, an extra-length DC 300XL with 50% more storage capacity. They are compatible with most cartridge systems including Hewlett-Packard, IBM, NCR, Tektronix and TI.

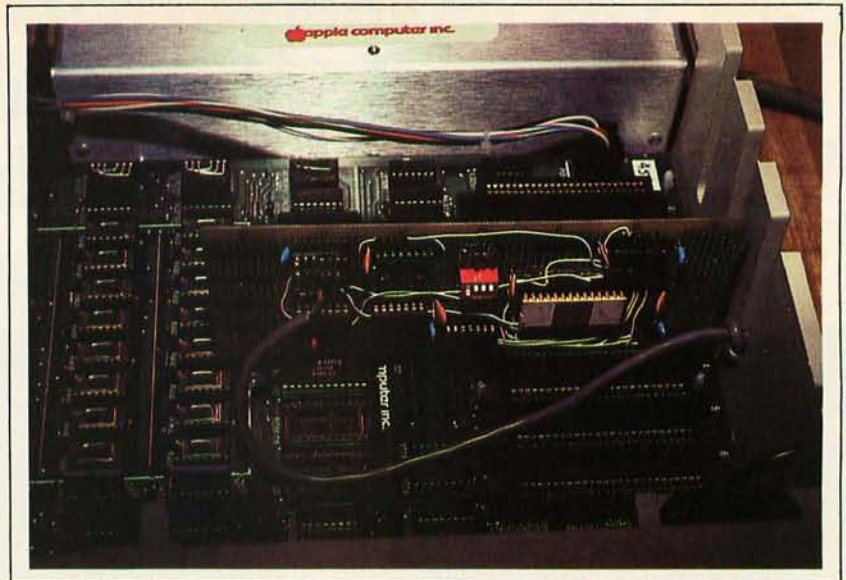
To find out where you can find Scotch Data Cartridges or virtually any other data recording medium, call toll-free: 800-328-1300. (In Minnesota, call collect: 612-736-9625.) Ask for the Data Recording Products Division.

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





Photo 2: The serial interface board installed inside the Apple II.



```

0300 A9 CE LDA #SCE
0302 8D C1 C0 STA $C0C1 SET 8251 MODE (SEE 8251 DATA SHEET)
0305 A9 27 LDA #$27
0307 8D C1 C0 STA $C0C1 SET 8251 COMMAND
030A 20 58 FC JSR $FC58 CLEAR THE SCREEN AND HOME
030D A9 60 LDA #$60 GET CURSOR CHAR
030F 20 ED FD JSR $FDED PUT CURSOR ON SCREEN
0312 C6 24 DEC $24 BACKUP SCREEN INDEX TO OVERWRITE
CURSOR
0314 AD C1 C0 LDA $C0C1 CHECK 8251 STATUS
0317 29 02 AND #$02 MASK OFF RECEIVE READY BIT
0319 F0 12 BEQ $032D BRANCH IF NOT READY
031B A9 A0 LDA #$A0 GET A BLANK
031D 20 ED FD JSR $FDED OVERWRITE THE CURSOR
0320 C6 24 DEC $24 BACKUP SCREEN INDEX
0322 AD C0 C0 LDA $C0C0 GET CHAR FROM 8251
0325 09 80 ORA #$80 SET BIT 7 HIGH
0327 20 ED FD JSR $FDED PUT CHAR ON THE SCREEN
032A 4C 0D 03 JMP $030D PUT UP NEXT CURSOR AND LOOP
032D 2C 00 C0 BIT $C000 CHAR ENTERED ON KEYBOARD?
0330 10 E2 BPL $0314 BRANCH IF NO
0332 AD 00 C0 LDA $C000 GET CHAR FROM KEYBOARD
0335 8D C0 C0 STA $C0C0 OUTPUT CHAR TO BE SENT BY 8251
0338 AD 10 C0 LDA $C010 RESET KEYBOARD
033B 4C 14 03 JMP $0314 CHECK FOR NEXT CHAR

```

Listing 1: Program in assembler language for the 6502 processor. This enables the Apple II to function as a full duplex terminal.

tween ground and +5 V. The +12 V and -12 V supply lines should also be decoupled to ground using 0.1  $\mu$ F capacitors. Do not use high value electrolytic capacitors, since this interferes with the Apple's switching power supply. The RS-232 input, output, and ground should go to a standard DB25 connector.

#### Using the Interface

Listing 1 contains a program, entered with the Apple's assembler, that sets the Apple up for use as a terminal. Data received from the input port is displayed on the screen, and whatever is typed on the keyboard is sent out the transmit line. This program operates the Apple as a full duplex terminal. In other words, there is no internal logical connection between the keyboard and the screen. The characters that are typed

Photo 3: The serial interface is used here to connect the Apple II to an Intel SDK-80 microcomputer.

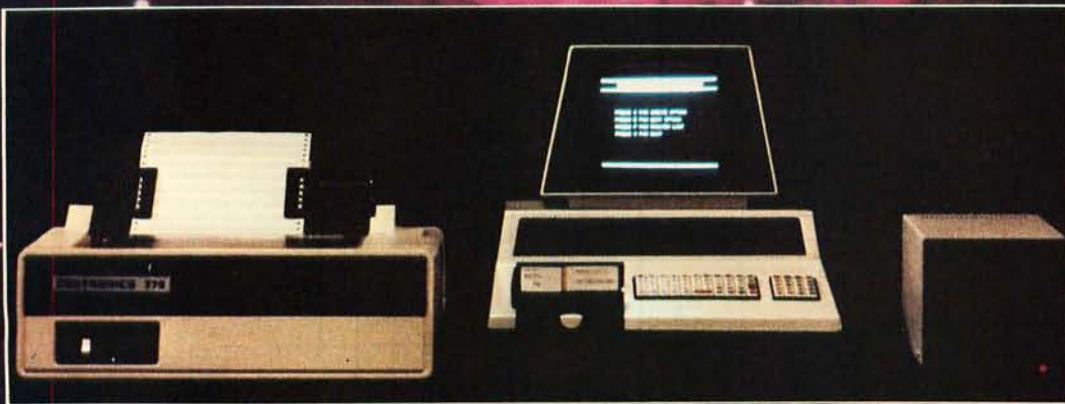




# COMPU THINK™

You've heard of our dual disk drives, memory expansion, and other peripherals which also includes software, i.e., Fortran, PLM, Basic compiler, Source-Editor, Autolink, Pagemate Database and a complete line of business applications.

*COMPU/THINK* manufactures complete small business systems, for the professional programmer, engineer and small businessman. We offer complete customer support including maintenance. If you're a small businessman who is not a programmer or a programmer who is interested in sophisticated products at reasonable prices, call us the company who thinks about its customers!



For further information call or write:

Frank Price,  
Director of Marketing

*COMPU/THINK*  
3260 Alpine Road  
Menlo Park, Calif. 94025  
(415) 854-2577

Dealer inquiries invited.

**"COMPUTER SYSTEMS FOR BUSINESS"**



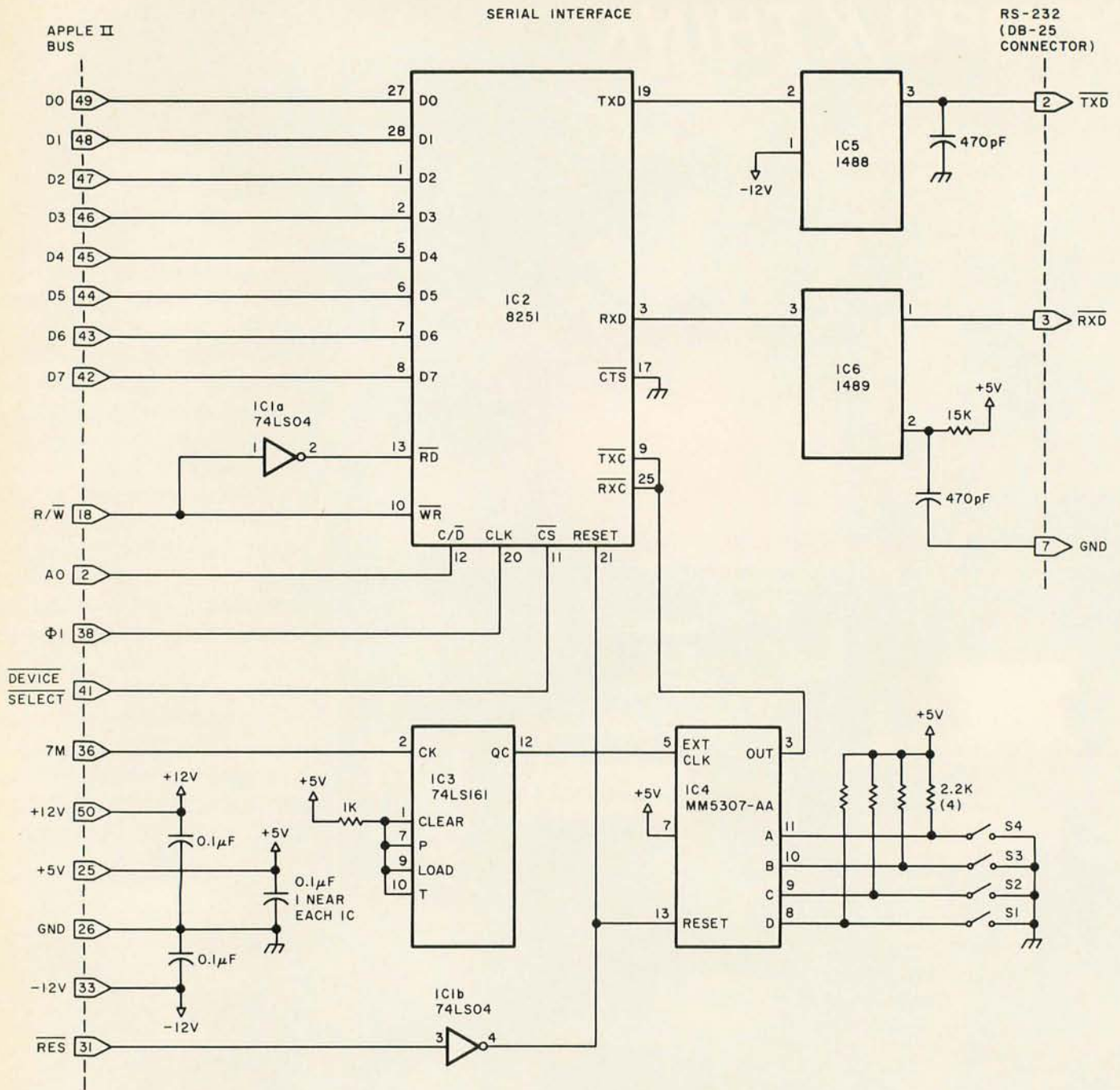
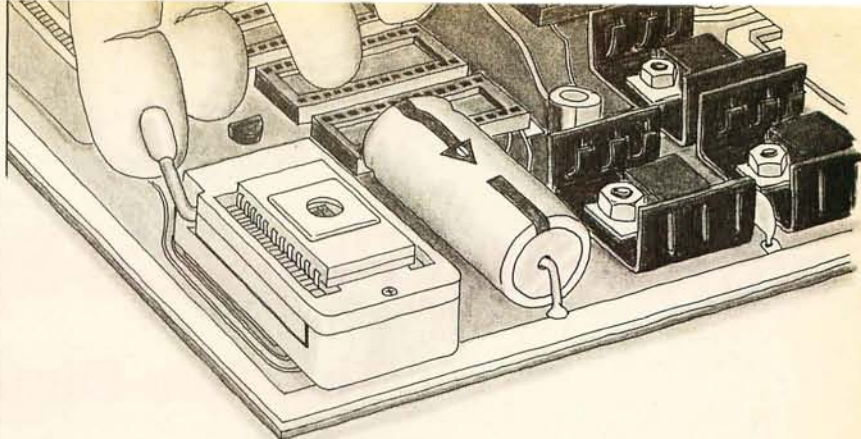


Figure 1: Schematic diagram for the serial interface.

Table 1: Power wiring table for figure 1.

Number	Type	+5 V	Gnd	-12 V	+12 V
IC1	74LS04	14	7	-	-
IC2	8251	26	4	-	-
IC3	74LS161	16	8	-	-
IC4	MM5307-AA	4	-	12	-
IC5	1488	-	7	1	14
IC6	1489	14	7	-	-





## EPROMs out at the touch of a finger.

**Data Rate Selection**

S4	S3	S2	S1	Data Rate (bps)
C	C	C	N	50
C	C	N	C	75
C	C	N	N	110
C	N	C	C	134.5
C	N	C	N	150
C	N	N	C	300
C	N	N	N	600
N	C	C	C	900
N	C	C	N	1200
N	C	N	C	1800
N	C	N	N	2400
N	N	C	C	3600
N	N	C	N	4800
N	N	N	C	7200
N	N	N	N	9600

C = closed                      N = open (not closed)

8251 set for ±16 mode

*Table 2: Switch settings to select various data rates for this serial interface. A dual in line pin-type switch may be used.*

appear on the screen only if the device you are communicating with echoes them back to you. With this program the board has communicated perfectly with an Intel single board computer at a data transmission rate of 600 bits per second.

### Conclusion

Some experimenters have faced difficulty in attempting to interface the Apple II to such devices as the Motorola 6820 PIA (peripheral interface adapter). Most of the problems stem from a 25 ns timing delay on the bus lines of the Apple. I advise erstwhile interfacers not to become bogged down in this sort of thing; there are too many new and useful integrated circuits available with which to work.

Not all highly programmable devices are as fussy about timing as are the standard support devices for the 6800 and 6502 processors. My design shows that other families of circuits may be utilized without much trouble. The design using the 8251 device has suffered no timing glitches such as the ones that plague circuits using the 6820 device.

The moral is to keep your eyes open to discover new and versatile integrated circuits and to experiment with them, whatever processor you use. Signetics has invented an interface circuit, the 2651, which is similar to the 8251. The principal difference is a built-in data rate generator. If I can obtain one, I know what my next experiment will be. ■

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.

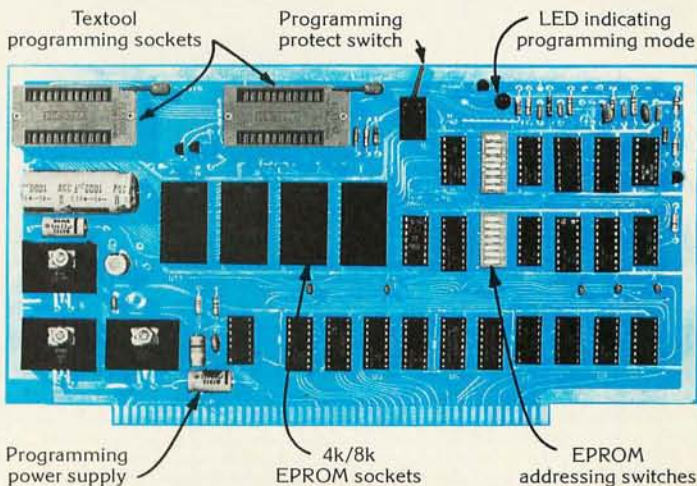
PB1 has two separate programming circuits so 2708 or 2716 (5v) type of EPROMs can be programmed without modifying the board. Programming voltage is generated on-board by a DC-DC converter; no need for an external power supply. Programming sockets are Dip Switch addressable to any 4k boundary. And complete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



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

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



# Simulating Physical Systems

## The Two-Dimensional Ideal Gas

Mark Zimmermann  
Caltech 130-33  
Pasadena CA 91125

Computers are becoming increasingly valuable in the sciences, for data reduction and analysis and for the simulation of physical systems. With a machine to do the repetitious work, an astronomer can follow the orbits of hundreds or thousands of stars as they are affected by their mutual gravitational fields and move to make a globular cluster or a spiral galaxy. A chemist can follow molecules in a liquid as they attract and repel and undergo chemical reactions. A physicist can watch the atoms of a gas moving from a low entropy, highly ordered state toward a more probable chaotic configuration, and can follow the random walk motion of any specific particle as it suffers collisions with the rest of the gas.

How does one go about setting up a physical simulation? It's necessary to determine the most important laws that govern the system under investigation. A star

cluster, for example, is controlled mainly by Newton's law of gravitation. The nuclear reactions which power individual stars are interesting, but probably not very important to the structure of the cluster as a whole. (An exception might be a cluster of extremely massive stars; such stars could run out of fuel and blow up before there was time for their orbits to settle down.)

The first step in programming any physical system is to cut away all the features except those which are crucial to it — in other words, to make a model. If the correct effects and features have been included, the model will act enough like the physical system to be useful and accurate, and the model will be small and simple enough to be computable in a reasonable amount of time and space.

Secondly, one must take the equations that govern the model and translate (and sometimes simplify) them into a form which a machine can handle. Today, only a few very high-level systems (such as MACSYMA, REDUCE, SHEEP, and FORMAC) can handle abstract equations and functions, and even these sophisticated systems can't do very much. Until people learn how to explain the details of problem solving mathematics better, most machines are best at manipulation of discrete, finite precision numbers. So, if one wants to compute the flight of a Frisbee, one needs to turn the continuous differential equations for its motions into discrete difference equations. It's analogous to the way one plots a diagonal line on a teletypewriter — the continuous line is broken up into a discrete set of points that the printer then approximates as best it can. If the printer can type smaller, the approximation is better. Similarly, if the smooth equations describing the Frisbee's flight are broken up into tinier steps, then the approximate solution the machine generates comes closer to the actual motion.

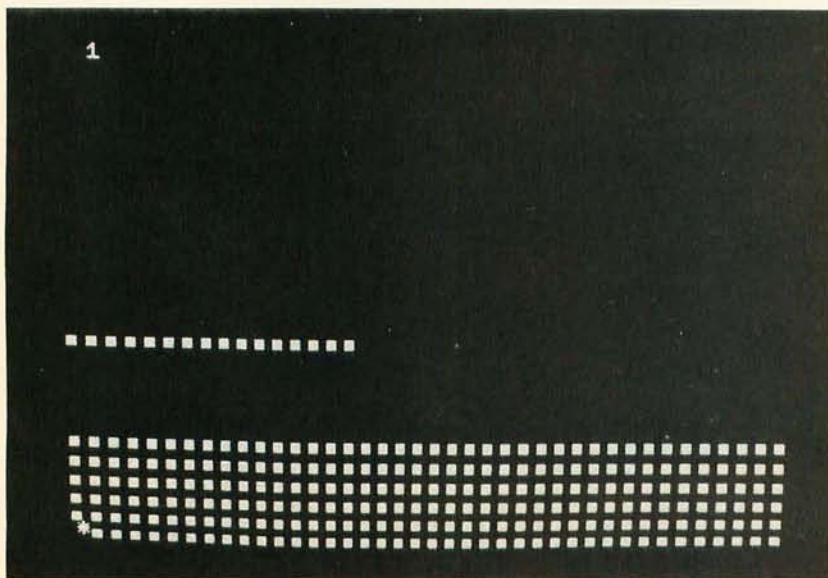
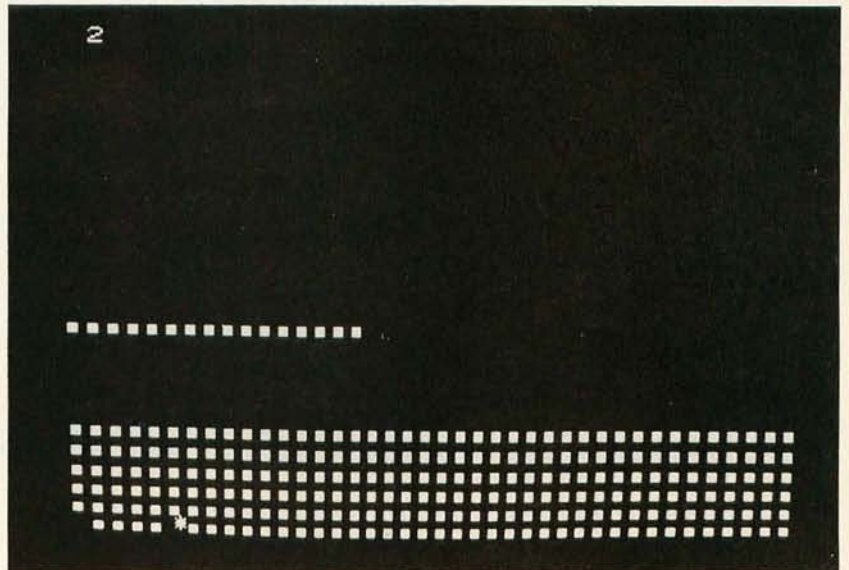


Photo 1: Initial configuration for a run of the ideal gas model.

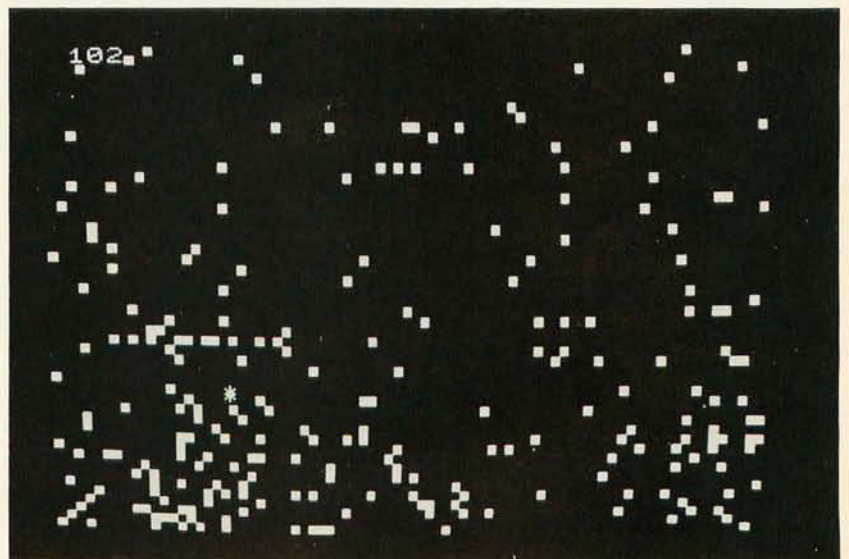


Finally, given the model of the physical system to be simulated, and given a translation of the equations controlling that model into a machine acceptable form, the rest is easy: just write the program! Ah, if it were only so. To avoid gross errors and smaller bugs, it's best to write in a high-level language (BASIC, FORTRAN, Pascal, etc), but then the resulting code usually runs unacceptably slowly. It seems to be a general consequence of Murphy's Law ("Anything that can go wrong, will!") that any physical system interesting enough to be worth simulating is too complex to be effectively simulated. So, compromises are always necessary. Astronomers try to simulate galaxies using a thousand point masses and an approximate force law, instead of using the actual ten billion stars with  $1/r^2$  fields. Chemists settle for a few hundred molecules in their "liquid," instead of  $10^{23}$  or so. All they can do is hope that enough of the many-body collective effects show up for their too small models to be interesting, and that the cost of computing comes down enough for them to simulate bigger systems next year. As calculations get cheaper, that last hope seems to be the best.

Another way to compromise between the human speed and efficiency of programming in a high-level language, and the computer speed and efficiency of programming in machine language is obvious: do both, and produce a hybrid program. The BASIC (or Pascal, or whatever) program provides the framework and handles non-time-critical tasks; it then calls machine language modules to perform the innermost loops, the time-consuming parts of the program which are simple enough to write accurately and rapidly in such a low-level language. As a developmental tool, this top-down approach is infinitely better than writing all machine language code and then spending days debugging it. In fact, if the program can be entirely written in the high-level language



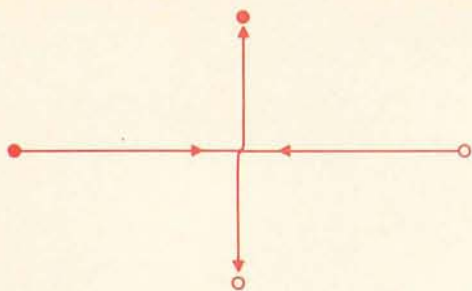
*Photo 2: One time step later, particle number 0 has moved ten units to the right and is colliding with particle number 31 at X=10, Y=0.*



*Photo 3: A view of the simulation 102 time steps after starting.*



Figure 1: 90 degree type collision for two particles with equal and opposite initial velocities.



and then run (slowly, perhaps) on small, special cases to test out the fundamental equations, so much the better. The machine language subroutines can then be written and substituted in only as necessary.

With this 3 step approach (model, translate, program), simulating physical systems isn't necessarily easy, but it is systematic and can be interesting and educational.

### The Ideal Gas

As an application of the above principles, I've programmed in BASIC and 6502 machine language (on a Commodore PET) a simulation of an ideal gas — a gas made of pointlike particles that interact only by direct collisions. An actual gas, of course, is made of molecules or atoms which have size and internal structure. The molecules may react when they collide with sufficient energy, and they may influence each other (via electrical forces) even when they are quite far apart. The gas may condense into a liquid or solid phase if its temperature is low enough and its pressure high enough.

The model I made does not include those features. It doesn't even include the three dimensions in which the physical gas moves! For speed and simplicity, I restricted the gas particles to move in two dimensions within the 50 by 80 cell "box" of the PET's video screen. The two-dimensional gas is interesting in itself, and it actually occurs, approximately, when atoms get adsorbed on the surface of some crystals. The adsorbed particles are relatively free to move from place to place on the crystal surface, but they are not free to leave the surface if the temperature is low enough. (If this physical system isn't exciting enough for you, you can imagine that the program is simulating a large number of balls on a billiard table, or perhaps hockey pucks sliding on ice.)

Several other features of the model I made are important. I used only 256 gas particles for two reasons: it made the machine language routines simpler, and more particles would have filled up too large a fraction of the screen. As a general rule, the errors in simulating a random process shrink as  $1/\sqrt{N}$ , where  $N$  is the number of objects in the simulation. For example, if a pollster asks 100 randomly chosen people for their opinion on some issue, he or she typically makes about  $1/\sqrt{100} = 10\%$  errors in estimating the general opinion based on the finite sample. If the average number of molecules in one cubic centimeter of air is

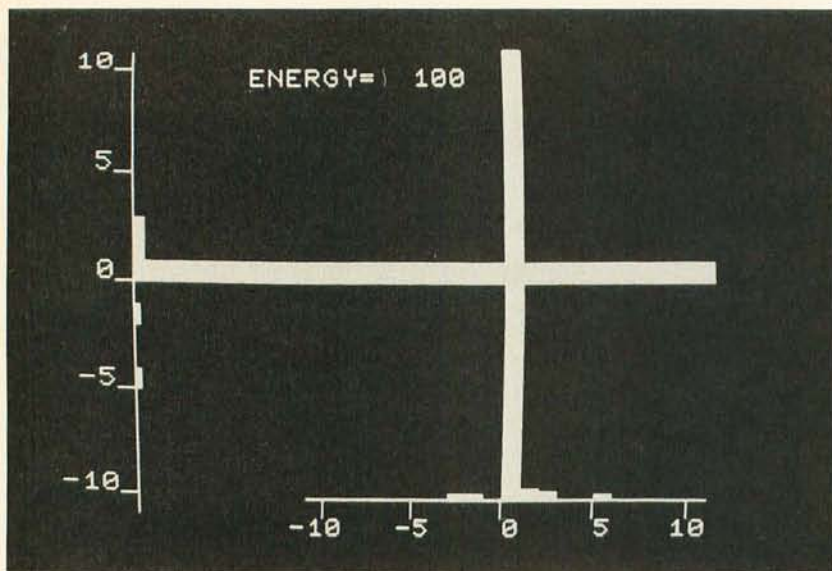


Photo 4: A velocity distribution histogram after 102 steps. Note the energy error (possibly due to roundoff and truncation error, or maybe I accidentally hit the G key). Energy error is worse at these low energies when most particles have only very small velocities.

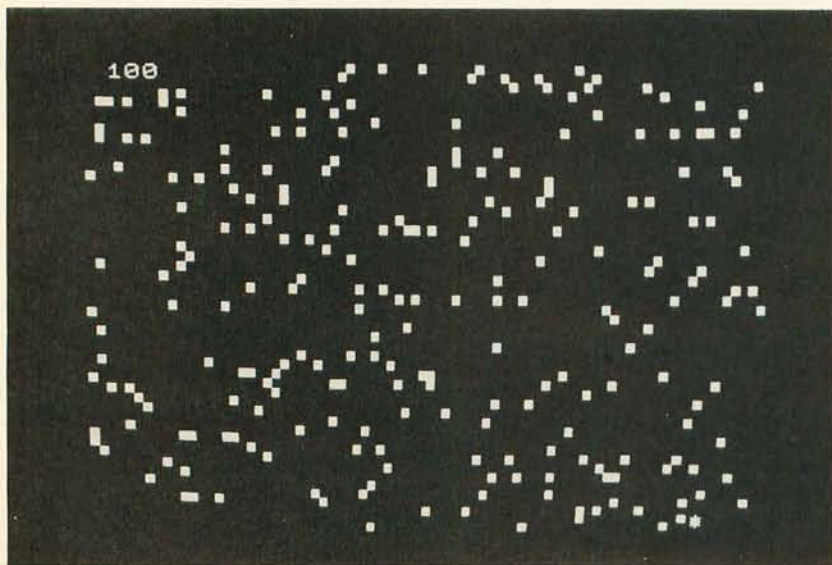


Photo 5: Configuration for a high temperature gas with a total energy of 1207 units.

Text continued on page 32.

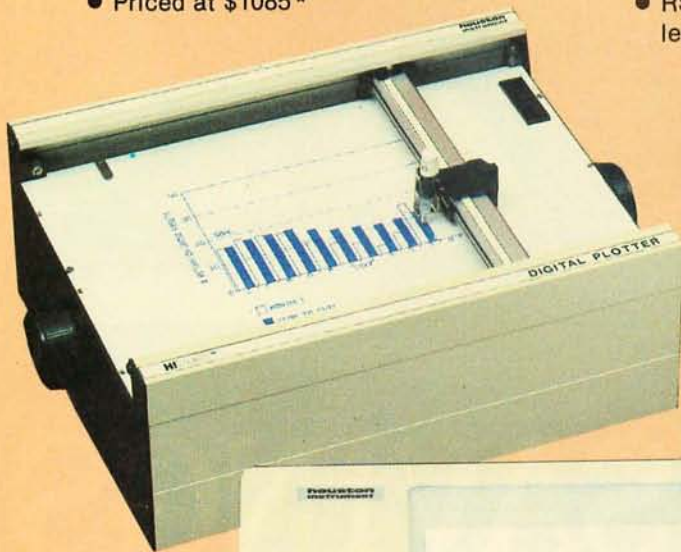


# Graphics for small systems were too expensive...

**HIPLØT**<sup>TM</sup>  
digital plotters

## The perfect small system output device

- Displays data in easy to read graphical format
- Both serial and parallel inputs built-in
- Uses standard 8½" x 11" paper
- Plotting speed up to 2.4 ips
- Resolution of both 0.01 and 0.005 in.
- Baud rate and step size easily changed
- Completely assembled and ready to use
- Priced at \$1085\*

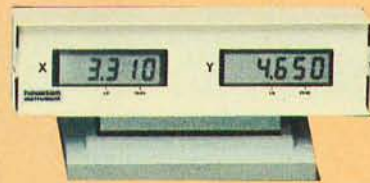


# Until Now

**HIPAD**<sup>TM</sup>  
digitizers

## The perfect small system input device

- Resolution and repeatability of 0.005 in.
- Origin is completely relocatable
- RS232C and 8 bit parallel interface selectable at the connector
  - Accuracies of ±0.015 in. (0.4mm)
    - Optional LC display shows actual values being inputted
  - Digitizing surface 11" x 11"
    - Priced at \$795\*



(Optional LC display)



\*U.S. Domestic Price Only  
TM Trademark of Houston Instrument

For rush literature requests  
or local sales office information only,  
persons outside Texas call toll free 1-800-531-5205.

**houston  
instrument**

DIVISION OF BAUSCH & LOMB

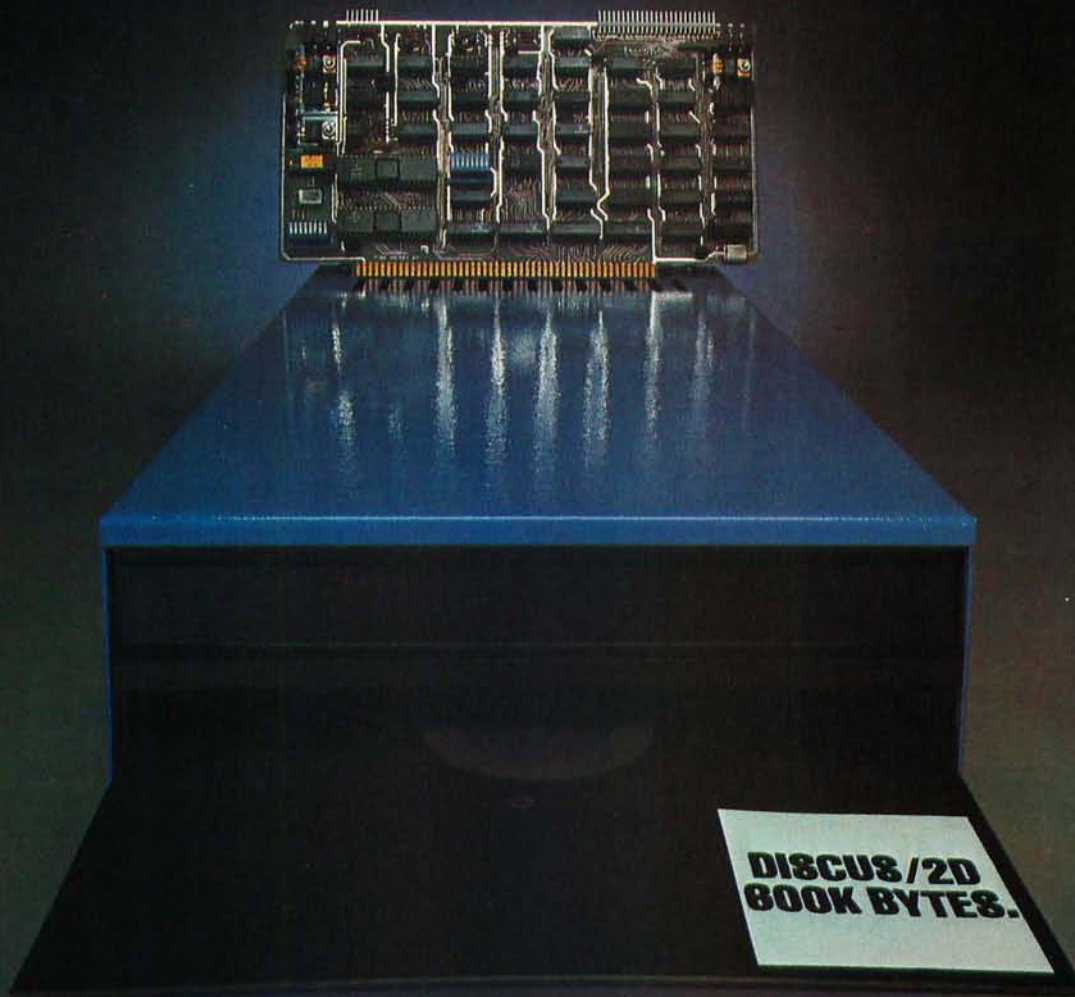
ONE HOUSTON SQUARE AUSTIN, TEXAS 78753  
(512) 837-2820 TWX 910-881-2022

"the graphics - recorder company"

EUROPEAN OFFICE Rochesterlaan 6 8240 Gistel Belgium  
Phone 059/277445 Telex Bausch 81399



# 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.

 Morrow makes disk memory for  
**Thinker Toys™**



# ASK FOR THINKER TOY™ PRODUCTS AT YOUR LOCAL DEALER NOW

## ALABAMA

Jack Robertson & Associates  
Computer Store  
586 Shade Crest Road  
Birmingham, AL 35226  
(205) 328-9890

## ALASKA

Computer Cache  
529 "I" Street  
Anchorage, AK 99510  
(907) 277-7914

## ARIZONA

\*Computerland-Phoenix  
Billmore Plaza  
3160 E. Camelback  
Phoenix, AZ 85016  
(602) 956-5727

## ARKANSAS

Microsystems  
Route 1, Box 765  
Rogers, AR 72756

## CALIFORNIA

Advanced Computer Products, Inc.  
1310 East Edinger  
Santa Ana, CA 92705  
(714) 558-8813

Bingham Electronics  
100 Vallecitos Way  
Los Gatos, CA 95030  
(408) 395-0010

Byte Shop-Berkeley  
(Computer Center)  
1514 University Avenue  
Berkeley, CA 94703  
(415) 845-6366

Byte Shop-Hayward  
1122 "B" Street  
Hayward, CA 94541  
(415) 537-2983

Byte Shop-Lawndale  
16508 Hawthorne Blvd.  
Lawndale, CA 90260  
(213) 371-2421

Byte of Palo Alto-I  
2233 El Camino Real  
Palo Alto, CA 94306  
(415) 327-8080

Byte of San Diego  
8038 Clairemont Mesa Blvd.  
San Diego, CA 92111  
(714) 565-8008

Byte of Palo Alto-II  
475 Sacramento  
San Francisco, CA 94111  
(415) 434-2983

Byte Shop-San Rafael  
509 "B" Francisco Blvd.  
San Rafael, CA 94901  
(415) 457-9311

Byte Shop-Santa Clara  
3400 El Camino Real  
Santa Clara, CA 95051  
(408) 249-4221

Computer Center, Inc.  
4014 Geary Blvd.  
San Francisco, CA 94118  
(415) 387-2513

Computer Components  
5848 Sepulveda Blvd.  
Van Nuys, CA 91411  
(213) 786-7411

\*Computerland, Inc.  
14400 Catalina Street  
San Leandro, CA 94577  
(415) 895-9363

\*Computerland-El Cerrito  
11074 San Pablo Avenue  
El Cerrito, CA 94530  
(415) 233-5010

\*Computerland-San Francisco  
117 Fremont Street  
San Francisco, CA 94105  
(415) 546-1592

Data Machines, Inc.  
1228 Folsom Street  
San Francisco, CA 94103  
(415) 864-7200

Digital Deli Computer Store  
80 W. El Camino Real  
Mt. View, CA 94040  
(415) 961-2670

Electronics Enterprises  
Rio Linda, CA 95673  
(916) 991-2010

I.C.E. House Inc.  
398 N.E. Street  
P.O. Box 336  
San Bernardino, CA 92401  
(714) 888-3690

Integrated Computer Systems  
3304 Pico Blvd.  
Santa Monica, CA 90405  
(213) 450-2060

Khalisa Computer Systems  
500 So. Lake Avenue  
Pasadena, CA 91101  
(213) 684-3311

Logic Systems  
5717 Bryce Canyon Place  
Sacramento, CA 95842  
(916) 331-7176

## ACC

505 Cypress Point Drive  
Mt. View, CA 94043  
(415) 969-4969

Max Computing Systems  
7417 Winding Way  
Fair Oaks, CA 95628  
(916) 961-5817

Micro-Sun Computer Center  
(Formerly Byte-Walnut Creek)  
2989 North Main  
Walnut Creek, CA 94596  
(415) 933-6252

Omega Enterprises  
921 N. La Jolla Avenue  
Hollywood, CA 90046  
(213) 654-2214  
(213) 656-7368

## P.C. Computers

10166 San Pablo Avenue  
El Cerrito, CA 94530  
(415) 527-6657

Pilgrim Computer Products  
1444 Pioneer Way  
El Cajon, CA 92020  
(714) 278-8764

Redding Computer Service  
610 W. Cypress Avenue  
Redding, CA 96001  
(916) 246-1170

## COLORADO

Computer Technology  
6311 Federal Blvd.  
Denver, CO 80221  
(303) 427-4438

## CONNECTICUT

R & R Computer Store  
130 Jefferson Avenue  
New London, CT 06320  
(203) 447-1079

## FLORIDA

Byte Shop-Ft. Lauderdale  
1044 E. Oakland Park Blvd.  
Ft. Lauderdale, FL 33334  
(305) 561-BYTE

Byte Shop  
7825 Bird Road  
Miami, FL 33155  
(305) 264-BYTE

Computer Center of the  
Palm Beaches  
2827 Exchange Court  
West Palm Beach, FL 33409  
(305) 689-3233

Digital Design Center  
601 Golden Harbour Drive  
Boca Raton, FL 33432  
(305) 994-4826

Microcomputer Systems, Inc.  
144 S. Dale Mabry  
Tampa, FL 33609  
(813) 879-4225

## GEORGIA

Micro Business Systems  
103 Commercial Avenue  
Carrollton, GA 30117  
(404) 834-7705

## HAWAII

Mahalo Microsystems Ltd.  
P.O. Box 8523  
Honolulu, HI 96815  
(808) 922-2152

## ILLINOIS

Bies Systems  
(Formerly-The Computer Store)  
7037 W. North Avenue  
Oak Park, IL 60302  
(312) 386-3323

\*Computerland-Peoria  
4507 N. Sterling  
Peoria, IL 61614  
(309) 688-6252

Computer Station  
3659 Nameoki Road  
Granite City, IL 62040  
(618) 452-1860

Illini Microcomputers  
612 E. Ogdan Avenue  
Naperville, IL 60540  
(312) 420-8813

Lillipute Computer Mart, Inc.  
4446 Oakton Street  
Skokie, IL 60076  
(312) 674-1383

## INDIANA

AudioSpecialists  
401 North Michigan  
South Bend, IN 46601  
(219) 234-5001

## KANSAS

Computer Center (Byte Shop #61)  
8515 Johnson Drive  
Mission, KS 66202  
(913) 432-BYTE

## MARYLAND

\*Computerland-Rockville  
16065 Frederick Rd. (Rt. 355)  
Rockville, MD 20855  
(301) 948-7676

## MASSACHUSETTS

Computer Mart, Inc.  
1395 Main Street  
Waltham, MA 02154  
(617) 899-4540

Computer Shop-Cambridge  
288 Norfolk Street  
Cambridge, MA 02139  
(617) 247-0700

## MICHIGAN

The Abacus  
Rt. 1, Box 193; US-31  
Berrien Springs, MI 49103  
(616) 429-3034

\*Computerland-Southfield  
29673 Northwestern Highway  
Southfield, MI 48034  
(313) 356-8111

Computer Mart-Royal Oak  
1800 W. 14 Mile Road  
Royal Oak, MI 48073  
(313) 576-0900

Micro Computer World  
313 Michigan NE  
Grand Rapids, MI 49503  
(616) 451-8972

Neal and Associates  
4215 Shetland Drive  
Ann Arbor, MI 48104  
(313) 973-0979

Tri-Cities Computer Mart  
3145 Shattuck  
Saginaw, MI 48602  
(517) 790-1360

## MINNESOTA

Microprogramming, Inc.  
1351 Larc Industrial Blvd.  
Burnsville, MN 55337  
(612) 894-3510

## NEBRASKA

Omaha Computer Store  
4540 S. 84th Street  
Omaha, NE 68127  
(402) 592-3590

## NEVADA

Byte-Reno (Cyber Sense, Inc.)  
4104 S. Kietzke Lane  
Reno, NV 89509  
(702) 826-8080

## NEW HAMPSHIRE

\*Computerland-Nashua  
419 Amherst Street  
Nashua, NH 03060  
(603) 889-5238

Microcomputers, Inc.  
36 Otterson Street  
Nashua, NH 03060  
(603) 889-1646

NEW JERSEY  
Applied Computer Research  
Systems  
445 Brick Blvd.  
Bricktown, NJ 08723  
(201) 477-4222

Atlantic Microsystems  
82 Maryknoll Road  
Metuchen, NJ 08840  
(201) 549-0189

The Computer Emporium  
Avenues of Commerce/Bldg. 103  
248 Route 38  
Cherry Hill, NJ 08002  
(609) 667-7555

## S-100, Inc.

7 White Place  
Clark, NJ 07066  
(201) 382-1318

## NEW YORK

Byte Shop-New York  
130 E. 40th Street  
New York, NY 10016  
(212) 889-4204

The Computer Corner, Inc.  
White Plains Mall  
200 Hamilton Avenue  
White Plains, NY 10601  
(914) WHY-DATA

Computer Enterprises  
P.O. Box 71  
Fayetteville, NY 13066  
(315) 637-6208

Computer Mart-New York, Inc.  
118 Madison Avenue  
New York, NY 10016  
(212) 686-7923

Computer Microsystems  
1311 Northern Blvd.  
Manhasset, NY 11030  
(516) 627-3640

Computer Shop of Syracuse, Inc.  
3470 Erie Blvd. East  
Dewitt, NY 13214  
(315) 446-1284

Home Computer Center  
671 Monroe Avenue  
Rochester, NY 14607  
(716) 244-6237

Long Island Computer  
General Store  
103 Atlantic Avenue  
Lynbrook, NY 11563  
(516) 887-1500

Micro World Computer Store  
435 Main Street  
Johnson City, NY 13790  
(607) 798-9800

Mini Micro Mart, Inc.  
1618 James Street  
Syracuse, NY 13202  
(315) 422-4467

## NORTH CAROLINA

Futureworld  
2514 University Drive  
Durham, NC 27707  
(919) 489-7486

## OHIO

Byte Shop-Ohio  
19524 Center Ridge Road  
Rocky River, OH 44116  
(216) 333-3261

\*Computerland-Cleveland  
1288 Som Center Road  
Cleveland, OH 44124  
(216) 461-1200

## OKLAHOMA

Microthetics, Inc.  
2918 N. MacArthur Blvd.  
Oklahoma City, OK 73127  
(405) 947-5646

## OREGON

Byte Shop-Beaverton  
3482 S.W. Cedar Hills Blvd.  
Beaverton, OR 97005  
(503) 644-2686

## PENNSYLVANIA

Byte of Pennsylvania  
1045 Lancaster Avenue  
Bryn Mawr, PA 19010  
(215) 525-7712

Marketline Systems, Inc.  
2337 Philmont Avenue  
Huntingdon Valley, PA 19006  
(800) 523-5355

## SOUTH CAROLINA

Byte Shop #32  
1920 Blossom Street  
P.O. Box 5144  
Columbia, SC 29205  
(803) 771-7824

## TEXAS

East Texas Computers  
305 Clemson Drive  
Tyler, TX 75703  
(214) 561-2635  
(214) 561-1648

Microbyte-Abacus  
2218 Crawford  
Houston, TX 77002  
(713) 757-1128

Micro Mike's  
905 Buchanan  
Amarillo, TX 79101  
(806) 372-3633

Neighborhood Computer Store  
4902 34th Street #20  
Lubbock, TX 79410  
(806) 797-1468

## UTAH

Byte of Salt Lake City  
161 E. 2nd South  
Salt Lake City, UT 84111  
(801) 355-1041

\*Computerland of Salt Lake City  
161 E. 2nd South  
Salt Lake City, UT 84111  
(801) 364-4416

## VIRGINIA

\*Computerland of Tysons Corner  
8411 Old Courthouse Road  
Vienna, VA 22180  
(703) 893-0424

The Computer Place  
2718 Colonial Avenue SW  
Roanoke, VA 24015  
(703) 982-3661

The Computer Systems Store  
1984 Chain Bridge Road  
McLean, VA 22102  
(703) 821-8333

Redi-PGMS  
7916 Westpark Drive  
McLean, VA 22102  
(703) 893-7200

## WASHINGTON

\*Computerland/SK  
1500 South 336th Street  
Federal Way, WA 98003  
(206) 927-8585  
(206) 838-9363

Personal Computers, Inc.  
South 104 Freya  
Spokane, WA 99202  
(509) 534-3955

## WISCONSIN

Lancer Electronics, Inc.  
2700 S. Chicago Avenue  
So. Milwaukee, WI 53172  
(414) 762-6500

## AUSTRALIA

Automation Statham Pty Ltd.  
47 Birch Street  
Bankstown, NSW 2200  
(02) 709-4144

## BELGIUM

Pulsion  
Avenue Albert Mahiels, 13/081  
B-4020  
Liege

## CANADA

Byte Shop-Vancouver  
2151 Burrard Street  
Vancouver, B.C. V6J 3H7  
(604) 736-0511

## Compumart

411 Roosevelt Avenue  
Ottawa, Ontario K2A 3X9  
(613) 725-3192

Custom Computing Systems, Inc.  
204 2nd Avenue N  
Saskatoon, Sask. S7K 2B5  
(306) 242-7808

## Home Computer Center

6101 Yonge Street  
Willowdale, Ontario M2M 3W2  
(416) 222-1165

Orthon Computer Company  
12411 Stony Plain Road  
Edmonton, Alberta T5N 3N3  
(403) 488-2921

Pacific Computer Store  
4509 Rupert Street  
Vancouver, B.C. V5R 2J4  
(604) 438-3282

TJB Microsystems, Ltd.  
10991 124th Street  
Edmonton, Alberta T5M 0H9  
(403) 455-5298

## Trintronics, Ltd.

186 Queen Street W  
Toronto, Ontario H5V 1Z1  
(416) 598-0260

## ENGLAND

AEM Systems Ltd.  
12A London Street  
Southport, England  
(0704) 79761

Interam Computer Systems Ltd.  
59 Moreton Street  
Victoria, London S.W.1  
01-834 0261/2733

## GERMANY

Computershop GMBH  
D-7800 Freiburg Im Breisgau  
Adelhauserstrasse 29  
West Germany

## JAPAN

Super Brain  
1-15-16 Sopokanda  
Chiyoda-Ku, Tokyo

## MEXICO

I.T.E.S.O.  
1342-8 Niños Heroes  
Guadalajara

## SINGAPORE

Og Departmental Store  
100 Upper Cross Street  
Singapore 1  
917788

Sys-Tech Pte Ltd.  
556B Rochor Centre  
Rochor Road, Singapore 7  
2927645



\*Thinker Toy™ Products may be purchased from all Computerland™ stores worldwide.



Decimal Memory Address	Contents Or Function
5632 thru 5799	Move particles one step forward in time, bouncing off walls as necessary.
5800 thru 6036	Plot particles on screen, colliding ones which fall in same cell on the 50 by 80 grid.
6144 thru 6399	High bytes of X coordinates.
6400 thru 6655	Low bytes of X coordinates.
6656 thru 6911	High bytes of Y coordinates.
6912 thru 7167	Low bytes of Y coordinates.
7168 thru 7423	High bytes of VX velocities.
7424 thru 7679	Low bytes of VX velocities.
7680 thru 7935	High bytes of VY velocities.
7936 thru 8191	Low bytes of VY velocities.
10	Current screen character at location to be plotted.
11 thru 25	Table of PET ¼ graphics symbols; translates to and from "binary graphics symbols."
26,27	Low, high bytes of current screen address.
28	"Binary graphics symbol" to be put onto current location (1, 2, 4, or 8).
29,30	High, low bytes of $M=(A+B+C+D)/2$ .
31,32	High, low bytes of $TEMP=M-B$ .
6050 thru 6074	Low bytes of table of left ends of screen lines.
6075 thru 6099	High bytes of table of left ends of screen lines.
6100 thru 6114	Table of graphics symbols, in order defined to be 1, 2, 3, 4, . . . . 15 in "binary graphics symbols."
5632 thru 5654	Move X coordinate.
5655 thru 5660	Check to see if in box; fix if not.
5661 thru 5679	Move Y coordinate.
5680 thru 5685	Check to see if in box; fix if not.
5686 thru 5689	Increment counter; do next particle if not done.
5690 thru 5726	Fix if gone off left edge.
5727 thru 5746	Fix if gone off right edge.
5747 thru 5779	Fix if gone off bottom.
5780 thru 5799	Fix if gone off top.
5800 thru 5809	Transfer table to page 0 of memory.
5810 thru 5824	Put address of screen left edge of line to be plotted into 26,27.
5825 thru 5848	Put "binary graphics symbol" to be plotted into 28, and add location in line to be plotted to 26,27.
5849 thru 5866	Find current graphics symbol which occupies space to be plotted in; look up in table and translate to "binary graphics symbol."
5867 thru 5882	Plot particle if space to which it goes isn't already occupied.
5883 thru 5886	Increment counter and go back to 5810 if not through.
5887 thru 6036	A collision has occurred! Scan back to see which particle has collided with the one about to be plotted, and fix their velocities, as in text.
6037 thru 6049	This space intentionally left blank.

Text continued from page 28:

$3 \times 10^{19}$ , then the fractional fluctuation in this number is about  $1/\sqrt{3 \times 10^{19}} \approx 0.2$  parts per billion — small, but measurable. (The human ear is sensitive enough to barely hear these fluctuations — try it, if you can find a quiet enough place!) So, the errors that the 256 particle gas model will tend to make are of the order of  $1/\sqrt{256} \approx 6\%$  — not terribly bad.

A second important feature of my model is the way it handles collisions. Time is broken into steps, and two particles which end a timestep in the same cell are considered to collide. It would be far more complicated to calculate distances between particles as they move and to declare a collision only if their center-to-center distance fell below a certain limit. It also turns out not to matter much, as far as the final equilibrium state of the gas is concerned. Actual collisions are sometimes grazing, sometimes head-on, and generally everywhere in between, depending on the details of the interactions between the molecules and their impact parameters. None of that really matters for our purposes.

The important feature of all collisions in gasses is that the collisions always conserve energy and momentum. Energy is just kinetic energy for pointlike particles:  $\frac{1}{2}mv^2$ . To simplify the arithmetic, I let all of my gas particles have mass  $m = 2$ , so their energies are just the squares of their velocities. In two dimensions, velocity has components along the X and Y axes; call them VX and VY. The momentum of a particle is just its mass times its velocity. Momentum thus has X and Y components, each of which must separately be conserved, that is, remain constant during a collision.

To be specific, suppose that VX and VY are arrays, and that particles numbered 1 and 2 are colliding. If arrays WX and WY are used to hold their velocities after the collision, then conservation of energy says that (total energy after)=(total energy before), that is,  $WX(1)^2+WY(1)^2+WX(2)^2+WY(2)^2=VX(1)^2+VY(1)^2+VX(2)^2+VY(2)^2$ . Conservation of X momentum says that  $WX(1)+WX(2)=VX(1)+VX(2)$ , and conserving Y momentum implies that  $WY(1)+WY(2)=VY(1)+VY(2)$ .

Now, if the velocities before the collision are known, then there are four velocities afterwards to solve for: WX(1), WY(1), WX(2), and WY(2). Three equations are not enough information to solve for four unknowns. The missing equation contains the details of the collision — whether it is head-on or glancing or what. One might write out this fourth equation (it's done in most freshman physics textbooks) in terms

Table 1: Comments on Gas machine language modules given in listing 2.

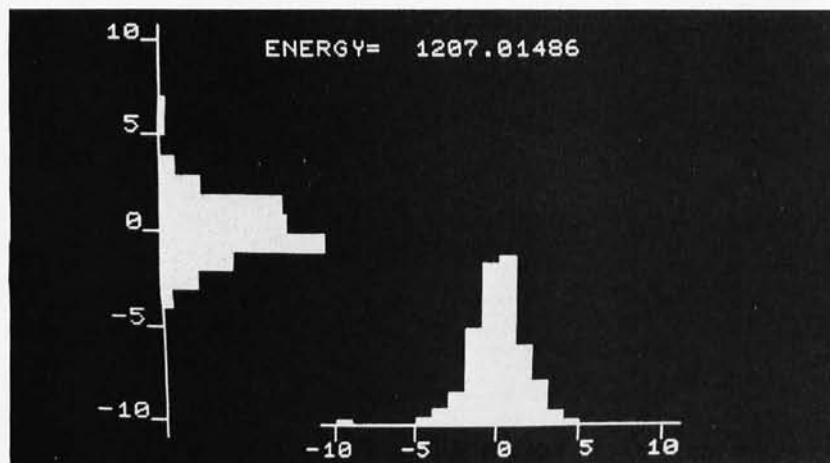


Photo 6: Velocity histogram for the high temperature gas shown in photo 5.



# MICROWORLD

TOLL-FREE  
1-800-528-1418

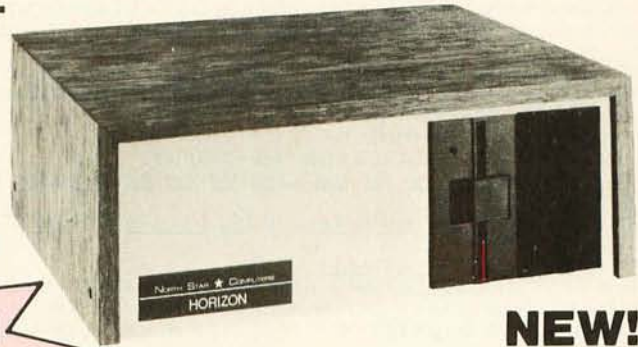
LOWEST PRICES • FAST DELIVERY • DEPENDABLE SERVICE

## DOUBLE DENSITY HORIZON I KIT

double the storage at the same price!

Today's best buy. 180K bytes per disk. The chosen computer for two MicroWorld systems . . . Autoscribe — The Paperwork Manager™ and Bookkeeper — The Office Accountant™. Single density still runs on your new Horizon, or you can copy and convert all North Star software and programs to double density.

- exclusive application software
- add'l 16K memory (kit), \$349
- add'l disk drive (kit), \$349



**NEW!**

**\$1349**  
(reg. \$1599)

Call for low assembled prices. Double density also available on North Star disk sub-system, \$599 kit.

RUN SUPERIOR  
MICROPOLIS BASIC

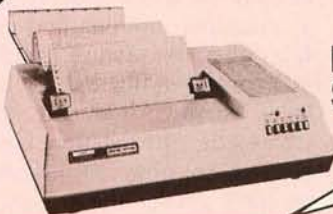


## MICROPOLIS DISK DRIVE FOR TRS-80

**\$499**

Introductory Price  
(reg. \$599)

INTERFACED  
TO YOUR COMPUTER  
FREE!



## HEATH DATA SYSTEMS PRINTER

**\$895**

NEW  
LOW PRICE!

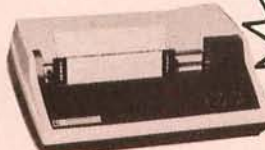
## SOROC IQ 120 VIDEO TERMINAL



**\$795**  
(reg. \$995)

Immediate  
Shipment!

## TI 810 PRINTER



**\$1695**  
(reg. \$1895)

## MicroWorld Specials

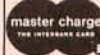
Integral Data Printer	....	\$ 749
Add for Tractors	.....	\$ 150
Mime Terminal	.....	\$ 742
Hazeltine 1410 Terminal	..	\$ 765
Hazeltine 1500 Terminal	..	\$1097
Teletype Model 43		
Printer	.....	\$1019
Dataproducts M-200		
Printer	.....	\$2921
Vector Graphics MZ	....	\$3225
Exidy 16K Sorcerer	....	\$1035
Data General		
microNOVA	.....	\$CALL
Qume Sprint 5 RO		
Printer (55cps)	.....	\$2895
DEC LS 120 Printer	....	\$CALL
Centronics 779 Printer		
(incl. tractors)	.....	\$1095
Micropolis 1042 Mod		
I Drive	.....	\$CALL
TI 59 Calculator	.....	\$ 219
Novation CAT Modem	..	\$ 199
TI 820 Terminal	.....	\$2199
North Star Horizon		
Software	.....	\$CALL
Dataproducts B-300		
Printer	.....	\$5346
IPSI 1620 Diablo RO	....	\$2705
Hitachi 9" Monitor	.....	\$ 184
Cromemco System III	...	\$5299
Imsai VDP-80	.....	\$CALL

## MICROWORLD™

Bringing information technology to your doorstep  
1425 W. 12th Pl. • Tempe, AZ 85281 • 602-894-1193

VISA

No extra charge for credit card orders



Circle 232 on inquiry card.

Freight collect, F.O.B. Tempe  
No other handling charges

Formerly Byte Shop Mail Order

**CALL TOLL-FREE 1-800-528-1418**







# 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 330 on inquiry card.

**SOROC**  
TECHNOLOGY, INC.

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



# There's an Ohio Scientific dealer near you.

## ALABAMA

Plainsman Micro Systems  
3808 Pepperill Parkway  
Office #1  
Auburn, AL 36830  
(205) 821-1694  
M.C.S. Corp.  
Pelham Mall  
Pelham, AL 35124  
(205) 663-1287

## ALASKA

Alert T.V.  
6122 Seward Highway  
Anchorage, AK 99502  
(907) 344-3311  
Scientific Business Instr's  
800 E. Diamond Blvd. Ste. 140  
Anchorage, AK 99502  
(907) 344-8352

## ARIZONA

The Computer Shop  
15 N. Central  
Colorado City, AZ 86021  
(602) 875-2451  
D.C.T. Co.  
1210 W. Alameda #103  
Tempe, AZ 85282  
(602) 966-6440

## ARKANSAS

Computerland of Little Rock  
1121 Rodney Parham  
Little Rock, AR 72212  
(501) 224-4508

## CALIFORNIA

Anahem Computer Equipment  
2974 W. Ball Rd.  
Anahem, CA 92804  
(714) 827-9750  
Shuey Aircraft  
1009 E. Vermont  
Anahem, CA 92805  
(714) 991-3940

Professional Services  
139 S. Beverly  
Beverly Hills, CA 90212  
(213) 550-1560  
Tri Source Corp.  
1660 Rollins  
Burlingame, CA 90014  
(415) 892-5418

I'S Audio-Visual Services  
10000 Hanna St.  
Chatsworth, CA 91311  
(213) 988-2059  
Silver Spur Electronics  
Communications  
13552 Central Ave.  
Chino, CA 91710  
(714) 627-8366

Alternative Computer Systems  
216 Full Circle  
Davis, CA 95616  
(916) 758-5364  
Advances in Computing  
8756 Warner  
Fountain Valley, CA 92706  
(714) 848-8388

Ohio Scientific West  
15461 Chemical Lane  
Huntington Beach, CA 92649  
(714) 891-2457  
Consumer Computers  
8907-A La Mesa Blvd.  
La Mesa, CA 92041  
(714) 465-8888

Computers-Are Fun  
2268 Westwood Blvd.  
Los Angeles, CA 90064  
(213) 475-0566  
Data Products Mgmt.  
128 N. Garfield  
Monterey Park, CA 91754  
(714) 973-5991

A.J.M. Enterprises  
P.O. Box 1396  
Ridgecrest, CA 93555  
(714) 975-8638  
Microtech Experts  
912 Cowper St.  
Palo Alto, CA 94301  
(415) 328-1712

The Computer Center  
8205 Ronson  
San Diego, CA 92111  
(714) 292-5302  
Olson Electronics  
Keary Mesa, 4840 Conroy  
San Diego, CA 92111  
(714) 292-1100

B. L. M. Systems Inc.  
One Ecker  
San Francisco, CA 94105  
(415) 946-1797  
Systems Engineering  
900 3rd Street  
San Francisco, CA 94107  
(415) 773-3150

Tech Service  
1200 Taylor #6  
San Francisco, CA 94108  
(415) 771-5061  
A. A. Office Equipment  
15296 E. 14th St.  
P.O. Box 3221  
San Leandro, CA 94578  
(415) 357-1737

Kirco Corp.  
P.O. Box 396  
Sierra Madre, CA 91024  
(213) 355-0720  
Pulse Technology  
5074 Gallatin Place  
Boulder, CO 80303  
(303) 444-3652

Sileo Electronics Co.  
381 S. Broadway  
Denver, CO 80209  
(303) 777-3222  
Tricom Computer Country  
3489 W. 72nd Ave., Suite 101  
Denver, CO 80030  
(303) 426-7743

Computer Shop  
835 Main #206  
Durango, CO 81301  
(303) 247-5905  
Byte Shop, Inc.  
3463 South Acoma  
Englewood, CO 80110  
(303) 761-8232

Total Data Systems  
125 Fairway Lane  
Fort Collins, CO 80521  
(303) 491-5682  
CONNECTICUT  
R & R Computer Sales  
130 Jefferson Ave.  
New London, CT 06320  
(203) 447-1079

NEW JERSEY  
Computer Corner  
240 Wanauke  
Pompton Lakes, NJ 07442  
(201) 635-7080  
Garden State Computer  
922 South Avenue  
Westfield, NJ 07090  
(201) 232-0511

## NEW YORK

Micromini Systems  
4020 Hempstead Ave.  
Bethpage, NY 11714  
(516) 731-7100  
DBIS  
475 White Plains Road  
Eastchester, NY 10707  
(914) 779-5292

Associated Consultants  
53 Ogden  
East Williston, NY 11596  
(516) 746-1079  
Work Force, Inc.  
315 Wait Whitman Rd.  
Huntington Station, NY 11746  
(516) 271-7711

Aristo-Craft  
314 5th Avenue  
New York, NY 10001  
(212) 279-9034  
Better Programming  
Systems, Inc.  
275 Fort Washington Ave.  
New York, NY 10032  
(212) 781-1861

Computer Mart of N. Y.  
118 Madison  
New York, NY 10016  
(212) 686-7323  
Brag Computer  
19 Cambridge  
Rochester, NY 14607  
(716) 442-5881

Universal Data Research  
234 Tennyson Terrace  
Williamsville, NY 14221  
(716) 689-7788  
NORTH CAROLINA  
Wessell, Inc.  
508 E. Central Ave.  
P.O. Box 686  
Raeleford, NC 28376  
(919) 875-2798

## NORTH DAKOTA

General Sys. Programming  
1013 University Avenue  
Grand Forks, ND 58201  
(701) 746-1042  
OHIO  
Band-Orch, Inc.  
337 E. State St.  
Alliance, OH 44601  
(216) 821-2600  
Lucas Office Equipment  
& Service  
869 E. Franklin  
Centerville, OH 45459  
(513) 433-8484

Econo Data  
580 Walnut  
Cincinnati, OH 45202  
(513) 421-7071  
Systems Support Associates  
2330 Victory Parkway  
Cincinnati, OH 45206  
(513) 281-4477  
Medical Business Systems  
6685 Beta Drive  
Cleveland, OH 44143  
(216) 461-7650  
Integrated Management Sys.  
6400 E. Broad St.  
Ste. 401  
Columbus, OH 43213  
(614) 866-1307

Astro Video Electronics Inc.  
504 E. Main St.  
Lancaster, OH 43130  
(614) 687-0629  
Johnson Computer  
123 W. Washington  
Medina, OH 44256  
(216) 725-4560  
Micro Systems Sales  
30 W. Aurora Road  
Northfield, OH 44067  
(216) 467-0003

## OKLAHOMA

Gauger Engineering  
910 Orient Street  
Clinton, OK 73601  
(405) 323-2320  
Accounting Systems  
2709 Orlando  
Oklahoma City, OK 73120  
(405) 751-1537  
Gauger Engineering  
3824 S. 79th East  
Tulsa, OK 74145  
(918) 627-1064

## OREGON

Schoofultures Inc.  
Box A Ohara Hall  
Marylhurst, OR 97036  
(503) 835-3544  
Fial Computer  
10675 SE 42nd Avenue  
Milwaukie, OR 97222  
(503) 854-9574

## PENNSYLVANIA

Broad Enterprises  
550 N. Derrill 15  
Lewisburg, PA 17837  
(717) 523-8641  
Television Parts Co. Inc.  
518 5th Ave.  
New Brighton, PA 15066  
(412) 846-4044

International  
Automation Inc.  
2nd Floor  
Mellon Bank Bldg.  
New Kensington, PA 15068  
(412) 337-8080  
Abacus Data Systems  
Route 8  
Reno, PA 16343  
(814) 677-8502

Creative Computer Systems  
& Software  
14 S. Church St.  
West Chester, PA 19380  
(215) 436-4750

## TEXAS

Personnel Cost Control  
11311 Stemmons Freeway  
Dallas, TX 75229  
(214) 241-5377  
Computer Imagining  
2825 Valley View  
Dallas, TX 75234  
(214) 247-6393

R. K. O. Enterprises  
1007 W. Harrison  
Harlingen, TX 78550  
(312) 428-6072  
Cybernetics  
16322 Timber Valley  
Houston, TX 77070  
(713) 376-8431

Mr. Computer  
744 FM 1960 W., Suite E  
Houston, TX 77090  
(713) 444-7419  
Mr. Computer  
17024 Butte Creek  
Houston, TX 77090  
(713) 353-0816

Kay Computers  
1230 Main  
League City, TX 77573  
(713) 332-5555  
Dates Computer Center  
2626 Kermit Hwy.  
Odessa, TX 79763  
(915) 333-4516

Computer Shop  
6812 San Pedro  
San Antonio, TX 78216  
(512) 828-0553  
UTAH  
Walker Electronics  
325 W. Main St.  
Lehi, UT 84043  
(801) 768-3698

Everton Publishers  
526 N. Main St.  
Logan, UT 84321  
(801) 752-8022  
Home Computer Store  
2343 East 3300 South  
Salt Lake City, UT 84109  
(801) 484-6502

TV Specialists  
170 E. 2100 South  
Salt Lake City, UT 84108  
(801) 486-7555  
VIRGINIA  
Community General Store  
2704 N. Pershing  
Arlington, VA 22201  
(703) 527-4600

H/B Computers  
217 E. Main St.  
Charlottesville, VA 22901  
(804) 295-1975  
Automated Business Svcs.  
1649 W. Broad St.  
Richmond, VA 23220  
(804) 355-4361

Microsystems, Inc.  
5320 Williamson  
Roanoke, VA 24012  
(703) 563-0693  
Microsystems of Virginia  
107 Lee  
Vinton, VA 24179  
(703) 563-0693

WASHINGTON  
Computerland of Bellevue  
14345 N.E. 20th  
Bellevue, WA 98007  
(206) 746-2070  
Ideafix  
12038 Main St.  
Bellevue, WA 98005  
(206) 454-9046

Ye Old Computer Shoppe  
1301 George Washington Way  
Richland, WA 99352  
(509) 946-3330  
Ye Old Computer Shoppe  
1605 E. Isaacs St.  
Walla Walla, WA 99362  
(509) 529-9333

WEST VIRGINIA  
Interactive Operations  
P.O. Box 1322  
Bluefield, WV 24701  
(304) 327-6583  
Computermart, Inc.  
P.O. Box 336  
Morgantown, WV 26505  
(304) 291-5400

WISCONSIN  
Indian Head Computer  
Systems  
405 S. Farwell St.  
Eau Claire, WI 54701  
(715) 834-8169  
MicroComp  
44 N. Main  
Fond du Lac, WI 54935  
(414) 922-2515

Specialty Office Machines  
20 East Second  
Fond du Lac, WI 54935  
(414) 922-5440  
American Microprocessors  
3121 Windsor Rd.  
Janesville, WI 53545  
(608) 752-0111

Integrated Micro  
206 Hood St.  
La Crosse, WI 54601  
(608) 784-7979  
Madison Computer Store  
1825 Monroe  
Madison, WI 53711  
(608) 255-5552

Faragher & Associates  
7635 W. Bluemond Rd.  
Milwaukee, WI 53213  
(414) 258-2588

## WYOMING

Control Technology  
204 Crazy Horse Lane  
Gardiner, WY 82716  
(307) 682-0300

CANADA  
Bectern  
1277 Chemin St. Jean  
Bernieres, Quebec,  
Canada G0S 1C0  
(418) 831-4522

Omega Computing Ltd.  
Box 220  
Station P  
Toronto, Ontario  
Canada M5S 2S7  
(416) 425-9200

Robo-Tronics  
509 16th N. W.  
Calgary, Alberta  
Canada T2M 0J6  
(403) 282-9468

ARGENTINA  
S. I. C.  
Venezuela 3392  
Buenos Aires  
Argentina 1211 Capital Fed.  
88-2547

AUSTRALIA  
Sys. Automation Prop. Ltd  
26 Clark St., Crows Nest,  
N.S.W.  
Australia 2065  
(02) 439-6477

BEELGIUM  
IEC (International Electronic)  
Avenue Charles Pieris, 3F  
B-1070 Bruxelles (Belgium)  
02521-9580

ENGLAND  
Mutek  
The Studio, Quarry Hill,  
Box Corsham  
Wiltshire, England  
022121-3289

Abacus Computers Limited  
62 New Cavendish Street  
London W1, England  
01-580-8841

American Data-Home &  
Office Computer  
150 Regent St.  
Ste. 500  
Chesham House  
London, W1R 5FA  
England 011-439-6288

U-Microcomputers  
P.O. Box 24  
Northwich, Cheshire  
CW11 1RS, England  
0606-5627

FRANCE  
Janaz Computer Shop  
12 Rue Pasquier  
75008 Paris, France  
329-6237

Electronic J.L.  
97 Rue Chantiers  
78000 Versailles, France  
950-2820

GREECE  
Compumak Ltd.  
117 Solon Street  
Athens 142, Greece  
3632952

ITALY  
Skylab  
Via M. Gioia 66  
20125 Milano  
Italy  
(02) 688-3806

Ediconsult S.R.L.  
Via Caccini 12  
Monza, Italy  
039-38-850

## MEXICO

Electronica S.A. De C. V.  
Varsovia 436  
Mexico 6. D. F.  
5-33-11-80

NETHERLANDS  
Ingenieurs Bureau  
Koopman  
Joh. Vermeer Str. 7  
3351 BM Papendrecht  
Netherlands  
078-56033

## PERU

Pereyra & Assoc. S.R.L.  
Aires Schreiber 225  
Ur. Aurora Miraflores  
Lima, Peru  
(01) 426-1111

PUERTO RICO  
Puerto Rico Computer Sales  
P.O. Box 2036  
Hato Rey,  
Puerto Rico 00919  
(809) 751-4042

ECUADOR  
Sociedad Anonima  
De Ventas  
P.O. Box 701  
Cueno, Ecuador  
830-770

## SWEDEN

Intron AB  
Box 3056  
18303 Taby  
Sweden  
(08) 756-0155

NETHERLAND  
Naalco Corp.  
4023 Basel  
Basel, Switzerland 4023  
(011416) 463626

VENEZUELA  
Elec. Data Processing C.A.  
P.O. Box 11-08-58  
E-1100 Caracas  
2-Local 39-Apartado  
Postal 1892  
Maracaibo, Venezuela  
7184

WEST GERMANY  
BISY  
Reinshtrasse 2  
4040 Neuss 1  
West Germany  
(02101) 28124

Microcomputer  
Datensysteme GmbH.  
Alfelder Strasse 6  
P.O. Box 11-08-58  
D-6100 Darmstadt  
West Germany  
(0615) 71-4444

## DISTRICT OF COLUMBIA

American Data Home Office  
Computer  
1630 15th Street  
Washington, D.C. 20005  
(202) 466-6612  
Newtronic  
1647 Lemoni N.W.  
Washington, D.C. 20034  
(202) 234-6646

## FLORIDA

Trans-Data Corp.  
161 Almeria Avenue  
Coral Gables, FL 33134  
(305) 576-7666  
Intercontinental Computer  
2754 N. W. N. River Drive  
Miami, FL 33142  
(305) 633-1546  
Micro Computer Systems  
144 S. Dale Mabry Hwy.  
Tampa, FL 33609  
(813) 879-4301

## GEORGIA

Electronic Information  
Systems  
1749 Rockville Pike  
170 Heatherwood Lane  
Athens, GA 30601  
(404) 353-2858  
Graham Business Computer  
5725 Buford Highway,  
Suite 216  
Atlanta, GA 30340  
(404) 457-8540

Columbus Software Center  
4723 Northgate, Box 8088  
Columbus, GA 31908  
(404) 563-7729  
Capital Computer Systems  
3596 El Camino Ave.  
Sacramento, GA 95821  
(916) 483-7298

## HAWAII

Small Computer Systems  
3149G Waiiala  
Honolulu, HI 96816  
(808) 732-5246  
IDAHO  
Cimco Distributors, Inc.  
1016 Park Lane  
Portello, ID 83201  
(208) 237-2448

## ILLINOIS

American Microprocessors  
1100 E. Broadway  
Alton, IL 62002  
(618) 465-4489  
Simbu Corp.  
800 N. Main St.  
Antioch, IL 60002  
(312) 395-8389  
Tech-Tronics  
715 S. University  
Carbondale, IL 62901  
(618) 549-8495

Adonis Computing  
2855 W. Nelson  
Chicago, IL 60618  
(312) 463-3620  
Electronic Systems  
611 N. Wells  
Chicago, IL 60610  
(312) 944-6565

A & H Associates, Ltd.  
2530 Crawford  
Evanston, IL 60602  
(312) 328-2600  
No Name  
2701 Grand Ave.  
Galesburg, IL 61401  
(309) 343-6135

Processor Systems  
228 School  
Geneva, IL 60134  
(312) 232-7195  
Computer/Micro Systems, Inc.  
1132 Waukegan  
Glenview, IL 60025  
(312) 724-3690

Tek-Aids Industries  
1711 Chestnut  
Glenview, IL 60025  
(312) 724-3620  
Autodata Corp.  
21000 S. Western Ave.  
Olympia Fields, IL 60461  
(815) 469-4775

American Microprocessors  
6934 N. University  
Peoria, IL 61614  
(309) 692-5852  
American Microprocessors  
20 N. Milwaukee  
Prairieville, IL 60069  
(312) 634-0076

Quincy Hobby Center  
6532 Maine St.  
Quincy, IL 62301  
(217) 223-8498  
Wysocki Electric  
5853 11th St.  
Rockford, IL 61109  
(815) 874-4846

INDIANA  
Elkhart Computer Company  
29934 Riviera  
Elkhart, IN 46514  
(219) 295-8181  
American Microprocessors  
146 N. Broad  
Griffith, IN 46319  
(219) 924-7901

American Microprocessors  
3602 East Washington  
Indianapolis, IN 46201  
(317) 359-7445  
Computer Management  
610 Monroe  
LaPorte, IN 46350  
(219) 362-5812

American Microprocessors  
8555 Irving  
Portage, IN 46368  
(219) 760-2278  
Computer Center  
19619 Orchard  
South Bend, IN 46637  
(219) 272-0252

IOWA  
American Microprocessors  
102 E. 4th  
Waterloo, IA 50703  
(319) 266-2255

KANSAS  
Columbus Computing  
Center  
217 4th Ave.  
Columbus, KS 68725  
(316) 429-3605

Dunn Electronics  
1009 S. Kansas  
Liberal, KS 67901  
(616) 624-1888  
Barney & Associates  
425 N. Broadway  
Pittsburg, KS 66762  
(616) 231-1970

Technigraphics  
5911 Claredon  
Wichita, KS 67220  
(316) 744-2443  
MAINE  
Maine Data  
52 Canco Rd.  
P.O. Box 121  
Woodfords Station  
Portland, ME 04101  
(207) 773-1051

## MARYLAND

The Mathbox  
4431 Leigh  
College Park, MD 20740  
(301) 277-6828  
Systems Engineering  
1749 Rockville Pike  
Rockville, MD 20842  
(301) 468-1822

The Math Box  
2621 University Blvd. W.  
Need, MD 20902  
(301) 933-6555  
MASSACHUSETTS  
Bradshaw Enterprises  
18 Harborview Drive  
Hingham, MA 02043  
(617) 749-8844  
Computer Shop/Aircom Inc.  
288 Norfolk St.  
Cambridge, MA 02139  
(617) 861-2670

MICHIGAN  
The Abacus  
Route 1, Box 193  
Niles Road  
Berrien Springs, MI 49103  
(616) 429-3034  
Kimble Terminals  
451 S. Eton  
Birmingham, MI 48008  
(313) 645-5553

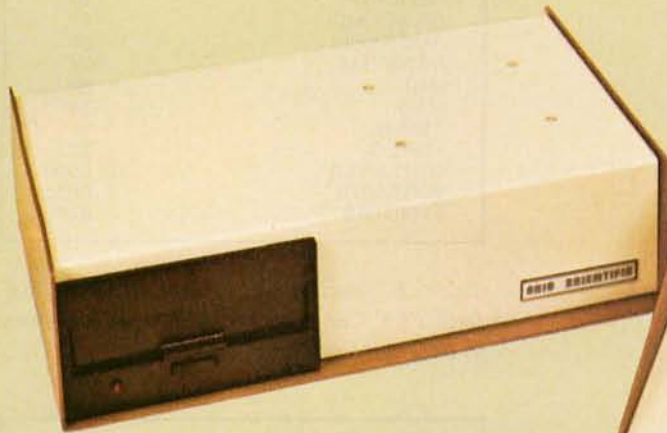
MicroComputer World  
313 Michigan N. E.  
Grand Rapids, MI 49503  
(616) 451-8972  
Concept Engineering  
3706 Malibu  
Lansing, MI 48910  
(517) 394-0585

Great Lakes Photo  
5001 Eastman  
Midland, MI 48640  
(517) 631-5461  
MINNESOTA  
Finco  
9100 W. Bloomington  
Floy-Ste. 170,  
Freeway Office Park  
Bloomington, MN 55431  
(612) 884-6744

North State Microcomputers  
1600 London Rd., Ste. 100  
Duluth, MN 55812  
(612) 278-2695  
Custom Computer Systems  
1823 Lowry  
Minneapolis, MN 55411  
(612) 598-3944



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.

Circle 290 on inquiry card.

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



Listing 2: The 6502 assembly language modules for use with the ideal gas program.

LABEL	MNEMONIC	COMMENTS
BEGINMOVE:	LDX #0	;initialize particle counter
	LDY #0	;clear Y register
TOP:	LDA VXLO,X	;move x coordinate of particle
	CLC	;by adding VX to X
	ADC XLO,X	
	STA XLO,X	
	LDA VXHI,X	
	ADC XHI,X	
	STA XHI,X	
	BMI NEGX	;bounce off left wall if x.LT.0
	CMP #80	
RETX:	BCS BIGX	;bounce off right wall if x.GE.80
	LDA VYLO,X	;move y coordinate
	CLC	;by adding VY to Y
	ADC VLO,X	
	STA YLO,X	
	LDA VYHI,X	
	ADC YHI,X	
	STA YHI,X	
	BMI NEGY	;bounce off bottom if y.LT.0
	CMP #50	
RETY:	BCS BIGY	;bounce off top if y.GE.50
	INX	
	BNE TOP	;do all 256 particles
	RTS	;back to BASIC control
NEGX:	TYA	;prepare to reflect -x to x
	SEC	;by subtracting from 0
	SBC XLO,X	
	STA XLO,X	
	TYA	;another 0 in accumulator
	SBC XHI,X	
	STA XHI,X	
REFLVX:	TYA	;reflect velocity vx also
	SEC	
	SBC VXLO,X	
	STA VXLO,X	
	TYA	
	SBC VXHI,X	
	STA VXHI,X	
	JMP RETX	;return to main program
BIGX:	LDA #255	;prepare to reflect x to 160-x
	SEC	;actually, 159.99...-x)
	SBC XLO,X	
	STA XLO,X	
	LDA #159	
	SBC XHI,X	
	STA XHI,X	
	JMP REFLVX	;reflect velocity vx using previous code
NEGY:	TYA	;reflect y to -y
	SEC	
	SBC YLO,X	
	STA YLO,X	
	TYA	
	SBC YHI,X	
	STA YHI,X	
REFLVY:	TYA	;reflect velocity vy also
	SEC	
	SBC VYLO,X	
	STA VYLO,X	
	TYA	
	SBC VYHI,X	
	STA VYHI,X	
	JMP RETY	;return to main program
BIGY:	LDA #255	;prepare to reflect y to 99.99...-y
	SEC	
	SBC YLO,X	
	STA YLO,X	
	LDA #99	
	SBC YHI,X	
	STA YHI,X	
	JMP REFLVY	;use previous code to reflect vy

Listing 2 continued on next page.

BEGINMOVE	5632
BEGINPLOT	5800
XHI	6144
XLO	6400
YHI	6656
YLO	6912
VXHI	7168
VXLO	7424
VYHI	7680
VYLO	7936
OLDCHAR	10
GRAFTAB	11
ADDRNOW	26
NEWSYMB	28
MHI	29
MLO	30
TMPHI	31
TMPLO	32
SCRTABLO	6050
SCRTABHI	6075
SYMBTAB	6100

Table 2: Specific addresses used in the 8 K byte PET Gas program. Addresses are given in decimal.

<i>cls</i>	= clear screen.
<i>b</i>	= backspace (cursor left).
<i>d</i>	= down (cursor down).
<i>r</i>	= right (cursor right).
<i>u</i>	= up (cursor up).
<i>home</i>	= cursor home.

Table 3: The PET uses special graphics symbols to denote cursor control characters. Since these special characters cannot be typeset, the above notation is used in the program.

Text continued from page 34:

or truncation errors. When an X coordinate ends up less than 0 or greater than 80, I reflect the particle off the left or right wall and reverse its X velocity; when a Y coordinate falls outside the box's range (0 to 50), I do the same for it. (Since I don't check for arithmetic overflows, if velocities get larger than about 32, there is a chance for error; this isn't a serious restriction, in practice.) In this format, addition and subtraction are trivial, and the only trick to dividing by 2 is to get the sign bit correct after shifting right.

That's all there is to the model. The details that are explained in the remarks in the BASIC listing (listing 1), and in the commentary about the listing 2 machine language modules in table 1, are probably of interest mainly to 6502 system users, especially PET owners who can use the program without modification. (At top speed, it makes about seven timesteps per second!) Much more interesting in general are the "bells and whistles" that can be added to the bare model for convenience and physical insight.



**Tinker, Tailor, Soldier, Sailor . . .  
Doctor, Lawyer . . . the Chieftain's here.**

No matter whether you're a serious hobbyist or a serious businessman, the Chieftain 6800 microcomputer with capabilities that surpass the Z-80 is made for you.

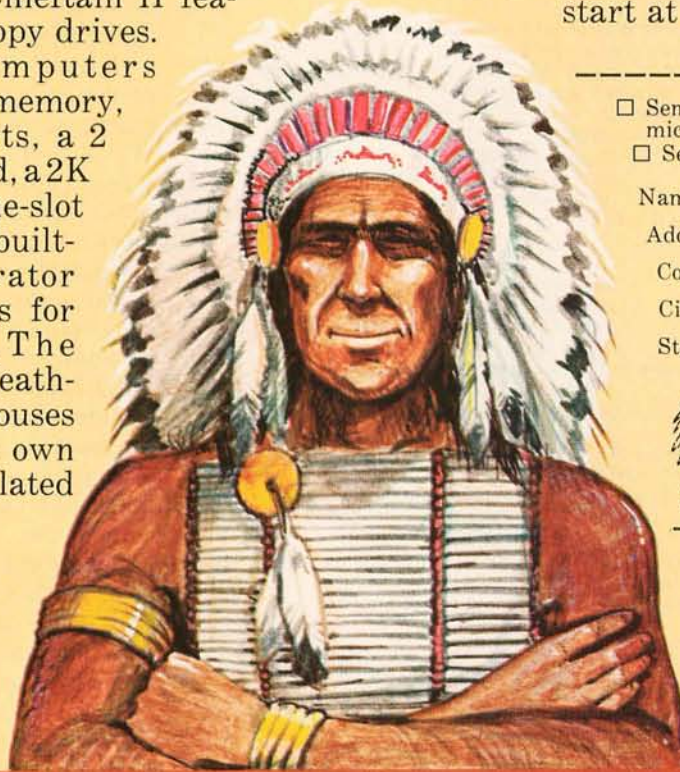
Smoke Signal's quality-packed Chieftain I features two 5.25-inch mini-floppy drives and Chieftain II features two 8-inch floppy drives.

Both microcomputers provide 32K static memory, two serial I/O ports, a 2 MHz processor board, a 2K RAM monitor, a nine-slot motherboard with built-in baud rate generator and gold connectors for high reliability. The Chieftain's stylish leather-grained cabinet houses the above with its own cooling fan and regulated power supply.

Every Chieftain is complete with system software and is totally burned-in as well as tested to further insure high reliability.

And it's expandable to 64K memory with up to 2 megabytes floppy disk storage.

So see your nearest Smoke Signal dealer, he'll be glad to show you how to get your wampum's worth. Systems start at \$2,595.



- Send information on your Chieftain microcomputer
- Send name of nearest dealer

Name \_\_\_\_\_

Address \_\_\_\_\_

Company \_\_\_\_\_

City \_\_\_\_\_

State/Zip \_\_\_\_\_



**SMOKE SIGNAL  
BROADCASTING**

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

Dealer inquiries invited.



# Hail to the Chieftain

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



Listing 2, continued:

```

BEGINPLOT:  LDX #15           ;transfer graphics symbol table to page 0
LOOP01:    LDA SYMBTAB-1,X   ;binary symbols allow quarter-character
          STA GRAFTAB-1,X   ;high resolution graphics
          DEX
          BNE LOOP01
TOPPLOT:   LDA YHI,X        ;get a particle's y coordinate
          LSR A             ;divide by 2
          TAY
          LDA SCRTABLO,Y    ;look up screen address in table
          STA ADDRNOW      ;for left end of screen line to be
          LDA SCRTABHI,Y   ;plotted on
          STA ADDRNOW+1    ;and store on page 0
          LDA #1
          BCC SKIP01      ;if carry is clear then y coordinate was even
          LDA #4          ;before division by 2
SKIP01:   STA NEWSYMB      ;store #1 or #4 here, if y even or odd
          LDA XHI,X       ;get particle's x coordinate
          LSR A           ;divide by 2
          BCC SKIP02     ;skip if x was even
          ASL NEWSYMB     ;double NEWSYMB if x odd
SKIP02:   ADC ADDRNOW      ;add x/2 to left edge address
          STA ADDRNOW     ;to get plotting address
          BCC SKIP03     ;skip if no carry
SKIP03:   INC ADDRNOW+1
          LDY #0
          LDA (ADDRNOW),Y ;get symbol currently occupying
                          ;particle's
          STA OLDCHAR     ;target plotting cell, OLDCHAR=
                          ;GRAFTAB-1
LOOP02:   LDY #15         ;prepare to look up symbol in table
          CMP OLDCHAR,Y
          BEQ FOUNDIT    ;exit when found in table
          DEY
          JMP LOOP02     ;have no fear, it will always be found! - OLD-
                          ;CHAR=GRAFTAB-1
FOUNDIT:  TYA            ;binary symbol in Y register, one bit for each ¼
          AND NEWSYMB    ;check for a collision
          BNE HIT        ;a hit!!! no need to plot, but must collide veloc-
                          ;ities now
          TYA            ;restore old binary symbol to accumulator
          ORA NEWSYMB    ;add new bit
          TAY
          LDA OLDCHAR,Y  ;look up new plotting symbol
          LDY #0
          STA (ADDRNOW),Y ;plot new symbol
INCRX:   INX             ;increment particle counter
          BNE TOPPLOT    ;loop until done
          RTS            ;back to BASIC control
HIT:     TXA
          TAY           ;transfer particle counter to Y register
LOOP03:  LDA XHI,X      ;colliding particle's x coordinate in accumulator
          DEY
          SEEK:  CMP XHI,Y ;look for the (previously plotted) colliding particle
          BNE SEEK      ;loop until found a matching x coordinate
          LDA YHI,X     ;do their y coordinates match too??
          CMP YHI,Y
          BNE LOOP03    ;if not, keep looking
          LDA VXLO,X   ;match found - prepare to collide velocities
          CLC
          ADC VXLO,Y
          STA MLO      ;MLO and MHI store M=(VX1+VY1+VX2+
                          ;VY2)/2
          LDA VXHI,X
          ADC VXHI,Y
          STA MHI
          LDA MLO
          CLC
          ADC VYLO,X
          STA MLO
          LDA MHI
          ADC VYHI,X
          STA MHI
          LDA MLO
          CLC
          ADC VYLO,Y
          STA MLO
          LDA MHI
          ADC VYHI,Y   ;now we've got the sum, must divide by 2
                          ;to get M
          CMP #128     ;first, essential to set carry flag for proper
                          ;division

```

Listing 2 continued on next page.

First, it's easy to write a loop to add up the kinetic energy of each particle; the total energy of the system should be conserved. Roundoff (from the division by 2, in particular) does make small errors occur, but I've found them to be tiny even after hundreds of timesteps. It is interesting to note that the energy is directly proportional to the temperature of the system. The eye can easily tell the difference between "hot" and "cold" gasses, with some experience.

It is also interesting to plot the velocities of the gas particles. In theory, after lots of collisions have occurred, the distributions of VX and VY velocities should be bell shaped (also called "Gaussian" or "normal") curves (see photos). It's quite satisfying to see a ridiculous initial distribution, with all the particles at rest except for one, evolve as collisions happen toward the normal curve. (The width of the distribution is proportional to the square root of the temperature.) There are fluctuations away from this equilibrium distribution, of course, but they are small, roughly  $1/\sqrt{N} \approx 6\%$  in this model.

Another educational phenomenon that this model can illustrate is called Brownian motion, the "random walk" that a particle in the gas executes as it is buffeted by other objects. It's a 1 line addition to the original program to change the symbol for one particle (number 0, for example) to something distinctive, so its motion can be followed. (An asterisk was used in the photos here.) On long timescales, the net motion of a particular particle is less than one might expect - the average distance it moves is  $(\text{average speed}) \times (\text{time})$ , but  $(\text{average speed}) \times \sqrt{(\text{time})}$ . (Albert Einstein got his Nobel Prize partly for his explanation of Brownian motion, published in 1905.)

There are many other "theoretical experiments" that one can do with this model of a gas. One could count the collisions off a wall and check the *ideal gas law* which relates pressure, density, and temperature. Another experiment could be to measure the "speed of sound" in the gas, by giving a push to the particles on one side of the box, and seeing how long it takes the resulting density wave to move across. (The box may be too small and the gas too dilute to do this cleanly, however; I'm not sure.) It might be nice to connect up the screen edges, so that particles which move off the right side appear at the left, etc. That way, one could set up a "wind" (a net nonzero momentum in some direction) and it would last forever (within roundoff) without hitting any box walls. Another possibility is to evolve a system forward in time for a while, and then reverse all velocities.



Effectively, this reverses time—if roundoff is unimportant, the particles should retrace their paths and return to the initial configuration, like a movie run backwards!

This simulation of a gas is extraordinarily simple in principle, but displays a surprising wealth of realistic physical phenomena. It's not surprising that slightly more complicated laws, acting on larger numbers of particles, can make galaxies and DNA molecules, snowflakes and cyclones. The challenge is to simplify and then simulate them!■

#### BIBLIOGRAPHY

1. Aarseth, Sverre J, and Myron Lecar, "Computer Simulations of Stellar Systems," *Annual Reviews of Astronomy and Astrophysics*, volume 13, 1975, pages 1 thru 22.
2. Lykos, Peter (editor), "Minicomputers and Large Scale Computations," from a symposium sponsored by the ACS Division of Computers in Chemistry, American Chemical Society, Washington DC, 1977. (See chapters 11 and 12 in particular.)
3. Reif, F, *Statistical Physics (Berkeley Physics Course)*, volume 5, McGraw-Hill, New York, 1967.

#### Listing 2, continued:

```

ROR A ;otherwise sign bit will be lost!!!
STA MHI
ROR MLO ;division by 2 completed
LDA MLO ;calculate after-collision velocities now,
as described
SEC ;in text
SBC VYLO,X
STA TMPLO ;save in temporary place
LDA MHI
SBC VYHI,X
STA TMPHI
LDA MLO ;proceed to collide all velocities
SEC
SBC VXLO,Y
STA VYLO,X
LDA MHI
SBC VXHI,Y
STA VYHI,X
LDA MLO
SEC
SBC VYLO,Y
STA VXLO,Y
LDA MHI
SBC VYHI,Y
STA VXHI,Y
LDA MLO
SEC
SBC VXLO,X
STA VYLO,Y
LDA MHI
SBC VXHI,X
STA VYHI,Y
LDA TMPLO
STA VXLO,X
LDA TMPHI
STA VXHI,X
JMP INCRX ;collision finished — go back to main program

```

# POWERFUL NEW CONCEPT

## P1-14 CARD-READER TERMINAL

This new concept in terminal equipment is offered for TTY type terminal replacement as well as for 3277 replacement\*.

- Typewriter style keyboard.
- 80 x 24 character display.
- Hand-fed Hollerith type card and/or badge reader.
- Compatible with modems for remote use.
- 12" diagonal screen.

- Half or Full duplex.
- Printer interface.
- Switch selectable baud rate and bit pattern to 9.6K BPS.

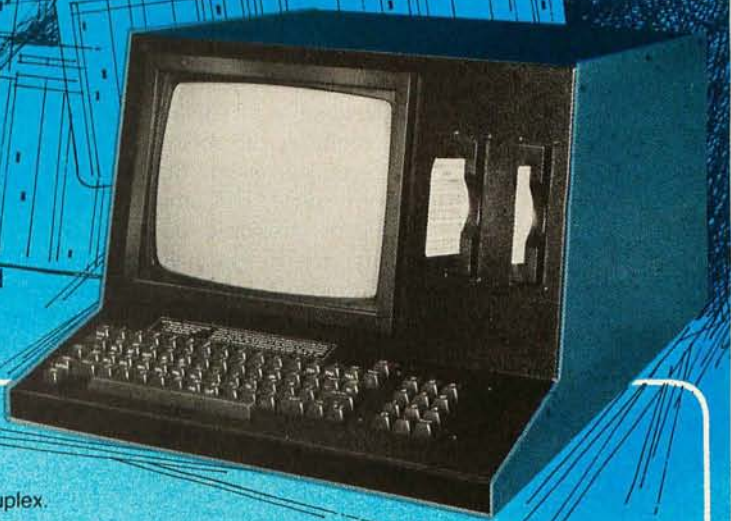
\$850 without reader.  
1995 with single reader.  
2595 with dual reader.

\*Requires Phone 1's P1-5 controller for 3271 or 3272 emulation.



### PHONE 1

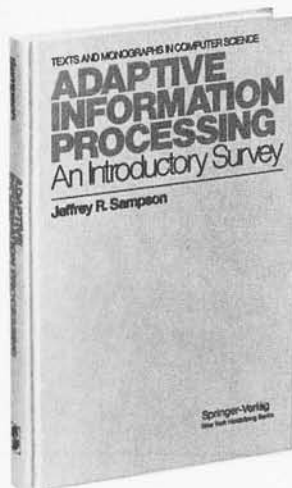
P.O. Box 1522 • Rockford, Illinois 61110  
Phone 815/962-8927





# Book Reviews

Adaptive Information Processing: An Introductory Survey  
by Jeffrey R Sampson  
Springer-Verlag,  
New York 1976  
214 pages  
\$14.80



A book that deals with theoretical computing machines, the biology of an amoeba, and a very good checkers program should pique the interest of many readers. *Adaptive Information Processing: An Introductory Survey* is excellent for someone who wants a thorough overview of the subjects covered.

The book deals with three broad topics: information and automata, biological information systems and artificial intelligence. The second and third are at opposite ends of the spectrum of adaptive information processors: living organisms and "intelligent" computer programs that mimic human thought. But the first topic, which deals with the nature of information and with certain imaginary, idealized computing machines, summarizes a body of knowledge that sets an upper bound on the transmission of data and on the problem solving limits of any computer. It is only in the light of these limitations that the later examination of living and nonliving information processing systems becomes meaningful.

The first section has five chapters on communication theory, coding information, finite automata, Turing machines, and cellular automata. The last three subjects refer to three levels of idealized computing machines that mathematicians and computer scientists have devised and studied to determine what problems can and cannot be solved on a given machine. Most important are two facts: firstly, the Turing machine is capable of solving any problem that *any* computer can solve; and secondly, there are certain problems that a Turing machine cannot solve. This implies that there are problems insoluble by computer. The fourth chapter is especially good for its condensation of the work done along these lines, in particular, the famous "halting" problem for the universal Turing machine.

The "Biological Information Processing" section devotes a chapter each to information processors on four levels: the biochemical, genetic, neural, and nervous system levels. The first chapter gives a concise description of the role of enzymes and DNA in the processes of biological information transfer. The fifth chapter deals with limited attempts of scientists to simulate various levels of biological processes via computer programs.

The final section deals with five artificial intelligence topics: pattern recognition, game playing, theorem proving, generalized problem solvers and natural language processing. Here, the author admits that his mate-

## See Sol<sup>®</sup> 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 Dell, (415) 961-2670. 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. **ID:** Boise: Byte Shop Computer Store, (208) 345-3811. **IL:** Lombard: Midwest Microcomputer, (312) 495-9889. **IA:** Davenport: Memory Bank, (319) 386-3330. **MA:** Waltham: 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. **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. NYC: Computer Mart of New York, (202) 686-7932. 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, (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. Lynnwood: Byte Shop Computer Store, (206) 775-7436. 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:** Prospect: A.J.F. Systems and Components Pty. Ltd., 269 1244. Sydney: Automation Statham, (02) 709.4144. **BELGIUM:** Bruxelles: Computerland, 02/511.34.45. **COLOMBIA:** Bogota: Video National, 326650. **DENMARK:** Copenhagen: Peter W. Holm Trading ApS 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.





# Sol<sup>®</sup>. 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<sup>®</sup>. 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**



rial emphasizes the heuristic programming school of thought, which favors the methods that produce the maximum amount of *intelligence*, rather than those schools that try to model human thought processes. Each chapter in this section describes the terminology, basic concepts, and techniques of the subject. The game playing chapter is useful for readers interested in designing sophisticated game playing programs.

These last chapters describe the most impressive "intelligent" programs in several fields: Guzman's See, which analyzes and recognizes solid geometric forms from a video picture; Samuels' checker playing program, one of the most successful game playing programs; the theorem proving Logic Theorist and the General Problem Solver (both by Newell, Shaw, and Simon); Weizen-

baum's Eliza and Raphael's Sir, both written to appear to understand conversational English.

Each chapter ends with a complete bibliography and a short set of exercises. A lot of material is presented in a short space, and the readability of the book varies with the reader's familiarity with the basic concepts of the subject being presented. Except for this one necessary shortcoming, the book still manages to cover some of the most important ideas and programs in computer science history. The section on biological information processing systems augments the book's value.

Gregg Williams  
1605 Eastmoreland #3  
Memphis TN 38104 ■

**BASIC Programming for Scientists and Engineers**  
by Wilbert N Hubin  
Prentice-Hall Inc, Englewood Cliffs, NJ 1978  
\$9.95 paperbound

With personal computers currently following a geometric growth curve, I think BASIC will become the Esperanto of the cognoscenti; it nearly is now. Since the professional community forms a large user group, I feel the science and engineering people will need the ability to work in other languages besides the ubiquitous FORTRAN. Mr Hubin's fine book is one of the best first books of BASIC that I have seen. It is suitable for both the experienced programmers seeking to add BASIC to their repertoires, and for the beginning science students who need both computer and technical problem solving experience.

The first portion of the book is devoted to learning the language. The various statements of BASIC are defined and illustrated, and there is a discussion of elementary terminal usage as well as hints for using BASIC in the most efficient manner. Each type of statement has review questions and problems for each subsection, and, for the insecure among us, answers. Hints on troubleshooting are a nice bonus for the newcomer, since it takes a little ACL (accumulated computer lore) before one develops a feel for debugging code. Segments of programs show just how code consisting of BASIC statements can be used to accomplish the reader's purpose.

The chapter on flowcharting ably demonstrates the fundamentals of this art, discusses their applications, and then provides a diverse sampling of problems to sharpen the reader's skills. The author's editorial on flowcharting may even bring old hands back to the fold of those who document programs before they become operational. Handily, once again, solution flowcharts are in the appendix.

The concluding two chapters are devoted

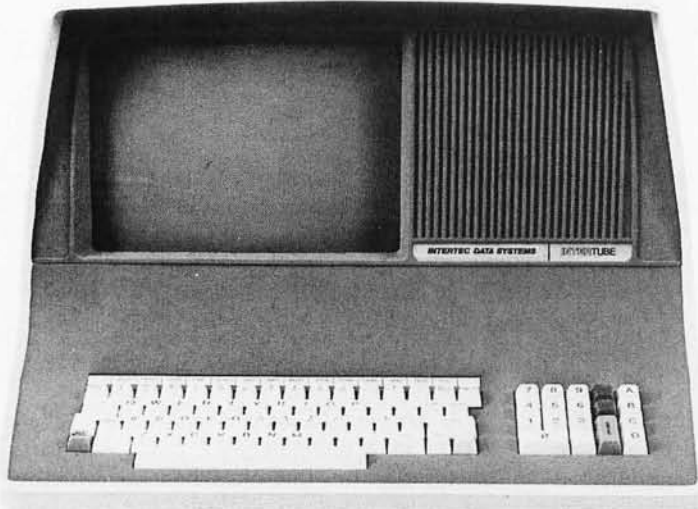
to solving technical problems with a computer. The problems deserve a mention here, since they form a nucleus of problems suitable for a science course. Equations of motion, centers of mass, Hermite polynomials, and others serve to show the student how to apply the computer to classroom concepts. The range of problems is superb, from simultaneous equations and least squares fit to solutions of differential equations and error analysis. Each application mastered will mean a valuable addition to the reader's skills. The problems are drawn from the gamut of the engineering ranks and the physical sciences, and footnotes refer the reader to the journals of science. Completion of these exercises will give the practitioner a mastery of BASIC and a few fundamentals of science.

The appendices offer a summary of BASIC statements and the meaning of each. There is a short example of terminal usage employing a Digital Equipment Corp PDP-11 as an example. Especially handy is the section on BASIC error messages, although it is a bit brief. In familiarizing yourself with a new machine or language, deciphering the error messages is usually a headache. The computer's opinion of the defects in a program is often expressed in a cryptic manner.

While machines vary, beginners' mistakes do not, and the common ones are listed. In addition, there is a useful index. The bibliography focuses on books applying computers to the physical sciences. Throughout the book, the print is well-displayed and easy to read. If you are thinking of learning BASIC, think of this book.

Noel K Julkowski  
18755 Van Buren St  
Salinas CA 93901 ■





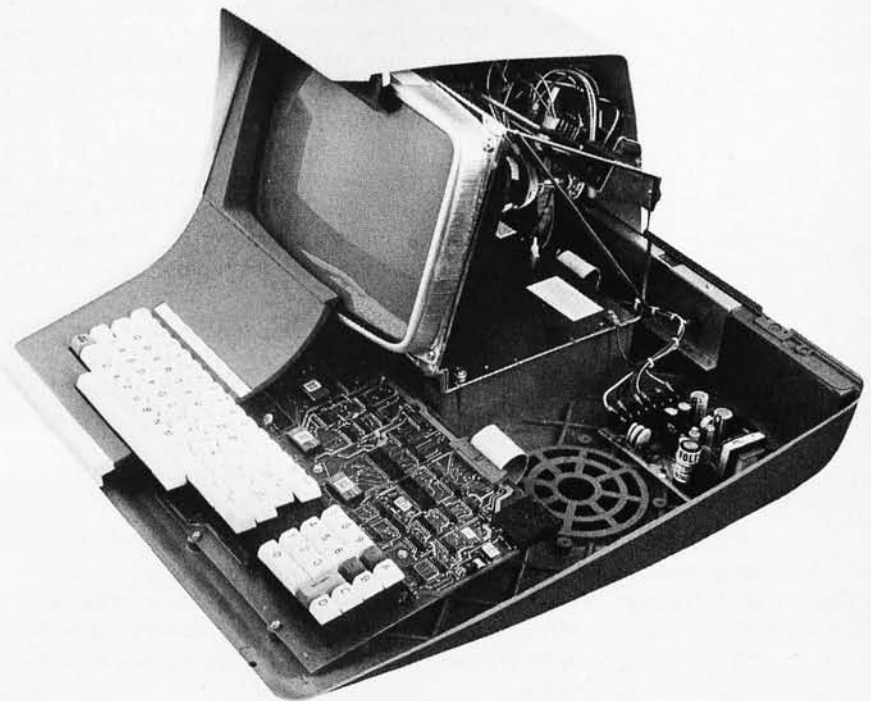
INTERTEC'S  
**INTERTUBE**<sup>®</sup>  
 VIDEO DISPLAY TERMINAL

**ATTENTION RETAILERS:**

InterTube Terminals are easy to sell for one simple reason. They outperform the competition so well that it's embarrassing to have any other terminal on display. Add to that InterTube's rugged design which insures you of the reliability that brings customers back. And modular design engineering that makes servicing a snap!

But best of all, the InterTube is readily available. Just a quick call and you'll have units in stock. Immediately! And our scheduled delivery program will help you keep them in stock.

Good margins, good service, good delivery. Simple? You bet it is! InterTube dealerships are now available in many areas. Contact us today and start selling from stock tomorrow!



The InterTube Video Display Terminal is truly representative of the latest state-of-the-art advances in microprocessor technology. Its basic teletypewriter compatability combined with its numerous "smart" terminal features satisfy the universal requirement for a low-cost, high performance video terminal.

You get everything you need for cleaner input and faster throughput. An upper and lower case character set displayed on a sharp 8 X 10 dot matrix. A full 24 line by 80 character screen. A status line which is displayed in half-intensity. A complete ASCII keyboard with an 18-key numeric pad.

You get full cursor addressing, automatic repeat of all keys, individual backspace and shiftlock keys. A graphics mode to facilitate easy design and display of all types of forms.

And you get everything your operators need to make their jobs a pleasure. A hooded display that cuts glare and gives extra privacy. A wide bandwidth monitor for sharp images everywhere on the screen. Below-the-line character descenders to make reading easier. A programmable white-on-black or black-on-white display, and a self-test mode for easy maintainability.

You get high powered text editing with such features as character and line insert/delete, full and/or partial block transmit, programmable end-of-line terminators, and protected fields. All standard. And all for a retail price you won't believe . . . only \$874. Incredible!



Corporate Headquarters: 2300 Broad River Road • Columbia, South Carolina 29210 • 803 / 798-9100 • TWX: 810-666-2115



# Sources of Numerical Error

Daniel R Buskirk  
POB 211  
The Rockefeller University  
New York NY 10021

A growing number of microcomputer enthusiasts are finding the need to perform control operations, evaluate complicated mathematical expressions and analyze statistical data. In short, many hackers want to tackle problems conventionally left to larger computers. To do this, they must become acquainted with error analysis.

Programmers need to be concerned about errors in any program involving the evaluation of a function or algebraic expression, or one which involves a large number of simple but repetitive operations. Even in control applications, it is often critical to be aware of the potential for error.

What do we mean by error? The numerical analyst, a professional mathematician involved with the design and analysis of numerical algorithms, recognizes three distinct types of error. The first is the *blunder*, which is not an error at all in the mathematical sense. A blunder is a gross error: a mistake in program logic, a typographical error, or perhaps only a misplaced decimal point. The mathematician, like the rest of us, must shrug his shoulders at a blunder, and hope to do better next time. Blunders need not concern us here.

Certainly blunders account for the vast majority of errors; but what other types of errors are there if we ignore blunders? One type is the truncation error. For example, take the infinite series representation of the function  $\sin(x)$ :

$$\sin(x) = \frac{x}{1!} - \frac{x^3}{3!} + \frac{x^5}{5!} - \dots$$

If we were to use this relation to evaluate  $\sin(x)$  in a computer, we could not carry this series on forever. Whenever we stop, we have failed to evaluate the remaining terms in the expression, or *truncated* the series. Those who understand a little calculus will recognize that this series *converges*; that is, it gets arbitrarily close to the correct value when sufficiently many terms are calculated. But there must always be a small but finite truncation error (if this computation is carried out on a digital computer).

Another calculation involving truncation error is the evaluation of integrals using the trapezoidal rule. Though an infinite series of trapezoids, each approaching zero width, will give us the area under the curve (its definite integral) exactly, any computer evaluation must settle for a finite number of trapezoids. Thus there will be truncation error. To be sure, it is generally possible to avoid the consideration of truncation error by simply requiring that the truncation error be less than the precision of the whole calculation. However, the clever programmer recognizes that there are usually several different infinite series representations of any function. Often, one of these series will require significantly fewer terms to come within the required precision.

The error of most concern to numerical programmers is not truncation error but rather *roundoff error*. Since the word length in most computers is fixed, any number that exceeds this length must be rounded off before it can be stored in the computer's memory. This error is the most significant, so we shall consider it in more detail.

Although almost all "big" computers store numbers in binary digits, the following examples are given in base ten because it is more familiar (and it is similar to the binary coded decimal format often used in microcomputer floating point packages).

Most computers store a real number by breaking it down into a mantissa and an exponent, much like scientific notation. A word which looks like this:

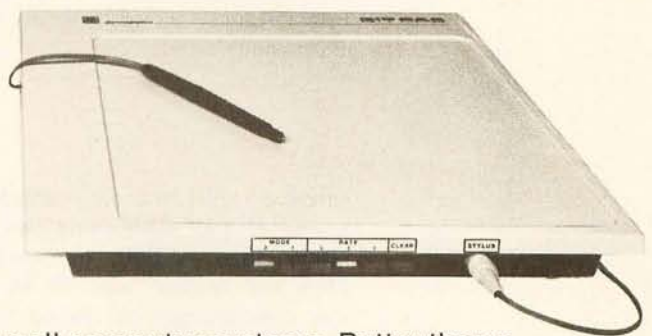
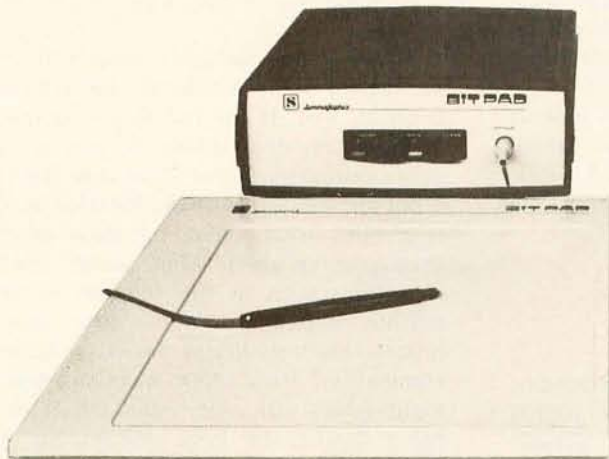
## About the Author

Daniel Buskirk is currently a graduate fellow at Rockefeller University, where he is studying neurobiology. He has a bachelor's degree in mathematics and zoology. His current professional interest is the application of mathematical and computer methods to the study of neuronal structure. When not working, he enjoys photography, playing the piano, and, of course, fiddling with microcomputers.



# 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 Bit Pad** One  
**Bit Pad 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**



7352 05

mantissa exponent

would represent the real number  $0.7352 \times 10^5$  or 73520. Now, if we wish to store a number larger than four decimal places, we must round it off. (It is true that our exponent here is limited to two decimal places. Any exponent with three or more places in this case represents an *overflow* condition. Since overflow is generally easily avoided, we will not discuss it here.) Consider the numbers 8,931,724 and 0.761253. In the first case, rounding off to  $0.8931 \times 10^7$  represents an error of 724. The error in rounding the second is  $53 \times 10^{-6}$ . Thus, it is most common for the numerical analyst to speak of relative error rather than absolute error. In this case, both errors will be on the order of  $10^{-4}$  of the value being stored in memory.

If this error seems trivial, let us look at an example, albeit a contrived one (more realistic examples will be examined later). For instance, if we wish to evaluate the expression:

$$\frac{1}{a-b}$$

where  $a = .89136$  and  $b = .89134$ . Rounding  $a$  and  $b$  and subtracting, we get 10,000 rather than 50,000, the correct answer. Thus our answer was off by a factor of five even though our round off error was very small. It might be argued that double precision calculation would have eliminated the problem completely. Clearly, accuracy increases with increased word length, but roundoff never disappears. Since some hand calculators use up to 13 decimal digits in storing numbers while displaying ten digits, we might expect them to have "more than enough" accuracy. But in many engineering and statistical problems, calculators can make significant errors. The reader concerned with calculator accuracy might wish to read the short article by Bernard Cole in the November 25 1976 issue of *Electronics*.

The reason for the problem with roundoff, even with 13 digit accuracy, is the situation most frustrating for numerical programmers. Roundoff occurs at every step of any program. In a very long program, roundoff error may have been introduced many millions of times. This error may propagate itself and accumulate into a very large error in the result. Programs in which this propagation of error is likely to occur (finding the inverse of a large matrix, for

instance) are generally so complicated that it is impossible to predict precisely what the effect of constant rounding off will be. Often the numerical analyst resorts to probability theory to get an idea of how much error is likely to be in the results.

Errors often become critical when functions are calculated. Let us assume we have a value for the variable  $x$  stored in memory. There is some error associated with  $x$  (perhaps roundoff error, or maybe  $x$  is the result of a physical measurement). We'll call this error  $\delta$ . Thus  $x = x_0 + \delta$ , where  $x_0$  is the unknown true value of  $x$ . It may be very easy to calculate some function of  $x$ ,  $f(x)$ , but what is the error of the result? Let us define the error of the result as  $\epsilon$ . Then:

$$f(x_0) + \epsilon = f(x_0 + \delta)$$

If we know our initial error  $\delta$  is small, we would like to assume the error  $\epsilon$  is small as well. If the function is simple, or involves only one variable, we can be confident the resulting error is not large if neither  $\delta$  nor the derivative of the function at  $x_0$  is large. But what about functions of more than one variable? What about complex algorithms such as the solution to simultaneous equations, often done using a process mathematicians know as Gaussian elimination? Very often, small errors in the input values will yield results which are off by a significantly large amount. So large, in fact, that the results are worthless and the programming is futile. This situation is distressingly common in everyday problems in science, engineering and the social sciences. Numerical analysts call a problem *well posed* if small errors in input still result in a reliable answer. However, even a well posed problem can be solved inaccurately if the programmer has not chosen his algorithm cautiously.

With all this talk about errors, what can be done? Is there any hope at all of obtaining consistently reliable results? Unfortunately, there are no general methods. However, the programmer who is aware of how errors can occur is in a better position to compensate for them. For instance, let's look at the general quadratic equation:

$$x^2 + 2bx + c = 0$$

[Note: The expression on the left side of this equation is equivalent to the familiar form used to generate the quadratic formula,  $ax^2 + bx + c$ . However, it leads directly to the computationally simpler form of the two roots  $X_1$  and  $X_2$  . . . CM]







## A Comparison of Bar Code Encoding Schemes

Robin C Moseley  
14 Standish Cir  
Andover MA 01810

The purpose of this article is to compare some of the encoding schemes which might be used for bar code software. The three most important characteristics of an encoding scheme are:

- Packing efficiency: how many data bytes per printed page.
- Vulnerability to wand speed changes and other timing errors.
- Number of storage bytes required for timing information, assuming post read processing of timing data.

Other less important factors include human readability and the constancy of DC output level.

Three methods have previously been defined in "A Proposed Standard for Publishing Binary Data in Machine Readable Form," by Walter Banks and Carl Helmers, November 1976 BYTE, page 10: bar width modulation (format 1), ratio recording (format 2), and fixed gap bar width modulation (format 3). The other schemes listed in table 1 include frequency modulation (FM), phase encoding (PE), nonreturn to zero inverted (NRZI), synchronized nonreturn to zero inverted (SNRZI), modified frequency modulation (MFM), group coded recording (GRC) and zero modulation (ZM).

In phase encoding (PE), a 1 is represented by a transition from white to black and a 0 by the opposite transition. Additional transitions are added to account for successive 1s or 0s. The frequency modulation (FM) encoding method provides a transition in either direction at every bit boundary, and an additional transition to mark each 1. The resulting code is very similar to that created by the phase encoding method, since both provide timing information at least once per bit.

The nonreturn to zero inverted (NRZI) encoding scheme generates a black to white (or vice versa) transition for every 1. The absence of a transition denotes a 0. This method has the disadvantage that no timing information is generated during a string of 0s. The synchronized nonreturn to zero inverted (SNRZI) method adds a 1 to every byte to guarantee at least one piece of timing information per byte. If the redundant clock transitions are eliminated from the frequency modulation code, the number of transitions per bit is halved, doubling the possible density of data for a given minimum module width; this is modified frequency modulation (MFM).

Zero modulation (ZM) and group coded recording (GCR) are modifications of the nonreturn to zero inverted method which are designed to guarantee timing information at least once every two or three bits, respectively. In group coded recording, each 4 bit

Table 1. Comparisons of various encoding schemes. Overheads such as parity and sync bytes were not included in the packing density calculations. The maximum timing bytes per data bit were determined assuming perfect bar codes and do not allow for such problems as dirty bar codes.

Encoding scheme	Packing density		Timing tolerances		Constant DC level	Memory requirement
	Average data bit duration ("modules")	Data bytes per page	Absolute timing tolerance ("modules")	Wand speed tolerance		Maximum timing bytes per data bit
Format 2	3	1170	0.5	25%	No	2
Format 3	2.5	1400	0.5	25%	No	2
FM/PE	2	1750	0.5	25%	Yes	2
Format 1	1.5	2330	0.5	25%	No	1
NRZI	1	3500	0.5	6%	No	1
SNRZI	1.125	3100	0.5	10%	No	1.125
MFM	1	3500	0.25	12.5%	No	1
GCR	1.25	2800	0.5	16.7%	No	1.25
ZM	1.125	3100	0.25	12.5%	Yes	1.125

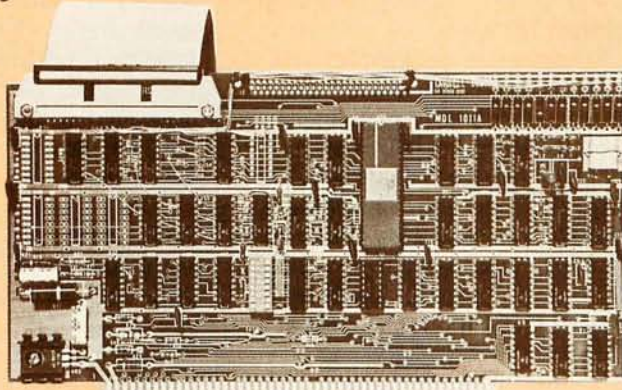


# The **TARBELL** Connection

In an effort to offer products that meet the continually changing demands of the microcomputer industry, TARBELL ELECTRONICS is pleased to offer immediate delivery of these quality components and operating software. All TARBELL products are available from computer store dealers everywhere.

## Tarbelle Floppy Disk Interface

- Plugs directly into your IMSAI or ALTAIR and handles up to 4 standard single drives in daisy-chain.
- Operates at standard 250K per second on normal disk 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.
- Kit \$190 . . . . . Assembled \$265.



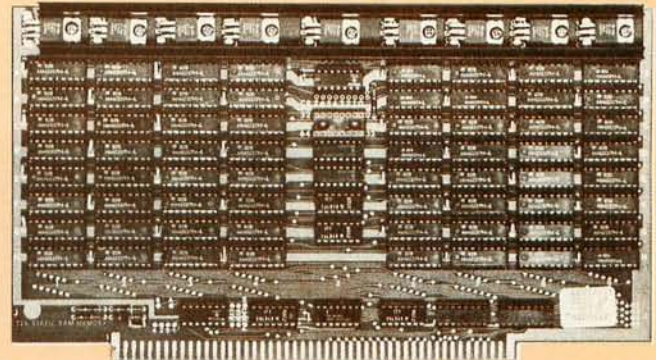
Specify drive for assembled units. Complete disk subsystems with operating software available. Please inquire for details.

## Tarbelle Disk BASIC

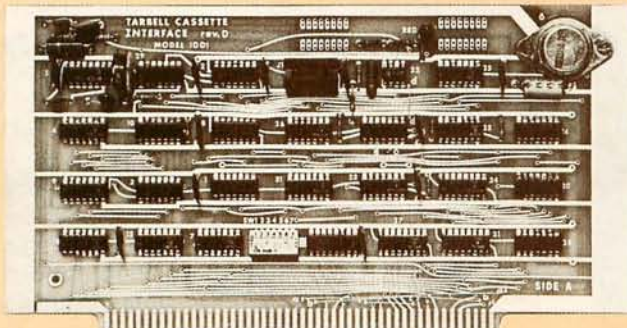
- Runs on 8080, 8085 or Z80
  - Searches a file quickly for a string.
  - Up to 64 files open at once.
  - Random Access.
  - Assignment of I/O.
  - Alphanumeric line labels allowed.
  - Read and Write string or numeric data.
  - Unlimited length of variable names and strings.
  - Procedures with independent variables.
  - Number system 10 digits BCD integer or floating point.
  - Chain to another program.
  - Cause programs to be appended onto programs already in memory.
  - Cause interpreter to enter edit mode using 15 single character edit commands.
- Occupies 24K of RAM. Tarbell BASIC on CP/M Disk . . . . . \$48.  
Source on paper or CP/M Disk . . . \$25.  
CP/M and BASIC-E on disk with manuals. . . . . \$100.

## Tarbelle 32K RAM Memory

- 32K Static Memory
- S-100 Bus Connector
- 9 regulators provide excellent heat distribution.
- Extended addressing (bank switching.)
- Phantom line.
- Low power requirement.
- 20-Page operating manual.
- Full 1-year warranty.
- Assembled and tested full price only \$625
- 16K version also available, assembled and tested only \$390.



## Tarbelle 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, and 4 extra control lines.
- 37-page manual included.
- Device code selectable by DIP-switch.
- Capable of generating Kansas City tapes.
- No modification required on audio cassette recorder.
- Complete kit \$120 . . . . . Assembled \$175.
- Manual may be purchased separately . . . . . \$8.
- Full 6-month warranty on kit and assembled units.

## Tarbelle Cassette BASIC

Includes most features of ALTAIR Extended BASIC, plus these added features:

- Assignment of I/O.
  - Alphanumeric line labels.
  - Unlimited length of variable names and strings.
  - Number system 10 digits BCD integer or floating point.
  - Procedures with independent variables.
  - Read and Write string data.
  - Multi-file capability.
- Full price with complete documentation . . . . . \$48.

Prepaid, COD, or cash only. California residents please add 6% sales tax.

ALTAIR is a trademark/tradename of Pertec Computer Corporation  
CP/M is a trademark/tradename of Digital Research

*Tarbelle*  
Electronics

950 DOVLEN PLACE • SUITE B  
CARSON, CALIFORNIA 90746  
(213) 538-4251 • (213) 538-2254



unit of data is mapped into a unique 5 bit word chosen to assure no more than two consecutive 0s. In zero modulation each bit is mapped into two bits and the result encoded in nonreturn to zero inverted format. The net result is comparable to that provided by group coded recording with the advantage, useful in the magnetic recording field, of a constant DC level.

All these schemes can be handled relatively simply in software. The deciding factor should be made on other grounds.

Table 1 compares the number of data bytes which can be printed on an 8.5 by 11 inch (21.6 by 27.5 cm) page, assuming a narrow bar width of 0.014 inches (0.04 cm) and a line to line spacing of 0.15 inches (0.38 cm). Several of the methods listed will provide between 2500 and 3500 bytes per page. Since packing density is not particularly critical in this application, the choice should be made on the basis of the remaining and crucial criterion: vulnerability to wand speed changes and other timing errors.

It is in this area that the requirements of hand held optical reading diverge from those of machine driven magnetic recording. In the magnetic recording field, short term variations of the relative velocity between the medium and the head are held to a mini-

mum. The designer's main concern is with the absolute value of the permissible phase error; ie: the amount by which timing error may apparently move a transition before playback errors occur. The speed of a hand held wand may vary widely from place to place on the data track. In this case we are concerned with the permissible percent speed change which can occur between two transitions relative to the average speed over the previous few transitions. This may be calculated as the percentage ratio of the permissible phase error to the maximum time which can occur between transitions.

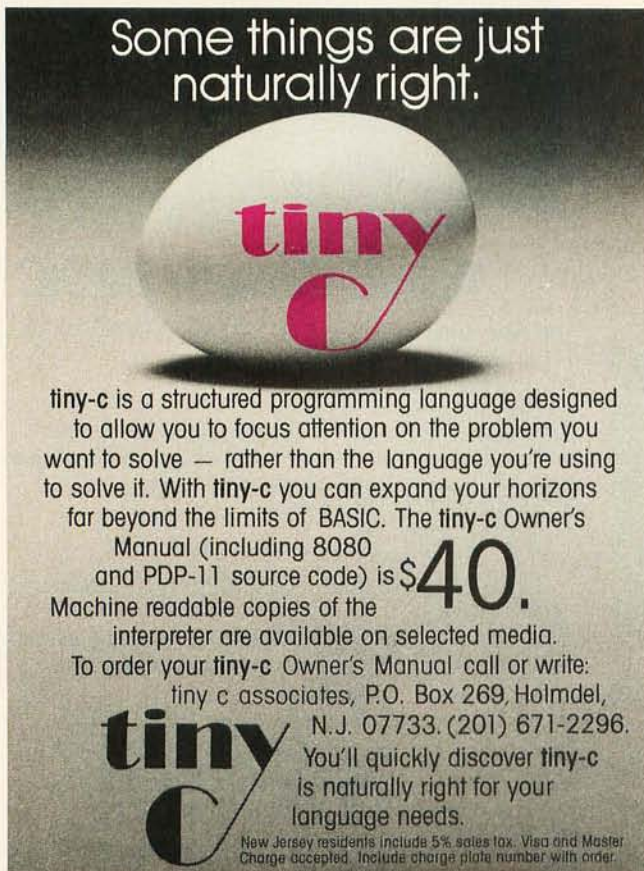
Table 1 expresses the timing tolerance of each scheme in terms of the permissible speed change and the absolute timing error. Since the modified frequency modulation and zero modulation methods have to distinguish between bars which are 1, 1.5 and 2 modules wide, they are both twice as sensitive as the others to absolute errors such as printing tolerances, and may be rejected for bar code printing for this reason.

The choice between the remainder may be made on the basis of a compromise between packing density and speed tolerance. The percent speed variations listed in table 1 are permissible only in the ideal case, in which printing tolerances and other timing errors are zero. In real life, short term consistency of wand speed is more critical than table 1 makes it appear to be. ASCII code printed by the nonreturn to zero inverted method can have eight successive zeros, even if the null character is not permitted. This leads to a very low speed change tolerance. The synchronized nonreturn to zero inverted method reduces the number of consecutive zeros to five by introducing an extra 1 per byte. Nevertheless, the speed tolerance is still low and both methods may be eliminated for this reason.

Of the remainder, group coded recording has the greatest packing density, by 20 percent, but the others have a 50 percent greater tolerance to speed variations. It is questionable whether the software complication and lower speed tolerance of group coded recording are worthwhile in this application.

This leaves frequency modulation, phase encoding, bar width modulation, ratio recording and fixed gap bar width modulation as alternatives. All these methods have the same speed and absolute timing tolerances. The choice may be made on the basis of packing density. The bar width modulation method comes out far ahead of the other methods. Bar width modulation is the logical choice for the encoding of printed software intended for recovery by a hand held light wand. ■

*Technical Forum is a feature intended as an interactive dialog on the technology of personal computing. The subject matter is open-ended, and the intent is to foster discussion and communication among readers of BYTE. We ask that all correspondents supply their full names and addresses to be printed with their commentaries.*



Some things are just naturally right.

tiny-c is a structured programming language designed to allow you to focus attention on the problem you want to solve — rather than the language you're using to solve it. With tiny-c you can expand your horizons far beyond the limits of BASIC. The tiny-c Owner's Manual (including 8080 and PDP-11 source code) is \$40. Machine readable copies of the interpreter are available on selected media.

To order your tiny-c Owner's Manual call or write:  
tiny c associates, P.O. Box 269, Holmdel, N.J. 07733. (201) 671-2296.

**tiny-c** You'll quickly discover tiny-c is naturally right for your language needs.

New Jersey residents include 5% sales tax. Visa and Master Charge accepted. Include charge plate number with order.



## BYTE's Bugs

### Puzzling Machine Language Puzzler

The "Machine Language Puzzler" in BYTE January 1979, page 52 was very interesting. However, I must disagree with the author's detailed analysis of how the program works. It is a CALL FFFD instruction located at address FFFD which repeatedly calls itself, pushing a return address of 0000 on the stack, until all of memory is zeroed including the program itself.

Let's take a detailed look at what happens after memory locations 0001 through FFFC have been zeroed. First, the CALL FFFD instruction is fetched from locations FFFD, FFFE, and FFFF. This causes the program counter to be loaded with FFFD, and 0s are written into locations 0000 and FFFF. At this point the CALL instruction has been changed to a CALL 00FD, but the program does *not* yet branch to address 00FD as stated. The next instruction is still fetched starting at address FFFD, since the CALL FFFD was fetched from memory *before* location FFFF changed from FF to 00. Now the CALL 00FD is fetched, 0s are written into locations FFFE and FFFD, and the program starts executing NOPs at address 00FD. Note that no NOPs are executed at all until all of memory has been zeroed.

In the case where memory only exists at addresses 0000 to 00FF and FF00 to FFFF, operation of the program is very complex. It proceeds as above through zeroing *all* existing memory and branching to a NOP at 00FD. When the FF (RST 7) is executed at location 0100, a 0101 is pushed on the stack at locations FFFC and FFFB. Memory continues to fill up with 0101s until a 01 is written at location 00FF. Starting at this point the return address pushed on the stack may be 0101, 0102, or 0103 depending on whether the RST 7 is executed at 0100, 0101, or 0102. Remember that one or two bytes of FF may be read as data of a LXI B, *data* instructions. The program ends up executing a complex sequence of LXI B, STAX B, and INX B instructions in a loop starting at address 0038 and ending with a RST 7 instruction at 0100, 0101, or 0102. The program will keep changing itself as the stack wraps around forever.

It is still an interesting program. The net effect, in the first case, is still the same. I wonder if a similar program that zeros out all of memory including itself exists for other microprocessors as well?

Keith Rubow  
18454 Bellefont Dr  
Azusa, CA 91702 ■

# Get a PASCAL ENGINE™

## *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 microengine™ 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
  - BASIC compiler
  - GRAPHIC package
  - File Manager
  - Screen oriented editor
  - 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 4/30/79



**CUTTING EDGE OF  
TECHNOLOGY, Inc.**

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



# Smart Memory Part I

Randy C Smith  
115 Crosby Ct #2  
Walnut Creek CA 94598

## About the Author

Randy Smith is employed by Semionics Associates as the design engineer for the REM S-100 board and is the coinventor of REM. His personal interests include artificial intelligence research, especially language comprehension.

There is a useful distinction being made today between two types of display terminals: so-called "dumb" terminals perform the necessary functions of data reception, transmission, and display. Their *intelligent* counterparts, however, are capable of performing sophisticated data manipulations on their own, relieving the host processor of some of the routine burden. The same distinction could be drawn from memory systems. In most machines the memory component forms a passive blackboard: its function, the principal one of any memory, is to remember. Yet memory systems can be built which take a more active processing role.

What kinds of things could a *smart memory* do? The normal random access memory has unique addresses for its cells, and an address must be provided to read or write information, one cell at a time. The concept of *address* or *location* as a necessary attribute of content may be difficult for beginning programmers to grasp. A far more palatable idea to the human thinker is that words, shapes, or sounds serve to "call up" the information associated with them.

Suppose we distribute some intelligence throughout our special memory system, animating it by changing each memory word into a *demon*. These demons are jumbled about together in a darkened cave, and their principal characteristic is that they

recognize when they are being spoken about. Aside from that, they are rather lazy, working only when standing up, and sitting down for a snooze at the earliest opportunity. For example, our demons might represent inventory information for a hardware store.

"Alright, everybody on your feet!"  
(Otherwise nobody would pay attention.)

"I want anyone who knows anything about hammers."  
(There is a resounding thud as all sorts of appliance demons, chain-saw demons, etc sit down and resume their naps.)

"Specifically, ball-peen hammers."  
(Claw hammer and jackhammer demons drop out, leaving, in this example, one solitary demon.)

"How many do we have on hand?"

We did not need to know where the demon was who answered us. A reply to our query emanated from the mouth of the cave. We don't even know how many demons lurk inside — since all demons work simultaneously, we got our answer in a time independent of their number. Consider what this means for information retrieval: if the preceding "program" takes N microseconds for a file of 10 inventory items, and the file grows to 10,000,000 items, the processing time required is still N microseconds. Therein lies one of the most tantalizing aspects of a memory system like this — adding more information (more memory) *improves* system performance:

- More items are processed in the same time;
- There are no address space saturation or segmentation problems, since addresses are not used — a single bit signal (on/off) can distinguish accesses to this memory from normal addressed memory requests.

A memory having qualities like those just illustrated is called an *associative memory* or CAM (*content addressable memory*). Not too surprisingly, associative computer memories in varying forms have been proposed many times before. The reasons why people

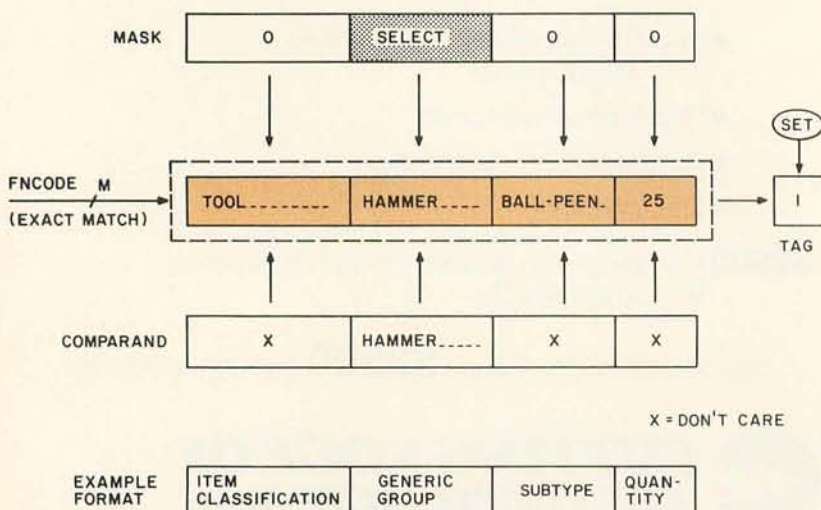


Figure 1: An example of full word parallel information retrieval.



LASTNAME	FIRSTNAME	JOB	AGE	SEX	HAIR	EYES	LASTRAISE	ETC	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
-	-	ENGINEER	45	F	BLD	BL	-	-	1	1	0	0	0	0	0	0	0	0
-	-	SECRETARY	33	F	-	-	-	-	1	0	0	0	0	0	0	0	0	0
-	-	-	-	-	-	-	-	-	1	0	0	0	0	0	0	0	0	0
JACKSON	SUE	-	-	-	-	-	-	-	1	0	0	0	0	0	0	0	0	0
-	-	JANITOR	50	M	-	-	8/78	-	1	0	0	0	0	0	0	0	0	0
-	-	MANAGER	-	F	-	-	-	-	1	0	0	0	0	0	0	0	0	0
JONES	MIKE	ENGINEER	38	M	BR	BR	-	-	1	1	1	1	1	1	0	0	0	0
-	-	-	-	F	-	-	-	-	1	0	0	0	0	0	0	0	0	0
-	-	ENGINEER	41	M	BR	BL	-	-	1	1	1	0	0	0	0	0	0	0
-	-	-	-	-	-	-	-	-	1	0	0	0	0	0	0	0	0	0
JETER	BOB	ENGINEER	27	M	BR	BR	5/78	-	1	1	1	1	1	1	1	1	1	1

- (1) SET
- (2) JOB = "ENGINEER"
- (3) HAIR = "BR"
- (4) EYES = "BR"
- (5) LASTNAME = "J??????"
- (6) AGE > 25
- (7) AGE < 30
- (8) SEX = "M"
- (9) READ(LASTNAME,FIRSTNAME)
- (10) READ(LASTRAISE)

Figure 2: When selecting a final response, check that one of the response bits is still set after all questions have been asked and answered.

(including the author) "reinvent" the concept with some regularity are twofold: the descriptions of this form of memory rarely make it past technical parallel machine architecture symposia or journals into the more commonplace world; and the beauty and power of a memory that can by its very nature eliminate or ease searching, sorting, table lookup, and pattern matching is so striking—the idea is so natural in human terms that it occurs to many individuals.

Figure 1 shows a conceptual associative memory word holding information from the previous example. It can be seen that a long word is desirable to store related data. Exact match was the only comparison function used (and is the basic, sometimes only, associative function available in the integrated circuit forms of this memory). A mask is applied to all the words and selects the part of the words to be treated (either matched against, or read out). The *comparand* is the common information that all words test. Due to the length of associative words, some real designs compare the words with the comparand one bit at a time (bit serial, word parallel). This reduces the amount of comparison logic and the size of the data paths to reasonable levels, although a full word comparison takes longer.

Comparisons are usually over lengths much less than the full word size, so the compromise is a good one. With each word

there is one separate bit of information for the response status, called the *tag*. The SET function forces the tags to their responding state (1), thereby activating all words initially. A good survey of associative memory articles and architectures is found in Yau and Fung. There is also a new, easy to follow book on the subject by Foster (see bibliography). The full word parallel design of figure 1 will be used for the examples, since it is the simplest conceptually. A more practical architecture that can be built for an S-100 computer will be outlined in part 2.

### Selection

More intelligence can be added to our demons.

"Everybody up!"

(1) SET — Load personnel file from diskette.

"Who, in my employ, — an engineer, brown hair and eyes,

(2) JOB = "engineer"

& (3) HAIR = "br"

& (4) EYES = "br"

last name "J . . ." something, between 25 and 30 years old — has been dating my daughter?"

Text continued on page 58.



For your SWTP 6800 Computer . . .

# PERCOM's™ 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 MINIDOS™, 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  
**\$599<sup>95</sup>**

fully assembled and tested  
shipping paid

# PERCOM™

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 MINIDOS™, 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 MINIDOS™
- 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

**INDEX™** 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 BANDAID™** Turn SWTP 8K BASIC into a random access data file disk BASIC. Includes many speed improvements, and program disk CHAINING . . . . . \$17.95  
**STRUBAL+™** 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  
**TOUCHUP™** 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+™ 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 FINDER™** General purpose information retrieval system and data base manager . . . . . \$99.95

™ trademark of PERCOM Data Company, Inc.

### Ordering information

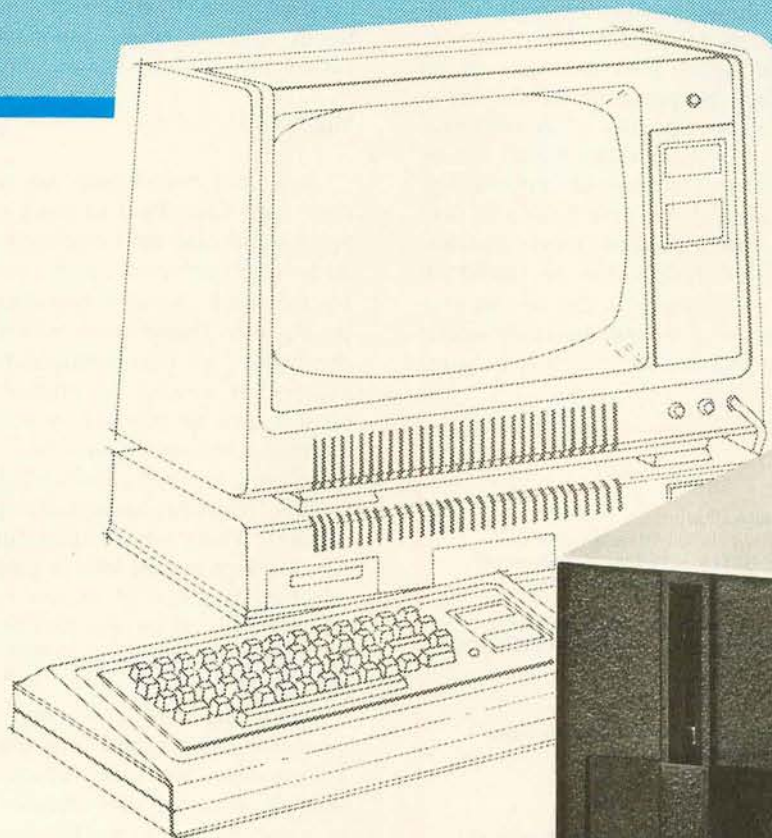
To order, call toll free 1-800-527-1592. MC and VISA welcome. COD orders require 30% deposit plus 5% handling charge. Allow three weeks for delivery. Allow three extra weeks if payment is by personal check. Texas residents add 5% sales tax.

**PERCOM 'peripherals for personal computing'**



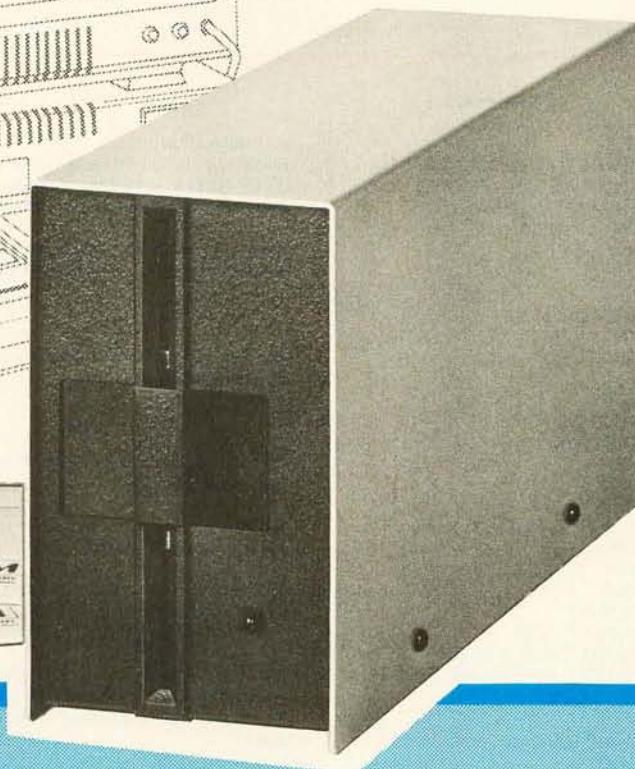
# NOW...

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



\*Trademark of Tandy Corporation.

Dual and triple drives  
also available.



only  
**\$399<sup>00</sup>**

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.



Text continued from page 55:

```
& (5) LASTNAME = "J?????????"
& (6) AGE > 25
& (7) AGE < 30
& (8) SEX = "m"

"Has he had a raise lately?"
(9) READ(LASTNAME,
        FIRSTNAME)
(10) READ(LASTRAISE)
```

Figure 2 shows another example of information retrieval, this time with a personnel file, and again with a single demon finally selected. Response of the demons is shown after each step. Any of the relational comparisons as well as exact match can be added easily to the function set. Information has been broken down into fields and field lengths the user deemed most valuable. Since this word format can be stored on floppy disk with the data, the driving program or operating system has easy access to it and can manipulate the mask to select

the field requested for each operation. A *top level* program could be as utterly readable as the one given with the example. So far, only the first step in utilizing information in the associative memory has been illustrated — the selection process. The overall set of entries is logically reduced by selection criteria to the subset of interest. Members of the smaller set may now be updated in parallel, or read out (in part, if desired) on some priority basis; the former involves parallel writing of the associative words, and the latter, responder resolution (when there is more than one answer).

### Multiwrite

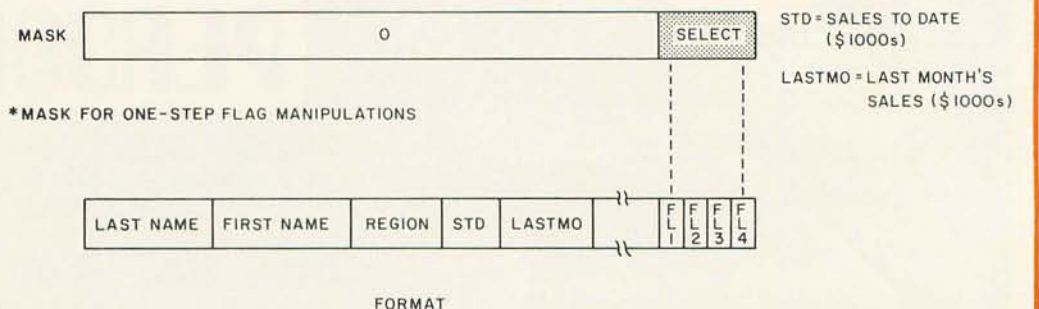
Now that the demons we want are on their feet, what kind of work can they do besides checking their description? They can all be told to change it at the point specified by the mask (ie: all responding words can be made to change their values at once to the value on the comparand bus). This process of writing a common datum, in parallel into all responding words, is called multiwrite responders by Foster, and he calls associative memories possessing this ability CAPPs (content addressable parallel processors). Whole sets of items can be updated (eg: marking certain bills as paid), or, if the selection criterion is known to produce a unique result, more specific information can be written (change John Q Williams job title to manager).

Again, we can be sending these associative write commands into the interior of a dark cave. We know which demons are reacting, but we don't know *where* they are, nor do we care. The nearest use of address information occurs when the mask is changed to operate on a specific field (whose relative location inside each word has been previously established).

By setting the mask to enable the writing of only a single bit (or bits), parallel program *flags* can be kept with each word, recording the word's membership in some selected group, with the flag itself possibly becoming

Command	Action
(1) SET	Activate all words.
(2) MW FL1,FL2,FL3,FL4,OF 16	Initialize all four flags at once.*
(3) ADD LASTMO TO STD	STD=STD + LASTMO for all words.
(4) REGION = 'W'	Select western region salesmen.
(5) STD > 100	
(6) MW FL1,0	FL1 = 0 marks the members of this group with sales to date over \$100,000.
(7) SET	
(8) REGION = 'E'	
(9) STD > 75	
(10) MW FL2,0	Eastern region salesmen with sales to date over \$75,000.
(11) SET	
(12) REGION = 'C'	
(13) STD > 50	
(14) MW FL3,0	Central region salesmen with sales to date over \$50,000.
(15) SET	
(16) FL1,FL2,FL3 = 111 <sub>2</sub>	All salesmen not included in the three* subsets above have FL4 = 0.
(17) MW FL4,0	
(18) SET	
(19) FL4 = 1	The union of the three subsets
(20) QUERY	Any members left in this set?
(21) JUMP Z, (26)	Transfer to statement 26 if not.
(22) READ(LASTNAME,FIRSTNAME)	
(23) PRINT(LASTNAME,FIRSTNAME)	Read the specified fields of the first responder and print them.
(24) NXT	Turn off first responder (select next one).
(25) JUMP (20)	
(26) END	

Table 1: A complete information processing example with parallel update, and the use of disjunctive sets.

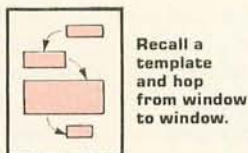
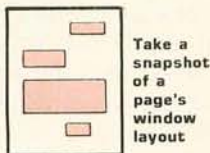




**Wordsmith** is the video text editing system you've been waiting for. Its power, flexibility and simplicity help you carve any text editing task down to size—in a way you can understand. We wanted a system that allows you to think in traditional ways about text layout, yet at the same time makes the traditionally tedious operations such as cut and paste simple and fast. We think we've done it. We want you to decide for yourself

## Flexibility

- **Logical/Physical Page Distinction.** Define your own hardcopy size. Wordsmith remembers the difference between the screen size and the hardcopy page size.
- **Modular Hardcopy Driver.** Drive a Gume® Sprint-5 or TTY-like device directly now, Diablo, NEC and other hardcopy devices soon.
- **Pure Text.** Wordsmith files are pure text with no control characters mixed in. This universal format keeps you as compatible with the world as possible. What you see on the screen is what you get as hardcopy.
- **Page Templates.** Snapshots of the block layout of a page can be saved as named disk files, then later recalled and superimposed on the current page. Use such "templates" for standard multicolumn layouts, common letter formats, and fixed-field forms. A single keystroke dispatches you quickly from block to block as you fill in your page.



- **File Switching.** Moving from document to document to examine, copy, move and change text is like rolling off a log. You're not confined to one disk file at a time anymore.

## Simplicity

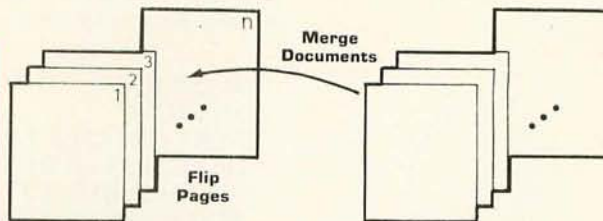
- **Auto Word Break.** Forget the right margin. Wordsmith notices when you won't be able to complete the current word and moves it to the next line for you as you continue typing.
- **Understandable Commands.** The most frequently used commands are single keystrokes. The rest are easily remembered abbreviations.
- **Informative Status Lines.** The top two screen lines constantly display page number information, document name, cursor position, tab stops and status/error phrases. You're always in touch with your document.

Page 3 of 8	File=ADV1	Cursor row 28, col 43
↓	↓	↓

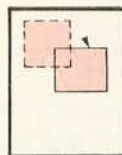
- **Protection Against Catastrophic Errors.** It's nearly impossible to ruin your document with a single bad command. Wordsmith's page oriented design and double-checking user interface help you do what you mean!

## Power

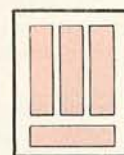
- **Page Oriented Philosophy.** A document is a collection of pages. The screen displays one entire page at a time. Simple random access page flipping commands take you quickly to any page in the document. Equally efficient commands allow you to insert, delete, copy and move pages both within one document and across documents.



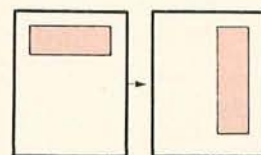
- **Extensive Block Manipulation Capabilities.** Using "windows", portions of text, charts, etc., can be quickly and effortlessly moved around on the current page, or across pages. The shape and size of any window can be changed in real time, with the contained text automatically reformatting itself (heeding word and paragraph boundaries) to conform to the new shape.



Move Text Blocks



Set Up Multiple Text Regions



Change Text Shape

- **Instantaneous Formatting.** Compacting (extraneous blank deletion) and right justifying are simple commands that tidy up a full page or window's worth of text in the blink of an eye. Random access cursor movement, line and character insert and delete, line and page split and join, and a host of other line and character level commands help you put text in its place quickly and accurately.

# The Wordsmith™ TEXT EDITOR

Defining the New Generation of Text Editing

from Micro Diversions, Inc.  
8455-D Tyco Rd.  
Vienna, Va. 22180  
(703) 827-0888

- Direct CP/M® and North Star DOS compatibility
- Available for 40x86, 24x80 and 16x64 memory-mapped video boards
- Fully reentrant for efficient multi-programming environments (6K program space, 5K data area)
- 8080 and Z80 compatibility

### Ordering Information:

\$200  
(Screensplitter™ Owners: \$80)  
Manual only: \$15  
Check, VISA, Mastercharge

1. CP/M or North Star DOS version?
2. TTY or GUME interface?
3. Brand and memory address of video display board?
4. Ship on single or double density, 5" or 8" diskette?

Inquire about our custom keyboard.







**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



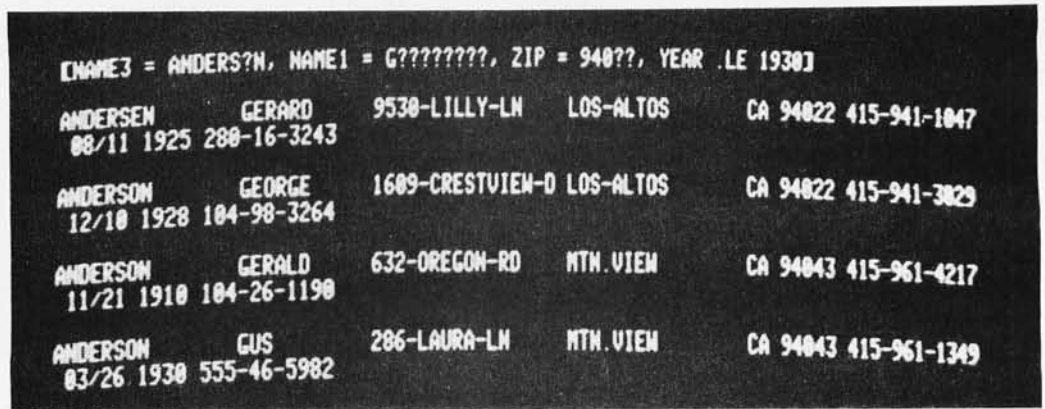


Photo 1: Video display of an inquiry to Semionics' associative memory board, REM, and the response. In the inquiry, ? is a don't care character which will match anything.

ory, an absolute word address can be derived and information read random access style.

The accessing of data via address makes this second responder resolution technique nonassociative, but it is sometimes used to avoid the extensive hardware of the priority list.

### The Real Time Pinch

When the first generation of computers was being built, hardware was critically expensive, and the von Neumann architecture — a general purpose design which truly minimizes hardware through serial processing — was not seriously questioned. With the plummeting cost of electronic parts, minimizing hardware has become less important to the designer. The desire to maximize throughput, particularly in multiuser situations, has led to the introduction of parallel processing at all architectural levels with the concomitant increase in hardware complexity — from multiprocessor systems, to machines incorporating multiple independent I/O (input/output) channels, down to distributed processing logic, as in an associative memory. The concept of a general purpose parallel computer is quite hazy, so the thrust has been to build specialized hardware for the von Neumann machine to deal with the parallel components of computing as they are recognized.

Some products for associative processing are commercially available. On the high end, STARAN is a very expensive associative machine from Goodyear Aerospace, and may be the only machine of its kind for sale. On only a slightly less grand level, there are a few 16 bit or smaller CAMS (integrated circuit associative memory integrated circuits), which even in quantities of 100 carry a price tag of about \$1.50+ per bit. They are fast parts, some with speeds in the 10 to 40 ns range. IBM also uses such fast, and small associative memories in the

virtual memory hardware of the 360/67 for quick address lookup. But associative memory for a large computer subsystem need not be nearly so fast, nor could it be tolerable at such a price. Cost, in the world of electronics, is not necessarily a function of complexity, but of volume.

Unfortunately, large manufacturers must usually see millions of projected sales before entering the marketplace with anything really new. Big businesses, meanwhile, cannot afford to walk away from years of accumulated software on their present machines, no matter how cumbersome. Software is expensive to create and maintain, so big installation inertia will keep sales volume at a trickle. Yet given the ubiquity of sorting, searching, merging, updating, and linking in such business systems, it is no small irony that a judiciously used associative memory subsystem could in many cases greatly reduce software complexity, and therefore expense (not to even mention greatly increase program speed). To review, costs will not come down, nor viable products become available until expected sales volume goes way up, and at \$1.50 per bit. . . .

The cycle, representative of large scale business, may perhaps be broken at the new grass roots level — the home, small business, or research system where inertia is at a minimum. An add-in associative memory can be designed with off-the-shelf integrated circuits and random access memories for a cost to memory ratio of only 2 or 3 to 1. This memory design is discussed in part 2 (May 1979 BYTE).

### BIBLIOGRAPHY

1. Foster, Caxton C, *Content Addressable Parallel Processors*, Van Nostrand Reinhold Co, New York, 1976.
2. Yau, S S and Fung, H S, "Associative Processor Architecture — A Survey," *Computing Surveys*, volume 9, number 1, March 1977. ■



## Horizon Disk Capacity Keeps Growing

The Horizon is now capable of 720K bytes on-line! The Horizon can connect to four double density 5¼" single-sided disk drives. Each of those drives can access 180K bytes of information. A four drive system accesses 720K bytes!

That's capacity you don't usually find in a microcomputer, but there's even more to come! The North Star disk controller board is designed so that two-sided disk drives may be added as soon as they become available from North Star.

Existing Horizons will accommodate the new two-sided drives so North Star owners can simply add additional drives to up-grade their system. Each two-sided drive will access 360K bytes! That means the maximum on-line disk storage for the Horizon will increase to over 1.4 million bytes!

## New Cabinet for Disk Drives

North Star additional disk drives are now available with the same high quality wood cover as the Horizon computer! The Additional Drive Cabinet (ADC) is designed to accept either one or two drives for the Horizon or for mounting North Star Micro Disk System drives. Like the Horizon, the ADC is available with either wood or blue metal cover. Included is a new power supply capable of powering one or two drives. The ADC is \$129 in kit form. Assembled, with one drive the ADC is \$599, with two drives \$999.

## Pascal Now Available for Horizon

The much-heralded Pascal language is now being offered for use with the North Star Horizon computer. North



Star, with the co-operation of the University of California at San Diego, is now delivering a Pascal Program Development system. North Star Pascal is ideally suited for developing large programs because of features such as: long variable names, block-structured control statements, and compilation. North Star Pascal is available on 5¼" diskettes for use with the Horizon or Micro Disk System. North Star Pascal will operate with either the Z80 or 8080 microprocessor.

Pascal, including documentation, is available in either single or double density versions for \$49. An auxiliary Pascal diskette, containing an 8080/Z80 assembler and some additional Pascal utilities, is available for \$29. Complete information is available at your local retail computer store.

Pascal, including documentation, is available in either single or double density versions for \$49.

An auxiliary Pascal diskette, containing an 8080/Z80 assembler and some additional Pascal utilities, is available for \$29. Complete information is available at your local retail computer store.

## First Double Density, Now Double Memory

The new North Star 32K RAM board (RAM-32) has doubled the memory density of the popular Horizon computer. Available either with the Horizon or other S-100 bus computers, the RAM-32 runs at full speed—no wait states—with the 4 MHz Z80A microprocessor (as well as with slower Z80 and 8080 processors). Addressability of the RAM-32 is switch-selectable in four 8K regions.

North Star RAM features like bank-switching and parity checking are standard. The parity checking capability means that the RAM-32 is constantly diagnosing itself. That's a plus for your system. The fact that parity checking is a North Star RAM-32 standard is a plus for your pocketbook! There is no extra charge for this important capability.

A Horizon with 48K of RAM can be configured by using one North Star 16K RAM board and a RAM-32. Need more memory? 56K can be configured by using two RAM-32 boards with one 8K region switched off.

## NORTH STAR MDS, ZPB, FPB FOR OTHER S-100 COMPUTERS

Upgrade your system with these North Star products—available for any S-100 computer: Micro Disk System—a complete 5¼" floppy disk system, Z80 Processor Board, or the Hardware Floating Point Board.

### Horizon and RAM board prices are:

	Kit	Assembled
Horizon - 1-16K	\$1599	\$1899
Horizon - 1-32K	1849	2099
Horizon - 2-32K	2249	2549
RAM-32	599	659
RAM-16	399	459

◀ A typical Horizon configuration: CRT, Horizon computer, Additional Drive Cabinet (ADC).

**NorthStar**  
Computers

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





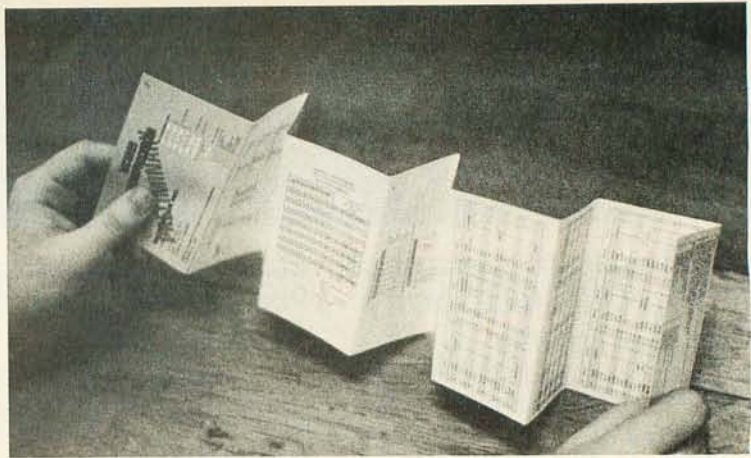
# BYTE's Bits

## Motorola 6809 Card Folding

A useful item of documentation furnished with the Motorola 6809 microprocessor is the *MC6809 Microprocessor Instruction Set Summary* card. Printed on heavy stock, it contains vital information for the programmer in condensed form. This combination of heavy stock and condensed information gives this document an information density of  $4.72 \times 10^7$  characters per slug, a figure imaginable only with advanced technology.

Users who peruse the card, however, might have difficulty in refolding it to its original compact configuration. Therefore we present here helpful instructions to refold the card.

The first step is to differentiate between the pages of the card. Luckily, this is much easier than integrating between the pages, or even reading between the lines. Here we employ the convention of using letters of the English alphabet. Upper case is preferred for clarity, but lower case may be employed if you are coding a word processing system.



Completely unfold the card and stretch it out on a flat surface. Using a pencil, inscribe the letter A on the top righthand corner of the first page, the page containing the title and programming model. Move the pencil down to the second page, and inscribe the character B in the top righthand corner. Continue this process, incrementing the alphabetic character down the length of the card until you reach the last page, which should bear the appellation J. This completes the page distinction routine.

Having identified the pages, you are now ready to begin the actual folding process. Grasp the bottom page J. Fold it up on top of page I. Now take page I, and fold along the F-G seam so that the back side of page I contacts the back side of page D. Take care that page J does not become unfolded from I.

Take heart, we're almost through. Grasp the top edge of page G and fold along the C-D seam so that the front side of page G contacts the back side of page A. Moving quickly now, fold the front side of page C to the front side of page B. Take the A-G aggregate, and fold the whole thing back onto page E. The folding process should now be complete, and the card returned to its original state.

User options at this point include: placing the card in your pocket, placing the card in a desk drawer, or binding the card with a paper clip.

Note please, that these instructions are based on preliminary folding information provided by Motorola. It is possible that actual production sample of the card will have a different foldout specification.

In addition to its unique topological properties, the card will be of interest because of the information printed on it. Included are addressing mode summaries, operation descriptions, register bit assignments, vectors and stacking order, and miscellaneous data. . . RS ■

### NE Computerized Bulletin Board

We have received an announcement from the New England Computerized Bulletin Board System informing us that they have been in operation since December 1977. In order to connect to the CBBS, a terminal with a modem or acoustic coupler and a phone line is necessary. The procedure is as follows: set your terminal to 300, or 110 bps (30 or 10 characters per second) full duplex. Dial (617)963-8310 and wait for the carrier. Place the phone in the acoustic coupler and hit carriage return on your terminal a few times. The CBBS will then respond and take you the rest of the way. ■

## Speakeasy Software™

FINANCIAL ANALYSIS  
SPORTSTRIVIA  
MICROTRIVIA

TRANSACTIONAL ANALYSIS  
WARLORDS • KIDSTUFF  
BULLS AND BEARS



## APPLE • PET • TRS-80

Now available at over 1,000 stores worldwide!

Speakeasy Software, LTD.

Box 1220, Kemptville, Ontario, Canada, K0G 1J0 (613) 258-2451



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

**New NRI Home Study Course Shows You How to Make Money Servicing, Repairing,  
and Programming Personal and Small Business Computers**

Seems like every time you turn around, somebody comes along with a new computer for home or business use. And they're being gobbled up to handle things like payrolls, billing, inventory, and other jobs for businesses of every size...to perform household functions like budgeting, environmental systems control, indexing recipes, and more.

### **Growing Demand for Computer Technicians... Learn in Your Spare Time**

Even before the microprocessor burst upon the scene, the U.S. Department of Labor forecast over a 100% increase in job openings for the decade through 1985. Most of them *new* jobs created by the expanding world of the computer. NRI can train you at home to service both microcomputers and their big brothers. Train you at your convenience, with clearly written "bite-size" lessons that you do evenings or weekends without quitting your present job.

### **Assemble Your Own Microcomputer**

NRI training includes practical experience. You start with meaningful experiments building and studying circuits on the NRI Discovery Lab®. Then you build your own test instruments like a transistorized volt-ohm meter, CMOS digital frequency counter...equipment you learn on, use later in your work.

And you build your own microcomputer, the only one designed for learning. 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. It's the



kind of "hands-on" training you need to repair and service units now on the market.

### **Mail Coupon for Free Catalog No Salesman Will Call**

Send today for our 100-page, full-color catalog. It describes NRI's new Microcomputer Technology course in detail, shows all equipment, kits, and lesson plans.

And it also tells about other NRI courses... Complete Communications with 2-meter

transceiver...TV/Audio/Video Systems Servicing with training on the only designed-for-learning 25" diagonal color TV with state-of-the-art computer programming. With more than a million students since 1914, NRI knows how to give you the most in home training for new opportunity. If coupon has been removed, write to NRI Schools, 3939 Wisconsin Ave., Washington, D.C. 20016.

### **RUSH FOR FREE CATALOG**



#### **NRI Schools**

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

Please check for one free catalog only.  
**NO SALESMAN WILL CALL**



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

- 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

- 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 170-049



# A Simulated View of the Galaxy

Mark Dahmke  
8312 Selleck Hall  
600 N 15th St  
Lincoln NE 68508

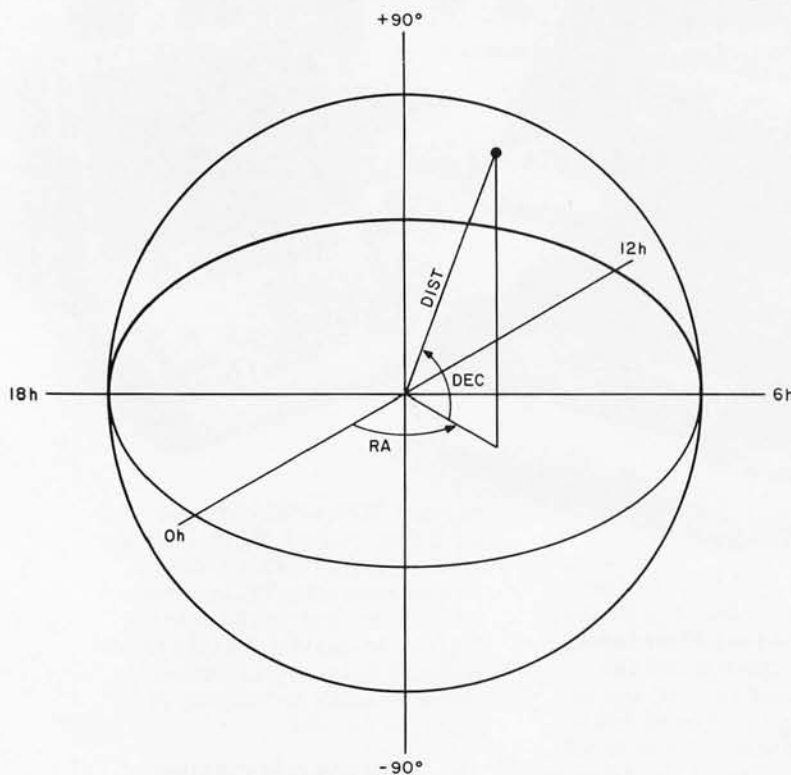


Figure 1: The celestial coordinate system.

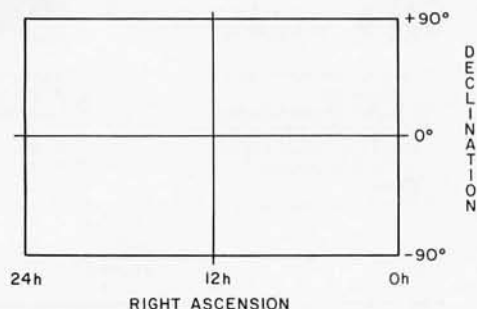


Figure 2: A Miller projection is used for plotting the data.

At one time or another, each of us lets our imagination wander; perhaps to places familiar to us, or places we have never been and can only dream about exploring. Often, my imagination leads me to the questions: "What does our sun look like from neighboring stars?" and "What do our familiar constellations look like from other points of view?" Have you ever wished that you could travel anywhere in the universe whenever you wanted to? With the help of computers and graphics displays we can begin to answer some of these questions and have fun exploring what we know about the galaxy at the same time.

## Getting Started

Several things are needed to simulate the stars in our galaxy; an algorithm that will allow us to shift our position with respect to the Earth based coordinate system; actual or hypothetical coordinates of stars; and a display device on which to plot the resulting star maps. The first version of this program was written four years ago and run on an IBM 1130 computer. Output was in the form of a printer plot. 50 stars were entered, using data on the 50 brightest stars in our sky. Since positions given in star catalogs are in celestial (spherical) coordinates, right ascension (RA) corresponding to longitude (0 to 23 hours), declination (DEC) corresponding to latitude (-90 to +90 degrees), and distance in light years were entered directly into a disk file. The program then performed the necessary conversions to get values in radians. Figure 1 shows the celestial coordinate system.



The author wishes to thank TRC Photographic Specialists of Omaha NE for their help.

### Coordinate Transformations

In order to display the stars as they would appear from another point in space, their coordinates must be converted to a manageable form. Shifting the origin of the coordinate system appears to be the easiest way to obtain the desired results. Declination and right ascension must be converted to radians first:

$$\begin{aligned} \text{RA} &= \text{RA} \times 0.261799 \\ \text{DEC} &= \text{DEC} \times 0.01745 \end{aligned}$$

where RA and DEC represent right ascension and declination, respectively. Then the celestial coordinates can be converted to rectangular coordinates:

$$\begin{aligned} X &= R \times \cos(\text{DEC}) \times \cos(\text{RA}) \\ Y &= R \times \cos(\text{DEC}) \times \sin(\text{RA}) \\ Z &= R \times \sin(\text{DEC}) \end{aligned}$$

The resulting rectangular coordinates are in units of light years, because of the variable R (distance). The coordinates may be kept in three arrays for easy manipulation.

Next, the origin must be shifted to the new point of view. The celestial coordinates of the destination or new origin are given by the user of the program (through console input) and converted to rectangular coordinates with the same set of equations used above. To shift the origin, the following three equations should be used:

$$\begin{aligned} X' &= X - X_0, \\ Y' &= Y - Y_0, \\ \text{and } Z' &= Z - Z_0, \end{aligned}$$

where  $X_0$ ,  $Y_0$ , and  $Z_0$  are the rectangular

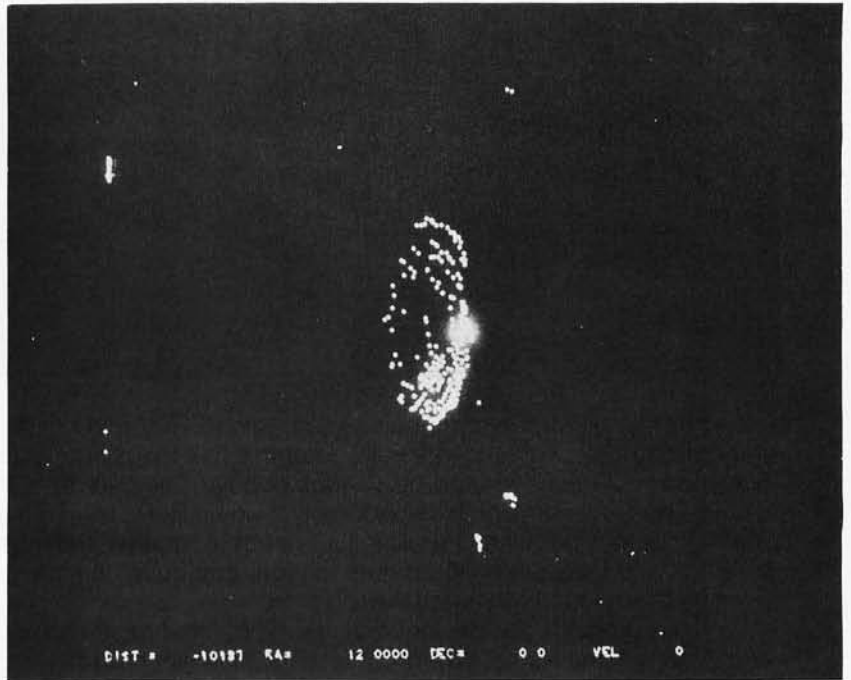


Photo 1: Side view of our galaxy from 90,987 light years.

coordinates of the new origin; X, Y, and Z are the old coordinates of a star in the three arrays; and X', Y' and Z' are the resulting shifted coordinates.

To display the stars, the rectangular coordinates must be converted back to celestial coordinates:

$$\begin{aligned} (R')^2 &= (X')^2 + (Y')^2 + (Z')^2, \\ \text{RA}' &= \arctan(Y'/Z'), \\ \text{DEC}' &= \arcsin(Z'/R'). \end{aligned}$$

It is also necessary to multiply by the appropriate scale factors to be compatible with the screen or window dimensions of the display device. The current version of the program displays the stars in the form of a Miller projection, as shown in figure 2. This produces a distorted view on the top and bottom of the display but does show the entire sky. An alternate format magnifies the window to display only a 50 by 50 degree frame. This gives the impression of looking out the window of a spaceship, but makes navigation difficult.

In order to shift the window, we must introduce some new variables to indicate in the program which rotations are required. This can most easily be accomplished by altering the equations used for shifting the origin:

A glossary is provided on page 80.

Text continued on page 70





## HELLO FELLOW COMPUTERIST ...

At this time I wish to introduce myself. I am PERRY POLLOCK, the owner, manufacturer and designer of the products advertised in this issue of this fine magazine. In the issues to come, I will be introducing more powerful interfaces for the various popular computers.

To take advantage of this opportunity, I would like to tell you a little about my beliefs, aims and policies. Starting out as a hobbyist, I realize your needs, concerns and most of all the requirements of a good, well designed and fairly priced interfaces for your computer. It is my goal to supply you with the most for your investment and the highest quality possible.

All the products are designed by me. They are first drawn out and logically analyzed. Then they are wire wrapped and tested. When I am satisfied that it functions well, then I will etch a sample printed circuit board, then and only then, will I commit the design to a mass production run.

All the parts used in our products are of the highest quality. The manuals are written so you can understand all the phases of construction and operation. How many times have we bought a product and it lacked for a good, understandable manual, or has it had so many flaws that we could swear that we were re-designing the product. ALL OF THIS IS IN THE PAST. These products are not offered unless they are right!!!

Another one of my aims is to let you know who you are dealing with. How many times have we ordered a product and wondered who we were really dealing with. Then ... if we had problems, how difficult was it to contact them? Because of all this, I have chosen to publish a picture of myself (I'm not vain, really) and a picture of my wife Korrine (pictured below). I am available 24 HOURS A DAY. I have a telephone answering service that will put your call through to me anytime day or night, or if you wish you can call me at home. (602) 886-5037. If you have a problem, question or just want to talk, give me a call.

I have many exciting new products under development. It will be an exciting year and I hope you will enjoy the interfaces designed for you and I. I know these interfaces have made my computer more enjoyable for me and hopefully for you.

Sincerely,

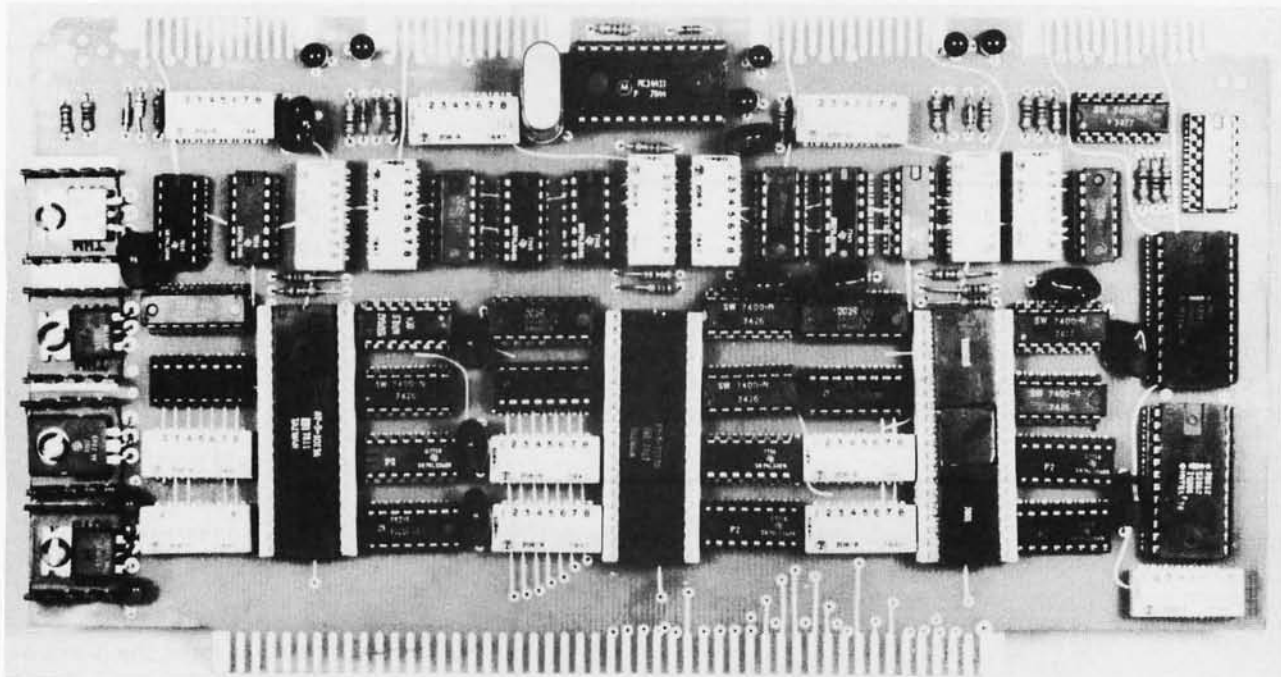
Perry and Korrine Pollock  
Your fellow computerists  
WORLD POWER SYSTEMS, INC.

P.S.: My guarantee ... If you are not satisfied with the product, return it to your dealer or me for a full refund within 5 days of purchase.





# 3 S+P INTERFACE CARD



A POWERFUL I/O INTERFACE CARD FOR ANY S-100 BUS. THREE SERIAL PORTS AND ONE PARALLEL PORT. FULLY HARDWARE OPERATED. NO SOFTWARE INITIALIZATION REQUIRED. IN ADDITION, THIS BOARD WILL OPERATE WITH ANY SOFTWARE. USER IS ABLE TO SELECT STATUS BITS TO FIT ANY SOFTWARE CONFIGURATION.

## FEATURES

- **SELECTABLE BAUD RATES:** All baud rates are dip switch selectable. Each port can be set for its own baud rate. CRYSTAL CONTROLLED baud rates. This interface card can operate with any Micro-processor at any speed. The 3 S+P does not depend on the CPU for its originating clock. 110-9600 baud.
- **EASY CONFIGURATION:** The 3 S+P is easy to set. All port addresses are set by dip switches. Each port can be assigned, independent of each other.
- **SOFTWARE COMPATIBLE:** The 3 S+P will be compatible with most software arrangements due to the ability to set the status bits and the parity. Parity, character length, stop bits all set by dip switches. Each port can be set to its own individual arrangement.
- **HIGH QUALITY:** The highest quality parts are used. P.C. Board is with plated through holes, solder mask, silk screen legend and gold plated contacts.
- **OUTPUT ARRANGEMENT:** All outputs terminate at the top of the card via a 26 contacts. Standard 26 pin IDC connectors mate with each port. RS-232, current loop at each serial port and full data lines at the parallel port connection. Operation is asynchronous mode, but can be configured for synchronous operation by minor re-configuration.
- **FULL DOCUMENTATION:** A complete manual of operation and construction is included. Easy construction and 3 hours is the estimated construction time. Just plug in, set the switches and enjoy all the different configured software. NO MORE changing the software to match your I/O board. Just set the board and enjoy.

Kit  
**\$159.95**

Assembled  
**\$189.95**

## OPTIONS

Connecting cables from 26 pin to standard DB-25 are separate. Molded factory cables are available for \$14.95 each. Cables have 26 pin IDC connector at one end and DB-25 female at other end, connected by ribbon cable.

## TERMS

CASH WITH ORDER, VISA, MASTER CHARGE. NO C.O.D.'S! PERSONAL CHECKS REQUIRE 3 WEEKS TO CLEAR.

ORDER FROM  
**WORLD POWER SYSTEMS, INC.**

1161 N. El Dorado Place, Tucson, Arizona 85715

24 Hour Order Phone No: 602-886-2537

STOCKING DISTRIBUTOR FOR SOUTHERN CALIFORNIA CONTACT: CALIFORNIA DIGITAL 213-679-9001



Table 1: Execution times of one iteration of the program with various numbers of stars. Times include plot or display device data transfer rates.

Number of Stars	IBM-1130	8080/BASIC	8080/ASM	IBM 370/158
10	4 minutes	10 seconds	0.5 seconds	0.1 seconds
100	6 minutes	100 seconds	5.0 seconds	0.3 seconds
400	8 minutes	400 seconds	20.0 seconds	1.0 seconds

Table 2: Star coordinates taken from star atlases and catalogues. Besides using real stars, the author also input 300 "imitation" stars to fill out the galaxy to what it actually looks like. The stars listed should be enough to produce interesting patterns in a reasonable amount of home computer time. Names (popular or scientific) are rough approximations in English alphabet. An asterisk represents fictitious "fill-out" stars to represent extragalactic objects.

Name	Right Ascension (hrs)	Declination (degrees)	Distance (light yrs)	Magnitude
A. CETUS	02.983	003.900	250.0	2.8
A2. LIB	14.800	-15.833	62.0	2.9
THI. ERI	02.933	-40.517	120.0	3.4
SUN	00.000	0.000	.1	-9.0
AND.GALAXY	00.667	4.100	1500000.0	7.8
AND. A	00.668	4.100	1500000.0	7.8
AND. B	00.666	4.200	1500005.0	7.8
AND. C	00.665	4.400	1500010.0	7.8
AND. D	00.668	4.300	1501000.0	7.8
AND. E	00.667	4.500	1500100.0	7.8
AND. F	00.660	4.000	1500150.0	7.8
AND. G	00.656	4.400	1500050.0	7.8
AND. H	00.660	4.550	1510000.0	7.8
AND. I	00.661	4.500	1510001.0	7.8
AND. J	00.667	4.600	1510000.0	7.8
EG224A	00.667	041.001	1500000.0	5.0
EG224B	00.669	041.000	1500000.0	5.0
EG224C	00.665	041.001	1500000.1	4.9
EG224D	00.666	041.002	1500001.0	5.0
EG224E	00.665	041.001	1500000.0	5.0
EG224F	00.668	040.999	1500000.0	5.0
EG225COMP	00.630	041.420	1500000.0	9.9
EG201COMP	00.667	040.600	1500000.0	9.5
PLEIADES	03.733	023.950	4300.0	4.7
SIRIUS	6.716	-16.6	8.7	-1.4
A.CENTAURI	14.600	-60.6	4.3	-2.2
CANOPUS	6.380	-52.6	2300.0	-7.7
VEGA	18.586	38.733	23.0	.1
CAPELLA	05.216	045.950	42.0	.2
ARCTURUS	14.223	019.450	32.0	.2
PROCYON	07.612	005.350	10.0	.5
ARCHERNAR	01.598	-57.483	70.0	.6
B CENTAURI	14.005	-60.133	130.0	.8
ALTAIR	19.805	008.733	18.0	.9
ALDEBARON	04.550	016.416	54.0	1.1
SPICA	13.376	-10.900	190.0	1.2
FORMALHAUT	22.915	-29.883	27.0	1.3
DENEK	20.662	045.100	465.0	1.3
RIGEL	05.202	-08.250	545.0	.3
BETELGEUSE	05.875	007.400	300.0	.9
BELLATRIX	05.367	006.300	230.0	1.7
E. ORION	05.567	-01.233	300.0	1.7
K. ORION	05.767	-09.683	2100.0	2.2
D. ORION	05.497	-00.333	600.0	2.5
L. ORION	05.550	009.917	1600.0	3.7
ANTARES	16.438	-26.316	170.0	1.2
REGULUS	10.095	012.216	70.0	1.3
B. LEO	11.800	014.733	43.0	2.2
G. LEO	10.300	019.983	90.0	2.6
E. LEO	09.733	023.917	100.0	3.1
TH. LEO	11.217	015.600	150.0	3.4

Table 2 continued on next page.

Text continued from page 67

$$\begin{aligned} X' &= X - X_0, \\ Y' &= Y - Y_0, \\ \text{and } Z' &= Z - Z_0, \end{aligned}$$

will become:

$$X' = (X - X_0) (\cos \phi) (\cos \theta) + (Y - Y_0) (\sin \theta) (\cos \phi) + (Z - Z_0) (\sin \phi)$$

$$Y' = (Y - Y_0) (\cos \theta) - (X - X_0) (\sin \theta)$$

$$Z' = (Z - Z_0) (\cos \phi) - (X - X_0) (\cos \theta) (\sin \phi) - (Y - Y_0) (\sin \theta) (\sin \phi)$$

where:

- $\theta$  = rotation about the X axis on the Y,Z plane,
- $\phi$  = rotation about the Z axis on the X,Y plane.

Also, when converting back to celestial coordinates, scale factors must be introduced to produce a 50 by 50 degree field of view. The user may wish to experiment with other window formats.

### Expanding the Model

Looking at the sky from various points of view in space is interesting, but I have found that animation really shows the power of the simulation technique, and of animated graphics. With the coordinates of over 400 stars (100 real stars and 300 that add the general shape of the Milky Way spiral arms of our own galaxy), we can begin the exploration of our universe. Unfortunately, 400 stars do not make a galaxy, or even a small

### About the Author

Mark Dahmke is currently employed by the University of Nebraska Computer Network as a programmer/analyst in the Academic Computing Services section. He is also a senior computer science major. At home Mark owns an 8080 based system with 32 K bytes of memory and a floppy disk drive. His work involves graphics, electronics, writing and systems programming.





# We make our Floppys as if your job depends on them. Because it does.

In your work, data is too important to lose. So if you use a Floppy Disk with even a minor flaw—like a dropout—you risk a lot. That's why Maxell has taken the danger out of Floppy Disks.

## **Maxell: the worlds most dependable Floppy Disks.**

We've devoted two generations to building our reputation as manufacturers of the world's finest magnetic media. Our Floppy Disk technology achieves a consistency that is rarely equaled . . . and never surpassed.

Even the jackets our floppys come in are made to resist heat and mechanical shock. And they're specially treated to prevent the build-up of static charges, so they do their part to increase the total reliability of their precious contents.

## **Made better than most specifications.**

To guarantee complete interchangeability, all Maxell floppys conform to ISO, ECMA, ANSI, JIS, and IBM standards.

But even more important to you, Maxell's own tolerances are tougher than the industry's.

And our inflexible Quality Control inspections permit nothing to blemish our hard-earned reputation.

So when your job depends on full data retrieval, depend on Maxell Floppy Disks. They work best . . . and so will you.

Maxell offers the full range of Floppy Disks, from standard 8-inch to 5¼-inch, plus Data Cassettes. *Dealer inquiries invited.*



**maxell.**  
DATA PRODUCTS  
The Quality Alternative

Maxell Corporation of America, Data Products Group  
60 Oxford Drive, Moonachie, NJ 07074 Tel. (201) 440-8020



Table 2, continued:

D. LEO	11.217	021.000	140.0	3.5
Z. LEO	10.250	023.567	500.0	3.6
M. LEO	09.850	026.167	110.0	4.1
R.D SCO	15.900	-28.500	450.0	4.0
SCO	16.883	-42.317	300.0	3.8
TH. SCO	17.567	-42.967	140.0	2.0
SHAULA	17.500	-37.067	200.0	1.7
E. SCO	16.783	-34.200	75.0	2.3
K. SCO	17.650	-39.000	360.0	2.5
D. SCO	15.938	-22.533	590.0	2.5
G. SCO	16.883	-42.317	100.0	3.8
POLLUX	07.705	028.150	31.0	1.2
CASTOR	07.523	032.000	44.0	1.6
E. GEM	06.700	025.167	200.0	3.2
GEM	06.217	022.517	300.0	3.4
D. GEM	07.300	022.033	300.0	3.5
Y. CAS	00.900	060.450	200.0	2.2
A. CAS	37.833	059.267	230.0	2.4
B. CAS	00.108	058.883	45.0	2.4
D. CAS	01.400	060.083	150.0	2.8
E. CAS	01.867	063.517	100.0	3.7
D. TAURUS	05.383	28.567	130.0	1.7
TAU	05.633	021.000	350.0	4.1
HYADES	04.250	016.000	300.0	4.0
E. TAU	04.450	019.117	300.0	4.0
E URSAE MAJ	12.863	056.233	50.0	1.7
DUBHE	11.000	062.017	105.0	1.9
N. UMA	13.767	049.467	210.0	1.9
MIZAR	13.367	055.183	190.0	2.2
D. UMA	12.233	057.200	100.0	2.2
B. UMA	10.980	056.650	76.0	2.4
Y. UMA	11.867	053.967	88.0	2.5
B CRUCIS	12.746	-59.416	465.0	1.5
A CRUCIS	12.396	-62.816	150.0	1.6
E CANIS MAJ	06.945	-28.900	325.0	1.6
ACRUX	12.400	-63.150	220.0	.9
E. CARINA	08.358	-59.350	330.0	1.7
B. CARINA	09.217	-69.517	300.0	1.8
A. TRIA	16.717	-68.933	130.0	1.8
MIRFAK	03.350	049.683	270.0	1.9
Y. VEL	08.133	-47.183	100.0	1.9
ALHENA	36.583	016.450	78.0	1.9
KAUS. AUST	18.350	-34.417	160.0	1.9
AL WAZOR	07.100	-26.317	650.0	1.9
MURZIM	06.342	-17.933	300.0	1.9
D. VEL	08.717	-54.517	70.0	2.0
ALNITAK	05.633	-01.967	400.0	2.0
B. AURIGAE	05.933	044.950	84.0	2.0
PEACOCK	20.367	-56.900	160.0	2.1
POLARIS	01.817	089.033	470.0	2.1
Y. UMI	01.530	073.000	500.0	4.7
N. UMI	01.620	076.000	700.0	5.7
D. UMI	01.795	086.100	650.0	5.0
E. UMI	16.850	082.130	550.0	5.1
TH. UMI	01.572	078.100	750.0	5.0
A. OPH	17.550	012.600	67.0	2.1
NUNKI	18.867	-26.367	160.0	2.2
A. AND	00.088	028.817	120.0	2.1
ALPHARD	09.417	-08.433	200.0	2.2
AL NA'IR	22.083	-47.200	91.0	2.2
SUHAIL	09.100	-43.233	220.0	2.2
B. PER ALGOL	03.082	040.767	100.0	2.2
A. ARI	02.067	023.233	74.0	2.2
B. GRUS	22.650	-47.150	325.0	2.2
B. CETI	00.683	-18.267	57.0	2.2
B. UMI	14.850	074.367	270.0	2.2
I. CARINA	09.267	-59.067	100.0	2.2
TH CENT.	14.067	-36.117	86.0	2.2
D. PUPPIS	08.033	-39.867	800.0	2.3
Y1. AND.	02.033	042.083	400.0	2.3
ALPHECCA	15.550	026.883	67.0	2.3
Y. CYGNUS	20.333	040.100	470.0	2.3
B. AND	01.117	035.350	75.0	2.4
Y. DRA	17.917	051.500	150.0	2.4
N. CMA	07.367	-29.200	270.0	2.4
A. PHE	00.400	-42.583	76.0	2.4
E. PEG	21.700	009.650	250.0	2.5
A. PEG	23.033	014.933	100.0	2.6
N. OPH	17.125	-15.667	76.0	2.6
Y. CRV	12.217	-17.267	130.0	2.8

fraction of it, but with a little imagination (which was all we had in the first place) we can mentally fill the gaps in the model. The current version of the simulation runs on an IBM 370-158 with a 2250 graphics display unit. The 2250 has a resolution of 4096 by 4096 points. With a slight modification to the program, it will run in a continuous loop, starting with a direction vector and velocity in light years per iteration. The effect is that of a space craft with almost unlimited velocity. With a fast processor, the impression of speed is dramatic. Velocities of 10,000 light years per second have been simulated. There are no relativistic effects, but it might be interesting to add the necessary equations—especially if color graphics are available. The Doppler shifts would be most striking. The stars in the direction of travel would be intensely blue, while those receding from the observer would be a deep red.

### Adding More Stars

As my desire to travel outward increased, I soon realized that I would have to have something to travel to. Additions to the model included the Andromeda galaxy (approximately 1.5 million light years away), the Magellanic clouds (our nearest intergalactic neighbors) and several other extragalactic objects. One problem with adding more stars is that the execution time goes up proportionately. When experimenting with computer based simulations, this soon becomes apparent. Note that in listing 1, the algorithms have been optimized to the extreme, to cut down on the execution time. Comparison tests were run on several systems with the results shown in table 1.

The IBM-1130 was slowed down by its printer, used to generate a printer plot of the star map. The 8080 is almost fast enough to compete with the 370, if it didn't have to do the floating point calculations in software. A floating point hardware board would probably decrease the times given for the 8080 by a factor of 10. The 370 is a multi-programming system—running several other programs at the same time. Thus, the simulation has to compete with other programs and is also slowed down by competition for peripheral devices such as video terminals, the 2250 graphics display, printers, and card readers.

### Implementation

The details of implementation depend on the computer, display device, and language used. The original IBM-1130 version used a printer plot because that was the only out-



# Include us in your plans for 1979!!

Sophisticated technology, low  
pressure living, with more pro-  
fessional and personal advantages  
than we can list.

**...that's why the  
big move is to  
NCR,  
Millsboro.**

▪ Long growth cycle projects. ▪ Rapid advancement. ▪ Direct computer access. ▪ Good internal communications. ▪ Real state-of-the-art developments. ▪ High internal visibility. ▪ In-plant recreation. ▪ Low cost of living. ▪ High quality of life. ▪ Beaches, boating, and wildlife preserves. ▪ Within reach of major Cultural Centers. ▪ Ground floor opportunities in the design and development of our new C-2140 ECR/POS Multi-Microprocessor Based Retail System.

You'll find solid professional and personal reasons for building a new career with us.

*The following are current career openings:*

## **SYSTEMS ANALYSTS/REAL TIME PROGRAMMERS**

- Operating System Design
- Microprocessor Software—Assembly Language
- I/O Drivers
- Diagnostics

## **TEST SYSTEMS ENGINEERS/DEVELOPMENT ENGINEERS**

- 8080 Based Microprocessor Design
- ATE Programming of Microprocessor Boards
- NMOS, EMOS, CMOS, LSI & MSI Technologies
- Multiprocessor Systems Architecture

## **SUPPLIERS QUALITY ASSURANCE**

- Vendor Quality Management
- Interfacing with Design Engineering, Product Test, Field Engineering, Purchasing & Manufacturing
- Components—Specification & Product Design

## **INDUSTRIAL/MANUFACTURING ENGINEERS**

- Assembly Routines, Labor Estimating, Production Line Layouts
- Facility & Capital Equipment Analysis
- ATE & CAM
- Production Support & R&D Liaison

## **POWER SUPPLY DESIGNERS**

- Design and Develop Low-Voltage Switching Power Supplies
- Adherence to UL/CSA and International Safety Standards
- Worst Case Design on Circuits

If you qualify for any of the above, call us at: 302-934-8111, or send resume and salary requirements, in complete confidence, to: Mr. Joseph G. Buskirk, NCR Corporation, Dept. \_\_\_\_\_, Engineering & Manufacturing, Mitchell Road, Millsboro, DE 19966.

# **NCR**

Complete Computer Systems

An equal opportunity employer



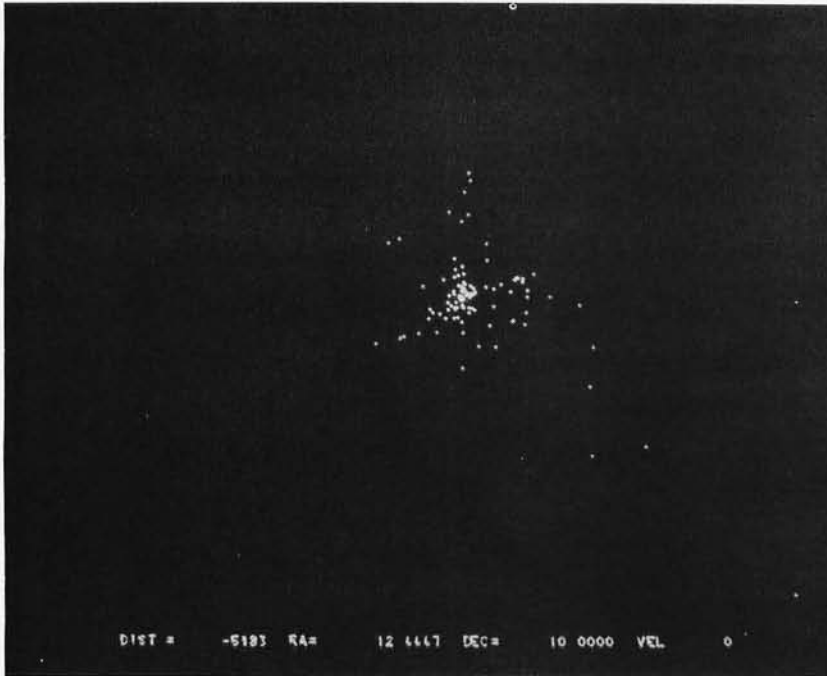


Photo 2: Our galaxy from -5983 light years.

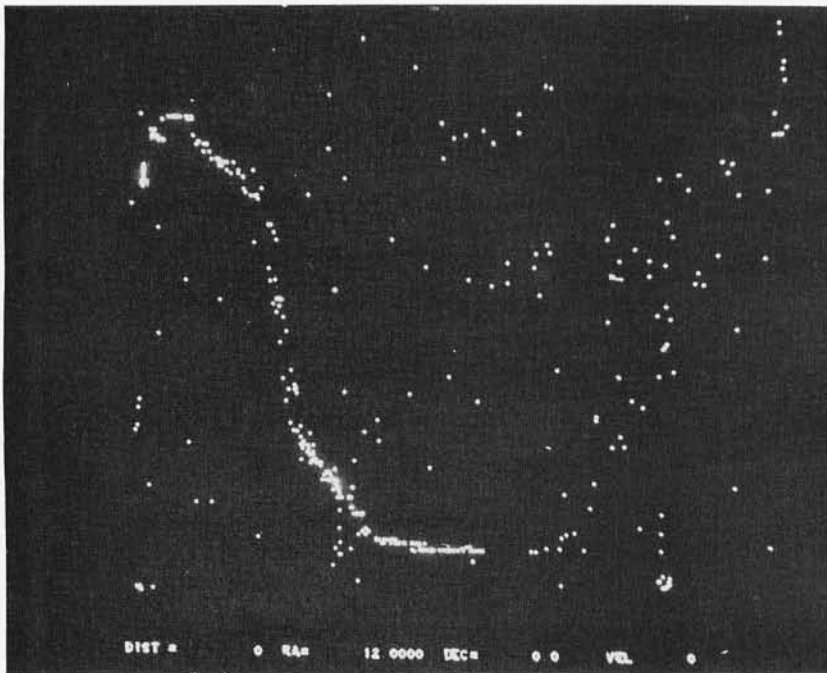


Photo 3: The night sky as seen from the Northern Hemisphere of Earth. Note the Big Dipper in the upper center, Leo just above and right of center, and the Milky Way down the left and across the middle.

put device available. Since the available memory was limited (8 K words), the program was written to make heavy use of disk files for storage of the starting coordinates and intermediate results. The last phase of the program scanned the disk file containing the shifted coordinates and produced a printer plot.

The second version ran on an IBM/360-65 and plotted on a Tektronix 4013 graphics display terminal. Although neither of these first two versions was animated, single star maps could be obtained.

The 2250 version required considerably more programming effort. Since the 2250 is a high speed device, true animation was finally possible. The 2250 refreshes its display from a core buffer loaded from the processor. Coordinates are plotted and mapped into the buffer; subroutine EXEC is then called and the entire buffer is sent to the display. Unfortunately the buffer must be cleared before another iteration can take place—but clearing the buffer also clears the screen. The solution is to maintain two separate buffers. One can be displayed on the screen while the other is being cleared and loaded. If this is not done, the display will flicker with a duty cycle of about 10 percent on, 90 percent off, since the calculation time is greater than the intermediate display time.

### Sample Output

Photo 1 is a side view of our galaxy from 90,987 light years. As you can see, the model is not accurate because the middle of the galaxy is almost empty. Also, the large bright spot on the right side of the galaxy represents the tight group of 100 stars that form our local constellations. At the bottom of the screen distance, right ascension, declination, and velocity have been displayed for reference. The minus sign on the distance means that the direction of travel is opposite the direction the right ascension/declination vector. Photo 2 is a view of our galaxy from -5983 light years. Photo 3 shows the sky from Earth (note the Big Dipper in the upper center, Leo just above and right of center, and the Milky Way down the left side and across the bottom). Photo 4 shows our local constellations from 2937 light years, against the background of the Milky Way. Photo 5 is another side view of the Milky Way from one million light years (viewed with the 50 by 50 degree window). The two small objects just below and to the right of the galaxy are the large and small Magellanic Clouds. They are approximately 100,000 light years from the Milky Way.

Text continued on page 80



SWITCHES CRYSTALS CONNECTORS HEAT SINKS FUSEHOLDERS TEST CLIPS BOOKS KITS DIP JUMPERS CABLE ASSEMBLIES SWITCHES CRYSTALS CONNECTORS HEAT SINKS

# Jim-pak<sup>®</sup>

electronic components

# One-Stop Component Center

## EXCITING NEW KITS!!

### Digital Stopwatch Kit

- ★ Use Intersil 7205 Chip
- ★ Plated thru double-sided P.C. Board
- ★ LED display (red)
- ★ Times to 59 min. 59.59 sec. with auto reset

- ★ Quartz crystal controlled
- ★ Three stopwatches in one: single event, split (cumulative) and taylor (sequential timing)
- ★ Uses 3 penlite batteries
- ★ Size: 4.5" x 2.15" x .90"

## JE900



## JE701

- ★ Bright .300 ht. common cathode display
- ★ Uses MM5314 clock chip
- ★ Switches for hours, minutes and hold functions
- ★ Hours easily viewable to 20 feet
- ★ Simulated walnut case
- ★ 115 VAC operation
- ★ 12 or 24 hour operation
- ★ Includes all components, case and wall transformer
- ★ Size: 6-3/4" x 3-1/8" x 1-3/4"



## JE747

- ★ Four .630" ht. and two .300" ht. common anode displays
- ★ Uses MM5314 clock chip
- ★ Switches for hours, minutes and hold functions
- ★ Hours easily viewable to 30 feet
- ★ Simulated walnut case
- ★ 115 VAC operation
- ★ 12 or 24 hour operation
- ★ Includes all components, case and wall transformer
- ★ Size: 6-3/4" x 3-1/8" x 1-3/4"

### 6-Digit Clock Kit

### Jumbo 6-Digit Clock Kit

NOW!!! OVER 300 AUTHORIZED DISTRIBUTORS ... HERE'S JUST A SAMPLING:

<b>ALABAMA</b> Mobile Lafayette Radio Electronics	<b>ALASKA</b> Anchorage TV Mart	<b>ARIZONA</b> Yuma Yuma Electronics	<b>CALIFORNIA</b> Bellflower Earl's Hobby Shop	<b>BERKELEY</b> Al Lasher Electronics	<b>MISSION VIEJO</b> Tower Electronics Corp.	<b>MONTEREY</b> Zackit	<b>OCEANSIDE</b> Electronic Center	<b>PALO ALTO</b> Zack Electronics	<b>PASADENA</b> Dow Radio Inc.	<b>SACRAMENTO</b> Heathkit Electronic Center	<b>SACRAMENTO</b> Zackit	<b>SAN CARLOS</b> J & H Outlet Store	<b>SAN DIEGO</b> Radio Shack A.S.C.	<b>SAN FERNANDO</b> Mira Mesa	<b>SANTA ANA</b> San Fernando Electronics	<b>SANTA CRUZ</b> Zack Electronics	<b>SANTA MARIA</b> United Radio & TV Supply	<b>SANTA MONICA</b> Mid-Step	<b>SUNNYVALE</b> Sunnyvale Electronics	<b>SUNNYVALE</b> Zackit	<b>VALLEJO</b> Micro-Sun Computer Center	<b>WALNUT CREEK</b> Micro-Sun Computer Center	<b>COLORADO</b> Aurora Cam Co Electronics	<b>DURANGO</b> The Computer Shop	<b>CONNECTICUT</b> Bridgeport Bridgeport Computer	<b>FLORIDA</b> Ft. Lauderdale Computers For You	<b>GEORGIA</b> Atlanta Atlanta Computer Mart	<b>COLUMBUS</b> Radio Wholesale	<b>HAWAII</b> Honolulu Integrated Circuit Supply	<b>IDAHO</b> Idaho Falls Audiotronics	<b>ILLINOIS</b> Evanston Tri-State Electronic Corp.	<b>EVANSTON</b> Moyer Electronics	<b>BOZEMAN</b> Tri-State Electronic Corp.	<b>ILLINOIS (Continued)</b> Oak Park Rockford Imperial Computer Systems	<b>INDIANA</b> Schaumburg East Chicago Acro Electronics Corp.	<b>IOWA</b> Indianola East Chicago Acro Electronics Corp.	<b>KANSAS</b> Wichita Amateur Radio Equipment Company	<b>KENTUCKY</b> Lexington Radio-Electronic Equipment Co.	<b>LOUISIANA</b> Baton Rouge Pelican Electronics	<b>HOUMA</b> Pelican Electronics	<b>METairie</b> Pelican Electronics	<b>MARYLAND</b> Churchville Churchville Electronics	<b>DAMASCUS</b> Damascus CB	<b>LA VALE</b> Computer Workshop	<b>ROCKVILLE</b> Heathkit Electronic Center	<b>TOWSON</b> Baynesville Electronics Inc.	<b>TOWSON</b> Heathkit Electronic Center	<b>MASSACHUSETTS</b> Pittsfield Pittsfield Radio Co. Inc.	<b>WALTHAM</b> Computer Mart Inc.	<b>WORCESTER</b> RM Electronics Inc.	<b>MICHIGAN</b> Ann Arbor Wedemeyer Electronic Supply	<b>CLAWSON</b> Radio Supply & Engineering	<b>DETROIT</b> Heathkit Electronic Center	<b>FLINT</b> Hobby Electronic Center	<b>GARDEN CITY</b> Computer Center	<b>LANSING</b> Fulton Radio Supply Co.	<b>LANSING</b> Wedemeyer Electronic Supply	<b>MIDLAND</b> Midland Computer Corp.	<b>MT. CLEMENS</b> The Computer Store	<b>NILES</b> Niles Radio Supply	<b>MINNESOTA</b> Duluth Northwest Radio of Duluth	<b>HOPKINS</b> Heathkit Electronic Center	<b>ST. PAUL</b> Heathkit Electronic Center	<b>MISSOURI</b> St. Paul Beckman Electronics	<b>EL DORADO SPRINGS</b> Beckman Electronics	<b>MONTANA</b> Billings Conley Radio Supply	<b>BOZEMAN</b> Electronic Service & Dist.	<b>NEBRASKA</b> Lincoln Lincoln Altair Computer Center	<b>OMAHA</b> Omaha Scott Electronic Supply Inc.	<b>OMAHA</b> Omaha Heathkit Electronic Center	<b>OMAHA</b> Omaha Omaha Computer Store	<b>NEVADA</b> Las Vegas Century 23	<b>NEW JERSEY</b> Brierton Radio Shack Associate Store	<b>CHERRY HILL</b> The Computer Emporium	<b>POMPON LAK</b> Computer Corner of New Jersey	<b>RAMSEY</b> Typetronic Computer Store	<b>NEW MEXICO</b> Las Cruces Mannie's Electronic Supply	<b>NEW YORK</b> Kingston Computer Tree Inc.	<b>NEW YORK</b> New York Greylock Electronics	<b>NEW YORK</b> Trojan Electronics	<b>UTICA</b> Am-Com Electronics	<b>NORTH CAROLINA</b> Boone Alpha Digital Systems	<b>DURHAM</b> Futureworld	<b>GREENSBORO</b> Byte Shop	<b>RALEIGH</b> Byte Shop of Raleigh	<b>NORTH DAKOTA</b> Fargo The Computer Company	<b>OHIO</b> Cincinnati Mead Electronics	<b>COLUMBUS</b> Heathkit Electronic Center	<b>DAYTON</b> Heathkit Electronic Center	<b>REYNOLDSBURG</b> Altair Computer Center	<b>UNIVERSAL AMATEUR RADIO</b>	<b>OKLAHOMA</b> Oklahoma City Bits, Bytes & Micros	<b>OREGON</b> Albany Oregon Ham Sales	<b>COOS BAY</b> Herrick Electronics	<b>PORTLAND</b> Portland Radio Supply	<b>SALEM</b> Computer Pathways	<b>PENNSYLVANIA</b> Hershey Microcomputer Systems Inc.	<b>PITTSBURGH</b> Heathkit Electronic Center	<b>YORK</b> G.Y.C. Company	<b>RHODE ISLAND</b> Cranston Jabbour Electronics City	<b>PAWBUCKET</b> Jabbour Electronics City	<b>TENNESSEE</b> Chattanooga William's Data Comp Div.	<b>TENNESSEE (Continued)</b> Clarksville Clarksville Masstronics	<b>COOKEVILLE</b> Wagon's Stereo Center	<b>KNOXVILLE</b> Eastern Micro	<b>NASHVILLE</b> Electra Distributing Co.	<b>TEXAS</b> Amarillo Computer Encounters Inc.	<b>DALLAS</b> CompuShop	<b>HOUSTON</b> Altair Computer Center	<b>HOUSTON</b> CompuShop	<b>HOUSTON</b> Interactive Computers	<b>SAN ANTONIO</b> Sherman Electronics Supply Inc.	<b>UTAH</b> Midvale Heathkit Electronic Center	<b>PROVO</b> Alpine Electronic Supply Co.	<b>VIRGINIA</b> Alexandria Computer Hardware Store	<b>ALEXANDRIA</b> Heathkit Electronic Center	<b>CHARLOTTESVILLE</b> Lafayette Radio	<b>FALLS CHURCH</b> Crossroad Electronics	<b>HAMPTON</b> Lafayette Radio	<b>NORFOLK</b> Avec Electronics Corp.	<b>RICHMOND</b> Avec Electronics Corp.	<b>ROANOKE</b> The Computer Place	<b>VIRGINIA BEACH</b> Heathkit Electronic Center	<b>WASHINGTON</b> Langhew Progress Electronics	<b>MOSES LAKE</b> Ron's Electronics	<b>PASCO</b> Riverview Electronics	<b>SEATTLE</b> Amateur Radio Supply	<b>SEATTLE</b> C-Com	<b>SEATTLE</b> Empire Electronics	<b>SPOKANE</b> Personal Computers	<b>TACOMA</b> C & G Electronics	<b>WEST VIRGINIA</b> Morgantown Electro Distributing Co.	<b>WHEELING</b> Lafayette Radio	<b>WISCONSIN</b> West Allis Olson Electronics	<b>CANADA</b> Alberta (Calgary) The Computer Shop	<b>ONTARIO (Willowdale)</b> Home Computer Centre	<b>QUEBEC (Montreal)</b> Wang's Microcenter	<b>ENGLAND</b> Berkshire NewBar Computing Store	<b>GUAM</b> Marianas Electronics	<b>PANAMA</b> Panama City Sonitel, S.A.	<b>SINGAPORE</b> Inter-trade (PTE) Ltd.
---	---------------------------------------	--	--	--	---	---------------------------	---------------------------------------	--------------------------------------	-----------------------------------	---	-----------------------------	---	--	----------------------------------	--	---------------------------------------	--	---------------------------------	---	----------------------------	---	--	---	-------------------------------------	---	---	--	------------------------------------	--	---	---	--------------------------------------	--	--	--	--	---	--	--	-------------------------------------	--	---	--------------------------------	-------------------------------------	--	---	---	---	--------------------------------------	---	---	--	--	---	---------------------------------------	---	---	--	--	------------------------------------	---	--	---	--	---	---	--	---	---	---	---	--	--	---	--	--	---	---	---	---------------------------------------	------------------------------------	---	------------------------------	--------------------------------	--	--	---	---	---	---	--------------------------------	--	---	--	--	-----------------------------------	--	---	-------------------------------	---	--	---	---	--	-----------------------------------	--	--	----------------------------	--	-----------------------------	---	---	--	--	--	---	---	--	-----------------------------------	--	---	--------------------------------------	---	--	--	---------------------------------------	--	-------------------------	--------------------------------------	--------------------------------------	------------------------------------	--	------------------------------------	---	---	---	--	---	-------------------------------------	---	--

ASK YOUR ELECTRONICS STORE TO STOCK JIM-PAK<sup>®</sup> TODAY!!

JIM-PAK<sup>®</sup> • 1021 HOWARD AVENUE, SAN CARLOS, CALIFORNIA 94070 • (415) 592-8097

SWITCHES CRYSTALS CONNECTORS HEAT SINKS FUSEHOLDERS TEST CLIPS BOOKS KITS DIP JUMPERS CABLE ASSEMBLIES SWITCHES CRYSTALS CONNECTORS HEAT SINKS



DIMENSION FX (400), FY(400), FZ (400)  
REAL NRA, NDEC, NEWR

C READ IN AND STORE RECTANGULAR COORDINATES FOR STARS IN FX,  
C FY, AND FZ ARRAYS.

DO 1 I = 1, 400  
READ (5, 100) CRA, CDEC, CDIST

C FIRST, CONVERT CRA, AND CDEC TO RADIANS

CRA = CRA \* .261799  
CDEC = CDEC \* .01745

CXY = DIST \* COS (CDEC)  
FX (I) = CXY \* COS (CRA)  
FY (I) = CXY \* SIN (CRA)  
FZ (I) = DIST \* SIN (CDEC)  
CONTINUE

100 FORMAT ( 3( 10F7.3) )

C RA, DEC, AND DIST REPRESENT THE POLAR COORDINATES FOR THE  
C DIRECTION VECTOR. VEL IS THE VELOCITY OR RATE OF CHANGE OVER  
C EACH ITERATION OF THE ALGORITHM.

DIST = 0.  
RA = 3.1415927  
DEC = 0.  
VEL = 0.

C ADVANCE THE DISTANCE COUNTER BY ADDING THE VELOCITY FOR ONE  
C ITERATION.

10 DIST = DIST + VEL

C NOW COMPUTE THE NEW LOCATION IN SPACE FROM RA, DEC, DIST.

AXY = DIST \* COS (DEC)  
AX = AXY \* COS (RA)  
AY = AXY \* SIN (RA)  
AZ = DIST \* SIN (DEC)

C NOW ENTER THE INNER DO LOOP WHERE THE SHIFTED COORDINATES  
C ARE FOUND, CONVERTED TO CELESTIAL COORDINATES AND PLOTTED.

DO 20 I = 1, 400

XP = FX (I) - AX  
YP = FY (I) - AY  
ZP = FZ (I) - AZ

NRA = ATAN (YP / XP)  
NEWR = SQRT (XP \* XP + YP \* YP + ZP \* ZP)  
NDEC = ARSIN (ZP / NEWR)

C TEST FOR QUADRANTS MESSED UP BY THE ARCTANGENT FUNCTION.

IF (XP .LT. 0.) NRA = NRA + 12.  
IF ((XP .GT. 0.) .AND. (YP .LT. 0.)) NRA = NRA + 24.

C TEST FOR SCREEN LIMITS.

IF (NRA .GT. 24.) NRA = NRA - 24.  
IF (NRA .LT. 0. ) NRA = NRA + 24.

C PLOT POINTS HERE, USING THE APPROPRIATE SUBROUTINE CALLS FOR THE  
C AVAILABLE DISPLAY DEVICE.

CALL P POINT ( -NRA, NDEC)

20 CONTINUE

C CLEAR SCREEN; PREPARE FOR NEXT ITERATION.

C TEST FOR CONSOLE INPUT; CHANGES IN DIRECTION, VELOCITY, SCREEN  
C WINDOW FRAMING, ETC.

GO TO 10

STOP  
END

Listing 1: Generalized FORTRAN version of galaxy simulation. This program can be converted almost directly into BASIC. Note: for those people not having an arcsin function:  $\arcsin(x) = \arctan(x) / \sqrt{1-x^2}$ .

# 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) 822-4498; 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 Munchen 40; Microcomputer Shop, Toelzerstr. 8, D-815 Holzkirchen; Wedel: Digitronic Computer Systems, Bei-der Doppel-liche 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.*

**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

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.

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

**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

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.

## 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.



# 3 POWERFUL INTERFACES FOR THE TRS-80\* AND S-100 BUS

## MASTER CONTROL CONSOLE

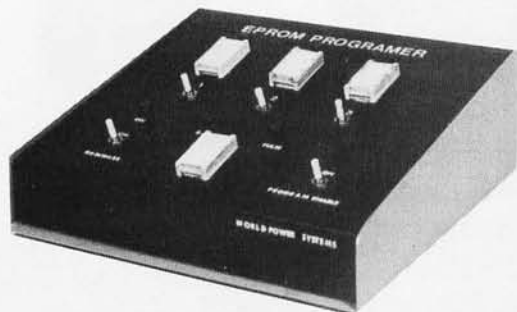


Model MCC-K (kit) \$129.95  
Model MCC-A (assem.) \$159.95

**A COMPLETE COMMAND CENTER FROM YOUR KEYBOARD OR FROM ANY LEVEL II OR DISK BASIC PROGRAM.** Turn on bells, sprinklers, sense fire and burglar alarm, anything that needs a switch can be controlled by the command center.

- **16 OUTPUT LINES:** With 8 relays, SPST, and 8 TTL diode protected signals.
- **16 OUTPUT LINES:** 8 lines with OPTO-COUPLEDERS and 8 TTL diode protected.
- **FULL LED PANEL:** For status indicators of all control lines.
- **COMPLETE WITH CABINET:** Has attractive sloping cabinet.
- **FULL HEAVY DUTY POWER SUPPLY:** Contains power supply. No external power needed.
- **EASY CONNECTION:** Plugs into TRS-80 expansion port edge card rear of keyboard or between keyboard and expansion interface.
- **2-EDGE CONNECTORS:** 2-additional expansion 40 pin edge connectors.
- **NEEDS NO SOFTWARE:** Operates from OUT and IN statements from BASIC or machine code statements. Example: (Out 5, 1=turn on switch 5, Out 5, 2=turn off switch 5, etc.)
- **COMPLETE MANUAL AND SAMPLE PROGRAMS:** Comes with comprehensive manual.

## EPROM PROGRAMMER +3



Model EPR-80K (kit) \$129.95  
Model EPR-80A (assem.) \$159.95

- **SELF CONTAINED:** Comes housed in an attractive cabinet with self contained power supply.
- **PROGRAMS:** This unit programs the popular 2708, 2716 Eproms. Personality modules for other Eproms will be available at a later date.
- **FIRMWARE:** On board firmware so that no software need be written or entered into your CPU system. The firmware can be shut off when not in use. Firmware residents at F0000. The firmware in and out of system is controlled from a switch on front panel.
- **3-ADDRESSABLE ROM LOCATIONS:** The Eprom Programmer has three sockets on front panel which are addressable to any location by dip switch. In addition each ROM location can be shut off or turned on by switches located on the front panel.
- **MONITOR:** A monitor is supplied within the firmware for performing several functions. Move memory, debug, verify, program from memory, program from TTY input, etc.
- **EASY CONNECTION:** The Eprom Programmer is attached with ease. For the TRS-80 users, the unit plugs into the rear of the keyboard or between the keyboard and expansion interface. Included with the unit are two additional 40 pin edge connections for interfacing of other interfaces. For the S-100 users, a molded connection cable is supplied and it is inserted into one of the connectors on your mother board. Plug it in and it is ready to use.
- **FULLY BUFFERED:** add address and data lines are fully buffered.
- **OTHER FEATURES:** Other features include status lights for which ROM selected, switch enable for programming, pulse (burn) indicator firmware select-deselect switch, on and off and dip switches for the addressing of each ROM location.

## SERIAL PARALLEL I/O MODULE



Model MS10-K \$129.95  
Model MS10-A (assem.) \$149.95

THIS POWERFUL INTERFACE MODULE ALLOWS THE TRS-80 COMPUTER OWNER TO COMMUNICATE OVER 8 SEPARATE RS-232 OR PARALLEL CHANNELS, ALL SELECTABLE FROM A SIMPLE COMMAND IN LEVEL-II OR DISK BASIC OR MACHINE CODE. NOW YOU CAN INTERFACE PRINTERS, TAPE READERS, OTHER RS-232 OR CURRENT LOOP SERIAL DEVICES OR ANY PARALLEL DEVICE.

- **8-SERIAL INPUT/OUTPUT PORTS:** Fully buffered.
- **8-PARALLEL INPUT/OUTPUT PORTS:** Fully buffered.
- **EASY CONNECTION:** Connects to the expansion port edge card connector between keyboard and expansion interface or direct to rear of the TRS-80 keyboard.
- **DIP SWITCH:** All ports, baud rate, parity, etc all set by dip switches.
- **ON BOARD FIRMWARE:** No software driver routine needed for operation of the module. Simple OUT and IN statements operate the module.
- **RS-232, CURRENT LOOP:** All 8 channels can be selected for RS-232 or current loop.
- **BAUD RATE SELECTION:** All channels dip switch selectable for individual baud rates from 110 to 9600 baud.
- **COMPLETE DOCUMENTATION:** Complete instruction manual. Just plug in and set the switches and you are able to communicate with the outside world. This module also includes 2 additional 40 pin edge connectors for connection of other interfaces.

### TERMS

CASH WITH ORDER, VISA, MASTER CHARGE. NO C.O.D.'S! PERSONAL CHECKS REQUIRE 3-WEEKS TO CLEAR.

### ORDER FROM

## WORLD POWER SYSTEMS, INC.

1161 North El Dorado Place, Tucson, Arizona 85715

24 Hours Order Phone No: 602-886-2537

(Dealers: Write or phone for information)

STOCKING DISTRIBUTOR FOR SOUTHERN CALIFORNIA CONTACT: CALIFORNIA DIGITAL 213-679-9001

\*Trademark: Radio Shack

WATCH FOR MODULE "50"

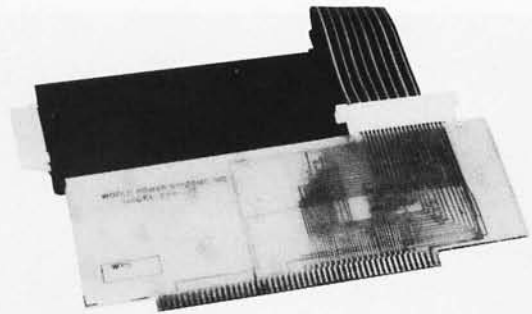


# 3 POWERFUL INTERFACES

## FOR THE TRS-80\* AND S-100 BUS

### TRS-80 TO S-100 BUS CABLE ADAPTER

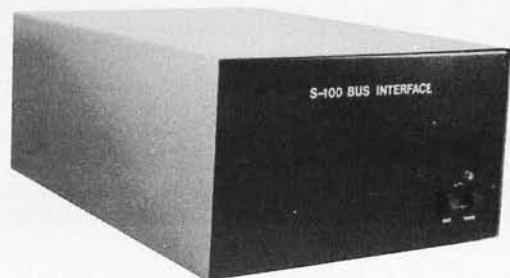
- **FULL INTERFACE:** Contained within the cable assembly, is a small enclosure. This enclosure contains all the logic to convert your TRS-80 to be compatible with the S-100 bus system.
- **FULL BUFFERING:** All address, data and signal lines are fully buffered.
- **EASY CONNECTION:** It is easy to connect. Just plug the one end of the cable into one slot on your S-100 system and plug the other end into the rear of the TRS-80 keyboard or between the expansion interface. Turn on and go . . .
- **TWO EDGE CONNECTORS:** Two addition 40 pin port edge connectors are provided for other connection of expansion interfaces.
- **POWER:** All power is derived from the S-100 bus structure. Since the TRS-80 will not support other devices hooked to its power supply, it is a must that your S-100 supply 8-10 volts D.C. Logic card contained within the cable has on board 5 volt regulator. Current requirements is 375 ma. Unit has separate terminal for exterior connection of DC power requirement if it is to be supplied outside the S-100 bus system.
- **FULL OPERATION MANUAL:** Not much need for a manual, but we have prepared one with full principal of operation, etc.



Model CAB-80K (kit) \$99.95  
Model CAB-80A (assem.) \$119.95

### TRS-80 TO S-100 BUS

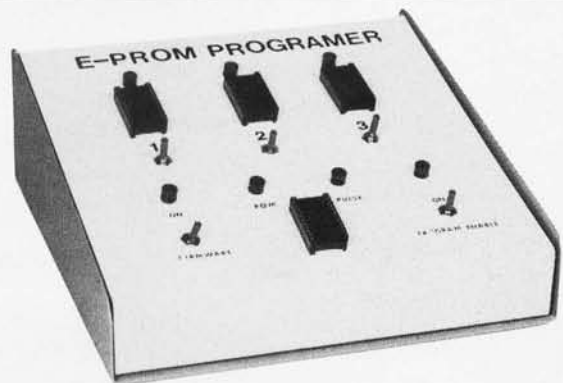
- **FULLY SELF CONTAINED POWER SUPPLY.** (10 AMP)
- **BUS TERMINATION:** Bus termination and conditioning for no cross talk or noise etc.
- **S-100 SIGNALS:** All required S-100 signals are generated by on board logic and is fully compatible with the TRS-80.
- **COMPLETE:** Comes complete with cabinet, card guides, on off switch and sockets. Nothing else to buy.
- **STAND ALONE:** This system can stand alone or can operate with the TRS-80. All input, output, address and signal lines fully buffered between TRS-80 and S-100 BUS system.
- **EASY CONNECTION:** Just plug it into the rear of the keyboard or between the keyboard and expansion interface. Also includes two 40 pin edge connectors for connection to other interfaces.



Model RSB-K (kit) \$249.95  
Model RSB-A (assem.) \$289.95

### S-100 EPROM PROGRAMMER +3

\*All the same features of the TRS-80 model. Comes complete with interface cable, S-100 plug-in card. Totally self-contained power supply, plus many other extras.



Model EPR-100K (kit) \$129.95  
Model EPR-100A (assem.) \$159.95

#### TERMS

CASH WITH ORDER, VISA, MASTER CHARGE. NO C.O.D.'S! PERSONAL CHECKS REQUIRE 3 WEEKS TO CLEAR.

#### ORDER FROM

## WORLD POWER SYSTEMS, INC.

1161 N. El Dorado Place, Tucson, Arizona 85715  
24 Hour Order Phone No: 602-886-2537

STOCKING DISTRIBUTOR FOR SOUTHERN CALIFORNIA CONTACT: CALIFORNIA DIGITAL 213-679-9001

\*Trademark: Radio Shack



Text continued from page 74.

### Other Possibilities

Computer enthusiasts who are also interested in astronomy or physics might want to experiment with the Doppler shift effect mentioned earlier—requiring a color graphics display. Also, giving the stars colors related to their surface temperatures might be interesting. Another possibility would be the addition of magnitude (brightness). The IBM-1130 version calculated magnitudes and used different printer characters to indicate stars, but the 2250 does not have a programmable intensity control.

Another interesting possibility lies in the three-dimensional nature of the model. If two images were plotted side by side on the screen at slightly different viewing angles, a pair of stereoscopic viewing glasses would permit a truly three-dimensional view. I have experimented with the stereo three-dimensional effect by placing similar Gould hard copy plots side by side. The sense of depth produced gives one a feeling of vertigo.

Since the model is animated, navigation experiments are possible. Perhaps the algorithms presented here could be written into a game program producing the ultimate celestial exploration game. ■

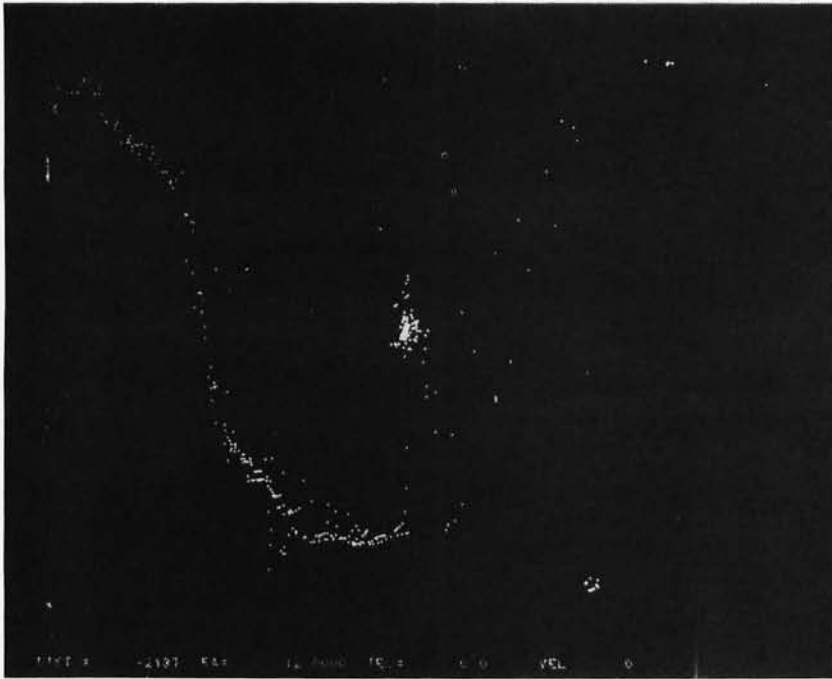


Photo 4: The local constellations from 2937 light years against the background of the Milky Way.



Photo 5: Another side view of the Milky Way galaxy from 1 million light years. The two small objects just below and to the right of the galaxy are the large and small Magellanic Clouds.

### GLOSSARY

**Buffer:** Temporary storage area in main memory, usually used to prepare or receive data from input or to output devices.

**Declination:** The angle from the celestial equator to the star. Equivalent to latitude (−90 to 90 degrees).

**Doppler shift:** Apparent changes in frequency due to direction of travel and speed. For example, if you are moving towards an object that is emitting light, the frequency of the observed light is higher. The reverse is true for the opposite direction of travel.

**Extragalactic objects:** Objects outside the domain of a galaxy.

**Light year:** The distance light will travel in one year at 186,284 miles per second (300,000 kilometers per second) — about 5,870,000,000,000 miles.

**Magnitude:** The brightness of a star. Each unit of magnitude signifies a difference in brightness factor of 2.512.

**Right ascension:** The arc measured along the equator, from 0 hours to the base of the star's vertical declination circle.



**FOR PERSONAL COMPUTER USERS**



# onComputing

**A new quarterly by  
the staff of BYTE®**

This totally new publication is entertaining, informative, and uncomplicated. It is edited for the attorney, accountant, writer and other professional or business person aware of the personal computer as a tool for business, education, home entertainment, laboratory work and other applications.

Compiled and edited by the staff of BYTE, latest developments covered in **onComputing** will include creative uses of the small computer, books for the computer user, how and where to buy your personal computer and numerous features concerning the fascinating world of the microprocessor.

Discount to charter subscribers will result in substantial savings. The initial price (U.S.) of \$2.50 per copy is sure to be increased. By acting immediately, your first year's subscription price will be held to just \$8.50. Add **onComputing** to your library of 'must' publications ... now!

# onComputing™

**GUIDE TO PERSONAL COMPUTING**

**SUBSCRIBE NOW! COMPLETE AND MAIL ATTACHED POSTAGE PAID REPLY CARD**  
onComputing, Inc. ■ 70 Main Street ■ Peterborough, N.H. 03301 ■ Tel. 603/924-7217



# Aw, cut it out!

**NEWS FLASH**  
Modified CP/M  
for TRS-80  
now available

**New CP/M  
implementations:**  
Double Density  
North Star,  
Helios, Altair,  
Micro and 8" iCOM.

Heath H8/H17  
modified CP/M  
available  
June 1

Software  
with / Manual  
Manual / 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, iCOM Attache and TRS-80. 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 Macro 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**

Software  
with / Manual  
Manual / Alone

- 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**

All  
Microsoft  
prices are  
discounted!!

## 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. Standard CP/M and TRS-80 CP/M versions available ..... **\$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**
- Accounts Payable** — Provides aged statements of accounts by vendor with check writing for selected invoices. Can be used alone or with General Ledger and/or with NAD. Requires CBASIC ..... **\$900/\$20**



Software for most popular 8080/Z80 computer disk systems, including NORTH STAR, MICROPOLIS, iCOM, SD SYSTEMS, HELIOS, ALTAIR, TRS-80 and 8" SOFT SECTORED formats.

- Software  
with / Manual  
Manual / Alone
- 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**
  - 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**

- Z80 Development Package** — Consists of: (1) disk file line editor, with global inter and intra-line facilities; (2) Z80 relocating assembler, Zilog/Mostek mnemonics, conditional assembly and cross reference table capabilities; (3) linking loader producing absolute Intel hex disk file for CP/M LOAD, DDT or SID facilities. Standard CP/M and TRS-80 CP/M versions available ..... **\$95/\$15**
- 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**
- DISINTEL** — Disk based disassembler to Intel 8080 or TDL/Xitan Z80 source code, listing and cross reference files. Intel or TDL/Xitan pseudo ops optional. Runs on 8080. Standard CP/M and TRS-80 CP/M versions available ..... **\$65/\$10**
- DISZILOG** — As DISINTEL to Zilog/Mostek mnemonic files. Runs on Z80 only. Standard CP/M and TRS-80 CP/M versions available ..... **\$65/\$10**
- 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**

- Software  
with / Manual  
Manual / Alone
- 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 Assembled 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**
  - 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 Co.

**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	
Sub total	
Shipping	
\$1.00 for C.O.D.	
Total	

Check enclosed     U.P.S. COD

Visa     Master Charge

Account # \_\_\_\_\_ Exp. Date \_\_\_\_\_

Signature \_\_\_\_\_

My computer configuration (specifying disk system):

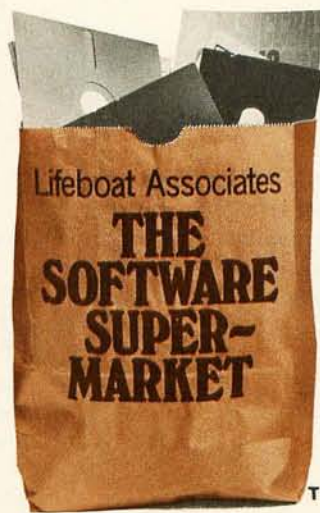
Name \_\_\_\_\_

Address (No. P.O. Box) \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

EFFECTIVE MARCH 1, 1979

™ 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.



# Marsport, Here I Come

Delmer D Hinrichs  
2116 S E 377th Av  
Washougal WA 98671

## The Three-Dimensional Celestial

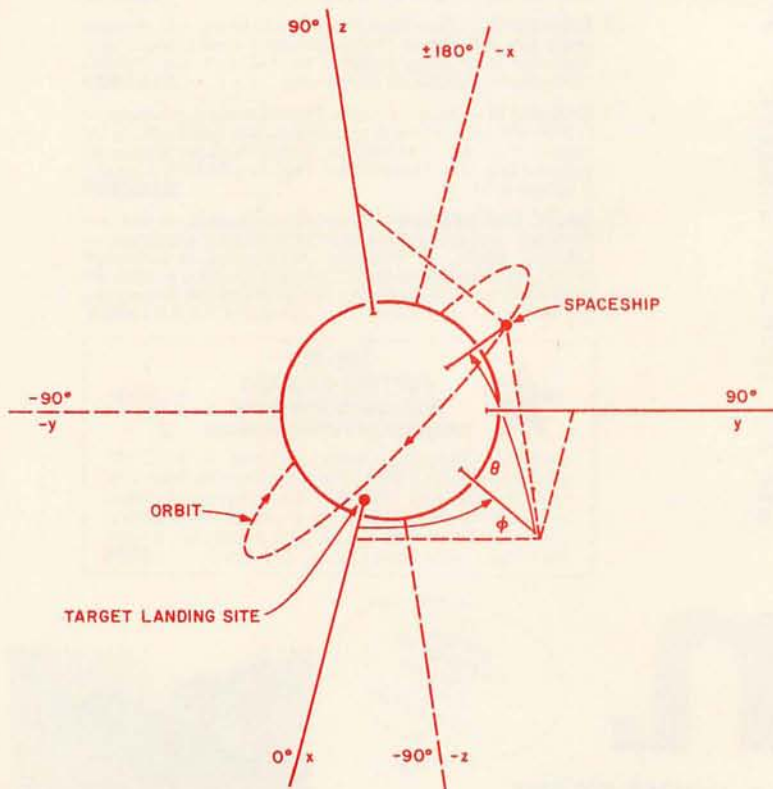


Figure 1: Mars, with the orbiting spaceship and the target landing site. Both rectangular and spherical coordinate systems are shown.

### Introduction

The motion of a freely falling body in a gravity field has many interesting characteristics. One of the better methods of showing this is with a simulation, in this case written for the Hewlett-Packard HP-67 or HP-97 programmable calculator.

Lunar lander simulation programs, in which the application of thrust is used to counteract gravity, have become quite popular. Extending the lunar lander concept to two dimensions allows study of the motion of bodies in orbit. Further extension to three dimensions, as in this program, makes it possible to investigate orbital plane changes. Since Mars has a much stronger gravity field than the moon, the effect of gravity is accentuated.

### Running the Program

This program is designed as a three-dimensional Mars lander so you can exercise your three-dimensional visualization of space. With a limited fuel supply you can pilot a spaceship from its initial orbit around a spherical simulation of Mars to a soft landing at a designated target site on Mars' surface. The initial orbit does *not* pass over the target site. The three-dimensional trajectory of the spaceship is calculated as a series of segments under your control.

Realistic features of the program include:

- True inverse square law gravity acts upon the estimated midpoint of each trajectory segment.
- The thrust of the spaceship's rocket engine simulates the use of a hydrogen-oxygen fuel, with an exhaust velocity of 4 km/s.
- The spaceship loses mass as fuel is used; with less total mass, the spaceship accelerates more rapidly for the same fuel usage rate.
- If the limited fuel supply is exhausted, the spaceship automatically free-falls to impact on the surface of Mars.
- After impact with or landing on Mars' surface, the actual landing position, velocity, and remaining fuel are interpolated from the segment-end conditions immediately before and after impact. Also, the distance along the spherical surface of Mars from the impact site to the target site is calculated.

To avoid some pilot errors, there are data entry checks: the maximum fuel usage rate is limited to 100 kg/s. The maximum segment duration is limited to 60 seconds. If an attempt is made to burn more fuel than actually remains, only the actual remaining fuel is burned.



# Mechanics Simulation for the HP 67/97

One difficult part of landing the spaceship with this program is to correctly interpret exactly where the spaceship is and where it is going at all times; that is, to visualize its movement in three dimensions. To make this as easy as possible, the position is displayed as the spaceship's altitude from Mars' spherical surface, plus two position angles,  $\phi$  and  $\theta$ , as shown in figure 1. The coordinate system is fixed with the origin at the center of Mars, and both position angles equal 0 at the designated target landing site. If Mars is considered as a globe like the Earth, then angle  $\phi$  is degrees of longitude and angle  $\theta$  is degrees of latitude. The X,Y plane intersects Mars' surface along its equator. Therefore, angle  $\phi$  is *in* the X,Y plane, and angle  $\theta$  is *from* the X,Y plane. Then Z and -Z are the north and south poles, respectively. The maximum range of angle  $\phi$  is  $\pm(0^\circ$  to  $180^\circ)$ , while the maximum range of angle  $\theta$  is  $\pm(0^\circ$  to  $90^\circ)$ . Note that when angle  $\theta$  is exactly  $\pm 90^\circ$ , angle  $\phi$  is indeterminate.

Similarly, the spaceship's velocity is displayed as a magnitude and two velocity angles,  $\phi$  and  $\theta$ . The velocity vector is parallel to the vector from the origin to a position with the same angles. Thus if velocity angles  $\phi$  and  $\theta$  are both 0, the spaceship's velocity is parallel to the X axis, and toward more positive X values, regardless of the spaceship's position.

Now that we know where we are and where we're going, let us check out the spaceship's operation, summarized in table 1. We must first decide on the initialization method we want to use. To start with a relatively easy landing problem, use the fixed initialization on the Three-Dimensional Mars Lander program card (program listing 1); this always puts the spaceship in the same position and at the same velocity in a nearly circular orbit. When landing from this fixed initialization becomes too easy, use one of the random initialization routines of program listing 2; these put the spaceship at a random altitude (107 to 3,607 km), in a

Step	Instructions	Input	Keys	Output
1	Prepare for Three-Dimensional Mars landing—Use either:			
	(a) Fixed initialization: (1) Load Three-Dimensional Mars Lander program; (2) Initialize; (3) Go to step 2.		E	0.000 Status
	(b) Random initialization: (1) Load Random Initialization Program; (2) Optionally, enter a random seed; (3) Optionally, spin for a random seed, wait for a few seconds, then stop; (4) Initialize for a random circular orbit, or for a random elliptical orbit; (5) Load Three-Dimensional Mars Lander	.xxxxxxx	B A R/S C E	0.000 0.xxx — 1.000 Status Status —
2	Optionally, reset segment duration, t seconds.	t	C	t/2
3	Enter either a free-fall or a rocket burn:			
	(a) Free-fall n segments of t seconds each;	n	A	Status
	(b) Rocket burn for one segment of t seconds; (1) Angle of thrust $\phi$ , degrees; (2) Angle of thrust $\theta$ , degrees; (3) Fuel usage rate, kg/s; (0 thru 100)	$\phi$ $\theta$ kg/s	ENTER ENTER B	Status
4	To calculate next trajectory segment, go to Step 2.			

## Notes

- When fuel is gone, there is a print/pause of 10000, then the spaceship free-falls to impact.
- After Mars impact, there is a print/pause of 3393, then the landing status is displayed.
- Status is a double stack review of:

	Stack Register
(a) Segment time, seconds (after landing, impact-to-target distance, km);	T
(b) Position angle $\phi$ , degrees;	Z
(c) Position angle $\theta$ , degrees;	Y
(d) Ship's altitude, km (after landing, vertical error of estimated position);	X
(e) Remaining fuel supply, kg;	T
(f) Velocity angle $\phi$ , degrees;	Z
(g) Velocity angle $\theta$ , degrees;	Y
(h) Ship's velocity, km/s.	X

- Any status display may be repeated by pressing D.

Table 1: Operating instructions for the optional random initialization program and for the Three-Dimensional Mars Lander program.



random three-dimensional direction from Mars, and going in a random direction. The circular initialization puts the horizontal spaceship in a circular orbit. The elliptical initialization puts the spaceship at a random location on an orbit of random ellipticity. Some of these elliptical orbits may eventually terminate on Mars if not modified.

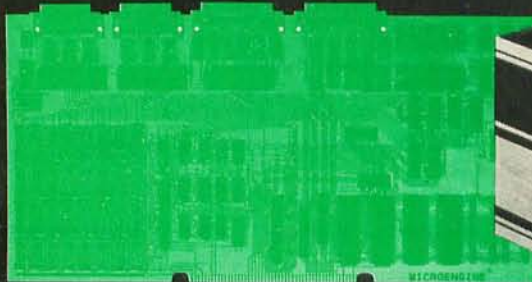
To repeat the same initial conditions with the random orbits, enter the same random seed prior to initialization. For an unpredictable initial status, use the SPIN routine, which increments the random seed until it is manually stopped. Repeated pressing of the C or E keys gives a different initial status each time.

After initialization, the user may change the segment duration (segment time stays as set until reset), then decide whether to free-fall or to make a rocket burn for each segment. Any number of segments of free-fall may be calculated automatically, without intermediate status displays. It is best not to free-fall too many segments at a time initially. Rocket burns are made one segment at a time by specifying the three-dimensional thrust angles and the fuel usage rate for each segment. At a fuel usage rate of 100 kg/s, the initial acceleration rate is about 0.45 gs, gradually increasing to about

4 gs as fuel is used up (gs are units of acceleration: at the Earth's surface, the acceleration of gravity is 1 g, or 9.81 m/s<sup>2</sup>). Of course, lower fuel usage rates will give lower acceleration rates. To reverse the direction of a vector in three dimensions (to reduce velocity), add  $\pm 180^\circ$  to velocity angle  $\phi$  and change the sign of velocity angle  $\theta$  to get the required thrust angles. (See figure 1 to help visualize this.) Segment duration, thrust angles, and fuel usage rate may be decimal numbers; the number of segments of free-fall must be an integer.

With the fixed initialization, the spaceship starts at position angles of  $\phi = 45^\circ$  and  $\theta = 35.264^\circ$  (see figure 1). If the spaceship were over the Earth instead of over Mars, this would correspond to a position about 175 km north of Baghdad, in Iraq. The designated landing site is at position angles of  $\phi = 0^\circ$  and  $\theta = 0^\circ$ , or (on the Earth) on the equator and on the Greenwich meridian, due south of Ghana off the Atlantic coast of Africa. Initially, the orbit of the spaceship is horizontal and it is heading due west. If it were over the Earth, the orbit would not cross the equator until just off the east coast of South

Text continued on page 100.



## PASCAL PERFORMANCE.

The new Pascal Computer System is driven by a unique 16-bit Pascal MICROENGINE™ — the first microprocessor hardware designed exclusively for direct high-level language execution. ■ The processor is incorporated into a single board computer system, the WD/90, which directly executes Pascal intermediate code generated by the University of California at San Diego (UCSD) Pascal compiler, Release III.0. ■ Since P-code output by the Pascal compiler represents an ideal architecture for a computer executing Pascal programs and since the WD/90 directly executes P-code (no interpreter), these programs execute up to five or more times faster than equivalent systems.

### WESTERN DIGITAL

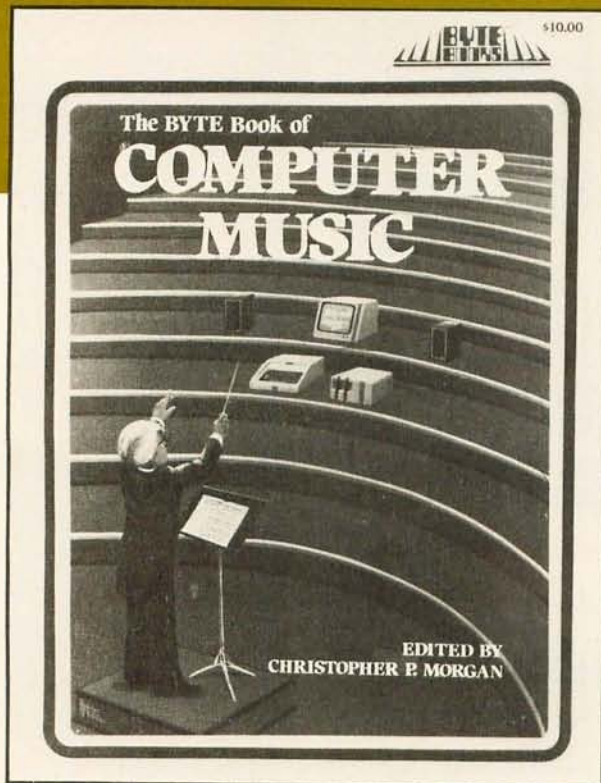
3128 Redhill Avenue, Box 2180 • Newport Beach, CA 92663  
(714) 557-3550, TWX 910-595-1139

The WD/90 Pascal MICROENGINE™ Computer includes: ■ Pascal MICROENGINE™ processor ■ 64K bytes of RAM Memory ■ Two RS-232 asynchronous/synchronous ports (110-19.2K baud-full duplex) ■ Two 8-bit parallel ports (500 kHz maximum data rate) ■ Floppy disk controller with direct memory access (DMA), switch selectable for: single or double density (IBM format); mini or standard floppy; 1 to 4 drives (same type) ■ Floating point hardware (proposed IEEE standard) ■ Memory Mapped I/O ■ Enclosed power supply ■ Complete UCSD Pascal Operating System (Release III.0)

FOR FURTHER INFORMATION CONTACT  
DISTRIBUTOR: CIT (714) 979-9920  
RETAIL: Your LOCAL COMPUTER Store  
OEM: Your WESTERN DIGITAL Sales Representative



# Turning computer programmers into computer composers!



For the first time:  
Hard-to-obtain  
computer music  
material has been  
collected into one  
convenient, easy-to-  
read book.

The BYTE Book of  
Computer Music com-  
bines the best from  
past issues of BYTE

magazine with exciting new material  
of vital interest to computer experimenters.

The articles range from flights of fancy about the reproductive systems of pianos to Fast Fourier transform programs written in BASIC and 6800 machine language. Included in this fascinating book, edited by Christopher P. Morgan, are articles discussing four-part melodies, a practical music interface tutorial, electronic organ chips, and a remarkable program that creates random music based on land terrain maps!

ISBN 0-931718-11-2 **\$10.00**

Buy this book at your favorite computer book store or order direct from BYTE BOOKS  
Add 50¢ per book for postage and handling



"BOOKS OF INTEREST TO COMPUTER PEOPLE"

70 Main Street Peterborough, New Hampshire 03458



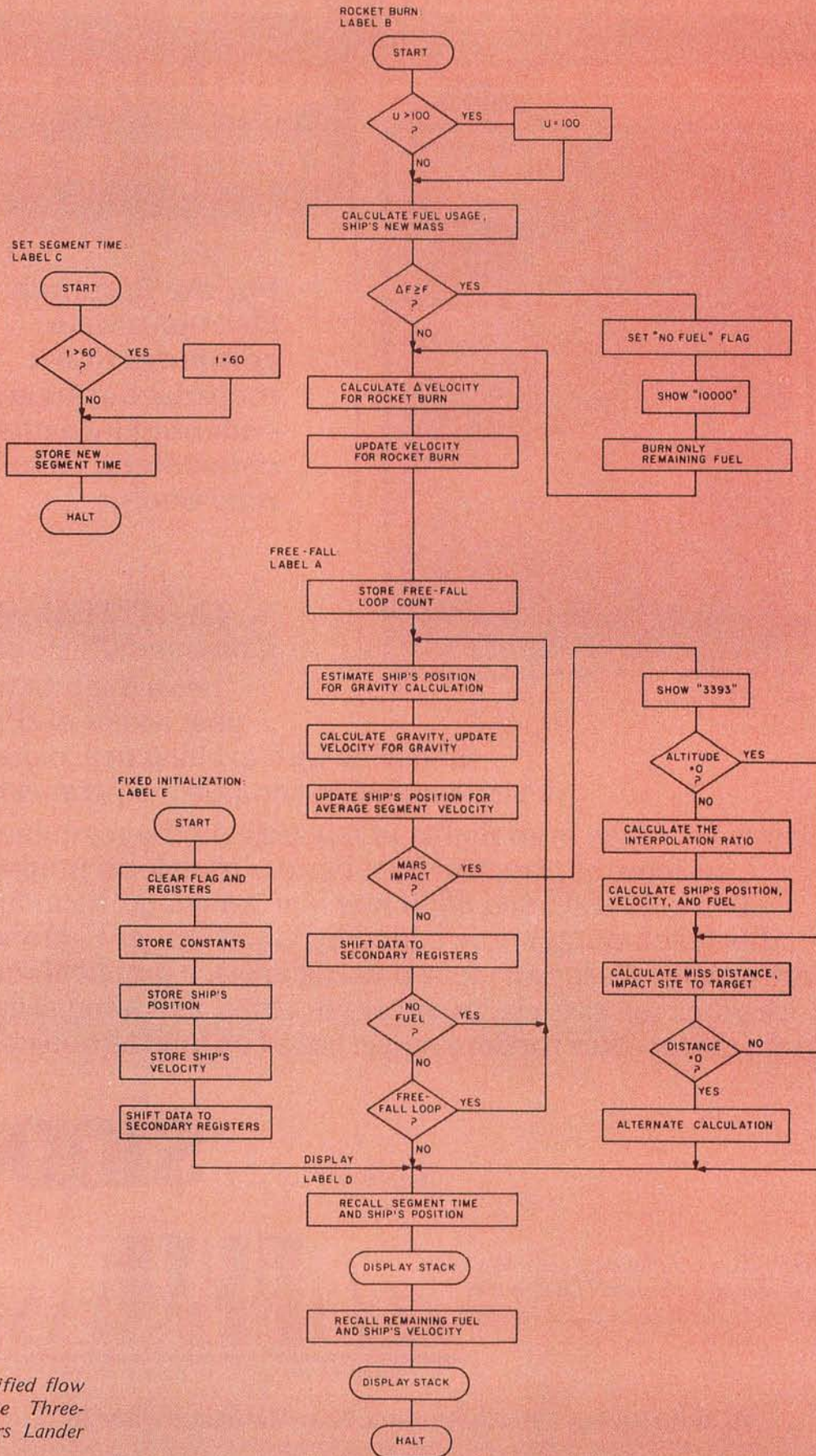


Figure 2: Simplified flow diagram for the Three-Dimensional Mars Lander program.





# OFFERS A NEW CONCEPT IN SOFTWARE PRESENTATION FOR IT'S EXCITING LINE OF PROGRAMS

## PR\$ MAKES A BREAK-THROUGH IN DOCUMENTATION

Every PR\$ program comes with a complete and instructive handbook. This unique documentation is written in clear and easy-to-understand English. PR\$ offers you a true fluency in computer-user dialogue.

## MICROFILE: A NEW DATAFILE MANAGEMENT PROGRAM

With PR\$ MICROFILE you can: Manage any list of items. Edit files. Sort items alphanumerically. Search by keys. Total columns. Justify columns. Save and retrieve data with mass storage media.

PR\$ MICROFILE documentation also solves one of the major concerns of beginners. A special chapter explains how you can interface newly acquired software with you specific configuration.

## CORE: AN INDISPENSABLE "BRAIN-SURGEON"

This PR\$ program is essential for the TRS-80 level II.

Here's a partial list of commands: Examine and modify memory. Display memory in Hex, ASCII, or CPU registers. Enter ASCII in memory. Fill

memory. Move block of memory. Verify memory. Locate string. Branch to routine. Go to and execute (two break-points available). Hex arithmetic. Question input ports and command output ports. Tape Cue, on/off. Read file in memory (bias available). Write file from memory. Memory test. Etc. Disk version soon available.

## A2FP: A PLOTTING PROGRAM FOR APPLE II

This PR\$ program is a "modern age" tool for students, engineers and researchers. A2FP plots 2-dimensional functions in HIRES graphics. Uses the full screen (280 x 192 points.) Plots on Cartesian coordinates. Gives complete parameters of plotted curves. Superimposes plots. Offers many plotting modes.

## DDS II: THE FAMOUS DYNAMIC DEBUGGING SYSTEM

DDS II is incredibly powerful. Although designed for microcomputers, it is even more sophisticated than the built-in debugging environments supported by most large main frames.

DDS II assembles and disassembles all 8080 code. Performs "software open-heart surgery", artfully displaying on

the screen all registers, program instructions and memory. Simulates dual screen capability. You can 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 the program. Includes a full array of monitoring tools. TRS-80 version soon available.

## PR\$ PROGRAMS ARE PROTECTED IN A BEAUTIFUL CASSETTE OR DISK FOLDER

The PR\$ cassette or floppy disk and manual for your PR\$ programs are protectively nestled in an efficient and durable gold-imprinted folder.

## PR\$ SUPPORTS YOUR MAJOR BRANDS

Over 20 packages are currently available. Use the coupon below for a complete description of each PR\$ program and listing of versions produced for each program.

## VISIT YOUR NEAREST DEALER TODAY

Let your dealer demonstrate the excellence of PR\$ programs.



Reference 489

**PR\$ THE PROGRAM OF THE MONTH CORPORATION**  
257 Central Park West, N. Y., N. Y. 10024

Please send me the items checked below:

List of dealers in my area  
 Complete description of programs and available versions  
 Advance releases of new programs

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_



Listing 1: Mars Lander program for the HP 67/97 programmable calculator. Clear flags, set for DEG, and set display to FIX 3 before recording program. User entry points are capitalized in comments.

Location	Program Steps						Commentary
001	LBL B	EEX	2	X<Y?	X≠Y	R↓	ROCKET BURN: Check fuel usage rate,
007	RCL A	X	RCL 7	—			calculate mass loss.
011	CHS	RCL 9	X#Y	X>Y?			Fuel gone?
015	GSB 9	R↓	STO 7				Update ship's mass and velocity for burn.
018	LST X	÷	LN	4			
022	GSB a	1					
024	LBL A	ST 1					FREE-FALL: Store number of segments.
026	LBL 0	GSB d	CF 0				Free-fall loop: Calculate position for
029	GSB b	X <sup>2</sup>	RCL A	X≠Y			gravity update, update velocity for
033	÷	RCL D	GSB a	P≠S			gravity, update ship's position.
037	RCL 4	+	R↑	RCL 6			
041	+	R↑	RCL 5	+	R↑		
046	P≠S	SF 0	GSB b				
049	RCL E	X#Y?	X>Y?	GTO 7			Impact?
053	—	STO 8	GSB 4				Shift data.
056	F? 1	GTO 0	RCL 0				No fuel?
059	X≠I	DSZ?	GTO 0				More free-fall segments?
062	LBL D	GSB 2	RCL E				DISPLAY: Current segment time, position,
065	—	RCL A	R↓	STK			fuel, and velocity status.
069	RCL 7	RCL 9	—				
072	GSB d	GSB c	STK	RTN			
076	LBL a	X	P→R	R↑	X≠Y		Subroutine; Spherical to rectangular, then
081	P→R	STO -4	R↓	STO -5			update velocity.
085	R↓	STO -6					
087	LBL d	RCL 6	RCL 5				Subroutine; Recall velocity.
090	RCL 4	RTN					
092	LBL b	RCL B	X				Subroutine; Calculate new position, then
095	RCL 1	+	F? 0				store new position only if
098	STO 1	R↑	RCL B	X			flag 0 is set.
102	RCL 3	+	F? 0				
105	STO 3	R↑	RCL B	X			
109	RCL 2	+	F? 0				
112	STO 2	R↑					
114	LBL c	R→P	R↓	X≠Y	R↑	RTN	Subroutine; Rectangular to spherical.
120	R→P	LBL 4	7	X≠I	STO 0		Subroutine; Shift final segment data into

Listing 1 continued on next page.



# BEYOND TRS-80<sup>T.M.</sup>

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**



Listing 1, continued:

125	LBL 8	RCL (i)	P $\neq$ S	STO (i)		secondary registers.
129	P $\neq$ S	DSZ?	GTO 8	RTN		
133	LBL 2	RCL 3	RCL 2			Subroutine; Recall position.
136	RCL 1	GTO c				(i)
138	LBL 7	- X -	-	X=0?		Impact; Exactly on surface?
142	GTO 6	STO - 8				Calculate interpolation ratio,
144	STO $\div$ 8	7	ST 1			then interpolate position,
147	LBL 5	P $\neq$ S	RCL (i)	P $\neq$ S		velocity, and fuel
151	RCL (i)	-	RCL 8	$\div$		data for instant of impact.
155	STO-(i)	DSZ?	GTO 5			
158	LBL 6	GSB 2	R $\downarrow$	COS		Calculate miss distance;
162	X $\neq$ Y	COS	X	COS $^{-1}$		
166	5	9	.	2	2	X
172	X $\neq$ 0?	GTO 3	RCL 2			if zero, alternate calculation:
175	RCL 3	R $\rightarrow$ P	LBL 3			
178	STO A	GTO D				Display impact status.
180	LBL 9	SF 1	X	X $\neq$ Y	RTN	Subroutine; Out of fuel.
185	LBL E	CF 1	CL REG			INITIALIZE: Store constants, the fixed
188	3	3	9	3	STO E	
193	4	3	EEX	3		
197	STO D	EEX	4	STO 9		initial position and velocity,
201	9	X	STO 7	GSB c		
205	$\div$	STO 1	STO 2			
208	STO 3	2	STO 4			
211	CHS	STO 5	GSB 4			
214	GTO D					then display the initial status.
215	LBL C	6	0	X>Y?	X $\neq$ Y	SEGMENT TIME: Check and store.
220	STO A	2	$\div$	STO B	RTN	

Listing 2: Optional random initialization for Mars Lander. Clear flags, set for DEG, and set display to FIX 3 before recording program. User entry points are capitalized in comments.

Location	Program Steps					Commentary	
001	LBL C	SF 2				CIRCULAR: Set for random circular orbit.	
003	LBL E	6	0	STO A	2	ELLIPTICAL: Set segment time, gravity	
008	$\div$	STO B	4	3	EEX	3	constant, Mars radius,
014	STO D	3	3	9	3	ship's mass, ship's random radius	
019	STO E	9	EEX	4		$\phi$ and $\theta$ .	

Listing 2 continued on page 98.





"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 Warme, has also included a **BASEX Loader** program which is capable of relocating programs anywhere in memory.

**NEW**

ISBN 0-931718-05-8  
Author: Paul Warme  
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 programmable 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
- SUPERWUMPUS \$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.



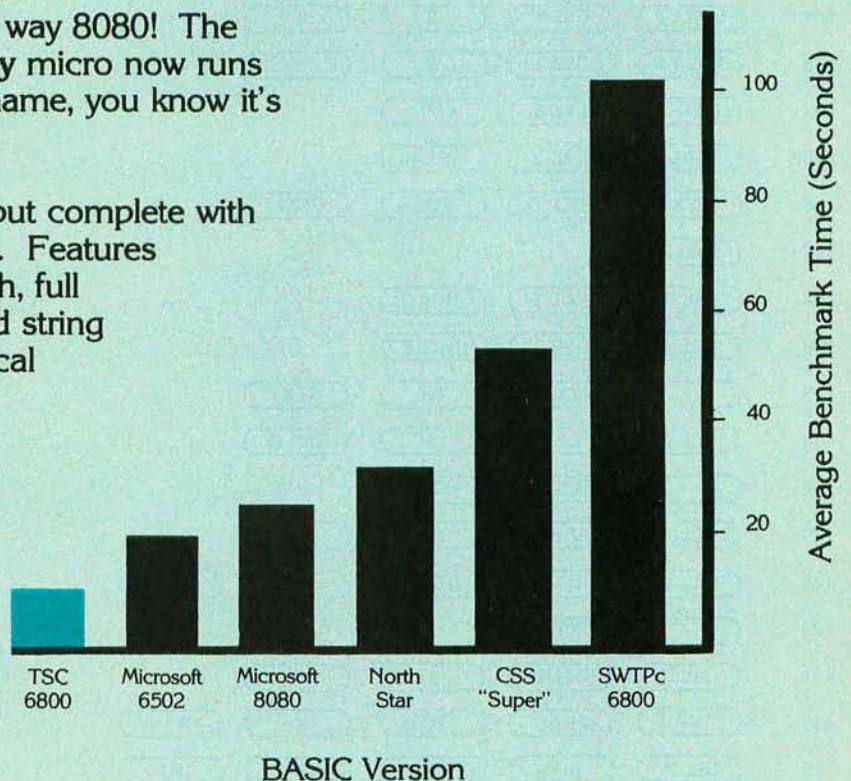
# TSC BASIC for 6800

The fastest floating point BASIC for any micro.

Move over 6502! Out of the way 8080! The fastest floating point BASIC for any micro now runs on the 6800. And with the TSC name, you know it's top quality.

TSC BASIC is not only fast, but complete with over 50 commands and functions. Features include six digit floating point math, full transcendental functions, unlimited string length, if/then/else construct, logical operators, and two-dimensional arrays (including string arrays).

Available now on KCS cassette for \$39.95. Requires 9K minimum, no source listing included. Soon to come is a version for the FLEX™ disk operating system.



**Technical Systems  
Consultants, Inc.**

Box 2574 W. Lafayette, IN 47906

Specialists in Software & Hardware for Industry & the Hobbyist

Graph based on benchmarks listed in October 1977 issue of Kilobaud™ magazine.



Listing 2, continued from page 92:

023	STO 7	3	.	5	EEX	3	
029	STO 8	GSB 0	STO + 8	GSB 1			Convert position to X, Y, Z, and store.
033	3.	6	0	X	GSB 1		
038	1	8	0	X			
042	RCL 8	P→R	R↓	X↔Y	R↑		
047	P→R	STO 1	R↓	STO 2			
051	R↓	STO 3					
053	RCL D	RCL 8	÷	$\sqrt{X}$			Calculate circular orbit velocity,
057	STO 9	GSB 1	STO 4				random X, Y, Z velocity for an orbit
060	RCL 1	X	GSB 1				horizontal at the ship's
063	STO 5	RCL 2	X	+			
067	CHS	RCL 3	÷	STO 6			position,
071	RCL 5	RCL 4	GSB 2				
074	RCL 9	÷	STO ÷ 4				adjust X, Y, Z velocity.
077	STO ÷ 5	STO ÷ 6	F? 2				Circular orbit?
080	GTO 5	GSB 1	2	÷			If elliptical orbit,
084	STO + 4	GSB 1	2	÷			make random
088	STO + 5	GSB 1	2	÷			X, Y, Z velocity adjustment.
092	STO + 6	LBL 5	7				
095	ST I	LBL 3	RCL (i)				Shift data from primary to
098	P↔S	STO (i)	P↔S	DSZ?			secondary registers.
102	GTO 3						
103	LBL D	RCL 3	RCL 2				DISPLAY: Show segment time,
106	RCL 1	GSB 2	RCL E				ship's position,
109	-	RCL A	R↓	STK			fuel,
113	RCL 7	EEX	4	STO 9			and velocity.
117	-	RCL 6	RCL 5				
120	RCL 4	GSB 2	STK	RTN			
124	LBL 1	1	GSB 0	.	5		Subroutine; Randomize position and velocity.
129	-	RTN					
131	LBL 0	RCL 0	$\pi$	+			Subroutine; Random number generator.
135	X <sup>2</sup>	FRAC	STO 0	X	RTN		
140	LBL 2	R→P	R↓	X↔Y	R↑		Subroutine; Rectangular to spherical.
145	R→P	RTN					
147	LBL A	CL REG	1	CHS			SPIN: A random seed randomizer.
151	ST I	CHS	STO + 0				
154	GTO (i)						
155	LBL B	STO 0	RTN				SEED: To store user's random seed.



# SYNCHRO-SOUND

The ORIGINAL Computer People Who KNOW computers and offer 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!



**TEXAS INSTRUMENTS**  
810 Multi-Copy Impact Printer  
ONLY **\$1599.00**  
SINGLE QUANTITY PRICE

We carry a full line of Texas Instruments products

## TERMINALS

LEAR-SIEGLER ADM-3A...  
ADM-31...  
ADM-42... }

CALL\* for prices



HAZELTINE

1400...  
1410...  
1500...  
Mod 1 Edit... } CALL\* for prices



**NORTHSTAR**  
Horizon II (kit)...

CALL\* for price

## PRINTERS

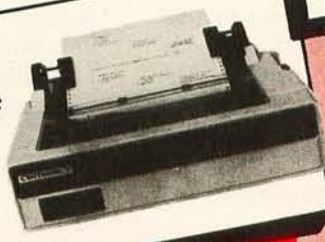
OKIDATA SL125...  
110... } CALL\* for prices



TELETYPE 43... } CALL\* for price

## CENTRONICS

Micro...  
779-2...  
700-2...  
703-0... } CALL\* for prices

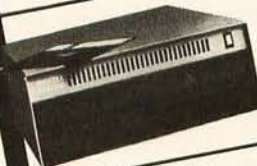


## COMPUTERS

**NORTHSTAR**  
Horizon II (kit)...

CALL\* for price

**DIGITAL SYSTEMS**  
DSC-2...  
Dble Density  
Dual Drive Disk... } CALL\* for prices



**CROMEMCO**  
System 3...

CALL\* for price



## MORE SPECIALS

Decwriter II	\$1395.00	44 Column Printer	\$295.00
Qume Sprint 5/45		Livermore Acoustic Coupler	249.00
RO	2795.00	Javelin 9" Monitor	159.95
Persci 277 Dble Density	1395.00	Pertec 4511-R	
Imsai PCS 80/15	599.00	10 M Hard Disk	CALL*
Anadex DP 8000 Printer	995.00		

\*Our prices are too low to advertise. Please call or write.

We have a full staff of Programmers and Computer Consultants to design, configure and deliver a Turnkey Computer System to meet your specific requirements.



# SYNCHRO-SOUND

ENTERPRISES, INC.

The Computer People  
193-25 Jamaica Avenue, Jamaica, New York 11423  
212/468-7067 TWX 710-582-5886

Hours 9-4 Daily and Saturday

Visit our new showroom Working units on display

BankAmericard Master Charge



Operation	Keys	Display	Explanation
Load Three-Dimensional Mars Lander program	—	0.000	—
Initialize (fixed orbit)	E	60.000 45.000 35.264 1803.152 80000.000 -45.000 0.000 2.828	T Default segment time, seconds Z Position angle $\phi$ , degrees Y Position angle $\theta$ , degrees X Ship's altitude, km T Initial fuel supply, kg Z Velocity angle $\phi$ , degrees Y Velocity angle $\theta$ , degrees X Ship's velocity, km/s
Rocket burn for 60 seconds, $\phi = 135^\circ$ , $\theta = 0^\circ$ , 100 kg/s	135, ENTER, 0, ENTER, 100, B	60.000 42.820 35.245 1802.794 74000.000 -46.751 -1.238 2.553	T Segment time, seconds Z Position angle $\phi$ , degrees Y Position angle $\theta$ , degrees X Ship's altitude, km T Remaining fuel supply, kg Z Velocity angle $\phi$ , degrees Y Velocity angle $\theta$ , degrees X Ship's velocity, km/s
Free-fall 66, 60 second segments	66, A	60.000 -115.974 -33.762 5.694 74000.000 145.618 -7.423 3.907	T Segment time, seconds Z Position angle $\phi$ , degrees Y Position angle $\theta$ , degrees X Ship's altitude, km T Remaining fuel supply, kg Z Velocity angle $\phi$ , degrees Y Velocity angle $\theta$ , degrees X Ship's velocity, km/s
Free-fall one, 35 second segment	35, C, 1, A	3393.000 6706.884 -118.488 -34.135 -0.206 74000.000 144.164 -6.425 3.913	Impact signal T Impact-to-target distance, km Z Impact position angle $\phi$ , degrees Y Impact position angle $\theta$ , degrees X Impact position vertical error, km T Remaining fuel supply, kg Z Impact velocity angle $\phi$ , degrees Y Impact velocity angle $\theta$ , degrees X Ship's impact velocity, km/s

Table 2: Demonstration of the Three-Dimensional Mars Lander program's operation. Note that the thrust from the rocket burn is directly opposite to the initial velocity.

Text continued from page 86:

America. Follow the demonstration example in table 2 to help to understand the spaceship control, and the status displays. The HP-97 prints status displays.

A good landing is within 100 m (0.100 km) of the target site, with a near-vertical descent ( $\phi = \pm 180^\circ$ , and  $\theta = 0^\circ$ , for velocity angles), and at an impact velocity of less than 1 m/s (0.001 km/s). There is plenty of fuel on board to make a good landing at the target site from even a "worst case" random orbit. The initial mass ratio is 9 to 1.

Note that the display reads in kilometers and in km/s; in the normal FIX 3 display format, you can read down to the nearest meter and m/s. When near to landing, it is helpful to change the display to FIX 6, so that you can read down to the nearest millimeter and mm/s. Also note that during descent, the spaceship's position is given in degrees, and on Mars' surface, one degree is about 60 km.

## Celestial Mechanics

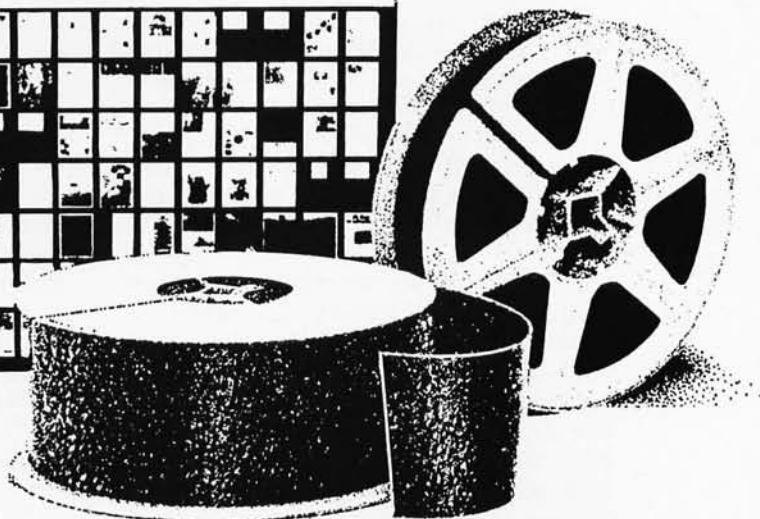
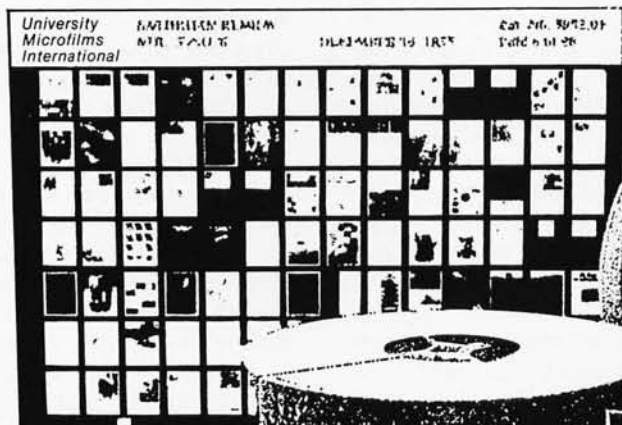
Celestial orbits of a relatively light body around a massive primary may be represented by the conic sections: circle, ellipse, parabola, and hyperbola, all formed by the intersection of a plane with a cone at various angles. In this program we are concerned only with circular and elliptical orbits, since parabolas and hyperbolas represent non-repeating, or one pass orbits.

In a circular orbit, the orbiting body always has the same velocity and the same distance from the primary. The attraction of gravity is exactly balanced by the centrifugal force at all times. Both the body's potential energy (a result of altitude) and its kinetic energy (a result of velocity) are constant.

An elliptical orbit is far more common; a circular orbit is really just a special case of an elliptical orbit. In an elliptical orbit, the body's velocity and its distance from the primary are continually varying. While the body's potential energy varies with its alti-



# BYTE<sup>T.M.</sup> is available in microform



Please send me additional information.

Name \_\_\_\_\_

Institution \_\_\_\_\_

Street \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_ Zip \_\_\_\_\_

## University Microfilms International

300 North Zeeb Road  
Dept. P.R.  
Ann Arbor, MI 48106  
U.S.A.

18 Bedford Row  
Dept. P.R.  
London, WC1R 4EJ  
England



tude, and its kinetic energy varies with its velocity, its total energy remains constant. Its energy is merely oscillating between kinetic and potential forms.

If we are in a spaceship, how do we change altitude with a minimum energy usage (ie: minimum fuel usage)? Under some special circumstances, this is fairly straightforward. For example, to go from one circular orbit to another circular orbit in the same plane — but at a different altitude — the minimum-fuel-usage maneuver is known as a *Hohmann transfer*. It is simply an ellipse tangent to both circular orbits. A Hohmann transfer is made in three stages:

- (1) Thrust along the current direction of motion (or against it) until the velocity has increased (or decreased) enough to form an elliptical orbit that reaches just up (or down) to the desired new circular orbit altitude;
- (2) Wait in elliptical transfer orbit until the new altitude has been reached on the opposite side of the primary from the start;
- (3) Thrust along the current direction of motion (or against it) until the orbit has been circularized at the new altitude. Note that the direction of this second thrust must be opposite to the initial direction of thrust (since we are now on the opposite side of the primary), though both increase (or decrease) the spaceship's velocity.

But how can we use this method to land on the surface of the primary? Just perform a Hohmann transfer to *zero* altitude, then stop! Of course, this assumes that the landing trajectory is tangent to the surface, and that we stop instantly. While this is theoretically the most efficient way to land from orbit, we can't quite actually do it this way; we have to leave some room to slow down and stop and a little extra for maneuvering room. However, the closer we can approach this theoretical minimum-fuel-usage landing, the lower the actual fuel usage will be.

*To repeat:* for a minimum-fuel-usage landing from orbit, an initial rocket burn is made when the spaceship is on the opposite side of the primary from the landing site to slow down enough to pass over the landing site at a low altitude; then free-fall until near to the target site. At the last possible moment, again make a rocket burn (or series of rocket burns) to stop orbital velocity, and to land vertically on the surface at the target site. Note that Mars' very thin atmosphere is ignored.

But what do we do when the landing site

is *not* in the plane of the orbit? Just change the plane of the orbit so that the landing site *is* in the plane of the orbit. This can create two complications:

- (1) Since orbital velocity around Mars is fairly high, it takes a lot of fuel to change the plane of the orbit;
- (2) In general, the heading of the spaceship in orbit is continually changing. But what is the proper heading to make the plane of the orbit pass through the landing site?

The answer to (1) is, literally, roundabout. If the plane change is very great, it will save fuel to first do a Hohmann transfer to a higher altitude so that the spaceship's velocity will be lower, before changing the plane of the orbit. Then come back down on another elliptical orbit to a low altitude over the target landing site. In answer to (2), there are two planes that the spaceship's orbit can be in, that also pass through the target site, where the heading does not change: the equator, and the Greenwich meridian. If we approach the target site along the equator or along the Greenwich meridian, there is no problem of constantly changing headings.

Note that any free-fall orbit is planar (that is, flat), and that the plane of the orbit always passes through the center of the primary. Therefore the orbit's path on the surface of the primary is always a *great circle*. (A great circle is formed by the intersection of the primary's surface with a plane passing through the center of the primary.) It passes over the equator twice for each complete orbit, and over the Greenwich meridian (or its extension, position angle  $\phi = \pm 180^\circ$ ) twice for each complete orbit.

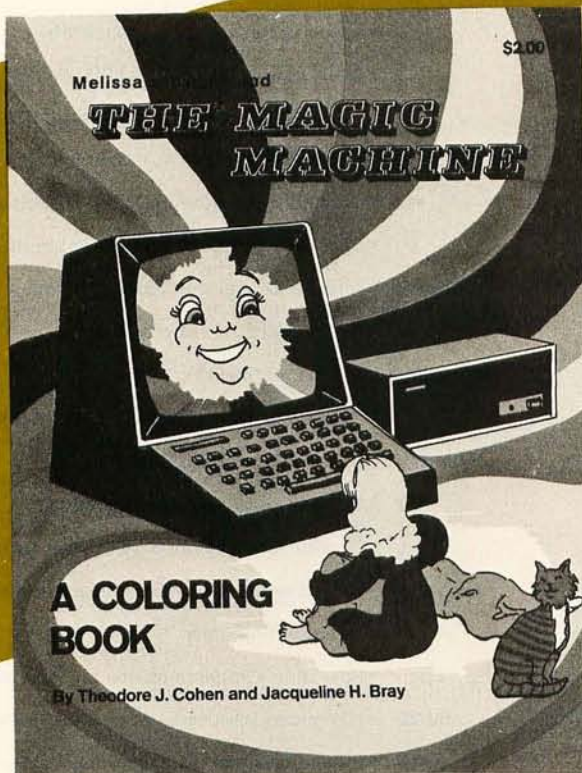
## Program Organization

To squeeze this rather complex program into the 224 program steps available in the Hewlett-Packard HP-67/97, considerable use was made of subroutines, as shown in program listing 1. Note that subroutines may have two entry points. To translate this program to other systems, remember that the HP-67/97 uses RPN (reverse Polish notation) on a 4 register stack. Therefore function symbols *follow* data entry, the same as though you were doing the calculation manually. Flags and conditional tests skip the following program step if the test is false.

The more important equations used for calculating the random initialization, the

Text continued on page 108.





# The Magic Machine

**A 32-page Coloring Book about Computers**

written and illustrated by Theodore Cohen and Jacqueline Bray

*The Magic Machine* is an introduction to computing for young children. The drawings and text show how two children find uses for a computer in their home.

*The Magic Machine* will help the child in your life to understand some of the functions of computers in his world, and to better understand the importance of computing in your world.

*The Magic Machine* comes COMPLETE WITH CRAYONS, and is lots of fun to color and read.

ISBN 0-931718-17-1

**\$2.00**

Buy this book at your favorite computer bookstore or order direct from BYTE BOOKS. Add 75¢ per book for postage and handling



70 Main Street, Peterborough, New Hampshire 03458



Operation	Variable Definition
Random Initialization: $V_{co} = \sqrt{C_g/R}$ $RV_z = -(RV_x P_x + RV_y P_y)/P_z$	$V_{co}$ = Velocity for a circular orbit, km/s $C_g$ = Mars' gravity constant, 43,000 km <sup>3</sup> /s <sup>2</sup> $R$ = Radius, Mars' center to spaceship, km $RV_z$ etc = Relative velocity in X,Y,Z directions
Spaceship's Trajectory: $V_r = V_i - V_{exh} \ln(M_f/M_i)$ $P_g = P_i + V_r t/2$ $g = C_g/R^2$ $V_f = V_r - gt$ $P_f = P_i + (V_i + V_f)t/2$	$P_x$ , etc = Spaceship's position in X,Y,Z coordinates $V_r$ = Spaceship's velocity after rocket burn, km/s $V_i$ and $V_f$ = Initial and final ship's velocity, km/s $V_{exh}$ = Rocket exhaust velocity, 4 km/s $M_i$ and $M_f$ = Initial and final ship's mass, kg $P_g$ = Position of spaceship for gravity calculation $P_i$ and $P_f$ = Initial and final ship's position $t$ = Segment duration time, seconds
After Impact with Mars' Surface: $V_{imp} = V_f + c/d(V_i - V_f)$ $P_{imp} = P_f + c/d(P_i - P_f)$ $\text{Distance} = 59.22(\cos^{-1}((\cos \phi) (\cos \theta)))$ or: $\text{Distance} = \sqrt{P_{y(imp)}^2 + P_{z(imp)}^2}$	$g$ = Gravity acceleration, 3.74 m/s <sup>2</sup> at surface $V_{imp}$ = Impact velocity on Mars' surface, km/s $c/d$ = Interpolation ratio $P_{imp}$ = Spaceship's impact position on Mars' surface 59.22 = Kilometers per degree along Mars' surface Distance = Impact-to-target distance along Mars' surface, km $\phi$ and $\theta$ = Spaceship's impact position angles, degrees $P_{y(imp)}$ = Spaceship's Y impact position, km $P_{z(imp)}$ = Spaceship's Z impact position, km

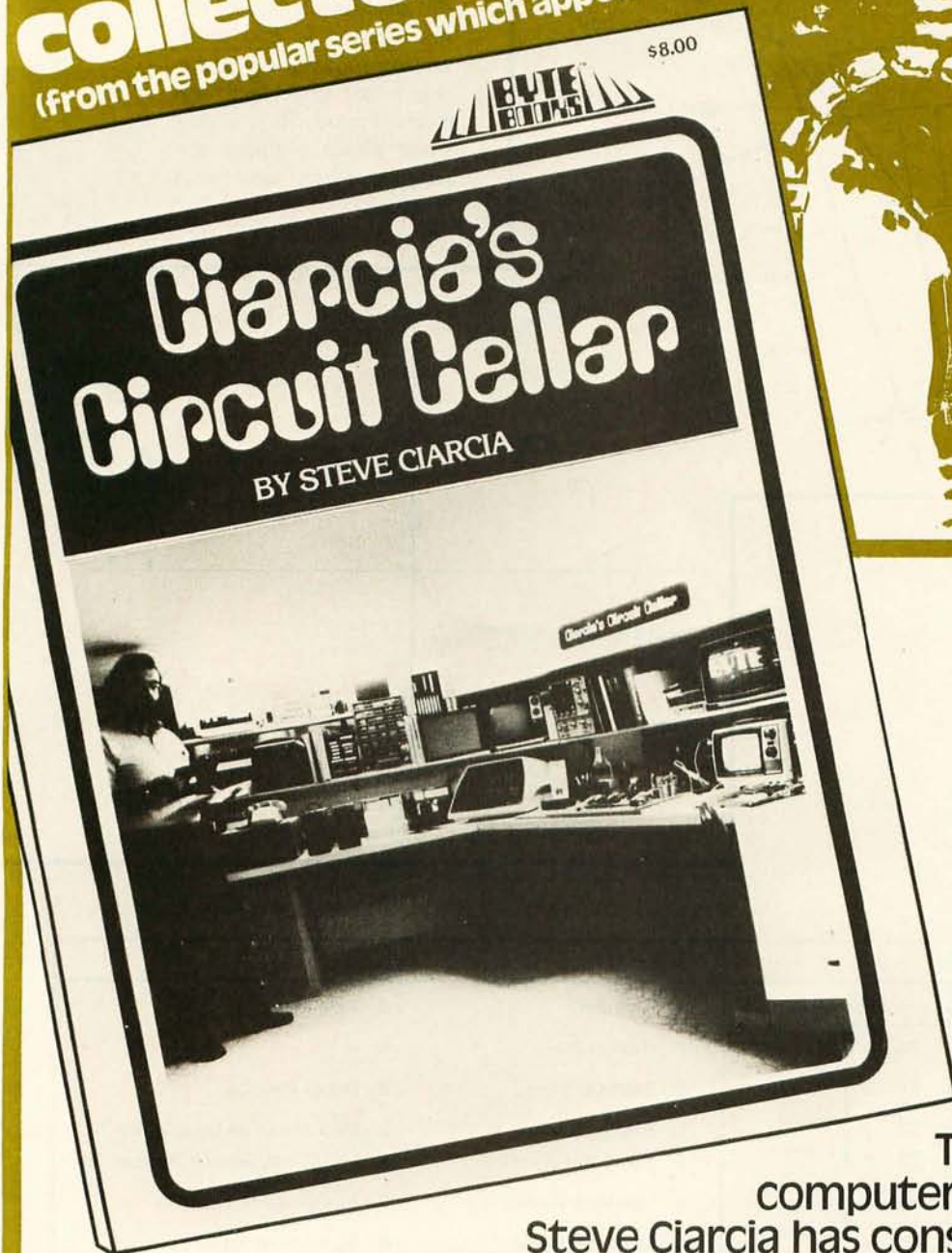
Table 3: Random initialization, spaceship trajectory, and impact status calculations. The trajectory and impact equations do not give exact velocity and impact data, but do give good approximations. The calculated values increase in accuracy as segment duration and velocity decrease and as radius increases. While the equations are shown in their simplest linear form, calculations are actually carried out in three dimensions, using rectangular or spherical coordinates. Note that the initial conditions for one segment were the final conditions for the previous segment.

Polar to Rectangular: $X = R \cos A$ $Y = R \sin A$	where: $X, Y$ = Rectangular coordinates $R, A$ = Radius and angle of polar coordinates
Rectangular to Polar: $R = \sqrt{X^2 + Y^2}$ $A = \tan^{-1}(Y/X)$	
For calculation of the angle A: a) If $X = 0$ , substitute a very small number for X, ie: perhaps $10^{-10}$ b) If $X < 0$ , add $180^\circ$ to A c) If $X < 0$ and $Y < 0$ , subtract $180^\circ$ from A	

Table 4: Polar-to-rectangular and rectangular-to-polar coordinate conversions.



**A hot collector's item.**  
(from the popular series which appeared in BYTE)



ISBN 0-931718-07-4

**\$8.00**

Buy this book at  
your favorite com-  
puter bookstore  
or direct from  
**BYTE BOOKS.™**

Add 50¢ per book for  
postage and handling

The marvelous  
computer projects that  
Steve Ciarcia has constructed in his  
cellar are explained in detail so that you  
can make your microcomputer perform the same  
useful functions. Each article is a complete tutorial,  
presented in such an easy-going style that even  
beginners can understand and enjoy.

**BYTE™**  
**BOOKS**  
"BOOKS OF INTEREST TO COMPUTER PEOPLE"

70 Main Street Peterborough, New Hampshire 03458



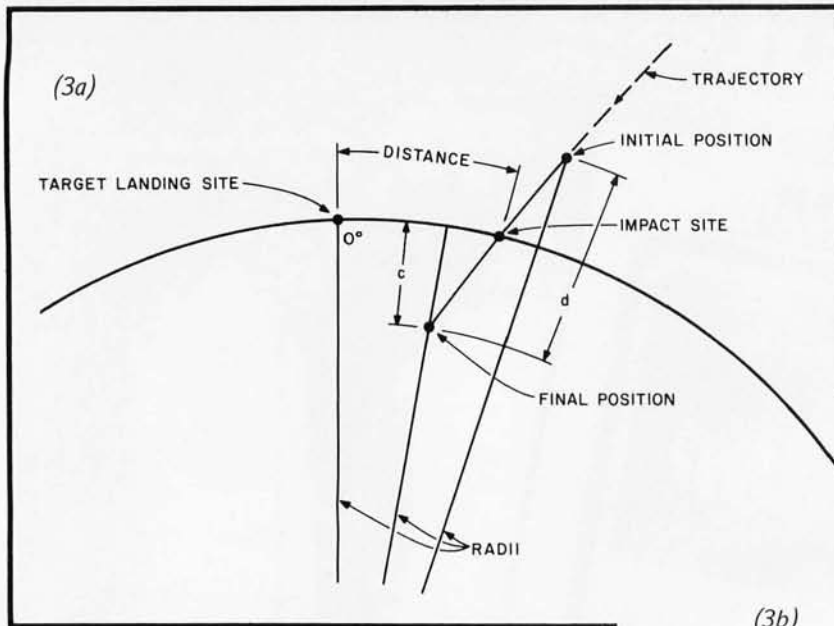


Figure 3: Interpolation of the spaceship's landing status. Figure 3a is a cross-section showing the spaceship's last trajectory segment. Figure 3b is a view from above showing impact position and miss distance.

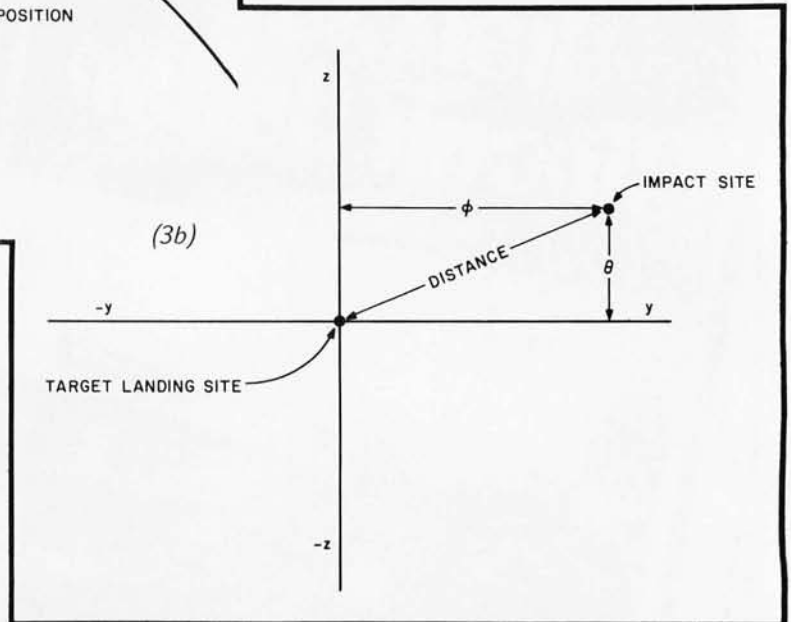
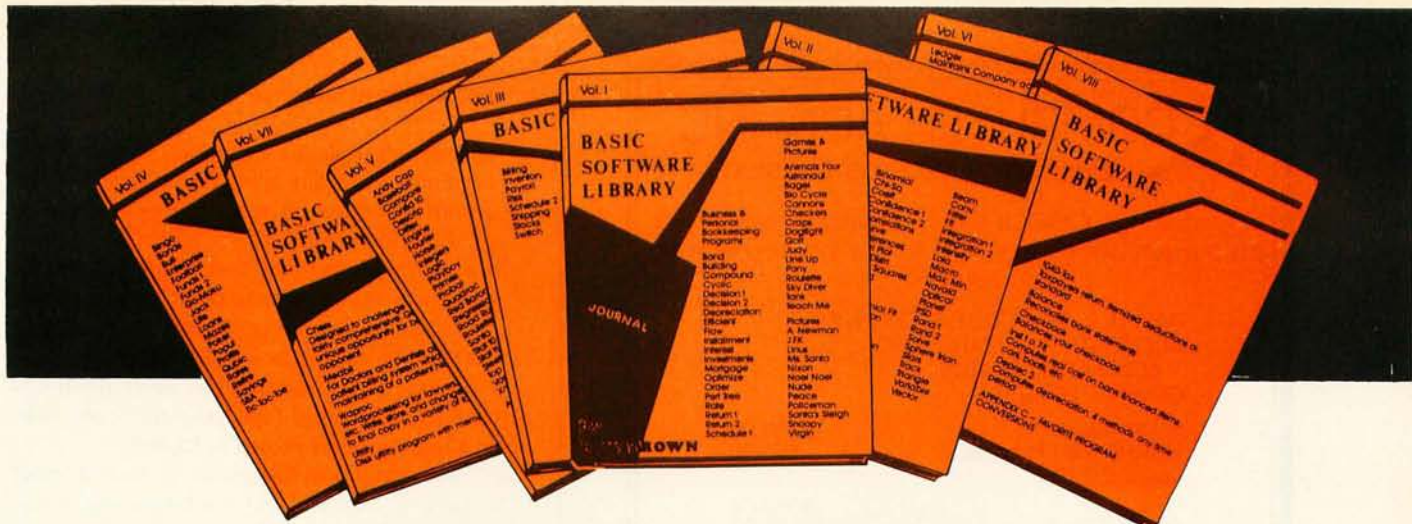


Table 5: Register, label, and flag usage for the Three-Dimensional Mars Lander program.

Registers		Labels	
Primary	Secondary		
0 Temporary Loop Count	S0 —	A Free-Fall	0 Free-Fall Loop
1 x } New Position	S1 x } Initial Position	B Rocket Burn	1 —
2 y } New Position	S2 y } Initial Position	C Segment Time	2 Recall Position
3 z } New Position	S3 z } Initial Position	D Display Status	3 Skip Alternate Calculation
4 x } New Velocity	S4 x } Initial Velocity	E Fixed Initialization	4 Shift Data, Second Register Set
5 y } New Velocity	S5 y } Initial Velocity	a Update Velocity	5 Interpolation Loop
6 z } New Velocity	S6 z } Initial Velocity	b Update Position	6 Skip Interpolation
7 Ship's Mass	S7 Ship's Mass	c Rectangular to Spherical	7 Mars Surface Impact
8 Last Altitude	S8 —	d Recall Velocity	8 Data Shift Loop
9 10,000	S9 —	e —	9 Out of Fuel
A Segment Time, t		<b>Flags</b>	
B t/2		0 On, Store New Position	
C —		1 On, Out of Fuel	
D Gravity Constant		2 —	
E Mars' Radius		3 —	
I Loop Count			





# 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	Binomial Chi-Sq. Coeff Confidence 1 Confidence 2 Correlations Curve Differences Dual Plot Exp-Distr Least Squares Paired Plot Plots Polynomial Fit Regression Stat 1 Stat 2 T-Distribution Unpaired Variance 1 Variance 2 XY APPENDIX A	Beam Conv Filter Fit Integration 1 Integration 2 Intensity Lola Macro Max. Min. Navald Optical Planet PSD Rand 1 Rand 2 Solve Sphere Titan Stars Track Triangle Variable Vector	Billing Inventory Payroll Risk Schedule 2 Shipping Stocks Switch	Bingo 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	Andy Cap Baseball Compare Confid 10 Descrip Differ Engine Foutler Horse Integers Logic Playboy Primes Probab Quadrac Red Baron Regression 2 Road Runner Roulette Santa Stat 10 Stat 11 Steel Xmas APPENDIX B	Ledger  Chess  Medbil  Wdproc  Utility  1040-Tax  Balance Checkbook Inst 1 o 78 Deprec 2 APPENDIX C — FAVORITE PROGRAM CONVERSIONS	Maintains Company accounts and generates financial reports. Includes routines for: P/yr, Inv, Dept, A/R, A/P.  Designed to challenge the average player, fairly comprehensive. Great fun for all, offers a unique opportunity for beginners in need of an opponent.  For Doctors and Dentists alike, a complete patient billing system which also permits the maintaining of a patient history record.  Wordprocessing for lawyers, publishers, writers, etc. Write, store, and change from rough draft to final copy in a variety of formats.  Disk utility program with memory testing.  Taxpayers return, Itemized deductions or standard  Reconciles bank statements  Balances your checkbook  Computes real cost on bank financed items; cars, boats, etc.  Computes depreciation, 4 methods, any time period

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 \$1.50 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

Phone orders call 800-327-6543

Information — (305) 361-1153





## COMPUTER AGE, INC. Business Systems Division

is offering OSBORNE'S quality software packages, written in CBASIC, for immediate delivery

PAYROLL WITH COST ACCOUNTING  
ACCOUNTS RECEIVABLE AND  
ACCOUNTS PAYABLE  
GENERAL LEDGER

8" CPM diskette	\$85.00
5" North Star CPM diskette	\$85.00

also:

CPM	\$145.00
CBASIC 5" or 8"	\$ 95.00

Other systems software also available

Complete turn-key Business Systems available including:

Auto-Scribe Word Processing System	\$7595.00
Bookkeeper Client Write-up System	\$6895.00
Integrated Business System of G/L, A/P, A/R, Payroll, Inventory	\$5995.00

Other systems to be available soon.

Custom programming services.

Computer Age, Inc.  
1308 N. Federal Hwy.  
Pompano Beach, FL 33062  
(305) 946-4999

Text continued from page 102:

spaceship's trajectory, and for interpolating landing conditions are given in table 3. The second equation on table 3 uses the method of direction cosines to set a horizontal orbit for any spaceship position. Many systems do not have rectangular-to-polar and polar-to-rectangular functions; these may be performed using software functions or sub-routines, with the equations given in table 4. The use of storage registers, labels, and flags in the program is shown in table 5.

The program operation is shown most clearly in figure 2. At the beginning of calculations for each segment, the same position, velocity, and fuel data are in both the primary and the secondary registers. During the rocket burn and free-fall calculations, only the data in the primary registers is progressively updated. After all trajectory calculations for the segment have been made, the secondary registers still contain the initial segment data, while the primary registers now contain the final segment data. Then there is a test for Mars impact during the segment; if impact has occurred, initial and final segment data are used to interpolate impact status; if impact has not occurred, primary register data is copied into the secondary registers in preparation for calculation of the next segment. If the program is still in a loop of free-fall segment calculations, the next segment is calculated; otherwise, the current status data is displayed and the program halts.

The impact interpolation method is shown in figure 3. The calculated impact-to-target distance is correct only for the hemisphere of Mars that is centered upon the designated target site. If the landing is within a square about 240 meters on a side centered upon the designated target site, roundoff in the cosine function causes a calculated miss distance of 0. If you are this close, Mars' surface may be considered as flat, and a simpler alternate miss distance calculation is used.

### Conclusions

This program may be considered as primarily a game program, or as primarily a celestial mechanics simulation program. In either case, as you learn how to control the spaceship for better landings using less fuel, you will also be learning more about the intuitive "feel" of celestial mechanics, and will gain a greater appreciation of some of the problems of space flight.

Watch that fuel gauge, and happy landings! ■

## 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

50 t Route 27  
Iselin, NJ 08830  
(201) 285-0600

STORE HOURS

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

Computer Mart of Pennsylvania

350 DeKalb Pike  
King of Prussia, PA 19406  
(215) 265-2580



# At last...get the power of the APL language on Z80-based microcomputers

Write finished applications software in a fraction of the time you'd need to write similar programs in BASIC, FORTRAN, or COBOL

APL is one of the most concise, powerful programming languages, but until now its use was limited to large mainframe computers because the language occupied so much memory. APL has been used by some companies with very large computers since 1966, to save countless costly hours of program preparation. Now Vanguard Systems Corporation has implemented this potent computer language to run on Z80 microprocessors.

APL/Z80™ is useful, not only for mathematics and engineering applications, but also for text processing and other business applications. It's easy to learn, quick to write. APL/Z80 helps you develop functional software, and debug it, in about one-fifth the time it takes you to program equivalent functions in BASIC, FORTRAN, or COBOL. APL/Z80 lets you focus on the problem you want to solve, rather than on the programming language you're using.

Your choice: one or many

In one line of code, APL often does what other languages require many lines to do. We haven't room here to show side-by-side comparisons of equivalent programs in APL, BASIC, FORTRAN, and COBOL. The other languages take too much space. But we can show you some sample APL programs. Test your current language yourself by writing an equivalent program for each example here. You'll quickly see the time advantages APL/Z80 offers.

Example

This APL/Z80 expression inputs a list of values (list B), computes the average of all items in the list, then prints the average:

```
□←(+ / B) ÷ ρ B ← □
```

In other languages, this expression may require at least one loop and perhaps 10 statements.

Example

This APL/Z80 expression inputs a list of values (list A), sorts the list from lowest to highest values, and prints out all values in the list A in ascending order:

```
□←A [ Δ A ← □ ]
```

In other languages, this expression usually takes two loops and 15 to 20 statements.

Example

This APL/Z80 function computes the mean, variance, and standard deviation for a list called X:

```

V R=STA      ;M:VAR:SD
[ ] R=N,V.    (VAR+(+/X-M+(+/X)N)*2)+(N-ρX)-1)÷0.5
V
    
```

In other languages, a program equivalent to this can be quite cumbersome. When you try writing one, you'll find yourself wishing you had APL/Z80 already.

Don't let the unusual symbols in APL/Z80 worry you. APL has so many complete functions built into the language itself, there aren't enough letters in the English alphabet to give every function a unique single-character name. Of course, APL/Z80 could name each function with four or five letters, as BASIC does, but that rapidly eats up memory. Besides, once you learn a language, you start using abbreviations anyway. APL/Z80 lets you use abbreviations from the very beginning, saving memory space both in your head and in your machine.

It has taken more than 2 years of concentrated work to produce APL/Z80, but it gives you much of the power of APL on a large mainframe, for a fraction of the cost. APL/Z80 can handle not only shared variables, but also arrays of up to 8 dimensions.

Whether you're an engineer, an educator, or a businessman, Vanguard Systems Corporation brings you the full power of APL at a price you can afford. Now you can enjoy the privacy and convenience of

## Check these APL/Z80 features:

- up to 27k byte active workspace on systems using CP/M<sup>®</sup>, or Digital Group systems using DISKMON
- system variables, execute, & format are implemented
- disk workspace and copy object library
- shared variables
- arrays up to 8 dimensions
- dynamic execution of system commands
- auxiliary processor for interfacing I/O ports
- auxiliary processor for indexed file systems
- canonical representation, fix
- latent expression
- can boot directly into application program from system power-on.

your own low-cost APL microcomputer, right on your desktop.

Software only, or hardware/software together

If you need both hardware and software, order our APL/DTC™ for only \$6495. This is a complete APL/Z80 hardware/software configuration with 26k

usable active APL workspace, dual quad-density mini-disk drives, and video console. Because each APL/DTC is custom-assembled, your unit will be shipped 30 to 60 days after we receive your order. Local maintenance on the hardware is available in major metropolitan areas. Write or call us for more details on machine specifications.

If you already own any Z80-based computer with CP/M<sup>®</sup> disk operating system, or a Digital Group system with DISKMON, you can get APL/Z80 on your machine for only \$350. This includes the end-user software license, object code floppy disk, and complete documentation. If you want to read the documentation before ordering the complete set, our user's manual is available separately at \$25 per copy.

We can ship your order now!

At Vanguard Systems, we're ready to ship your APL/Z80™ license/disk/documentation package or user's manual today. We have them in stock for immediate delivery. Act now to begin saving hours and headaches by developing powerful, precise applications programs in APL/Z80. Mark the items you need and mail the coupon today with your check, money order, or VISA/MasterCharge information. You'll be glad you did.

©Trademark of Digital Research

Please rush the items ordered below. I understand the software license for APL/Z80™ covers one machine for one end-user and includes a non-disclosure agreement to protect Vanguard Systems Corporation's proprietary rights. Prices and specifications subject to change without notice.

### Complete APL/Z80™ Software Packages

include end-user limited license, object code disk, and documentation manual:

- for CP/M<sup>®</sup> disk operating system, \$350 specify version (check one)
  - for serial ASCII APL terminal
  - for 64-char. video display (Vect. Graph., Proc. Tech. or compatible)
  - for 80-char. video display (compatible w/Vect. Graph. & similar boards)
  - for Digital Group DISKMON operating system, \$350

Please describe your disk to be sure you get the correct object code disk for your machine (check one box in each column):

SIZE	DENSITY	FORMAT
<input type="checkbox"/> 5" floppy	<input type="checkbox"/> single	<input type="checkbox"/> soft-sectored 8"
<input type="checkbox"/> 8" floppy	<input type="checkbox"/> double	<input type="checkbox"/> OSI
	<input type="checkbox"/> quadruple	<input type="checkbox"/> Micropolis
		<input type="checkbox"/> North Star compatible

### Accessories

- APL Video Character Generator ROM, \$25 (directly replaces MCM-6571-A to give true APL characters)
- APL/ASCII Character Generator Board, \$89.95, for Vector Graphic, Processor Technology, & similar boards

### APL/Z80™ User's Manual alone

- \$25

### APL/DTC™ Hardware/Software Unit

- A complete machine/software configuration. Includes CPU, dual quad-density mini-disk drives, video terminal, APL character generator, end-user limited license for software, object code disk, and documentation. \$6495, shipped freight collect FOB San Antonio.

NOTE: Texas residents must add 5.5% sales tax to all prices. We ship UPS, so P.O. box address must give phone number. International customers should write for details on shipping rates & requirements before ordering.

Enclosed is my check for \$ \_\_\_\_\_ Card # \_\_\_\_\_ exp. date \_\_\_\_\_  
 OR Charge to:  MasterCharge  Visa Signature \_\_\_\_\_  
 Ship to: Name \_\_\_\_\_  
 Address \_\_\_\_\_ Phone \_\_\_\_\_  
 City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

**VANGUARD SYSTEMS Corp.**

6812 San Pedro  
San Antonio, TX 78216

(512) 828-0554



# The Standard

## Data Encryption Algorithm

### Part 2: Implementing the Algorithm

Robert V Meushaw  
4188 Brittany Dr  
Ellicott City MD 21043

Part 1 of this article described the five basic functions which must be performed to implement the Standard Data Encryption Algorithm:

permutation operations,  
table lookup,  
circular rotation,  
byte exchange, and  
modulo 2 addition.

Of course, there are many iterations of these functions in the encryption and decryption process.

#### Design Approach

When I began the design, I knew that there were many possible approaches. However, I also knew that the one hard constraint I faced was the amount of memory available on the basic KIM-1 computer. This constraint was the determining factor in the design, and, as a consequence, in the efficiency and speed of the implementation. In order to determine how much memory I would have for the program, I began to estimate the amount of storage I would need to hold all of the tables I needed. My preliminary estimate was that for each entry in each permutation table I would need one byte (I actually needed slightly more, as you will see). This assumption meant that I would need 312 bytes — almost one third of the memory available to me. I next looked at the Select S1 thru S8 function. There are eight separate tables with 64 entries each. However, since each table entry required only four bits instead of eight (the entries range from hexadecimal 0 to F), I knew that if I was clever I could get away with half a byte per entry. I would

still need 256 bytes for these tables, of course. So before I even started on the program, one half my available memory was committed.

The impact of the above results became clear when I looked at the memory requirements for subkeys K1 thru K16. Each subkey would require 6 to 8 bytes (depending on how data was represented), giving a possible total storage requirement of 128 bytes. Since I would be left with only about 128 bytes for the program (and I didn't think that was enough) I made the decision to generate each subkey as I needed it.

#### Module Design Difficulties

The actual design of the individual modules went through several iterations. My primary problem was that the optimization of the overall program meant that the design of each module was intimately involved with the design of other modules—not usually a good design approach. A revision of any module usually resulted in several iterations of changes to other modules. An example of this coupling is the following:

- efficient design of the Select S1 thru S8 module requires inputs to be available as 8 bytes of 6 bits each.
- in order to generate the input as required above, the subkey and the results of the Select E permutation must be represented as 8 bytes of 6 bits each.
- the design of the module which performed the permutation function had to be modified and reoptimized to allow for less than 8 bits per byte in the result.



I am sure that many readers have encountered the same type of difficulty in developing relatively complex software which must be optimized for speed, space, or both. It was a frustrating experience because of the many revisions required.

### Data Movement

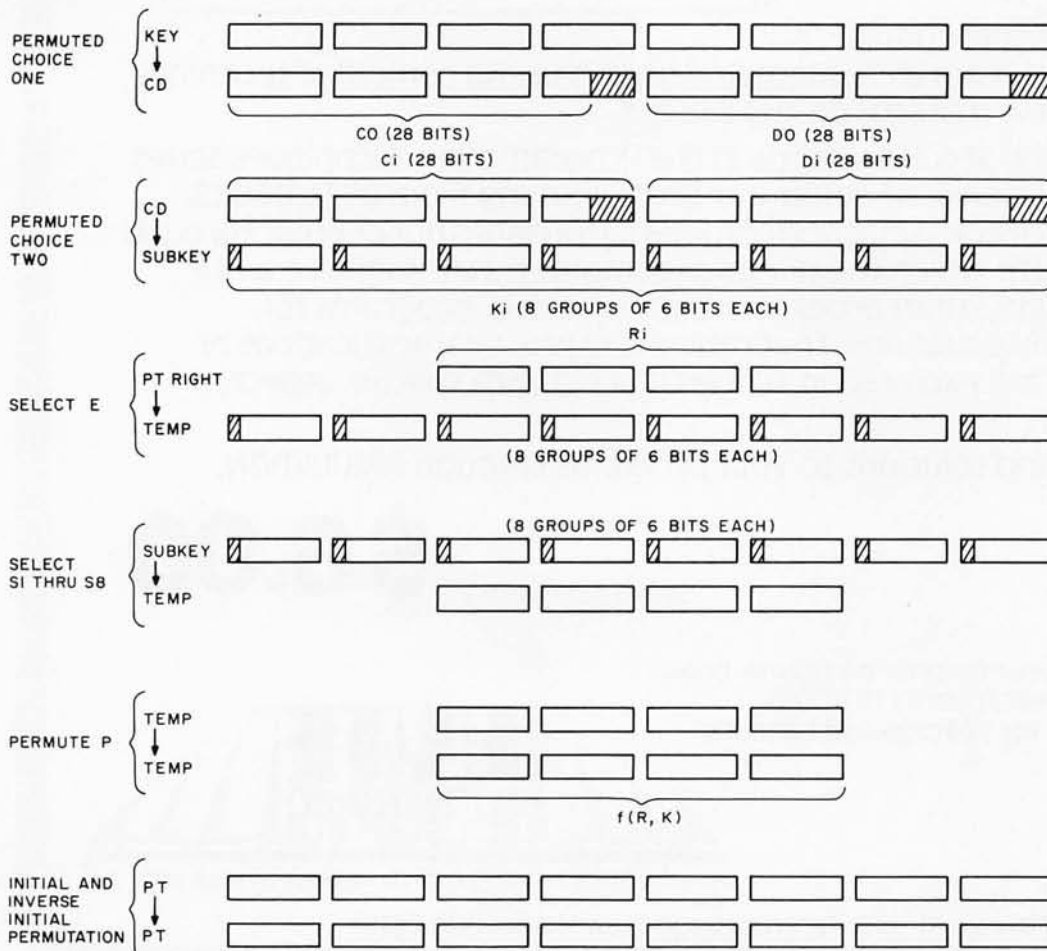
One of the first tasks in designing this program, or any program, was the definition of the data structures and the data transfers which will occur. The basic data elements to be manipulated are:

- 8 bytes of plaintext input (PT)
- 8 bytes of key (KEY)
- 8 bytes of subkey (SUBKEY)
- 8 bytes for  $C_i$  and  $D_i$  (CD)
- 8 bytes of storage for intermediate results (TEMP).

Text continued on page 114.

1	PT	Initial permutation	→	PT
2	Key	Permuted Choice 1	→	CD
3	CD	Permuted Choice 2	→	Subkey
4	PTright	Select E	→	Temp
5	Temp ⊕ Subkey		→	Subkey
6	Subkey	Select S1 thru S8	→	Temp
7	Temp	Permute P	→	Temp
8	PTleft ⊕ Temp		→	PTleft
9	PT	Inverse initial permutation	→	PT

*Table 8: Data transformations and movement used in software implementation of the Standard Data Encryption Algorithm. This table does not include the exchange of PTright and PTrleft used in block transformation.*



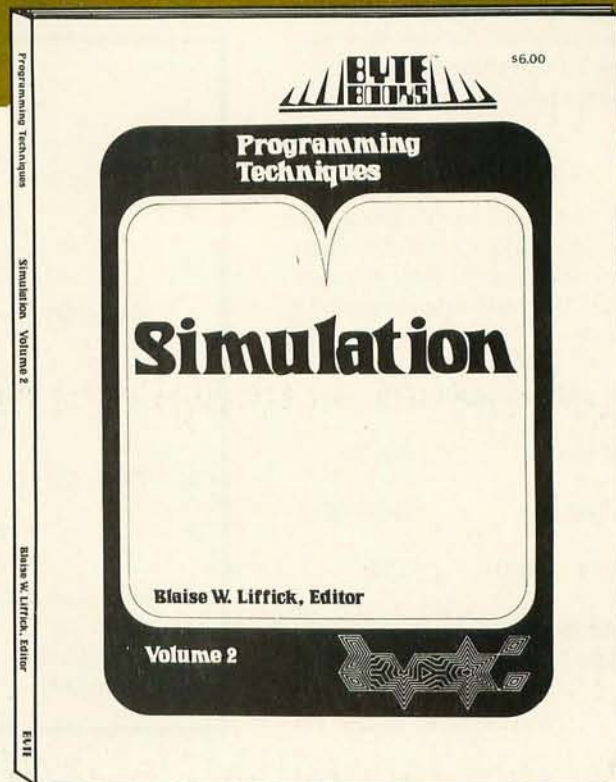
*Table 9: Data format and data movement used in the software implementation of the Standard Data Encryption Algorithm.*



# Solve Problems By Simulation...

with simulations of many concepts, including

- wave motion
- flying objects
- artificial intelligence
- electronic circuits
- and robot motion!



SIMULATION is a collection of the best articles from BYTE Magazine on this useful computer technique, plus exciting new material on the subject.

SIMULATION is the second volume in the Programming Techniques series on the art and science of computer programming from BYTE BOOKS. Editor Blaise W. Liffick's selection of material furnishes not only background information from which the personal computer user is able to write and maintain simulation programs, but also actual programs for simulating many situations. Theoretical and practical applications of this technique are explored in articles dealing with specific aspects of simulation.

Learn how to find solutions to your problems through SIMULATION.

## \$6.00

ISBN 0-931718-13-9

Buy this book at your favorite computer bookstore or order direct from BYTE BOOKS. Add 50¢ per book for postage and handling



70 Main Street, Peterborough, New Hampshire 03458



# "Efficiency is in. Extravagance is out." — Vector Graphic

That's why when you look for top-quality, low-cost, add-on-memory you should always look for Vector Graphic on your memory boards. It means they stand behind every product through over 200 Vector Graphic dealers.

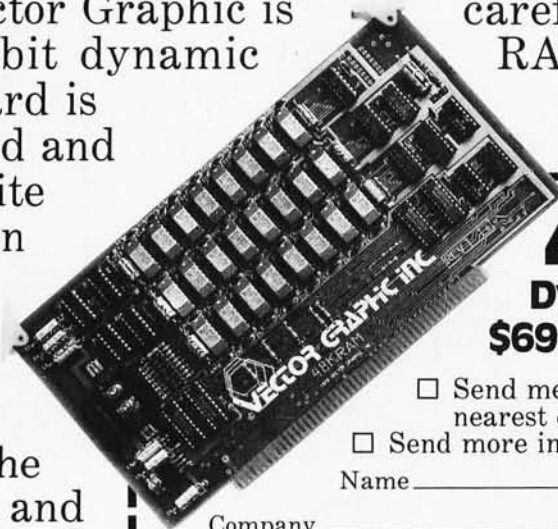
Vector Graphic is the only one who designs in so much quality for so little cost.

The 48K Dynamic RAM memory board is used in the Vector MZ microcomputer, although any Z-80/S-100 computer system can take advantage of the problem-free transparent refresh offered in this high-quality, low-cost add-on-memory.

It's no secret, Vector Graphic is state-of-the-art 16K-bit dynamic boards. And each board is thermally cycled, aged and continuously read-write tested over 400 million error-free cycles.

The new 48K board consumes less than 4 watts total power and provides the same superior design and reliability found in all products from Vector Graphic. Remember, it's memory that works.

carefully assembling  
RAMs into



**48K RAM**  
**Dynamic Memory**  
**\$695** (suggested U.S. retail price)

- Send me the name of the nearest dealer  
 Send more information

Name \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City/State/Zip \_\_\_\_\_

**VECTOR GRAPHIC INC.**

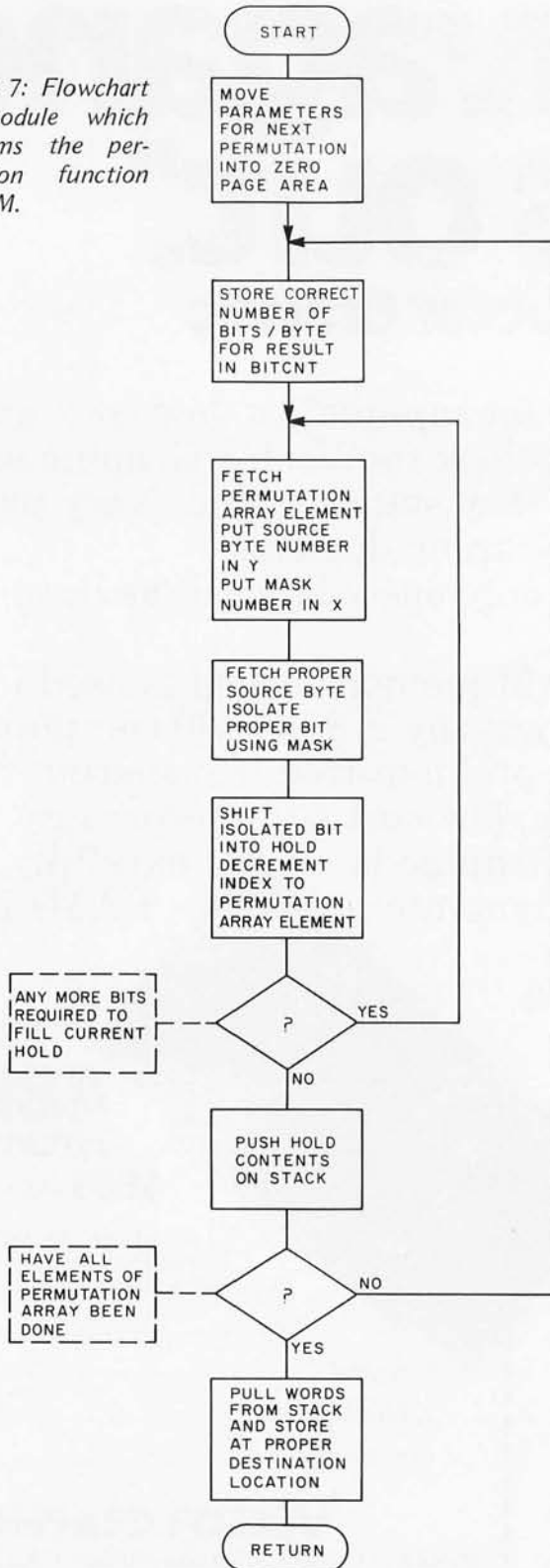
31364 Via Colinas, Westlake Village, CA 91361, (213) 991-2302

— Dealer inquiries invited —



Table 8 depicts the data transformations and data transfers that occur. The first item shows that the plaintext data is permuted by the initial permutation and stored in the bytes originally occupied by the plaintext data.

Figure 7: Flowchart of module which performs the permutation function TFORM.



For each of the transformations which occur, table 9 shows the format of both the data input and the results of the operation. Each rectangular box represents one byte. As an example, consider the transformation Permuted Choice 2 (PC-2). The input is  $C_i$  (28 bits) and  $D_i$  (28 bits) and the output is stored as 8 blocks of 6 bits each. The label CD (to the left) shows the *source* data, and subkey shows the *destination* of the results of the permutation.

Permutation Module: TFORM

At this point I can begin the detailed explanation of the major modules. The module where most of the work is done (and where most of the time is spent) is TFORM. Steps 1, 2, 3, 4, 7 and 9 of table 8 depict the permutation functions performed. The operation of this module is similar in each case; only the input parameters are different. The primary input parameters to TFORM are: *source* data address, *destination* address for results, and *permutation table* address. For example, to perform the permutation shown in step 4 of table 8, TFORM would get the source address of PT (right), the destination address of TEMP, and the table address of the Select E permutation.

A general flowchart of TFORM is shown in figure 7. It provides a top level description of the operation for those readers who want to program the function on different machines.

The first task is to update the input parameters used by the routine. In addition to the parameters described above, the routine also needs the number of elements in the permutation table (PCOUNT), the number of bytes in the result of the permutation (WCOUNT), and the number of bits in each result byte (BCOUNT).

Here's how the permutation is done. The first element of the permutation table is obtained. This element tells which bit of the input is the first bit of the result, as follows: referring to figure 8, bits 0, 1 and 2 refer to the byte of the source data to be used; bits 3, 4, 5 and 6 refer to a mask number to be used to isolate the proper bit. At this point, an example might help. Figure 9 shows how the first bit of Permuted P is obtained. The first bit of the result is bit 16 of the input — this corresponds to byte 1 of the input

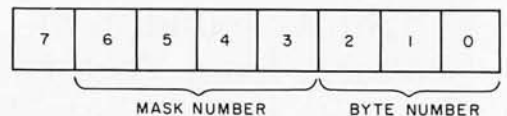


Figure 8: Format of elements of permutation table.



# NEW!



WHY CUT?  
WHY STRIP?  
WHY SLIT?

WHY NOT...

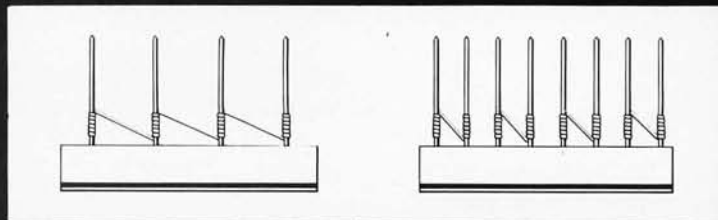
# JUST WRAP™

U.S.A.  
FOREIGN  
PATENTS  
PENDING

- AWG 30 Wire
- .025" Square Posts
- Daisy Chain or Point To Point
- No Stripping or Slitting Required
- ....JUST WRAP™....
- Built In Cut Off
- Easy Loading of Wire
- Available Wire Colors:  
Blue, White, Red & Yellow

**\$14.95\***

JUST WRAP TOOL WITH ONE 50 FT. ROLL OF WIRE		
COLOR	PART NO.	U.S. LIST PRICE
BLUE	JW-1-B	\$14.95
WHITE	JW-1-W	14.95
YELLOW	JW-1-Y	14.95
RED	JW-1-R	14.95
REPLACEMENT ROLL OF WIRE 50 FT.		
BLUE	R-JW-B	2.98
WHITE	R-JW-W	2.98
YELLOW	R-JW-Y	2.98
RED	R-JW-R	2.98



DAISY CHAIN

POINT TO POINT



OK MACHINE & TOOL CORPORATION 3455 CONNER ST., BRONX, N.Y. 10475 (212) 994-6600/TELEX 125091

\*MINIMUM BILLING \$25.00 / ADD SHIPPING CHARGE \$2.00 / NEW YORK CITY / STATE RESIDENTS ADD APPLICABLE TAX.



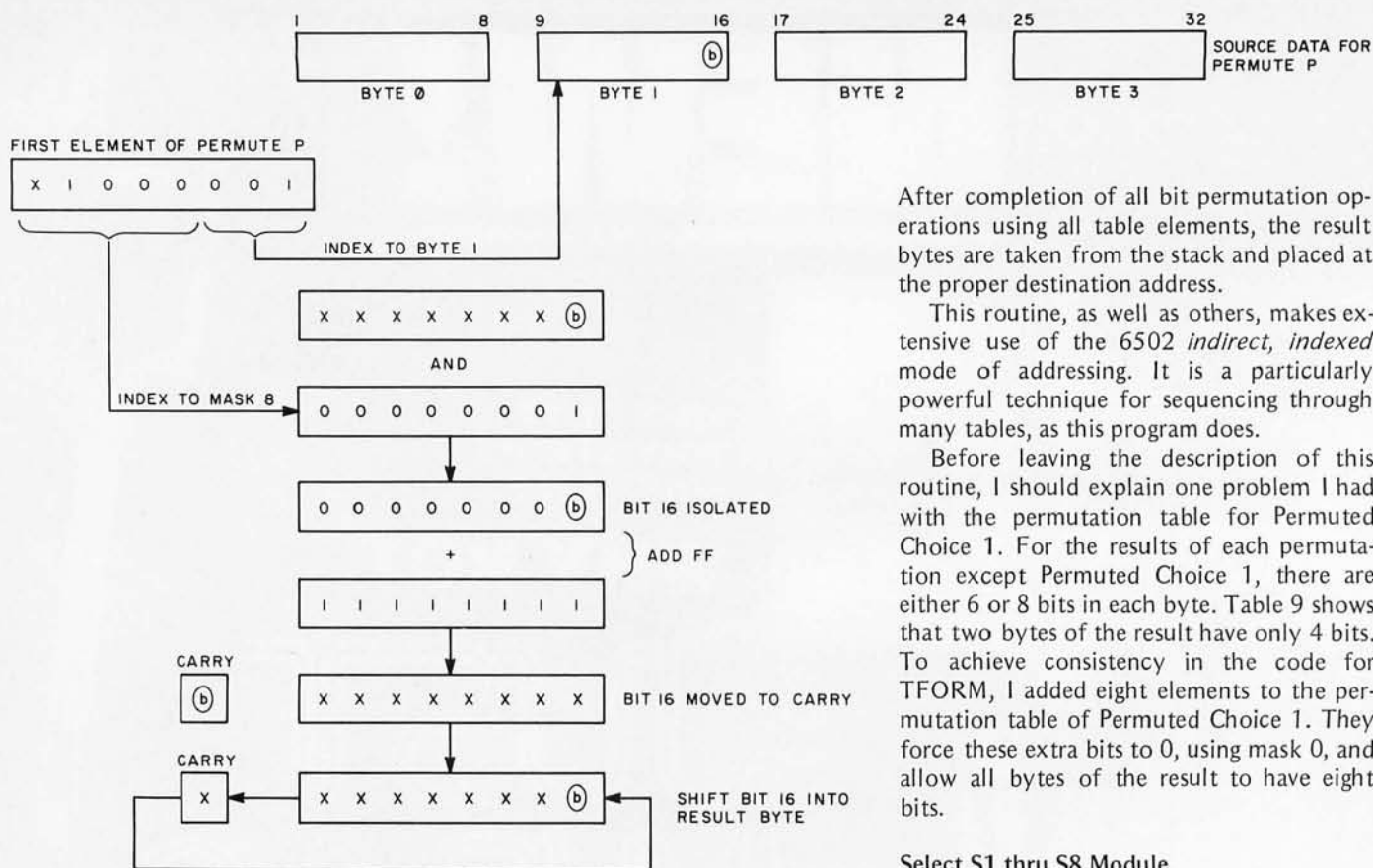


Figure 9: Example of permutation operation being used to obtain first bit of Permute P result.

ANDed with mask 8. Once the bit is isolated, it is forced into the carry bit by first clearing the carry bit and then adding hexadecimal FF. The value of the carry bit is then shifted into the result byte.

The process described above is continued for all the elements of the permutation table. The number of bits in each result byte is controlled by BCOUNT. Each result byte is temporarily stored on the program stack.

After completion of all bit permutation operations using all table elements, the result bytes are taken from the stack and placed at the proper destination address.

This routine, as well as others, makes extensive use of the 6502 *indirect, indexed* mode of addressing. It is a particularly powerful technique for sequencing through many tables, as this program does.

Before leaving the description of this routine, I should explain one problem I had with the permutation table for Permuted Choice 1. For the results of each permutation except Permuted Choice 1, there are either 6 or 8 bits in each byte. Table 9 shows that two bytes of the result have only 4 bits. To achieve consistency in the code for TFORM, I added eight elements to the permutation table of Permuted Choice 1. They force these extra bits to 0, using mask 0, and allow all bytes of the result to have eight bits.

### Select S1 thru S8 Module

As described before, the Select S1 thru S8 function transforms groups of six bits into groups of four bits according to tables S1 thru S8. Table 9 shows that each group of six bits is contained in one byte of source data. Figure 10 shows the organization of the data for the tables S1 thru S8.

In order to transform each 6 bit source group into the proper 4 bit result group, you must generate an *index* into the segment containing the S1 thru S8 data. As seen in

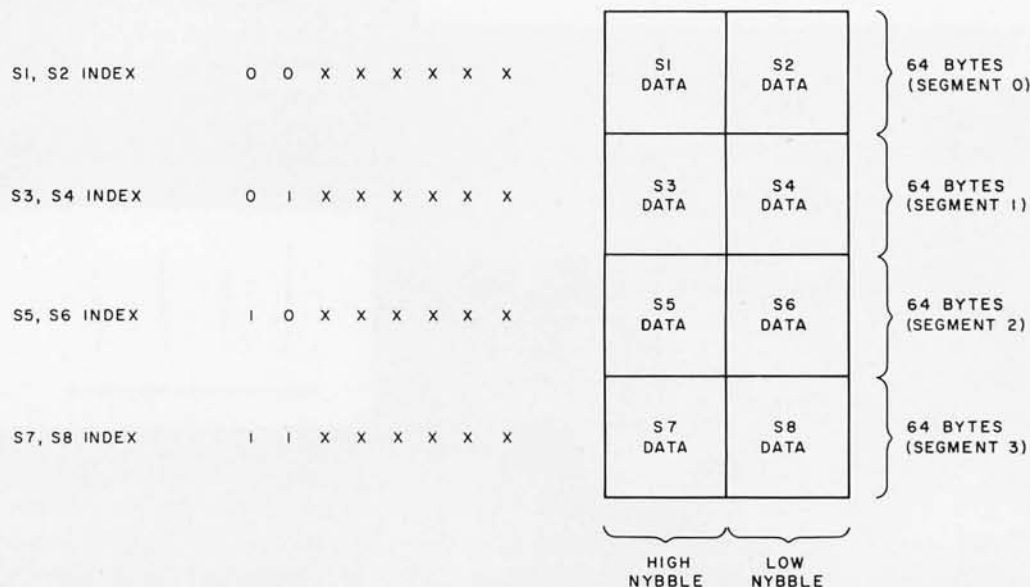


Figure 10: Table organization for Select S1 through S8 data.



# Some plain words about Word Processing

Microtronix introduces the "Turnkey" Word Processing Package for \$2150



Simply put, Word Processing is a system that treats text as a steady stream of characters. Think of it as a form of paperless typing that enables you to compose, edit, and store large amounts of text. Just punch in the copy, edit and print. It's really that simple.

## Word Processing: The Keyword is Flexibility.

Paperwork: It's expensive not only in time and money, but in space as well. Cutting through the wads of paperwork is what Word Processing is all about.

- Correspondence Direct mail, questionnaires, press releases, sales proposals, and announcements.
- Academic Graduate theses, literary manuscripts, and research notes.
- Legal Documents Leases, wills, and briefs.
- Accounting Ledger and journal entries, billings and invoices, collection letters, and monthly statements.

Type that standard form and save for future use on audio cassette (included) or optional disc drive. Add variable information and with the press of a button your final copy is printed.

## The \$8000.00 word Processing Package at a fraction of the cost.

You've read about Lanier Word Processing, and IBM's Mag Card Unit. Now think practical. Here's a system that performs on a par with the "biggies" that is tailored to your budget.

### The System

**Radio Shack TRS-80 Level I with 16K memory.** Serviceable at any local Radio Shack Store . . . \$799

**Anderson-Jacobson 841 Serial Printer.** The "State of the Art" bidirectional terminal containing a heavy duty IBM 745 Selectric. An excellent "off-line" typewriter as well. . . . \$1195.00

**"The Electric Pencil" - Software.** Designed for the TRS-80. Features include correction, insertion and deletion of letters, words, lines, and paragraphs. Contains user defined output format. Add \$50. for disk base version. . . . \$99.95

**TRS-232 Interface - To connect your TRS-80 to the Anderson-Jacobson 841.** No expansion interface needed . . . . . \$49.95

Pick up the phone and call our toll-free number. Talk to us about options. We can adapt a Word Processing Package to your present system.

## Other Equipment

**Special Sale on Printers: Save \$50 to \$150.**  
Integral Data IP/125 . . . . . \$749  
IP/225 Tractor . . . . . \$899  
Anadex DP 8000 Bi-directional Tractor . . . \$995  
Texas Inst. 15" Bi-directional Tractor . . . \$1895

**Micropolis Disk Drive for the TRS-80**  
1027-I Expands storage capacity to 89K or approximately 15,000 words per diskette. . . . \$499  
1037-II Double density dual unit. 77 tracks 400 K. . . . . \$1195

**Modems**  
Novation (Radio Shack) "Cat" send/receive with free software. . . . . \$199.95

## Discounts on TRS-80 Hardware Extensive Software available

Write for our free catalog. Major credit cards accepted.

**Toll Free Microline**  
800-532-4550  
In Penna. and Can(215)665-1112

Microtronix  
P.O. Box Q  
Phila. Pa. 19105

microtronix

Microtronix Price Match Policy: We will match any currently advertised price providing the item is in stock. Shipping/handling: Software - \$2.50 initial chg. \$ .50 each additional item. Add \$2.00 for Air Service in the following states: AL, AK, AR, CA, FL, GA, HI, ID, IL, IN, IA, KS, KY, MI, MN, MT, NE, NV, NM, ND, OR, TN, TX, UT, WA, WI, WY. Hardware-call for details. Pa. res. add 6%. All products subject to availability and guaranteed by the manufacturer.

Circle 226 on inquiry card.



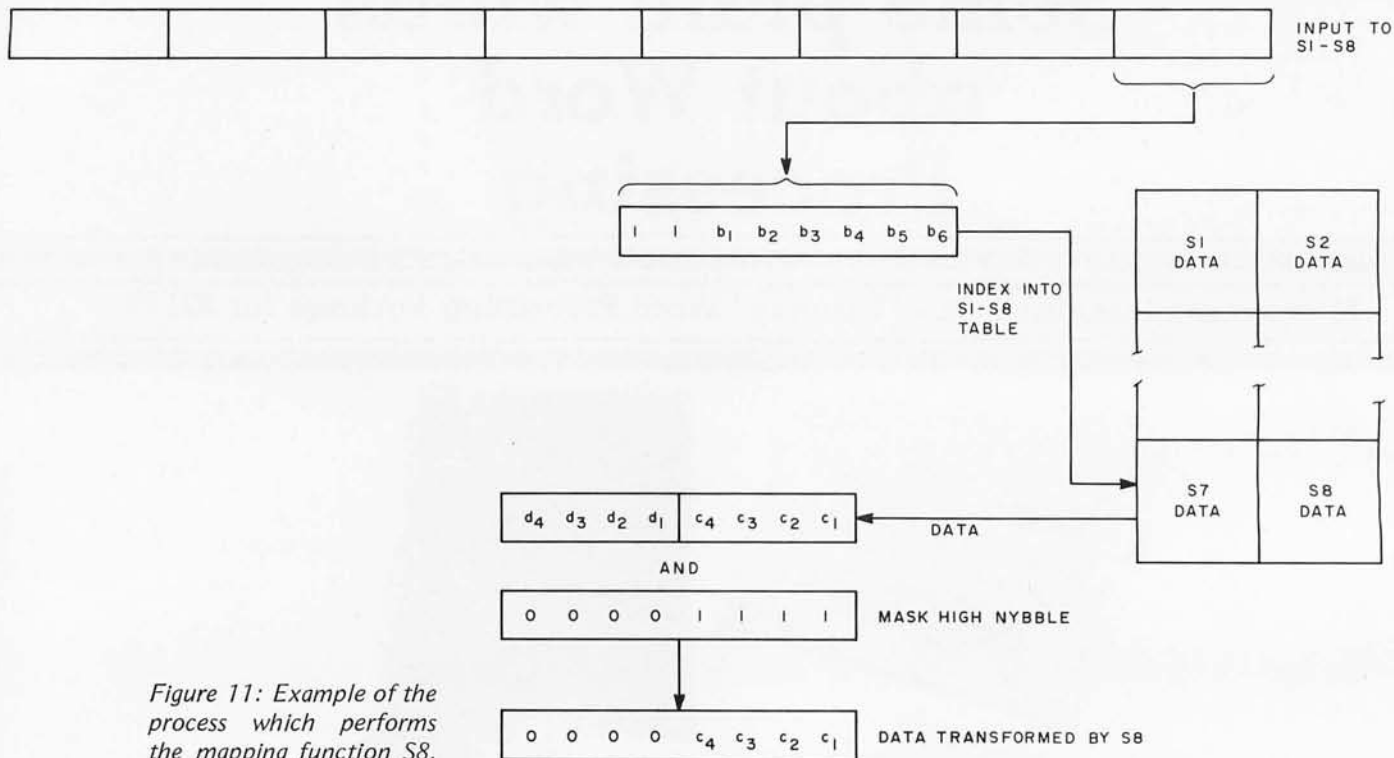


Figure 11: Example of the process which performs the mapping function S8.

figure 10, the index into each individual table is controlled by bits 6 and 7 of the index byte.

Let's examine how to map the last byte of the source data using S8. Figure 11 shows that the low order 6 bits from the source byte are used to select a byte from the 64 bytes in the S7, S8 segment. To access the correct 64 byte segment (S7, S8) we force the two high order bits to 11. The resulting byte is used as an index into the table. If you mask the high 4 bit word of the accessed byte (which also contains S7 data), the proper S8 data is selected. Of course, the table data must be properly ordered within S8, but that's fairly easy.

In order to carry out the other transformations, you proceed in a similar fashion. The only changes would be the two high order bits used to index the proper segment of the table, and whether you mask the low or high nybble.

A general flowchart of this module is provided in figure 12.

#### ROTATE Module

As I said before, I decided to generate each subkey as I needed it. To generate subkeys  $K_1$  thru  $K_{16}$ , it is necessary to perform left rotations of  $C_i$  and  $D_i$  and then perform Permuted Choice 2 as shown in part 1. The number of left shifts is determined by using the iteration count, LOOPCT, as an index into the table SHIFTM. This module is

relatively straightforward except for the problem caused by the half byte boundary shown in figure 13.

A second problem arises in the case of decryption. In this case, the subkeys must be generated in reverse order (ie:  $K_{16}$  thru  $K_1$ ). In order to generate them properly, the rotation of  $C_i$  and  $D_i$  is done by right shifting and by using the SHIFTM table in reverse sequence and by performing Permuted Choice 2 *before* the right rotation is done. This may seem strange, but I gave it a great deal of thought to make sure it was right. It is the simplest way that I could devise to do the decryption correctly, and it works!

#### What's Left?

The only remaining module is the one which swaps two groups of four bytes each. This module is called SWAP, and it performs the swap function and block transform function discussed in Part 1.

#### Put Them All Together

The main module, DES is really a master controller for the other modules. It initializes the parameters used by TFORM, performs the appropriate modulo 2 additions shown in table 8, makes sure that subkeys are properly generated during encryption and decryption, and maintains the iteration count. Figure 14 is a general flowchart for this module.



**WHEN THE FUN AND GAMES ARE OVER,** you shouldn't have to gamble on your microcomputer's ability to get down to business. You won't with **Outpost 11**. It's a serious unit with quality components: Cherry, full ASCII keyboard; Setchell-Carlson CRT, 24 x 80 characters, 7 x 9 dot matrix; inverse, grey, blink; form generation characters; Shugart floppy disk drives; M6800 CPU; 32 k bytes RAM; glass-epoxy PC boards, manufactured and tested to Mil Q 9858-A; entire unit 100-hour burn in tested; IC's tested to Mil P 883; I/O interrupt prioritizing structure; soft-sectored disk format; business BASIC; self diagnostics; software development packages; etc; etc; etc. All this and more at only \$2,595, suggested retail price. See **Outpost 11** at a dealer listed or write us for the name of a dealer near you.

**TANO** Corporation, 4301 Poche Court West,  
New Orleans, La. 70129



## THE SERIOUS MICROCOMPUTER



Dealers: DALLAS, Eclectic Corp. — 214-358-1307 • GREENVILLE SC, Plus, Inc. — 803-242-9090 • HOUSTON, Eclectic Corp. — 713-228-7798 • IDAHO FALLS ID, Great Plains Computer Co. — 208-526-9051 • NEWORLEANS, TANO — 504-254-3500 • SALT LAKE CITY UT, Home Computer Store — 801-484-6502 • SEATTLE, Empire Electronics — 206-244-5200. Dealer inquiries invited — 504-254-3500. TWX 810-591-5229.



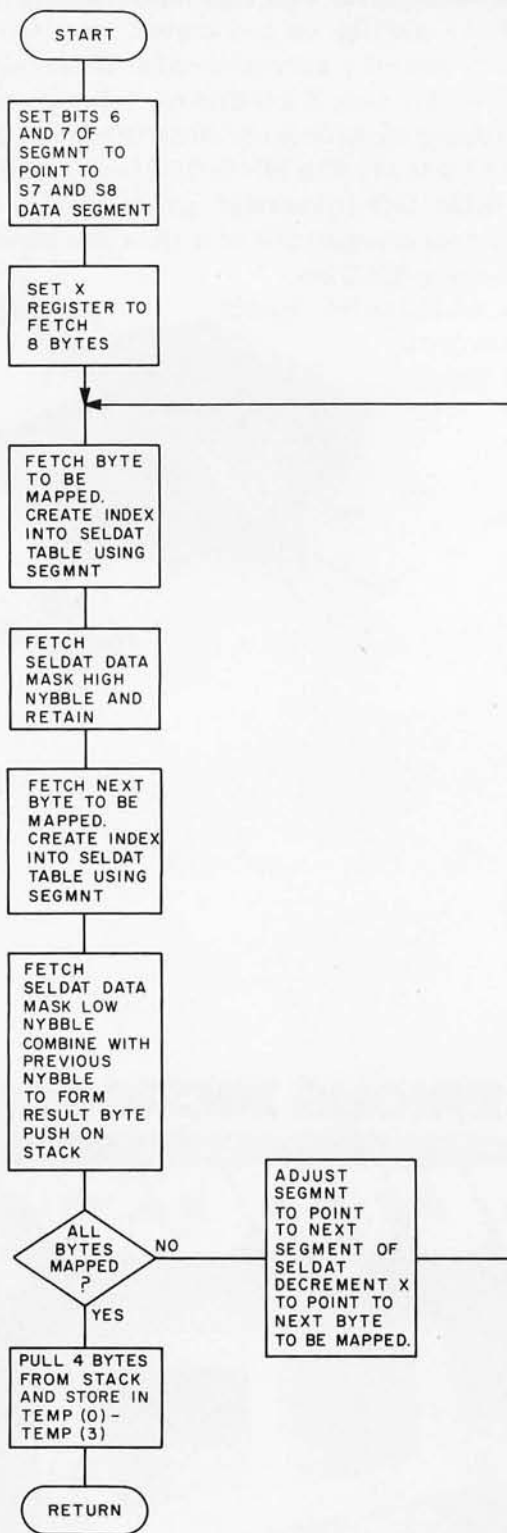


Figure 12: Flowchart of module which performs the select S1 through S8 mapping function SELECT.

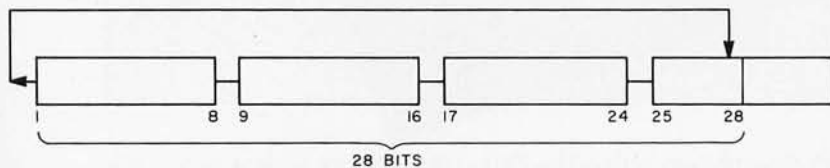


Figure 13: Rotation of the bits in  $C_i, D_i$  requires special attention to bit 28 because it is in the middle of a byte.

The only particular point worth noting is that the parameters used by TFORM to perform the proper permutation are stored sequentially in the order used. The order of the information in the table DATA is:

- Initial Permutation data
  - Permuted Choice 1 data
  - Permuted Choice 2 data
  - Select E data
  - Permute P data
  - Inverse Initial Permutation data
- } 16 iterations

Once the Initial Permutation and Permuted Choice 1 are performed, the DES routine sequences TFORM thru Permuted Choice 2, Select E, and Permute P, for 16 iterations. Then TFORM performs the inverse Initial Permutation to complete the encrypt or decrypt operation.

### Using the Program

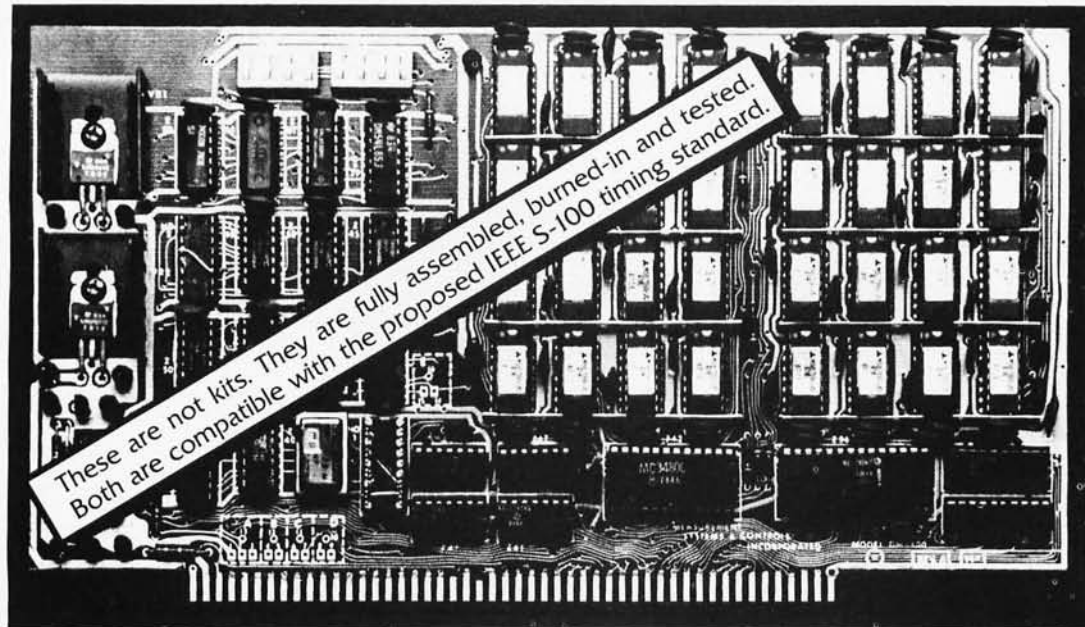
The Standard Data Encryption Algorithm program is written as a subroutine which can be called at hexadecimal address 0176. In order to use the routine, three things must be supplied: mode, plaintext, and key. The mode byte (location 0000) is set to 00 for encryption or FF for decryption. The plaintext is 8 bytes of data (locations 0001 thru 0008) which is to be encrypted or decrypted. The key is eight random bytes provided by you (locations 0009 thru 0010) to control the algorithm. The encrypted (or decrypted) result is returned to locations 0001 thru 0008.

A call to DES uses 12 bytes of stack storage. If your other programs use the stack, you should take care to avoid overwriting the main routine. Many of the page zero locations used by DES may be used for other purposes between calls. These hexadecimal locations are 0011 thru 002C and 0038 thru 0040. A memory map of the entire program is shown in figure 15.

When the encryption key is loaded, you should make sure that the bits are nearly as random as possible, since it is the randomness of the key which makes it difficult for an outsider to decrypt the cipher. If you attempt to load ASCII characters as key, it is likely that the most significant bit of each byte will be zero. This will substantially reduce the strength of the algorithm. An alternate way to handle the key is as 16 ASCII characters, with random contents in the four low order bits. The four low order bits of these characters can be compacted to form the eight bytes of key which the algorithm requires.

Text continued on page 124.





64K bytes of fast, low power dynamic RAM.

**\$695<sup>00</sup>**

32K bytes of faster static RAM.

**\$595<sup>00</sup>**

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 — \$695<sup>00</sup>
  - DM4800 48K RAM — \$595<sup>00</sup>
  - DM3200 32K RAM — \$495<sup>00</sup>

- UNCommon Static RAM
- SM3200 32K RAM — \$595<sup>00</sup>

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



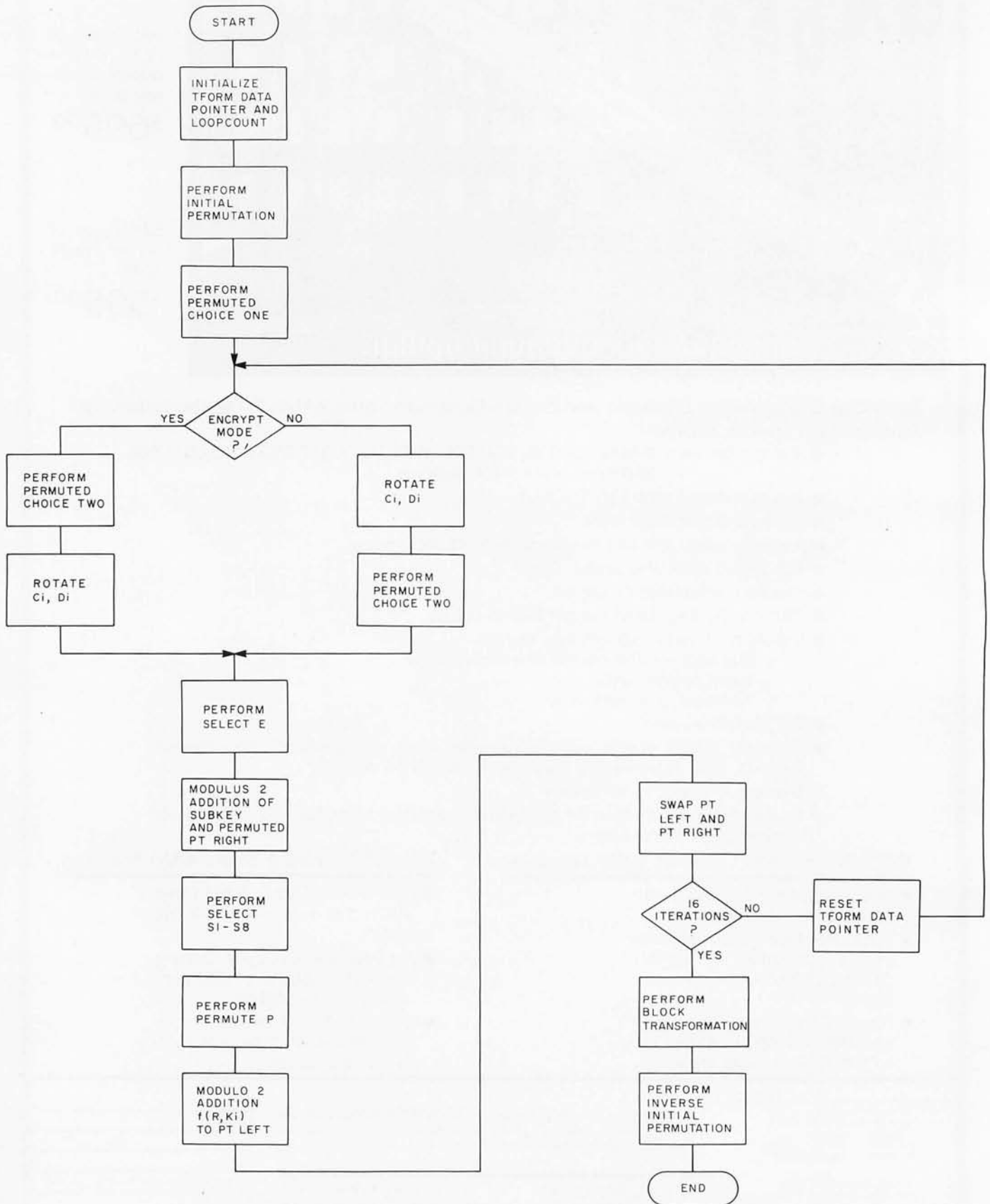


Figure 14: Flowchart of the main routine for the Standard Data Encryption Algorithm.







		CLC		} Initialization	
		LDA	\$00		
		STA	WORD 1		
		STA	WORD 2		
		STA	WORD 3		
		.	.		
		.	.		
		STA	WORD 8		
2 bytes	3 cycles	LDA	SOURCE 1		} Basic in line coding to permute one bit
2 bytes	2 cycles	AND	\$XX		
2 bytes	2 cycles	ADC	\$FF		
2 bytes	5 cycles	ROL	WORD 1		
8 bytes	12 cycles	LDA	SOURCE 2		
total	total	AND	\$XX		
		ADC	\$FF		
		ROL	WORD 1		
		.	.		
		.	.		

Table 10: 6502 instructions which could be used in line code the permutation function. Fastest time to permute one bit requires 12 cycles and 8 bytes of memory.

Key	Plain	Cipher
7CA110454A1A6E57	01A1D6D039776742	690F5B0D9A26939B
0131D9619DC1376E	5CD54CA83DEF57DA	7A389D10354BD271
07A1133E4A0B2686	0248D43806F67172	868EBB51CAB4599A
3849674C2602319E	51454B582DDF440A	7178876E01F19B2A
04B915BA43FEB5B6	42FD443059577FA2	AF37FB421F8C4095
0113B970FD34F2CE	059B5E0851CF143A	86A560F10EC6D85B
0170F175468FB5E6	0756D8E0774761D2	0CD3DA020021DC09
43297FAD38E373FE	762514B829BF486A	EA676B2CB7DB2B7A
07A7137045DA2A16	3BDD119049372802	DFD64A815CAF1A0F
04689104C2FD3B2F	26955F6835AF609A	5C513C9C4886C088
37D06BB516CB7546	164D5E404F275232	0A2AEEAE3FF4AB77
1F08260D1AC2465E	6B056E18759F5CCA	EF1BF03E5DFA575A
584023641ABA6176	004BD6EF09176062	88BF0DB6D70DEE56
025816164629B007	480D39006EE762F2	A1F9915541020B56
49793EBC79B3258F	437540C8698F3CFA	6FBF1CAFCD0556
4FB05E1515AB73A7	072D43A077075292	2F22E49BAB7CA1AC
49E95D6D4CA229BF	02FE55778117F12A	5A6B612CC26CCE4A
018310DC409B26D6	1D9D5C5018F728C2	5F4C038ED12B2E41
1C587F1C13924FEF	305532286D6F295A	63FAC0D034D9F793

Table 11: Sample test words for the Standard Data Encryption Algorithm.

Text continued from page 120:

Data encrypted using the Standard Data Encryption Algorithm will be decrypted properly as long as the correct 8 byte boundaries are maintained. This allows you to independently decrypt 8 byte blocks of data in memory. There are other ways of using the encryption algorithm which require data to be decrypted in the same sequence as it was encrypted. If you are interested in adapting DES to these other techniques, you should refer to textbooks dealing with cryptography.

As a final note in using the encryption

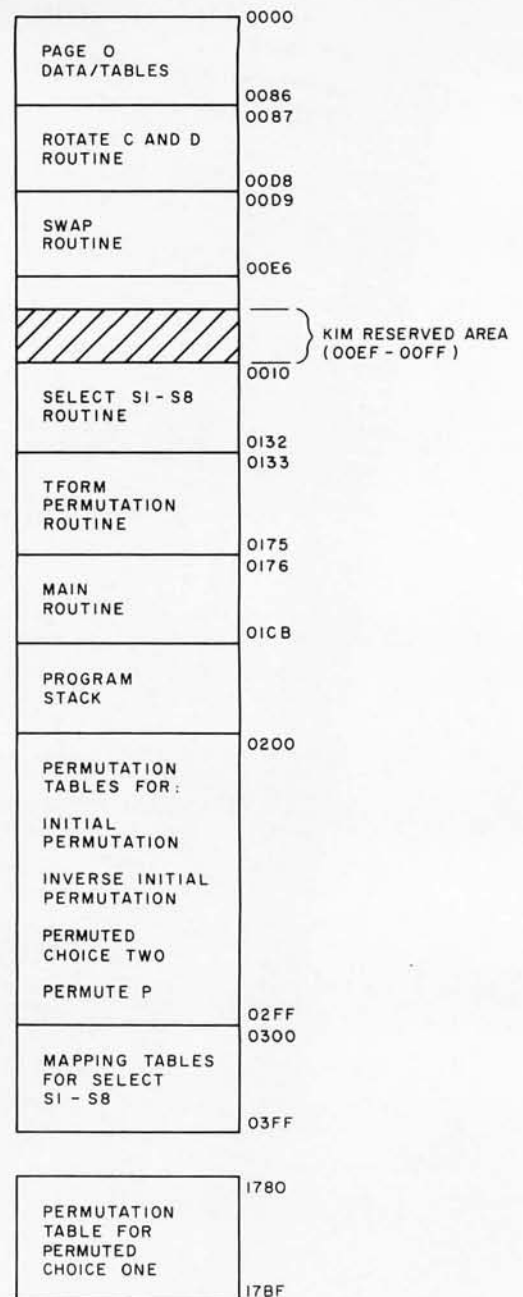


Figure 15: Memory map for the Standard Data Encryption Algorithm program.

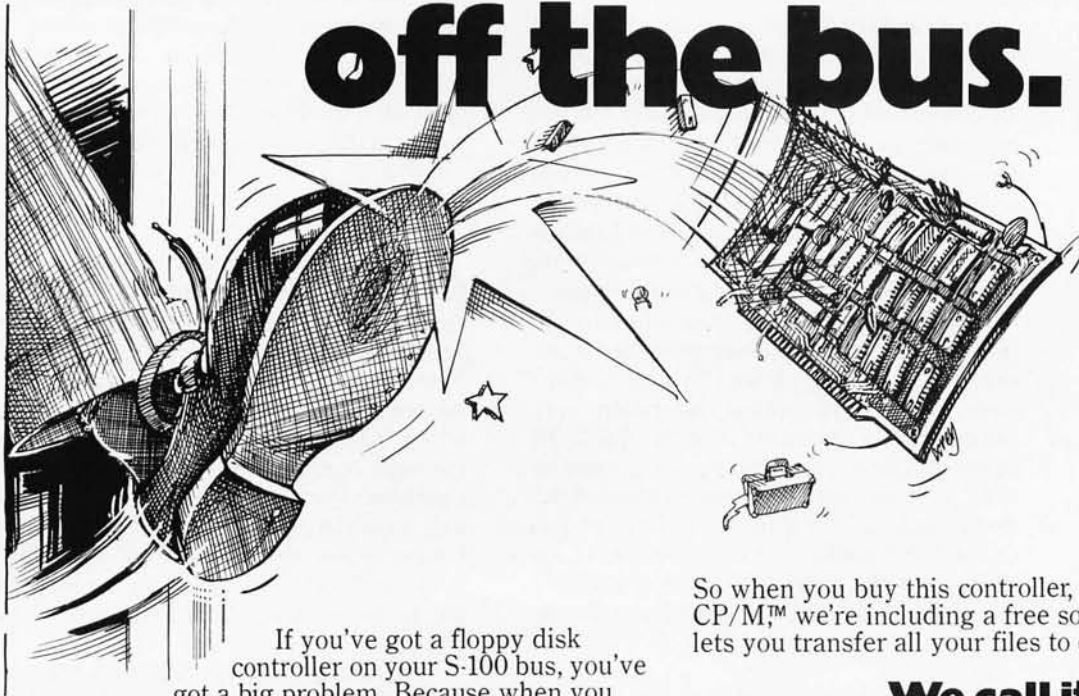
program, all of the routines, permutation and selection tables, and TFORM input parameter tables (array DATA) may be relocated by altering a small number of address references.

### Timing Analysis

One of my primary objectives in programming the Standard Data Encryption Algorithm was to determine the efficiency of the 6502 processor in handling a task which requires lots of bit manipulation. In order to determine the efficiency of the implementation, I calculated the approx-



# At last. A controller you'll never have to throw off the bus.



If you've got a floppy disk controller on your S-100 bus, you've got a big problem. Because when you want to upgrade your system from single to double density, or from single-sided to double-sided, or from 5" to 8" floppy, you'll have to throw that old controller off the bus.

But not any more you don't. Because at DATASPEED, we've developed one controller that works with all four kinds of floppy disk drives. And doubles the density, too.

## Works with all floppy disk drives.

Single-sided minifloppys.<sup>TM</sup> Double-sided minis. Single-sided maxis. Even the new double-sided maxis with up to 8 megabytes. This is the only controller in the world that works with all four.

## Handles any upgrade.

When you want to go from single-sided to double-sided drives, this great new controller reads each side automatically. And you can upgrade from 5" to 8" disks just by changing a simple Header socket.

## Packs in twice the data.

Now you can pack double density data on every side of every disk. Because we've designed in a bootstrap PROM that automatically controls any shift from single to double density. And, of course, when you're running double density, you can transfer data in half the time.

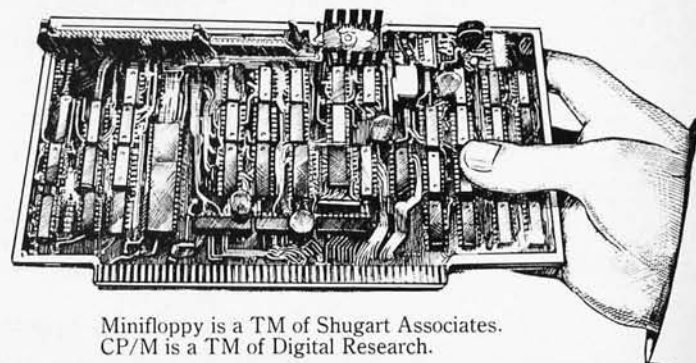
So when you buy this controller, and a compatible CP/M<sup>TM</sup> we're including a free software package that lets you transfer all your files to double density.

## We call it The Conductor.

The DATASPEED Floppy Disk Controller. It handles all your upgrades. It packs in twice as much. And at only \$295, it's even the cheapest way to go. That's why this is one controller you'll never have to throw off the bus. And that's why we had to call it The Conductor. Ask for it at your local computer shop or send \$295 for immediate delivery. By the way, we have Double-Density CP/M<sup>TM</sup> for only \$100. Complete disk drive systems are available.

Write us for more information. Dealer inquiries welcome. And watch our future ads for trade-in offers. DATASPEED, INC., 1302 Noe Street, San Francisco, CA 94131.

## THE CONDUCTOR<sup>TM</sup>



Minifloppy is a TM of Shugart Associates.  
CP/M is a TM of Digital Research.



imate number of machine cycles spent in each module during one encryption cycle. The cycle times which I used for each instruction were taken from the data provided by MOS for the 6502. My calculations revealed the following times:

DES (Main) Routine	—	4300 cycles
Rotate	—	1900 cycles
Select S1-S8	—	7500 cycles
TFORM	—	146000 cycles

This indicates that over 90 percent of the time is spent in the module TFORM. These calculations also indicate that the total encryption time is approximately 160 ms; assuming the 1  $\mu$ s cycle time of the KIM-1. In order to verify these calculations, I timed a loop which performed 256 encryption operations. The observed execution time was 164 ms. Not bad for a rough estimate. Maximum throughput would be about 390 bps.

I next wondered what maximum throughput could be achieved, given unlimited memory. The two most obvious changes to make were to perform subkey generation only once, and to optimize TFORM. Table 10 shows the basic instructions which could be used to code the basic permutation functions, such as Permute P in line. It also shows the number of machine cycles required and the number of bytes of memory required. These changes would reduce the

number of cycles spent in TFORM to about 16900. The time for one encryption cycle would be reduced to about 31 ms, and maximum throughput would increase to 2000 bps. Memory requirements would increase to about 3500 bytes.

It is clear that although the 6502 can perform at a reasonable rate, its instruction set is not well suited to high speed implementation of the Standard Data Encryption Algorithm. If bit test instructions were available, similar to those of the Zilog Z-80, it would theoretically be possible to reduce the time spent in TFORM by 50 percent. It would then make sense to speed up the other routines. I would not be surprised if throughputs of 8,000 to 10,000 bps were possible.

## Conclusions

I have demonstrated that the Standard Data Encryption Algorithm can be implemented on the basic KIM-1 with reasonable performance. However, it is clear that the instruction sets available for most processors are not well suited to an efficient implementation of the algorithm. It is also clear that the basic functions necessary to perform the algorithm (ie: bit permutations) are not well suited to implementation in software. I have shown that an increase in memory to about 3500 bytes will allow the throughput to be increased from 390 bps to about 2000 bps.

I have attempted to present a coherent description of the Standard Data Encryption Algorithm for those readers who may be interested in reprogramming it. Table 11 provides a set of test words to verify your implementation. These test words are part of those available from National Bureau of Standards Special Publication 500-20.

The coding of my encryption program is provided in listing 1. For anyone interested in obtaining a KIM compatible cassette with the Standard Data Encryption Algorithm program, several driver routines for Teletype and keypad, a shortened version of the program, and complete documentation, send \$6 to R Meushaw, 4188 Brittany Dr, Ellicott City MD 21043.

## REFERENCES

*Data Encryption Standard*, FIPS Publication 46, US Department of Commerce/National Bureau of Standards, 1977.

*Validating the Correctness of Hardware Implementations of the NBS Data Encryption Standard*, NBS Special Publication 500-20, US Department of Commerce/National Bureau of Standards, 1977.

Katzan, H, *The Standard Data Encryption Algorithm*, Petrocelli Books Inc, New York, 1977.

Listing 1: The DES program implemented on the basic KIM-1 module.

```

*****
*
* MICRO - DATA ENCRYPTION STANDARD PROGRAM *
*
* BY *
* ROBERT V. MEUSHAW *
*
* (ENTRY 0176) *
*****

0087          ORG          $0087

          *****
          MEMORY LOCATIONS
          *****

0087  MODE * $0000          ENCRYPT/DECRYPT MODE
0087  PTL  * $0001          PT(LEFT) START
0087  PTR  * $0005          PT(RIGHT) START
0087  KEY  * $0009          KEY START
0087  TEMP * $0011          TEMPORARY STORAGE
0087  SUBKEY * $0019        SUBKEY START
0087  CD1  * $0021          START OF C(I)
0087  CD2  * $0022
0087  CD3  * $0023
0087  CD4  * $0024
0087  CD5  * $0025          START OF D(I)
0087  CD6  * $0026
0087  CD7  * $0027
0087  CD8  * $0028
0087  LOOPCT * $0029        ITERATION COUNT
0087  BITCNT * $002A        # BITS PER WORD
0087  SEGMENT * $002A       DATA POINTER FOR S1-S8
0087  HOLD * $002B          TEMPORARY STORAGE

```

Listing 1 continued on next page.



16K BYTES OF MEMORY, SPEECH,  
ACTION SOUNDS, MUSIC  
AND COLOR



FCC, CSA  
AND UL APPROVED

FREE  
\$300. WORTH OF  
14 PROGRAMS—INCLUDING  
EDU-BASIC AND LEVEL 2 BASIC.

Two years ago we wrote a piece on the most startling product of the decade. The first personal computer. It actually brought the miracle of computing power within reach of small businesses. At less than \$1000, it was even affordable for home use.

That was two years ago. Today, that same unit, and other second and third generation models are still being sold. Enter now Interact's fourth generation American-made personal computer with total sound, color, 16,000 bytes or words of usable memory, and superb ease of handling at hundreds of dollars less than any comparably equipped computer.

#### GIANT COMPUTER HARDWARE

Beneath its cover is the Intel 8080<sup>®</sup> micro-processor brain—a powerful logic component used in computers costing tens of thousands of dollars. Interact loads data up to 5 times faster than most other compacts. Its 8080 brain does all of the complex data saving, processing and retrieval chores. All that's left is typing in the data through the 9 inch, 53-key standard typewriter keyboard.

#### WHY IT COSTS LESS

Since the unit performs in **color**, it is designed to hook up to any TV antenna terminal. If we included a color screen (CRT), we'd have to charge more. Witness the 16K Radio Shack Model. It's only black and white, and with its screen that isn't even a TV, it costs \$899.00. Ours, with full sound and color is several hundred dollars less. Interact **full sound** is generated three ways: There are game action sounds from the microprocessor, tunes within the programs and actual speech and music from any cassette software. *In fact, it is the only computer able to transmit full sound through a TV. Image resolution is superb.*

#### THE MOST EFFICIENT BUSINESS TOOL EVER

Interact<sup>®</sup> comes ready to handle a wide range of business applications. Its Level II Basic, and 16K byte system capacity give you the instruction set and the room to write your own programs for payroll, inventory, client records, etc. For accountants, attorneys, doctors, salespeople, and small businesses, *it's a lot of computer for very little money.*

For the enlightened computer expert, our Level II Basic is Interact's version of the Microsoft<sup>™</sup> and is equivalent to all Level II programs currently available. The program includes: a super-set of operations in floating point with integer and string arrays, direct memory access, direct statement execution, two character variable names, user definable functions, multi-statement lines, editing, scrolling, file management, and more.

#### AN INCOMPARABLE SCHOOL TEACHER

Since it can talk, play music and perform in color, Interact is a phenomenal teacher.

That's why High/Scope, an educational research foundation, was commissioned to develop an exclusive Language Arts program for it. The 8-unit program ranges from Letter Recognition for preschoolers through Word Root, Grammar, Critical Reading and Writing exercises for the 8 to 15 year old. Students listen, take notes and prepare assignments through the computer. Similar math and foreign language programs are also being prepared. By comparison, *any one of these courses given by a tutor or commercial school could easily cost as much as the computer itself.*



#### IT'S A BRILLIANT MUSIC TEACHER

A comprehensive music program and a piano keyboard overlay turn the computer into a perfect pitch maestro. You can practice, write a tune or record. To create a melody, you can select both key and tempo. A staff is displayed on which to write your song, note by note, complete with rests and values. Play the composition back; correct any note; instantly transpose it to another key; or store it on a blank cassette for later revision. A student can listen to his lesson and transpose it into another key for use with F, B<sup>b</sup>, E<sup>b</sup> horns, etc. The youngster then plays along in the right key, in the correct meter. *It's a fantastic application.*

#### OF COURSE, IT PLAYS GAMES

Interact is a total entertainment center with color, sound, and music. There are Chess, Backgammon, Hangman, Regatta Races, Concentration, Trailblazers, Blackjack, Star Track—games that would cost any arcade owner \$2000 or more. Challenge the computer or another opponent. Each game will bring family and friends together for hours of quality fun.

#### FCC AND CSA APPROVED FOR YOUR TV

The Interact computer, with built-in storage and programmability, is FCC and CSA approved for attachment to any TV. It is UL listed and operates on standard 110V household current. It's portable, too: weighs 12 pounds and is only 19" L x 12" W x 8" D.

# If you're thinking about a Home Computer, make sure it's not just a game

**SPECIAL OFFER—OVER \$300 WORTH OF FREE PROGRAMS—INCLUDING LEVEL II** Interact is exceptional. But, there is just no way to prove it, unless you are enjoying it in your own home and business. You have to try it. That's why we are giving you 14 different full color and sound programs **FREE**—including **Edu-Basic** and the **Basic Level II** program for advanced applications. It's our way of backing up everything we've said and making it worth your while to check it out for yourself. Your \$300 **FREE** value includes:

**Edu-Basic<sup>™</sup> • Level II Basic • Blackjack • Compute-A-Color<sup>™</sup> • Hangman<sup>™</sup> • Knockdown<sup>™</sup> • Trailblazers<sup>™</sup> • Dogfight<sup>™</sup> • Showdown<sup>™</sup> • Regatta<sup>™</sup> • Concentration • Add-Em-Up<sup>™</sup> • Computer Maze<sup>™</sup> • Biorhythm<sup>™</sup> and 1 Blank Data Tape.**

Fourteen programs are actually more than other computers have to offer. They're yours **FREE** with your purchase of the Interact. If, after 15 days you are not satisfied with your Interact, you may return it for a prompt refund of the purchase price. Sorry, but you'll have to return the 14 programs and the data cassette also. The unit is backed by a ninety-day parts and labor limited factory warranty.

CREDIT CARD ORDERS CALL TOLL FREE

**800-621-5809**

ILLINOIS RES: 800-972-5858

24 HOURS - 7 DAYS/WEEK

Please send me the Interact Computer, with 2 Hand Controls, connecting RF adapter and the 14 Free Program Library—including Basic Level II and 1 Blank Data Tape. If not satisfied, I can return same for a prompt refund within 15 days.

I enclose \$588.00 plus \$17.95 shipping and insurance. Allow 2-3 week delivery.

(Ill. residents add 5% tax.)

I also want the following programs:

StarTrack ..... \$24.95  
 MicroChess (vs. computer) ..... \$24.95  
 VideoChess (vs. opponent) ..... \$19.95  
 Backgammon ..... \$24.95  
 Reversi ..... \$19.95  
 Music Maestro ..... \$24.95

Total amount enclosed \$ \_\_\_\_\_

Check  Money Order

Charge My Credit Card:

American Express  Master Charge  Carte  
 BankAmer/Visa  Diners Club  Blanche

Credit Card No. \_\_\_\_\_

Master Charge # \_\_\_\_\_ Exp. Date \_\_\_\_\_

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_

Signature \_\_\_\_\_

B4

© Camelot 79

801 Green Bay Rd., Lake Bluff, IL 60044

**Camelot DIRECT**  
A DIVISION OF UNITED EDUCATORS, INC.



Listing 1, continued:

```

0087 POINT * $002C          POINTER FOR TFORM DATA
0087 SELDAT * $002D        SI-S8 DATA ADDRESS
0087 MASK * $002F          BIT MASK ARRAY START
0087 INFO * $0038          START OF TFORM DATA
0087 SOURCE * $003A        SOURCE DATA ADDRESS
0087 DEST * $003A          DESTINATION DATA ADDRESS
0087 PERMUT * $003C        PERMUTE ARRAY ADDRESS
0087 PCOUNT * $003E        PERMUTE ARRAY LENGTH
0087 BCOUNT * $003F        # BITS PER WORD
0087 WCOUNT * $0040       # WORDS IN DESTINATION
0087 DATA * $0041        DATA FOR PROPER TFORM
0087 SHIFT * $0047        ROTATE DATA FOR C(I),D(I)

```

```

*****
ROTATE CD SUBROUTINE
*****

```

```

0087 R6 29          ROTATE LD% LOOPCT
0089 24 00          BIT MODE
008B 30 24          BMI SRIGHT
008D B4 77          LDY SHIFTH,X
008F A5 24          SLEFT LDA CD4
0091 0A 29          ASL LDA CD4
0092 26 23          ROL CD3
0093 A 22          ROL CD2
0094 26 21          ROL CD1
0095 90 02          BCC SKP1
0096 09 10          ORA #10
0097 C 24          STA CD4
0098 A5 28          LDA CD8
0099 0A 27          ASL LDA CD7
009A 26 26          ROL CD6
009B 26 25          ROL CD5
009C 90 02          BCC SKP2
009D 09 10          ORA #10
009E 95 28          STA CD8
009F 0A 27          ASL LDA CD7
00A0 26 26          ROL CD6
00A1 26 25          ROL CD5
00A2 90 02          BCC SKP2
00A3 09 10          ORA #10
00A4 95 28          STA CD8
00A5 08 88          DEY
00A6 00 80          BNE SLEFT
00A7 8A 8A          TXR
00A8 49 0F          SRIGHT EOR #0F
00A9 AA          TAX
00AA B4 77          LDY SHIFTH,X
00AB A9 10          LDA #10
00AC 25 24          AND CD4
00AD 18          CLC
00AE 69 FF          ADC #FF
00AF 66 23          ROR CD3
00B0 66 24          ROR CD4
00B1 A9 10          LDA #10
00B2 25 28          AND CD8
00B3 18          CLC
00B4 69 FF          ADC #FF
00B5 66 25          ROR CD5
00B6 66 26          ROR CD6
00B7 66 27          ROR CD7
00B8 66 28          ROR CD8
00B9 88          DEY

```

Continued below:

```

013D B9 41 00 L5          LDA DATA,Y
0140 95 38          STA INFO,X
0142 88          DEY
0143 CA          BPL L5
0144 10 F7          STORE # BITS PER WORD IN
0146 A5 3F          LDA BCOUNT
0148 85 2A          STA BITCNT
014A A4 3E          LDY PCOUNT
014C B1 3C          LDA (PERMUT),Y
014E AA          PUT COPY IN X
014F 29 07          GET PROPER WORD #
IN Y
0151 A8          RETRIEVE ARRAY ELEMENT
0152 8A          AND ISOLATE BIT
0153 4A          MASK #. PUT IT IN
0154 4A          X REG.
0155 4A          TAX
0156 AA          LOAD SOURCE WORD
0157 B1 38          ISOLATE PROPER BIT
0159 35 2F          IF BIT IS 1, GET IT INTO
015B 18          CARRY AND MOVE INTO
015C 69 FF          ,HOLD,
015E 26 2B          ROL HOLD
0160 A5 2B          LDA HOLD
0162 C6 3E          DEC PCOUNT
0164 30 04          BMI EXIT
0166 C6 2A          DEC BITCNT
0168 00 DF          BNE L7
016A 48          PHA
016B 10 DF          BPL L6
016D A4 40          LDY WCOUNT
016F 68          PLA
0170 91 3A          STA (DEST),Y
0172 88          DEY
0173 10 FA          BPL L8
0175 60          RTS

```

```

*****
DES (MAIN) SUBROUTINE
*****

```

```

DES 0176 08          CLEAR DECIMAL MODE
0177 A9 FF          LDA FF
0179 85 2C          STA POINT
017B A9 0F          LDA #0F
017D 85 29          STA LOOPCT
017F 20 33 01       JSR TFORM
0182 20 33 01       JSR TFORM
0185 24 00          BIT MODE
0187 30 08          BMI SKP3
0189 20 87 00       JSR ROTATE
018C 20 33 01       JSR TFORM
018F 30 06          BMI SKP4
0191 20 33 01       JSR TFORM
0194 20 87 00       JSR ROTATE
0197 20 33 01       JSR TFORM
019A A2 07          LDY #07
019C B5 11          LDA TEMP,X
019E 55 19          EOR SUBKEY,X
01A0 29 3F          AND #3F
01A2 95 19          STA SUBKEY,X
01A4 CA          DEY
01A5 10 F5          BPL L10
01A7 20 00 01       JSR SELECT

```

Continued below:



```

PERFORM 'PERMUTE-P',
PERFORM MOD 2 ADDITION
OF PT(LEFT) AND
F( PT(RIGHT) )
STORE IN PT(LEFT)

EXCHANGE PTL AND PTR
DECREMENT LOOP COUNT,
EXIT IF DONE
ELSE ADJUST POINTER
FOR TFORM ROUTINE
AND CONTINUE
PERFORM 'BLOCK', TRANSFORM
PERFORM 'IP(INVERSE)',
DES COMPLETED

```

```

01A4 20 33 01 JSR TFORM
01A5 03 03 LDX #03
01A6 B5 01 LDA PTL,X
01A7 55 11 EOR TEMP,X
01B1 95 01 STA PTL,X
01B3 0A DEX
01B5 10 BPL L11
01B6 20 D9 00 JSR SWAP
01B8 C6 29 DEC LOOPCT
01B9 30 06 BMI FIN
01BF 49 11 LDA #11
01C1 85 2C STA POINT
01C3 D0 C0 BNE L9
01C5 20 D9 00 JSR SWAP
01C8 20 33 01 JSR TFORM
01CB 60 RTS

```

```

*****
PROGRAM DATA
*****

```

```

ADDR OF S1-S8 DATA
BIT MASK TO FORCE 0
BIT 1 MASK
BIT 2 MASK
BIT 3 MASK
BIT 4 MASK
BIT 5 MASK
BIT 6 MASK
BIT 7 MASK
BIT 8 MASK
IP DATA: SOURCE ADDR
DEST ADDR
PERMUTE ADDR
-LENGTH
DEST BITS/WORD
DEST # BYTES
PC-1 DATA:
PC-2 DATA:
SELECT-E DATA:
PERMUTE-P DATA:
IP(INVERSE) DATA:

```

```

0020 00 03
002F 00
0030 80
0031 40
0032 20
0033 10
0034 08
0035 04
0036 02
0037 01
0041 01 00
0043 01 00
0045 00 02
0047 3F
0048 08
0049 07
004A 09 00
004C 21 00
004E 80 17
0050 3F
0051 08
0052 07
0053 21 00
0055 19 00
0057 80 02
0059 2F
005A 06
005B 07
005C 05 00
005E 11 00
0060 60 02
0062 2F
0063 06
0064 07
0065 11 00
0067 11 00
0069 E0 02
006B 1F
006C 08
006D 03
006E 01 00
0070 01 00

```

```

0006 00 DF BNE LOOP
0008 60 RTS
GO TO LOOP
ELSE RETURN

*****
SWAP PT(LEFT)/PT(RIGHT) SUBROUTINE
*****

LDX #03
L2 LDA PTL,X
LDY PTR,X
STY PTL,X
STA PTR,X
DEX
BPL L2
CONTINUE UNTIL FINISHED,
THEN RETURN
RTS

```

```

*****
SELECT FUNCTION S1-S8 SUBROUTINE
*****

```

```

0100 ORG #0100
SELECT LDA #C0 STORE 11000000 TO ACCESS
STA SEGMENT CORRECT DATA SEGMENT
LDX #07 SET X TO TRANSFORM 8 BYTES
L3 LDA SUBKEY,X GET BYTE
ORA SEGMENT ADJUST INDEX INTO SELECT
TAY TRANSFORM MATRIX
LDA (SELDAT),Y GET MATRIX DATA
AND #0F MASK HIGH NIBBLE
STA HOLD STORE TEMPORARILY
DEX GET NEXT
LDA SUBKEY,X ADJUST INDEX INTO SELECT
ORA SEGMENT TRANSFORM MATRIX
TAY GET MATRIX DATA
LDA (SELDAT),Y GET MATRIX DATA
AND #0F MASK LOW NIBBLE
ORA HOLD COMBINE WITH PREVIOUS DATA
PHA AND PUSH ON STACK
LDA SEGMENT ADJUST POINTER INTO
SEC CORRECT DATA
SEGMENT
CONTINUE UNTIL ALL
BYTES TRANSFORMED
L4 PULL FOUR BYTES FROM
STACK AND PUT INTO
TEMP(0)-TEMP(3)
L5 STA TEMP,X
INX
CPX #04
BNE L4
RTS

```

```

0009 A2 03
000B B5 01
000D B4 05
000F 94 01
00E1 95 05
00E3 CA
00E4 10 F5
00E6 60

```

```

*****
TFORM PERMUTATION SUBROUTINE
*****

```

```

0100 ORG #0100
SELECT LDA #C0 STORE 11000000 TO ACCESS
STA SEGMENT CORRECT DATA SEGMENT
LDX #07 SET X TO TRANSFORM 8 BYTES
L3 LDA SUBKEY,X GET BYTE
ORA SEGMENT ADJUST INDEX INTO SELECT
TAY TRANSFORM MATRIX
LDA (SELDAT),Y GET MATRIX DATA
AND #0F MASK HIGH NIBBLE
STA HOLD STORE TEMPORARILY
DEX GET NEXT
LDA SUBKEY,X ADJUST INDEX INTO SELECT
ORA SEGMENT TRANSFORM MATRIX
TAY GET MATRIX DATA
LDA (SELDAT),Y GET MATRIX DATA
AND #0F MASK LOW NIBBLE
ORA HOLD COMBINE WITH PREVIOUS DATA
PHA AND PUSH ON STACK
LDA SEGMENT ADJUST POINTER INTO
SEC CORRECT DATA
SEGMENT
CONTINUE UNTIL ALL
BYTES TRANSFORMED
L4 PULL FOUR BYTES FROM
STACK AND PUT INTO
TEMP(0)-TEMP(3)
L5 STA TEMP,X
INX
CPX #04
BNE L4
RTS

```

```

0133 A5 2C
0135 18
0136 69 09
0138 85 2C
013A A8
013B A2 08

```

```

*****
TFORM PERMUTATION SUBROUTINE
*****

```

```

LOAD OLD POINTER TO DATA USED
BY TFORM. UPDATE POINTER
TO GET NEXT SET OF DATA -
SOURCE ADDR, DEST ADDR,
PERMUTE ARRAY ADDR, #BITS,
#WORDS, ARRAY LENGTH.
TFORM LDA POINT
CLC
ADC #09
STA POINT
TAY
LDX #08

```









# 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.



A Product of GRT Corporation  
Consumer Computer Group  
1286 North Lawrence Station Road, Sunnyvale, California 94086, 408/734-2910

**THE REASON  
YOU BOUGHT  
YOUR COMPUTER.**





# Queuing Theory, the Science of Wait Control

## Part 1: Queue Representation

Len Gorney  
POB 96 RD 1  
Clarks Summit PA 18411

How many times have you waited in a line? Do you always get to a supermarket checkout counter without having to wait? Is the pump at the gas station always open and ready for you as you drive into the service area? It's difficult to imagine anyone going anywhere and not having to wait in a line.

Since we're computer oriented, let's define a waiting line by its proper name — that is, a queue.

A queue is a waiting line controlled by some service mechanism. A customer enters a queue at the *tail* of the queue, waits in line until he or she arrives at the *head* of the queue, is serviced at the head of the queue, and, finally, leaves the queue. At the supermarket a customer pushes a cart to one of the lines formed at the checkout area and waits in a line until finally arriving at the cash register at the head of that line. After checking out the purchases, that customer leaves the queue.

### Queue Examples

Other examples of queues can be found in many areas of our everyday lives. The supermarket checkout queue is a commercial type of queuing system. Other commercial queues include the bank teller queue, the barbershop queue, the gas station queue, etc. The field of transportation is not without its share of queues: traffic lights, turnpike toll booths, airport runways, loading and unloading docks are but a few examples.

Of course, we have personal queues. How about that shelf of books you're planning to read some day?

### Let's Have Order

A queue is defined as a waiting line, and since a waiting line has both a beginning (tail) and an end (head), a queue must also have both these properties.

The head and tail idea implies that customers entering (being inserted) or leaving (being deleted) must follow a definite ordering scheme as members of the queue. This ordering scheme is defined as the dispatching discipline of the queue.

The usual dispatching discipline of a queue is known as *first in first out* or *FIFO*. An orderly queue exhibits this scheme. The first person entering the queue is the first person to receive service, and the last person entering the queue is the last person to receive service. Any person entering after the first but before the last must spend some time waiting in the queue before service may be rendered.

The first in first out discipline is but one of many ordering schemes that queues follow. Other servicing disciplines include last in first out (eg: a stack of dishes), a priority queue, and shortest line first or longest line first (these are multiple queuing systems and will be discussed later).

### Queue Representation

How can we represent a queue as part of a computer program? The following piece of BASIC coding (a one-dimensional array) could be used to represent a queue in a computer program:

```
10 DIM Q(100).
```

A queue is nothing more than a special purpose one-dimensional array. Just as the ordinary one-dimensional array is represented as a single row or a single column structure  $n$  locations long or deep, the queue can be represented as a single row structure  $n$  locations long.

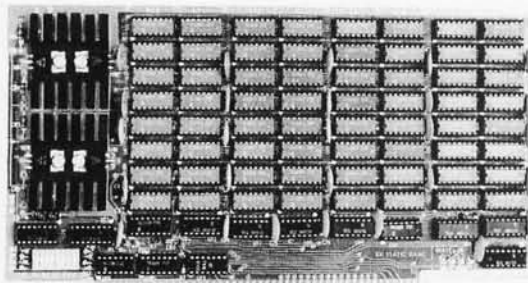
### Over and Under

When an array is dimensioned to 100 locations, the program cannot access the



# ? Wondering which memory is best for you?

base 2 offers the following products to the S-100 market at the industry's lowest prices:



## 8K Static Memory Board

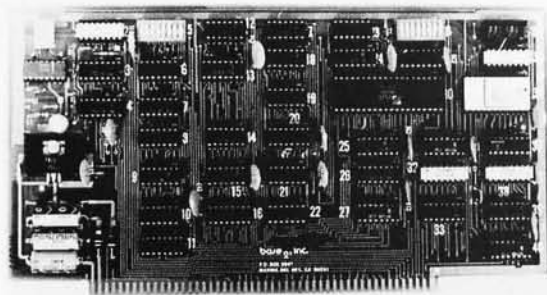
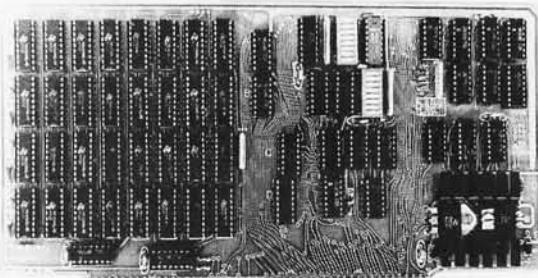
This 8K board is available in two versions. The 8KS-B operates at 450ns for use with 8080 and 8080A microprocessor systems and Z-80 systems operating at 2MHz. The 8KS-Z operates at 250ns and is suitable for use with Z-80 systems operating at 4MHz. Both kits feature factory fresh 2102's (low power on 8KS-B) and includes sockets for all IC's. Support logic is low power Schottky to minimize power consumption. Address and data lines are fully buffered and 4K bank addressing is DIP switch selectable. Memory Protect/Unprotect, selectable wait states and battery backup are also designed into the board. Circuit boards are solder masked and silk-screened for ease of construction. These kits are the best memory value on the market! Available from stock . . .

**8KS-B \$125** (assembled and tested add \$25.00)  
**8KS-Z \$145** (assembled and tested add \$25.00)

## 16K Static Memory Board

Base 2 can now offer the same price/performance in a 16K static RAM as in its popular 8K RAM. This kit includes 8K bank addressing with 4K boundary address setting on DIP switches. This low power unit provides on-board bank selection for unlimited expansion . . . No MUX board required. Using highest quality boards and components we expect this kit to be one of the most popular units on the market. Available in two speed ranges, the 16KS-B operates at 450ns while the 16KS-Z operates at 250ns.

**16KS-B \$285** (assembled and tested add \$25.00)  
**16KS-Z \$325** (assembled and tested add \$25.00)

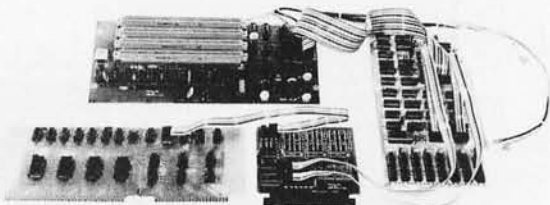


## Z-80 CPU Board

Our Z-80 card is also offered in two speed ranges. The CPZ-1 operates at 2MHz and the CPZ-2 operates at 4MHz. These cards offer the maximum in versatility at unbelievably low cost. A socket is included on the board for a 2708 EPROM which is addressable to any 4K boundary above 32K. The power-on jump feature can be selected to address any 4K boundary above 32K or the on-board 2708. An On-board run-stop flip-flop and optional generation of Memory Write allows the board to run with or without a front panel. The board can be selected to run in either the 8080 mode, to take advantage of existing software, or in the Z-80 mode for maximum efficiency. For use in existing systems, a wait state may be added to the M1 cycle, Memory request cycle, on-board ROM cycle, input cycle and output cycle. DMA grant tri-states all signals from the processor board. All this and more on top quality PC boards, fully socketed with fresh IC's. **CPZ-1 \$110 CPZ-2 \$125**

## S-100 for Digital Group Systems

This kit offers, at long last, the ability to take advantage of S-100 products within your existing Digital Group mainframe. Once installed, up to four S-100 boards can be used in addition to the existing boards in the D.G. system. The system includes an "intelligent" mother board, ribbon cables to link existing D.G. CPU to the DGS-100 board and a power wiring harness. The DGS-100 is designed to fit in the 5-3/4" x 12" empty area in the standard D.G. cabinet. It may seem expensive but there's a lot here! End your frustration! **DGS-100 \$295**



# base 2. inc.

Send for more details on these products. Get on our mailing list for information on more soon to be announced products at factory-direct prices from BASE 2. Why pay more when you can get the best at these prices???

P.O. Box 3548 • Fullerton, Calif. 92634  
 (714) 992-4344

CA residents add 6% tax  
 MC/BAC accepted • FOB — U.S. destination



Listing 1: Simple BASIC simulation of a row queue. Pseudorandom number generation is done to ensure that the queue simulation works correctly as described in the text. A sample run of the program is also shown.

```

1000 DIM Q(5)
1001 REM
1002 REM INITIALIZE QUEUE TO EMPTY STATE
1003 REM
1010 FOR J2 = 1 TO 5
1020 Q(J2) = -9
1030 NEXT J2
1031 REM
1032 REM INITIALIZE TAIL TO HEAD OF QUEUE
1033 REM
1040 T = 5
1041 REM
1042 REM START OF MAIN SIMULATION LOOP
1043 REM
1050 FOR J2 = 1 TO 15
1051 REM
1052 REM GENERATE A RANDOM NUMBER TO DETERMINE
1053 REM AN INSERTION WHEN N <= 5
1054 REM A DELETION WHEN N >= 6
1055 REM
1060 N = INT ( RND (1) * 10 ) + 1
1070 PRINT "NUMBER="; N;
1080 IF N <= 5 GOSUB 1170
1090 IF N >= 6 GOSUB 1240
1091 REM
1092 REM PRINT QUEUE CONTENTS
1093 REM PRINT TAIL POINTER VALUE
1094 REM
1100 PRINT " QUEUE=";
1110 FOR J3 = 1 TO 5
1120 PRINT Q(J3);
1130 NEXT J3
1140 PRINT " TAIL="; T
1141 REM
1142 REM END OF MAIN SIMULATION LOOP
1143 REM
1150 NEXT J2
1160 STOP
1161 REM
1162 REM I N S E R T I O N   R O U T I N E
1163 REM
1164 REM WHEN T = 0 QUEUE IS FULL, I.E. OVERFLOW
1165 REM ELSE, INSERT N AT TAIL AND DECREMENT TAIL

```

104th or -36th location. These integer values are not within the boundaries of the dimensioning statement. If the program attempts to address out of range locations during execution of the program, an *overflow* or *underflow* condition occurs. Overflow occurs when a location greater than that given in the dimensioning statement is addressed. Likewise, underflow occurs when a negative subscript is given as an addressing value.

Some BASIC interpreters allow for addressing location 0 of an array. If an array is dimensioned to 100 locations, the actual number of legally addressable locations is 101 (counting location 0 as the first available location).

The program listings in this article do not take advantage of this extra available array location. The first available location is always array location 1, and the last available location is equal to the integer value given in the dimensioning statement.

Let's get back to overflow and underflow as these conditions apply to queues. If we assume that our queuing program will not address a location above or below those given in the dimensioning statement, overflow and underflow take on a somewhat different meaning.

A queue overflow occurs when the program attempts to insert an item into our queue and the queue is filled to its capacity. Underflow in a queue structure occurs when the program attempts to delete an item from the queue but there are no items in the queue.

#### Queue Operations

Items in an ordinary one-dimensional array can have many operations performed

**NEW FROM XITEX**


**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 T<sup>2</sup>L electrical interface
- Interfaces directly with the XITEX<sup>®</sup> SCP-100 Video Terminal Board; Teletypes<sup>®</sup> Models 15, 28, 33, etc.; or the equivalent

## \$95 MORSE TRANSCIVER



**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<sup>®</sup> direct.

MC/Visa accepted

**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

**XITEX CORP.**  
13628 Neutron • P. O. Box 402110  
Dallas, Texas 75240 • (214) 386-3859



on them. A program can insert items anywhere within the array, and items can be removed from any legal location within the array. Items can be examined and left in place or moved to any location within an array.

A queue can have only two operations performed upon its items. The first of these allowable operations is the insertion of an item into the queue. This insertion can be done only at the tail of the queue. The second operation allows for deletion. Deletion is done only at the head of the queue.

### The Simple Row Queue

The program shown in listing 1 is a simulation of a row queue (see figure 1). The mechanics of a row queue follow the definitions we have seen so far.

The row queue has its tail at location 1 of array Q, while its head is at location 5 of array Q. The choice of these locations for tail and head is arbitrary. I chose this scheme

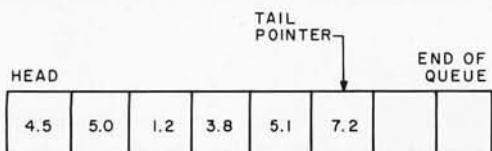


Figure 1: Simple row queue. This type of queue has a stationary "head" and a moving "tail." As data items are deleted from the head, all of the data items in the queue are moved toward the head, and the tail pointer is decremented by 1. As more data is entered into the queue at the tail, the location of the tail pointer is incremented by one location.

Listing 1, continued:

```

1166 REM
1170 IF T = 0 GOTO 1220
1180 PRINT " INSERTION";
1190 Q(T) = N
1200 T = T + 1
1210 RETURN
1220 PRINT " OVERFLOW ";
1230 RETURN
1231 REM
1232 REM   D E L E T I O N   R O U T I N E
1233 REM
1234 REM WHEN T = 5 QUEUE IS EMPTY, I. E. UNDERFLOW
1235 REM ELSE, DELETE N AT HEAD OF QUEUE
1236 REM AND MOVE REMAINING ITEMS TOWARD HEAD
1237 REM
1240 IF T = 5 GOTO 1350
1250 PRINT " DELETION ";
1260 T = T + 1
1270 FOR J4 = 5 TO T STEP -1
1280 IF J4 = 1 GOTO 1330
1290 J5 = J4 - 1
1300 Q(J4) = Q(J5)
1310 NEXT J4
1320 RETURN
1330 Q(1) = -9
1340 RETURN
1350 PRINT " UNDERFLOW";
1360 RETURN
1370 END

```

```

RUN
NUMBER= 7 UNDERFLOW QUEUE=-9 -9 -9 -9 -9 TAIL= 5
NUMBER= 3 INSERTION QUEUE=-9 -9 -9 -9 3 TAIL= 4
NUMBER= 7 DELETION QUEUE=-9 -9 -9 -9 -9 TAIL= 5
NUMBER= 4 INSERTION QUEUE=-9 -9 -9 -9 4 TAIL= 4
NUMBER= 1 INSERTION QUEUE=-9 -9 -9 1 4 TAIL= 3
NUMBER= 3 INSERTION QUEUE=-9 -9 3 1 4 TAIL= 2
NUMBER= 2 INSERTION QUEUE=-9 2 3 1 4 TAIL= 1
NUMBER= 5 INSERTION QUEUE= 5 2 3 1 4 TAIL= 0
NUMBER= 2 OVERFLOW QUEUE= 5 2 3 1 4 TAIL= 0
NUMBER= 8 DELETION QUEUE=-9 5 2 3 1 TAIL= 1
NUMBER= 7 DELETION QUEUE=-9 -9 5 2 3 TAIL= 2
NUMBER= 8 DELETION QUEUE=-9 -9 -9 5 2 TAIL= 3
NUMBER= 3 INSERTION QUEUE=-9 -9 3 5 2 TAIL= 2
NUMBER= 4 INSERTION QUEUE=-9 4 3 5 2 TAIL= 1
NUMBER= 9 DELETION QUEUE=-9 -9 4 3 5 TAIL= 2

```

## \$95 Stand Alone Video Terminal



```

αΒΓδεθϋϗϘϙϚϛϜϝϞϟϠϡϢϣϤϥϦϧϨϩϪϫϬϭϮϯϰϱϲϳϴϵ϶ϷϸϹϺϻϼϽϾϿ
!"#$%&'()*+,-./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.

**»»XITEX CORP**

13628 Neutron P. O. Box 402110  
Dallas, Texas 75240 (214) 386-3859

Overseas orders and dealers inquiries welcome



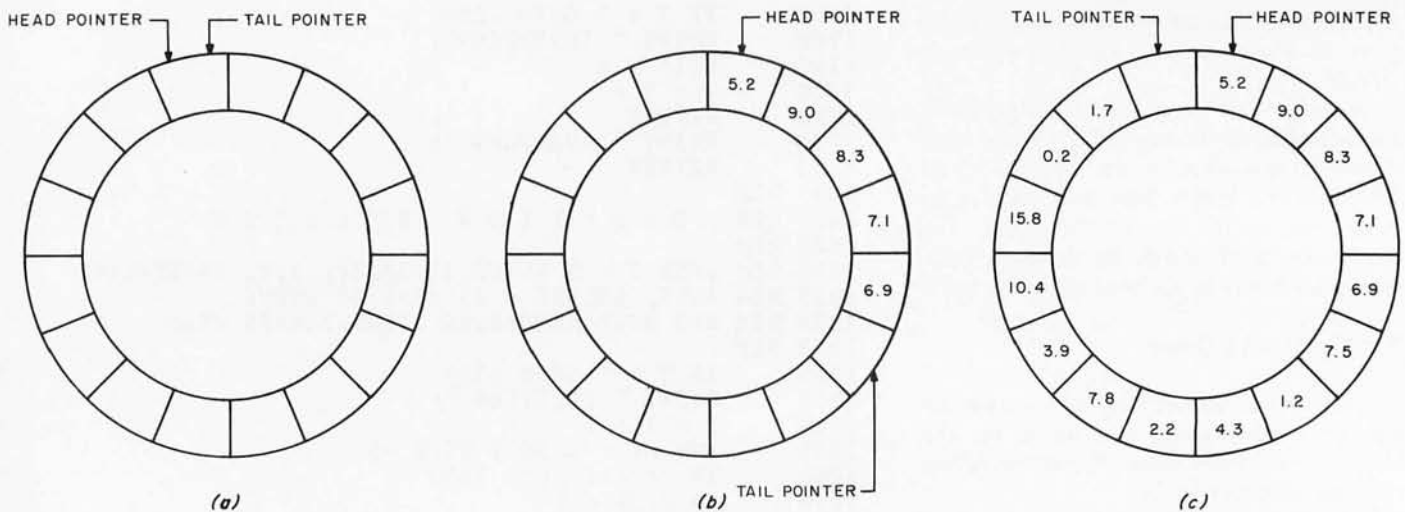


Figure 2: Circular queue in three states of use. Figure 2a is an empty queue, in which the head pointer and the tail pointer point to the same location in the queue. Figure 2b shows a partially filled circular queue. The tail pointer moves ahead of the head pointer as data items are added to the queue. As an item is deleted, the head pointer moves towards the tail pointer. Figure 2c shows a full queue. In this state the tail pointer has caught up with the head pointer. Note that one location in the queue will be left empty. If this were not done, the next item added to the queue would make the head and tail pointers point to the same location, which would seem to indicate that the queue was empty.

because it is easier to output the queue during execution of the program in a normal left-to-right reading fashion.

The head (service facility area) of the queue of listing 1 is always at location Q(5). The tail of the queue (the location in the queue where items will be inserted) moves from location 5 toward location 0 of array Q as items are inserted into the queue. When items are deleted, the tail of the queue moves from its present value toward location 5.

The tail of the row queue is indicated by a tail pointer (variable T). When T is 5 the queue is empty: that is, there are no items in the queue. When T is 0 the queue is filled to its capacity and no insertions can be made without causing an overflow condition.

To simulate the action of a queue properly, listing 1 generates pseudorandom numbers to determine queue insertion or deletion. The importance of randomness in proper queue operation is explained later.

Before you execute the program in listing 1, run through its operations with pencil and paper. This approach will show you how the program will *run* before the actual operation is simulated by the computer. This method will also clarify the mechanics of a simple row queue operation.

### The Circular Queue

A major disadvantage of our simple row

queue is the fact that items must be moved toward the head of the queue after each deletion. [Editor's Note: This is not true for all implementations of a row queue. Often, the pointers indicating the head and tail of the row queue are moved instead of all the data inside the queue. . . .RGAC] The loop in line numbers 1370 through 1400 of listing 1 accomplishes this move. If we're trying to represent a queue simulation in a computer program, why not use some programming techniques to take advantage of decreasing execution time and thereby eliminate some of the unwieldy code?

The circular queue, figure 2, is also represented as a special purpose one-dimensional array. The simple row queue has a pointer to keep track of the location where the next item insertion was to take place. The circular queue also has this tail pointer.

The difference between the row and circular queue lies in the addition of another pointer to indicate the location of the head of the queue. The simple row queue always has its head at the last available location of the array Q. The circular queue structure can have its head anywhere within the queue.

### Circular Queue Representation

The circular queue operates in the same manner as the simple row queue. Items are still inserted into the location given as the tail point location of array Q.



# 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.

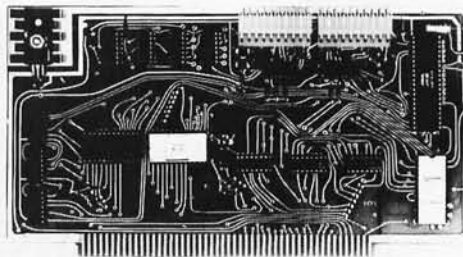
PROVIDES MONITOR AND TAPE SOFTWARE in ROM. TERMINAL AND TAPE PORTS on SAME BOARD. CONTROLS ONE or TWO TAPE UNITS (CC-8 or 3M3B).

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). \$320.00 assembled and tested.

↑ CP/M<sup>®</sup> is now available, rewritten as necessary to utilize it with the double density disk controller card above. \$100.00 with manuals, \$70.00 without manuals. CBASIC and other software can be supplied by our dealers, in double density form.

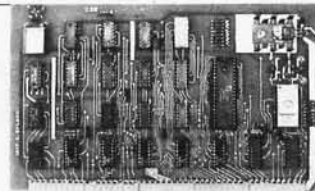
↓ SWTP Disk drive owners, you can now use your drive with CP/M<sup>®</sup> and our Z80 board below. All CP/M<sup>®</sup> compatible programs will run in your altered SWTP.

↓ Tape Software—We can now supply XITAN Z80 software in KC Standard or CC-9 formats.

## 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



Listing 2: BASIC listing for a circular queue simulation. Lines 1900 through 2100 are the insertion routine; lines 2110 through 2270 are the deletion routine. A sample run of the program is shown at the end of the listing.

```

1000 DIM Q(5)
1001 REM
1002 REM INITIALIZE QUEUE TO EMPTY STATE
1003 REM
1010 FOR J2 = 1 TO 5
1020 Q(J2) = -9
1030 NEXT J2
1031 REM
1032 REM INITIALIZE HEAD AND TAIL POINTERS
1033 REM TO HEAD OF QUEUE LOCATION
1034 REM
1040 H = 5
1050 T = 5
1051 REM
1052 REM START OF MAIN SIMULATION LOOP
1053 REM
1060 FOR J3 = 1 TO 10
1061 REM
1062 REM GENERATE A RANDOM NUMBER TO DETERMINE
1063 REM AN INSERTION WHEN N <= 5
1064 REM A DELETION WHEN N >= 6
1065 REM
1070 N = INT ( RND (1) * 10 ) + 1
1080 IF N <= 5 GOSUB 1900
1090 IF N >= 6 GOSUB 2110
1091 REM
1092 REM PRINT QUEUE CONTENTS
1093 REM PRINT TAIL AND HEAD POINTER VALUES
1094 REM
1100 FOR J4 = 1 TO 5
1110 PRINT Q(J4);
1120 NEXT J4
1130 PRINT " TAIL AT"; T; " HEAD AT"; H
1131 REM
1132 REM END OF MAIN SIMULATION LOOP
1133 REM
1140 NEXT J3
1150 STOP
1151 REM
1152 REM I N S E R T I O N   R O U T I N E
1153 REM
1154 REM CHECK TAIL AND HEAD POINTER VALUES
1155 REM
1900 IF H = T GOTO 1970
1910 IF H < T GOTO 2030
1920 IF T >= 1 GOTO 2030
1930 IF H = 5 GOTO 2080
1931 REM
1932 REM INSERT ITEM AT Q(H)
1933 REM SINCE QUEUE IS EMPTY
1934 REM
1940 Q(5) = N
1950 T = 4
1960 GOTO 2050
1970 IF T <> 0 GOTO 2000
1971 REM
1972 REM RESET POINTERS TO HEAD OF QUEUE
1973 REM
1980 H = 5
1990 T = 5
1991 REM
1992 REM CHECK IF Q(T) EMPTY FOR POSSIBLE INSERT
1993 REM
2000 IF Q(T) <> -9 GOTO 2080
2010 H = 5
2020 T = 5

```

Listing 2 continued on page 140.

The major difference is in the way which the program controls the head location of the queue. A new variable called H (for head pointer) points to the array location which holds the item ready for deletion.

An item is inserted into the queue at the location pointed to by the tail pointer. After this insertion, the pointer is moved by one location in readiness for another insertion. When an item is deleted, the head pointer comes into play. In the simple row queue, the head is always at the last available location. In the circular queue, the head of the queue is defined by the value of the head pointer variable H. After an item is deleted, the head pointer is moved one location toward the value of the tail pointer. In this structure, data items remain stationary; only the pointers vary, indicating relative positions of the tail and the head of the queue.

This queue structure is clearly advantageous when we're dealing with long queues. If a row queue is filled to its capacity and an item is deleted, every remaining item has to be moved one at a time toward the stationary head of the row queue. The circular queue moves the head pointer by only one location, thereby cutting program execution time.

The tradeoff is time versus space. The circular queue program is longer than the simple row queue; however, the time to execute the circular queue routine is shorter since the majority of code execution in the simple row queue is during the moving of the items after a delete operation.

In the circular queue, the tail pointer chases the head pointer during insertions. During deletions, the head pointer chases the tail pointer.

When the circular queue is filled to capacity, the head and tail pointers are at adjacent locations. No more items may be inserted simply because there is no more available space to fit an item into the queue. An overflow condition occurs if an insertion is attempted on a filled queue.

An underflow occurs when the queue is empty and a deletion is attempted. An empty circular queue is one in which the tail and the head pointers are at the same location in the array Q.

The program given in listing 2 simulates a circular queue. Again, a pencil and paper method of initial execution may prove helpful. After the mechanics of this structure are understood, then execute the program.

This completes our discussion of two different types of queues and their representation in a computer. In part 2 we will consider queues in the world around us and fit them into the structures already developed.



# TRS-80 SOLUTIONS

## BIZ-80

Software products oriented to four levels of TRS-80 supported systems — **ALL SYSTEMS UPWARD COMPATIBLE**

### SYSTEM-S \$99.95

A stand-alone 16K Level II with one cassette tape

### SYSTEM-I \$249.95

A 32K Level II with DOS, optional printer (CRT oriented) and one disk

### SYSTEM-II \$499.95

A 32K Level II with DOS, line printer and two disks

### SYSTEM-III Write for full particulars

A 48K Level II with DOS, line printer and two-plus disks

- Inventory •Mailing - names and addresses
- Accounts Receivable •Order Processing •Invoicing
- Accounts Payable •General Ledger •Fixed Assets
- Profit & Loss Statements •Word Processing
- Labor Scheduling •Sales Analysis/Statistics
- Patient Billing •And MORE...

## BIZ-80

A PLAN — not a package

17 Briar Cliff Dr. Milford, NH  
603-673-5284

## Level 2 Sampler

Adventure D 32K	\$24.95	End Zone 16K*	\$7.95
Pork Barrel 16K	\$9.95	Inventory I D 32K	\$59.95
'Round the Horn 16K	\$9.95	Accts. Rec. D 16K	\$59.95
Star Trek III.3 16K	\$14.95	Payroll I D 32K	\$59.95
X-Wing Fighter 16K	\$7.95	Mail List I D 16K	\$19.95
Ten Pin 16K	\$7.95	Mail List II D 32K	\$99.95
Slalom 16K	\$7.95	Appt. Log 16K	\$9.95
Cribbage 16K*	\$7.95	Ham Radio 16K	\$9.95
Sargon 16K	\$19.95	Renumber D 4-48K	\$25.00
Backgammon 16K	\$7.95	Personal Finance 16K	\$9.95
Inventory II D 32K	\$150.00	Tarot 16K*	\$9.95

\* Also available in Level I

D = Disk

**TS&E TRS-80 Software Exchange**

17 BRIAR CLIFF DRIVE MILFORD, NEW HAMPSHIRE 03055

SEND FOR OUR COMPLETE CATALOG TODAY!

# SoftSide™

"your BASIC software magazine"

IF YOU HAVEN'T SUBSCRIBED TO SOFTSIDE, YOU MISSED:

**OCTOBER** Cribbage, State Capital Quiz, Death Star, Pillbox, Calculator

**NOVEMBER** End Zone, Troll's Gold, Shopping List, Level I to Level II, Octal to Hex Conversion

**DECEMBER** Santa Paravia, Mortgage Calculation, Six Million Dollar (/10K) Clock, Spelling Bee, Biorhythms

**JANUARY** 'Round the Horn, Kiddy Slot, Writing Good Computer Games-Part I, Ten Pin Bowling, High Speed Graphics, Comput-A-Sketch

**FEBRUARY** Form 1040, Writing Good Computer Games-Part II, Concentration, Elements Quiz, Cribbage Update

12 issues — \$15.00

HOW MUCH LONGER CAN THIS GO ON?

Softside Subscriptions  
Box 68 Milford, NH 03055

603-673-5144

## SoftSide™ Cassettes

Each month brings you a new issue of SoftSide PLUS the prerecorded cassette version of that month's feature programs, ready to run. That's all included in your six month membership for only \$38.00 [Thirty programs for only about a dollar apiece]



SEND IN YOUR ORDER TODAY — LEAVE THE CODING TO US!



SoftSide Cassettes  
PO Box 68 Milford, NH 03055

603-673-5144

NEW PUBLICATION

# PROG 80

Dedicated to the serious programmer, from enthusiastic hobbyist to professional

### PREMIER EDITION FEATURES

Inkey Routines by Lance Micklus  
Simple SIMON-monitor/disassembler written in BASIC

Variables in Level II-how to determine which variables have been used

Subscriptions: 4 issues, \$10.00

PO Box 68 Milford, NH 03055



# 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     | Tab Function           |
| 7 x 10 Char. Matrix  | Backspace Key          |
| White or Black Char. | Shiftlock Key          |
| Transparent Mode     | 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**

**\$149.00**  
0-300 Baud Stand Alone  
Crystal Controlled RS232



**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

Listing 2, continued:

```

2021 REM
2022 REM NORMAL TAIL INSERTION
2023 REM
2030 Q(T) = N
2040 T = T - 1
2050 PRINT " "
2060 PRINT "ARRIVAL"
2070 RETURN
2080 PRINT " "
2090 PRINT "OVERFLOW"
2100 RETURN
2101 REM
2102 REM DELETION ROUTINE
2103 REM
2104 REM CHECK POINTER VALUES FOR POSSIBLE DELETE
2105 REM
2110 IF H = T GOTO 2150
2120 IF H > 0 GOTO 2190
2130 H = 5
2140 GOTO 2180
2150 IF H <> 0 GOTO 2180
2160 H = 5
2170 T = 5
2171 REM
2172 REM DELETE FROM Q(H) IF Q(H) HAS AN ITEM
2173 REM ELSE, QUEUE IS EMPTY, I.E. UNDERFLOW
2174 REM
2180 IF Q(H) = -9 GOTO 2240
2190 Q(H) = -9
2200 H = H - 1
2201 REM
2202 REM RESET POINTERS FOR NEXT DELETE
2203 REM
2210 IF H <> 0 GOTO 2260
2220 H = 5
2230 RETURN
2240 PRINT " "
2250 PRINT "UNDERFLOW"
2260 RETURN
2270 END
    
```

RUN

ARRIVAL  
-9 -9 -9 -9 3 TAIL AT 4 HEAD AT 5

ARRIVAL  
-9 -9 -9 2 3 TAIL AT 3 HEAD AT 5

ARRIVAL  
-9 -9 4 2 3 TAIL AT 2 HEAD AT 5  
-9 -9 4 2 -9 TAIL AT 2 HEAD AT 4

ARRIVAL  
-9 5 4 2 -9 TAIL AT 1 HEAD AT 4

ARRIVAL  
3 5 4 2 -9 TAIL AT 0 HEAD AT 4

ARRIVAL  
3 5 4 2 1 TAIL AT 4 HEAD AT 4

OVERFLOW  
3 5 4 -9 1 TAIL AT 4 HEAD AT 3

ARRIVAL  
3 5 4 3 1 TAIL AT 3 HEAD AT 3

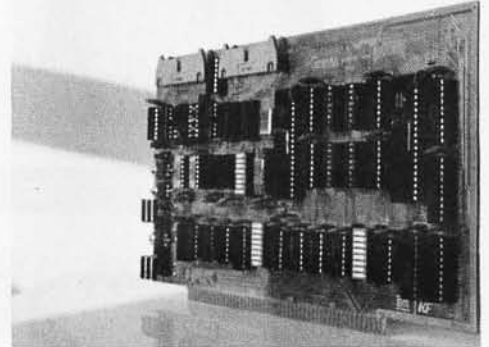


# NEW! the •FULL FUNCTION •DUAL CHANNEL S-100 I/O BOARD

\$189 "unkit", \$249 assembled

Our new I/O board gives you unparalleled flexibility and operating convenience . . . the specs speak for themselves:

- 2 independently addressable serial ports dip switch selectable addresses
- Real LSI hardware UARTS for minimum CPU housekeeping
- RS232C, current loop (20 mA), and TTL and signals on both ports
- Precision, crystal-controlled baud rates up to 19.2 KBaud (individually dip switch selectable)
- Transmit and receive interrupts on both channels, jumperable to any vectored interrupt line
- Industry standard RS232 level converters with five RS232 handshaking lines per port
- Optically isolated current loop with provisions for both on-board, and off-board, current sources
- UART parameters, interrupt enables, and RS232 handshaking lines are software programmable, with power-on hardware default to customer-specified hard-wired settings for maximum flexibility
- Port connectors mate directly to ribbon cable and DB25 connectors in standard pinouts
- RS232 lines will conform to either master or slave configurations
- Board gives full feature operation with both 2 and 4 MHz systems
- Low power consumption: +8V @ 450 mA max (350 mA typ); +16V @ 150 mA max (70 mA typ); -16V @ 70 mA max (55 mA typ)
- No software initialization required for board operation, although board parameters may be altered by software



Amazingly enough, all these features won't cost you more than other types of I/O boards that do a whole lot less.

Visit your local computer store and see one in person, or order direct from us.

## NEW too! Godbout's got S-100 Bank Select!

We're happy to announce a new family of S-100 Econoram™ boards, each with two independently selectable banks – perfect for Alpha Micro Systems, Marinchip, and similarly structured machines. Low power, 4 MHz operation, and of course . . . completely static operation.

Name	Storage	Bus	Addressable on	Design	Unkit	Assm	CSC
Econoram XII™ -16	16K X 8	S-100	8K boundaries	static	\$369	\$419	\$519
Econoram XII™ -24	24K X 8	S-100	8K boundaries	static	\$479	\$539	\$649
Econoram XIII™	32K X 8	S-100	16K boundaries	static	\$629	\$699	\$849

Please note: CompuKit™ from Godbout boards are generally 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) program (200 hour burn-in, guaranteed 4 MHz operation over the full commercial temperature range, and immediate replacement in event of failure within 1 year of invoice date).

### ... AND WE STILL LEAD THE MEMORY PACK IN PRICE, SELECTION, AND BUSS SUPPORT:

Name	Storage	Bus	Design	Speed	Configuration	Unkit	Assm	CSC
ECONORAM II™	8K X 8	S-100	static	2 MHz	dual 4K	\$139	\$159	N/A
ECONORAM IV™	16K X 8	S-100	static	4 MHz	single 16K	\$295	\$329	\$429
ECONORAM VI™	12K X 8	H8	static	2 MHz	1-8K, 1-4K	\$200	\$270	N/A
ECONORAM VII™	24K X 8	S-100	static	4 MHz	2-4K, 2-8K	\$445	\$485	\$605
ECONORAM IX™	32K X 8	Dig Grp	static	4 MHz	2-4K, 1-8K, 1-16K	\$649	N/A	N/A
ECONORAM X™	32K X 8	S-100	static	4 MHz	2-8K, 1-16K	\$599	\$649	\$789
ECONORAM XI™	32K X 8	SBC	static	4 MHz	2-8K, 1-16K	N/A	N/A	\$1050

## TRS-80 CONVERSION KIT \$109 (3/\$320)

Our kit is warranted for 1 year, comes complete with dip shunts, and uses 250 ns access time chips for operation at 4 MHz. Upgrades 4K TRS-80 to 16K, or populates Memory Expansion Module (our easy-to-follow instructions show you how); also expands memory in APPLE and Evidy Sorcerer computers.

COMING SOON: Memory Management System that allows Altair and Insai owners do bank select – the easy, efficient way, without heavy retrofitting. Expand your system to half-a-megabyte of memory by letting our memory management do the work, so you don't have to waste a bunch of I/O space . . . just what you've needed for those BIG memory systems. Also, look for our new high-speed motherboard in the months ahead.

TERMS: Allow 5% shipping, excess refunded. Cal res add tax. VISA®/Mastercharge® call our 24 hour order desk at (415) 562-0636. COD OK with street address for UPS (UPS COD charge applies). Prices good through cover month of magazine.

# CompuKit™

BOX 2355, OAKLAND AIRPORT, CA 94614

from **GODBOUT**

**HOT-OFF-THE-PRESSES-CATALOGUE:** Our new catalogue is something you need if you're into electronics. Parts, kits, computers, electronic music, specials . . . it's really packed, and it's free. Just send us your name and address, we'll take care of the rest.



# NEECO

## PET 2001 — 32K



# PROUDLY ANNOUNCES THE NEWEST PET MICROCOMPUTERS BY COMMODORE!

### The PET™ is now a truly sophisticated Business System with the announcement of these Peripherals.

The PET™, incorporated with the Floppy Disk and Printer makes an ideal business system for most professional and specialized fields: medicine, law, dental, research, engineering, bookmaking, printing, education, energy conservation, etc. The PET™ Business System as a management tool delivers information to all levels of business, previously attainable only with equipment many times more expensive. The PET™ Business System is one of the most cost efficient business tools

today. It offers a wide range of applications from logging management strategy in major corporations to organizing accounts and inventory control of small businesses. Here are just a few of the cost-saving uses in the corporation, professional office or small business: stock control, purchasing forecasting, manufacturing costing, customer records, making lists, etc. The PET™ Floppy Disk and Printer, a complete business system at a reasonable price — Take a closer look at these Peripherals.

PRODUCT	DESCRIPTION	PRICE	AVAILABILITY
PET 2001—8K*	8K RAM	\$ 795	IMMEDIATE
PET 2001—16K	16K RAM	\$ 995	MAY-JUNE
PET 2001—32K*	32K RAM	\$1195	IMMEDIATE
PET 2021 PRINTER	ELECTROSTATIC	\$ 550	JULY-AUGUST
PET 2022 PRINTER	TRACTOR/ROLL	\$ 995	JULY-AUGUST
PET 2023	ROLL FEED	\$ 850	JULY-AUGUST
PET 2040	MINI-FLOPPY	\$1095	JULY-AUGUST
PET C2N	2nd CASSETTE	\$ 100	IMMEDIATE
NEW PET USER MANUAL		\$ 10	IMMEDIATE

\* THESE UNITS INCLUDE THE C2N CASSETTE AND SMALL KEYBOARD. THE FULL SIZE KEYBOARDS MAY NOT BE AVAILABLE UNTIL THIS SUMMER.

NEECO IS NOW ACCEPTING \$25 DEPOSITS ON THE SYSTEM COMPONENTS OF YOUR CHOICE! PURCHASE ORDERS ARE ACCEPTED IN LIEU OF DEPOSITS. NEECO IS A FULL CUSTOMER SERVICE ORIENTED COMPANY. PLEASE CALL FOR ADDITIONAL INFORMATION

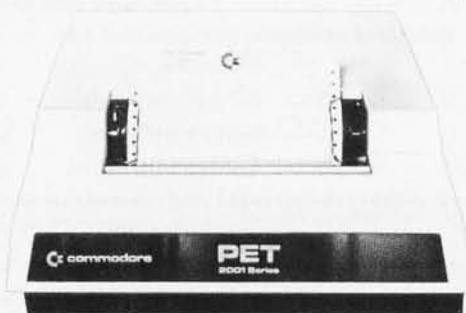
## THE NEW commodore PET PERIPHERALS!



2040

### Dual Drive Floppy Disk

The Dual Drive Floppy is the latest in Disk technology with extremely large storage capability and excellent file management. As the Commodore disk is an "Intelligent" peripheral, it uses none of the RAM (user) memory of the PET™. The Floppy Disk operating system used with the PET™ computer enables a program to read or write data in the background while simultaneously transferring data over the IEEE to the PET™. The Floppy Disk is a reliable low cost unit, and is convenient for high speed data transfer. Due to the latest technological advances incorporated in this disk, a total of 360K bytes are available in the two standard 5 1/4" disks, without the problems of double tracking or double density. This is achieved by the use of two microprocessors and fifteen memory I.C.s built into the disk unit. Only two connections are necessary — an A/C cord and PET™ interface cord.



2022

### Tractor Feed Printer

The Tractor Feed Printer is a high specification printer that can print onto paper (multiple copies) all the PET™ characters — letters (upper and lower case), numbers and graphics available in the PET™. The tractor feed capability has the advantage of accepting mailing labels, using standard preprinted forms (customized), cheque printing for salaries, payables, etc. Again, the only connections required are an A/C cord and PET™ connecting cord. The PET™ is programmable, allowing the printer to format print for width, decimal position, leading and trailing zero's, left margin justified, lines per page, etc. It accepts 8 1/2" paper giving up to four copies. Bidirectional printing enables increased speed of printing.



2021

ELECTROSTATIC PRINTER

\$549<sup>95</sup>



C2N SECOND CASSETTE

\$99<sup>95</sup>

## NEW ENGLAND AREA SUB-DEALERSHIP INQUIRIES INVITED!

NEECO IS PLEASED TO ANNOUNCE THAT WE ARE MOVING INTO A NEW 9,000 SQUARE FOOT FACILITY IN THE BOSTON (NEEDHAM, MASS.) AREA. OUR NEW LOCATION WILL ENABLE US TO PROVIDE BETTER CUSTOMER SERVICE VIA OUR NEW 2,800 SQUARE FOOT SHOWROOM, OUR 1200 SQUARE FOOT SERVICE FACILITY, AND OUR SEVEN DIRECT TELEPHONE LINES (SO YOU WILL NEVER HEAR A BUSY SIGNAL!). WE NOW ARE AUTHORIZED TO SERVICE IN-WARRANTY PETS. SO IF YOU HAVE A PROBLEM OR A QUESTION CALL NEECO, WHERE OUR COMMODORE PET CUSTOMERS COUNT! FULL BUSINESS SOFTWARE PROGRAMMING AVAILABLE. \* FEEL FREE TO CALL AND ASK QUESTIONS — ARE YOU ON OUR MAILING LIST?

# NEECO

NEW ENGLAND ELECTRONICS CO., INC.  
679 HIGHLAND AVE., NEEDHAM, MASS. 02194  
MON.-FRI. 9:30-5:30, SAT. 10-2, EST.

(617) 449-1760 AS OF APRIL 1.  
(413) 739-9626 UNTIL APRIL 1.  
VISA/MASTERCARD ACCEPTED



# INTRODUCING — THE NEW DUAL DRIVE MINIFLOPPY FOR PET!

**NEW!**



NOW WITH  
OPTIONAL 400K  
(DUAL DENSITY)

**CUSTOMER ORDERS  
ARE NOW BEING  
SHIPPED WITHIN  
TEN DAYS!!!**

DKH641 IS A PRODUCT OF COMPUTHINK.

- \* DUAL MINI FLOPPY DRIVE WITH 100K PER DISK SIDE FOR TOTAL 200K ON LINE.
- \* COMMERCIAL LOADING SPEEDS \* 8K LOADS IN 2.6 SECONDS COMPLETE.
- \* DOS REORGANIZES SPACE AFTER SAVE OR ERASE FOR EFFICIENT STORAGE.
- \* DISKMON ADDS OVER 20 COMMANDS TO BASIC INCLUDING DISK DATA FILES.
- \* DISKMON COMMANDS SUPPORT COMMERCIAL PRINTER OFF PARALLEL PORT SUCH AS CENTRONICS LINE OF PRINTERS (AVAILABLE FROM NEECO)
- \* FULL DISK SOFTWARE SUPPORT \* FORTRAN & PLM COMPILERS \*
- \* 90 DAY MANUFACTURER'S WARRANTY ON HARDWARE \* READY TO USE ON DELIVERY. FULL MANUAL AND UTILITY DISKETTE INCLUDED.
- \* CALL OR WRITE FOR COMPLETE INFORMATION ON THE "DISKDRIVER".
- \* THIS SYSTEM REQUIRES EXPANDAPET MEMORY (MINIMUM 16K)

DKH642	— DUAL DRIVE SYSTEM, COMPLETE WITH DISKMON	.....	\$1295.00
ASM789D	— PET ASSEMBLER ON DISKETTE WITH MANUAL	.....	\$49.95
LNK456	— AUTOLINK LINKING LOADER ON DISKETTE WITH MANUAL	.....	\$49.95
PLM400	— COMPILER ON DISKETTE (AVAILABLE APRIL/MAY)	.....	\$49.95
FOR300	— FORTRAN COMPILER ON DISKETTE (AVAILABLE APRIL/MAY)	.....	\$69.95
DKL067	— DISKMON ASSEMBLER LISTING/DOS	.....	\$19.95
DATA100	— COMPLETE DATA BASE SYSTEM (PRICE APPROXIMATE)	.....	\$400.00
BASCOMP	— BASIC COMPILER ON DISKETTE (AVAILABLE MAY)	.....	\$49.95
NGP200	— 20 GAMES ON DISKETTES	.....	\$49.95
BKGAM	— BACKGAMMON ON DISKETTE	.....	\$24.95
MICRO	— MICROCHESS ON DISKETTE	.....	\$24.95
CEN779(1)	— CENTRONICS 779-1, ROLL FEED DOT MATRIX COMMERCIAL PRINTER	.....	\$1245.00
CEN779(2)	— SAME AS 779(1) BUT WITH TRACTOR FEED — PLUG INTO PET	.....	\$1345.00
AX10M	— ELECTROSTATIC 5.5 INCH PRINTER WITH ALL OF PET'S GRAPHICS	.....	\$495.00

## PET COMPUTER

NEECO  
NOW OFFERS  
A FULL SIX  
MONTH  
WARRANTY  
ON ALL  
PETS! — AN  
ADDITIONAL  
3 MONTHS!



by  
**COMMODORE**

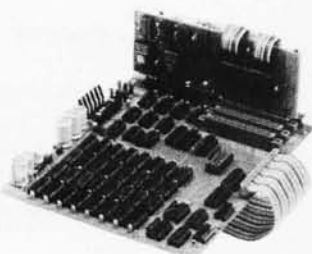
## WHY NOT BUY FROM THE BEST?

- |                   |               |  |
|-------------------|---------------|--|
| 8K PET .....      | <b>\$ 795</b> | * NEECO IS A CUSTOMER ORIENTED, FULL SERVICE COMPANY.    |
| 24K PET (8 + 16K) | <b>\$1220</b> | * PETS RECEIVE 48 HR. 'BURNIN' BY NEECO BEFORE SHIPMENT. |
| 32K PET (8 + 24K) | <b>\$1320</b> | * FULL CUSTOMER SERVICE AND FULL PRODUCT SUPPORT.        |
- ALL PRICES INCLUDE 48 HR. PRE-SHIPMENT TESTING & 3 FREE CASSETTE PROGRAMS  
PRICES SHOWN ABOVE INCLUDE EXPANDAPET. PME MEMORIES WILL HAVE HIGHER PRICING.
- \* 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)	<b>\$425</b>
24K (+8K PET = 32K)	<b>\$525</b>
32K (+8K PET = 40K)	<b>\$615</b>

OPTIONAL PLUG-IN BOARDS 32K UNIT ALLOWS 8K OF  
4K EPROM DAUGHTER BOARD ASSEMBLY LANGUAGE  
USING 2716 EPROMS .... \$50 SUBROUTINES ACCESSED  
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.

**NOW AVAILABLE! \$139.95**

NPK-101 IS A PRODUCT OF NEW ENGLAND ELECTRONICS.

**WE CANNOT LIST ALL OF 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.  
679 HIGHLAND AVE., NEEDHAM, MASS. 02194  
MON.-FRI. 9:30-5:30, SAT. 10-2, EST.

(617) 449-1760 AS OF APRIL 1.  
(413) 739-9626 UNTIL APRIL 1.  
VISA/MASTERCHARGE ACCEPTED



# Cryptography

## Part 2: Using the Pocket

John P Costas, Phd  
Senior Consulting Engineer  
GE Company  
Court St Bldg 4, Rm 38A  
Syracuse NY 13221

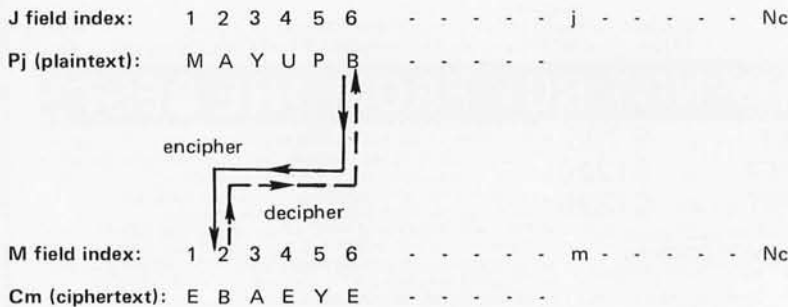


Table 8: A transposition mode operation using program Crypto. In this example the number displayed by the calculator (J.M) is 6.002. When enciphering, this means that the character in position 6 of the plaintext is placed in position 2 of the ciphertext. If this were deciphering, the character in position 2 of the ciphertext would be placed in position 6 of the plaintext.

(1)	Alphabetical Order	(2)	(3)	Numerical Order	(4)
A		07	01	F	
B		02	02	B	
C		26	03	T	
D		23	04	L	
E		08	05	Z	
F		01	06	X	
G		09	07	A	
H		13	08	E	
I		11	09	G	
J		15	10	Y	
K		20	11	I	
L		04	12	Q	
M		22	13	H	
N		14	14	N	
O		16	15	J	
P		19	16	O	
Q		12	17	S	
R		25	18	W	
S		17	19	P	
T		03	20	K	
U		21	21	U	
V		24	22	M	
W		18	23	D	
X		06	24	V	
Y		10	25	R	
Z		05	26	C	

Table 9: Mixed alphabet used in the examples. Column 2 was derived from program Crypto using values of A: 0.5, 1.625, 3.125, 26 and R/S:0.

As mentioned in part 1 of this article (March 1979 BYTE, page 56), a field cipher is a technique for encoding plaintext so that it can be easily decoded with pencil and paper (or calculator) in the field, so to speak. The calculator program of listing 1 when used with the procedures described offers the user an effective field cipher capability. Unlike most field cipher machines, which perform substitution only, the program Crypto (listing 1) offers both transposition and substitution. The transposition operation is mandatory and provides the main strength of the cipher. Substitution may be added for further protection if desired. The basic principles of operation are first described, including detailed instructions for usage. Following this, a discussion of program organization is given.

Since Crypto performs both transposition and (optionally) substitution, a transposition table and substitution key are involved in the processing of each character. It is convenient to define a few terms:

- Na — alphabet size (no practical limit);
- Nc — number of characters in message (300 maximum);
- J — plaintext character position (1, 2, ..., Nc);
- M — ciphertext character position (1, 2, ..., Nc);
- P — plaintext character (A, B, C, ...);
- $\bar{P}$  — plaintext character value;
- C — ciphertext character (A, B, C, ...);
- $\bar{C}$  — ciphertext character value;
- K — key value used in substitution process.

The program uses a random number generator which must be initialized with a *seed*, R0, and two parameters, A1 and A2. These three numbers plus the character count are entered into the stack, after which A is depressed. One more number completes the entry, after which R/S is depressed. The



# in the Field

## Calculator

demonstration numerical key is: R0 = 0.5; A1 = 1.625; and A2 = 3.125.

### Transposition Only Mode

The character manipulations for transposition only are illustrated in table 8. The top two rows, an index row and a plaintext character row, are concerned with plaintext. The bottom two rows are ciphertext index and ciphertext. Each time Crypto is cycled, a pair of integers is displayed in the format:

J.M

and are interpreted in the enciphering operation as "plaintext character from position J goes to ciphertext position M." Number J is simply indexed every cycle (1, 2, ..., Nc). Crypto produces the M values randomly in the range 1 to Nc with no repetitions (transposition table). For the cycle illustrated in table 8, the display shows 6.002, which requires that the B from J = 6 be moved to M = 2. By this means the plaintext characters are reordered in a random fashion to form the ciphertext.

The deciphering operation works in an obviously reverse fashion. The displayed J.M is read as "ciphertext character at position M goes to plaintext position J." Thus in table 8 6.002 would return the B from ciphertext position 2 to the correct plaintext position 6.

### Mixed Alphabet Generation

If the optional substitution operation is to be added to the transposition operation, numerical equivalence for each character of the alphabet must be established. In the discussion which followed the Vigenère Tableau method (March 1979 BYTE, page 57, table 3), an ordered alphabet was used in which the numerical values ran, in order, from 0 to one less than the alphabet size (Na-1). In the work which follows, two changes are made. The numerical equivalents are moved

Location	Keys					
01	fLBLA	fCLREG	fP→S	STO3	STO4	hR↓
07	STO2	hR↓	STO1	hR↓	STO0	STOA
13	R/S	hCFO	fx<0?	hSFO	hABS	STOC
19	hCF1	fx = 0?	hSF1	fFIX	2	ENT↑
25	2	9	hy <sup>x</sup>	STOE	1	STO6
31	fLBL1	5	0	STO5	fLBL5	RCL4
37	fGSBE	STO9	3	0	STO8	÷
43	fINT	STO7	1	9	-	CHS
49	hST1	RCL8	RCL9	-	RCL8	RCL7
55	X	+	2	h x↔y	hy <sup>x</sup>	STO7
61	RCL(i)	h x↔y	÷	gFRAC	.	5
67	gx>y?	GTO4	1	STO-5	RCL5	fx ≠ 0?
73	GTO5	fLBL2	RCL3	fGSBE	STO9	1
79	9	hST1	RCL(i)	STO8	RCLE	STO7
85	fLBL3	RCL8	RCL7	gx>y?	GTO6	STO-8
91	fLBL9	1	RCL7	gx = y?	GTO7	2
97	STO÷7	GTO3	fLBL7	fDSZ	RCL(i)	STO8
103	RCLE	STO7	GTO3	fLBL6	RCL9	fx = 0?
109	GTO8	1	STO-9	GTO9	fLBL4	2
115	STO÷7	fLBL8	RCL7	STO+(i)	2	0
121	hRCI	- .	3	0	X	RCL7
127	fLN	2	fLN	÷	.	1
133	+	fINT	-	EEX	3	÷
139	RCL6	+	STO5	DSP3	R/S	hF71

Listing 1 continued on page 152.

#### Entries:

A: A0, A1, A2, Nc  
 R/S: Na  
 Na=0 transposition only.  
 Na≠0 transposition and substitution  
 +Na encipher  
 -Na decipher

#### Registers:

0 Rj  
 1 A1  
 2 A2  
 3 S  
 4 Nc  
 5 utility  
 6 J  
 7 utility  
 8 utility  
 9 R  
 S0-S9 M-field bit storage  
 A R2j  
 B not used  
 C Na  
 D not used  
 E 2<sup>29</sup>

Listing 1: Crypto program written for the HP 67. This program performs encryption and decryption functions by transposition and substitution as described in the text. The value of Nc must be less than or equal to 300 and the value of Na must not exceed 999. Flag F0 has two states: true for decipher and false for encipher mode. Flag F1 is true when only transposition mode is wanted and false when the dual transposition and substitution mode is used. Flag F2 is used in the random number generation loop.







# The COMPUTER FACTORY

TO ORDER CALL TOLL FREE 800-223-7318



## COMMODORE "PET" USED

only \$795 \$549

- 14K ROM Operating system
- 8K RAM Memory
- 9" Video Monitor
- Built in Keyboard
- Digitally controlled tape

Today's best value in personal computers, along with the latest in peripherals, are always in stock at the COMPUTER FACTORY.

## 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



\$549

PET 8 1/2

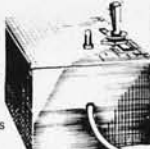
## ELECTROSTATIC PRINTER 2021

- 80 column dot matrix
- Full PET graphics
- 8 1/2 inch paper!

## PET PRINTERS

2023 \$849  
2022 \$995  
(Includes Tractors)

- Bottom and Rear Tractor Feed
- 8 1/2" Paper Width
- 6504 Microprocessor Controlled
- 112 cps Bi-directional
- 4K ROM • 1/2K RAM
- Upper/Lower Case and Graphics
- 7 x 6 Dot Matrix



**PET MUSIC BOX**  
Add music and sound effects to your programs. Compose, play, and hear music on your pet. Completely self-contained (no wiring). Free 3 programs including Star Wars theme, sound effects, etc. \$39.

## DUAL DRIVE FLOPPY DISK 2040 \$1095

- 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

## SINGLE DRIVE FLOPPY UNIT 2041 \$595

- Intelligent mini floppy
- 171.5K net user storage

**FREE**

**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

\$35 of Software with purchase of any computer on this page

## PERIPHERALS FOR PET

- 24K Memory Expansion ... \$499
- 16K Memory Expansion ... 399
- PET to RS232 Serial ... 169
- 2 Way Serial/Communication ... 249
- Modern Board for PET ... 375
- PET to S100 (4-slot) ... 160
- Second Cassette Drive ... 95
- Parallel Printer Interface ... 199

## NEW! BILLINGS MICROSYSTEM EXPANDABLE TO 2 MEGABYTES



- features:
- 12" CRT
  - 64K RAM
  - Z-80
  - Dual mini floppy
  - 320 K Storage
  - Graphics
  - 94 Keys
  - 2 RS-232 ports
  - 1 parallel port

only \$3645

BUSINESS SOFTWARE AVAILABLE!

## Compucolor II

COMPUCOLOR II Disk-Based Model 3  
Advanced hardware and software technology gives you:

- 13" 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 full file management capability resident in the COMPUCOLOR II in 16K of ROM. Color is fantastic, but COMPUCOLOR II has the power to handle complex tasks and small business applications. An impressive software library supplements your own creativity.



\$1495 Complete!  
16K Model add \$200  
32K Model add \$500

## BUSINESS COMPUTERS



### Data General micro NOVA

The ultimate in small business computers when matched with COMPUTER FACTORY'S microcomputer. 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, DOS, 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 \$4495
- VDP/80 \$6995



## SORCERER SPECIAL 12" Video Monitor for SORCERER (\$299 value) ONLY

\$125 with 8K unit  
95 with 16K unit  
65 with 32K unit

- by 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
  - S-100 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

## The Computer of the Future is here Now! PASCAL MICROENGINE™

\$2995

Western Digital's new 16-bit Pascal Computer System

- 64K bytes (32K words) of RAM
- 2 RS-232 ports
- 2 8-bit parallel ports
- Floppy disk controller
- Floating point hardware
- Memory Mapped I/O
- Enclosed power supply

## RADIO SHACK • PET • SORCERER • APPLE • COMPUCOLOR • ETC. PRINTERS • PRINTERS • PRINTERS

The COMPUTER FACTORY'S extensive inventory and wide selection of computer CENTRONICS 779 ... \$1045 AXIOM (Parallel) ... 395 printers assures you of finding the printer AXIOM (Serial) ... 495 best suited for your needs and EXPANDOR (Tractors) 425 specifications. The following printers work INTEGRAL DATA ... 795 well with all known personal computers. QUME or DIABLO ... 3400

## APPLE II from \$970



Min Credit Card Order \$75



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.

Open Mon.-Fri. 10-6 Sat. 10-4

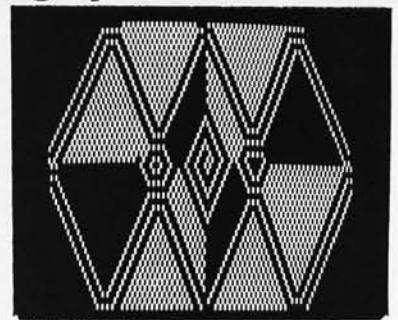
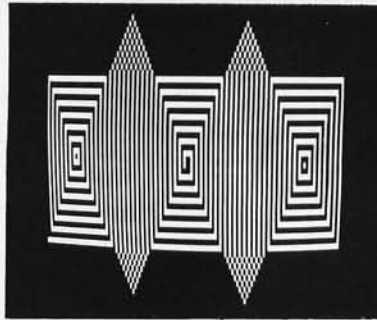
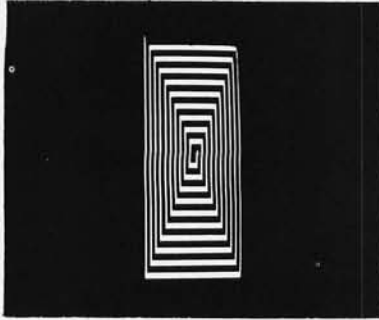
**SPECIAL SALE**  
Buy any computer and take 10% off price of printer of your choice

TO ORDER CALL TOLL FREE 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

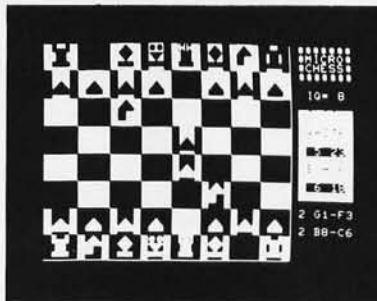


# PET / TRS-80 / APPLE: Personal Software brings you the finest!



**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**



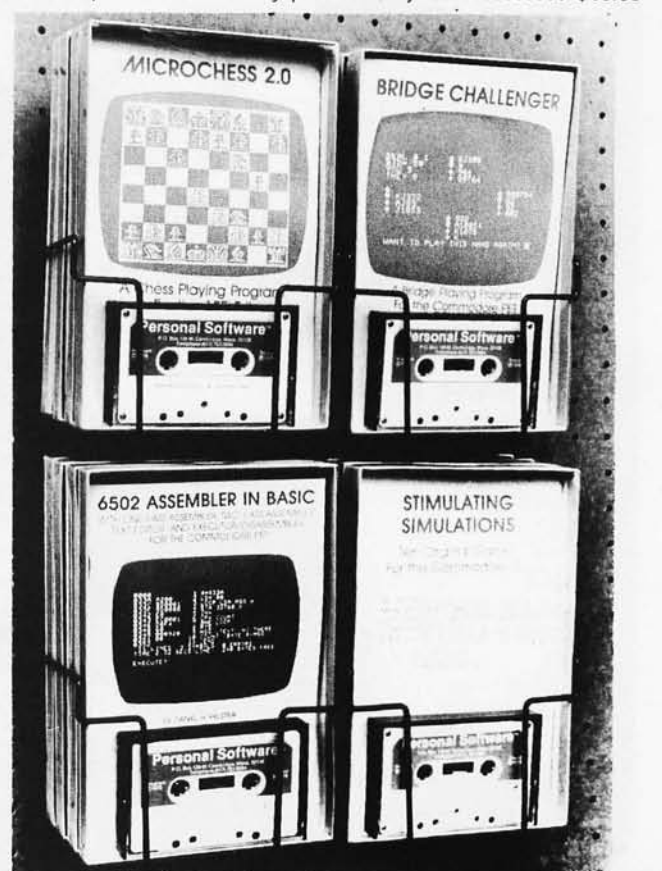
**MICROCHESS** is the culmination of two years of chessplaying program development by Peter Jennings, author of the famous 1K byte chess program for the KIM-1. MICROCHESS 2.0 for 8K PETs and 16K APPLES, in 6502 machine language, offers 8 levels of play to suit everyone from the beginner learning chess 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**

**TIME TREK** by Brad Templeton with sound effects for 8K PETs is Personal Software's answer to the proliferation of Star Trek 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 275 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 first at (617) 783-0694. If you know what you want and have your VISA/MC card ready, you can use any telephone to



**DIAL TOLL FREE**  
**1-800-325-6400**  
 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-B4, Cambridge, MA 02138

# Look for Personal Software™ products at the dealer nearest you!

## ALABAMA

BYTE SHOP  
Huntsville, AL 35805  
COMPUTERLAND  
Huntsville, AL 35805  
THE LOGIC STORE  
Opelika, AL 36801  
**ALASKA**  
ALPHA ELECTRONICS  
Anchorage, AK 99503  
**ARIZONA**  
PERSONAL COMPUTER PLACE  
Mesa, AZ 85202  
COMPUTERLAND OF PHOENIX  
Phoenix, AZ 85016  
COMPUTER SHOWROOM  
Tucson, AZ 85710  
**ARKANSAS**  
COMPUTERLAND  
Little Rock, AR 72212  
DATA COPE  
Little Rock, AR 72204  
**CALIFORNIA**  
JAY-KERN ELECTRONICS  
Bakersfield, CA 93305  
BYTE SHOP  
Burbank, CA 91506  
BYTE SHOP OF SACRAMENTO  
Citrus Heights, CA 95610  
COAST COMPUTER CENTER  
Costa Mesa, CA 92627  
CAPITOL COMPUTER SYSTEMS  
Davis, CA 95616  
COMPUTERLAND SAN DIEGO EAST  
El Cajon, CA 92020  
COMPUTERLAND OF EL CERRITO  
El Cerrito, CA 94530  
BUSINESS ENHANCEMENT  
COMPU SERVICE  
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  
BYTE SHOP  
Mountain View, CA 94040  
HOBBY WORLD ELECTRONICS  
Northridge, CA 91324  
COMPUTERS-MADE-EASY  
Palmdale, CA 93550  
BYTE SHOP OF PLACENTIA  
Placentia, CA 92670  
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  
COMPUTERLAND (Central)  
San Leandro, CA 94577  
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  
COMPUTERS PLUS  
Sunnyvale, CA 94087  
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

BYTE SHOP  
Boulder, CO 80301  
COMPUTERLAND  
Colorado Springs, CO 80917  
AMPTEC  
Denver, CO 80216  
COMPUTERLAND  
Denver, CO 80222  
BYTE SHOP  
Englewood, CO 80110  
MICRO WORLD ELECTRONIX  
Lakewood, CO 80226  
**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  
PAPERBACK BOOKSMITH  
Sarasota, FL 33581  
AMF ELECTRONICS  
Tampa, FL 33612  
MICRO COMPUTER SYSTEMS  
Tampa, FL 33609  
COMPUTER CENTER OF  
PALM BEACHES  
West Palm Beach, FL 33409  
**GEORGIA**  
ADVANCE COMPUTER TECH  
Atlanta, GA 30328  
COMPU SHOP  
Atlanta, GA 30342  
DATAMART  
Atlanta, GA 30305  
THE LOGIC STORE  
Columbus, GA 31906  
COMPUTERLAND OF ATLANTA  
Smyrna, GA 30080  
**HAWAII**  
COMPUTERLAND  
Honolulu, HI 96813  
MICROCOMPUTER SYSTEMS  
Honolulu, HI 96813  
RADIO SHACK (Dealer)  
Lihue, HI 96766  
**IDAHO**  
NORTHWEST COMPUTER CENTER  
Boise, ID 83704  
**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  
ILLINI MICROCOMPUTERS  
Naperville, IL 60540  
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**  
SYNCHRONIZED SYSTEMS  
Des Moines, IA 50310  
THE COMPUTER CENTER  
Waterloo, IA 50701  
**KANSAS**  
PERSONAL COMPUTER CENTER  
Overland Park, KS 66206  
COMPUTER SYSTEMS DESIGN  
Wichita, KS 67214  
**LOUISIANA**  
COMPUTER 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**  
FORSYTHE COMPUTERS  
Clayton, MO 63105  
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  
TYPTRONIC COMPUTER STORE  
Ramsey, NJ 07446  
**NEW YORK**  
COMPUTERLAND  
Buffalo, NY 14150  
COMPUTERLAND  
Carle 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

COMPUTER MART OF NEW YORK  
New York, NY 10016  
AUTOMATIC SYSTEMS  
Poughkeepsie, NY 12603  
COMPUTER HOUSE  
Rochester, NY 14609  
THE COMPUTER STORE  
Rochester, NY 14618  
HOME COMPUTER CENTER  
Rochester, NY 14607  
THE COMPUTER CORNER  
White Plains, NY 10601  
READOUT COMPUTER STORE  
Williamsville, NY 14221  
**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  
COMPUTER SOLUTIONS  
Dayton, OH 45409  
DAYTON COMPUTER MART  
Dayton, OH 45409  
ASTRO VIDEO ELECTRONICS  
Lancaster, OH 43130  
COMPUTERLAND OF CLEVELAND  
Mayfield Heights, OH 44121  
RADIO SHACK (Dealer)  
St. Clairsville, OH 43950  
**OKLAHOMA**  
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  
Tigart, OR 97223  
**PENNSYLVANIA**  
BYTE SHOP  
Bryn Mawr, PA 19010  
PERSONAL COMPUTER CENTER  
Frazer, 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  
COMPU SHOP  
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  
COMPUTERLAND OF HOUSTON BAY  
Houston, TX 77058  
NEIGHBORHOOD COMPUTER  
Lubbock, TX 79401  
COMPUTER PATCH OF SANTA FE  
Odessa, TX 79762  
COMPU SHOP  
Richardson, TX 75080  
THE COMPUTER SHOP  
San Antonio, TX 78216  
COMPUTER SOLUTIONS  
San Antonio, TX 78229

WICHITA COMPUTER SYSTEMS  
Wichita Falls, TX 76301  
**UTAH**  
ADP SYSTEMS  
Logan, UT 84321  
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  
COW, INC.  
Blacksburg, VA 24060  
HOME COMPUTER CENTER  
Newport News, VA 23606  
COMPUTER TECHNIQUES  
Richmond, VA 23235  
THE COMPUTER PLACE  
Roanoke, VA 24015  
COMPUTER WORKSHOP  
Springfield, VA 22151  
COMPUTERLAND  
Vienna, VA 22180  
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  
PERSONAL COMPUTERS  
Spokane, WA 99202  
COMPUTERLAND  
Tacoma, WA 98499  
**WISCONSIN**  
BYTE SHOP OF MILWAUKEE  
Greenfield, WI 53227  
COMPUTERLAND  
Madison, WI 53711  
MADISON COMPUTER STORE  
Madison, WI 53711  
COMPUTERLAND  
Milwaukee, WI 53222  
FOX VALLEY  
COMPUTER STORE  
Neenah, WI 54956  
**AUSTRALIA**  
ELECTRONIC CONCEPTS PTY. LTD.  
COMPUTERLAND  
Sydney, N.S.W.  
**CANADA**  
COMPU SHOP  
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  
MINICOMP SYSTEMS  
Halifax, Nova Scotia B3K 2G1  
KOBETEK SYSTEMS  
Wolfville, Nova Scotia B0P 1X0  
LYNTRONICS  
Downsview, Ontario M2J 2W6  
COMPUTER CIRCUITS  
London, Ontario N6A 3H2  
COMPU MART  
Ottawa, Ontario K2A 1J2  
COMPUTER INNOVATIONS  
Ottawa, Ontario K1B 4A8  
RICHVALE TELECOMMUNICATIONS  
Richmond Hill, Ontario  
THE COMPUTER CENTRE  
Sarnia, Ontario N7T 1B4  
COMPUTER MART  
Toronto, Ontario M4G 3B5  
THE COMPUTER PLACE  
Toronto, Ontario M5V 1Z1  
COMPUTER SPECIALIST  
Toronto, Ontario M3K 1E7  
HOUSE OF COMPUTERS  
Toronto, Ontario  
MARKETRON  
Toronto, Ontario  
MICRO-WARE  
Toronto, Ontario M4E 2L2  
COMPU CENTRE  
Montreal, Quebec H1J 1Z4  
FUTUR BYTE  
Montreal, Quebec H3B 3C9  
CUSTOM COMPUTING SERVICES  
Saskatoon, Saskatchewan S7K 2B5  
DIGITAL SERVICE  
Saskatoon, Saskatchewan S7J 3A9  
**PUERTO RICO**  
MICROCOMPUTER STORE  
Rio Piedras, PR 00921  
**PLUS 17 DEALERS IN EUROPE!**



WEINA      CONTC  
NNTOU      LTTRY.

The same message enciphered in the dual mode (table 13) becomes:

(A: 0.5, 1.625, 3.125, 40 R/S: 26)

SFHU      JIFY  
IMPAI      XRVXZ  
SAVVW      PARTU  
SGIWM      VFFBG.

In the dual mode operation a conversion operation may be saved at each end of the system by using the numerical  $\bar{C}_m$  data directly as the cryptogram. The disadvantage to this is that the number of characters to be transmitted is doubled. In some circumstances transmission of numerals may be preferred over alphabetic characters in spite of the expanded volume.

Use of Nulls

Many procedures may be followed which will aid in protecting the cipher. One of these is the use of nulls. This procedure is very simple to use and actually speeds up the enciphering and deciphering process as discussed in the text box on search strategy. To use this technique, specify a message character length ( $N_c$ ) to program Crypto which is larger than the actual message length. For example, consider a message of length 100 and an  $N_c$  value specification of, say, 125. Crypto is used in the normal way until all 100 message characters are processed into the ciphertext. At this point the 125 character ciphertext contains 25 (scattered) blank spaces. Fill these blank spaces with characters chosen by you at random. When finished, the cryptogram will contain 25 totally irrelevant characters randomly located in the ciphertext.

The nulls present no problem to the decipherer since Crypto will point that person to genuine data for the first 100 processing cycles; after that the nulls are indicated. It might be wise to clearly delineate the end of a message by appending some prearranged terminal symbol to the plaintext. The speed of operation may be greatly increased by use of nulls since this keeps the mean processor time low, as discussed in the text box on search strategy. The longer messages should definitely use nulls to speed up the process. The use of nulls is clearly advantageous, since this presents the cryptanalyst with some additional possibilities that must be sorted out. Make sure that the nulls you supply blend well with the genuine ciphertext. Do not attempt, for example, to bal-

1. Prepare table as example table 11b shows and enter plaintext  $P_j$ . (11a)
2. Switch calculator to RUN and ON.
3. Load program.
4. Input data  $R_0, A_1, A_2, N_c$ . Follow each entry *except the last* with ENT↑. Press A.
5. Input data 0.
6. Depress R/S to start program.
7. Calculator will stop with a number in the form J.M. Copy plaintext character at position J to ciphertext position M.
8. Depress R/S and return to step 7.
9. Repeat the steps 7 and 8 loop. Pressing R/S after character  $N_c$  will cause the ERROR sign to flash. When flashing stops, press R/S one time.
10. If program is to be restarted, return to step 4.

Encipherment Example (11b)

J,M	01	02	03	04	05	06	07	08	09	10
$P_j$	M	A	Y	U	P	B	I	D	P	R
$C_m$	A	B	M	P	D	I	P	R	U	Y

Table 11: Crypto instructions for enciphering in the transposition only mode. The key is A:0.5, 1.625, 3.125, 10 R/S: 0.

1. Prepare table as example table 12b shows and enter ciphertext  $C_m$ . (12a)
2. Switch calculator to RUN and ON.
3. Load program.
4. Input data  $R_0, A_1, A_2, N_c$ . Follow each entry *except the last* with ENT↑. Press A.
5. Input data 0.
6. Depress R/S to start program.
7. Calculator will stop with a number in the form J.M. Copy ciphertext character at position M to plaintext position J.
8. Depress R/S and return to step 7.
9. Repeat the steps 7 and 8 loop. Pressing R/S after character  $N_c$  will cause the ERROR sign to flash. When flashing stops, press R/S one time.
10. If program is to be restarted, return to step 4.

Decipherment Example (12b)

J,M	01	02	03	04	05	06	07	08	09	10
$C_m$	A	B	M	P	D	I	P	R	U	Y
$P_j$	M	A	Y	U	P	B	I	D	P	R

Table 12: Crypto instructions for deciphering in the transposition only mode. The key is A:0.5, 1.625, 3.125, 10 R/S: 0.

1. Prepare table as example table 13b shows. Enter plaintext  $P_j$  and, using alphabet table, enter  $\bar{P}_j$  values. (13a)
2. Switch calculator to RUN and ON.
3. Load program.
4. Input data  $R_0, A_1, A_2, N_c$ . Follow each entry *except the last* with ENT↑. Press A.
5. Input data  $N_a$ .
6. Press R/S to start program.
7. Calculator will stop with a number in the form J.M. At index J select and enter  $\bar{P}_j$  and press R/S.
8. Calculator will stop with a number in the form J.M  $\bar{C}_m$ . At index M in table enter  $C_m$  from display.
9. Press R/S and return to step 7.
10. Repeat the steps 7, 8 and 9 loop. Pressing R/S after character  $N_c$  flashes the ERROR sign. When flashing stops, press R/S one time.
11. Using alphabet table convert  $\bar{C}_m$  to  $C_m$  to obtain ciphertext.
12. If program is to be restarted, return to step 4.

Encipherment Example (13b)

J,M	01	02	03	04	05	06	07	08	09	10	index.
$P_j$	M	A	Y	U	P	B	I	D	P	R	plaintext.
$\bar{P}_j$	22	07	10	21	19	02	11	23	19	25	entered at step 7 from alphabet table.
$\bar{C}_m$	13	01	10	22	19	11	05	06	22	09	program output from step 8.
$C_m$	H	F	Y	M	P	I	Z	X	M	G	from alphabet table.

Table 13: Crypto instructions for enciphering in the dual transposition and substitution mode. The sample table used for enciphering is shown in table 13b. The key is A:0.5, 1.625, 3.125, 10 R/S: 26; table 9 used.



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

**APPELISTENER**—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



Listing 1, continued from page 145:

145	GTOfa	ENT↑	1	-	RCL0	RCLC
151	X	fINT	hF?0	GTOfc	+	GTOfd
157	gLBLfc	CHS	RCLC	+	+	gLBLfd
163	RCLC	gx>y?	CLX	-	1	+
169	EEX	6	÷	RCL5	+	DSP6
175	R/S	gLBLfa	1	STO-3	RCL3	h 1/x
181	1	STO+6	6	RCL3	gx>y?	GTO1
187	GTO2	fLBLE	hSF2	RCLA	gLBLfe	RCL1
193	+	RCL2	hy <sup>x</sup>	gFRAC	STOA	hF?2
199	GTOfe	X	fINT	RCL0	RCL1	+
205	RCL2	hy <sup>x</sup>	gFRAC	STO0	RCLA	-
211	h 1/x	hR↓	hRTN			

Listing 2: Keygen program written for the HP 67. This program generates numerical keys from alphabetic phrases for program Crypto. When using this program, the user needs to know both the key base and the number of the key within the key sequence produced. A detailed description of how to operate program Keygen is given in table 15.

Location	Keys					
1	fLBLD	ENT↑	EEX	1	0	÷
7	fFIX	DSP4	STO6	STO7	STOD	CLX
13	STO9	1	.	2	5	STOA
19	RCL6	EEX	3	X	gFRAC	.
25	7	5	X	+	STOB	RCL6
31	EEX	6	X	gFRAC	3	.
37	7	5	X	RCLA	+	STOC
43	hRTN	fLBLE	STO8	fLBL9	RCL9	RCL8
49	gx>y?	GTO8	RCL6	STO7	STOD	CLX
55	STO9	fLBL8	RCL8	RCL9	-	1
61	-	fx=0?	GTO7	hSTI	fLBL6	gGSBfd
67	fDSZ	GTO6	fLBL7	RCL8	STO9	gGSBfd
73	RCL7	RCL9	+	R/S	RCLC	.
79	7	5	X	RCLA	+	R/S
85	RCLD	3	.	7	5	X
91	RCLA	+	R/S	1	STO+8	GTO9
97	gLBLfd	RCL7	RCLB	+	RCLC	hy <sup>x</sup>
103	gFRAC	STO7	RCLD	RCLB	+	RCLC
109	hy <sup>x</sup>	gFRAC	STOE	RCLB	+	RCLC
115	hy <sup>x</sup>	gFRAC	STOD	RCL7	-	h 1/x
121	hRTN					

ance out the letter frequency count in a transposition only cipher by manipulation of the nulls.

As an example of the use of nulls the following 40 character demonstration message is used with RRYYY appended as end of message indicator. An alphabet length of 60 is chosen, which yields 15 nulls. The cryptogram follows with the nulls underlined:

A: 0.5, 1.625, 3.125, 60  
R/S: 0  
(transposition only)

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

The 15 nulls are distributed randomly throughout the ciphertext. The reader may verify the operation by deciphering this cryptogram. Note that the first null pointed to will be on plaintext character 46, which is the start of the junk region.

In addition to the use of nulls, some other precautions may be taken to protect the cipher. The beginning and end of a message can represent sources of vulnerability. Standard or easily guessed salutations and signatures can be of great help to the cryptanalyst. One counter to this is to insert a few nonsense words at the beginning and end of each message using prearranged delineation flags. There is also the *bisection* method, which involves starting the message from some point near the middle, going to the end and then picking up the start. This buries the head and tail of the message somewhere in the middle of the cryptographic process.

The key of program Crypto is the 3 number group (R<sub>0</sub>, A<sub>1</sub>, A<sub>2</sub>). Program Keygen (listing 2) provides for convenient generation of thousands of keys from an easily remembered keyphrase. There is absolutely *no excuse* for using a given key more than once. In dual mode operation use one key for the mixed alphabet transposition table (table 9) and a different key for the Crypto enciphering operation. (By the way, do not be overly impressed by the added complexity of the dual mode cipher. In this business, complexity and security are not necessarily correlated. The transposition only mode represents a very effective cipher in spite of its simplicity of operation. Don't be afraid to use it.)

The limited speed, storage and I/O (input/output) facilities of today's pocket







# 5 reasons why you should not buy the electric pencil II™

© 1978 Michael Shrayer



Check the appropriate box(es):

- You love typing the same copy 20 thousand times a day.
- Your secretary can type 250 words per minute.
- You're dying to spend \$15,000 on a word processing system, just for the tax investment credit.
- All your capital assets are tied up in a 10-year supply of correction fluid.
- You never commit a single thought to paper.

If you have checked one or more boxes, you do not need The Electric Pencil. On the other hand, you may want to join the thousands of people who haven't checked a single box.

## 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 an Imsai VIO, Processor Tech. VDM-1, Polymorphic VTI, Solid State Music VB-1B or Vector Graphic video interface. REX versions also 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, e.g., SS-IIA, DV-XIB.

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	VIO	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	VIO	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	VIO	NEC Spinwriter	300.
SSH	SOL	Helios/TTY	250.
DSH	SOL	Helios/Diablo	300.

## Attention: TRS-80 Users!

The Electric Pencil has been designed to work with both Level I (16K system) and Level II models of the TRS-80, and with virtually any printer you choose. Two versions, one for use with cassette, and one for use with disk, are available on cassette.

The TRS-80 disk version is easily transferred to disk and is fully interactive with the READ, WRITE, DIR, and KILL routines of TRSDOS 2.1.

Version	Storage	Price
TRC	Cassette	\$100.
TRD	Disk	\$150.

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 or word hyphenations is not required since lines of text are formatted automatically.

As text is typed and the end of a 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 as it occurs, which eliminates guesswork. Text may be reviewed at will by variable speed scrolling both in the forward and reverse directions. By using the search or search and replace functions, any string of characters may be located and/or replaced with any other string of characters as desired.

Numerous combinations of line length, page length, line spacing and page spacing permit automatic formatting of any form. Character spacing, bold face, multicolumn and bidirectional printing are included in the Diablo versions. Multiple columns with right and left justified margins may be printed in a single pass.

## Wide screen video

Versions are available for Imsai VIO video users with the huge 80x24 character screen. These versions put almost twice as many characters on the screen!!!

## CP/M versions

Digital Research's CP/M, as well as its derivatives, including IMDOS and CDOS, and Helios PTDOS versions are also available. There are several NEC Spinwriter print packages. A utility program that converts The Electric Pencil to CP/M to Pencil files, called **CONVERT**, is only \$35.

## Features

- CP/M, IMDOS and HELIOS compatible
- Supports four disk drives
- Dynamic print formatting
- DIABLO and NEC printer packages
- Multi-column formatting in one pass
- Print value chaining
- Page-at-a-time scrolling
- Bidirectional multispeed scrolling controls
- 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

## Upgrading policy

Any version of The Electric Pencil

m  
ss

**MICHAEL SHRAYER SOFTWARE, INC.**  
1253 Vista Superba Drive  
Glendale, CA. 91205  
(213) 956-1593

may be upgraded at any time by simply returning the *original* disk or cassette and the price difference between versions, plus \$15 to Michael Shrayer Software. Only the originally purchased cassette or diskette will be accepted for upgrading under this policy.

**Demand a demo from your dealer!**





**ACCOUNTS PAYABLE AND ACCOUNTS RECEIVABLE**

by Lon Poole and Mary Borchers

□ This is a set of 21 programs which constitute an invoice-linked accounts payable and a low-volume invoice accounts receivable system for small business. 318 pp. \$15.00.

# Bits Presents the Osborne Library

**6800 ASSEMBLY LANGUAGE PROGRAMMING**

by Lance A. Leventhal

□ Lance A. Leventhal discusses assembly language programming for computers using the 6800 microprocessor. The 6800 instruction set is presented in depth with chapters on assemblers, simple programs, code conversion, tables and lists, subroutine, input/output, interrupts, program design and documentation, and sample projects. \$8.50.

**8080 A / 8085 ASSEMBLY LANGUAGE PROGRAMMING**

by Lance A. Leventhal

□ This book provides an introduction to assembly language programming for the 8080 A and the 8085 processors. Included are sections on the instruction sets for the two processors, assemblers, simple program examples, code conversion, table and lists, subroutines, IO, interrupts, program design, and debugging. Many examples and illustrations are included to cover critical points. 467 pp. \$8.50.

**PAYROLL WITH COST ACCOUNTING IN BASIC**

by Lon Poole

□ Includes program listings with remarks, descriptions, discussion of the principles of each program, file layouts, and a complete user's manual with step-by-step instructions, flow charts and sample reports with CRT displays. All 35 programs are written in the widely used computer language BASIC, and work together to produce a payroll, right down to the printing of paychecks and maintaining of employee records \$15.00.

**INTRODUCTION TO MICROMPUTERS Volume 0**

by Adam Osborne

□ Written for the absolute beginner, "The Beginners Book" tells you what microcomputer systems are all about: the component parts, options available, and what they can do for you. **Volume 0** also gives an introduction to micro-computer logic. \$7.95.

**SOME COMMON BASIC PROGRAMS**  
by Lon Poole and Mary Borchers

□ At last, a single source for all those hard to find mathematics programs! **Some Common BASIC Programs** combines a diversity of practical algorithms in one book: matrix multiplication, regression analysis, principal on a loan, integration by Simpson's rule, roots of equations, operations on two vectors, chi-square test, check writer, geometric mean and variation, coordinate conversion and a function plotting algorithm. These are just some of the many programs previously available only as part of software math package systems for large scale computers. All the programs are written in a restricted BASIC suitable for most microcomputer BASIC packages, and have been tested and debugged by the authors. \$8.50.

**AN INTRODUCTION TO MICROCOMPUTERS, Vol. 1, 2 and 3**

by Adam Osborne

Microcomputer designers and users are presented with a continually expanding array of processors and support chips. Each of these microprocessor families has its own advantages and disadvantages for a given application.

□ **Volume 1** is subtitled "Basic Concept". This is the book which presents a framework of ideas concerning the design and use of small computers implemented with LSI. Topics include definitions of the microcomputer, fundamental concepts of logic and numbering characteristics of instruction sets, etc. \$8.50.

□ **Volume 2** describes different microprocessors in such a manner as to make them easily comparable to one another. Architecture, timing, instruction set and usage are detailed for each. (Includes hardcover binder). \$20.00.

□ **Volume 3** includes descriptions of memory devices, parallel and serial I/O devices, CPU single and multi-support devices, system busses, and much more. (Includes hardcover binder) \$20.-

Volumes 2 and 3 are published in loose-leaf form with hardcover binder. Update subscriptions available.

**GENERAL LEDGER**

by Osborne & Associates

□ **General Ledger** is the complement to the other two books in the Osborne & Associates series of BASIC business programs: *Payroll with Cost Accounting* and *Accounts Payable and Accounts Receivable*. It is written in an extended BASIC with information to aid the user in implementing it in his or her own version of BASIC. **General Ledger** accepts postings from *Account Payable*, *Accounts Receivable*, or postings entered directly; maintains balances for current month, quarter, years and previous three years; and prepares trial balances, income statements, balance sheet and other financial reports. Well documented business software at a very reasonable price. \$15.00.

**BITS**<sup>T.M.</sup>  
inc

POB 428, 25 Route 101 West  
Peterborough, NH 03458

Books to erase the impossible

Charge Card Orders May Be Placed on Our

Toll-Free Number: 800-258-5477  
(In New Hampshire Call 924-3355)



For Ordering Use Coupon on Page 189

In place of the old keyphrase PATRICIA ZLOTNIK, three keystream generator numbers ( $R_0, A_1, A_2$ ) now become the key. The demonstration values are chosen as:

$$(0.5, 1.625, 3.125). \quad (7)$$

This move from keyphrase to numerical key required by automation is undesirable. A word or phrase is much more easily remembered than a sequence of digits. In order to humanize this process, the program Keygen is written which accepts a keyphrase and produces any number of machine-oriented keys ( $R_0, A_1, A_2$ ).

The ideal sequence generator would provide an infinite sequence of  $R_n$  values, each value being statistically independent of all other values. In practice the sequence must eventually repeat. There is a finite number of digits in the representation of  $R_n$ , so there is a finite number of different  $R_n$  values that may be produced. Since  $R_{n+1}$  is a function only of  $R_n$ , once a value is produced that has appeared before, a computational cycle is entered which cannot be broken and a periodic sequence results. This can create serious cryptographic vulnerability problems, especially if the sequence repeats during the processing of a message. Other shortcomings of sequence generators, such as correlation tendencies or biases, can also be exploited by the cryptanalyst.

Protection against looping is provided in Crypto using a technique ascribed by D E Knuth and J Gait to R W Floyd. See especially problem numbers 6 and 7 in Section 3.1 of the Knuth book in the bibliography. Floyd's algorithm requires that a second sequence generator be used, which is cycled twice for every cycle of the first generator. The values of  $R_n$  and  $R_{2n}$  are compared. As Knuth shows, equality will always be reached before cycling begins. After each cycle of  $R_n$ , comparison is made with  $R_{2n}$ , and, if equality is detected, Crypto halts (at step 211). If this occurs (very, very unlikely), pick another ( $R_0, A_1, A_2$ ) key and try again. The author has tested many keys selected at random and found sequence lengths much longer than required for any message, even in the worst cases. The demonstration key (0.5, 1.625, 3.125), for example, has a nonrepeating sequence length which lies between 18,303 and 24,403, after which cycling takes place with a period of 6101.

### Transposition Operation

The operating principles of program Crypto can be explained with the aid of

### Search Strategy

The method of generation of the random integer R for selection of M-field cells (phase A, figure 1) does not preclude repetition in the random number sequence. That is, on a given pass an M cell can be pointed to that which has already been used. The bits in the special registers are used to represent M-field cells, bit *off* meaning cell open and bit *on* meaning cell already used. Access to and control of these bits currently involves arithmetic rather than logical operations, and processor time becomes an important consideration.

In the phase A portion of figure 1, repeated trials are made to find an open cell. Up to T such trials are permitted before phase B is entered as a slow but sure last resort solution. Timing runs indicate that one phase A trial requires 4.375 seconds of processor time. Hence we define a time cost  $C_a$  as:

$$C_a = 4.375 \text{ seconds.} \quad (8)$$

This is the time required to test one isolated bit in one of the ten special registers.

In phase B an exhaustive search is made of each bit in the M-field. The overhead is lower here and it takes only 1.533 seconds to search each cell. However, the mean cell number searched until the specified empty cell is found will be roughly half the number of characters in the message ( $N_c/2$ ). Hence the mean cost of the phase B operation  $C_b$ , is:

$$C_b = 1.533 \left( \frac{N_c}{2} \right) = 0.767 N_c. \quad (9)$$

Note that the phase B cost increases with the number of characters in the message. For long messages, the cost of phase B becomes much greater than the cost of phase A. We seek now a strategy which minimizes the mean overall time cost ( $C_o$ ) for an M cell selection in the transposition table generation. (The substitution operation takes a very short time to complete.)

If the number of open cells is S then the probability of success ( $P_s$ ) per phase A trial is simply:

$$P_s = \frac{S}{N_c}. \quad (10)$$

On a given phase A pass, let the first success be on trial K. The probability of this is:

$$(1-P_s)^{K-1} P_s;$$

and the total cost of this phase A operation is:

$$(K)(C_a).$$

The probability that T consecutive failures will occur in phase A (and hence require use of phase B) is:

$$(1-P_s)^T.$$

The cost when this occurs is:

$$(T C_a + C_b).$$

Putting these results together, the mean overall cost for a transposition table entry calculation becomes:



$$C_o = \sum_{k=1}^T (1-P_s)^{K-1} P_s K C_a + (1-P_s)^T (T C_a + C_b). \quad (11)$$

Using the identity:

$$\sum_{N=0}^{K-1} N X^N = X \left[ \frac{K X^{K-1}}{X-1} - \frac{X^K - 1}{(X-1)^2} \right] \quad (12)$$

allows equation 11 to be reduced to:

$$C_o = C_a \left[ \frac{1 - (1 - P_s)^T}{P_s} \right] + C_b (1 - P_s)^T. \quad (13)$$

The function  $C_o$  is monotonic in  $T$  and behaves as indicated in figure 2. When  $T$  is equal to 0, no phase A trials are made and the cost is simply the phase B cost ( $C_b$ ). As  $T$  increases without limit (success in phase A is forced to prevent use of phase B) the mean overall cost has an asymptote of  $C_a/P_s$ . If this value is smaller than the cost of phase B ( $C_b$ ), the lowest mean cost (time) is achieved with the penalty that some calculations may never finish.

As the encipherment (or decipherment) progresses,  $S$  becomes smaller and eventually the critical point is reached when the value of the asymptote  $C_a/P_s$  equals the cost of phase B ( $C_b$ ). Using equations (8), (9) and (10), this critical value ( $S_c$ ) is seen to be:

$$\begin{aligned} S_c &= (N_c) \left( \frac{C_a}{C_b} \right) \\ &= (N_c) \left( \frac{C_a}{0.767 N_c} \right) = 5.7; \end{aligned} \quad (14)$$

which simply says that when the number of empty cells reaches approximately 6, phase A operation is too expensive (in time) because the probability of success is too low. The strategy at this point is to cut out phase A completely and go directly to phase B. The parameter  $T$  controls the exchange of maximum processor time for a transposition table calculation to the mean processor time. Increasing  $T$  results in lower mean times and longer maximum times.

Figure 2 shows that, for sufficiently large values of  $T$ , the mean time ( $C_o$ ) becomes inversely proportional to the probability of success in phase A ( $P_s$ ) and hence the number of opens cells ( $S$ ). One way of keeping the probability of success ( $P_s$ ) high and the mean cost ( $C_o$ ) low is to pick a number for  $N_c$  (message length) which is greater than the actual message length. The program is then used only to process all the legitimate message characters. The remaining spaces are filled with randomly selected characters (nulls). By this artifice, the number of available cells ( $S$ ) is not permitted to run down to its critical value. Use of this technique is detailed in the main text.

The 2 phase approach of figure 1 has real value even if faster computation is at hand. Random tests of isolated  $M$  cells will always be faster than the contiguous  $M$ -field search required in phase B. Hence the optimization strategy will always be able to contribute to computational efficiency. Additionally, the pseudorandom nature of the transposition table calculations helps isolate the resulting cryptogram from the key-stream generator, hence strengthening the cipher.

### Key Generation

Those concerned with field ciphers generally concede that the basic method of operation cannot be kept secret. The security of the cipher, therefore, rests in the key. In some of the examples given in part 1 of

figure 1. The ten special registers  $S_0$ - $S_9$  of the HP 67 are reserved for up to 300 ciphertext character position indicators ( $M$ -field). A bit is reset (0) if the corresponding position is open and can accept a ciphertext character. Conversely, the bit is set (1) if that  $M$ -field position has been filled in a previous transposition operation.

The transposition operation of figure 1 is comprised of two phases, A and B. Upon entry to phase A the sequence generator is cycled and a random integer number  $R$  in the range 0 to  $N_c - 1$  is generated. Position  $R$  is then tested in the  $M$ -field and if the  $R$ th position is open the bit is set and phase B is bypassed. If the position is already filled, additional tries via loop A are executed. If an open position is not found in  $T$  trials, phase B is entered.

Phase B is demanding of processor time, but success here is guaranteed. A count  $S$  is kept of the number of open spaces remaining in the  $M$ -field. The sequence generator is cycled and random integer number  $R$  is generated in the range 0 to  $S - 1$ . The entire  $M$ -field is then searched and the open positions are counted until the  $R$ th one is reached. When this happens the corresponding bit in the  $M$ -field is set and phase B is complete.

Following phases A and B an  $M$  value is computed and the transposition pair  $J.M$  is displayed with the program halted. The transposition portion of the program is now complete.

### Substitution Operation

In dual mode operation the user would at this point enter  $\bar{P}_j$  (encipher) or  $\bar{C}_m$  (decipher) and press  $R/S$  to restart the program. The necessary residue arithmetic would be done as shown in table 10 and the program would again halt showing either:

$J.M \bar{C}_m$  (encipher)

or

$J.M \bar{P}_j$  (decipher).

The substitution key is generated from the  $R_n$  register of the Floyd algorithm; the sequence generator is not cycled for this operation. In the transposition only mode, this whole process is bypassed as indicated in figure 1.

### Throughput Optimization Strategy

After this information is disposed of by the user, the program is restarted. If the number of open spaces in the  $M$ -field is  $Q$

# 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

ALL PRICES AND PROGRAMS ARE SUBJECT TO CHANGE WITHOUT NOTICE



this article, the keys were easily remembered keyphrases such as ROYAL NEW ZEALAND NAVY, PHYSICAL EXAMINATION, and our own PATRICIA ZLOTNIK. In program Crypto the key becomes the 3 number group ( $R_0, A_1, A_2$ ) such as (0.5, 1.625, 3.125).

Since keyphrases are more easily remembered than a sequence of digits, program Keygen has been written to permit the use of keyphrases for the generation of keys for program Crypto. One part of the program key is a 10 digit integer which we may call the key base. Once this base number is entered into Keygen, a number of keys may be generated. Each key triplet is identified by a key number N. If a different key base is used, a different sequence of ( $R_0, A_1, A_2$ ) keys will be generated. If Keygen is employed, the user needs to know both the key base used to produce the sequence of keys and the number of the key within the sequence.

A convenient way of relating keyphrase to key base is to number the normal alphabet using 2 digit numbers. That is: A = 01, B = 02, C = 03, . . . , X = 24, Y = 25, Z = 26. Now simply associate each letter with the *second digit* of its corresponding numerical value. Ten characters are selected from the keyphrase and their digit-for-character equivalences form the key base. For example, calling once more upon our friend from the main text yields:

PATRICIAZL (keyphrase);  
6108939162 (key base).

Using Keygen with this key base, a table of keys may be created and listed by key number N as follows:

N	$R_0$	$A_1$	$A_2$
1	0.6233	1.7175	2.8561
2	0.4283	1.7423	2.6784
3	0.6564	1.7579	3.5444
4	0.3809	1.8209	3.8895
5	0.6771	1.9392	4.8296
6	0.6119	1.9619	3.9956
7	0.7612	1.7418	2.3276
8	0.7039	1.9241	3.4082
9	0.9190	1.7517	2.4218
10	0.9546	1.3436	3.4242

A little imagination in the use of Keygen should make it possible never to have to repeat the use of a key. For example, in a multiple-user environment, each user could be assigned a unique block of key numbers. These would be used in some form of rotation that could be restarted after a new key base is invoked. All users must know the key base by prearrangement. The key number, however, could be contained in the cryptogram. If certain groups are set aside by prearrangement as control groups, the key number information could be contained in these characters.

For example, let the third group of each cryptogram be a control group and assume the same alphabetic-numeric equivalence described in the keyphrase-key base relationship. Let the center character of the third group indicate mode: even number for transposition only, odd number for dual mode. The first two characters of this group could represent mixed alphabet key number for dual mode or would be nulls in the transposition only mode. The last two characters could represent the encipherment operation key number. The control group JNGTI, for example, signals dual mode, indicates key number 4 for mixed alphabet generation, and shows that key number 9 was used in encipherment. The control group is inserted into the cryptogram after encipherment and removed before decipherment.

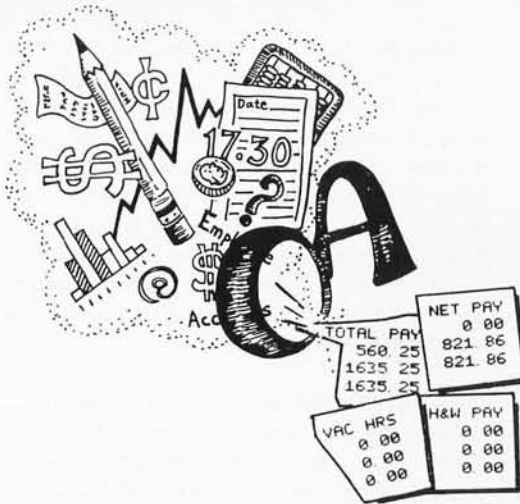
or less, phase A is skipped and phase B is entered directly. Otherwise the program loops back and enters phase A. This strategy and the choices of T and Q are designed to minimize the mean processing time (details are in the text box on search strategy). Coincidentally this approach presents the cryptanalyst with a highly non-linear, multivalued barrier from the cryptogram back to the key ( $R_0, A_1, A_2$ ). On some passes  $R_n$  is cycled only once. At the other extreme it is also possible that  $R_n$  is cycled T times in phase A and one time in phase B for a total of T + 1 cycles of the  $R_n$  generator. The *luck of the draw* nature of the transposition algorithm can produce some dramatic changes in the flow of events arising from very minor situation differences, such as adding or subtracting one character from the plaintext. This algorithm has some interesting trapdoor or one way properties.

### General Remarks

With the notable exception of Vernam's onetime key, all cryptographic systems are considered to be vulnerable to cryptanalytic attack. As a consequence any proposed cryptographic technique must be evaluated for degree of security before being used. The adversary roles of the cryptographer and the cryptanalyst have existed for centuries. Mathematical proofs of security (usually based on the impossibility of testing the vast number of combinations offered) have lured innumerable amateurs and a few professionals over the years into positions that later proved embarrassing to the people who formulated the proofs. These proofs of invulnerability were destroyed by competent cryptanalysts who accepted the futility of exhaustive searches and instead searched for other means to break the system. The question of security, which is the very core of cryptography, encompasses many disciplines and occupies the full-time efforts of thousands of talented people worldwide. Part III of the Shannon paper and sections VI and VII of the Diffie and Hellman paper are highly recommended for background in this area (see bibliography).

Standard evaluation methods of secrecy systems involve cryptanalytic attacks on the system. The *ciphertext only* attack is the weakest test, since the analyst is given only ciphertext with which to work. Systems which fail this test are rated as very weak. The *known plaintext* attack allows the analyst access to corresponding portions of plaintext and ciphertext. The most severe test is the *chosen plaintext* attack, in which

## BUSINESS SOFTWARE FOR MICROCOMPUTERS



Osborne & Associates is publishing its business systems in book form. These systems represent five years of development and testing by O&A programmers, and the books include more than a year's worth of extensive and detailed documentation.

What systems are we selling?

- 1) PAYROLL WITH COST ACCOUNTING
- 2) ACCOUNTS PAYABLE AND ACCOUNTS RECEIVABLE
- 3) GENERAL LEDGER

Each book sells for \$15.00, and includes source listings in Wang BASIC, program and system documentation, and user's manual. Each is a complete package by itself, or all three may be implemented together

to form a complete system with interdependent files.

And if Wang BASIC won't work, or you don't know programming, or you'd rather not key in thousands of words of source code, take a look at the list of consultants who have adopted O&A programs, converted them to run on many popular systems, and are waiting to hear from you.

### CP/M CBASIC: GOOD NEWS FOR CONSULTANTS, COMPUTER STORES AND SOFTWARE HOUSES

Osborne & Associates is converting its business software from Wang BASIC — as it was originally published — to CP/M CBASIC, which runs on many floppy disk-based microcomputer systems. We will only sell the CP/M magnetic surface to consultants, computer stores and software houses. Osborne & Associates prefers to write and sell books, not customize the programs or answer the end user's questions. The disk for each book sells for \$250.00. Once you buy the floppy disk you can copy it, resell it, change it or use it. We place no restriction on the magnetic surface; we copyright only the printed word in our books. CBASIC Payroll is available now. All three systems are scheduled to be available in the first half of 1979; call or write for the exact availability of each system.

If you are an end user interested in the CBASIC programs, write or call us. We will put you in touch with your closest dealer.

<p><b>ALPHA MICRO:</b> P. Burke THE BASIC BUSINESS SOFTWARE CO., INC. P.O. Box 2032 Salt Lake City, UT 84110 (801) 363-1199</p> <p><b>APPLE II:</b> Roger Varnes ADVANCED COMPUTER TECHNOLOGIES 290 Hilderbrand Avenue N.E. Atlanta, GA 30328 (404) 255-8984</p> <p>Joe Poston A.C.E. COMPUTER SYSTEMS 2449 North Westshore Tampa, FL 33607 (813) 872-8301</p>	<p><b>IBM 5110:</b> Mark Sherman DATA WORKS 35 E. Wacker Drive, Suite 1843 Chicago, IL 60601 (312) 726-2572</p> <p><b>MICROPOLIS. PROCESSOR TECHNOLOGY. NORTHSTAR:</b> David Price DAP SYSTEMS 3901 Victoria Lane Midlothian, VA 23113</p> <p><b>MICROSOFT disk BASIC:</b> Dan Kindred GNAT COMPUTERS, INC. 7895 Convoy Court San Diego, CA 92111 (714) 560-0433</p>	<p><b>TRS-80:</b> Don French FMG CORPORATION 3312 Denbury Drive Fort Worth, TX 76133 (817) 738-0251</p> <p>James E. Smith, Jr. THE READY CORPORATION P.O. Box 532 Pleasanton, CA 94566 (415) 443-4876</p> <p>Irwin Taranto TARANTO &amp; ASSOCIATES P.O. Box 6073 San Rafael, CA 94903 (415) 472-1415</p>	<p><b>DIGITAL GROUP Z80 under OASIS BASIC:</b> Charles Finn THE SYSTEMS GROUP 2993 Boring Ridge Drive Decatur, GA 30034 (404) 289-8969</p> <p><b>Wang BASIC:</b> Richard Armour ATLANTIC COMPUTING &amp; CONSULTING P.O. Box 7294 Hampton, VA 23666 (804) 340-9350</p> <p><b>BASIC for ZILOG MCZ, ZDS</b> Timothy Fossum CUSTOM COMPUTER SYSTEMS 4328 Pennington Lane Racine, WI 53403 (414) 554-0320</p>
--	--	---	---

**OSBORNE & ASSOCIATES, INC.**  
P.O. Box 2036, Berkeley, CA 94702  
630 Bancroft Way, Berkeley, CA 94710  
(415) 548-2805 TWX 910-366-7277

Attention: Dept. 119

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ STATE \_\_\_\_\_

ZIP \_\_\_\_\_ PHONE \_\_\_\_\_

I am a dealer interested in purchasing CBASIC programs for resale. Please send description and order information for:

I am an end user interested in running CBASIC programs. Please notify me of the closest dealer for:

CBASIC Payroll with Cost Accounting  
 CBASIC Accounts Payable/Receivable  
 CBASIC General Ledger

BOOK	PRICE	QUANTITY	AMOUNT
09-8 Payroll with Cost Accounting	\$15.00		
13-6 Accounts Payable/Receivable	\$15.00		
20-9 General Ledger	\$15.00		

**SHIPPING** (Shipping for large orders to be arranged)

All foreign orders \$4.00 per book for airmail

\$0.45 per book 4th class (allow 3-4 weeks in the U.S.)

\$0.75 per book UPS in the U.S. (allow 10 days)

\$1.50 per book special rush shipment by air in the U.S.

California residents tax shipping

**TOTAL AMOUNT ENCLOSED**

Please send the following information:

Becoming an O&A dealer

School discounts

List of foreign distributors

Other O&A publications

Calif. residents add 6% sales tax.  
S.F. BART residents add 6-1/2 % sales tax.

Payment in advance must be enclosed for purchases of up to \$70.00. Invoicing U.S. purchases over \$70.00 available upon approval of your account. All foreign orders must be prepaid in U.S. dollars drawn on a U.S. bank.





Table 15 gives detailed user instructions for program Keygen. An error halt at program location 120 (very unlikely) indicates that a looping condition has been detected in the Keygen random number generator. The largest permissible key number value for this key base is one less than the difference between the contents of register 8 and register I. Either stay within this limitation or change the key base. As a precaution, one could generate the highest numbered key to be used when a new key base is invoked to insure that there are no looping problems within Keygen. As mentioned before, it is very unlikely that this condition will ever be encountered. The 3 sequence generator cycles required by the Floyd algorithm serve double duty in Keygen. For each key triplet generated, the  $R_n$  register of Keygen supplies the seed; one less than  $R_{2n}$  is used to compute  $A_1$ ; and  $R_{2n}$  is employed in the  $A_2$  calculation.

1. Prepare table as example table 14b shows. Enter ciphertext  $C_m$  and, using alphabet table, enter  $\bar{C}_m$  values. (14a)
2. Switch calculator to RUN and ON.
3. Load program.
4. Input data  $R_0, A_1, A_2, N_c$ . Follow each entry *except the last* with ENT↑. Press A.
5. Input data  $N_a$ ; follow  $N_a$  with CHS (that is enter  $-N_a$ ).
6. Press R/S to start program.
7. Calculator will stop with J.M in display. At index M, select  $\bar{C}_m$  and enter. Press R/S.
8. Calculator will stop with a number in the form J.M Pj. At index J in table enter Pj from display.
9. Press R/S and return to step 7.
10. Repeat the steps 7, 8 and 9 loop. Pressing R/S after character  $N_c$  flashes the ERROR sign. When flashing stops press R/S one time.
11. Using alphabet table convert Pj to Pj to obtain plaintext.
12. If program is to be restarted, return to step 4.

**Decipherment Example** (14b)

J,M	01	02	03	04	05	06	07	08	09	10	index
$C_m$	H	F	Y	M	P	I	Z	X	M	G	ciphertext
$\bar{C}_m$	13	01	10	22	19	11	05	06	22	09	from alphabet table. Enter at step 7.
Pj	22	07	10	21	19	02	11	23	19	25	from program at step 8.
Pj	M	A	Y	U	P	B	I	D	P	R	from alphabet table.

Table 14: Crypto instructions for deciphering in the dual transposition and substitution mode. The sample table used in deciphering is shown in table 14a. The key is A:0.5, 1.625, 3.125, 10 R/S: -26; table 9 used.

1. Set calculator switches to RUN and ON.
2. Load program.
3. Enter the 10 digit integer key base number and press D.
4. Enter key number N desired and press E.
5. Display will show a number in the form  $N.R_0$  with four digits assigned to  $R_0$ . Key number N is shown for identification only.
6. Press R/S to obtain  $A_1$ .
7. Press R/S to obtain  $A_2$ . This completes key number N data ( $R_0, A_1, A_2$ ).
8. If R/S is pressed at this point, the program cycles back to step 5 with N+1 replacing N. Thus, the 5,6,7,8 loop may be used to obtain a sequence of keys.
9. After step 7, the user may start a new sequence by returning to step 4. To save time, plan use so that N values are called for in ascending order.
10. Step 3 may be entered after step 7 to change the key base.

Table 15: Detailed instructions for using program Keygen to generate keys which are used with program Crypto.

the analyst chooses the plaintext source material and the corresponding ciphertext is also made available for analysis.

With the above in mind, the trapdoor systems described earlier display yet another fascinating difference from the classical cryptographic techniques. Normally the material for plaintext attacks must be obtained through devious means. In the trapdoor case the public encryption key invites

chosen plaintext attack at the leisure of the analyst. If the system is strong enough to survive this test, it is strong indeed by classical standards. The revival of the *large number of possibilities* argument which has been discredited so many times in the past is also most curious. Can it be that the trapdoor approach results in a situation in which large numbers are both necessary and sufficient? Consider this remarkable statement by Martin Gardner:

*Computers and complexity theory are pushing cryptography into an exciting phase, and one that may be tinged with sadness. All over the world there are clever men and women, some of them geniuses, who have devoted their lives to the mastery of modern cryptanalysis. Since World War II even those government and military ciphers that are not one-time pads have become so difficult to break that the talents of these experts have gradually become less useful. Now these people are standing on trapdoors that are about to spring open and drop them completely from sight.*

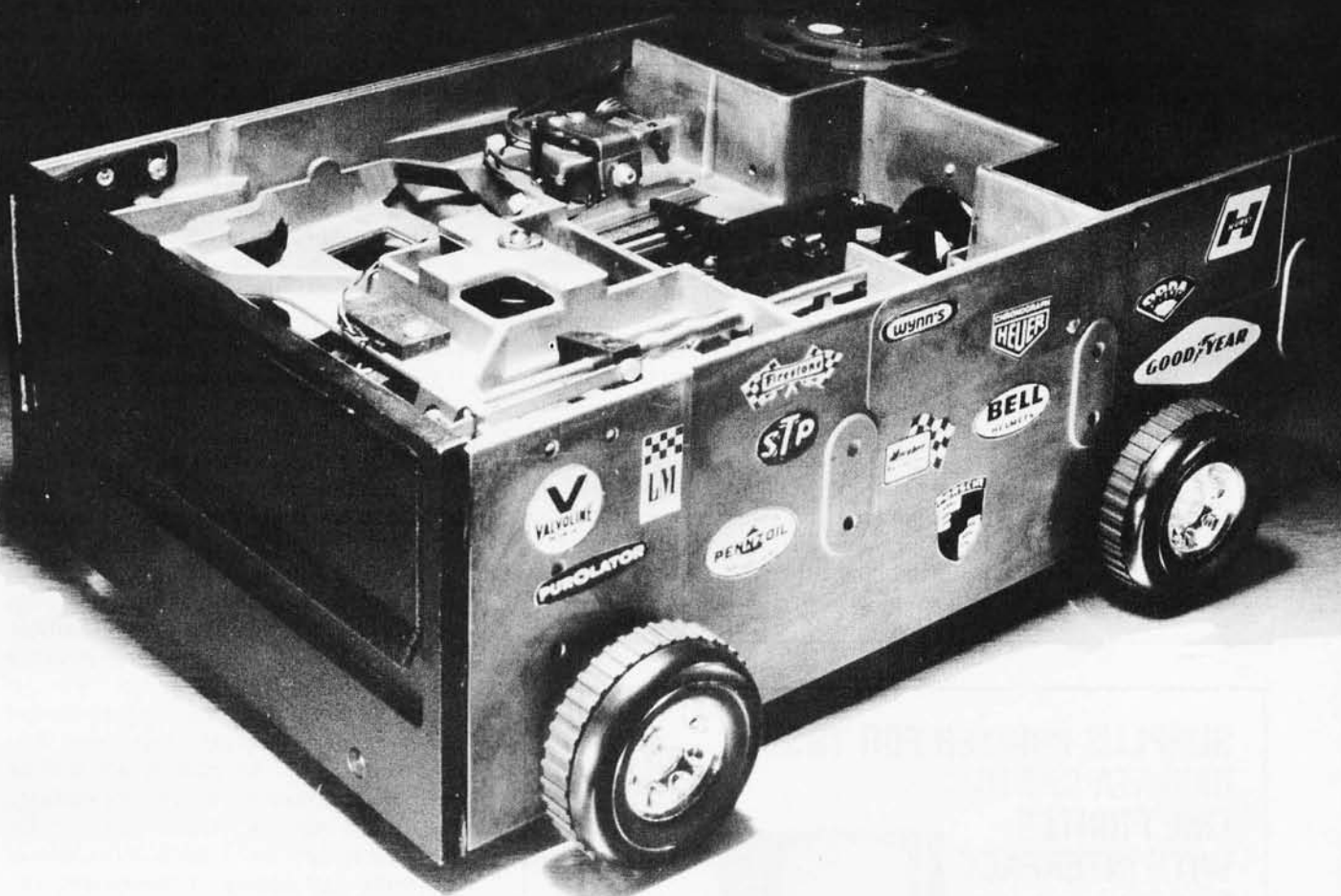
This statement, cited in the bibliography, is made all the more remarkable when one considers the stature of the man who made it. Aside from the trapdoor hypothesis, there is the indication here that emerging technology has been favoring the cryptographer and that the cryptanalyst is being outdistanced in this phase of the race. Advances in computer technology may have given governments the privacy they seek for their communications. Will further advances extend this same privilege to the common citizen?

Progress in communication techniques, data processing and data storage has made it increasingly convenient for governments to invade the privacy of their citizens. Further developments in cryptographic theory and related digital processing devices are bound to lower costs considerably. The step from insuring the privacy of computer based business transactions to insuring the privacy of personal communications and records is not too hard to imagine. Science knows no politics or philosophy. Technology, which in the past has permitted established groups to invade the privacy of the individual, may be about to make restitution.

### Evaluation of Crypto

In the qualitative discussion which follows, a known plaintext attack will be

# Drive a Winner.



## FULL SIZE. DUAL DENSITY. AFFORDABLE PRICE

We are offering, for a limited time, the industry proven Remex RFD1000B Disc Drive at an introductory price of \$395. This is the lowest price ever advertised for a full size disc drive. This drive can operate in either single or double density mode and can store up to 800k bytes unformatted. It has been on the market for three years and has been proven in the field.

We are also a service center and ready to service what we sell at rates that keep hobbyist and small OEM budgets in mind.

# \$ 395.00

\*Decals and Wheels not included in purchase price.

**BONUS OFFER:** We will include two important options-Optical Write Protect and a Door Lock Mechanism-list price value \$50. for only \$25. for ordering promptly. If you include check or money order with your order, we will include these two options absolutely FREE.

**The Computer Factory**  
P. O. Box 155  
Arlington Ma. 02174

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Disc Drives @ \$395.	
Options Packages @ \$25.	
Shipping (\$6.00/drive)	
Tax (Mass. Residents)	
<b>TOTAL</b>	

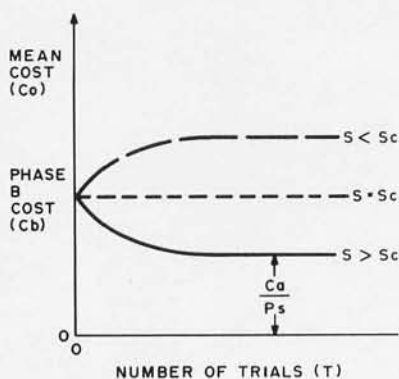
- Check or M.O. with order  
(Get free options package)
- C.O.D. (Include 25% with order)
- M.C. # \_\_\_\_\_
- Visa # \_\_\_\_\_

Signature \_\_\_\_\_

**the computer factory**



Figure 2: Graph showing the variation in the mean cost with respect to the number of trials allowed to take place to find an empty cell.



assumed as the testing vehicle. The reason for making transposition mandatory in Crypto may be demonstrated by considering a known plaintext attack on a substitution cipher. In such a cipher, character positions remain unaltered in the cryptogram. The ciphertext character values are the modulo sums of key and plaintext values. The known plaintext attack removes the plaintext value cover to reveal the key generator values. The analyst then attempts to determine the generator parameter settings by use of the known sequence of

generator key numbers. In a straight substitution cipher the security load is carried entirely by the keystream generator. Gait indicates that shift register generators produce very poor ciphers, especially the linear congruential generators which are in common use (see bibliography).

No claim for greatness is made for the generator used in Crypto as defined in equation (5). We have ignored Knuth's admonition not to select a random generator at random. While this algorithm appears to be satisfactory, there would be no hesitation in replacement by a better algorithm that fits into the available coding space.

The sequence generator and the organizational logic of Crypto (figure 1) work together against the cryptanalyst. Consider a transposition only cipher and a known plaintext attack. The characters of the plaintext are scattered throughout the ciphertext with replications. There are 13 Ts in the sample of known plaintext, for example, and 48 Ts in the cryptogram. There are too many ways to relate these two groups (plaintext-ciphertext) in order to get sequence generator output strings for analysis.

It should also be noted in figure 1 that that the phase A/phase B logic plays an important role in frustrating analysis. Even if consecutive plaintext transpositions could be identified, this does not mean that sequential outputs of the random number generator were involved. There may have been several loop A cycles in search of an open M field position between placements. The future behavior of the system of figure 1 from any point on is a function of the *entire past history* of the system. This seems to demand a chosen plaintext attack based on the beginning of the message. The analyst cannot jump into the middle of the process, so to speak. In fact, even if the entire transposition sequence ( $M_1, M_2, \dots, M_{Nc}$ ) were known, there does not appear to be a sure way of working back to the ( $R_0, A_1, A_2$ ) generating key. The quantizing operation  $INT [Nc \times R_{2n}]$  defines only a range for  $R_{2n}$  when the result is given, and represents a complicating factor. The *lost* odd cycle of the sequence generator in the transposition operation should also prove quite annoying to the analyst. The Floyd algorithm is thus used to protect the cipher in two ways.

Further protection may be obtained from the substitution operation. If the alphabet is expanded to include numerals, the scrambled order of numerals in the transposition only cryptogram may still be too revealing. In such cases the dual mode of operation is highly recommended. I believe that a very effective cryptographic

## 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

capability results if Crypto is used according to the instructions given.

The author wishes to express his thanks to Dr J C Buchta and Dr S B Akers, Jr, both of the General Electric Company, for many interesting comments and criticisms.

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

#### BIBLIOGRAPHY

1. Kahn, David, *The Codebreakers, the Story of Secret Writing*, Macmillan, New York, 1967.
2. Vernam, G S, "Cipher Printing Telegraph Systems for Secret Wire and Radio Telegraphic Communications," *Journal of the American Institute of Electrical Engineers*, volume 45, pages 109 thru 115, 1926.
3. Shannon, C E, "Communication Theory of Secrecy Systems," *Bell System Technical Journal*, volume 28, October 1949, pages 656 thru 715.
4. Diffie, W and Hellman, M E, "New Directions in Cryptography," *IEEE Transactions on Information Theory*, volume IT-22, number 6, November 1976, pages 644 thru 654.
5. Knuth, D E, *The Art of Computer Programming, volume 2, Seminumerical Algorithms*, Addison-Wesley, Reading MA, 1969.
6. Rivest, R L, Shamir, A and Adleman, L, "A Method for Obtaining Digital Signatures and Public Key Cryptosystems," *Communications of the ACM*, volume 21, number 2, February 1978, pages 120 thru 126 and 179.
7. Gait, J, "A New Nonlinear Pseudorandom Number Generator," *IEEE Transactions on Software Engineering*, volume SE-3, number 5, September 1977, pages 359 thru 363.
8. Gardner, Martin, "Mathematical Games/A New Kind of Cipher That Would Take Millions of Years to Break," *Scientific American*, August 1977, pages 120 thru 124.
9. Gaines, Helen F, *Cryptanalysis, A Study of Ciphers and Their Solutions*, Dover, New York, 1956. (Formerly published under the title, *Elementary Cryptanalysis*.) ■

# 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



# Life Can Be Easy

Randy Soderstrom  
4601 Goldfinch Dr  
Madison WI 53714

I've written a fairly short and simple program (about 220 bytes) to play Life on an 8080 based system. You need only two pages of memory for the program and the playing board. When this was originally written, I had only 1 K bytes of memory in my Altair, so this version is a simple one. A few extensions are suggested, but they are not necessary to enjoy Life.

The playing board is a 16 by 16 grid taking one page (256 bytes) of memory. Only the two least significant bits of each byte are used, and the leftmost column and top row are used as a border. If you don't use the border, the top of the board is next to the bottom, and the right edge is next to the left edge.

The board is arranged as shown in figure 1. The number in each box is its address in memory. It is initialized by first setting all locations 00 through 0F (the top row) and 10, 20, 30 . . . E0, F0 (left

column) are set to hexadecimal FF. Each cell with FF is a border cell and is ignored by the rest of the program. The function of the border will become clear later.

The initial pattern must be loaded by some other loader program or through your front panel. You simply draw the first generation on a sheet of graph paper numbered as in figure 1, then set the address of each line cell to hexadecimal 01.

Each byte looks like figure 2. Note that only the two least significant bits of each byte are used. Bit zero is a 1 if that cell is alive this generation. If it will be alive next generation, bit one is also a 1. To make the next generation into this generation, we need only shift each memory location to the right.

The program is written to be simple — not efficient or fast — and consists of six main routines that are called repeatedly for each cell (see listing 1). Subroutine NCOUNT, for example, is called about 1,900 times each generation.

The first routine, BDINIT, initializes the board (clears it and sets up border) and then jumps to your loader to get the initial pattern. After you have loaded an initial pattern, you will want to write it out on your terminal before the next generation is computed. This is done by routine WRITE. The border characters are written as a slash and the live cells as a star.

Before a line is written, it is scanned for live characters. If none are alive, a slash and a carriage return are output, and the next line is checked. This saves the computer the task of writing a line of blanks and can save considerable time in writing out small patterns.

Now we have the board set up and the initial pattern loaded and checked. The computer is ready to calculate the next generation. Since the status of a cell (alive or dead next generation) depends only on the number of live neighbors, the program simply goes from one cell to the next counting the number of live neigh-

00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F
20															2F
30															3F
40															4F
50					55	56	57	58	59	5A	5B				5F
60	61	62	63	64	65	66	67	68	69	6A	6B	6C	6D	6E	6F
70	71	72	73	74	75	76	77	78	79	7A	7B	7C	7D	7E	7F
80					85	86	87	88	89	8A	8B				8F
90															9F
A0															AF
B0															BF
C0															CF
D0	D1	D2													DF
E0	E1	E2	E3	E4											EF
F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	FA	FB	FC	FD	FE	FF

Figure 1: Layout of the Life board in memory. The number of each box is its address. The shaded boxes are border cells.

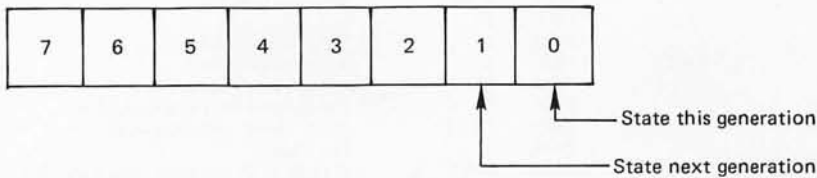


Figure 2: Bit zero is the present generation bit. Bit one is the next generation bit. The rest of the word is not used.

bors. For example, if we are looking at the cell at location hexadecimal 68, we would check cells 57 thru 59, 67, 69 and 77 thru 79. This is done by subroutine VALCK. When the routine is exited, register E holds the number of live neighboring cells.

Next subroutine ESET is called. This routine sets the next generation bit if register E equals 3, clears it if register E equals 0, 1, 4, 5, 6, 7, or 8 and sets it equal

to the present generation if register E equals 2. The only variation from this procedure concerns the border cells. They are treated as dead cells when counting neighbors. If we are pointing to a border cell when VALCK is called, the routine is exited before any tests are performed. To initialize the board, begin at BDINIT. After you have loaded the first generation, enter at WRITE, and your work is done.

*Listing 1: The board initialization routine (BDINIT) sets the entire board (figure 1) to 00. Next the border cells are set to FF. A jump is then made to the loader program to get the initial pattern. Subroutine WRITE displays the board on the video display. Border characters are written as a slash, live cells as a star. If your display doesn't scroll on a carriage return, you will have to change this routine. The next generation is calculated by subroutine MOVE by calling VALCK and ESET for each cell. After MOVE is done, routine UPDATE is entered and the board is output. Update rotates each nonborder cell to the right. The next generation bit moves into the present generation bit. VALCK is called by the main MOVE routine. MOVE sets register pair BC to the address of the current cell. The HL registers look at its neighbors. NCOUNT checks the cell addressed by register pair HL. If that cell is alive, register E is incremented. This routine is called repeatedly by VALCK which sets up the HL register pair before calling. ESET sets the next generation bit based on the contents of register E. ESET is called after VALCK and determines the number of live neighbors.*

Hexadecimal Address	Hexadecimal Code	Label	Op Code	Operand	Comment
0A00	06 00	BDINIT	MVI	B,00	This part sets every byte of page 08 to 00.
0A02	68		MOV	L,B	
0A03	26 09		MVI	H,09	
0A05	70	CLEAR	MOV	M,B	This section sets the top row (address 00 thru hexadecimal 10) to hexadecimal FF.
0A06	2C		INR	L	
0A07	C2 05 0A		JNZ	CLEAR	
0A0A	3E 11		MVI	A,11	
0A0C	06 FF		MVI	B,FF	
0A0E	2E 00		MVI	L,00	
0A10	70	TOPROW	MOV	M,B	
0A11	2C		INR	L	
0A12	BD		CPR	L	
0A13	C2 10 0A		JNZ	TOPROW	
0A16	2D		DCR	L	L = 10.
0A17	AF		XRA	A	Number of cells per row. Add 10, move pointer down one row.
0A18	57		MOV	D,A	
0A19	1E 10		MVI	E,10	
0A1B	70	EDGE	MOV	M,B	Done when L = 00. Jump to loader. Start of board. Number of characters per line. Save starting address of this line. Write a carriage return.
0A1C	19		DAD	D	
0A1D	BD		CPR	L	
0A1E	C2 1B 0A		JNZ	EDGE	
0A21	C7		RST	0	Start of board. Number of characters per line. Save starting address of this line. Write a carriage return.
0A22	21 00 09	WRITE	LXI	H,00 09	
0A25	0E 0F	BWRITE	MVI	C,0F	
0A27	5D		MOV	E,L	
0A28	AF		XRA	A	

Listing 1 continued on next page.



Listing 1, continued:

0A29	FF		RST	7	Output routine.
0A2A	00		NOP		
0A2B	00		NOP		
0A2C	00		NOP		
0A2D	3E	2F	MVI	A,2F	Write a slash (/).
0A2F	FF		RST	7	
0A30	AF		XRA	A	Clear accumulator.
0A31	2C		INR	L	Point to next cell.
0A32	B6		ORA	M	If alive value is nonzero.
0A33	0D		DCR	C	Decrement character counter.
0A34	C2	31 0A	JNZ	TEST	If not done with live go to test.
0A37	B7		ORA	A	Set flags.
0A38	C4	42 0A	CNZ	WRTLIN	If register A nonzero, there are live cells.
0A3B	2C		INR	L	
0A3C	CA	65 0A	JZ	MOVE	Compute next move if done writing board.
0A3F	C3	25 0A	JMP	BWRITE	
0A42	6B		MOV	L,E	Address of start of line.
0A43	0E	0F	MVI	C,0F	Restore character counter.
0A45	2C		INR	L	Point to first nonborder cell.
0A46	7E		MOV	A,M	
0A47	FE	01	CPI	01	
0A49	CA	57 0A	JZ	ALIVE	Jump if cell is alive.
0A4C	FE	FF	CPI	FF	
0A4E	CA	5D 0A	JZ	SLASH	Jump if border cell.
0A51	3E	20	MVI	A,""	Must be dead cell.
0A53	FF		RST	7	Write dead cell.
0A54	C3	60 0A	JMP	OVER	
0A57	3E	2A	MVI	A,""	Living cell.
0A59	FF		RST	7	
0A5A	C3	60 0A	JMP	OVER	
0A5D	3E	2F	MVI	A,"/"	Dead cell or border.
0A5F	FF		RST	7	
0A60	0D		DCR	C	Decrement character counter.
0A61	C2	45 0A	JNZ	NEXT	Jump if not done with line.
0A64	C9		RET		
0A65	0E	11	MVI	C,11	Address of first nonborder cell.
0A67	26	09	MVI	H,09	Page of board.
0A69	44		MOV	B,H	Page of board.
0A6A	CD	8A 0A	CAL	VALCK	E returns number of living neighbors.
0A6D	CD	BD 0A	CAL	ESET	Set next generation bit of current cell.
0A70	0C		INR	C	Point to next cell.
0A71	CA	77 0A	JZ	UPDATE	Go to update routine if done with board.
0A74	C3	6A 0A	JMP	NXCELL	If not done go to next cell.
0A77	2E	0A	MVI	L,0A	First nonborder cell.
0A79	7E		MOV	A,M	Get cell from memory.
0A7A	FE	FF	CPI	FF	Border cell?
0A7C	CA	83 0A	JZ	BRDR	Then don't rotate.
0A7F	1F		RAR		Rotate next generation into this generation.
0A80	E6	01	ANI	01	Clear unused bits.
0A82	77		MOV	M,A	Put it back.
0A83	2C		INR	L	Point to next cell.
0A84	C2	79 0A	JNZ	LOOP	Do next cell.
0A87	C3	22 0A	JMP	WRITE	
0A8A	1E	00	MVI	E,00	E counts number of living around cell.
0A8C	0A		LDAX	B	Get current cell.
0A8D	FE	FF	CPI	FF	Is this a border?
0A8F	C8		RZ		Skip all tests.
0A90	79		MOV	A,C	Put address of cell in accumulator.
0A91	D6	11	SUI	11	Address of cell above and left of current cell.
0A93	6F		MOV	L,A	Put new address in register L.
0A94	CD	B5 0A	CAL	NCOUNT	Test it.
0A97	2C		INR	L	Point to neighbor above current cell.
0A98	CD	B5 0A	CAL	NCOUNT	Test it.
0A9B	2C		INR	L	Neighbor above and right of current cell.
0A9C	CD	B5 0A	CAL	NCOUNT	Test it.
0A9F	69		MOV	L,C	Cell to the left of current cell.
0AA0	2D		DCR	L	
0AA1	CD	B5 0A	CAL	NCOUNT	Test it.
0AA4	2C		INR	L	Cell to right of current cell.
0AA5	2C		INR	L	
0AA6	CD	B5 0A	CAL	NCOUNT	Test it.
0AA9	79		MOV	A,C	Cell below and left of current cell.
0AAA	C6	0F	ADI	0F	
0AAC	6F		MOV	L,A	
0AAD	CD	B5 0A	CAL	NCOUNT	Test it.
0ABD	2C		INR	L	Cell below current cell.
0AB1	CD	B5 0A	CAL	NCOUNT	Test it.
0AB4	2C		INR	L	Cell below and right of current cell.
0AB5	7E		MOV	A,M	Get cell from memory.
0AB6	FE	FF	CPI	FF	Border cell?
0AB8	C8		RZ		Return if so.
0AB9	1F		RAR		Rotate low bit into carry.
0ABA	D0		RNC		Return if dead cell.
0ABB	1C		INR	E	Count if alive.
0ABC	C9		RET		

0ABD	0A		ESET	LDAX	B	Get current cell addressed by BC.
0ABE	FE	FF		CPI	FF	Border cell?
0ACO	C8			RZ		Return if border.
0AC1	E6	01		ANI	01	Clear next generation bit.
0AC3	1D			DCR	E	
0AC4	1D			DCR	E	
0AC5	CA	D2	0A	JZ	SRVIVE	If register E is 2 cell will survive.
0AC8	1D			DCR	E	
0AC9	CA	CE	0A	JZ	ALIVE	If register E is 3 cell is alive next generation.
0ACC	02			STAX	B	Cell is dead next generation.
0ACD	C9			RET		
0ACE	F6	02	ALIVE	ORI	02	Set next generation bit.
0AD0	02			STAX	B	Put back in memory.
0AD1	C9			RET		
0AD2	FE	00	SRVIVE	CPI	00	Cell dead now?
0AD4	02			STAX	B	
0AD5	C8			RZ		If dead, return.
0AD6	F6	02		ORI	02	If alive now, set next generation bit and put back in memory.
0AD8	02			STAX	B	
0AD9	C9			RET		

### Possible Improvements

In this program the time needed to compute the next generation is insignificant compared to the time needed to write out and observe the pattern. I feel that any effort to speed up execution just isn't worth the trouble.

The first routine you should add would be a better way to load the initial pattern. If you have cursor control (up-down, right-left), it should be easy to add a fast, easy loader. A 16 by 16 grid is small for doing

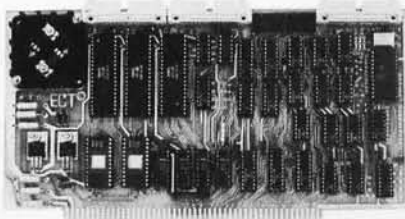
any serious experimenting on. Many interesting patterns run into the border; or if you don't use the border, the left edge interferes with the right and top interferes with bottom. You will have to use the dual addition instructions and complement arithmetic in VALCK, because adjacent cells won't always be on the same page.

I am interested in hearing about any improvements to this program or about any interesting patterns you may discover. Have fun!■

# SPECIALIZING IN QUALITY MICROCOMPUTER HARDWARE

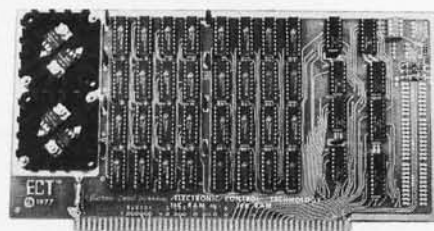
INDUSTRIAL • EDUCATIONAL • SMALL BUSINESS • PERSONAL

BUILDING BLOCKS FOR MICROCOMPUTER SYSTEMS, CONTROL & TEST EQUIPMENT

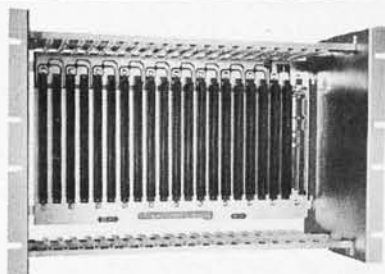


### R<sup>2</sup> I/O

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

763 RAMSEY AVE.  
HILLSIDE, N.J. 07205

**ELECTRONIC CONTROL TECHNOLOGY (201) 686-8080**



# An Easy Way to Calculate Sines and Cosines

Robert Grappel  
148 Wood St  
Lexington MA 02173

The instruction set of a typical 8 bit processor can be quite confining at times. Any task requiring more than simple integer addition and subtraction can become a nuisance. There are reference books from which multiplication and division routines can be obtained, and square root and other functions can be built by using expansion, iteration, or other well-known methods. Implementing these algorithms on a microprocessor uses much space and programming time. Trigonometric functions are among this class of

difficult functions. However, if one can tolerate accuracy of one part in 100, and allow about 1 ms per computation, the routine described in this article will provide sine and cosine values in a very simple 40 byte routine. I have coded it for a Motorola M6800 processor but it could easily be converted to any other processor.

## Theory

The algorithm is based on two trigonometric identities:

$$\begin{aligned}\sin(\theta+s) &= \sin(\theta)\cos(s) + \cos(\theta)\sin(s) \\ \cos(\theta+s) &= \cos(\theta)\cos(s) - \sin(\theta)\sin(s)\end{aligned}$$

where  $\theta$  is the angle we are interested in and  $s$  is a small step in angle added to  $\theta$ . If we make the step small enough, we can approximate  $\sin(s)$  and  $\cos(s)$  as follows:

$$\begin{aligned}\sin(s) &= s \\ \cos(s) &= 1\end{aligned}$$

Combining these four equations we get:

$$\begin{aligned}\sin(\theta+s) &= \sin(\theta) + s \cos(\theta) \\ \cos(\theta+s) &= \cos(\theta) - s \sin(\theta)\end{aligned}$$

Solving for sine and substituting into the cosine formula:

$$\cos(\theta+s) = (1+s^2)\cos(\theta) - s \sin(\theta+s)$$

Since  $s$  is very small, we can neglect  $s^2$  and write:

$$\cos(\theta+s) = \cos(\theta) - s \sin(\theta+s)$$

Given that we have values for  $\sin(\theta)$  and  $\cos(\theta)$  at some point, we can get to any other angle by stepping through the two approximations, first computing  $\sin(\theta+s)$  and then using that to compute  $\cos(\theta+s)$ . We choose to start at  $\theta$  equal to zero, and set  $\cos(\theta)$  to the largest positive value that can

Location	Op Code	Operand	Label	Assembly Code
				* SUBROUTINE TO COMPUTE SINE AND COSINE
				* AS SINGLE-BYTE INTEGERS (SIGNED)
				* STEP SIZE OF 1/16 RADIAN, OR 3.58 DEGREES
				* ACCURACY OF ABOUT 1% FOR RANGE 0
				THROUGH 90 DEGREES
				*
0000			THETA	RMB 1 *ARGUMENT TO FUNCTION
0001			SINE	RMB 1 *SINE OF THETA
0002			COSINE	RMB 1 *COSINE OF THETA
0003	86	7E	START	LDA A #126 *BEGIN INITIALIZATION
0005	B7	0002		STA A COSINE
0008	7F	0001		CLR SINE
000B	B6	0000		LDA A THETA
000E	F6	0002		LDA B COSINE *COMPUTE NEW SINE
0011	57		CYCLE	ASR B
0012	57			ASR B
0013	57			ASR B
0014	57			ASR B
0015	FB	0001		ADD B SINE
0018	F7	0001		STA B SINE
001B	57			ASR B *COMPUTE NEW COSINE
001C	57			ASR B
001D	57			ASR B
001E	57			ASR B
001F	F0	0002		SUB B COSINE
0022	50			NEG B
0023	F7	0002		STA B COSINE
0026	4A			DEC A
0027	2C	E8		BGE CYCLE *LOOP UNTIL DONE
0029	39			RTS

Listing 1: 6800 routine for computing sines and cosines over the range 0 to  $\pi/2$  radians (0 to 90 degrees).

be stored as a signed byte without causing overflow when negated and decremented. Hence  $\cos(0) = 126$ . Similarly the  $\sin(0) = 0$ . The step size is chosen to be 0.0625 radian or about  $3.58^\circ$ . The step size must be a binary fraction so that all the multiplication involved in the equations can be performed by arithmetic shifts. If more accuracy is needed, the step size is easily reduced by introducing more shifts into the algorithm.

### Program

The assembly code program for the Motorola 6800 version of the routine is shown in listing 1. When called with the angle stored in variable THETA, it returns the sine and cosine of that angle. The accuracy is quite good for angles less than  $\pi/2$  radians (90 degrees). For angles larger than  $\pi/2$  radians, other trigonometric identities can be used:

$$\begin{aligned}\sin(\theta) &= \cos(\pi/2-\theta) = \sin(\pi-\theta) \\ \cos(\theta) &= \sin(\pi/2-\theta) = (-\cos(\pi-\theta))\end{aligned}$$

Thus, the sine and cosine of any angle can be computed from the values over the range 0 to  $\pi/2$  radians. These identities can be coded quite easily.

All the other trigonometric functions can be computed from the values of sine and cosine. All that is needed is an integer division routine such as the following:

$$\begin{aligned}\operatorname{cosec}(\theta) &= 126/\sin(\theta) \\ \sec(\theta) &= 126/\cos(\theta) \\ \tan(\theta) &= \sin(\theta)/\cos(\theta) \\ \cot(\theta) &= \cos(\theta)/\sin(\theta)\end{aligned}$$

Be careful of overflows and division by zero problems.

This algorithm can perform other tricks. It can generate continuous sine waves of any desired amplitude, period, or phase. Coupled with a digital to analog converter, it could form part of a modem or synthesizer. It could simulate mixers, AM or FM modulators, keyers, etc.

The maximum frequency it can generate depends on the processor cycle time. A 6800 processor running with a 1 MHz clock could generate a 200 Hz sine wave since there are about 50 machine cycles per step, and about 100 steps per wave. Increasing the step size to 0.125 radians would increase the maximum frequency to about 500 Hz. A step size of 0.25 radians would yield a maximum frequency of nearly 1050 Hz.

I hope that this algorithm will help programmers solve problems involving trigonometric functions, and that applications for microcomputers will expand into new areas where these functions are useful. ■

## The people who know more about acoustic couplers know why you should buy Datec.

The heavy-duty coupler

... Datec did it.



There is a reason so many Datec customers are communication line technicians, computer engineers and data processing experts. They recommend Datec for the simple, solid state, rugged design that has proven to be more reliable than bigger name couplers.

Acoustic couplers are the work horses of a data communications system. They should work every time, every day, so that you can install them and then forget them.

No wonder communication line technicians have nicknamed the Datec 32 the "heavy duty" acoustic coupler.

### CRYSTAL CONTROL

Crystal controlled transmitter and receiver insures long-term stability and reliability, even in the most unfriendly operating environment.



This process reduces the probability of field failure below 2% for the first 1000 hours of operation. We find the faulty one before we ship it.

### BIG EARS

Rugged, tight-fitting rubber cups effectively seal out vibration and room noise. They aren't beautiful, but they work.



### TALKS WHEN IT RAINS

Datec couplers are highly sensitive, operating at received levels of -55dBm or lower. Our sensitive receiver can pull weak signals out of the "mud" of leaky, rain-soaked telephone cables.

### GUARANTEED

Remove a few screws and the PC board pops out. It couldn't be simpler. Any problems incurred through normal use, and it's replaced or repaired free with no questions asked during the first year.

### READILY AVAILABLE

Datec 300 bps acoustic couplers are readily available in both originate and originate/answer models. All Datec equipment including the new Datec 212 is Bell compatible. OEM inquiries are welcome.

Call Merri Beth Tice for assistance.

## Datec™

DATEC DID IT.  
Quality—designed in, burned-in and guaranteed.  
DATEC, INCORPORATED  
PO BOX 839, CHAPEL HILL, NC 27514, (919) 967-5605

Circle 90 on inquiry card.



Listing 1: TI-59 calculator program for the digital circuit simulator.

```

000 76 LBL          041 00 00          080 73 RC#
001 38 SIN          042 20 20          081 10 10
002 86 STF          043 71 SBR          082 22 INV
003 00 00          044 00 00          083 59 INT
004 61 GTD          045 60 60          084 85 +
005 33 X²          046 92 RTN          085 43 RCL
006 00 0           047 68 NDP          086 30 30
007 76 LBL          048 68 NDP          087 85 +
008 35 1/X          049 68 NDP          088 43 RCL
009 71 SBR          050 71 SBR          089 29 29
010 40 IND          051 00 00          090 75 -
011 09 09          052 30 30          091 93 .
012 43 RCL          053 71 SBR          092 01 1
013 30 30          054 00 00          093 95 =
014 55 +           055 60 60          094 22 INV
015 01 1           056 92 RTN          095 67 EQ
016 00 0           057 68 NDP          096 01 01
017 95 =           058 68 NDP          097 01 01
018 92 RTN          059 68 NDP          098 01 1
019 68 NDP          060 01 1           099 42 STD
020 43 RCL          061 94 +/-          100 30 30
021 29 29          062 49 PRD          101 92 RTN
022 49 PRD          063 30 30          102 68 NDP
023 30 30          064 01 1           103 68 NDP
024 92 RTN          065 44 SUM          104 76 LBL
025 68 NDP          066 30 30          105 15 E
026 68 NDP          067 92 RTN          106 03 3
027 68 NDP          068 68 NDP          107 00 0
028 68 NDP          069 68 NDP          108 32 XIT
029 68 NDP          070 43 RCL          109 00 0
030 43 RCL          071 29 29          110 32 XIT
031 29 29          072 75 -           111 42 STD
032 67, EQ          073 43 RCL          112 10 10
033 00 00          074 30 30          113 01 1
034 37 37          075 95 =           114 63 EX#
035 42 STD          076 33 X²          115 10 10
036 30 30          077 42 STD          116 76 LBL
037 92 RTN          078 30 30          117 28 LDG
038 68 NDP          079 92 RTN          118 63 EX#
039 68 NDP
040 71 SBR

```

Listing 1 continued on opposite page.

The program in listing 1 was developed for a TI-59 calculator to allow simulation or testing of combinational logic circuits. The circuit elements allowed and their identification numbers are:

Number	Type
20	AND
30	OR
40	NAND
50	NOR
60	NOT
70	XOR
80	SR latch

Registers 11 through 25 are used to store the input values to the circuit. The circuit elements themselves are stored in registers 31 through 99. A code word is stored in each register that defines its inputs and its function. The format used is:

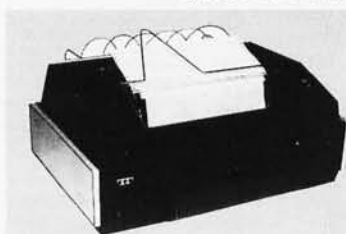
XXYYZZ.V,

where:

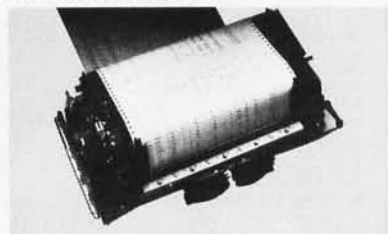
- XX = Input Device 1
- YY = Input Device 2
- ZZ = Device Identification Number
- V = Output of this device (0 or 1).

### IMMEDIATE DELIVERY

#### MODEL 40 300 LPM PRINTERS



- Mechanism or complete assembly
- 80-column friction feed
- 80-column tractor feed
- 132-column tractor feed



#### INTERFACES

- EIA-RS232
- Simplified EIA-like interface
- Standard serial interface
- Parallel device interface

### FEDERAL Communications Corporation

11126 Shady Trail, Dallas, Texas 75229, (214) 620-0644,  
TELEX 732211 TWX 910-860-5529

## TELETYPE<sup>®</sup>

#### MODEL 43 TERMINALS



- 4310 RO (Receive Only)
- 4320 KSR (Keyboard Send-Receive)
- 4340 BSR (Buffered Send-Receive)

#### INTERFACES

- TTL Serial
- EIA RS232 or DC20 to 60ma
- 103-type built-in modem

Note that the complete code must be entered for each device. Therefore, for the NOT device the same input number is entered for both XX and YY.

The minus sign is used as a code to indicate that a device has been asserted. At the start of each run the machine automatically sets all registers to a positive value. After the run is completed, each register should have a minus sign. The output value is given by the first digit to the right of the decimal point.

The circuit itself is set up on the machine by storing the appropriate values in registers 31 and greater. Devices are assigned registers consecutively starting with 31, in any order desired. However, the program runs faster with consecutive assignments. A 0 stored in a register tells the calculator that all devices have been processed. Therefore, you must be certain that no register numbers are skipped and that the last valid register is followed with a register containing 0.

The input values are stored into registers 11 through 25 by the following coding:

logical 0	store - 1.0
logical 1	store - 1.1

An alternate, and more convenient, method is available for registers 11 through 18. Just enter the logical value, 0 or 1, and press one of the keys A to D or A' to D' in accordance with the following assignment table:

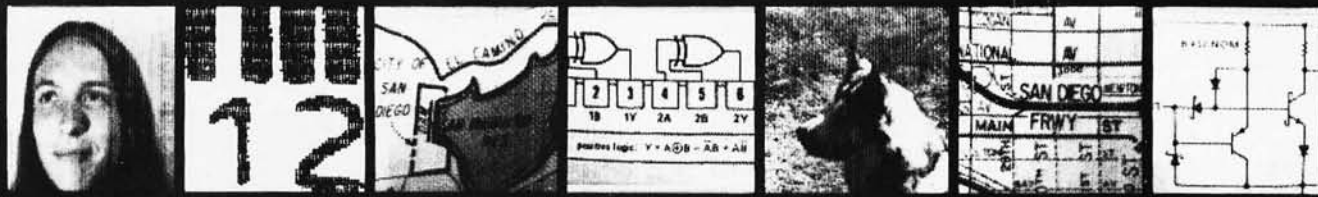
A → 11	A' → 15
B → 12	B' → 16
C → 13	C' → 17
D → 14	D' → 18

Listing 1, continued:

119	10	10	173	77	GE	227	01	1	281	32	X:T
120	44	SUM	174	38	SIN	228	94	+/-	282	01	1
121	10	10	175	22	INV	229	64	PD#	283	05	5
122	63	EX*	176	59	INT	230	10	10	284	42	STD
123	10	10	177	65	x	231	61	GTD	285	10	10
124	50	I×I	178	01	1	232	33	X²	286	61	GTD
125	22	INV	179	00	0	233	76	LBL	287	42	STD
126	67	EQ	180	94	+/-	234	23	LNK	288	76	LBL
127	28	LDG	181	95	=	235	87	IFF	289	17	B'
128	76	LBL	182	42	STD	236	00	00	290	32	X:T
129	39	CDS	183	30	30	237	39	CDS	291	01	1
130	22	INV	184	01	1	238	43	RCL	292	06	6
131	86	STF	185	00	0	239	30	30	293	42	STD
132	00	00	186	00	0	240	91	R/S	294	10	10
133	63	EX*	187	49	PRD	241	81	RST	295	61	GTD
134	10	10	188	27	27	242	76	LBL	296	42	STD
135	03	3	189	43	RCL	243	11	R	297	76	LBL
136	00	0	190	27	27	244	32	X:T	298	18	C'
137	42	STD	191	59	INT	245	01	1	299	32	X:T
138	10	10	192	22	INV	246	01	1	300	01	1
139	76	LBL	193	44	SUM	247	42	STD	301	07	7
140	33	X²	194	27	27	248	10	10	302	42	STD
141	43	RCL	195	42	STD	249	61	GTD	303	10	10
142	10	10	196	26	26	250	42	STD	304	61	GTD
143	85	+	197	73	RC*	251	91	R/S	305	42	STD
144	01	1	198	26	26	252	76	LBL	306	76	LBL
145	95	=	199	77	GE	253	12	B	307	19	D'
146	66	PRU	200	38	SIN	254	32	X:T	308	32	X:T
147	42	STD	201	22	INV	255	01	1	309	01	1
148	10	10	202	59	INT	256	02	2	310	08	8
149	73	RC*	203	65	x	257	42	STD	311	42	STD
150	10	10	204	01	1	258	10	10	312	10	10
151	67	EQ	205	00	0	259	61	GTD	313	61	GTD
152	23	LNK	206	94	+/-	260	42	STD	314	42	STD
153	22	INV	207	95	=	261	76	LBL	315	91	R/S
154	77	GE	208	42	STD	262	13	C	316	76	LBL
155	33	X²	209	29	29	263	32	X:T	317	42	STD
156	55	+	210	43	RCL	264	01	1	318	01	1
157	01	1	211	27	27	265	03	3	319	94	+/-
158	00	0	212	65	x	266	42	STD	320	72	ST*
159	00	0	213	01	1	267	10	10	321	10	10
160	00	0	214	00	0	268	61	GTD	322	32	X:T
161	00	0	215	00	0	269	42	STD	323	65	x
162	95	=	216	95	=	270	76	LBL	324	93	.
163	42	STD	217	59	INT	271	14	D	325	01	1
164	27	27	218	42	STD	272	32	X:T	326	95	=
165	59	INT	219	09	09	273	01	1	327	22	INV
166	22	INV	220	71	SBR	274	04	4	328	74	SM*
167	44	SUM	221	35	1/X	275	42	STD	329	10	10
168	27	27	222	63	EX*	276	10	10	330	65	x
169	42	STD	223	10	10	277	61	GTD	331	01	1
170	26	26	224	59	INT	278	42	STD	332	00	0
171	73	RC*	225	74	SM*	279	76	LBL	333	95	=
172	26	26	226	10	10	280	16	R'	334	91	R/S

# THE MICRO WORKS

**THE INDUSTRY LEADER IN AFFORDABLE HI-RES VIDEO ANALYSIS FOR ALL S-100 AND S-50 COMPUTERS**



The DS-80 features full compatibility with the proposed IEEE S-100 standard and all current S-100 CPUs. New improved circuit design enhances performance. The DS-80 offers random access video digitization of up to 256 X 256 spatial resolution and 64 levels of grey scale, plus controls for brightness, contrast and width. It is versatile enough to handle any video processing task—from U.P.C. codes (above) and blood cell counting to computer portraiture and character recognition. The DS-80 comes fully assembled, tested and burned in. Included is portrait software compatible with the Vector Graphic High Resolution Graphics Display Board.

**DS-65 FOR THE APPLE...  
COMING SOON!**

Please allow two weeks for delivery.  
Master Charge and BankAmericard

**DS-80 for the S-100 bus \$349.95  
DS-68 for the S-50 bus 169.95**

**P.O. BOX 1110 DEL MAR, CA. 92014 714-756-2687**



Set Up	
Register	Contents
31	111270
32	311370
33	323450
34	121260
35	323330
36	0

Truth Table			
11	12	13	OUTPUT
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	1

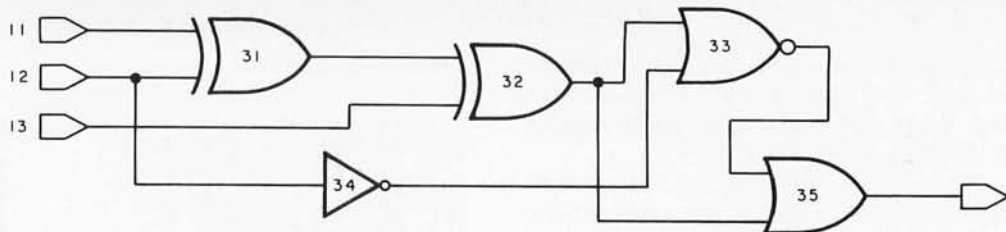


Figure 1: Example of a digital circuit simulation. All of the logic gates are numbered sequentially. In this circuit there are three inputs (11, 12, 13) and one output. The set up of the registers is shown, along with a truth table which is a result of running the program and giving different inputs to 11, 12 and 13.

The circuit in figure 1 demonstrates the principles involved.

Note that the code number for each device type is the actual line number for the subroutine that simulates that device. Since memory is at a premium, each device was programmed in as short as possible sequence that obtained the desired result. No attempt was made to follow any structured programming techniques!

Also, the calculator is programmed to assert only those devices whose inputs are connected to devices that are asserted.

Therefore, circuits with feedback (like the crossed-NOR flip flop) cannot be directly simulated. Note that program runs faster in natural order of circuit evaluation.

This program uses some of the more advanced programming features of the TI-59 calculator, such as indirect addressing and flag operations. However, the program is straightforward and should be fairly easy to understand for most novice programmers.

The advantage of the simulator, of course, is the ease of setting up and quickly changing any reasonable circuit. No power supply is required and no purchasing of components is required until the circuit is thoroughly acceptable on the simulator.

The program is stored on both edges of one card. The data on a particular circuit can be stored on a card by pressing "3 2nd Write." ■

# Megabytes 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 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 it's 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

# BYTE's Bits

## Another Life

I've discovered a fourth glider and two new oscillators for Jonathan Millen's "One-Dimensional Life" (December 1978 BYTE, page 68). The new glider has period 5; it evolves from hexadecimal location 65F. My first new oscillator can be made by starting with either 394F or 22 cells in a row — it has period 13. The other oscillator, with period 21, has the ancestor 12157.

**Paul Heckbert**  
4 Ames St, H303  
Cambridge MA 02139

## Call For Papers: Sixth Data Communications Symposium

The Sixth Data Communications Symposium, scheduled for November 27 thru 29 in Pacific Grove CA, will concentrate on the design of systems for network user services. Original research and development papers are being solicited for topics related either to the application of specific technical issues that

arise from the application nature of a data communication system, or to the application of general technical problems that are directly applicable to the planning, analysis, and design of the systems across the boundary between applications. Four copies of a completed paper and a 500 word summary should be sent no later than April 1 to Dr Wushow Chou, North Carolina State University, Computer Studies Program, POB 5490, Raleigh NC 27650. Include name, address, phone number, and affiliation. All papers will be refereed and authors of selected papers will be notified by June 1, 1979. All papers accepted for presentation will be published in the conference proceedings. ■

## Data Transfer

It is practical to transfer programs directly from one microcomputer to another computer over the telephone without intermediate storage by using readily available equipment. Specifically, I have read TRS-80 BASIC programs into the CSU-Long Beach PDP 11/45 operating under RSTS. The terminal used was a 33 ASR Teletype with an AJ 260 acoustic coupler. The Small Systems Hardware RS-232 interface unit was used to output from the TRS-80.

Many terminals have an auxiliary or similar connector for attaching other RS-232 devices to the terminal. The trick is to connect pin 3 of the TRS-80 RS-232 output to pin 2 of this plug. (Normally, pin 3 would be connected to pin 3 of the auxiliary connector if the terminal is to be used as a printer. The other pins connections remain the same but probably only pin 7 is needed.) After establishing contact with the PDP 11/45 an LLIST command to the TRS-80 causes it to output directly to the PDP 11/45. In my case, the PDP 11/45 checked each statement as it was entered and could send back error messages to the Teletype. Since the operation was full duplex without echo this did not interfere with the data transmission from the TRS-80. If a half duplex system is used it is essential that there be no turn-around on the line during transmission since the TRS-80 does not stop until the end of the LLIST. The program is immediately executable on the PDP 11/45.

A 10,000 byte program was transmitted in 17 minutes at 110 baud. Obviously a higher rate could be used to speed up the process.

**Dr Edward M McCormick**  
13100 Chapman, Apt 3-113  
Garden Grove CA 92640

# 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.

April 1979 © BYTE Publications Inc 175



# The Power of the HP-67 Programmable Calculator, Part 2

Listing 1: A simultaneous equations program which can solve systems of up to nine equations in nine unknowns. Listing 2 explains how to run this program.

PROGRAM TITLE: Simultaneous Equations									
APPLICATION: Solves systems of up to 9 simultaneous equations.									
PROGRAMMER: Bob Arp					DATE: 12-16-76				
REGISTERS									
0	Yn	1	A9	2	A8	3	A7	4	A6
5	A5	6	A4	7	A3	8	A2	9	A1
SO	Yn	S1	A9	S2	A8	S3	A7	S4	A6
S5	A5	S6	A4	S7	A3	S8	A2	S9	A1
A	#Eqs in System	B	Pri reg Pointer	C	Sec reg Pointer	D	Pivotal Eq Counter	E	Equation Counter
I	Misc Storage								
LABELS									
A	Part 1 Start	B	Divide	C	Mult/Subtract	D	Part 2 Start	E	Mult/Subtract
0	E/C initial	b	Clear R0-R9	c	Recall term	d	Mult/Sub Loop	e	
0	Divide Loop	1	Test D	2	Mult Loop	3	Call Sub a	4	Sub Loop
5	1st term loop	6	Inc E/Dec D	7	Disp X #	8	Call next piv	9	Disp Xn
					SET STATUS				
					FLG		TRIG		
					ON OFF		DISP		
							DEG		
							SCI		
							ENG		
							RAD		
							n_5		
PROGRAM CODES				DEFINITIONS AND REMARKS					
NUM	ADD	NUMERIC	SYMBOLIC						
001	31	25	11 f	LBL	A	With the number of system equations keyed into the calculator, pressing A initializes part 1 of the program by clearing all registers, storing n, programming the display and calling for the first pivotal equation.			
002		31	43 f	CLR	REG				
003		31	42 f	PIS					
004		31	43 f	CLR	REG				
005		35	23		h	ENG			
006		33	11	STO	A				
007			01			1			
008		33	14	STO	D				
009		23	05	DSP	5				
010		35	22		h	RTN			
011	31	25	12 f	LBL	B	With a pivotal equation stored in the primary registers, pressing B causes each coefficient of the equation to be divided by its pivotal term. The results are stored in the secondary registers, and they must be stored on a data card labeled 1A(Z), where Z is the number of the current system of equations.			
012	32	22	11 g	GSB	f a				
013		34	24	RCL	(i)				
014		33	15	STO	E				
015	31	25	00 f	LBL	0				
016		34	12	RCL	B				
017	32	22	13 g	GSB	f c				
018		34	15	RCL	E				
019			81			÷			
020		34	13	RCL	C				
021		35	33		h	ST I			
022		35	53		h	Rv			
023		33	24	STO	(i)				
024		34	12	RCL	B				
025		31	51		f	X=0			
026		22	01	GTO	1				
027			01			1	Decrement register pointers and return to beginning of loop.		
028			51			-			
029		33	12	STO	B				
030		34	13	RCL	C				
031			01			1			
032			51			-			
033		33	13	STO	C				
034		22	00	GTO	0				
035	31	25	01 f	LBL	1	When all pivotal equations have been divided by their pivotal term, jump to display n loop.			
036		34	11	RCL	A				
037		34	14	RCL	D				
038		32	51		g	X=Y			
039		22	09	GTO	9				
040		34	14	RCL	D	Initialize equation counter and clear primary registers R0-R9.			
041			01			1			
042			61			+			

Listing 1 continued on opposite page.

## Example Program

Last month I described the features and performance of the Hewlett-Packard HP-67 and HP-97 programmable calculators. This month I conclude with a practical application program. I have chosen for an example a program which uses the more powerful HP-67 operations. Likewise, I have chosen to write a program which will provide the solution to a general set of simultaneous equations, traditionally one of the most laborious mathematical solutions to obtain, yet one of the most useful solutions in electrical engineering.

The HP Math Pac contains a program to solve four simultaneous equations in four unknowns by Gaussian elimination, and the Standard Pac contains a program to solve three simultaneous equations in three unknowns by matrix operations. The program shown in listing 1 solves any system of up to nine simultaneous equations in nine unknowns by the method of "Gaussian elimination using the largest pivots." [Because of its efficiency, the Gaussian elimination pivot method is a popular method for solving simultaneous equations. The term "pivot" refers to the (r, r), a diagonal element of the coefficient matrix during the rth step of the process. This method is discussed in a number of numerical methods books. See also the reference at the end of this article. . .CM] The primary utility of this program would be in calculator aided design.

When the analysis of an electronic system is based upon a linear model, the unknown quantities will usually appear only to the first power, and the coefficients in the equations will usually be constants. Such a set of n equations relating n unknowns can be expressed in the form:

$$\text{Equation 1: } A_1X_1 + A_2X_2 + \dots + A_nX_n = Y_1$$

$$\text{Equation 2: } B_1X_1 + B_2X_2 + \dots + B_nX_n = Y_2$$

$$\text{Equation 3: } \dots \quad \dots \quad \dots \quad \dots$$

$$\text{Equation n: } m_1X_1 + m_2X_2 + \dots + m_nX_n = Y_n$$

Listing 1, continued:

Robert C Arp Jr  
3961 Acapulco Dr  
Campbell CA 95008

in which each X is an unknown quantity, the m terms are the coefficients of the unknowns and the Y terms are the right-hand sides of the equations.

The Gaussian Elimination Pivot Method

To solve a general system of simultaneous equations by Gaussian elimination using the largest pivots, perform the following steps:

1. Inspect the coefficient ( $A_1, B_1, \dots, m_1$ ) of the first term ( $X_1$ ) in each of the system equations. The equation having the largest coefficient (in absolute value) of the first term is taken as the first pivotal equation.

2. Divide the first pivotal equation, equation 1(1), by the coefficient  $A_1$  of its first term  $X_1$ . The result will be a new equation, equation 1A (1), in which the coefficient of the first term is 1. (The digit enclosed by parentheses in each equation label indicates the number of the system to which the equation belongs.)

3. Multiply equation 1A(1) by the coefficient  $B_1$  of the first term  $X_1$  of the second equation, equation 2(1) to obtain the new equation, equation 1B(1).

4. Subtract equation 1B(1) from the second equation, equation 2(1), to eliminate the first term of equation 2(1). The resulting equation will be one of the equations in a new system with  $n-1$  equations in  $n-1$  unknowns.

5. Repeat steps 3 and 4 with each of the remaining equations in the original system. The set of equations, for which the first term has been eliminated, forms a new system having  $n-1$  equations with  $X_2, X_3, \dots, X_n$  as unknowns.

6. Inspect the coefficient of the first term in each of the new system's equations. The equation having the largest coefficient (in absolute value) of the first term is taken as the next pivotal equation.

7. Divide the new pivotal equation by the coefficient of its first term. The result will be a new A equation in which the coefficient of the first term is 1.

8. Multiply the new A equation by the

NUM ADD	PROGRAM CODES		DEFINITIONS AND REMARKS
	NUMERIC	SYMBOLIC	
043	33 15	STO E	
044	32 22 12	g GSB f b	
045	31 41	f w/ DATA	
046	35 22	h RTN	
047	31 25 13	f LBL C	With the coefficients of equation 1A(Z)
048	32 22 11	g GSB f a	stored in the secondary registers and the
049	34 24	RCL (i)	coefficients of each remaining equation in
050	31 25 02	f LBL 2	the current system stored, in turn, in the
051	34 13	RCL C	primary registers, pressing C causes each
052	32 22 13	g GSB f c	coefficient of equation 1A(Z) to be multi-
053	35 52	h X $\dagger$ Y	plied by the first coefficient of each re-
054	71	x	maining equation, in turn, to yield a new
055	33 24	STO (i)	equation, 1B(Z), where Z is the number of
056	01	1	the current system of equations. Equation
057	00	0	1B(Z) is then subtracted from the current
058	34 13	RCL C	remaining equation, eliminating the first
059	32 51	g X=Y	coefficient of the current remaining equa-
060	22 03	GTO 3	tion. The result of processing a system in
061	35 82	h LST X	this manner is a new set of equations which
062	34 13	RCL C	has a number of unknowns that is one less
063	01	1	than the number of unknowns in the system
064	51	-	that is presently being processed.
065	33 13	STO C	
066	35 53	h Rv	
067	22 02	GTO 2	
068	31 25 03	f LBL 3	
069	32 22 11	g GSB f a	
070	31 25 04	f LBL 4	
071	34 12	RCL B	
072	32 22 13	g GSB f c	
073	34 13	RCL C	
074	32 22 13	g GSB f c	
075	51	-	
076	33 24	STO (1)	
077	01	1	
078	00	0	
079	34 13	RCL C	
080	32 51	g X=Y	If all terms of the current equation have
081	22 05	GTO 5	been processed, jump to fLBL 5.
082	01	1	Decrement register pointers and return to
083	51	-	beginning of loop.
084	33 13	STO C	
085	34 12	RCL B	
086	01	1	
087	51	-	
088	33 12	STO B	
089	22 04	GTO 4	
090	31 25 05	f LBL 5	Stores the address of the first coefficient
091	34 14	RCL D	of each equation of the new system in re-
092	01	1	gister I.
093	61	+	
094	33 14	STO D	
095	34 11	RCL A	
096	34 14	RCL D	
097	51	-	
098	01	1	
099	01	1	
100	61	+	
101	35 33	h ST I	
102	34 14	STO D	
103	01	1	
104	51	-	
105	33 14	STO D	
106	34 24	RCL (i)	Recalls the first coefficient of each equa-
107	35 64	h ABS	tion of the new system, stores the absolute
108	35 33	h ST I	value of the coefficient in I and displays
109	31 84	f -x-	the absolute value for 5 seconds with a
110	34 11	RCL A	flashing decimal point.
111	34 15	RCL E	
112	32 51	g X=Y	If all equations of the current system have
113	22 08	GTO 8	been processed, jump to "call for next piv-
114	01	1	otal equation."
115	61	+	
116	33 15	STO E	Update E register and clear primary regis-
117	32 22 12	g GSB f b	ters R0-R9.
118	31 41	f w/ DATA	
119	35 22	h RTN	
120	31 25 08	f LBL 8	
121	32 22 12	g GSB f b	Calls for the next pivotal equation.
122	34 14	RCL D	
123	01	1	
124	61	+	
125	33 14	RCL D	
126	31 41	f w/ DATA	
127	35 22	h RTN	
128	31 25 09	f LBL 9	Displays n with flashing decimal point in a
129	34 11	RCL A	continuous loop when Xn has been computed.
130	31 84	f -x-	

Listing 1 continued on next page.



Listing 1, continued:

NUM ADD	PROGRAM CODES			DEFINITIONS AND REMARKS
	NUMERIC	SYMBOLIC		
131	22	09	GTO	9
132		84		R/S
133	31	25	f LBL	D
134		31	f PLS	
135	34	00	RCL	0
136	33	01	STO	1
137		00		0
138	33	00	STO	0
139		01		1
140	33	15	STO	E
141		35	h RTN	
142	31	25	f LBL	E
143		01		1
144		00		0
145	35	33	h ST I	
146	34	24	RCL (i)	
147	33	00	STO	0
148		01		1
149	33	12	STO	B
150		01		1
151		01		1
152	33	13	STO	C
153	32	25	g LBL	f d
154	34	00	RCL	0
155	34	12	RCL	B
156	32	22	g GSB	f c
157	34	13	RCL	C
158	32	22	g GSB	f c
159		71		x
160		51		-
161	33	00	STO	0
162	34	15	RCL	E
163	34	12	RCL	B
164	32	51	g X=Y	
165	22	06	GTO	6
166	34	12	RCL	B
167		01		1
168		61		+
169	33	12	STO	B
170	34	13	RCL	C
171		01		1
172		61		+
173	33	13	STO	C
174	22	31	f GTO	f d
175	31	25	f LBL	6
176	34	15	RCL	E
177		01		1
178		61		+
179	33	15	STO	E
180	35	33	h ST I	
181	34	00	RCL	0
182	33	24	STO (i)	
183	34	14	RCL	D
184		01		1
185		51		-
186	33	14	STO	D
187	31	25	f LBL	7
188	34	14	RCL	D
189	31	84	f -x-	
190	22	07	GTO	7
191		34		R/S
192	32	25	g LBL	f a
193	34	11	RCL	A
194	34	14	RCL	D
195		51		-
196		01		1
197		61		+
198	35	33	h ST I	
199	33	12	STO	B
200		01		1
201		00		0
202		61		+
203	33	13	STO	C
204	35	22	h RTN	
205	32	25	g LBL	f b
206		00		0
207	33	00	STO	0
208	33	01	STO	1
209	33	02	STO	2
210	33	03	STO	3
211	33	04	STO	4
212	33	05	STO	5
213	33	06	STO	6
214	33	07	STO	7
215	33	08	STO	8
216	33	09	STO	9
217	35	22	h RTN	
218	32	25	g LBL	f c
219	35	33	h ST I	
220		44		CLX
221	34	24	RCL (i)	
222	35	22	h RTN	
223		84		R/S
224				

CALCULATOR PROGRAM  
CONTINUATION WORKSHEET

TREBOR ENGINEERING

coefficient of the first term of the second system equation to obtain a new B equation.

9. Subtract the new B equation from the second system equation to eliminate the first term of the second system equation. The resulting equation will be one of the equations in a new system which has one less unknown than the system being processed.

10. Repeat steps 8 and 9 with each of the remaining equations in the system being processed. The resulting set of equations, from which the first term has, again, been eliminated, forms a new system of equations having one less unknown and one less equation than the preceding system.

11. Repeat steps 6 thru 10 until a final set is obtained which consists of the single equation:

$$ZX_n = Y_n$$

Being the only equation in the system, it must, of course, be the pivotal equation. When this pivotal equation is divided by the coefficient of its first term, the value of  $X_n$  will be known.

12. The value for  $X_n$  must then be substituted into the  $(n-1)A$  equation and the equation must be solved for  $X_{(n-1)}$ .

13. The values which have been obtained for  $X_n$  and  $X_{(n-1)}$  must then be substituted into the  $(n-2)A$  equation and the equation solved for  $X_{(n-2)}$ .

14. Continue in this manner until the 1A equation is solved for  $X_1$  of the original system of equations after substituting the values obtained for all other unknowns.

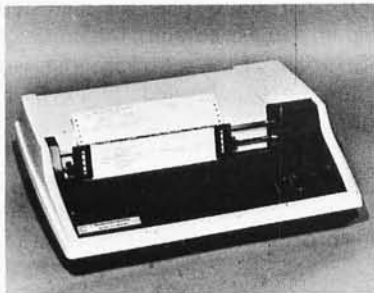
15. The solution should be checked by substituting the values obtained for the unknowns into each equation of the original system, performing the indicated multiplications, additions and subtractions, and comparing the left side of the equation to the right side. They should be reasonably close to equality.

In electronics engineering, the system of simultaneous equations could be the result of writing the mesh equations for a circuit such as that shown in figure 1. The nine mesh equations for this circuit are listed in table 1.

The system of nine simultaneous equations for the circuit are shown in standard form in table 2. The first pivotal equation is equation 1. The unknowns in a system of mesh equations are the currents. The right side of each equation is a summation of the voltage sources in the mesh represented by the equation.

The instructions for running the simultaneous equations program in listing 1 are shown in listing 2. Using the system of nine

# 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



## Opportunity for growth in a dynamic market with an expanding product line

The Electro Optics and Devices/Solid State Division, Lancaster, PA, has a position available for a Marketing Manager for our personal computer products.

Individual should have experience in the personal computer industry in sales or marketing, engineering experience also desirable and a college degree is preferred.



### Responsibilities:

- Distribution
- Merchandising
- Product Planning
- Liaison Between Sales and Engineering
- 25% Travel Involved

Send resume in confidence to:

C. E. Hyde, Manager, Employment  
RCA Corporation  
New Holland Avenue  
Lancaster, PA 17604

Competitive starting salary plus company paid benefits.

An Equal Opportunity Employer M/F

# RCA



equations (table 2) in a sample run of the program, listing 3 shows the contents of the registers at various points in the program, and listing 4 summarizes the original coefficients of the equations plus the calculated currents.

A "check" program and its instructions are shown in listings 5 and 6. Note that the quantity obtained for the left side of the equation may not be exactly equal to the right side due to round off approximations.

The "simultaneous equations" program of listing 1 calculates the values of the unknowns for any system containing no more than nine equations. The program is listed on calculator program worksheets upon which the addresses of program memory are preprinted. In addition, the program work-

$$\begin{aligned} \text{Mesh 1: } & -40 + 1I_1 + 2(I_1 - I_2) + 3(I_1 - I_3) = 0 \\ \text{Mesh 2: } & 2(I_2 - I_1) + 4I_2 + 5(I_2 - I_4) + 6(I_2 - I_3) = 0 \\ \text{Mesh 3: } & 3(I_3 - I_1) + 6(I_3 - I_2) + 7(I_3 - I_5) = 0 \\ \text{Mesh 4: } & 5(I_4 - I_2) + 8I_4 + 9(I_4 - I_6) + 10(I_4 - I_5) = 0 \\ \text{Mesh 5: } & 7(I_5 - I_3) + 10(I_5 - I_4) + 11(I_5 - I_7) = 0 \\ \text{Mesh 6: } & 9(I_6 - I_4) + 12I_6 + 13(I_6 - I_8) + 14(I_6 - I_7) = 0 \\ \text{Mesh 7: } & 11(I_7 - I_5) + 14(I_7 - I_6) + 15(I_7 - I_9) = 0 \\ \text{Mesh 8: } & 13(I_8 - I_6) + 16I_8 + 17I_8 + 18(I_8 - I_9) = 0 \\ \text{Mesh 9: } & 15(I_9 - I_7) + 18(I_9 - I_8) + 19I_9 = 0 \end{aligned}$$

Table 1: The nine equations for the circuit shown in figure 1.

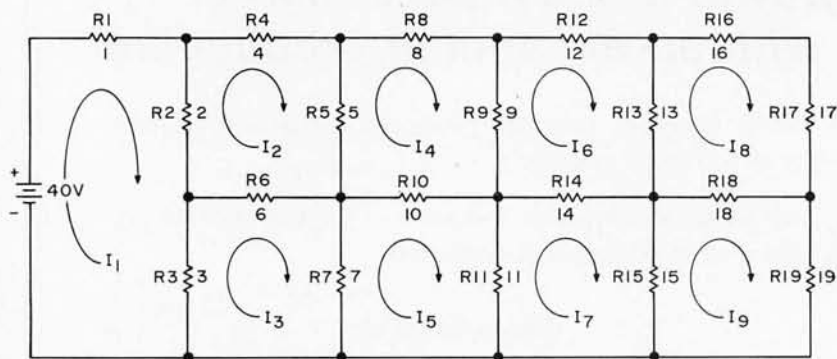


Figure 1: An example of the type of circuit for which nine mesh equations may be written. The resulting system of equations contains nine unknown currents.

Equation 1:	6I <sub>1</sub>	-2I <sub>2</sub>	-3I <sub>3</sub>	+0I <sub>4</sub>	+0I <sub>5</sub>	+0I <sub>6</sub>	+0I <sub>7</sub>	+0I <sub>8</sub>	+0I <sub>9</sub>	= 40
Equation 2:	-2I <sub>1</sub>	+17I <sub>2</sub>	-6I <sub>3</sub>	-5I <sub>4</sub>	+0I <sub>5</sub>	+0I <sub>6</sub>	+0I <sub>7</sub>	+0I <sub>8</sub>	+0I <sub>9</sub>	= 0
Equation 3:	-3I <sub>1</sub>	-6I <sub>2</sub>	+16I <sub>3</sub>	+0I <sub>4</sub>	-7I <sub>5</sub>	+0I <sub>6</sub>	+0I <sub>7</sub>	+0I <sub>8</sub>	+0I <sub>9</sub>	= 0
Equation 4:	0I <sub>1</sub>	-5I <sub>2</sub>	+0I <sub>3</sub>	+32I <sub>4</sub>	-10I <sub>5</sub>	-9I <sub>6</sub>	+0I <sub>7</sub>	+0I <sub>8</sub>	+0I <sub>9</sub>	= 0
Equation 5:	0I <sub>1</sub>	+0I <sub>2</sub>	-7I <sub>3</sub>	-10I <sub>4</sub>	+28I <sub>5</sub>	+0I <sub>6</sub>	-11I <sub>7</sub>	+0I <sub>8</sub>	+0I <sub>9</sub>	= 0
Equation 6:	0I <sub>1</sub>	+0I <sub>2</sub>	+0I <sub>3</sub>	-9I <sub>4</sub>	+0I <sub>5</sub>	+48I <sub>6</sub>	-14I <sub>7</sub>	-13I <sub>8</sub>	+0I <sub>9</sub>	= 0
Equation 7:	0I <sub>1</sub>	+0I <sub>2</sub>	+0I <sub>3</sub>	+0I <sub>4</sub>	-11I <sub>5</sub>	-14I <sub>6</sub>	+40I <sub>7</sub>	+0I <sub>8</sub>	-15I <sub>9</sub>	= 0
Equation 8:	0I <sub>1</sub>	+0I <sub>2</sub>	+0I <sub>3</sub>	+0I <sub>4</sub>	+0I <sub>5</sub>	-13I <sub>6</sub>	+0I <sub>7</sub>	+64I <sub>8</sub>	-18I <sub>9</sub>	= 0
Equation 9:	0I <sub>1</sub>	+0I <sub>2</sub>	+0I <sub>3</sub>	+0I <sub>4</sub>	+0I <sub>5</sub>	+0I <sub>6</sub>	-15I <sub>7</sub>	-18I <sub>8</sub>	+52I <sub>9</sub>	= 0

Table 2: The nine simultaneous equations for the circuit in figure 1, shown here in standard form (ie: with the variables arranged in order for each equation).

sheets have labeled columns for listing the symbolic key codes, the numeric codes which appear in the display for each step of the program, and a column for comments.

The first page of the set of program worksheets contains pre-labeled blocks which allow other useful information about the program to be stored. For example, the first section of listing 1 contains the following information about the simultaneous equations program in abbreviated form:

#### A. Registers

- Registers R0 thru R9 and RS0 thru RS9 are used to store constants in a sequence that is reversed from the order in which they appear in the equations of each system. Note: Processing the first system (n equations) yields a system of n-1 equations; processing the second system (n-1 equations) yields a system of n-2 equations; . . . processing the nth system (1 equation) yields X<sub>n</sub>.
- Register A is used to store the number of equations in the original system of simultaneous equations.
- Register B is used as a pointer for the registers R0 thru R9; register C is used as a pointer for the registers RS0 thru RS9. Registers B and C are decremented in a manner which allows constants to be indirectly recalled from the primary and secondary storage registers so that, using these constants, mathematical operations may be performed upon each equation of each system.
- Register D starts at 1 and counts the number of pivotal equations that have been divided by their first term. When D=A, all pivotal equations have been processed, and X<sub>n</sub> has been computed.
- Register E starts at D+1 and counts the number of equations in each system that have been processed. When all equations of a system have been processed, E=A and the display calls for the next pivotal equation.
- Register I takes care of miscellaneous temporary storage.

#### B. Labels

The main program has two parts which are actually subdivided into several smaller programs. Furthermore, most of the subprograms contain one or more subroutines which are used to conserve program steps.

# Personal Computing... It All Comes Together at NCC '79.

Only during the National Computer Conference will you have an opportunity to experience personal computing to the fullest. And that's why the 1979 Personal Computing Festival, June 4-7 in New York's Sheraton Center Hotel, formerly the Americana, is different. As a conference within a conference, it will give you the chance to explore the complete spectrum of information processing while concentrating on those aspects of personal computing you won't want to miss...including equipment, applications, ideas, and new developments that have created excitement throughout the entire computing community.

Only at NCC '79 will you find such a panorama of computer products on display...ranging from micros to maxis, from processors to peripherals. Included will be the latest innovations in low-cost computing for business, professional, and home use.

Against the backdrop of the prestigious NCC, the Personal Computing Festival has attracted many well-known experts and personalities who will participate in an information-packed technical program and compete for prizes for the best presentations. Join them in exploring applications ranging from use of small business systems and financial analysis to personal networking, new information utilities, and aid to the handicapped.

You will also have ample opportunity to discuss new ideas and novel approaches to shared problems, to find out what to expect in the year ahead, and observe interesting and clever applications demonstrated by the individuals who developed them.

Plan now to take part in a unique personal computing experience at NCC '79. You can register for the Festival at the Sheraton Center Hotel, 52nd Street between 7th Avenue and Avenue of the Americas, for only \$15 which includes your copy of the



**NCC '79 Personal Computing Proceedings.** Registrations, excluding the **Proceedings**, also are available at \$5 for one day and \$9 for all four days. The **Proceedings** will be available separately at \$8. For additional information on NCC '79, including housing and registration procedures, contact AFIPS, 210 Summit Avenue, Montvale, N.J. 07645; telephone 201/391-9810. To obtain information on the special NCC Travel Service call toll-free 800/556-6882.



**NCC '79**

PERSONAL COMPUTING FESTIVAL

c/o AFIPS, 210 Summit Avenue, Montvale, N.J. 07645



Listing 2: Detailed instructions for running the simultaneous equations program in listing 1.

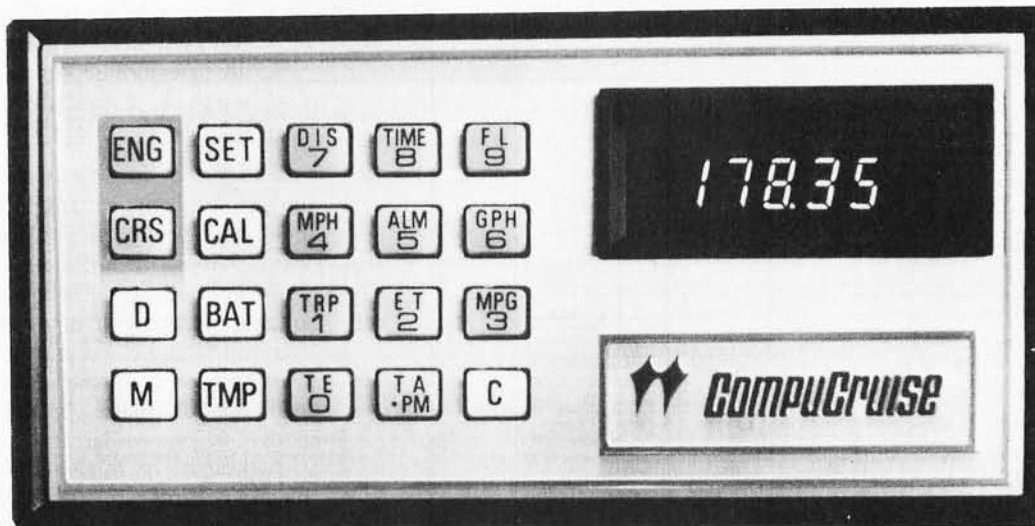
PROGRAM TITLE: Simultaneous Equations					
APPLICATION: Solves Systems of up to 9 equations					
PROGRAMMER: Bob Arp			DATE: 12-16-76		
STEP NO.	INSTRUCTIONS AND REMARKS	INPUTS		OUTPUTS	
		LABEL	KEY	DISPLAY	CARD
1.	Turn calculator on.				
2.	Place W/PRGM-RUN switch in RUN position.			0.00	
3.	Insert side 1 of program card labeled "Simultaneous Equations".			crd	
4.	When crd appears in the display, insert side 2.			0.00000 00	
5.	Key in number of equations in the system.		n	n.	
6.	Press A.	START PART I	A	1.00000 00	
7.	The "1.00000 00" which appears in the display calls for the coefficients of the first pivotal equation to be stored in the primary registers. Store A1(1) in Rn, A2(1) in Rn-1, ..., An(1) in R1, and Y1(1) in R0. Coefficients which are zero need not be stored. The "(1)" refers to the first system.		A1(1) STO n A2(1) STO n-1 ... An(1) STO 1 Y1(1) STO 0		
8.	Press B.	DIVIDE	B	crd	
9.	When crd appears in the display insert side 1 of card 1A(1), where "(1)" is the number of the current pivotal equation (and system) being processed.			crd	
10.	When crd appears again, insert side 2 of card 1A(1).			0.00000	1A(1)
11.	Store the coefficients of the second equation of the first system in the primary registers. Store B1(1) in Rn, B2(1) in Rn-1, ..., Bn(1) in R1 and Y2(1) in R0.		B1(1) STO n B2(1) STO n-1 ... Bn(1) STO 1 Y2(1) STO 0		
12.	Press C.	MULT/SUB.	C	m1(w)(2) Displayed for 5 seconds with flashing decimal point.	
13.	When flashing decimal point appears, record the absolute value of the coefficient for the first term of each equation, w, of the new system, 2, as it appears in the display. If the coefficient is missed while the decimal point is flashing, it may be recalled by pressing h RCI after step 15, before proceeding with step 16.			crd	
14.	When crd appears in the display, insert side 1 of card w(2).			crd	
15.	When crd appears in the display again, insert side 2 of card w(2).			0.00000 00	w(2)
16.	Insert side 2 of card 1A(1).	1A(1)		crd	
17.	When crd appears in the display press CLX.		CLX	0.00000 00	
18.	Store the next equation of the current system, 1, in the primary registers. Store m1(x) in Rn, m2(x) in Rn-1, ..., mn(x) in R1 and Yx in R0, where, x is the number of the equation in system 1 currently being processed.	In General,	m1(x) STO Rn m2(x) STO Rn-1 ... mn(x) STO R1 Y(x) STO		

1. Subprogram A: initiates the first part of the main program.
2. Subprogram B: divides pivotal equations by their first term and outputs an A equation.
3. Subprogram C: multiplies A equations by the coefficient of the first term of each succeeding system equation, subtracts the results of the multiplication from that equation and outputs the equations of a new system.
4. Subprogram D: initiates the second part of the main program.
5. Subprogram E: operating upon the A equations, computes  $X_1$  thru  $X_{(n-1)}$  by multiplying the previously computed X values by their constants and subtracting the results from the right side of the A equation.
6. Subroutine a: initializes B and C registers every time B is pressed after a new pivotal equation is stored in the primary registers and every time C is pressed after a new equation is stored in the primary registers.
7. Subroutine b: clears registers R0 thru R9 to 0.
8. Subroutine c: recalls each term of the equation being processed in the proper order.
9. Loops d, 0, 2, 4: these loops allow the same mathematical operation to be performed many times within the same subprogram.
10. Routine 1: compares the contents of D to the contents of A and transfers execution to routine 9 when  $D=A$ .
11. Routine 3: a short routine which calls subroutine a.
12. Routine 5: stores the address of the first coefficient of each equation of the new system being generated in register I, then recalls the coefficient, stores its absolute value in I, and finally displays the absolute value of the coefficient for 5 seconds.
13. Routine 6: increments E register and decrements D register in the second part of the main program.
14. Routine 7: displays the number of the unknown X which has been computed in a continuous loop until R/S is pressed.
15. Routine 8: calls for the next pivotal equation by displaying its number.

Listing 2 continued on next page.

# CompuCruise

## The Computerized Copilot



At the push of a button your onboard navigational computer will perform 44 important functions in your car, van or truck:

- **Computerized Cruise Control** - More than a simple speed maintaining device available as an option by automobile manufacturers. It establishes and maintains a preselected road speed. You tell the computer how fast you want to travel and CompuCruise takes over. It also features resume and traffic flow adjust.
- **Efficient Fuel Management** - CompuCruise is programmed to answer any question regarding fuel usage. It will tell you your most fuel efficient driving speed; which brand and grade of fuel is most economical in your vehicle (tests show in excess of 11% difference in major unleaded brands alone); effects of tire brands, types & pressures; when tune-up and repair is needed; whether tune-ups have been properly performed; plus other useful fuel saving data.
- **Trip Computer**- By inputting expected trip distance, CompuCruise will continually display time, distance or fuel to arrival... all computed and updated once a second and based on current vehicle speed and fuel consumption.
- **To Empty Function** - Automatic data sensors allow CompuCruise to display time, distance, or fuel to empty... based on current vehicle speed and fuel consumption.
- **Highly Accurate Quartz Crystal Time Function**- Displays time of day; elapsed trip time (hours and minutes); elapsed time (minutes and seconds until 59 min. 59 sec. then hours and minutes); easily set wakeup or reminder alarm.
- **Temperature** - Inside temperature, outside temperature (if desired, outside temperature sensor can be located to provide engine coolant temperature). Displayed in fahrenheit or celsius.
- **Battery - Generator Voltage** - CompuCruise will warn you of impending electrical failure by displaying battery and charging voltage.
- **Sophisticated Yet Simple** - Because of its automatic data sensors, CompuCruise can perform all of its functions with the touch of a button. Yet with all its sophistication, its operation can easily be learned in a few minutes. It can be used with any foreign or domestic vehicle, (except diesel or fuel injected engines) and can be installed by a trained mechanic in less than two hours.

### EACH COMPUCRUISE CONTAINS:

1. Command Module 3"x 6"x 1 3/16"
2. Throttle Servo
3. Speed Sensor
4. Flow Sensor
5. 2 Temperature Sensors
6. Brake-Clutch Disengagement Switch
7. Mounting Hardware for flush or bracket mounting.
8. Installation Manual
9. Use Manual

CompuCruise provides other advantages. The cruise control helps to eliminate speeding tickets. The computer serves as a diagnostic instrument to detect minor engine problems before they become major and costly ones. The precision clock and trip computer provide valuable enroute information whether cross country or local shopping. The battery voltage readout is especially helpful. Present vehicle instrumentation tells you nothing about battery condition. With CompuCruise, you are warned before failure that service is necessary.

Available for \$199.95, (Add \$5.50 for front wheel drive) plus \$2.50 for insured UPS shipping and handling from:

**BITS**<sup>T.M.</sup>  
**inc**

P.O. Box 428, 25 Route 101,  
Peterborough, N.H. 03458

Call your charge card  
orders toll-free:

1-800-258-5477  
In N.H.: 924-3355

AMERICAN  
VISA





Listing 2, continued:

STEP NO.	INSTRUCTIONS AND REMARKS	INPUTS		OUTPUTS	
		LABEL	KEY	DISPLAY	CARD
19.	GO TO step 12 until the digit "2.00000 00" appears in the display, calling for the second pivotal equation. A new pivotal equation must be stored in the primary registers each time the program halts automatically and displays a digit, Z, indicating the desired pivotal equation. When the pivotal equation digit is displayed, the decimal point will not be flashing, nor will the digit be displayed in a continuous loop. The digit, Z, is also the number of the system being processed. The first pivotal equation must be stored by using the keyboard. Subsequent pivotal equations are stored by inserting a data card.		0	2.00000 00	
20.	The new pivotal equation is that equation of the new system, Z, for which the largest (in absolute value) first term has been observed. This equation, as are the other equations of the new system, Z, is stored on a magnetic card.				
21.	Insert side 2 of the card which contains the new pivotal equation.	1(Z)		crd	
22.	When crd appears in the display, press CLX.		CLX	2.00000 00	
23.	Press f P $\frac{f}{S}$ .		f P $\frac{f}{S}$	2.00000 00	
24.	Press B.	DIVIDE	B	crd	
25.	When crd appears in the display, insert side 1 of card 1A(Z).			crd	
26.	When crd appears again, insert side 2 of card 1A(Z).			0.00000 00	1A(Z)
27.	Press f P $\frac{f}{S}$ .		f P $\frac{f}{S}$	0.00000 00	
28.	Insert side 2 of card w(Z) [Card w(Z) no longer needed], where w is the equation of the system, Z, currently being processed.	w(Z)		crd	
29.	When crd appears in the display, press CLX.		CLX	0.00000 00	
30.	Press f P $\frac{f}{S}$ .		f P $\frac{f}{S}$	0.00000 00	
31.	Press C.			ml(w)(Z+1) Displayed for 5 seconds with flashing decimal point.	
32.	When flashing decimal point appears, record the absolute value of the coefficient for the first term of each equation, w, of the system being created. If the coefficient is missed while the decimal point is flashing, it may be recalled by pressing h RCI after step 34, before proceeding with step 35.			crd	
33.	When crd appears in the display, insert side 1 of w(Z+1).			crd	
34.	When crd appears in the display again, insert side 2 of card w(Z+1).			0.00000 00	w(Z+1)
35.	Insert side 2 of card 1A(Z).	1A(Z)		crd	
36.	When crd appears in the display press CLX.		CLX	0.00000 00	
37.	GO TO step 27 until a new digit "2.00000 00" appears in the display, calling for the next pivotal equation.				
38.	When the new digit "2.00000 00" appears in the display, GO TO step 21. Eventually, the digit "n.00000 00" will appear in the display. The nth pivotal equation is the only equation				

16. Routine 9: displays the value of  $X_n$  with flashing decimal in a continuous loop until R/S is pressed.

C. Display

The information under DISP indicates that engineering notation has been selected and that numbers appearing in the display will be rounded off to five significant digits after the first one. When engineering notation is selected, numbers are shown in the display with exponents of 10 that are multiples of 3. As with all HP-67 display formats (unless f RND is pressed), calculations are performed using full 10 digit numbers (10 digit mantissa and 2 digit exponent of 10).

The instructions to be used while running the simultaneous equations program, shown in listing 2, are listed on calculator run worksheets. These worksheets list the manual steps which must be followed to obtain the solution to the system of equations, inputs you must supply to the calculator by pressing keys or inserting cards, and outputs from the calculator in the display or on cards.

Although it might appear that many magnetic cards are needed to run the program, note that cards containing the equations of a system are no longer needed after the equations have been processed with the pivotal equation of the system. Therefore, these cards may then be used to record the equations of another system.

These instructions are self-explanatory (I hope), therefore, I will allow them to speak for themselves. Please note, however, that the instructions contain loops that refer you to steps previously accomplished. Remember that n pivotal equations must be processed and each equation contained in a pivotal's system must be processed with the pivotal equation.

As a further aid in understanding both the program and the HP-67, listing 3 shows what is stored in each register after selected program steps. The calculator register worksheets illustrated in these figures are a valuable debugging tool and serve as explicit program documentation.

All of the forms shown in this article, except the one shown in listing 4, may be used with any HP-67 (and with other calculators as well) program. The form shown in listing 4 has been prepared specifically for simultaneous equations. This worksheet can be used to list the constants of the original system of equations, to record the first terms of each of the other systems as they appear in the display so that the pivotal equations may be easily spotted, and finally, to record the value of each unknown.

Listing 2 continued on opposite page.

**Conclusion**

With the help of special forms designed for the occasion, the powerful repertoire of the HP-67 (and the HP-97) has been examined, yet I have taken from you none of the pleasures in store as you begin your adventures with this versatile calculator.

The example program presented will be an added attraction to those anticipating the purchase of an HP-67, as well as to those fortunates who already possess one. When you look at the price tag on the HP-67, compare its cost to the cost of computer time and memory which would be necessary to run similar programs. In addition, think of the programs you could run on the HP-67 which might never be run otherwise.

*Listing 2, continued:*

STEP NO.	INSTRUCTIONS AND REMARKS	INPUTS		OUTPUTS	
		LABEL	KEY	DISPLAY	CARD
39.	Press B.	DIVIDE	f P/S B	n.00000 00 n.00000 00 Displayed with flashing decimal in a continuous loop.	
40.	The "n.00000 00" displayed with flashing decimal in a continuous loop indicates that Xn has been computed and is stored in RS0.				
41.	Press R/S.		R/S	n.00000 00	
42.	Press D.	START PART II	D	1.00000 00	
43.	Insert side 2 of card 1A(n-1).	1A(n-1)		crd	
44.	When crd appears in the display, press CLX.		CLX	1.00000 00	
45.	Press E.		E	n-1.000000 Displayed with flashing decimal in a continuous loop.	
46.	The "n-1.000000" displayed with flashing decimal in a continuous loop indicates that Xn-1 has been computed and is stored in R2 (Xn is now stored in R1).				
47.	Press R/S.		R/S	n-1.000000	
48.	Insert side 2 of card 1A(1).	1A(1)		crd	
49.	When crd appears in the display, press CLX.		CLX	2.00000 00	
50.	Press E.		E	1.00000 00 Displayed with flashing decimal in a continuous loop.	
51.	The "1.00000 00" displayed with flashing decimal in a continuous loop indicates that X1 has been computed and is stored in Rn.				
52.	Press R/S.	END	R/S	1.00000 00	
53.	Recall each X value from the primary registers by pressing R1 through R9.		RCL 1 RCL 2 ... RCL n	Xn Xn-1 ... X1	

**REFERENCES**

Kuo, Benjamin C, *Linear Networks and Systems*, McGraw-Hill, New York, 1967, pages 63 to 104. A good discussion of introductory network theory.

Pearson, Carl (ed), *Handbook of Applied Mathematics*, Van Nostrand, New York, 1974, pages 906 to 908. Gives a treatment of the Gaussian elimination method.

*Listings 3, 4, 5 and 6 are continued on pages 186 and 188.*

*Listing 3: Selected register worksheets for the sample program discussed in the text. These sheets illustrate the contents of the registers at various key points in the program.*

PROGRAM TITLE: 9 Equation Example									
APPLICATION: Calculator-Aided Design									
PROGRAMMER: Bob Arp					DATA CARD LABEL: None				
LAST PROGRAM STEP: 010					NEXT PROGRAM STEP: 011				
EQUATION:			EQUATION:			COUNTERS AND CONSTANTS			
REG	CONTENTS	LBL	REG	CONTENTS	LBL	REG	CONTENTS	LABEL	
R0	0.00000 00		RS0	0.00000 00		A	9.00000 00		
R1	0.00000 00		RS1	0.00000 00		B	0.00000 00		
R2	0.00000 00		RS2	0.00000 00		C	0.00000 00		
R3	0.00000 00		RS3	0.00000 00		D	1.00000 00		
R4	0.00000 00		RS4	0.00000 00		E	0.00000 00		
R5	0.00000 00		RS5	0.00000 00		I	0.00000 00		
R6	0.00000 00		RS6	0.00000 00		X	1.00000 00		
R7	0.00000 00		RS7	0.00000 00		Y	9.00000 00		
R8	0.00000 00		RS8	0.00000 00		Z	0.00000 00		
R9	0.00000 00		RS9	0.00000 00		T	0.00000 00		
						LSX			
PROGRAMMER:					DATA CARD LABEL: EQ. 1A(1)				
LAST PROGRAM STEP: 046					NEXT PROGRAM STEP: 047				
EQUATION:			EQUATION: 1A(1)			COUNTERS AND CONSTANTS			
REG	CONTENTS	LBL	REG	CONTENTS	LBL	REG	CONTENTS	LABEL	
R0	0.00000		RS0	6.66667	Y	A	9.00000		
R1	0.00000		RS1	0.00000	A9	B	0.00000		
R2	0.00000		RS2	0.00000	A8	C	10.00000		
R3	0.00000		RS3	0.00000	A7	D	1.00000		
R4	0.00000		RS4	0.00000	A6	E	2.00000		
R5	0.00000		RS5	0.00000	A5	I	10.00000		
R6	0.00000		RS6	0.00000	A4	X	0.00000		
R7	0.00000		RS7	-5.00000	A3	Y	2.00000		
R8	0.00000		RS8	-3.33333	A2	Z	1.00000		
R9	0.00000		RS9	1.00000	A1	T	9.00000		
						LSX			
PROGRAMMER:					DATA CARD LABEL: 1(2)				
LAST PROGRAM STEP: 119					NEXT PROGRAM STEP: 120				
EQUATION:			EQUATION: 1(2)			COUNTERS AND CONSTANTS			
REG	CONTENTS	LBL	REG	CONTENTS	LBL	REG	CONTENTS	LABEL	
R0	0.00000		RS0	13.33333	Y	A	9.00000		
R1	0.00000		RS1	0.00000	A8	B	0.00000		
R2	0.00000		RS2	0.00000	A7	C	10.00000		
R3	0.00000		RS3	0.00000	A6	D	1.00000		
R4	0.00000		RS4	0.00000	A5	E	3.00000		
R5	0.00000		RS5	0.00000	A4	I	16.33333		
R6	0.00000		RS6	-5.00000	A3	X	0.00000		
R7	0.00000		RS7	-7.00000	A2	Y	3.00000		
R8	0.00000		RS8	16.33333	A1	Z	9.00000		
R9	0.00000		RS9	0.00000		T	16.33333		
						LSX			
PROGRAMMER:					DATA CARD LABEL: 2(2)				
LAST PROGRAM STEP: 119					NEXT PROGRAM STEP: 120				
EQUATION:			EQUATION: 2(2)			COUNTERS AND CONSTANTS			
REG	CONTENTS	LBL	REG	CONTENTS	LBL	REG	CONTENTS	LABEL	
R0	0.00000		RS0	20.00000	Y	A	9.00000		
R1	0.00000		RS1	0.00000	B9	B	0.00000		
R2	0.00000		RS2	0.00000	B8	C	10.00000		
R3	0.00000		RS3	0.00000	B7	D	1.00000		
R4	0.00000		RS4	0.00000	B6	E	4.00000		

*Listing 3 continued on next page.*



Listing 3, continued:

R5	0.00000		RS5	-7.00000	B5	I	-7.00000	
R6	0.00000		RS6	0.00000	B4	X	0.00000	
R7	0.00000		RS7	14.50000	B3	Y	4.00000	
R8	0.00000		RS8	-7.00000	B2	Z	9.00000	
R9	0.00000		RS9	0.00000	B1	T	-7.00000	
						LSX		
PROGRAMMER:			DATA CARD LABEL: 1A(2)					
LAST PROGRAM STEP: 046			NEXT PROGRAM STEP: 047					
EQUATION:			EQUATION: 1A(2)			COUNTERS AND CONSTANTS		
REG	CONTENTS	LBL	REG	CONTENTS	LBL	REG	CONTENTS	LABEL
R0	0.00000		RS0	.816327	Y	A	9.00000	
R1	0.00000		RS1	0.00000	A9	B	0.00000	
R2	0.00000		RS2	0.00000	A8	C	10.00000	
R3	0.00000		RS3	0.00000	A7	D	2.00000	
R4	0.00000		RS4	0.00000	A6	E	3.00000	
R5	0.00000		RS5	0.00000	A5	I	10.00000	
R6	0.00000		RS6	-.306122	A4	X	0.00000	
R7	0.00000		RS7	-.428571	A3	Y	3.00000	
R8	0.00000		RS8	1.00000	A2	Z	2.00000	
R9	0.00000		RS9	0.00000	A1	T	9.00000	
						LSX		
PROGRAMMER:			DATA CARD LABEL: 1(3)					
LAST PROGRAM STEP: 119			NEXT PROGRAM STEP: 120					
EQUATION:			EQUATION: 1(3)			COUNTERS AND CONSTANTS		
REG	CONTENTS	LBL	REG	CONTENTS	LBL	REG	CONTENTS	LABEL
R0	0.00000		RS0	25.7143	Y	A	9.00000	
R1	0.00000		RS1	0.00000	A9	B	0.00000	
R2	0.00000		RS2	0.00000	A8	C	10.00000	
R3	0.00000		RS3	0.00000	A7	D	2.00000	
R4	0.00000		RS4	0.00000	A6	E	4.00000	
R5	0.00000		RS5	-7.00000	A5	I	11.50000	
R6	0.00000		RS6	-2.14286	A4	X	0.00000	
R7	0.00000		RS7	11.50000	A3	Y	4.00000	
R8	0.00000		RS8	0.00000	A2	Z	9.00000	
R9	0.00000		RS9	0.00000	A1	T	11.50000	
						LSX		
PROGRAMMER:			DATA CARD LABEL: 1(9)					
LAST PROGRAM STEP: 127			NEXT PROGRAM STEP: 128					
EQUATION:			EQUATION: 1(9)			COUNTERS AND CONSTANTS		
REG	CONTENTS	LBL	REG	CONTENTS	LBL	REG	CONTENTS	LABEL
R0	0.00000		RS0	8.16534	Y1	A	9.00000	
R1	0.00000		RS1	36.9574	A9	B	0.00000	
R2	0.00000		RS2	0.00000	A8	C	10.00000	
R3	0.00000		RS3	0.00000	A7	D	9.00000	
R4	0.00000		RS4	0.00000	A6	E	9.00000	
R5	0.00000		RS5	0.00000	A5	I	36.9574	
R6	0.00000		RS6	0.00000	A4	X	9.00000	
R7	0.00000		RS7	0.00000	A3	Y	0.00000	

R8	0.00000		RS8	0.00000	A2	Z	9.00000	
R9	0.00000		RS9	0.00000	A1	T	9.00000	
						LSX		
PROGRAMMER:			DATA CARD LABEL: 1A(9)					
LAST PROGRAM STEP: 130			NEXT PROGRAM STEP: 131					
EQUATION:			EQUATION: 1A(9)			COUNTERS AND CONSTANTS		
REG	CONTENTS	LBL	REG	CONTENTS	LBL	REG	CONTENTS	LABEL
R0	-8.16534		RS0	.220939	Y	A	9.00000	
R1	36.9574		RS1	1.00000	A9	B	0.00000	
R2	0.00000		RS2	0.00000	A8	C	10.00000	
R3	0.00000		RS3	0.00000	A7	D	9.00000	
R4	0.00000		RS4	0.00000	A6	E	36.9574	
R5	0.00000		RS5	0.00000	A5	I	10.00000	
R6	0.00000		RS6	0.00000	A4	X	9.00000	
R7	0.00000		RS7	0.00000	A3	Y	9.00000	
R8	0.00000		RS8	0.00000	A2	Z	9.00000	
R9	0.00000		RS9	0.00000	A1	T	9.00000	
						LSX		
APPLICATION: D has just been pressed to initiate Part II.								
PROGRAMMER:			DATA CARD LABEL:					
LAST PROGRAM STEP: 141			NEXT PROGRAM STEP: 142					
EQUATION:			EQUATION:			COUNTERS AND CONSTANTS		
REG	CONTENTS	LBL	REG	CONTENTS	LBL	REG	CONTENTS	LABEL
R0	0.00000		RS0	8.16534		A	9.00000	
R1	.220939	I9	RS1	36.9574		B	0.00000	
R2	0.00000		RS2	0.00000		C	10.00000	
R3	0.00000		RS3	0.00000		D	9.00000	
R4	0.00000		RS4	0.00000		E	1.00000	
R5	0.00000		RS5	0.00000		I	-.220939	
R6	0.00000		RS6	0.00000		X	1.00000	
R7	0.00000		RS7	0.00000		Y	0.00000	
R8	0.00000		RS8	0.00000		Z	-.220939	
R9	0.00000		RS9	0.00000		T	-.220939	
						LSX		
PROGRAMMER:			DATA CARD LABEL:					
LAST PROGRAM STEP: 189			NEXT PROGRAM STEP: 190					
EQUATION:			EQUATION: 1A(8)			COUNTERS AND CONSTANTS		
REG	CONTENTS	LBL	REG	CONTENTS	LBL	REG	CONTENTS	LABEL
R0	.140633		RS0	.0645869		A	9.00000	
R1	.220939	I9	RS1	-.344197		B	1.00000	
R2	.140633	I8	RS2	1.00000		C	11.00000	
R3	0.00000		RS3	0.00000		D	8.00000	
R4	0.00000		RS4	0.00000		E	2.00000	
R5	0.00000		RS5	0.00000		I	2.00000	
R6	0.00000		RS6	0.00000		X	8.00000	
R7	0.00000		RS7	0.00000		Y	8.00000	
R8	0.00000		RS8	0.00000		Z	8.00000	
R9	0.00000		RS9	0.00000		T	8.00000	
						LSX		

CALCULATOR REGISTER WORKSHEET

TREBOR ENGINEERING

Listing 4: A special simultaneous equations worksheet showing the constants of the original nine equations of the sample problem discussed in the text. The first terms of each of the intermediate systems are shown along with the solution.

TITLE: Nine Equations Example										PAGE 1 OF 1	
APPLICATION: Solves systems of up to 9 simultaneous equations										DATE: 12/27/76	
SYSTEM 1 CONSTANTS											
EQ #	m1	m2	m3	m4	m5	m6	m7	m8	m9	Y	
1	6	-2	-3	0	0	0	0	0	0	40	
2	-2	17	-6	-5	0	0	0	0	0	0	
3	-3	-6	16	0	-7	0	0	0	0	0	
4	0	-5	0	32	-10	-9	0	0	0	0	
5	0	0	-7	-10	28	0	-11	0	0	0	
6	0	0	0	-9	0	48	-14	-13	0	0	
7	0	0	0	0	-11	-14	40	0	-15	0	
8	0	0	0	0	0	-13	0	64	-18	0	
9	0	0	0	0	0	0	-15	-18	52	0	
REG	R9	R8	R7	R6	R5	R4	R3	R2	R1	R0	
FIRST TERMS (ABSOLUTE VALUE)											
EQ #	SYSTEM									VARIABLES	
1	2	3	4	5	6	7	8	9	X1	9.12165	
2	16.3333	11.5000	30.0701	19.4895	44.7189	28.1314	59.4605	.220939	X2	2.49275	
3	7.0000	2.1428	11.3043	3.3834	15.9096	4.6250	20.4661	X3	3.24814		
4	5.0000	7.0000	9.0000	11.0000	13.0000	15.0000	X4	9.28924			
5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	X5	1.37839			
6	0.0000	0.0000	0.0000	0.0000	0.0000	X6	.386434				
7	0.0000	0.0000	0.0000	X7	.597162						
8	0.0000	X8	.140634								
9	0.0000	X9	.220939								

SIMULTANEOUS EQUATIONS WORKSHEET

TREBOR ENGINEERING

# COMPUTERWARE for 6800's

## THE BASICS

(that we're famous for...)

- **Random SSB Basic** 89.95
- **Flex Disk Basic** 49.95
- **Cassette Basic** 29.95
- **Prom Basic** CASSETTE 100.00  
2716 250.00
- **Renbas** W/ SOURCE LIST 24.95  
W/ SOURCE DISK 34.95

We register our BASIC owners and offer future enhancements at reasonable prices.

## FOR WORK

- **CHECK FILE** 49.95
- **HOME MAILING (VI)** 49.95
- **HOME INVENTORY** 49.95
- **BUSINESS MAILING (V2)** 89.95

\*\*\*\*\*  
write for information about our  
**COMMERCIAL BUSINESS SOFTWARE**  
including:

- INVENTORY CONTROL
- ORDER ENTRY
- ACCOUNTS RECEIVABLE
- MAILING SYSTEM
- and MORE

all using **RANDOM ACCESS** capabilities

## AND PLAY

- **LEARN BASIC** 39.95
- **LEARN ASSEMBLER** 19.95
- **PILOT** DISK 24.95  
W/ SOURCE LIST 37.95  
W/ SOURCE DISK 49.95

- **MUSIC** for the Newtech Model 68  
4-Part Music # 1 24.95  
4-Part Music # 2 24.95  
Interpreter - coming soon -  
compose on your keyboard!

for more information circle inquiry no.  
for **quick** information **write** to us

### ORDERING INFORMATION

- always specify cassette, Flex disk, or SSB disk
- on Pre-paid orders Computerware will pay shipping charges
- for C.O.D. orders shipping charges are extra
- Calif. residents add 6% sales tax

## COMPUTERWARE

6800 specialists  
830 FIRST STREET  
ENCINITAS, CALIF. 92024  
(714) 436-3512

\$

\$ Send us this coupon before \$  
\$ April 30, 1979 and get \$  
\$  Both Learn Basic \$  
\$ and Learn Assembler 49.95 \$  
\$  10% off any software order \$  
\$ of more than \$50.00 \$  
\$

# Albert Einstein

March 14, 1879—March 14, 1979

World renowned photographer Lotte Jacobi announces the release of an outstanding series of photographs of the man who by his powers of reason and moments of wild speculation became instrumental in shaping the modern world.

This unique portfolio of 25 five by seven portraits, selected from photographs taken over a span of two decades, have been assembled to mark the centennial of Albert Einstein's birth.

The price of this remarkable set is \$22.95, first class postage and handling included. Available from:

**BITS** T.M. inc POB 428, 25 Route 101 West,  
Peterborough, N.H. 03458  
Books to erase the impossible



Charge Card Orders May Be Placed  
On Our Toll-Free Number:  
800-258-5477  
(In New Hampshire Call 924-3355)





Listing 5: Instructions for running the program in listing 6 which checks the solutions obtained by the program in listing 1.

Blank coding forms like the ones used in this article may be purchased from Robert C Arp Jr, 3961 Acapulco Dr, Campbell CA 95008.

Listing 6: A program which accepts the coefficients calculated by listing 1 and checks them for accuracy.

PROGRAM TITLE: Simultaneous Equations Check Program PAGE 1 OF 2				
APPLICATION: Checks solutions to systems of up to 9 equations				
PROGRAMMER: Bob Arp		DATE: 12-27-76		
STEP NO.	INSTRUCTIONS AND REMARKS	INPUTS		OUTPUTS
		LABEL	KEY	DISPLAY CARD
1.	Before the check program can be initiated, all values of X must be stored in the primary registers as follows: X1 in Rn, X2 in R(n-1), ..., Xn in R1. The values of X are stored in this manner at the end of the "SIMULTANEOUS EQUATIONS" program.			
2.	Key in the number of system equations.		n	n.
3.	Press A.	START	A	n.00000 00
4.	Store the coefficients of equation 1 into the primary registers as follows: A1 in Rn, A2 in R(n-1), ..., An in R1. Constants which are zero need not be entered.	EQ 1	A1 STO Rn A2 STO Rn-1 ... An STO R1	
5.	Press B.	MULT/ADD	B	≈Y1 Displayed with flashing decimal in a continuous loop.
6.	Press R/S.	HALT	R/S	≈Y1
7.	The number which appears in the display should be approximately equal to Y1.			
8.	Store the coefficients of equation 2 in the primary registers as follows: B1 in Rn, B2 in R(n-1), ..., Bn in R1. Constants which are zero need not be entered.	EQ 2	B1 STO Rn B2 STO Rn-1 ... Bn STO R1	
9.	Press B.	MULT/ADD	B	≈Y2 Displayed with flashing decimal in a continuous loop.
10.	Press R/S.	HALT	R/S	≈Y2
11.	The number which appears in the display should be approximately equal to Y2.			
	...			
12.	Store the coefficients of equation n in the primary registers as follows: m1 in Rn, m2 in R(n-1), ..., mn in R1.	EQ n	m1 STO Rn m2 STO Rn-1 ... mn STO R1	
13.	Press B.	MULT/ADD	B	≈Yn Displayed with flashing decimal in a continuous loop.
14.	Press R/S.	END	R/S	≈Yn
15.	The number which appears in the display should be approximately equal to Yn.			

CALCULATOR RUN WORKSHEET

TREBOR ENGINEERING

PROGRAM TITLE: SIMULTANEOUS EQUATIONS CHECK PROGRAM PAGE 1 OF 2																		
APPLICATION: Checks solutions to systems of up to 9 equations.																		
PROGRAMMER: Bob Arp					DATE:													
REGISTERS																		
0	1	m9	2	m8	3	m7	4	m6	5	m5	6	m4	7	m3	8	m2	9	m1
S0	S1	X9	S2	X8	S3	X7	S4	X6	S5	X5	S6	X4	S7	X3	S8	X2	S9	X1
A #	Eqs in System	B Pri reg pointer	C Sec reg pointer	D Term counter	E Y storage	I Misc storage												
LABELS										FLG	SET STATUS							
A	Start	B	Mult/ Add	C	D	E	0	FLAGS		TRIG	DISP							
a	b	c	d	e	1	ON	OFF	DEG	FIX									
0	Mult/ add loop	1	Clear registers	2	Disp loop	3	4	2	GRA	SCI								
									RAD	ENG	Y							
										n	5							
NUM	PROGRAM CODES					DEFINITIONS AND REMARKS												
ADD	NUMERIC	SYMBOLIC																
001	31	25	11	f	LBL	A	With all values of X stored in primary registers and with the number of system equations keyed into the calculator, pressing A initializes the check program by storing the values of X in the secondary registers and clearing the primary registers.											
002	23	05			DSP	5												
003	35	23			h	ENG												
004	31	42			f	PIS												
005	31	43	r		CL	REG												
006	33	11			STO	A												
007	35	22			h	RTN												
008	31	25	12	f	LBL	B	When the program halts and displays the number of system equations, the coefficients of the first system equation must be stored in the primary registers; coefficients which are zero need not be stored. The coefficients must be stored in the registers as indicated above under the "REGISTERS" heading (see CALCULATOR RUN WORKSHEET).											
009	34	11			RCL	A												
010	33	12			STO	B												
011	33	14			STO	D												
012		01				1												
013		00				0												
014		61				+												
015	33	13			STO	C												
016		00				0												
017		41				▲	During subsequent halts, the coefficients of the other system equations are stored, in turn, in the primary registers.											
018	33	15			STO	E												
019	31	25	00	f	LBL	0												
020	34	12			RCL	B	After the coefficients of an equation have been stored, pressing B causes each value of X to be multiplied by the appropriate constant, and the sum of the multiplications to be stored in register E. The Multiply/Add loop continues until the term counter, D, indicates that n terms have been processed.											
021	35	33			h	ST	I											
022		44				CLX												
023	34	24			RCL	(i)												
024	34	13			RCL	C												
025	35	33			h	ST	I											
026		44				CLX												
027	34	24			RCL	(i)												
028		71				x												
029	34	15			RCL	E												
030		61				+												
031	33	15			STO	E												
032		01				1												
033	34	14			RCL	D												
034	32	51			g	X=Y												
035	22	01			GTO	1												
036		01				1												
037		51				-												
038	33	14			STO	D												
039	34	12			RCL	B												
040		01				1												
041		51				-												
042	33	12			STO	B												
043	34	13			RCL	C												
044		01				1												
045		51				-												
046	33	13			STO	C												
047	22	00			GTO	0												
048	31	25	01	f	LBL	1	Clears primary registers; allows the next system equation to be stored with no attention paid to the coefficients which are zero.											
049		00				0												
050	33	00			STO	0												
051	33	01			STO	1												
052	33	02			STO	2												
053	33	03			STO	3												
054	33	04			STO	4												
055	33	05			STO	5												
056	33	06			STO	6												
057	33	07			STO	7												
058	33	08			STO	8												
059	33	09			STO	9												
060	31	25	02	f	LBL	2	Recalls the value of the Y term stored in E and displays this value with a flashing decimal point in a continuous loop; pressing R/S breaks the loop and displays Y.											
061	34	15			RCL	E												
062	31	84			f	-x-												
063	22	02			GTO	2												
064		84			R/S													
065																		
066																		
.																		
.																		
.																		
080																		

CALCULATOR PROGRAM CONTINUATION WORKSHEET

TREBOR ENGINEERING

The Fourth  
Trenton Computer Festival

# TCF-79

April 21 & 22, 1979

10 AM to 6 PM  
SATURDAY, 21st

at TRENTON STATE COLLEGE  
Trenton, New Jersey

10 AM to 4 PM  
SUNDAY, 22nd

- Super Outdoor Flea Market
- Indoor Commercial Exhibit Area
- Forums, Talks and Seminars
- Convenient to NY, PA, MD and DEL

Hundreds of Door Prizes • Banquet Saturday Night

For additional information call 609-771-2487

Admission \$4 - Students \$2

Banquet \$10. Avoid disappointment - pre-register for the banquet! Send your check for \$10 per person to: TCF 79, Trenton State College, Trenton, N.J. 08625.

Sponsored by:

Amateur Computer Group of New Jersey  
Philadelphia Area Computer Society  
Trenton State College Digital Computer Society

Dept. of Engineering Technology, Trenton State College  
I.E.E.E., Princeton Section

### STAR SHIP SIMULATION

by Roger Garrett

Star Ship Simulation is a design for a program to simulate the operations of the starship Enterprise, as defined on the original TV program, on a computer. Navigation, communication, helm, medical, engineering, and science functions are realized, along with the actions of several other Federation and enemy craft. The program is presented in a general structured form with information to aid the user in implementing it for a particular hardware/software set-up. pp.122, \$6.95.

### PROGRAMMING THE 6800 MICROPROCESSOR

by Bob Southern

This self-instruction workbook is a guide to the fundamentals of assembly language and machine code programming of the 6800 microprocessor and its peripheral devices. Considerable coverage is given to programming of the input and output devices. The asynchronous communications, interface adapter, each with their various modes of operations, are explored in detail in both noninterrupt and interrupt modes. Program design and documentation are emphasized along with programming hints and aids. 200 pp., \$6.75.

### SCIENTIFIC AND ENGINEERING PROBLEM SOLVING WITH THE COMPUTER

by William Ralph Bennett Jr.

One of the most exciting books we've seen in years. Besides teaching BASIC (which it does admirably), this lively, lucid book presents a wealth of imaginative and unusual applications programs and simulations taken from many disciplines. The exercises run the gamut from random processes to the dynamics of motion, from entropy in language to the Watergate problem. You'll discover BASIC applications in lasers and in the Fourier series and the law (!). In its diversity and elegant style, it ranks with Donald Knuth's works as a milestone in the art of computing. Hardcover, 457 pp, \$19.95.



# BITS

POB 428, 25 Route 101 West  
Peterborough, NH 03458

Books to erase the impossible

Name \_\_\_\_\_

Address \_\_\_\_\_

Check enclosed  
 VISA     MC    Expires \_\_\_\_\_

Postage \$.75/book or \$1.00 outside U.S.

Prices subject to change without notice



DIAL YOUR BANK ORDER ON OUR TOLL-FREE LINE 800-258-5477

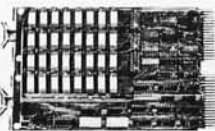


# 64KB MICROPROCESSOR MEMORIES

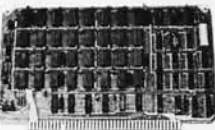
- S-100 - \$695.00
- SBC 80/10 - \$750.00
- LSI 11 - \$750.00
- 6800 - \$750.00



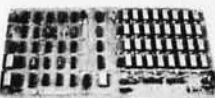
CI-S100 64K x 8



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 \$750.00 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 \$750.00.

**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 \$750.00

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.



## BASIC Cross-Reference Table Generator

William and Alice Englander  
1966 Titus St  
San Diego CA 92110

A standard compiler feature for high level languages like COBOL and PL/I is a cross-reference of the source program. In the simplest case, each named element in the program is listed in a report with the line numbers of all statements containing that element. Words which have special meanings in the language being cross-referenced, such as READ or IF, are ignored.

Features of more sophisticated cross-reference facilities include placing the elements in alphabetical order, showing the statement number in which an element is defined separate from its references, defining the use of the element as a sending or receiving field and cross-referencing both data elements and procedural elements (statement labels).

As we began program development in BASIC on our microprocessor, we discovered the pleasures of using BASIC, but were surprised to find that cross-references of our BASIC programs could not be produced with any of our regular system software. In addition, our survey of the literature did not turn up any BASIC cross-reference programs.

A cross-reference can be an extremely useful programming aid. When you are debugging a program, it allows you to quickly find each statement which deals with a particular variable. For example, if the program is looping you can look at each reference of the loop control variable to ensure that it has been initialized, that it is being incremented, and that a check for the upper limit is being made. A cross-reference is

Text continued on page 192.

CBASIC BSGAME

CBASIC COMPILER VER 1.01

```

1: PRINT "BINARY SEARCH GAME"
2: PRINT
3: INPUT "HIT RETURN WHEN READY TO PLAY";LINE ANS$
4: RANDOMIZE
5: 10 LOW=1
6: HIGH=1000
7: NO=INT(RND*HIGH)+1
8: FOR I=1 TO 24
9: PRINT
10: NEXT I
11: 20 PRINT
12: PRINT "ENTER NUMBER IN THE RANGE";LOW;"THROUGH";HIGH
13: INPUT GUESS
14: IF (GUESS<LOW) OR (GUESS>HIGH) OR (GUESS<>INT(GUESS)) THEN\
15: PRINT "TRY AGAIN";\
16: GO TO 20
17: IF GUESS<NO THEN\
18: LOW=INT(GUESS+1);\
19: PRINT "YOU'RE LOW";\
20: GO TO 20
21: IF GUESS>NO THEN\
22: HIGH=INT(GUESS-1);\
23: PRINT "YOU'RE HIGH";\
24: GO TO 20
25: PRINT "YOU WIN!!!"
26: PRINT
27: PRINT "PLAY AGAIN?"
28: INPUT ANS$
29: IF LEFT$(ANS$,1)="Y" THEN\
30: GO TO 10
31: PRINT "END OF BINARY SEARCH GAME"
32: STOP
33: END

```

NO ERRORS DETECTED

CRUN XREF  
CRUN VER 1.03

ENTER NAME OF PROGRAM TO BE CROSS-REFERENCED BSGAME

CROSS-REFERENCE LISTING OF PROGRAM B:BSGAME.BAS

VARIABLE	REFERENCES									
I	8	10								
NO	7	17	21							
LOW	5	12	14	18						
ANS\$	3	28	29							
HIGH	6	7	12	14	22					
GUESS	13	14	14	14	14	17	18	21	22	

*Listing 1: An example program with a cross-reference table generated by the BASIC cross-reference generator program.*

**About the Authors**

*William and Alice Englander have a programming and consulting firm in the San Diego area. While most of their program development is done on customers' large scale computers, they also do work for customers on their IMSAI 8080 disk based system. They are both computer systems instructors at National University.*

Please send \_\_\_\_\_ copies of BYTE Nybble # \_\_\_\_\_ at \$ \_\_\_\_\_ postpaid.

\_\_\_\_\_ *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.



handy when you need to make a program change, too. You can quickly see what names have already been used if you need to define a new variable. And you can double check your planned changes against uses of the existing variables, which may enable you to use existing ones instead of having to define new ones.

In BASIC, a cross-reference listing can be especially useful in helping you to verify that you have used correct names in your code. Since BASIC sets up variables for you without requiring explicit definitions, you can accidentally miscode a variable name and cause some elusive program problems. A quick look at the cross-reference would alert you right away since you would see both the correct name and the improperly coded name.

Our BASIC cross-reference program was written using C-BASIC on an IMSAI 8080 disk based system running under CP/M. Depending on your configuration, enhancements could probably be made which would speed up the processing time. A typical program and cross-reference table is shown in listing 1 on the preceding page. ■

*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 can be 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 punched with three holes for collection in loose leaf binders, and come in an attractive folder which serves as a cover. This month the BASIC Cross-Reference Table Generator has been added to the Nybbles Library. You can order a personal copy of this program (BYTE Nybbles Library Document #105) for \$.75 postpaid (\$1.05 overseas postpaid) by filling out the coupon on the preceding page.*

## BYTE's Bugs

### Motor Source Error

A list of stepping motor sources in "A Stepping Motor Primer, Part 1: Theory of Operation," by Paul Giacomo (February 1979 BYTE, page 90) was incomplete. We omitted Superior Electric Co, 383G Middle St, Bristol CT 06010, a major manufacturer of stepping motors. ■

### Polyphony Made Accurate

Perusal of my copy of the January 1979 BYTE, containing my article "Polyphony Made Easy," reveals two errors in the schematic on page 106.

First the trivial one: the counters are incorrectly labeled as 7473 (in fact, both are called IC10a). They are, in reality, 7493s.

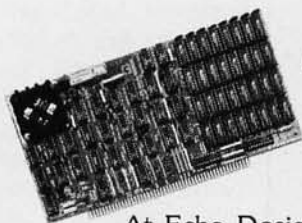
Second, the multiplexers — all nine of them — have a pinout error. Instead of "B A C" along the bottom of each one (input address), they should read "A B C," with the pin numbers changed accordingly to "11 to 9."

These are not crippling errors — anyone who's reasonably familiar with TTL (transistor-transistor logic) would spot the first one immediately, and the second would cause scrambled key codes but would sooner or later be figured out.

Steven K Roberts  
129 N Galt Av  
Louisville KY 40206 ■

### Finishing the Job

The Programming Quickie "Single Stepping the 8080 Processor" (January 1979 BYTE, page 179) has one small bug in it. A line of code was left out of the program listing on page 180. The last line of the program should read: 118A JMP FINI C37D10. ■



## Get your PC masters in as little as 2 weeks

At Echo Design your circuit drawings can be converted into finished artwork masters in only 2 to 6 weeks, depending on complexity.

We do board layouts for many of the biggest names in the business.

And we have broad capability. Such as computer boards having 450 ICs.

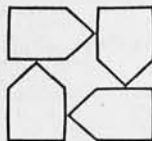
Choose any or all these services:

- Layout (to digitizing standards if desired)
- Assembly drawing
- Tape-up (artwork)
- Schematic drawing
- Fab drawing
- Bill of material
- Printed board

Place a call now to John Offenbacher or Al Chew and get your new board moving at competitive prices.

**FREE**  
Ask for  
a copy

Basic  
Guidelines  
for  
Printed  
Circuit  
Partitioning



**echo**  
DESIGN AND  
DEVELOPMENT  
CORPORATION

195 EAST GISH ROAD • SAN JOSE, CA 95112  
**408-292-0918**

We also provide contract technical personnel world wide

---

# BYTE News . . .

---

32 Bit Microprocessors Are Rumored. While Zilog and Motorola are struggling to get their 16 bit microprocessor-ICs into production, Texas Instruments and Intel have been delivering theirs for some time. Now rumors abound that both TI and Intel will show prototype 32 bit processors by the end of the year and may be in production by the end of 1980 or the beginning of 1981.

Tremendous Growth of Personal Computer Systems Predicted for 1979. Mike Shea, marketing director for Atari, who recently brought two personal computer systems to the market, predicts a four to sixfold increase in personal computer sales for this year. He feels that between 200,000 and 300,000 personal computer systems will be sold this year, compared to 50,000 last year, and said that in the future Atari will pay less attention to developing new game consoles and instead concentrate on bringing out new software for existing units.

Fairchild Camera & Instruments predicts that 4.6 million programmable video games will be sold this year, worldwide, compared to 2.1 million in 1978. Further, they predict that 18 million cartridges, worth \$110 million, will be sold, compared to 5.7 million, worth \$18 million, last year.

Nonvideo games growth should prove even more dynamic, according to industry pundits. Sales should reach \$290 million in 1979, and possibly \$500 million in 1980.

Lear Seigler Shipped 40,000 Video Terminals in 1978. The Data Products division of Lear Seigler announced that in 1978 they shipped 40,000 video display terminals. This was more than they shipped in their six previous years of doing business. LS is predicting an increase in video display sales in 1979 of 25 to 30 percent.

Centronix Reports 20 Percent of Its Printers Go to Personal Computer Makers. Centronix, the leading maker of dot matrix printers, predicts that about 20 percent of its 1979 business will be from Tandy (Radio Shack TRS-80) and from Apple Inc. At the beginning of the year they were shipping 1700 printers per month to Tandy (in other words, 20,400 per year). Centronix is getting set to introduce a high density dot matrix printer and a word processing impact printer to compete with Diablo and Queme.

Computer Stores Becoming Big Business. Computer stores are becoming mass merchandisers, judging by an order recently placed with Perkin-Elmer Corp. Their terminal division announced that Micro-Age, a chain of five computer stores in Arizona and Texas, placed an order with them for 2000 of their new Bantam video display terminals. That's a far cry from the garage-type computer store operations of just a year or two ago.

Battle Shaping Up in 32K EROM. In February 1978 Texas Instruments introduced its TMS 2532 4K by 8 EROM (erasable read only memory), with full production promised for April or May. This meant that they were well ahead of all the other integrated circuit manufacturers. They accepted orders for the device at \$54 in 100 price lots. Intel introduced their 2732 erasable read only memory in November. Needless to say, the pinouts were different and a heated debate developed in the JEDEC committee over which would be the standard. TI hoped their 10 month lead would favor them. However, they encountered production problems and only started to deliver samples by year-end. Intel, in the meantime, is in production and has already lined up at least one second source. TI is promising production quantities by April. The unit price on the Intel part is currently \$140. The 2732 also uses the same pinout as the 2716 and 2708 EROMs.

HP May Be Developing Personal Computer System. Hewlett-Packard is rumored to be developing a new personal computer system at its Corvallis Oregon Consumer Products division. HP has been selling a desktop computer with BASIC in read only memory and an IEEE-488 interface for a few years now. It is expected that the system will be a scaled down version of this system, that it will have a base price of \$1000, and that it will be on the market this fall.

Tandy Developing New Computer. Tandy is rumored to be in development of a second generation Radio Shack TRS-80, possibly with color capability. Tandy, which has a 200,000 square foot plant and staff of 700 making the TRS-80, is supposedly looking for an outside manufacturer of the new system. Tandy also plans to develop many new software packages for introduction this year.

Magnavox Files Suit on Microprocessor Video Game Patents. Magnavox, the originator of video games played on home TV receivers, has filed suit against several manufacturers of programmable TV video games; among them



are Fairchild, Bally, Sears Roebuck and Montgomery Ward. Magnavox has won previous suits on dedicated, non-programmable video games. Some industry experts feel that if Magnavox is successful in this suit, the next step might be to try to license makers of personal computers that connect to home TV receivers.

DEC Forms Retail Products Group. Digital Equipment Corporation, the largest manufacturer of minicomputers, has formed a retail products group. Its initial objective is planning for expansion based on its successful experience with a retail store, which opened last August in Manchester NH. Located in a shopping mall, the store sells small computer systems starting at less than \$10,000.

Flat Panel Displays Getting Closer to Production. Last month I reported on a flat panel terminal display being readied for production by General Telephone and Electronics. Several other companies have also announced that they have display panels in development. However, none appear near to replacing the present video displays, such as that of GT&E. Nonetheless, they are worth reviewing.

Datascreen Corp, of Mountain View CA, will soon start sampling a 40 character LCD (liquid crystal display) panel (5 by 10 dots) which works off 5 V and consumes 250 mW.

Westinghouse has already demonstrated a 180 by 180 line LCD panel for TV use. Hitachi has shown a 120 line panel. Neither, however, is near production.

Electroluminescent type panel samples are already available from Sharp. A 480 character display using a 7 by 9 dot matrix, with complete drive electronics, is currently available for \$2500. A 240 by 320 dot graphics panel will be available next year.

ISSCC Gives Preview of New Technology Coming. The annual International Solid State Circuits Conference, held in Philadelphia, February 14 to 16, saw the presentation of new hardware technology still in the research and development stage. These devices will not be on the market for at least a year yet, and most are still 2 to 3 years off. But all are real and coming. Here's a partial list of some of those presented at the ISSCC:

From Intel: a self-refreshing dynamic 4 K programmable memory with 200 ns access, an NMOS 4 K static programmable memory with 25 ns access, a 16 K HMOS static programmable memory with 45 ns access, a 5 V only 16 K dynamic programmable memory with 100 ns access and an analog I/O (input/output) microprocessor with on board erasable read only memory.

From Texas Instruments: a simple 1 transistor cell.

From Nippon Telephone and Telegraph: a 128 K bit read only memory and a megabit full wafer MOS programmable memory with 350 ns access.

From Hitachi: a 1 K programmable memory with 5 ns access.

The Robots Are Taking Over. There are already about 20,000 robots at work in US factories. But this is just the beginning. Japan and several European countries are already ahead of the US in introducing manufacturing robots and automation under computer control.

Automation experts claim that in most manufacturing situations a product spends 95 percent of its time moving and waiting. Time is money. Hence, automation can cut this wasted time tremendously, effecting considerable savings.

Zilog Reports \$18 million in Sales. Zilog, the creator and maker of the Z-80 processor, has reported sales for 1978 of \$18 million. The company, which started in late 1975, and brought the Z-80 to the market in 1976, operated in the red in 1976 and 1977. A company spokesman said that in 1978 they were "at breakeven."

The Altair May Live Again. When Pertec bought MITS and its Altair line of PC system in 1977, they deserted the hobbyists who made the Altair a success. Pertec tried to change the Altair into a small business computer system. Things did not go too well. Pertec moved MITS from Albuquerque to California and then Pertec stopped making Altairs in June 1978. Pertec now is going to resurrect the Altair and start producing it again, in a new plant it is building in Albuquerque (of all places). Pertec plans to market it to small business users and not to personal computer users.

Computers Produce \$350 Million Trade Surplus. It seems that all we read about in the newspapers are trade deficits. Well, last year the US exported \$350 million in computer gear. Canada was the biggest purchaser (\$12 million), and Japan was second (\$10 million). Actually the US exported \$406 million but imported \$56 million in computer gear.

IBM Keeps Growing and Growing. When microcomputers came out and skyrocketed in popularity, many pundits predicted that IBM's domination of the computer business was coming to an end. However, that is not what has

happened. Today IBM has a larger backlog of orders than ever before. Their current backlog is more than four times the computing power it has ever shipped. Delivery time on its new 303X large computers is now over two years, and IBM has orders for about 13,000 of these machines, which replace large 370s.

**Paper Newspapers and Mail May Soon Be a Thing of the Past.** The ground work for a digital electronic mail system is now in the works. Imagine having your newspapers, magazines, bills, etc, delivered to you directly via your personal computer system, and likewise being able to write letters (with on line text editing, naturally) and then transmit them at the press of a button. It is already here in some large corporations and government agencies. But during the 1980s, this technology will explode into business offices and homes. It is rumored that TI, HP and IBM are developing personal computer systems specifically for these emerging applications.

Further, last December Xerox filed a petition with the FCC to develop a digital mail/communication system using microwave. It would provide for document distribution, data communication, etc, at rates up to 256 K bytes, which is far greater than current telephone systems and even than Bell's new T-carrier system now being installed. Xerox claims they will be able to deliver documents at less cost than the US mail. Each office desk would be equipped with a keyboard, video display, disk and processor; and would be able to do word processing, sorting, etc, in addition to mail handling. The mail handling naturally would be controlled by computer and hence include automatic addressing, priority routing, multipoint delivery, automatic transmission of previously stored messages, scan messages, etc.

GT&E is setting up a group to test market (in early 1980) a system to transmit data via telephone lines onto modified TV receivers in homes and offices. The system will be similar to the Viewdata systems currently under test by the British Postal System. GT&E is also negotiating for Viewdata licenses. ITT, TI and RCA reportedly are doing the same. TI, however, is currently testing a home information system in Salt Lake City that sends data over regular broadcast channels.

Also getting into the business is the US Postal Service, which last fall asked the US Postal Rate Commission for authority to offer an on line service called Electronic Computer Originated Mail (ECOM). ECOM is expected to start this year. The sender writes a "letter" on a terminal and sends it via telephone to the post office, who routes it to the destination post office where it is printed and delivered in the conventional way. This will be used mostly for mailing bills, overdue notices, etc.

This communications revolution will be boosted by the new Advanced Communications Service (ACS) for which AT&T recently received approval. ACS will lower data transmission costs and increase service. It will lower costs via shared communications facilities and make possible interfacing of incompatible terminals and computers and provide user selectable communications capabilities.

A few personal computer groups have already started a simple system called PCNET. The leading PCNET activity is run by the CACHE group (Chicago Area Computer Hobbyist Exchange). Other PCNET groups are functioning in the San Francisco, LA and Atlanta areas. The PCNET uses modems and telephone lines for communication. A writeup on PCNET appeared in the November 1978 BYTE.

Another personal computer approach has been taken by AMRAD (Amateur Radio Research and Development Corp) in McLean VA. They have established a bulletin board type system using telephone and 2 meter radio telephone. ■

Sol Libes  
UCTI  
1776 Raritan Rd  
Scotch Plains NJ 07076

# PET PRINTER ADAPTER

GET HARD COPY FROM YOUR  
COMMODORE PET USING A  
STANDARD RS-232 PRINTER



1200B

1200C

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, needlepoint 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



**TRS-80 SOFTWARE ON COMPATIBLE CASSETTES OR DISKETTES**

SUPERZAP Hex dump utility for examining & changing disk sectors or main memory... Needs DOS 2.1 and 32K	\$25.
DISASSEMBLER IN MACHINE CODE Works with disk object load modules & provides location reference table, also disassembles any ram locations	\$25.
ASSEMBLE MODS FOR DISK OPERATION Changes your TRS-80 non disk assembler to provide full disk I/O utilities	\$25.
LOAD MODULE - Accepts EDTASM created load modules from tape & converts & stores them in DOS executable format on disk	\$25.
LEVEL I RELOCATED IN LEVEL II RAM (16K) - Run your non-convertible Level I programs or make Level I compatible tapes in your Level II machine	\$15.
ACCOUNTS RECEIVABLE AND INVENTORY CONTROL - Disk based systems requiring DOS 2.1 (utilizes random files) - By Mike Kelleher	\$30. ea.
BASIC DIRECTORY - Allows review & execution of disk (directory) programs while under BASIC, with automatic Index Feature	\$15.
ANYSORT - Utility program allows definition & manipulation of any form of data file. Useful for record keeping & inventory control	\$15.
TRIBBLE TRAP - One of the best Level II graphics games we've seen	\$ 7.
Above 3 programs by Ralph Burris require Level II.	
3-D REAL TIME LUNAR LANDER, \$10; PLAY CHESS, \$5.; TWINS PARADOX, \$2.; By Michael Dreiger (16K Level II)	
MICRO TEST EDITOR (Word Processor) 4K, \$8.; BIG PRINT, \$2.; & CONCEN- TRATION 16K, \$4.; By Don Coon (Level II only)	
MAIL LIST - Disk based program which SORTS & prints LABELS By James Beauchamp	\$35.
FINANCEER - 20 Financial type programs on disk by James Beauchamp	\$35.
JOB ENTRY & STATUS REPORT - By Al Hargis requires 32K & DOS 2.1, handles 340 jobs in 48K	\$75.
DATA-SET CONTROL PACKAGE - Provides cassette file OPEN, READ, WRITE & CLOSE functions plus 2 utility programs & full documentation	\$ 8.
PERSONAL FINANCE PACKAGE - (3 Programs)	\$15.
MORTGAGE CALCULATIONS & MATH TEST	\$ 5. ea.
The above 3 programs by John DeMita	
HOROSCOPE CASTING BY COMPUTER - by D. L. Pitman	\$10.
Level II has output formatted for printer	
QUBIC - By Alvin Files (3-D tic tac toe with graphics) Level II (16 K)	\$ 4.
HERO'S QUEST - A version of swords & sorcery-16 K (Level II)	\$ 5.
SEND FOR FREE CATALOG FOR COMPLETE PROGRAM LISTING. A FEW SAMPLE GAMES FOLLOW: STAR TREK (8K), FLIGHT SIMULATOR (4K), FOOTBALL (8K)	\$ 5. ea.

ADD \$2 FOR PROGRAMS ON CASSETTE, \$5 FOR DISKETTE (INCLUDES SHIPPING AND HANDLING) Colorado residents add 6% sales tax.



Apparat, Incorporated  
6000 E. Evans Av. Bldg. 2  
Denver, Co. 80222 (303) 758-7275

SOFTWARE ROYALTY PLANS, PET PROGRAMS, AND TRS-80 COMPATIBLE PERIPHERALS ALSO AVAILABLE

New DOS now available. Call or write for details.

Continued from page 6:

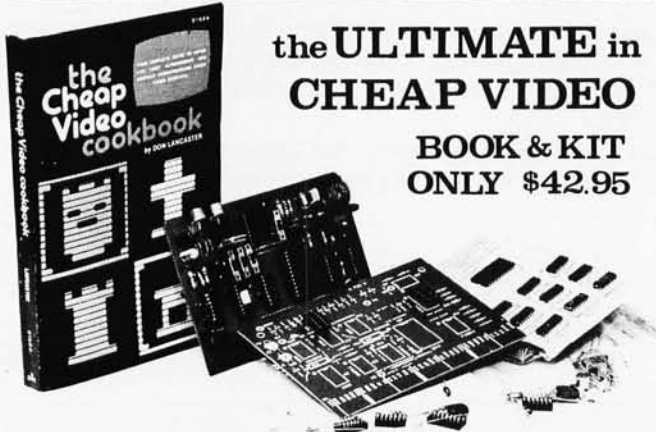
Another cause for possibility of losing files is just plain lack of experience with the system involved. A friend of mine who works at Digital Equipment Corporation tells the tale of how he once forgot which of several operating systems he was working on - and deleted a whole slew of files thanks to a "feature" known as wild card operations. Such operations are shortcuts to allow more than one file name to match the file name specified to the operating system. This friend's problem came from the fact that one PDP-11 operating system had a wild card specification that in another operating system was a unique specification.

There are more than just wild card opportunities for not understanding or forgetting how the operating system software works. There are many ways in which the user of any small computer can interfere in disk filing operations so that the file will be lost, or a whole disk file directory will be lost. For example, all it takes is the simple removal of the disk from the drive or resetting of the computer while an operation is being performed. Thus the fundamental rule of small computer and big computer use is "don't touch the computer during a disk (or tape or any other filing) operation."

But when you introduce the possibility of physical errors due to imperfect media, the whole problem gets complicated, and sometimes such a simplistic rule has to be violated. My problem may have resulted from the facts that I have been using one floppy disk for three months solidly and that I was updating a file one stormy winter day. Because floppy disk media are contact media, they are indeed subject to wear. Whether it was wear or the wiles of Peterborough Flicker And Flash division of New Hampshire Public Service, on the day of the disaster I got a little message from the physical I/O disk drivers which support the operating system.

It was an ominous message, for several reasons. First, it occurred during a "krunch" operation which is the UCSD Pascal system's disk file compression program. Second, it occurred after the last file had been moved, so it was most likely during a directory write operation. Third, it was one of these frustrating situations where an apparently infinite retry loop was involved, with one error message coming every 15 or 20 seconds. So, I violated the rule stated above and reset the computer.

That was the end. The directory was no longer valid, I had no alternate directory, and I had not the foggiest idea ahead of time about what to do to fix this situation. The



**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.

**RIA ELECTRONICS, DEPT. 4-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: \_\_\_\_\_

**RIA ELECTRONICS DEPT. 4-B, 1020 W. WILSHIRE BLVD., OKLAHOMA CITY, OK 73116**

directory included maybe 20 or 30 Pascal programs which I had written during the preceding month or so, including a really useful one called "littleblackbook." Well, in my experience using computers, the best course of action following such a disaster has always been to sit back and contemplate what has happened, to avoid compounding the problem with hastily conceived actions.

One thing was obvious. Only the directory had gotten zapped. This was confirmed by the use of some of the utility functions built into the UCSD Pascal system software: in the Filer portion of the system, one can scan for bad blocks on a disk, then enter a fixup routine to try and recover most of the data. The bad block was obviously in the directory, due to its physical location on the disk and that in using another copy of the system no directory could be found among the remaining data on the damaged disk. Knowing this, plus the fact that the files in the UCSD are stored contiguously on the disk, I knew that all the actual data was out there and that I just could not get at it through the normal directory methods.

But, if I could read the disk without the benefit of paying attention to such niceties as file structures, I would be able in principle to recover from this problem by writing a

relatively simple program. Well, I proceeded to do exactly that. Since most of my data was in the form of programs, my first step was to write a program which would search arbitrary disk blocks in sequence from a starting block to the end of the disk. As each block was read by the program, I printed a confirmation message giving the current block number.

In this search, the program would look for the key word PROGRAM which begins every program's text file. When found, I would print out the first 20 characters of the file starting at the word PROGRAM. This would give me a physical block address directory of all the Pascal programs on the damaged disk. The program entitled Recover found in listing 1 accomplished this end for me, using the low level I/O procedures of UCSD Pascal called UNITREAD, UNITBUSY and UNITCLEAR. Output was directed to the screen and to the printer using the usual techniques of the 85/P implementation of UCSD Pascal: a control P character is intercepted from the keyboard to toggle on and off the output to the Diablo Hytype II printer I have on the system.

Once I had this printed directory of physical blocks which had the word "PRO-

## A price that's hard to beat.

Because of new technology and high-volume company sales, Central Data Corporation has reduced the price of its 16K RAM board by \$40 and its 32K RAM board by \$50. Plus, we now offer full 48K and 64K RAM boards. Our 16K, 32K, and 48K boards are expandable to 64K in 16K increments.

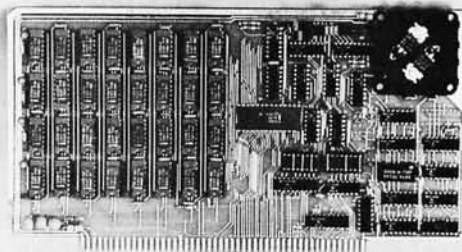
- 16K RAM--\$249
- 32K RAM--\$425
- 48K RAM--\$599
- 64K RAM--\$775
- Memory Expansion Package (16K)--\$185

Our boards come complete--fully assembled, tested, burned-in, and ready to use.

## A product that's better than ever.

We've also made improvements to our board's 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.



Central Data Corporation's RAM Board

### Standard Features

- S-100 and Z-80 compatible
- Power-saving dynamic board with on-board invisible refresh
- One-year guarantee on parts and labor

### 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  
Champaign, Illinois 61820  
(217) 359-8010



**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.

**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*

**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.

**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**

2020 Milvia Street  
Berkeley, CA 94704  
Tel 415 848-8233 Telex 336311  
DEPT. B

GRAM" in them, I proceeded to modify and extend Recover until I had a second Pascal program called Grabber which would physically grab the good data from the damaged disk and write it on the new system disk as a file called A.TEXT. Grabber starts at a block address obtained by Recover's listing and transfers all data to the new file. This continues until a block is found containing the magical key word END, which marks the last line of every Pascal program in the system.

The text of Grabber is found in listing 2 accompanying this editorial. It has a couple of minor technical points worth noting. First, the UCSD Pascal system editor program tries to keep integral lines of text (marked by carriage return codes) within one block of 512 bytes of data. Since lines vary in size there is usually a segment of null data at the end of each block. Second, the UCSD Pascal system uses a form of data compression to eliminate redundant spaces at the beginning of each line of text in a file, so the first two bytes physically following a carriage return character are often (but not always) not text at all but codes indicating line compression. Thus in converting the file, the conversion program Grabber had to ignore all nonprinting characters except carriage returns and various combinations of characters following a carriage return.

The end result of running Grabber is always a file called A.TEXT, which I can then change to a name appropriate for the program being recovered. In this way, the new system disk could be restored with the contents of any program I wanted to use from the old disk. Now, of course, the old disk will never be modified in any way until I have recovered all the data I want from it.

The final version of the Grabber program as I wrote it is shown in listing 2a. It is still not perfect, for there are various strange combinations of carriage return and indentation codes which crop up when a file is recovered in this manner. It only handles the most common states of indentation codes. The exceptions are relatively benign, in that they get turned into arbitrary characters at the beginning of lines. These characters can in turn be edited out of the file after the grabber has completed its operation. Verification of the success of this strategy has been provided by several programs which compile and run as expected after transfer to new files using Grabber.

As for new operating procedures, I have now started to make a more regular practice of backing up files on my system disk. It turns out that there is no particular difficulty in transferring the entire contents of a

disk from one drive to another using the UCSD Pascal system's filer program. So, readers who wish to learn from my little fiasco should consider taking the time at least once per day to copy all the files on their main disk to a backup disk as a little bit of logical insurance against a serious filing system problem which may or may not ever happen. This is an important practice even if all you are using your computer for is fun and games, for every program that is ever written takes time and energy to create and type into a computer.

*Listing 1: The first stage in the process of recovery from the directory zeroing disaster was to write an exploratory Pascal program called Recovery. The zapping of course only applied to the current system disk, copied from the master supplied with the system. Thus it was possible to make a new system disk for the purposes of compiling programs such as this one.*

[Program to scan blocks on disk for text string "PROGRAM"]

```
PROGRAM recovery;
CONST
  disk = 5;
VAR
  blocknr,i,j : INTEGER;
  anychar : CHAR;
  buffer : PACKED ARRAY[0..511] OF CHAR;

PROCEDURE initialize;
BEGIN
  WRITELN('Enter starting block number for scan');
  READLN(blocknr);
  FOR j := 0 TO 511 DO buffer[j] := ' ';
END {initialize};

PROCEDURE findprogram;
BEGIN
  WRITELN('Checking Block #',blocknr);
  UNITCLEAR(disk);
  UNITREAD(disk,buffer,512,blocknr,0);
  UNITWAIT(disk);
  j := 0;
  WHILE j < 480 DO
    BEGIN
      IF (
        (buffer[j+0]='P') AND
        (buffer[j+1]='R') AND
        (buffer[j+2]='O') AND
        (buffer[j+3]='G') AND
        (buffer[j+4]='R') AND
        (buffer[j+5]='A') AND
        (buffer[j+6]='M'))
      THEN
        BEGIN
          FOR i := j TO j+20 DO WRITE(buffer[i]);
          WRITELN('');
          j := 505
        END;
        j := j + 1
      END;
      blocknr := blocknr + 1
    END {findprogram};
  BEGIN {recovery}
  initialize;
  REPEAT
    findprogram
  UNTIL blocknr > 1100;
END. {recovery}
```

# 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 Flowchartix™ 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 Flowchartix 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 Flowchartix, 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 Flowchartix**  
 2 pads of 50 = \$7.90 + \$2.85 pkg & ship  
 10 pads of 50 = \$34.35 + \$6.45 pkg & ship

**78P4 Print-Out Design Sheets**  
 1 pad of 50 = \$7.45 + \$3.15 pkg & ship  
 5 pads of 50 = \$32.10 + \$6.75 pkg & ship

**3-hole punched vinyl pockets for 78P4 Design Sheets**  
 set of 5 for \$2.65 + \$1.35 pkg & ship  
 set of 12 for \$5.00 + \$1.85 pkg & ship

**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 & ship  
 10 pads of 50 = \$26.85 + \$3.35 pkg & ship

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.

Sample of one sheet of each form + associated labels & literature \$2.50

Charge to:  Master Charge  Visa exp. date \_\_\_\_\_

Card # \_\_\_\_\_

Enclosed is my check for \$ \_\_\_\_\_

Signature \_\_\_\_\_

Name \_\_\_\_\_

Address \_\_\_\_\_ Phone \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

# Stirling/Bekdorf™

4407 Parkwood □ San Antonio, TX 78218 □ (512) 824-5643



**You don't buy a  
personal computer  
everyday.**

**So when you do,  
make sure you know  
what you're buying.**

**Hayden can help with  
4 introductory guides!**

**A Consumer's Guide to Personal  
Computing and Microcomputers**  
(Freiberger/Chew)

You need no previous knowledge of microcomputers to understand and use the introductory principles and products that are explained and reviewed.

#5680-X, paper, \$7.95

**Small Computer Systems  
Handbook** (Libes)

A primer covering the practical knowledge you should have to be able to intelligently purchase, assemble, interconnect, and program the microcomputer. #5678-8, paper, \$8.45

**The 6800 Microprocessor:  
A Self-Study Course with  
Applications** (Leventhal)

A self-teaching introduction to the popular 6800 microprocessor, containing 15 lessons that emphasize the control applications of microcomputers.

#5120-4, paper, \$7.95

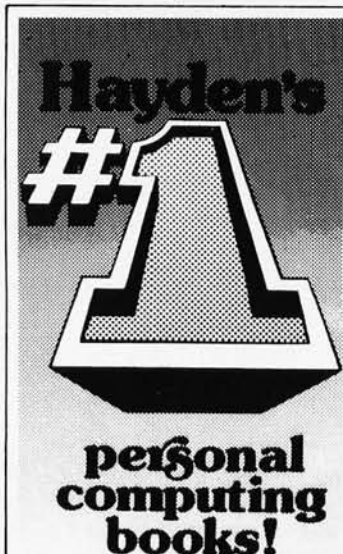
**APL: An Introduction** (Peelle)

Teach yourself the APL language by using this book — with or without a computer! Includes many examples of APL expressions and selected exercises.

#5122-0, paper, \$8.50

**Hayden Book Company, Inc.**  
50 Essex Street  
Rochelle Park, NJ 07660

**Available at your  
local computer store!**



*Listing 2: The second stage in the process of recovery was a modification and extension of the first program, now renamed Grabber. Once the earlier version of the program had printed out a rough listing of block numbers and names of programs, the program shown at (a) was created to transfer these files from the bad disk to a good disk. At (b) is shown an example run for recovery of a Pascal program of some 5 blocks in length.*

```
[program to copy physical IO files to "A.TEXT" text file]           (2a)
PROGRAM grabtext;
CONST
  acarriagereturn = 13 {decimal integer equivalent of ASCII <CR>};
  indentcode = 16 {decimal integer equivalent of ASCII <DLE>};
  disk = 5 {physical unit address of righthand floppy drive};
VAR
  blockcount,blocknr,i,j,k : INTEGER;
  onecharacter,anychar : CHAR;
  buffer : PACKED ARRAY[0..511] OF CHAR;
  filename : STRING[32];
  ifoundareturn : (no,yes,spacecount);
  theoutput : FILE OF CHAR;

PROCEDURE initialize;
BEGIN
  blockcount := -1;
  ifoundareturn := no;
  Writeln('Enter starting block number to grab from right drive');
  Readln(blocknr);
  filename := 'A.TEXT';
  Writeln('Output will be to the file "A.TEXT"');
  Writeln('Do you approve?');
  Read(KEYBOARD,anychar);
  Writeln(anychar);
  IF anychar<>'y' THEN
    BEGIN
      Writeln('When you have figured out what you want to do,',
        ' try me again');
      blocknr := 9999 {to force premature end of program}
    END;
  REWRITE(theoutput,filename)
END {initialize};

PROCEDURE makenormal;
BEGIN {simply transfer if printing character}
  IF (
    (k >= ORD(' '))
    AND
    (k <= ORD('}'))
  )
  THEN
    WRITE(theoutput,onecharacter);
  ifoundareturn := no {--> first state}
END {makenormal};

PROCEDURE transferblock;
BEGIN
  {first grab the block from the bad disk}
  Writeln('Transferring Block #',blocknr);
  UNITCLEAR(disk);
  UNITREAD(disk,buffer,512,blocknr,0);
  UNITWAIT(disk);

  {then transfer the block to output file}
  FOR j := 0 TO 511 DO
    BEGIN
      onecharacter := buffer[j];

      {test for end of file}
      IF j>3 THEN
        BEGIN
          IF (
            (buffer[j-3]='E') AND
            (buffer[j-2]='N') AND
            (buffer[j-1]='D') AND
            (onecharacter = '.'))
          THEN
            BEGIN
              Writeln('I found END. in block #',blocknr);
              blocknr := 2000
            END
          END
        END
      END
    END
  END
```

*Listing 2a continued on opposite page.*

```

{ legal possibilities are as follows
... <any><any>...<any>
... <CR><CR> ...
... <CR><DLE><n><any> ...
... <CR><DLE><n><DLE><n>...<DLE><n><any>...
}
k := ORD(onecharacter);
CASE ifoundareturn OF

no:
  IF k <> acarriagereturn THEN
    makenormal
  ELSE
    BEGIN
      WRITE(theoutput,onecharacter);
      ifoundareturn := yes (--> next state)
    END {IF...ELSE...};

yes:
  BEGIN
    IF k=indentcode THEN
      BEGIN
        WRITE(theoutput,onecharacter);
        ifoundareturn := spacecount (-->next state)
      END
    ELSE
      BEGIN
        IF k = acarriagereturn THEN (-->same state)
          WRITE(theoutput,onecharacter)
        ELSE (-->first state)
          makenormal
        END
      END
    END;

spacecount:
  BEGIN
    WRITE(theoutput,onecharacter);
    ifoundareturn := yes (--> previous state)
  END
END {CASE};
END {FOR};
blocknr := blocknr + 1
END {transferblock};

BEGIN {grabber}
  initialize;
  IF blocknr < 1103 THEN
    REPEAT

      {put an upper limit on number of blocks to transfer}
      blockcount := blockcount - 1;
      IF blockcount < 1 THEN
        BEGIN
          WRITELN('Enter number of blocks to do');
          READLN(blockcount);
          IF blockcount = 0 THEN blocknr := 9999;
          IF blockcount > 20 THEN blockcount := 20
        END;

        IF blocknr < 1103 THEN transferblock

      UNTIL blocknr > 1102;

    CLOSE(theoutput, LOCK)

  END.

Enter starting block number to grab from right drive      (2b)
259
Output will be to the file "A.TEXT"
Do you approve?
y
Enter number of blocks to do
5
Transferring Block #259
Transferring Block #260
Transferring Block #261
Transferring Block #262
I found END. in block #262 ■

```

## BYTE's Bugs

### Historical Correction

Regarding Keith S Reid-Green's article "The History of Computers: The IBM 704" (January 1979 BYTE, page 190), the magnetic core storage unit, shown in photo 1, is the IBM 737. It had a capacity of 4096 36 bit words. The 32 K core storage, referred to in the article, is the IBM 738 and did contain a minor amount of solid state logic.

The IBM 711 (photo 3) could read any of 80 card columns, selectable by a plugboard whose access is shown under the identification tag. Only 72 of those 80 columns could be read at any one time, however. Also the Q bit of the multiplier-quotient register was used in multiply to contain bits of partial product during shifts.

I am sure that all of us "old-timers" who worked on the 704 appreciate your nostalgic look backward to the early days of this industry.

Warren G Tisdale  
Rt 6 Box 348N  
Raleigh NC 27612 ■

### Commander in Chief Generalized

Regarding the program Commander in Chief, presented in December 1978 BYTE, page 192, there are several minor errors: location 093 should read  $\div$  instead of  $-$ ; and PGM should be inserted at location 041. To get different games each time, one need only enter any number before pressing E. The program can be modified in the following manner to remove the necessity of entering a new seed number for each game:

128 (LBL)  
129 (LN~~X~~)  
130 (RLL)  
131 (9)  
132 (\*CM'S)  
133 (STO)  
134 (9)  
135 (CLR)  
136 (1/x)  
137 (R/S)

Dennis Grundler  
818 E 22nd St  
Marysville CA 95901 ■



# Event Queue

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 9-11, **Computer Contract Negotiation**, Atlanta GA. This 3 day course is designed to give participants sound answers to the complex ramifications of preparing and negotiating computer contracts. Contact Brandon Consulting Group Inc, 505 Park Av, NY NY 10022.

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 PI, 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.

April 16-20, **Data Communication Systems and Networks**, George Washington University, Washington DC. This course is designed for systems analysts, engineers, managers, and others who need a better working knowledge of data communication systems. The course will be of particular value to those who are currently planning, designing or implementing a computer that involves data communications. The objective of the course is to provide participants with an understanding of the basic principles and current techniques involved in computer to computer and terminal to computer communications and networking. Contact Continuing Engineering Education, George Washington University, Washington DC 20052.

April 18-20, **Understanding and Using**

**Computer Graphics**, Dallas TX. This course is for people who are now using or making decisions about using computer graphics and its role in their organization. It will describe computer graphics; show how installing computer graphics can be justified; explain what hardware and software systems are available and give costs and performance comparisons. Contact Frost and Sullivan, 106 Fulton St, NY NY 10038.

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, **PASCAL Programming for Mini and Microcomputers**, Ramada Inn, Woburn MA. This course covers a general approach to the use of high level languages in small computers, including an intensive course in PASCAL programming, and an introduction to structured programming techniques. Contact Institute for Advanced Professional Studies, One Gateway Center, Newton MA 02158.

April 23-27, **High Speed Computer Organization: Super Machines and Low Cost Systems**, Holiday Inn, Westwood CA. For computer designers, system architects, project leaders and managers involved in the implementation, application and evaluation of high speed computing systems. The course provides a thorough understanding of the principles of high speed computer organization and their use in cost effective systems. Several commercial and paper high speed computers are presented and compared. Contact UCLA Extension, 10995 Le Conte Av, Los Angeles CA 90024.

April 24-26, **Electro/79 Show and Convention**, New York Coliseum and Americana 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 (ICCCM)**, Washington DC. Individuals involved in computer capacity management will present papers on research, experiments and other activities concerned with the importance, requirements and benefits of capacity management in today's data processing environment. Contact Marken Communications, 2275 E Bayshore Rd, Palo Alto CA 94303.

May 11-13, **The West Coast Computer Faire**, San Francisco Civic Auditorium. This is a conference and exposition on personal computers for home, business, and industry. Contact Computer Faire, POB 1579, Palo Alto CA 94302, (415) 851-7075.

May 21-25, **Systems Analysis Workshop**, Chicago IL. This workshop will teach systems analysts and others needing systems analysis skills to use a practical set of tools and techniques to evaluate user requests and document requirements for new data processing systems. Contact Brandon Systems Institute, 4720 Montgomery Ln, Bethesda MD 20014.

June 6-8, **Eighth Annual Conference of the MUMPS Users Group**, Marriott Hotel, Atlanta GA. Papers will be presented on all aspects of MUMPS development, implementation, and use. Contact Judith Faulkner, Program Committee, Department of Psychiatry, Clinical Sciences Center, 600 Highland Av, Madison WI 53792.

June 6-8, **Twelfth Annual Association of Small College Computer Users in Education Conference**, Denison University, Granville OH. Sessions will include the presentation of papers and demonstrations of the educational use of microcomputers, computer textbook surveys, discussions with authors of computer texts, administrative uses of computers in small colleges, and a tutorial on microprocessors. Contact Douglas Hughes, Computer Center, Denison University, Granville OH 43055, (614) 587-0810.

June 6-8, **Computer Contract Negotiation**, NY NY. This 3 day course is designed to give participants sound answers to the complex ramifications of preparing and negotiating computer contracts. Contact Brandon Consulting Group Inc, 505 Park Av, NY NY 10022.

June 19-21, **International Microcomputers / Minicomputers / Microprocessors '79**, Palais des Expositions, Geneva Switzerland. The 1979 conference program will probe advances in systems and equipment with emphasis on practical applications and uses of minicomputers and microcomputers as well as the techniques important to their development. Contact Industrial & Scientific Conference Management Inc, 222 W Adams St, Chicago IL 60606.

June 20-22, **The 1979 Symposium of the Wilmington Section of the Instrument Society of America**, University of Delaware, Newark DE. The symposium theme: *Measurement Technology for the '80s* is being programmed by three of ISA's divisions: Process Measurement and Control, Analysis Instrumentation, and Water and Waste Water Industries. Contact A H Straightiff, E I Du Pont de Nemours and Co Inc, (302) 366-3810.

June 27-29, **Machine Processing of Remotely Sensed Data**, Purdue University, W Lafayette IN. The symposium will focus upon the theory, implementation and novel applications of machine processing of remotely sensed data. Contact Purdue University, Laboratory for Applications of Remote Sensing, 1220 Potter Dr, W Lafayette IN 47906. ■

# VRData CORP. MORE DATA PER DOLLAR

## ① TRS-80 Complete System

Includes: CPU/Keyboard, Power Supply, Video Monitor, Cassette Recorder, Manual, and Game Cassette.

## ② Line Printer

## ③ Mini Disk System

## ④ C-10 Cassettes

## ⑤ Verbatim Diskettes



### Description

	Each
TRS-80 Complete System	\$ 628.20
Level II-4K RAM	
TRS-80 Complete System	\$ 889.20
Level II-16K RAM	
Expansion Interface	\$ 269.10
Pertec FD200 Disk Drive	\$ 385.00
BASF 6106	\$ 495.00
Centronics 779 Printer	\$1299.00
Centronics 101 Printer	\$1400.00
Anadex DP-8000 Printer	\$ 995.00
Centronics P1 Printer	\$ 445.00
560 (selectric) Printer	\$ 975.00
Memory Unit (installed)	\$ 138.00
(kit)	\$ 98.00
Verbatim Diskettes ea.	\$ 4.95
3	\$ 12.00
10	\$ 37.00
Maxell Diskettes ea.	\$ 7.50
3	\$ 21.00
10	\$ 60.00
C-10 Cassettes	\$ 4.50
25	\$ 18.75
C-30 Cassettes	\$ 23.95
12	
Paper (9½" x 11" fanfold, 3500 sheets)	\$ 29.95

## 1 MEG OF DISK MEMORY on line for TRS-80 \$2670

### Includes:

2 Double Density 8" Disk Drives  
with Controller  
1 HUH Electronics 8100—  
S-100 Interface to TRS-80  
**FREE with package**  
1 CP/M Software for TRS-80  
\$145.00 value

Write or call for new innovations—  
Printers, Disks, Etc.

VRData CORP.

777 Henderson Boulevard N-6  
Folcroft Industrial Park  
Folcroft PA 19032  
(215) 461-5300



In Washington, DC area: (703) 938-1099

## MODEL 3400 DUAL DRIVE SUB-SYSTEM

Your system is only as good as the components that make it up. The heart of the 3400 Sub-System is the proven excellence of the Innotronics manufactured Model 410/420 Diskette Drives. They are complemented by a custom enclosure design made up of top quality components and featuring distinctive solid woods such as cherry and walnut for the desk top Model 3400 F.

If your system demands consistently high performance from your 8-inch Floppy Disks, then this equipment is the answer.

Available for the first time a fully integrated design that you can customize to your needs. We believe we manufacture the highest quality Diskette Drives and Integrated Sub-Systems on the market today.

**INNOTRONICS**

BROOKS ROAD, LINCOLN, MASS.  
01773 TEL. 617-259-0600



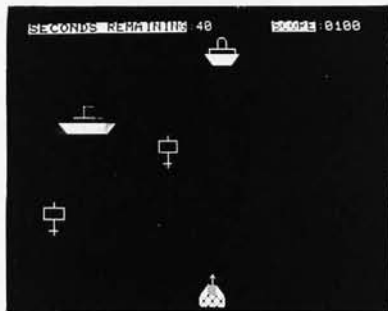
3400 Rack Mounted Subsystem



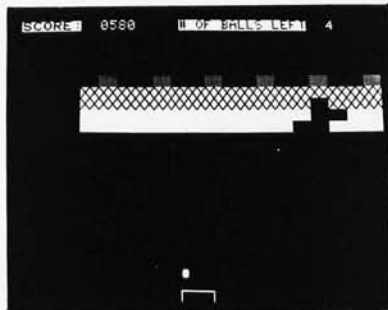
3400F Table or Desk Top Subsystem



# 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	209.75
PRICE	4.29	TAXES	28.00
CLOTHES	44.89	MEDICAL	2.00
ENTERTAIN	21.73	INSUR	201.55
EDUC	2.00	SAVINGS	8.23
FOOD	14.26	UTIL	36.41
GIFTS	3.44	VACATION	1823.41
HOUSE	5.33	MISC	78.13

\*\*\*\*\*

Total amount spent was 4350.99  
 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

# Clubs and Newsletters

### Exchange Information with Brazilian TRS-80 Group

A Brazilian TRS-80 users group is interested in starting a software and hardware experience exchange with other user groups. Contact Douglas Gilson, RUA Sambaiba #516, Leblon, Rio De Janeiro 20,000 BRAZIL.

### The Cleveland Digital Group

The Cleveland Digital Group meets at 2 PM on the third Sunday of each month in the old railroad station at Safier's Inc, 8700 Harvard, Cleveland OH 44105. Write the club at the above address for more information.

### The Valley Computer Club Changes Meeting Location

The Valley Computer Club of Burbank CA is no longer meeting at the Harvard School in Studio City. The club, which has 228 members, now meets at the Burbank Board of Realtors Hall, 2006 W Magnolia Blvd in Burbank. The time remains the same as the first Wednesday of each month at 7 PM. Inquiries should be sent to The Valley Computer Club, POB 6545, Burbank CA 91510.

### Apple II Users Group in Denver Area

A new Apple II users group, called Apple Pi, has been formed in the Denver area. They meet at 7:30 PM the first Thursday of each month in room 271, Green Center, Colorado School of Mines campus in Golden CO. They have begun a software exchange and are planning a training, hardware and software ideas exchange as well as a newsletter. Contact Austin R Brown Jr, secretary, 407 Peery Pky, Golden CO 80401, (303) 279-5388.

### Educational, Recreational Computer Club

The ERCC (Educational, Recreational Computer Club) was formed in Owosso MI in September of 1978. Meetings are scheduled monthly and usually include a speaker. A large portion of each meeting is devoted to discussion and trade of programming ideas. Plans for the future include forming a club library and possible group purchases. A newsletter is published monthly and is available for \$2.50 a year to nonmembers. Contact Paul Heimnick, 1415 Olmstead St, Owosso MI 48867, (517) 723-7602.

### St Louis Area Computer Club

The St Louis Area Computer Club meets at 7 PM on the first Thursday of the month at the Thornhill Branch of the St Louis County Library on Fee Fee Rd north of Olive Rd. The meetings are open to the public. Club dues are \$5 which includes a newsletter. Contact SLACC, POB 28924, St Louis MO 63132.

### Glitch Kickers Computer Club

The Glitch Kickers Computer Club has recently formed in Des Moines IA and is looking for new members. The club is open to anyone, whether you have a computer or are just interested in learning about computers. The club plans to work in several areas, among them education, writing software and starting a personal computer network. The club meets the first and third Saturday of each month at 2 PM. The meeting place is the Computer Emporium, 3711 Douglas, Des Moines IA. For further information, call (515) 279-8861.

### Commodore PET 2001 User Group

PET User Group is an organization for people interested in the Commodore PET 2001 computer. Their purpose is to share and exchange applications, programs, and hardware expansion techniques; and to provide general user feedback. The first year membership is \$5 and will include six issues of the *PET User Notes*. Write Gene Beals, POB 371, Montgomeryville PA 18936.

### Delaware Club Develops Home Heater Control

Jodie Hobson, president of the Delaware Users of Microprocessor Systems, writes to tell us that his club is interested in both hardware and software and they are combining both in the development of a home heater control as a club project. The club meets the first Monday of each month at the University of Delaware. Contact Jodie at 318 B Chapel Av, Claymont DE 19703 or call (302) 792-2319.

### New Mexico Computer Society

Dick Franzen, president of the NMCS (New Mexico Computer Society), has written to inform us of the existence of his club. NMCS promotes the understanding and use of computer technology in all areas of our society. They have a

diverse membership including high school and college students; housewives; electronic and computer technicians; and various professional and business people. Anyone interested in computers, regardless of their level of understanding or expertise, is encouraged to attend one of their meetings. The club's interest groups include: TRS-80 basic programming, TRS-80 advanced programming, TRS-80 business applications, M6800, software, personal programmable calculators, and computer technology. NMCS meets quarterly; however, each of the interest groups has its own meeting schedule which is published in their monthly newsletter, the *Bit Stream*. For more information, write or call Dick at POB 26544, Albuquerque NM 87125, (505) 292-1572.

#### MicroComputer Investors Association

The January 1979 issue of *The MicroComputer Investor*, the journal of the MicroComputer Investors Association, continues to reflect admirably upon the activities of the association. In this issue there are 18 articles within the journal's 214 pages. Each article deals with utilizing microcomputers to make or manage investments. The association is professional and nonprofit in nature. Dues are currently \$30 per year. Membership in the association carries with it the requirement for each member to submit one article per year for publishing in the association's journal. Persons desiring to become members of the MicroComputer Investors Association should send a self-addressed stamped envelope to J Williams, 902 Anderson Dr, Fredericksburg VA 22401.

#### Caterpillar Computer Club

The members of the Caterpillar Computer Club are interested in home built as well as prepackaged systems to be used in home applications or civic interest applications. Some instrumentation is club owned and may be loaned out. They meet the first Thursday of each month at 7 PM in the Caterpillar Administration Building, 100 NE Adams, Peoria IL 61629. Contact Robert Miller, club president, 1539 Moss, Peoria IL 61606.

#### Publication for Apple II Owners

Apple Puget Sound Program Library Exchange (A.P.P.L.E.) is an association of approximately 400 members throughout the United States. Each month they publish a magazine called *Call - A.P.P.L.E.* which contains information on the Apple II's capabilities, utility, programs and general tidbits of useful facts. Volume I has been compiled into a bound edition consisting of all the articles published in 1978. For further information about obtaining the magazine or Volume I, contact *Call - A.P.P.L.E.*, 6708 39th Av SW, Seattle WA 98136.

#### Newsletter for Computalk CT-1 Speech Synthesizer

Computalk Consultants, manufacturers of the Computalk CT-1 speech synthesizer, have announced the first issue of *The Word from Computalk*, a user newsletter. *The Word* is a 16 page newsletter designed to open up two way communication between Computalk Consultants and users of the CT-1 speech synthesizer and other interested parties. It contains items of interest about CT-1 applications, new software, new hardware, software fixes, software written by users, technical manual updates, and more. The premier issue of *The Word* is free to all who write for a copy. Five issues will be included with the purchase of each CT-1 speech synthesizer. Additional copies of *The Word* will cost 60¢ each and may be obtained by writing to the company at 1730 21st St, Suite A, Santa Monica CA 90404.

#### Attention: Phoenix AZ Computer Users

A new computer club is forming in the metropolitan Phoenix area. For more information, call or write Marc Tessler, 3520 W Dunlap Av, #106, Phoenix AZ 85021, (602) 249-6224.

#### Attention: Long Island Computer Enthusiasts

Aileen Harrison, treasurer and secretary of the Long Island Computer Association, has written us that the club meets at 8 PM on the third Friday of the month at New York Institute of Technology, Route 25A, Old Westbury NY, building 500, room 508. One hour before the regular meeting the 6800 users group meets at the same location and every second Friday of the month the 8080 user group meets. The club is entering its fourth year and has approximately 140 members. The meetings consist of various programs such as "show and tell," tutorials, hardware lectures, language lectures, group discussions by members, computer manufacturer presentations, and presentations by computer stores describing the products they market. The dues are \$10 per year and every paid member gets a free raffle chance each month on some "goodie." Also paid members are entitled to borrow USCD Pascal disks and users manual on a monthly first come first serve basis. Members receive a copy of the monthly meeting notice. For more information, contact Aileen at 36 Irene Lane E, Plainview NY 11803. ■



Featuring

**RCA**

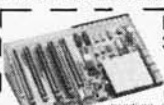
Own a powerful home computer system, starting for just \$99.95—a price that gets you up and running the very first night with your TV set for video display. \$99.95 ELF II includes RCA 1802 8-bit microprocessor addressable to 64K bytes with DMA, interrupt, 16 registers, ALU, 256 byte RAM, full hex keyboard, two digit hex output display, stable crystal clock for timing purposes, RCA 1801 video IC to display your programs on any video monitor or TV screen and 5 slot plug-in expansion bus less connectors to expand ELF II.

**Write and run programs—the very first night—even if you've never used a computer before!**

**ELF II with video graphics system gets you up and running for just \$99.95**

**ELF II Explodes Into A Giant!** Master ELF II's 99.95 capabilities, then expand with GIANT BOARD™ to record and play back programs, edit and debug programs, communicate with remote devices and make things happen in the outside world. KLUGE BOARD to use ELF II as a controller. 4K RAM BOARDS. TINY BASIC. ASCII KEYBOARD. LIGHT PEN. ELF BUG MONITOR. COLOR GRAPHICS & MUSIC SYSTEM. TEXT EDITOR. ASSEMBLER. DISASSEMBLER. VIDEO DISPLAY BOARD. and...

**More Breakthroughs Coming Soon!** Soon to be introduced: ELF II special application kits... PROGRAMMER... A/D, D/A Converter... Controller Board... and more! So don't be trapped into buying a dinosaur that's already obsolete. An ongoing commitment to develop the RCA 1802 for the home computer use by Netronics keeps you right on the cutting edge of today's home computer technology. Order your ELF II, direct from the factory, with the coupon below! Netronics guarantees your success!



**Netronics R&D Ltd., Dept BY-4**  
333 Litchfield Road, New Milford, CT 06776

Yes! I want my own computer! Please rush me—

- 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, 36 printable characters, onboard regulator, parity logic, selection and choice of 4 hand shaking signals to mate with almost any computer. \$64.95 plus \$3 p&h
  - Deluxe metal cabinet for ASCII Keyboard**. \$19.95 plus \$2 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. Comments include SAVE, LOAD, =, X, +, -

**PHONE ORDERS ACCEPTED!**  
Call (203) 354-9375

Total Enclosed \$ \_\_\_\_\_  
(Conn. res. add tax)

**CHARGE IT!** Exp. Date \_\_\_\_\_  
 Visa  Master Charge  
(Bank # \_\_\_\_\_)

Account # \_\_\_\_\_

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 with no additional hardware. Also plays tick-tack-toe plus a drawing game that uses ELF II's hex keyboard as a joystick. 4k memory required. \$14.95 postpaid
- Tom Pittman's Short Course on Tiny Basic for ELF II. \$5 postpaid
- 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
- Text Editor** on cassette tape gives you the ability to insert, delete or edit lines and words from your programs while they are displayed on your video monitor. (Add printer and you can use ELF II to type error-free letters plus insert names and addresses from your mailing list.) \$19.95 postpaid
- Assembler** on cassette tape translates assembly language programs into hexadecimal machine code for ELF II use. Mnemonic abbreviations for instructions (rather than numerics) make programs easier to read and help prevent errors. \$19.95 postpaid
- Disassembler** on cassette tape takes machine code 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! (Requires 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 INQUIRIES INVITED**



Continued from page 8:

### 1802 QUEST FOR INFORMATION

Hey, how about some support for the poor little 1802? It is no longer an obscure processor used by few of us. Many personal computers utilize this chip—the RCA VIP, Quest Super Elf, Netronics Elf II, many homebrew systems, and others. An 1802 recently went up in an OSCAR satellite! Much software is available to 1802 users, including debug and monitor routines, video games, Tiny BASIC, and general purpose programs available from the many 1802 based clubs.

Writing one's own software is simple, due to the unique COSMAC architecture. The processor contains sixteen 16 bit general purpose registers that can be used to hold data and memory addresses to point to stacks, subroutines, etc. The program counter can be changed to any one of these under program control, facilitating the use of subroutines.

What about hardware? The 1802 is completely static and CMOS, resulting in very low power dissipation, an important consideration when designing battery operated systems. It is available in two voltage versions: 4 to 6 V and 4 to 12 V. There is also an on chip direct memory access controller that simplifies loading of programmable memory, since

this can be done in hardware without the need for a bootstrap read only memory. Memory interface is simple and straightforward, because no bizarre data multiplexing is performed; sequential high and low order bytes of the memory address are strobed onto an 8 bit bus by two timing pulses. Once decoded, the address is used just as any other 16 bit address bus. Hardware single step is also easily implemented. I/O (input/output) is especially simple, due to three binary encoded output lines that can be controlled by the processor to select one of eight input and output devices directly. Also available are four flag lines that can be tested by the processor to determine a course of action. These features, coupled with the simple 93 instruction set and RCA support chips make software and hardware development painless (and sometimes even fun).

We avid 1802 fans are no longer a tiny minority, and would like some support from BYTE, a magazine that many of us subscribe to for the purpose of discovering the latest in the computer world. The 6800 and 8080A are good processors, but there are others on the market.

In addition, please go a little heavier on hardware. Also, I would like to see an article on the *very basics* (no pun intended!) of Pascal. I've read and reread the previous pieces, but I still can't make

heads nor tails out of a Pascal listing.

Other than these few gripes, I enjoy your magazine, and look forward to its arrival every month.

Ivan Dzombak  
621 Spring St  
Latrobe PA 15650

[Authors take note! Our articles come from our readers. Let's see some more information on the 1802—RGAC.]

### CANCELLED AND HAPPY?

Recently I took advantage of your offer to receive one free issue of BYTE by filing for a subscription and canceling after receiving the first issue.

Although I did cancel the subscription upon receiving the first free issue, I do wish to compliment you on the quality of BYTE. I canceled not because I did not think BYTE to be a good buy for the computer hobbyist, but because it made it clear to me just how big the hobby is! As an active amateur radio operator in the process of designing and building some new major pieces of hardware, I decided that I had better get more of that work out of the way before I delve into computers too deeply.

I expect to return to BYTE in about a year or so—a short time before I begin any extensive home computer experimentation. That first issue of BYTE has convinced me that it will provide the means for coming up to speed on the subject.

Richard A Griffiths  
6510 Foster St  
District Heights MD 20028

### A BASE COMMENT

I enjoyed Harold Pritchard's tip on using an ordinary calculator for addition and subtraction of hexadecimal numbers (January 1979 BYTE, page 165). Your readers might be interested to know that this technique works for all number bases from 2 through 99. To use for other bases, all you need do is find the number to add or subtract for carries and borrows. The "magic number" is simply 100 minus the base being used. For hexadecimal it's  $100 - 16 = 84$  as we've seen. For octal it's  $100 - 8 = 92$ , and for binary,  $100 - 2 = 98$ . As with hexadecimal, four digits is the most you can work with using an 8 digit calculator.

David L Johnson  
4106 Montreal Av  
Prince George, VA 23875

### COPYRIGHT INFORMATION GATHERING

I'm becoming more and more interested in the question of software copyrights. I'm sure the editors at BYTE agree that this is a subject which is confusing to anybody who starts talking about it; there are no legal precedents, nobody really knows how to

## 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

define the dividing line between expected use of published software and theft.

I'm polling editors and the major computing magazines, hoping they will help me define some of these issues. I'd appreciate getting your views on this thorny subject. Besides being editor of *Dr Dobb's Journal*, I'm getting a master's degree at Stanford in journalism—this quarter I'm taking a course in the law school entitled "Communications Law." I will be talking (and in fact, am already talking) with lawyers and legal scholars on this subject—frankly, they're more confused than anybody else. One consensus among the legal people I've talked to is this: the dividing line between expected use and theft is money.

When you publish software, what do you expect will happen to it? An interested computerist will adopt or adapt the program for his or her own use? A club will play around with it? Another magazine—nonprofit, for instance like mine—will reprint it? When do your hackles rise over use of software originally printed in your magazine? When does it become unfair?

What I want to do is gather comments from people like you and combine them with advice and facts from legal scholars. After which, I will write an article attempting to pull this data together and make sense of it. Hopefully, the article will be the first of many others in which people in the field will try to arrive at some working conclusions.

I look forward to hearing from you.

Suzanne Rodriguez  
Dr Dobb's Journal  
POB E  
1263 El Camino Real  
Menlo Park CA 94025

*When we publish software, it is subject to copyright, the only meaningful form of protection. Just as we would expect someone to formally ask for permission to reprint an article published in BYTE magazine, we would expect similar respect from anyone going beyond the bounds of fair use with respect to program copies taken from our products. In short, when we publish a program with copyright protection, whether as part of a book or as part of an article, we would expect anyone copying and distributing such a program to write requesting permission to do so. We are not averse to giving permissions with credit, and no publisher with a long-term view would, in my opinion, have a blanket policy against granting such permissions.*

*If anyone were to widely reproduce copies of our products without our permission, chances are we would find out about such use and be forced to examine the effects and our options in such a situation. There is a matter of our own reputation, which can be compromised by indiscriminate reproduction of our products even if there is no monetary gain to be had by the person or*

*persons engaging in such unauthorized reproduction.*

*As for software publishing, when we buy a program for reproduction in book form, or as a simple listing plus documentation (often accompanied by machine readable code), we treat it in the same way as we treat the ideas of an author writing a conventional article or book. We are buying the embodiment of those ideas in a particular written or program form, not the ideas or concepts which constitute the program or work of writing. Because of the rampant confusion in the software area, our typical contract with authors of software explicitly states that we are buying an exclusive license to the software reproductions in book form, with the rights to license the software in other ways to manufacturers or media distributors retained by the author. The act of sale of the book or listing copy is then, in our view, totally analogous to the act of sale of such items as a phonograph recording, a book about some subject, a video recording, or other relatively conventional published work. This act of sale carries with it an implied zone of fair use reproduction possibilities, but is in no way a license to widespread reproduction whether it is done commercially or by some "non-profit" entity.*

*Basically, there should be a software*

*publishing analogue of the ASCAP or BMI organizations of the music world, but the field is too young at present. There are a number of questions to be answered as history unfolds in this field but, contrary to your letter's viewpoint, there are historical precedents which can certainly be examined and applied to the new concept of computer programs as works of authorship and original composition. . . .CH*

#### IBM Emulation Information Needed

As an avid BYTE reader, I have, as a last resort, turned to you to request some assistance. I am looking for a software house that can supply the communications software for effecting IBM 3780 and Teletype emulation using a standard mini/micro system. There are a number of manufacturers (ADDS, Datapoint, SYCOR) who have such emulators available when one purchases or leases their equipment; however, I do not wish to be tied down to any one manufacturer. The software is proprietary and cannot be used on the standard systems. Can you supply any leads in this area?

George J Lehmann  
Data Processing Consultant  
163 S Sycamore Av  
Hollywood CA 90036

## 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 by NETRONICS

As featured in POPULAR ELECTRONICS

Shown with optional 4k Memory Board, GIANT BOARD™ & King Board.

## ELF II featuring RCA COSMAC microprocessor / mini-COMPUTER \$99.95

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, =, \*, ( ), 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 keyboard 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-4  
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



## THE SHAPE OF LIFE

I liked the articles on Life in the December 1978 BYTE.

An area of Life that I find particularly fascinating is the behavior of Life forms in universes other than the flat two-dimensional universe. For example, in cylindrical or torus shaped universes it is possible for various kinds of stable "shock waves" to exist. These consist of complete loops around the universe and travel at the velocity of light, or twice as fast as a space ship. The simplest forms look like combs and can leave various kinds of debris behind or simply empty space. Another class of objects not found in the flat universes are "universal oscillators" that can exist in finite universes of the torus type and which engulf the entire universe.

To investigate these kinds of Life forms I wrote a program in COSMAC 1802 machine language that runs on the RCA VIP Computer. The geometry of the universe can be selected by the user. Speed is very desirable if you are trying to determine the fate of a particular pattern and I spent considerable effort to maximize the program speed. The program calculates about five generations per second for an almost full universe up to 25 generations per second for an almost empty one. The actual

speed can be set to a lower value by the user and this is useful for examining a pattern in detail or for designing new patterns.

To make the program generally useful I added pattern storage and pattern editing features. Those readers who are interested in obtaining copies of the program can write to ARESKO, POB 43, Audubon PA 19407.

Brian Astle  
22 Fieldston Rd  
Princeton NJ 08540

## KUDOS

After reading so many complaints (and suffering from the same problem myself) about vendors of computer peripherals, I'd like to salute one of the "good guys" of the industry. We're always quick to condemn, but how many of us take the time to give praise when someone's worked hard to earn it???

I nominate for "The Good Guy of the Month Award" Warren Rosenkrantz, superstar of V R Data Corporation in Folcroft PA. After dealing with several other rather questionable firms, I received a flyer from V R Data congratulating me on the purchase of my Radio Shack TRS-80 and listing several peripherals at very attractive prices. I inves-

tigated and, to make a long story short, began what I hope to be a long and rewarding business relationship.

Warren and his staff exhibited a willingness to help a fledgling computerist. They brought back that old, forgotten trait that makes good businessmen great—the customer comes first. Sure, like everyone else in this mad industry, we had problems such as printer modifications that didn't work and the disk drive that gave weird results. However, Mr Rosenkrantz spent considerable time and effort to correct these problems and, together, I think we both learned a lot. He's also very knowledgeable in the field of electronics and is quickly becoming a pro on the TRS-80. What do you expect from a guy who starts work at 5:30 AM and sometimes doesn't quit until after 10 PM?

I reiterate that praise is something earned—and Warren Rosenkrantz of V R Data Corporation has certainly earned praise from this very satisfied customer.

Clifford W Coughlin  
30 S Kirklyn Av  
Upper Darby PA 19082

## "THUS & SO" IMPLEMENTATION

In the December 1978 BYTE Carl Helmers, comparing BASIC to Pascal, made the point that:

*In BASIC I would have to reference [a procedure] in the program with a number artificially created for that purpose. I might say GOSUB 10000, for example, when I really mean to call and execute a thus-and-so procedure.*

Good point! Because of this lack of expressiveness in ordinary BASIC the Canon model BX-1 allows statements such as GOSUB "Thus&so". Elsewhere in the program the same alphanumeric literal appears as a label, identified as such by the keyword FLAG. Note that, due to using quotes, it is possible to use upper and lower case, special characters, spaces and even graphic characters. It is not necessary to begin with a letter or to avoid keywords of the language. The BX-1 does, however, limit the length of the label to eight characters.

GOTO may be used in the same way. Furthermore, the BX-1 executes statements such as ON A\$ GOTO "YES", "NO", "MAYBE", "HELP!". If A\$ matches any of the literal strings shown, then a branch to the location so labeled will occur. If there is no match, execution continues with the next statement. The statement form except with GOSUB is also in the BX-1 language.

As far as I am aware, the observation of Mr Helmers is correct for all other BASIC implementations.

Craig Busse  
Canon USA, INC  
140 Industrial Dr  
Elmhurst, IL 60126 ■

## 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  $\mu$ 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:

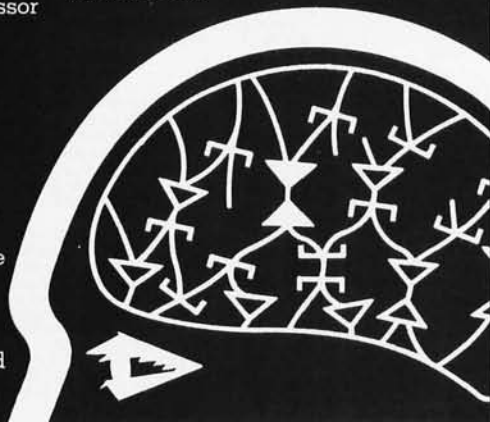
Pattern Recognition • Information Retrieval • Compiling & Interpreting  
• Natural Language Processing • Code Compression • Artificial Intelligence

Price: \$325

4K firmware package of REM routines: \$80

**SEMIONICS**

41 Tunnel Road • Berkeley • CA 94705  
(415) 548-2400





## 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



2224 N. University, Peoria, IL 61604  
Phone 309/686-9352

\*Trademark of Apple Computer Co. Inc.

## 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

WE SHIP FROM STOCK — EVERYTHING FACTORY FRESH, FULLY WARRANTED

TELETYPE MODEL 43 TTL ..... \$985  
RS232 ..... \$1,045  
(We stock Teletype Paper and Ribbons)

HAZELTINE 1500 assembled ..... \$945  
1510 ..... \$1,085

PER SCI  
Model 277 Dual Disk Drive, single density ..... \$1,210  
Slimline cabinet w/power supply ..... \$299

**MARINCHIP SYSTEMS M9900 CPU**  
The Complete, Compatible 16 bit CPU for the S-100 Bus

	Kit	Assembled
M9900 CPU .....	\$550	\$700
PROM/RAM/SIO .....	\$275	\$350
Pascal .....		\$150
META .....		\$100
System Generation Kit .....		\$100
Documentation only .....		\$ 20

Assemble your own system or let us assemble one for you. Our system will include:

- M9900 CPU PROM/RAM/SIO PASCAL
- TEI 12 slot mainframe TARBELL Disk Controller
- IMS 64K Fully static memory (Four 16K Boards)
- PER SCI Model 277 Dual Disk Drive, Slimline cabinet, power supply.
- COMPLETELY TESTED ..... \$5,700

IN ADDITION: With the purchase of this system, \$50 off the price of any terminal we stock.

We also configure systems to suit your individual requirements.

IMS MEMORY BOARDS, 16KB, FULLY STATIC ..... \$459  
S-100 MAINFRAME 12 slot, TEI Model MCS-112 ..... \$433

To Order: \$10 shipping for Teletype, Hazeltine, PerSci and Mainframe. \$3 shipping for other items. 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.

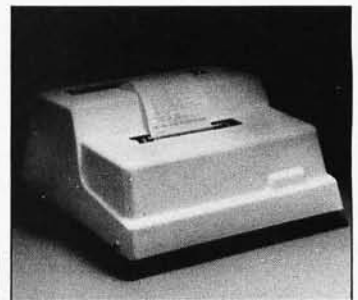
**JOHN D. OWENS ASSOCIATES, INC.**  
147 NORWOOD AVENUE  
STATEN ISLAND, NEW YORK 10304

DAY, EVENING, WEEKEND, HOLIDAY CALLS WELCOME!  
(212) 448-6283 (212) 448-6298

# 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.





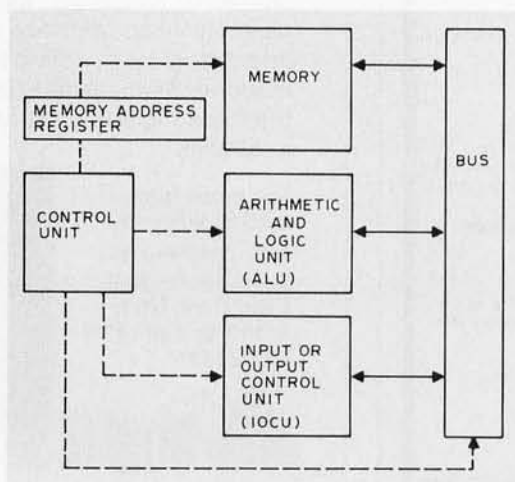
# An Introduction to Microprogramming

Ben E Cline  
702 Southgate Dr  
Blacksburg VA 24060

Many computer users have not been exposed to the subject of microprogramming although it was introduced more than 25 years ago. With the advent of microprogrammed microprocessors, though, more and more people are gaining access to the world of microprogramming. The purpose of this article is to provide an introduction to the subject.

The word *microprogramming* was introduced in 1951 by M V Wilkes to describe a method of implementing the control circuits of a digital computer that differed from the conventional hardwired logic approach. The actions of a microprogrammed processor during the execution of an instruction are determined by a program in high speed memory called the control store. The data paths, memory units, and arithmetic and logic circuits of the processor are directly controlled by bits in a microinstruction held in the control store. Each machine instruction results in the execution of one or more microinstructions.

Figure 1: Functional block diagram of a conventional bus structured computer. Solid lines indicate data paths and broken lines indicate control lines.



## Conventional versus Microprogrammable Architectures

Figure 1 is a functional block diagram of a conventional bus structured computer. The memory unit is used to hold both data and machine instructions. The arithmetic and logic unit (ALU) performs arithmetic and logic functions such as addition, logical AND, etc. The input and output (IO) control unit communicates with the external world. Data is passed between memory and the arithmetic and logic unit by a bus system. The IO, arithmetic and logic unit, memory, and bus circuits are controlled by hardwired logic to generate the necessary signals to fetch, decode and execute machine instructions.

A microprogrammed architecture is presented in figure 2. This functional diagram is similar to figure 1 except for the control unit. The conventional control unit has been replaced with a programmable control unit. Each step of the machine level instruction fetch and each step of a machine instruction execution is controlled by a microinstruction. The microinstructions are held in the control store. The control store is a high-speed memory which is usually independent of main memory. The address control unit determines which microinstruction will be fetched and executed next. Several addressing methods are discussed later in this article. The microinstruction register (MIR) holds the current microinstruction being executed. The microinstruction in the register is decoded by the decode logic which generates signals to control IO, arithmetic and logic unit, memory and bus according to the actions specified in the microinstruction.

The decode and address control circuits of the microprogrammable architecture are

# RADIO SHACK COMPUTER OWNERS

# TRS-80™ MONTHLY NEWSLETTER

24  
HOUR ORDER LINE  
(914) 425-1535



- PRACTICAL APPLICATIONS
- BUSINESS
- GAMBLING • GAMES
- EDUCATION
- PERSONAL FINANCE
- BEGINNER'S CORNER
- NEW PRODUCTS
- SOFTWARE EXCHANGE
- MARKET PLACE
- QUESTIONS AND ANSWERS
- PROGRAM PRINTOUTS
- ... AND MORE

**FREE**

## WORD PROCESSING PROGRAM (Cassette or Disk)

For Writing Letters, Text, Mailing Lists, Files, Etc.  
With Each New Subscriptions or Renewal

## COMPUTRONICS

MATHEMATICAL APPLICATIONS SERVICE™

Box 149

New City, New York 10956

ONE YEAR SUBSCRIPTION \$24 \_\_\_\_\_  
 TWO YEAR SUBSCRIPTION \$48 \_\_\_\_\_  
 SAMPLE OF LATEST ISSUE \$4 \_\_\_\_\_  
 START MY SUBSCRIPTION WITH ISSUE \_\_\_\_\_  
 (#1 - July 1978 • #7 - January 1979)  
 NEW SUBSCRIPTION \_\_\_\_\_ RENEWAL \_\_\_\_\_  
 CREDIT CARD NUMBER \_\_\_\_\_ EXP. DATE \_\_\_\_\_  
 SIGNATURE \_\_\_\_\_  
 NAME \_\_\_\_\_  
 ADDRESS \_\_\_\_\_

Send for **FREE** Software Catalogue (Including listings of hundreds of TRS-80 programs available on cassette and diskette).

### PERSONAL INFORMATION MANAGEMENT SYSTEM



Personal Information Management System is indeed a data base management program. It's carefully customized for the small system owner. You can define and construct your own data bases. Each record can contain up to ten fields. You define what goes in each. Then modify it whenever you want

through use of just three commands. You can search, list, sort and also sum columns of numbers. Complete source listing is included. Check No. 10 on the coupon. **ONLY \$9.95\***

### Z80 INSTRUCTION HANDBOOK



Your complete guide to the powerful Z80 instruction set. Machine codes are presented in both octal and hexadecimal format. A convenient index lists all instructions alphabetically along with machine codes and timing information. Industry standard mnemonics are used throughout. A practical guide for the novice, intermediate or advanced programmer. Pocket size. Check No. 20 on coupon. **JUST \$4.95\***

Check No. 20 on coupon. **JUST \$4.95\***

### CALCULATING WITH BASIC



Here's a variety of programs in BASIC language to help the student, scientist, engineer, technician or hobbyist apply the language to practical problems. Covers mathematics, finance and statistics, mechanical engineering and electronics. For fun between such serious applications, Hangman and Space Capture games are also provided. A real steal at such a low price. Order now. Available for shipment in March. Check No. 30 on coupon. **ONLY \$7.95\***

Check No. 30 on coupon. **ONLY \$7.95\***

### LEARN MICROCOMPUTERS

A new multimedia information package. Includes text (Understanding Microcomputers) plus high-quality cassette. For the beginner. Covers all the basics quickly, easily and enjoyably. All the fundamentals behind the operation of virtually every microcomputer. Clear. Concise. Tells what to look for in buying a microcomputer. Companion tape includes chapter-by-chapter synopsis of the book. Check No. 40 on coupon. **JUST \$14.95\***

### 6800 & 8080 SOFTWARE COOKBOOKS

Now you can cook up mouthwatering programs. Delectable "how to" facts include 8080 or 6800 instruction sets. How to manipulate stacks. Flow charts. Source listings. General purpose routines for multiple precision operation. Programming time delays for real time. And much more. Includes floating point arithmetic routines. Check No. 50 (6800) and No. 60 (8080) on coupon. **ONLY \$10.95\* EACH**



### SCELBI Publications

P. O. Box 133 PP STN, Milford, CT 06460

**\*IMPORTANT ORDERING INFO!** Include 75 cents postage/handling for each item. Prices shown are for North American customers. Master Charge, VISA, Postal and Bank Money Orders preferred. Personal checks delay shipping up to 4 weeks.

No. 10  No. 20  No. 30  No. 40  No. 50  No. 60

Name (please print) \_\_\_\_\_

Card No. \_\_\_\_\_ Bank No. \_\_\_\_\_ Exp. \_\_\_\_\_

Address \_\_\_\_\_

City/State \_\_\_\_\_ Zip \_\_\_\_\_

Signature \_\_\_\_\_ Amt. Enclosed \_\_\_\_\_



much simpler than the control circuits used to implement the full instruction set of the conventional machine. However, the simplicity of the elementary hardwired microcontroller is partially offset by the addition of a new element: the control store. A significant part of the cost of a microprogram-

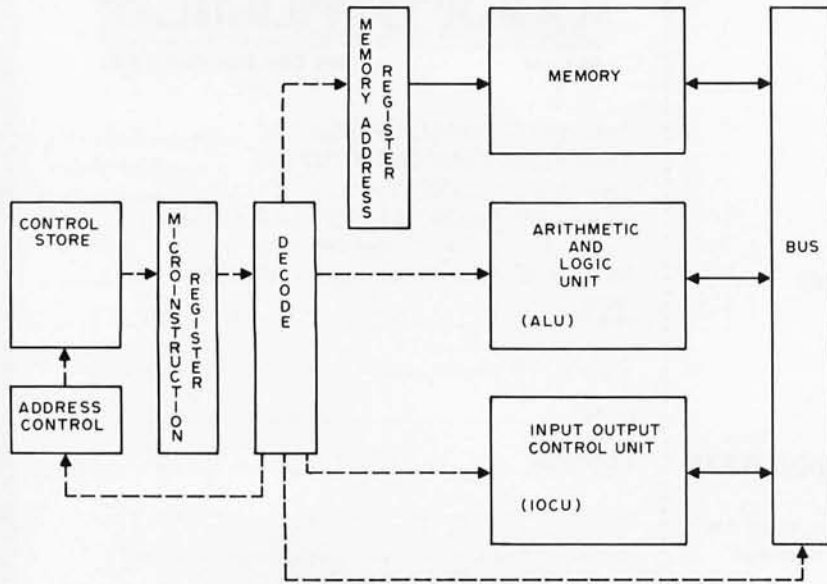


Figure 2: Functional block diagram of a microprogrammed bus structured computer. Solid lines indicate data paths and broken lines are used to indicate control lines.

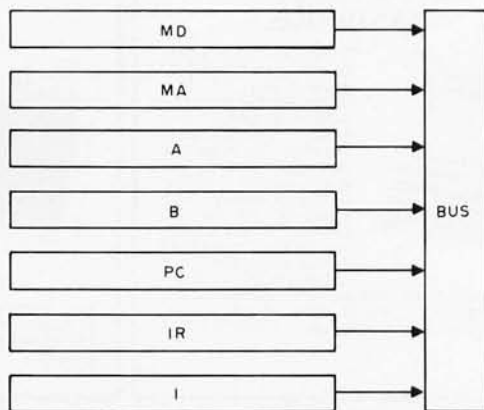


Figure 3: Input side of a typical bus in a hypothetical computer. The register names (MD, MA, etc) are not important and serve only as labels for this example.

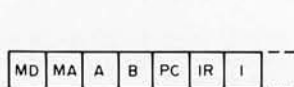


Figure 4: Portion of a horizontal microinstruction to control the connection of registers to the bus in figure 3. Each box is a microinstruction bit that enables the indicated register-to-bus connection.

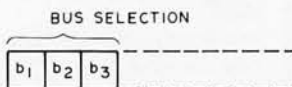


Figure 5: Portion of a vertical microinstruction to control the connection of registers to the bus in figure 3. Here, three bits are used to encode a choice between seven registers or a 0 "no operation."

med computer also lies in the set of *microprograms* which must be developed and debugged to simulate a full virtual machine instruction set. As a result, the costs of the two types of computer architecture are probably comparable.

The microprogrammable central processor is often referred to as the *host* machine because many different *virtual* machines can be superimposed on it by changing the control store. By implementing different microprograms in the control store the hardware seems to change from the viewpoint of the virtual machine software. For this reason, a microprogrammable computer is said to *emulate* the architecture of a particular virtual machine.

This emulation technique is a powerful tool. It enables the same basic hardware to implement the instruction sets of many different computers. For the homebrew computer builder who goes this route, a basic 8 bit microprogrammed machine acting as the host might be programmed to emulate any one of the existing 8 bit microprocessors. The same host machine might even be used to emulate an IBM 370 so that some widely available public domain software could be utilized. Potential microprogrammers should be warned, however, that creating the microprogram for such an emulation is not a trivial undertaking.

### Microinstruction Formats

There are two microinstruction formats: *horizontal* and *vertical*. Most machines use a combination of these two. In a horizontal system, each bit in the microinstruction controls one data path or function in the machine. Figure 3 shows the input side of one bus in a hypothetical machine containing several registers. The A, B, MA, MD, PC, IR and I registers may be logically switched onto this bus, which might then route the data to one input of the arithmetic and logic unit.

Figure 4 shows a portion of a possible horizontal microinstruction format to control the data paths of figure 3. Seven bits are reserved in each microinstruction to indicate which, if any, registers are to be switched onto the bus. If all these bits are 0, no data is put on the bus and the bus carries a value of 0. If any of the seven bits of the current microinstruction is 1, the corresponding register is put on the bus. To avoid conflicts, only one bit position in the 7 bit bus field may be logical 1 at any given time. Depending on the electronics of the bus structure, switching more than one register onto the bus at the same time may damage the hardware or simply give unpredictable results.

A vertical microinstruction format groups similar functions into operation codes called *micro-orders*. A micro-order for the bus input of figure 3 is given in figure 5. Since only one binary code can exist in the 3 bit field, it is not possible to put more than one register on the bus at a time. The vertical microinstruction format is more compact than a corresponding horizontal format.

Each microinstruction typically contains bits to control all computer functions. In a microinstruction, the two inputs of the arithmetic and logic unit and the destination of the output would be specified. The main memory read and write functions are specified by microinstruction bits. Bits for testing register quantities are also provided along with bits to cause jumps and subroutine calls in the microprogram. "No operation" may be specified if a particular bus or function is not used for a microprogram step.

### Control Store Addressing

The control store is much like a conventional memory. In cases of machines where user microprogramming is not allowed, a read only memory is used to contain the standard virtual machine instruction set. If the manufacturer supplies microinstructions to emulate more than one machine, or if user microprogramming is allowed, a programmable memory called a *writable control store* is used. If users are allowed to add instructions but not alter the basic instruction set, part of control store will be read only memory for the basic instruction set and part will be writable control store for additional instructions.

Homebrew computer people who choose to do microprogramming will most likely implement a writable control store and hardware to load it. Another alternative is to use inexpensive high-speed programmable read only memory to store microinstructions.

One control store addressing technique often used is to execute microinstructions in sequence. This technique is typically used with the vertical microprogramming format. A microinstruction counter, which is similar to a program counter or instruction counter in a virtual machine environment, is used to step through the microprogram. A microinstruction may contain a jump command which is indicated by a certain bit pattern in one of the micro-orders. With this technique the jump address is contained in the microinstruction in place of certain other micro-orders; thus, not all operations can be specified in a microinstruction that specifies a jump function.

Another addressing technique uses a field

in each microinstruction to specify the address of the next microinstruction to be executed. Horizontal microcoding formats typically use this technique. This method requires additional bits in each microinstruction that the sequencing method does not need.

### Executing Virtual Machine Instructions

Executing a virtual machine instruction typically begins with the microprogrammed instruction fetch. The instruction fetch is performed by a microprogram routine which sends the virtual machine program counter contents to a memory address register, cycles memory and puts the instruction which comes back from memory into the instruction register (IR). This instruction has a virtual machine op code which indicates which operation should be performed. To emulate the instruction, the proper microprogram in control store must be selected and executed. For example, if the op code 4 means ADD and the ADD microprogram begins in control store location 100, the next microinstruction fetched after loading the ADD instruction into the instruction register should be fetched from location 100.

One method of providing the proper mapping between op code and control store address is by an indirect jump through the instruction register op code field. When the op code indirect jump is specified (by a specific bit pattern in the current microinstruction), normal control store addressing is suspended and the op code gives the address of the next microinstruction to be fetched and executed. If a 4 bit op code is used, an op code indirect jump would cause the next microinstruction to be fetched from a control store location from 0 thru 15, depending on the op code value. The first 16 locations of the control store would contain jump instructions to the microprograms for each of the 16 op codes. If the ADD instruction is op code 4 and the ADD microprogram is at location 100, control store location 4 would contain a microinstruction specifying a jump to location 100 (see figure 6).

A second method for relating op codes to microprograms is the use of a read only memory mapper. A special read only memory contains the beginning address of microprograms which emulate each virtual machine instruction. When the mapper is invoked, the op code in the instruction register is used to address the read only memory which looks up the proper address of the microprogram to emulate the virtual machine instruction indicated by the op code (see figure 7).



This method is used in such machines as the HP 2100 minicomputer. A memory mapper is not flexible enough to be used in a computer where the virtual machine instruction set is altered dynamically. To change the virtual machine instruction set easily, a new mapper must be invoked. The read only

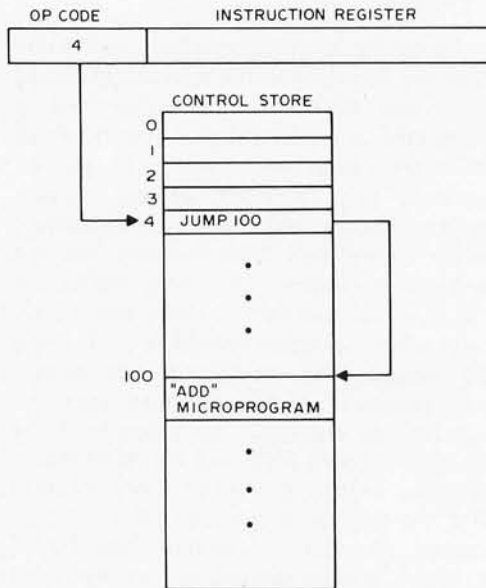


Figure 6: Mapping an op code into a microprogram routine by means of a table of indirect jumps. Here the op code 4 picks the fifth jump in the table, causing the microprogram to execute the ADD routine.

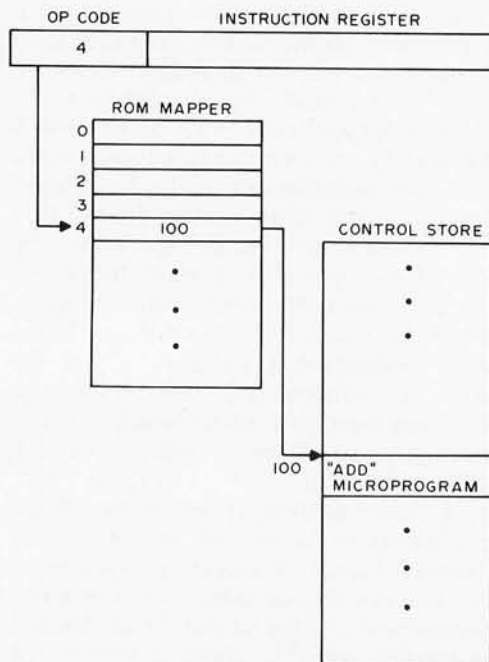


Figure 7: Another way to map microroutines: the instruction register op code field is used to address a special read only memory that points to the proper microprogram routine. Here the example of figure 6 is illustrated using a read only memory mapper.

memory mapper is most useful for manufacturers who supply a fixed set of microprograms that emulate only one virtual machine.

In both mapping techniques, a table of beginning addresses of microprograms is kept — one in control store and one in an independent read only memory. These tables are referred to as *jump tables*.

### Hybrid Systems

Some of the flexibility of a microprogrammed processor is lost when certain functions are not controlled entirely by microinstructions. For example, input/output on the HP 2100 minicomputer is handled in hardware and merely initiated and synchronized by microcode. As more control functions are performed in hardware and the ability to use different instruction formats is hampered, the number of different virtual machine instruction sets that can be easily emulated decreases. On the other hand, if certain control functions are handled by hardware and the machine level instruction format is relatively fixed, a virtual machine instruction set may be emulated efficiently.

The hybrid combination of microprogramming with some custom hardware is used in most general purpose computers. Functions which cannot be handled easily in microcode, such as isolating specific instruction register bits, are delegated to hardware. The flexibility of microcode is still available for instruction sets that take advantage of the hardware functions.

### Advantages and Disadvantages

There are several advantages to a microprogrammable architecture. For computer designers, the choice of the virtual machine instruction set may be postponed longer than with a conventional architecture, allowing hardware and software design to overlap and influence each other. Instructions may be added after the computer has been designed, built and marketed. As examples of this, the HP 2100 minicomputer's floating point option is implemented entirely in microcode, and the DEC LSI-11 floating point feature is achieved by plugging in an extra control store read only memory.

It is also possible with a microprogrammed machine to market a line of computers with similar instruction sets even though the actual hardware of less expensive machines may be very different from the more complex models. The IBM 360 computer uses 32 bit words and 16 general purpose registers. Some of the smaller IBM 360s have less than 16 registers and 32 bit data paths but are

**\$ Have you gotten one of Don Lancaster's INCREDIBLE SECRET MONEY MACHINES yet?**



**do it now!**

**GUARANTEE:**  
If your INCREDIBLE SECRET MONEY MACHINE fails to work for you for any reason, send it back for a full refund.

Synergetics, Dept. B-84, Box 1112, Parker, AZ 85344

Please send me \_\_\_\_\_ INCREDIBLE SECRET MONEY MACHINES at \$6.95 each postpaid. Price includes \$1 postage & handling.

I enclose a total of \$ \_\_\_\_\_, check or moneyorder, ...or

You can charge my Bank Americard/ Visa card no.: \_\_\_\_\_

expiration date: \_\_\_\_\_ signature: \_\_\_\_\_

name: \_\_\_\_\_

address: \_\_\_\_\_

city: \_\_\_\_\_ state: \_\_\_\_\_ zip: \_\_\_\_\_

**TSA SOFTWARE**

**announces**

**our new product line**


<b>DAISY</b>	On screen WORD PROCESSING with a serial terminal.
<b>WPDAISY</b>	DAISY with a built in text formatter.
<b>DATABASE</b>	A complete data management system with on screen updating.
<b>TSA/OS</b>	Our operating system. Includes a full library of disk, terminal and device drivers.
<b>RLASM</b>	A relocatable linking macro assembler with linking loader and symbolic debugger.

**We provide well tested products with the support you need on both coasts.**

**- DEALER INQUIRIES INVITED -**

39 Williams Drive  
Monroe, CT 06468  
(203) 261-7963

**CATCH THE S-100 INC. BUS!**



	LIST PRICE	OUR SPECIAL CASH PRICE
S.D. Versafloppy Disk Controller Kit	159.00	135.00
I.M.C. "Pro" Dual Extender Card	39.00	33.00
Ithaca Audio TRS-80 16K Memory Upgrade Kit	140.00	119.00
T.E.I. 22 Slot Mainframe Fully Assembled with All Edge Connectors	845.00	633.00
Centronics 779 Printer w/tractor feed	1350.00	995.00
IMSAI S-10 2-1 Kit - Serial Interface	125.00	106.00
IMSAI I-KB-1 Microprocessor Controlled Keyboard	395.00	170.00

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**

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 8:00 AM and 4:30 PM Eastern Time. (Friday 8 AM - Noon).

\*Calls from continental U.S. only.

**BYTE's New Toll-free Subscriber W.A.T.S. Line**

**(800) 258-5485**

We thank you and look forward to serving you.

9178



## TAKE A BIGGER BYTE

If you're looking for a big piece of the action, come to Parker Brothers, a leader in the Toy and Game industry. Our Beverly, Massachusetts location puts you in the spotlight of the technological R&D capital of the country, and within ten minutes of the sailing capital of the world. So, get a bigger bite out of life. Come to Parker Brothers, and investigate the satisfaction of the New England way of life.

### Microcomputer Programmer

Programming single board computer prototypes in assembly language and PL/M, you will provide software development support for our rapidly growing Electronics Development Section. Involvement includes final production development; responsibility for liaison with vendor programmers; programming microcomputer-controlled test equipment to meet QC requirements; final algorithm development and programming production microcomputers.

A BSCS and/or 1-3 years experience in microcomputer programming; hardware interface experience and proficiency in at least one microcomputer assembly language; familiarity with the Intel development system and/or a four bit microcomputer helpful.

Please send resume and salary history to:

**Michele Peluso**  
**PARKER BROTHERS**  
 50 Dunham Road, Beverly, MA 01915

An Equal Opportunity Employer M/F



©1935  
 Parker Brothers



microprogrammed to appear like full-sized 360s. Such microcoded versions are, of course, slower than the more expensive models.

Some manufacturers allow the user to add special instructions to their machine by use of microprogramming. Functions or portions of routines that are executed frequently in the user's system are good candidates for implementation in microcode. Microcode routines run faster than similar routines executed in main memory.

One disadvantage of allowing user microprogramming is the possibility of altering the standard instruction set. This could eliminate compatibility with other machines of the same model and decrease the reliability of a system's software. Since manufacturers sell both hardware and software, user microprogramming is usually not provided because of the compatibility factor. The design of microprogramming by the user seems presently limited to special applications and people who design their own computers from the ground up.

### Studying Microprogramming

Studying the microprogramming users manual for one or more user microprogrammable machines will provide much information about microprogramming. Another source (although heavy reading) of information is a copy of IBM's patents on the system 360. If a microprogrammable machine is available, writing some simple microprograms will provide a lot of insight. If no microprogrammable machine is available, the microprogrammable architecture of a real or hypothetical machine can be simulated on a conventional machine. A simulator usually will not provide insight into the hardware timing problems that can be encountered on a real machine, but it can be used to try out microcoding ideas.

It is possible that a microprocessor system could be converted to support user microprogramming. The National IMP-16 and Raytheon RP-16 both use read only memory to control bit-sliced register and arithmetic and logic units. It is possible that a programmable read only memory or a writable control store could be substituted for the standard read only memory if timing problems could be overcome and if the control logic in the standard read only memory circuits can be simulated.

Another possibility is the use of a transistor-transistor logic (TTL) bipolar microcontroller integrated circuit. This chip is typically a 4 bit slice in some microprogrammed central processor's data paths. Putting four 4 bit microcontrollers together

## PET™ EXPANDOR PRINTER

FROM PETSHACK Software House

P.O. Box 966

Mishawaka, IN 46544

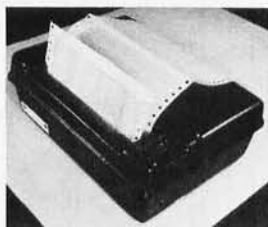


Tel: (219) 255 3408



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

with a control store and address control logic implements the central processor of a 16 bit computer. This technique is being used for the next generation of high performance minicomputers and is a plausible way for the homebrew computer designer to implement a microcoded machine.

Although this type of project would allow more people to work with microprogramming, it seems to be a sizable engineering problem. Is anyone interested?

### Conclusion

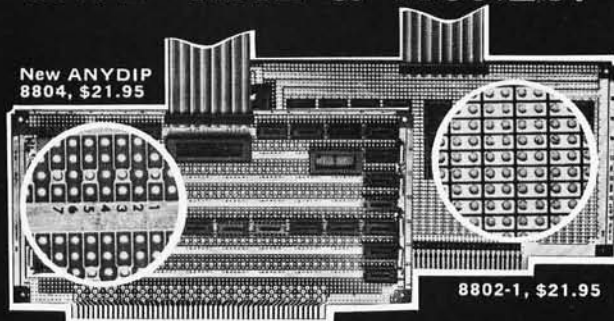
Microprogramming offers something for both hardware and software proponents. The software fan can approach microprogramming from the programming viewpoint. Since the microprograms in control store must be efficient for the machine to run quickly, the design and programming of microcode is a challenging activity. Microassemblers and microcode editing and debugging programs should also appeal to the software person. The design and implementation of a microprogrammed machine should similarly interest the hardware enthusiast. A microprogrammable machine that resembles a new design may be used to test, at least partially, a new hardware design. Microprogramming should interest and challenge many computer experimenters. ■

### REFERENCES

1. Chu, Yaohan, *Computer Organization and Microprogramming*, Prentice-Hall, Englewood Cliffs NJ, 1972.
2. Husson, Samir S, *Microprogramming Principles and Practices*, Prentice-Hall, Englewood Cliffs NJ, 1970.
3. *Microprogramming Guide* (for Hewlett-Packard Model 2100 Computer), Hewlett-Packard Co, Cupertino CA, 1972.
4. Rosin, Robert F, "Contemporary Concepts of Microprogramming and Emulation," *Computing Surveys*, volume 1, number 4, December 1969, pages 197 thru 212.
5. Wilkes, M V, "The Growth of Interest in Microprogramming - A Literature Survey," *Computing Surveys*, volume 1, number 3, pages 139 thru 145.

**Editor's Note:** *BYTE* is looking for more articles on the subject of homebrew computers with microprogrammed instruction sets. This is one of the most advanced state of the art techniques in computer science, yet it should be possible for individuals and clubs to do significant work in this area. . . .CH

## VECTOR PACKAGING SYSTEMS SAVE TIME & MONEY!



### S-100 CARDS

Five models available. Universal tinned buses, pads or plain. 0.042 inch diameter holes on 0.1 inch grid for mounting anything anywhere. For interface, memory, breadboarding.

### R681-2 RECEPTACLE FITS 8803 MOTHERBOARD

Model R681-1 has 0.062 inch long 0.025 inch square tails.



## SLIT WRAP

### TEFZEL\* Insulation Wire Wrapping Tools:

U. S. & foreign patents



daisy-chain wraps

P184 with 100 feet of wire, \$30.00.

● Up to 4X faster.

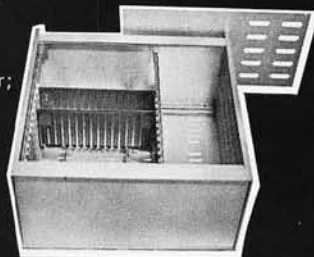
● Heavy insulation.

P184-4T with NiCad batteries, recharger, 100' of wire: \$105.00.

### BEAUTIFUL VP2 ENCLOSURE—supplied completely assembled for packaging.

S-100 based systems. Clear aluminum with blue vinyl finished slide-off sides, top, and perforated bottom cover; heavy chassis plate, removable front and rear panels, adjustable connector/Motherboard mounting struts, card guides (plastic guides supplied uninstalled).

VP2, \$159.00. VP1, cards mount perpendicular to front, \$163.00. BP17-9 accessory back panel, \$10.95.



### Low-noise model 8803 S-100 Motherboard not shown.

Eleven positions ready for connectors. Glass epoxy, solder masked etched circuitry for passive and active termination, twelve tantalum capacitors and instructions. \$29.50.

\*DuPont trademark Prices subject to change without notice.

Send for complete data. Packaging systems for other card sizes and systems, rack mounting are available  
**VECTOR ELECTRONIC COMPANY, INC.**

12460 Gladstone Avenue, Sylmar, CA 91342  
telephone (213) 365-9661; TWX (910) 496-1539  
ad number 627901



# A Digital Alphanumeric Display

Daniel Chester  
 Dept of Computer Sciences  
 University of Texas at Austin  
 Austin TX 78712

The demand for microprocessors for personal use is growing phenomenally. If these personal computers are to be more than fancy desk calculators, however, they need to be able to receive and display letters of the alphabet as well as numbers. While there are numerous terminals on the market that make such communications possible, they are so expensive that a complete computer system is still prohibitively priced. How can the costs of inputting and outputting alphabetical characters be reduced?

Getting letters into a computer is relatively easy. There are lots of surplus keyboards around which can do this for a reasonable cost. The hard part is getting the computer to answer back in a readable form that isn't just a string of digits. Television displays will do the job, if you have a spare television; but there is another way that will permit you to build a terminal without a television, a way which may even provide you with an alphanumeric terminal little larger than a pocket calculator. The secret is to use the same digital displays that desk calculators use.

## Editor's Note:

*Although prices have been significantly reduced since this article was written in 1976, the ideas presented are still quite valid. The learning experience involved with designing and building any type of interface is invaluable. . . .RGAC*

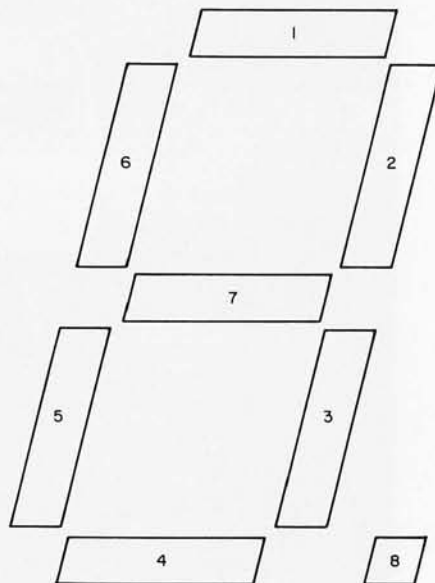


Figure 1: Labelled 7 segment digital display.

A	A	T	t	#	≡
B	b	U	u	'	'
C	c	V	v	(	⌈
D	d	W	w	)	⌋
E	E	X	x	*	⊠
F	F	Y	y	+	+
G	g	Z	z	'	┘
H	h	0	0	-	-
I	i	1	1	.	.
J	j	2	2	/	↙
K	k	3	3	:	⋮
L	L	4	4	;	⋮
M	m	5	5	<	⌈
N	n	6	6	=	=
O	o	7	7	>	⌋
P	p	8	8	?	⌋
Q	q	9	9	┘	┘
R	r	!	!	≦	≦
S	s	"	"	≧	≧

Table 1: Alphanumeric characters and corresponding output from the 7 segment digital display.

A digital display consists of a decimal point and seven line segments. If the decimal point and line segments are numbered as shown in figure 1, each display pattern represents eight bits of information. Only 21 of the 256 possible patterns are used by calculators. After a few hours of experimenting, I found, surprisingly, that most letters of the alphabet are included among the remaining 235 patterns. Although far from ideal, it is possible to display a large, recognizable character set on 7 segment digital readouts. The character set that I came up with is shown in table 1. One of the shortcomings of this set is that some letters are upper case and others are lower case. This inconvenience is unavoidable, except for a few letters like C, G, and U. Some letters, like K and X, are impossible to display others, like M, V and W, are just difficult. For these letters, and the other symbols in the character set, I chose patterns that are in some sense "close" to the desired

# THE MM-103 DATA MODEM AND COMMUNICATIONS ADAPTER

## FCC APPROVED

Both the modem and telephone system interface are FCC approved, accomplishing all the required protective functions with a miniaturized, proprietary protective coupler.

## WARRANTY

One year limited warranty. Ten-day unconditional return privilege. Minimal cost, 24-hour exchange policy for units not in warranty.

## HIGH QUALITY

-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. Flexible, software-controlled, maskable interrupt system.

## ASSEMBLED & TESTED

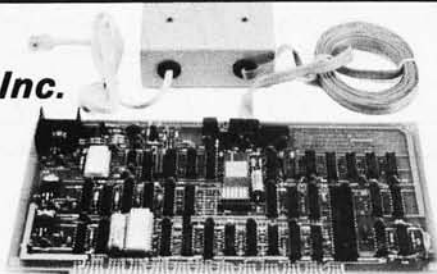
Not a kit! (FCC registration prohibits kits)

**LOW PRICE—\$319.<sup>95</sup> For Modem AND Coupler**



**Potomac Micro-Magic, Inc.**

write for brochure:  
**POTOMAC MICRO-MAGIC, INC.**  
P.O. Box 11149  
Alexandria, VA 22312



Call for further information:  
**VOICE: (703) 750-3727**  
**MODEM: (703) 750-0930**



# APPLE II SOFTWARE



**TURF ANALYSIS** Take the guesswork out of handicapping with this new and easy way to handicap horse racing on the APPLE II. This program provides incredibly accurate predictions through the use of multiple regression and you don't have to know statistics to use it. You may use as many variables and as much data as you like. You're only limited by the available memory in your computer. TURF ANALYSIS has been fully tested and more often than not, it will beat the experts. (Requires >16k of free memory.)

..... \$20.00

**THE FORECASTER** Let your APPLE do the work for you. THE FORECASTER performs a complete linear regression analysis and gives you an accurate regression equation within seconds. Your data is then graphed in High Resolution Graphics and a trend line is plotted by using the regression equation. THE FORECASTER is an excellent tool for those important trend analysis. (Requires >16k of free memory.) Applesoft firmware card required

..... \$15.00

**MATRIX INVERT** This program will quickly find the inverse and determinant of a symmetrical matrix or solve a system of symmetrical linear equations. (Requires >16k of free memory.)

..... \$12.00

**THE PLOTTER** With the APPLE II, this program will allow you to easily plot equations in High Resolution Graphics in just seconds. THE PLOTTER is perfect for the beginning or advanced math student. (Requires >16k of free memory.) Applesoft firmware card required

..... \$13.00

**SOLO RACE** is a very exciting and challenging Low Resolution auto race game where you drive a race car over curvy roads and around obstacles. You are allowed only 5 wrecks at which time you must have accumulated as many points as possible. This challenging game is superbly written and is sure to give hours of fun. (Requires >16k of free memory.)

..... \$8.00

**MANDALA SUPREME** (Side 2: Game of Thinkum) You can now create artistic objects on the APPLE II similar to the popular Double Bessel Function within minutes. Simply enter a few numbers, and the APPLE will mathematically create a superior 3 dimensional-like object. (Requires >16k of free memory.) Applesoft firmware card required

..... \$15.00

**FUNPAK 1** The FUNPAK 1 is a small library of 5 programs all rolled into one. If you like a challenge, the Rat Race Maze, Mine Field or Canyon Bomber has it. On the other hand, if you're interested in a little sound odyssey, then try the Music Machine or Sound. The FUNPAK 1 is sure to give hours of enjoyment. (Requires >16k of free memory.)

..... \$8.00



**PRO FOOTBALL** Never before has there been a program that can predict such unbelievably accurate pointspreads with the APPLE II. This program was fully tested during the 1978 season and it consistently beat the experts. You may predict real or hypothetical games within seconds from data saved on cassette or disk. The data file requires only 10 minutes per week to maintain and will instantly give you a complete rundown of the season's activity. Each program includes a complete 1978 season data file. (Requires >22k of free memory.)

..... \$20.00

**COLLEGE FOOTBALL** Similar to the PRO FOOTBALL program, COLLEGE FOOTBALL will give accurate pointspread predictions within seconds on the APPLE II. This program contains over 78 major college football teams and a complete 1978 season file. (Requires >35k of free memory.)

..... \$20.00

See your dealer

Or for immediate delivery

SEND CHECK OR MONEY ORDER TO:

**Systems Design Lab**

121 8th St. Altizer  
Huntington, W. Va. 25705  
304-525-8932

All programs have been completely tested  
and documented.



This is a sample of the  
 digital display code for  
 alphanumeric characters.  
 Now your computer can  
 flash its message in  
 English!!

Figure 2: Sample message written in 7 segment display code.

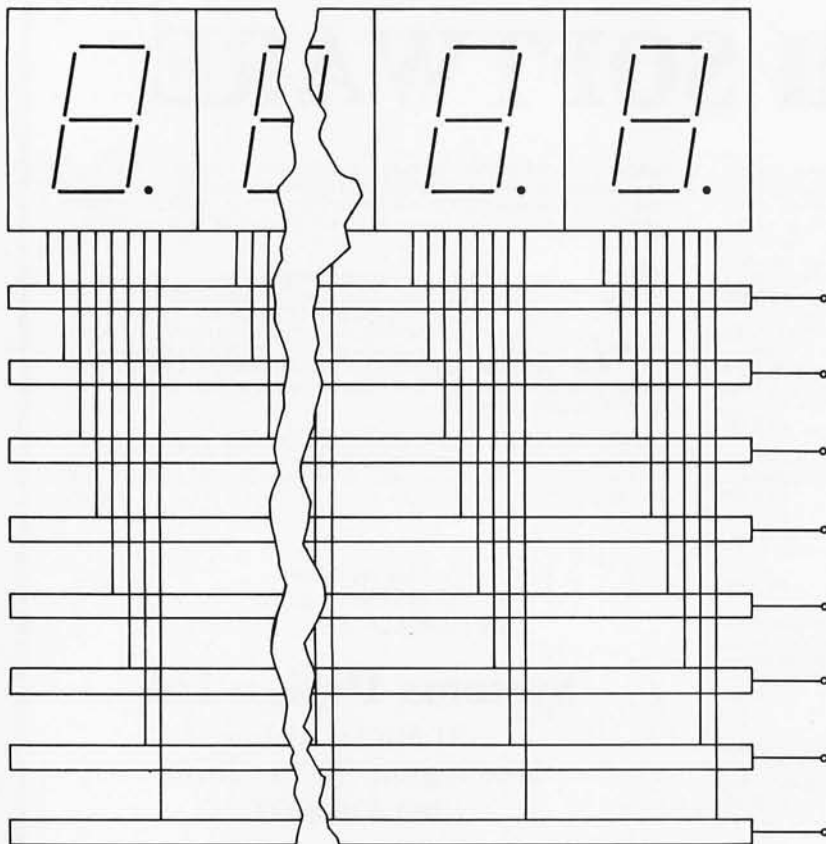


Figure 3: Block diagram of an alphanumeric display panel.

ones. Even with these imperfections, however, this display code is quite readable, as is shown by the sentences in figure 2.

A simple 8 character alphanumeric display panel can be made from eight single digit readouts and eight shift registers. Each shift register corresponds to a different line segment in the digital displays. All the bits in register 1 are connected in parallel to segment one in each of the readouts, and the other registers are connected in similar fashion to the other segments as shown in figure 3. When an 8 bit pattern is fed into the registers via their left shift inputs and the registers are shifted, the appropriate display character appears on the rightmost readout. As more characters are entered in this way, they progress, ticker tape fashion, across the display panel until they disappear at the left end of the display. To make this display panel compatible with other computers besides your own, you can use a 256 word by 8 bit read only memory to convert from ASCII code to the display code required by this panel. To extend the panel, just add more readouts and more shift registers so as to extend the original eight registers.

The most practical form of alphanumeric input is the ASCII encoded keyboard, but the digital display code makes possible a computer terminal the size of a pocket calculator. Alphabetical characters could be entered by drawing them with a stylus on a pattern of eight metal sensing areas arranged as shown in figure 1. A small number of digital readouts would display the output. ■

# BYTE's Bits

Call for Papers: Third International Conference on Computer Software and Applications

Papers are being solicited for the Third International Conference on Computer Software and Applications (COMPSAC 79). Sponsored by the IEEE Computer Society, COMPSAC 79 will bring together computer practitioners, users, and researchers to share their ideas, experiences, and requirements for applications software, management techniques, and software development support, including automated techniques. The conference will be held November 5 thru 8 at the Palmer House, Chicago IL. Some of the areas where papers are invited include: software development methodology, software management, database management systems, data communication and computer networking, computers and biomedicine, business office automation, industrial and design automation, application oriented languages, software testing and tools, and legal implication of electronic data processing technology. Papers should range in length between 1000 and 5000 words. The submission deadline is June 1, 1979. For additional information, contact Dr William Smith, executive director, Toll Electronic Switching and Operator Services Division, Bell Laboratories, Naperville IL 60540. ■

Call for Papers: Twelfth Annual Microprogramming Workshop

The Twelfth Annual Microprogramming Workshop to be held November 18 thru 21, 1979 at the Hershey Motor Lodge Convention Center, Hershey PA will provide a forum for practical and theoretical aspects of firmware and related areas. Authors in industry and academia are encouraged to submit papers for formal presentation. Topics for consideration at the workshop include, but are not limited to: directly executable (intermediate) languages; language oriented architectures; emulation; microprogrammable host machines; on chip microprogramming; microprogramming experience; microprogramming languages; firmware development methodology; support tools for microprogramming; database support; operating systems and security kernel support; and signal processing. Formal sessions will be enhanced by informal discussions in a workshop atmosphere. Papers should be submitted in triplicate by June 1, 1979 to Richard A Belgard, MICRO-12 program chairman, Data General Corp, 62 Alexander Dr, Research Triangle Park NC 27709. ■

## 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-ettes — 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

## 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**

Circle 32 on inquiry card.



# NOTICE TO BYTE READERS

## Withdrawal Of Offer

In the October, 1978 issue of  
BYTE,  
Reston Publishing Company  
of Reston, Virginia,  
advertised a computer kit,  
RECOMP I.

This product is NOT available,  
however, and  
the offer is withdrawn.

We regret any inconvenience  
to potential purchasers.

### Reston Publishing Company

1140 Sunset Hills Road  
Reston, Virginia, 22090

## Programming Quickies

# Label and File Program

Andrew A Carpenter  
POB 841  
Gordonsville VA 22942

I occasionally need to order a part that I cannot obtain at my local vendor. Thus, I wrote a parts order program for this purpose on my SwTPC computer. The program generates two letters and two address labels. I keep one letter for my file.

Lines 8 and 2100 erase the screen and place the cursor in the upper left hand portion of my CT-1024 terminal. The program starts off by asking if a vendor's name and address is needed. If not, the program jumps to the *letter form* at line 2100. The user keys in the information prompted by lines 2110 thru 2245. If only one line is needed for parts, a carriage return may be entered when prompted for the second part (lines 2220 thru 2245).

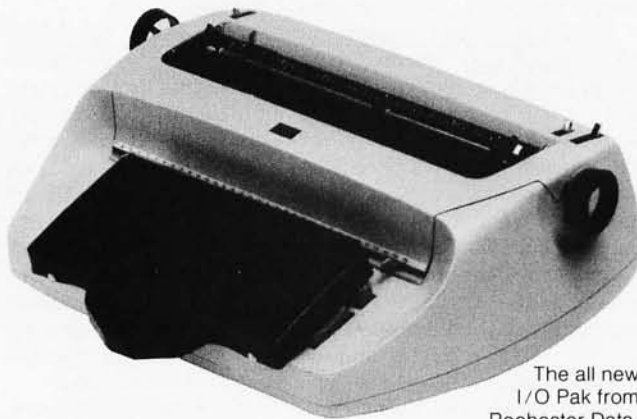
If an address is required, the user is prompted to enter the first letter in the manufacturer's name. The letter B will list lines 250 thru 278 on the PR-40 (Bell and Howell) printer. The command LIST #7 on lines 50 thru 110 lists the lines noted on the number 7 output device. In this case, the output device is the printer. Lines 200 thru 2000 are reserved for vendor's names and addresses. They may be changed to suit the user's requirements. Lines 50 thru 150 select the various sections of the address file.

*Listing 1: Parts order  
program written for the  
SwTPC 6800 computer.*

```
0008 PRINT CHR$(16); CHR$(22)
0010 PRINT "'PARTS ORDER'"
0012 INPUT "NEED AN ADDRESS (Y/N)", B$
0015 IF B$="N" GOTO 2100
0020 PRINT "FILES ARE LISTED A-Z"
0030 INPUT "WHICH FILE ARE YOU
SEARCHING FOR", A$
0050 IF A$="A" LIST #7, 200,248
0060 IF A$="B" LIST #7, 250,278
0065 IF A$="C" LIST #7, 280,298
0070 IF A$="D" LIST #7, 300,318
0080 IF A$="G" LIST #7, 350,378
0100 IF A$="L" LIST #7, 450,498
```

## 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

**\$395<sup>00</sup>**

**Write today for more information.**

**ROCHESTER DATA**

Incorporated

3100 Monroe Avenue, Rochester, New York 14618

```

0110 IF A$="M" LIST #7, 500,610
0155 PRINT
0160 GOTO 2100
0200 ADMIRAL DISTRIBUTOR
0202 DIXIE APPLIANCE CO.
0204 BOX 12766
0206 ROANOKE, VA. 24028
0208 -----
0250 BELL & HOWELL DISTRIBUTOR
0252 BELL & HOWELL CO.
0254 GENERAL SERVICES
0256 7100 MCCORMICK ROAD
0258 CHICAGO, ILL. 60645
0260 -----
0280 CONCORD DISTRIBUTOR
0281 STEREO LAB II, INC.
0282 2350 MIDDLE COUNTRY RD.
0283 CENTEREACH, NY 11720
0284 -----
0300 DELCO DISTRIBUTOR
0302 MOLLEN BROS. AUTO
0304 2727 W. BROAD ST.
0306 RICHMOND, VA.
2100 PRINT CHR$(16); CHR$(22)
2105 PRINT #7,
2107 PRINT "'LETTER FORM'"
2108 PRINT
2110 INPUT "COMPANY NAME", A$, L$
2130 INPUT "ADDRESS", B$, M$
2150 INPUT "CITY & STATE", C$, N$
2170 INPUT "DATE", E$
2190 INPUT "MFR", F$
2210 INPUT "MODEL & EQUIP TYPE", G$
2220 INPUT "QUAN & PART NO.", I$,
2230 INPUT "PART DESCRIP", H$
2235 PRINT
2240 INPUT "QUAN & PART NO.", O$,
2245 INPUT "PART DESCRIP", P$,
2260 FOR I=1 TO 2
2265 PRINT #7, "-----"
2270 PRINT #7,
2280 PRINT #7, TAB(20);
"A.A. CARPENTER"
2290 PRINT #7, TAB(20); "TV SERVICE"
2300 PRINT #7, TAB(20); "GORDONSVILLE,
VA."
2310 PRINT #7,
2320 PRINT #7, TAB(20); E$
2330 PRINT #7,
2340 PRINT #7,
2350 PRINT #7, A$+L$
2353 PRINT #7, B$+M$
2355 PRINT #7, C$+N$
2358 PRINT #7,
2363 PRINT #7, "GENTLEMEN:"
2365 PRINT #7,
2370 PRINT #7, "PLEASE SEND C.O.D. THE
FOLLOWING PARTS"
2380 PRINT #7, "FOR A "; F$; " MODEL "; G$;
" "
2390 PRINT #7,
2400 PRINT #7, I$; " "; H$
2405 PRINT #7, O$; " "; P$
2410 PRINT #7,
2420 PRINT #7, "THANK YOU."
2430 PRINT #7,
2440 PRINT #7, TAB(20); "YOURS TRULY,"
2460 PRINT #7,
2470 PRINT #7,
2480 PRINT #7, TAB(20); "A.A. CARPENTER"
2490 PRINT #7,
2500 NEXT I
2505 PRINT #7, "-----"
2510 PRINT #7, "-----"
2520 PRINT #7, A$+L$
2530 PRINT #7, B$+M$
2540 PRINT #7, C$+N$
2550 PRINT #7, "-----"
2560 PRINT #7, "A.A. CARPENTER, TV
SERVICE"
2570 PRINT #7, "BOX 841"
2580 PRINT #7, "GORDONSVILLE, VA.
22942"
2590 PRINT #7, "-----"
2600 END ■

```

# New North Star Software



- **DOS** \$35  
Enables any program to execute all North Star Disk and/or Meca Tape commands. Allows batch command list and more.
  - **PRO-TYPE WORD PROCESSOR** \$75  
Easy to learn. Combines text input, editing and printing in one program. Features right margin justification, tabs, paging, underlining, relocation of text blocks, etc. Requires only 8K of memory. Manual alone, \$25.
  - **GUIDE TO BASEX** \$33  
A new interactive compiler similar to BASIC for 8080-type microcomputers (Z-80, 8085). Executes programs up to 10 times faster than equivalent programs while requiring about half the memory space. Features include: array variables; string manipulation; arithmetic operations on signed 16 bit intergers; and versatile 10 communication functions. Manual alone \$8.
  - **BASEX TAPE and DISK GUIDE** \$35  
Allows your BASEX programs to access up to four North Star Disk and/or Meca Tape drives. All operations can be executed from the Keyboard. Manual alone \$20.00
- Specify:**  
North Star Disk/Meca Tape/Other  
Send for Free Literature  
**INTERACTIVE MICROWARE INC.**  
P.O. Box 771  
State College, PA 16801  
**(814) 238-8294**





# Microcomputer Timesharing

## A Review of the Techniques, With Pointers to Further Reading

Kenneth J Johnson  
56 Hodge Ln  
Hartford, Northwich  
Cheshire CW8 3AG  
ENGLAND

Until I read Steve Ciarcia's article "Having a 'Private Affair' with your Computer" in April 1977 *BYTE*, page 18, I had not envisaged my 6800 or my 8080 as the basis of a timesharing system. Then I asked myself, "Why not? Why shouldn't a microprocessor be capable of supporting a timesharing system?" I subsequently had the opportunity at the *ONLINE* conference held in London England on May 14 1977 to see Robert Uiterwyk's 6800 based multi-user system. This prompted me to search back through the literature (especially that of the time when timesharing systems were first being introduced) to check on the problems their designers encountered and their solutions. This article is the outcome. It does not set out to specify in detail how a timesharing system can be established, but it does deal with the main problems involved. Perhaps it will provide a starting point for readers' systems development.

### Requirements

Timesharing has been defined in many different ways. For our purpose it will be taken to mean the concurrent, effective utilization of computer resources by several users, possibly at remote terminals. It will imply multiprogramming, possibly multiprocessing; in general, multiple access to system resources.

The key requirement in any multiprogramming or timesharing system is that programs and data should not be bound, that is, converted into hardware dependent form, until the moment of execution. This

requirement has many implications and may involve many problems, some of which have been solved in different ways with varying degrees of success. This article examines what is perhaps the main problem: relocating programs and data in a multiprogramming environment. The related problems of scheduling and priority systems, memory addressing algorithms and resource allocation are also discussed briefly.

### The Problem

A timesharing system should be designed to execute user programs in such a way as to provide reasonable service and to satisfy each user's requirements. This means that each user should believe that he has all the benefits of a dedicated computer. It is the basic philosophy of timesharing and leads directly to the concept of virtual machines linked to physical computer resources through address mapping tables.

Typically, individual user programs are allowed exclusive use of the computer resources in some order of priority for short periods. They are stopped after a certain time, frequently before completion, to allow other user programs to be given their exclusive use of resources. They are continued at some future time from the point where they were stopped, in either the same memory area or a memory area different from the one they were allocated when first allowed to run.

To be able to continue a program in this way, the system must have facilities to preserve the status of a program when it is

PET 2001 • PET 2001 • PET 2001 • PET 2001 • PET 2001 • PET 2001 • PET 2001

## Programmer's Guides for the PET™

### TIS



#### WORKBOOKS FOR THE COMMODORE PET 2001

**Getting Started with Your PET** WB-1 \$4.00

Covers the fundamentals of PET BASIC: calculator and program mode, data input and output, data representation, program storage on the cassette.

**PET String and Array Handling** WB-2 \$3.95

Covers string and substring search, concatenation, replacement and manipulation.

**PET Graphics** WB-3 \$4.95

Covers use of cursor control and special graphics symbols to draw plots, histograms, and sketches.

**PET Cassette I/O** WB-4 \$4.95

Covers OPEN, CLOSE, string and numeric data files.

**Miscellaneous PET Features** WB-5 \$3.95

Covers the clock, random number generator, upper and lowercase alphabetic characters, saving memory space, etc.

**PET Control and Logic** WB-6 \$3.95

Covers IF, GOSUB, logical operations, and ON X.

Add \$1.50 for shipping and handling.

Dealer Inquiries Invited  
TIS  
P.O. Box 921  
Los Alamos, NM 87544  
Money back guarantee

We also sell PET Software. Write for details.

PET is a trademark of Commodore Business Machines

PET 2001 • PET 2001 • PET 2001 • PET 2001 • PET 2001 • PET 2001 • PET 2001

# 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



# IMMEDIATE DELIVERY

Domestic & Export

## DEC LSI - 11 COMPONENTS

A full and complete  
line with software  
support available.



### Mini Computer Suppliers, Inc.

25 CHATHAM ROAD  
SUMMIT, NEW JERSEY 07901  
SINCE 1973

(201) 277-6150 Telex 13-6476

## 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

# \_\_\_\_\_



state	condition
active	in a working state.
wait	ready to run whenever brought into main memory.
user wait	waiting for the user to issue a command.
IO wait	temporarily held up waiting to be serviced by IO device.
file wait	temporarily delayed until another user program has finished using requested program of data file.
dormant	stopped running and has returned control to supervisory program, but its machine conditions have been preserved.
dead	terminated.

Table 1: All possible states that a program may exist in at a particular point in its execution cycle.

stopped and to restore it when it is resumed. That is to say, at the point in time when one user's program is stopped and another user's program is resumed, the instantaneous description of the former program must be saved and the description of the latter restored. These instantaneous descriptions are typically referred to as the current "state" of the user program. The state of a program typically contains such information as the contents of the accumulators, program counter, and condition code register. The stateword might also contain pointers to the address mapping tables which determine the correspondence between virtual and physical addresses.

To explain this process in more detail, it is necessary to examine the factors which make multiprogramming possible and to study a typical system in operation.

### Multiprogramming Requirements

Technically, there are a number of considerations which decide whether it is possible to run programs together. In the book *Computer Timesharing* (see references), Popell specifies a minimum of five:

- A supervisory program referred to as executive, monitor, or supervisor.
- An interrupt processing system.
- Memory protection facilities to prevent one program from destroying others.
- Dynamic program and data relocatability so that the same routine can be reentrant. That is, the routine can be used, unmodified, in different memory locations at different times.
- Direct access facilities, or at least the facility for the convenient addressing of peripheral equipment. (For personal computers the floppy disk is the typical example of a direct access device.)

Typically, user programs to be run are stored in auxiliary memory, usually disk, readily accessible so that the supervisory program can switch them into main mem-

ory when their times to operate arrive. Each program is allocated the required area in main memory and that area is protected by either hardware or software, from interference by other programs. Any instruction attempting to address an area outside the allocated memory block is trapped and prompts an error message.

A system of priorities is usually implemented. The supervisory program permits the execution of the program with the highest priority until such time as it is suspended for some reason. Priorities are usually determined by a scheduling algorithm which is used by the supervisory program to keep a record of the status of each user program. Table 1 lists all the possible states of a program at a particular point in time.

If, by bringing a program into its area in main memory, there is a storage conflict, the program with the lower priority status must be restored to its place in auxiliary memory. This process is variously called swapping, switching, push-pull or roll out-roll in.

The most common cause of program suspension is a peripheral operation such as IO. But there are others such as a machine or program error or the lowering of priorities. Until suspended, however, user programs run for periods of time determined by the scheduling algorithm. At the end of each program's appropriate time slice (or when it changes status) the supervisory program determines which user program is to be run next. The state of the program which is to be suspended (contents of accumulators, index registers, condition code register, etc) will then be saved either in a supervisor's stack or dumped to auxiliary memory.

The supervisory program then retrieves the next user program from auxiliary storage, together with that program's old state. It loads this program into main memory, processes it, restores it, proceeds to the next user program and so on, until it returns to the first user program to give it a second burst of processing (if required). Then it continues the cycle. It can be seen that the quintessential function of the supervisory program in a timesharing system is scheduling.

### Scheduling

On early machines, programs were assembled into the part or parts of main memory they were to occupy during run time in much the same way as they are on microcomputers today. If a large program required too much memory, it was necessary to assemble the program in sections, transferring each section as it was completed to auxiliary storage and restoring it (if nec-

**"BIG-EDIT" FOR BIG APPLE II PROGRAMMERS**

- Convert your INTEGER or APPLESOFT BASIC programs to "text" files on disk for easy editing and subroutine library development!
- Quickly change lines in "text" programs; search and replace occurrences of strings; merge lines from other program files; restructure programs!
- Renumber your programs — you specify the starting number and increment!
- Strip REM's from "execution" versions of your programs (improves speed and frees up memory)!
- Create and edit non-program text files (letters, announcements . . . )!
- Prints upper and lower case on line printer, inverse video on screen!
- Comes complete with System Disk, User's Manual and handy Reference Card!

REQUIRED: APPLE II with Floppy-Disk drive, APPLESOFT BASIC in ROM, and 32K minimum RAM (48K is recommended). "BIG-EDIT" supports optional printer.

GARVEY, MARTIN & SAMPSON, INC.  
210 Bavarian Drive (C)  
Middletown, Ohio 45042  
Phone: (513) 423-6608

Enclosed is \$39.95. Send me "BIG-EDIT" (ASAP!).

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City/State/Zip \_\_\_\_\_

**C/PM<sup>®</sup> 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<sup>®</sup> is a trademark of Digital Research

**ATTENTION SSB DISC SYSTEM USERS**

- Run mini FLEX formatted software on your SSB BFD-68 System without any hardware changes. Here's how! Obtain the Mini FLEX Dos from SWTPCo and get Ed Smith's M68FB (Flex Boot) program on a SSB formatted disc. Use M68FB to load FLEX Dos to memory and manually add the patches included with Flex Boot, and you are up and running in Mini FLEX. Price includes diskette, instructions and a commented assembly listing. **M68FB ..... \$25.00**

**S-M-I-T-H-B-U-G**

- From the same programmer that developed SMARTBUG (a 1K single 2708 MIKBUG replacement) for Smoke Signal Broadcasting comes an enhanced 2K version that provides a built in mnemonic Disassembler/Trace, plus many new features designed to aid rapid program development and debugging. SMITHBUG contains an equivalent function for all the SMARTBUG commands except *tape load* and *save*. It uses the upper 2K memory space from Hex F800 to the FFFF and can be used stand alone or as an adjunct to your present monitor. For SWTPCo MP-A2 board users with an ACIA, a SWTBUG compatible version is available (with instructions on how to use it in an adjunct to SWTBUG if desired). Delivery of either version on a 2716 will depend upon price and availability. Both versions are presently available on 2708's. A software only package (i.e. manual with assembly listing) may be ordered if you wish to burn your own. Specify present monitor.

SMITHBUG on 2708's ..... \$60.00

SMITHBUG manual only ... \$30.00

- Order direct by check or MC/VISA bank card. California residents add 6% sales tax. Customers outside of U.S. or Canada, add \$5 for air postage and handling.
- Dealer inquiries welcome.

Ed Smith's **SOFTWARE WORKS**

P.O. Box 339, Redondo Beach, CA 90277, (213) 373-3350

**NORTH STAR ★ DISK OWNERS****THE MOST COST-EFFECTIVE MACHINE  
LANGUAGE DEVELOPMENT SYSTEMS AVAILABLE  
THE XL-8080 & XL-Z80 SYSTEMS****1**

**EDITOR** \*\* Create & modify source listings using 15 powerful commands. Provides string search/replacement, auto-line numbering, multi-disk file storage, automatic memory management, built-in tab, printer listings and much more. Also, a North Star-compatible line editor provides rapid line edit capability.

**2**

**ASSEMBLER** \*\* Processes source listings directly from disk and optionally stores binary code in memory or on disk. Features multi-disk/file processing, multi-length labels, symbol table listing, console or printer output, etc. Allows any size program (source or code) to be processed!

**3**

**DISASSEMBLER** \*\* Processes an object file on disk and produces source file listings both on a second disk file and on the console or printer.

\*\*MAXIMIZES DISK CAPABILITY  
\*\*USES EXISTING DOS USER I/O ROUTINES  
\*\*REQUIRES LESS THAN 16K MEMORY TO OPERATE

XL-8080 SYSTEM w/complete documentation ..... \$39.95

XL-Z80 SYSTEM (same as above but processes  
Z80 Zilog-format files ..... \$59.95

XL-ZP/M SYSTEM (Z80 Assembler for CP/M) ..... \$59.95

Available at your local computer store or by sending check or money order to:

**COMPUTER PRODUCTS INC.**  
P.O. Box 805  
Mesa, AZ 85202

Dealer inquiries welcome



# 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 and I/O device 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  
Software inc. minicomputer

2340 SW Canyon Road  
Portland, Oregon 97201  
(503) 226-7760  
TWX 910-464-4779

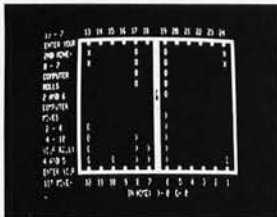
DEC, PDP, RSTS, RT-11, RSX, IAS, and LSI-11 are trademarks of Digital Eq. Corp.

Improve your game with . . .

## >>> FASTGAMMON >>>™

An exciting new backgammon opponent!

>>> FASTGAMMON >>>  
ON THE TRS-80



You Play  
X's  
Computer  
Plays O's

**OUTSTANDING FEATURES!** — Computer makes good moves instantaneously. Literal and graphic displays of each move. Option to replay same rolls. Eight-page instruction manual.

Available on cassette (\$20) for:

TRS-80 (level II)\*  
APPLE II\*  
SOL\*

COMPAL-80\*  
POLY-88\*

Available on diskette (\$25) for:

TRS-80\*  
APPLE II\*\*

COMPAL-80\*\*\*  
SOL/NORTH STAR\*

\*16K RAM required. \*\*24K RAM required. \*\*\*Micropolis dual density

SEE IT NOW AT YOUR LOCAL COMPUTER DEALER



OR ORDER DIRECT FROM

## Quality Software

10051 Odessa Avenue, Sepulveda, CA 91343  
(California residents add 6% sales tax)

essary in overlays) immediately prior to entry. For this purpose, a suitable portion of memory was reserved for the segment of the program being assembled, and for each instruction two separate addresses had to be recorded: one giving the address of the current instruction and the other indicating the address it would occupy at run time. With elaborations, this technique became the basis of early timesharing systems.

Basic to the running of these early systems was the concept of independent peripheral operation. The processor, having initiated an IO routine for one program, could then proceed to service the computational needs of other programs until the IO routine signaled its completion by interrupting the processor operation. For various reasons, these timesharing arrangements did not fully utilize even the relatively slow storage access time on some computers. The multiprogramming concept was developed fully to realize this potential. The logic was incontrovertible: if the machine had spare memory and spare peripherals, these could have been utilized by a second program. If this still left unused capacity, why not load a third program to use the peripherals and access time not required by the first and second programs; and so on.

Tsujigado showed that it was theoretically possible to process simultaneously a large number of programs (256) in the conversational mode. Although theoretically possible, this would be impractical even now on large computers because of the large memory requirements. In consequence, it is necessary to resort to swapping techniques, and a suitable scheduling algorithm.

The swapping techniques adopted initially depended upon the hardware design (the control mechanisms varied widely between manufacturers and between models). Some hardware is still required for effective control of the process, but the software usually provides the necessary control procedures. In "Computer Software" (see references) Archibald et al specify the necessary software features. They include:

- A means of reserving memory and peripherals for exclusive use by individual programs for predetermined periods of time.
- A means of switching from one program to another to optimize computer performance.
- Facilities to relocate programs dynamically during execution as the overall pattern of programs in the computer changes.

The effect of these routines is to provide multiprogramming facilities which enable

many users to initiate programs and to schedule them through the system according to their relative predetermined priorities.

The simplest system is based on a circular queue for "round robin" scheduling. Each program accepted into the system is assigned a fixed time slice and processor operation is switched from one program to another in round robin fashion until each program is completed. In this arrangement, only one active user program is in main memory at one time. Other active programs are held on disk.

In other systems several user programs may reside in main memory simultaneously. The operational switching between them is controlled by a clock which is used to generate an interrupt to signal the processor that a certain time period has elapsed. The scheduling algorithm is then entered every time a clock interrupt occurs. If it is found that the program in main memory has exhausted its time slice or has changed its status, that program is swapped for the next program in the queue.

Most sophisticated installations of any size find the need to operate a system of queues. The appropriate queue to be serviced by the processor at any particular time will be selected according to priority and program type by the scheduling algorithm. Programs are initiated, or released for processing by being selected from the tops of the various queues which are formed in accordance with the particular installation's design philosophy. In addition to systems of queues, the supervisory program normally has to deal with systems of priorities. Again, what determines these priorities will be a matter of design philosophy. Various criteria are used in practice. Usually it is possible for the system itself to cause priorities to be modified while programs are being queued. Such modifications are especially desirable in real time systems because one program might be continually bypassed; or because a deadline is approaching and the program concerned is not being serviced.

From time to time it may be that a program being queued will have to take precedence over a program being serviced. Downgrading of priorities happens often in scheduling systems. To facilitate this, some operating systems provide a roll in-roll out facility which enables the supervisory program to make a request for processing time on behalf of a higher priority program in the queue. This will result in a lower priority program being rolled out to enable the new program to be processed. Programs rolled out in this way are written into temporary storage along with their current status. When changing circumstances permit the reloading



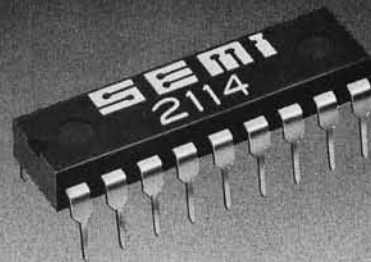
**The world's only single-chip LSI Universal Printer Controller is here!**

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 Ampere) 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

## The experienced 2114 4K static RAM



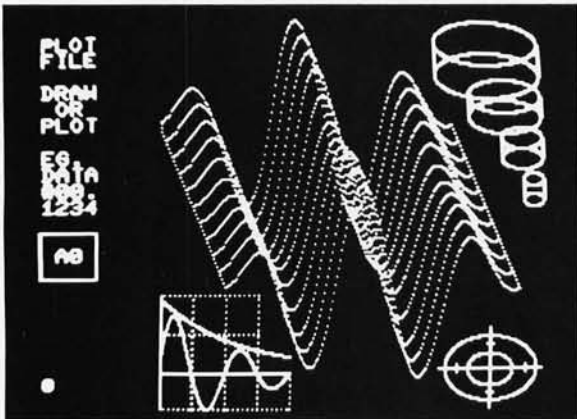
From EMM — the industry's largest supplier of 4K static RAMs — a 2114 with a year and a half of delivery behind it. Not a new part. Just a new pin-out of a proven part. 1K x 4 organization. 5V only. Standard 18-pin DIP. It draws only 300 mw, has all the speed you need for microprocessor applications.

**EMM SEMI, INC.**

A division of Electronic Memories & Magnetics Corporation  
 3883 North 28th Avenue, Phoenix, Arizona 85017 (602) 263-0202



## NEW! for the PET™ HIGH RESOLUTION GRAPHICS!



Now there is a complete Software Package and a simple, low cost Logic Circuit that gives the PET 2001 HIGH RESOLUTION GRAPHICS. It can plot 3-D images, pictures, fancy graphs, maps—almost anything! Points are plotted on a high resolution matrix of 236h.x191v. Graphic displays can be stored on tape cassettes.

Do it yourself with the Graphics Hardware Manual from Conley Graphics. Complete hardware information, diagrams, and easy to understand explanations allow you to build your own Logic Circuit for the affordable price of ONLY \$15. Parts are readily available from popular electronics stores. Now, high resolution graphics opens up a world of new uses for the PET!

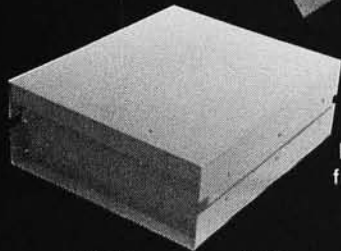
Complete Software Package and Graphics Hardware Manual ..... \$19.95

Mail Order To: **CONLEY GRAPHICS**  
211 Purdue Avenue, Kensington, CA. 94708

Calif. residents add 6% Sales Tax PET is a trademark of Commodore Business Mach.

## Main/Frames from \$200 Main/Frames from \$200

- 14 Basic Models Available
- Assembled & Tested
- Power Supply:  
8v @ 15A, ± 16v @ 3A
- 15 Slot Motherboard  
(connectors optional)
- Card cage & guides
- Fan, line cord, fuse, power  
& reset switches, EMI filter
- 8v @ 30A, ± 16v @ 10A  
option on some models



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 MasterCharge

of programs temporarily suspended, the supervisory program will automatically roll in these programs and they will restart from where they left off.

It may be that the exact locations in memory which such programs and their data were using are no longer available. To deal with this situation, operating systems provide the facility to relocate programs dynamically.

#### Scheduling Methods

To summarize the discussion so far, there are basically two methods of scheduling:

- Simple swapping systems with only one program at a time residing in main memory for a fixed unit of time in accordance with a system of priorities.
- Elaborate systems which overcome the disadvantage of only one user program in main memory at a time with consequent waste of time due to switching.

This necessity of switching programs into and out of main memory at speeds approaching the internal clock rate leads to further problems which can only be solved with additional hardware and software facilities. In particular, since a given user program does not always get loaded into the same place in memory it leads to addressing problems.

#### Addressing Techniques

In most systems, individual programmers will have to write their programs without knowing which other programs, if any, will share main memory with theirs. The implication must be that they will need to use symbolic addresses that will be converted to absolute addresses at some time by the supervisory program when allocating memory space and peripherals to the various programs. This necessity has led to the present timesharing philosophy which requires the conceptual separation of absolute storage addresses from the logical system addresses.

In a multiprogramming system, resources are not normally allocated to programs until execution time. Since the physical resources allocated may be different during each time slice, it is essential that the run time representation of programs should be in hardware independent form. This means that the addresses in particular should be virtual addresses. Physical addresses will be represented by an address mapping table which will be updated whenever programs are moved from main memory to temporary storage and vice versa.

As Wegner points out, the structure of the address mapping table will depend not

only on the relation between the virtual address space and the physical address space, but also upon the hardware facilities available for performing address mapping. For example, in "Addressing Structures" (see references) Gammage recalls that the need for dynamic program relocation was met on second generation machines by the provision of a single base register, the contents of which were added to a virtual address generated within the program to map it into an actual main storage address.

The major drawback here was that the program had to be moved between main storage and temporary storage as a single unit (a wasteful process where large programs are involved). It also meant that no program could be larger than the available main memory space.

To overcome these problems, more elaborate addressing structures were devised. These structures reflected the hierarchical organization of problem oriented programs and the need in real time systems to provide for the organization of sets of independent, multiprogrammed jobs. To give the facility of dynamic program relocation, for example, some machines were fitted with special hardware. IBM built upon the addressing system of the IBM 360, which allowed only two levels of addressing, and provided a third level. They did this by providing two sets of additional base registers, one set to act in the same way as the base registers of the IBM 360 (being accessible to the programmer). The other set, sometimes known as segment registers, accessible only to the supervisory program, are used in allocating storage.

Gammage outlines three such schemes, but suggests that because these schemes use variable length segments as the basic unit for storage swapping, they are very inefficient in terms of storage utilization. Their inefficiencies cannot be overcome completely unless a full paging system is employed, using fixed length units for swapping.

#### Paging

Most modern machines provide some kind of virtual memory structure if they are to be used for multiprogramming. This addressing space may be provided by hardware or created interpretively by software. Most modern systems also interpose an address mapping structure between virtual and physical addresses.

Typically, the virtual address of a word in memory consists of two parts. The first refers to a page number (a fixed size block of main memory). The second refers to a location within the block. In operation, secondary memory is connected to these

# What's happened to "the right to be let alone?"

Brandeis called it "the right most valued by civilized men." In today's computer age, it is rapidly disappearing. Covering all the technological and legal aspects of the problem, the editor of *Privacy Journal* has now written

"one of the most helpful books I have read this year—a book you cannot read without discovering how endangered is your right to be let alone and what you can do to shore it up."—Bill Moyers.



## PRIVACY

### HOW TO PROTECT WHAT'S LEFT OF IT

ROBERT ELLIS SMITH

\$10.00 at all booksellers

ANCHOR PRESS/DOUBLEDAY

## 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



# FREE Catalog

Your source of 4-way relief from problems with minicomputer supplies and accessories:

**1. One-stop shopping**

Minicomputer Accessories free catalog has over 800 products. Magnetic media. Racks. Line-printer paper. Computer-room furniture. Cables and connectors... both standard and custom-built. Buy any quantity you need when you need it.

**2. Hassle-free ordering**

Minicomputer Accessories lets you order by mail or phone. Keep the catalog close. It makes once-tough tasks like ordering media easy, fast and foolproof.

**3. Lightning-fast shipment**

Minicomputer Accessories ships your order within 24 hours from distribution centers in California and New Jersey. Our shelves are always loaded with emergency items so yours don't have to be. Need your order faster than 3 to 4 days? We'll arrange for services to get it there next day.

**4. Field-proven quality**

Minicomputer Accessories demands stringent testing and star performance before any product is included in our catalog. That's why we have the confidence to guarantee every product for at least 45 days...and some for up to 10 full years.



Send for your **FREE CATALOG**. It's your problem-solver from Minicomputer Accessories Corporation.

130 S. Wolfe Rd. P.O. Box 9004 Sunnyvale, CA 94086 (408) 737-8700

Announcing . . .

## SMALL BUSINESS COMPUTERS Magazine

The magazine for users and potential users of small business computer products and services

- The monthly magazine for businessmen in the process of purchasing or installing their first computers.
- The practical *how to* publication written in non technical language and stressing business applications for small computer systems. Each monthly issue includes:

**FEATURE SURVEY REPORTS:** Such as, *Software Packages for Small Business Applications*, *Small Manufacturing Systems*, *Inventory Control Systems*, *Microcomputer Business Applications*, and so on.

**APPLICATION STORIES:** Real life examples of computer applications in the small business environment — capabilities, benefits, what to watch for, and much more of direct interest to the small businessman.

**COMPUTER PROFILES • IDEAS AND INNOVATIONS • INFORMATIVE ADS**

**SPECIAL CHARTER SUBSCRIPTION**  
12 issues @ 50% off

Receive the next 12 issues of **Small Business Computer Magazine** for just \$9... 50% off the cover price

Mail the coupon today to: **SMALL BUSINESS COMPUTERS Magazine**  
33 Watchung Plaza • Montclair, NJ 07042

**SMALL BUSINESS COMPUTERS Magazine** • 33 Watchung Plaza • Montclair, NJ 07042

- YES. Enter my charter subscription at the 1/2-price cost of \$9 for 12 monthly issues.
- Check enclosed.  Bill me.

Name \_\_\_\_\_  
 Organization \_\_\_\_\_  
 Address \_\_\_\_\_  
 City/State \_\_\_\_\_ Zip \_\_\_\_\_

blocks through high speed IO devices that permit programs to be swapped directly from disk into any one of the main memory blocks without interfering with processor operation. This process is known as direct memory access and allows execution of one user program in one block of memory while programs are being swapped to and from another block.

Main memory is similarly divided into physical pages, each capable of handling one page of a program or block of data. Program pages, although the same size as main memory pages, will not necessarily be contiguous in main memory and may well occupy different main memory pages at different times. One of the functions of the supervisory program in a paging environment is to form and keep up to date a page table which establishes a mapping of the program and data pages into physical pages. By this means, the address of a page within a program is transformed via the page table into an absolute memory location.

In practice, to achieve dynamic relocation, it is necessary to extend the instruction address to include a segment number as well as a page and location number and to leave the binding of address parameters until run time. The segment number is then used to access a segment table belonging to the user whose program is running at that instant. The reference in the segment table is to the page table which in turn maps onto the physical page and through this to the physical address.

This scheme can be very clumsy and take too long, unless the machine is fitted with additional registers which permit the development of an associative memory. The associative memory combines the segment and page numbers, so that only one interrogation is required to find the number of the physical page containing the appropriate address. Systems in which page registers are designed to be accessed associatively operate various page turning algorithms which determine:

- Whether certain pages are in memory.
- Whether pages are to be preserved or overlaid.
- How recently pages have been used so that, if need be, they can be disposed of when new pages are brought into memory.

These systems are the basis of the virtual memory concept which in turn provides the means for dynamic relocation.

### Dynamic Relocation

Let us spell out the need for dynamic relocation in a timesharing system. In general, a program consists of instructions and data.

While being executed it will contain references to intermediate results. These will need to be mapped or translated into references to specific parts of the machine (machine addresses, device numbers, etc). This can be accomplished at three different times:

- During compilation, assembly, or translation into machine code. The result is an absolute program which will be assigned to the same memory locations and use the same peripherals each time it is run, assuming they are available. (This is the most common scheme for user programs in typical personal computers.)
- When the program is loaded. Most machines have a relocating loader which enables programs to be relocated statically.
- During execution, using dynamic relocation.

In multiprogramming it is difficult, if not impossible, to allocate memory concurrently to two or more independently written programs if they are absolute programs. The allocation method requires that the particular combination of programs to be run at any one time and their storage requirements are known in advance. This is information that is not always available when the programs are written.

If the absolute addresses are left untranslated by the assembler or compiler and translated by a relocating loader into actual addresses only when the program is loaded for execution, the particular combination of programs to be loaded together can be decided just prior to loading. This method is known as static relocation. Using static relocation it is possible, with a relocating loader, to allocate memory to a program each time it is executed, provided:

- The program can be separated into a data part and a procedure part.
- The procedure part is never modified during execution.
- The data part, including the contents of registers at the time of interrupt, contains no absolute memory addresses.
- When the program is interrupted, the data part is dumped onto auxiliary storage.

These four conditions are not difficult to achieve. Nevertheless, the relocation of an interrupted program by this method has a number of significant drawbacks, which are summarized by Denning in his article "Virtual Memory" (see references).

In dynamic relocation, the translation of virtual addresses to main memory addresses

# MEDIA BITZ II

**NOW! SAVE UP TO 25%  
ON 3M FLOPPY DISKETTES**

For Professional Data Processing  
Results Specify -  
"SCOTCH" 3M Floppy Diskettes

ITEM CODE	DESCRIPTION	PRICE	* SPECIAL PRICE EACH	* SPECIAL BOX OF 10
3M-740-0	8" Soft-sectored IBM format for IBM, IMSAI, Cromemco	\$6.50	\$5.50	\$49.00
3M-740-32	8" 32-sectors, hard sectored for Shugart, Tektronics, Processor Tech	\$6.80	\$5.80	\$51.00
3M-744-0	5" Soft-sectored IBM format for Apple, TRS-80, IMSAI, Cromemco, SWTPC, Compu-color, Intelligent Systems	\$6.50	\$5.50	\$49.00
3M-744-10	5" 10-sectors, hard sectored for NorthStar, Wang	\$6.50	\$5.50	\$49.00
3M-744-16	5" 16-sectors, hard sectored for Micropolis, Altair, FCC	\$6.50	\$5.50	\$49.00

\*To qualify for these SPECIAL prices, payment must accompany order, or call with credit card. Prices are F.O.B. our warehouse. Add \$1.50 shipping & handling per each 10 (or less) diskettes. N.Y. state residents add appropriate sales tax.

Shipments will be made from stock.

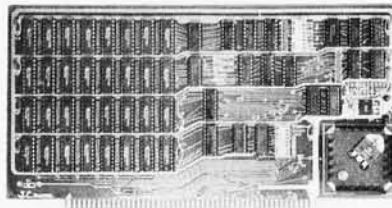
Order today from your authorized dealer for 3M Company "SCOTCH" brand 740 diskettes.

Call (315) 637-6208 or Send order to:

**computer  
enterprises**

P.O. Box 71 • Fayetteville, N.Y. 13066

## 16K STATIC RAM



Kit price  
**\$285** 450 nsec  
**\$320** 250 nsec  
Memory Chips

Add \$25 for assembled, tested, Guaranteed.

**Static TMS 4044-** Fully Static 4Kx1 Memory chips for better data integrity and DMA compatibility.

**Fully S-100 Bus Compatible-** All lines fully buffered, Dip Switch Addressable in two 8K blocks, 4K increments. Write Protectable in 2 blocks, Memory Disable using Phantom (pin 67) or strappable to any other pin.

**Bank Select-** Using Output port 40H (Cromemco software compatible)-addressable to 512KB of RAM or for time share. Also has alternate port 80H-making over 1 million byte of RAM available.

**Quality Components-** First quality parts, fully socketed. Glass epoxy board with silk screened legends, solder masks, Gold Contacts.

**Guaranteed-** parts and labor for 90 days. You may return the undamaged board within 10 days for a full refund. Foreign and kit purchasers-parts only guaranteed; no return privilege.

**Orders-** You may phone for Visa, MC, COD orders. (\$4 handling charge for COD orders only) Personal checks must clear prior to shipping. Shipping-Stock to 72 hours normally. Will notify expected shipping date for delays beyond this. Illinois residents add 5% tax. Please include phone number with order.

**S.C. Digital**

P.O. Box 906  
Aurora, IL 60507

Phone:  
312-897-7749



*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 \*995<sup>00</sup> computers systems available. All  
Additional Drives \*795<sup>00</sup> include full access to Program  
Library. Systems start at \*4,995<sup>00</sup>

<p style="text-align: center;"><b>DOSCHG</b></p> <p>Patches to connect Thinker Toys 8" Disk Drives to North Star DOS &amp; Basic. Fully supports all North Star Functions on 8" disk.</p> <p style="text-align: right;"><b>\$49.95</b></p>	<p style="text-align: center;"><b>CSUB</b></p> <p>A set of Functions defined in North Star Basic that handle all disc accessing (Sequential, Random, &amp; Keyed Access) and all CRT display, formatting &amp; Input. A SUPERB APPLICATION PROGRAM DEVELOPMENT PACKAGE.</p> <p style="text-align: right;"><b>\$49.95</b></p>	<p style="text-align: center;"><b>TIMESHARE</b></p> <p>Patches to North Star DOS &amp; BASIC that take advantage of the versatility of the Horizon computer to implement an interrupt driven bank-switching time sharing system. Requires additional memory &amp; terminals.</p> <p style="text-align: right;"><b>\$49.95</b></p>
--	--	---

**Micro Mike's**  
905 Buchanan, Amarillo, Texas 79101  
806-372-3633

is delayed until the last possible moment (until access to memory is required in running the program). Because the program contains no absolute addresses, it is independent of the actual memory allocation it receives. This means that it can be interrupted at any time and subsequently reloaded into a different part of memory without modification. This desirable facility can only be achieved at the expense of additional hardware and more complex instruction formats. This is desirable since instructions in general must now hold untranslated addresses in a form appropriate to the relocation technique adopted.

There is also the related problem of storage protection (the need to prevent user programs from interfering with each other while being processed). The usual solution to this problem is to allow them to operate in well defined areas of memory only (unrestricted access to all parts of memory being reserved for the supervisory program only). Frequently the technique used to achieve dynamic relocation can also be used to effect storage protection.

#### Conclusion

Many programs running concurrently in a multiprogramming environment typically require far larger total memory space than is available in a particular system. The virtual memory concept and dynamic relocation techniques outlined here have solved many of the problems of managing and optimizing the use of large, hierarchical memories. These techniques are often seen in large computer systems and can be adapted (in principle) for use in microcomputer time-sharing systems. ■

#### REFERENCES

1. Archibald, HIA, et al, "Computer Software," *Journal of the Institute of Administrative Management*, England, 1966.
2. Coffman, EG Jr, and Kleinrock, L, "Computer Scheduling Methods and their Countermeasures," volume 32, AFIPS, *SJCC*, 1968.
3. Denning, PJ, "Virtual Memory," *Computing Surveys*, volume 2, number 3, Sept 1970.
4. Dennis, JB, "Segmentation and the Design of Multi-programmed Computer Systems," *IEEE International Convention Record*, Part 3, 1965.
5. Dennis, JB, and Glaser, EL, "The Structure of On-line Information Processing Systems," *Information System Sciences: Proc of 2nd Congress*, Walker, DW, ed, 1965.
6. Gammage, ND, "Addressing Structures," *Journal of British Computer Manufacturers*, 1966.
7. Popell, SD, ed, *Computer Timesharing*, Prentice-Hall, Englewood Cliffs NJ, 1966.
8. Tsujigado, M, "Multi-programming, Swapping and Program Residence Priority in the FACOM 230-60," AFIPS, *SJCC*, volume 32, 1968.
9. Wegner, P, "Machine Organization for Multi-programming," *Proc-ACM National Meeting*, 1967.

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**

*Saron Associates*

102 Avenida Dela Estrella  
Suite 208  
San Clemente, CA 92672  
(714) 492-7633

# BAS

## BUSINESS APPLICATION SOFTWARE

- ACCOUNTS PAYABLE
- ACCOUNTS RECEIVABLE
- GENERAL LEDGER

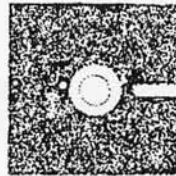
- \* COMPATIBLE MODULES
- \* ALSO INDEPENDENTLY INSTALLABLE
- \* PROGRAMS IN EACH MODULE ALLOW:
  - All File Maintenance
  - Utility File Listing
  - Individual Account Inquiries
  - Original Journals
  - Automatic Master File updating
  - Fast Accurate Keyboard input
- A/R: CUSTOMER STATEMENTS
- AGEING & 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 <input type="checkbox"/> or Dual Density <input type="checkbox"/>			

NAME \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_



## 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**

## 6800 SOFTWARE

FOR: EXORcisor™, SWTP/FLEX™, Smoke Signal, MSI, EPA, Wavemate, Cincinnati Milacron, Conrac 480, Mizar Labs, and more.

### BUSINESS BASIC COMPILER (\$210)

- 10 Digits BCD
- Formatted Output
- String Manipulation
- Disk File I/O
- Error Trapping Under Program Control
- Long Variable Names
- If - Then - Else
- Fast Execution
- SDOS Compatible

### SDOS - SD'S OPERATING SYSTEM\* (\$220)

- Files to 2.15 Billion Bytes
- Dynamic Allocation and Expansion of Files
- Random and Sequential Access
- Supports Floppies and Large Drives Simultaneously
- Long File Names
- Easily Interfaced to New Drives and Peripherals
- Simple Command Interface
- Command Files
- Extensive Error Reporting
- Interrupt-Driven

### MAL - 6800 ASSEMBLER (\$140)

- Long Labels
- Conditional Assembly
- Sorted Symbol Table Dump
- Extended Arithmetic Operations
- Motorola Compatible
- Error Cross Reference
- SDOS Compatible

### EDIT - CONTEXT EDITOR (\$110)

- Change, Delete, Replace Text with Automatic Display of Change
- Single Keystroke 'Display Next Line'
- Powerful Macro Facilities
- More Useful than Motorola's Editor
- SDOS Compatible

### IDB - INTERPRETIVE DEBUGGER (\$ 70)

- Single Step with Register Display
- 4 Realtime Conditional Breakpoints
- Several Display Modes
- MIKBUG Compatible
- Much More Useful than MIKBUG
- Requires 3K ROM, no special hardware

EXORcisor is a trademark of Motorola Inc. FLEX is a trademark of Technical Systems Consultants.

\*Not available for SWTP and Smoke Signal



### SOFTWARE DYNAMICS

2111 W. Crescent, Suite G  
Anaheim, CA 92801  
(714)635-4760



## 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



# A Binary Guessing Game

Mark Zimmermann  
MJ House, Caltech 1-87  
Pasadena CA 91126

James Blodgett  
45 Southern Blvd  
Albany NY 12209

## Calculator Pattern Recognition

Humans and animals do not as a rule behave at random: instinct and past experience play too important a role. In the computer, a good pseudorandom string of digits isn't hard to produce, but to get genuinely unpredictable output is tremendously difficult.

This article introduces pattern recognition and gives a sample program that recognizes patterns with better than random accuracy. The program is in game format to add to the fun, but it can be easily adapted to other purposes.

We will look only at binary patterns (ie: sequences of 0s and 1s). This is not a limitation, since *any* string of symbols can be encoded into a corresponding binary sequence using a suitable conversion code such as ASCII, and, of course, neurons and flip flops are binary devices. (One could encode the text of this article up to this point in binary, and attempt to predict the rest of what we are going to say; if you want to try, good luck!)

Consider the string:

1 0 1 0 1 1 0 1

What is the next digit?

There is no correct answer, and in fact, there is no "best" answer. A lot depends on what kind of system generated the string. [*Recent mathematical work has shown that, in general, there can be no "best" element following a given string of elements; that indeed any element can be shown to be the correct successor to any given string . . . CM*] If the string were generated by an algorithm with almost no "memory" of the immediate past, but with a possible bias toward 0 or 1 (such as a roulette wheel), a good strategy would be to note the majority of 1s appearing and to bet on 1 in the future, regardless of what the last digit was. On the other hand, a human producing a pattern may tend to repeat sequences made in the past, even if an attempt is made to avoid them.

It is useful to define the term "depth"

at this point to mean the longest recent sequence of digits that a program will consider. The basic pattern recognition algorithm we have developed simply looks at the last few digits in a string, checks to see what choice followed that sequence *previously*, and guesses that the same choice will follow this time.

As a specific example, consider the above binary string. A depth 0 algorithm does not look back at all; it has no memory. It simply guesses that the next digit will be the same as the present one (a 1 in the previous example). A depth 1 program checks back to the previous time that a 1 occurred (the sixth digit in our example), and, since it is followed by a 0, makes the prediction 0. A depth 2 routine searches for the previous occurrence of 01, and a depth 3 for 101.

The program listed in this article performs the procedure described above precisely, to depth 3. (Special circumstances which require further processing are discussed below.) All this is not difficult when you have plenty of program and memory space. Implementing it on the HP-25 calculator requires considerable economization, though. If readers with calculators have need of "bit packing and manipulation" it would be worth their while to spend a few hours puzzling out the logic involved, but for applications and gaming, this isn't necessary.

Now that you know the algorithm, it is possible to defeat it in a competition by taking advantage of its weakness (an over-reliance on past patterns). For a simple depth N program, it is possible to generate a pattern of length  $2^{N+1}$  that varies in such a fashion that the program is constantly one step behind and *never* gets a right answer. A depth 0 routine, which just guesses that the most recent digit will be repeated again, is fooled by the simple string 1010101010. . . . A depth 1 program will fail when it meets 110011001100. . . , that is, the pattern 1100 repeated continuously. A pattern that will defeat depth 2 is 11101000. This combination is not unique,

but once such a pattern is found and used, the program will always guess incorrectly. We won't mention a pattern to defeat our depth 3 program, but one can be found fairly easily now that you know how it works.

The program is about evenly matched with human opponents. It is very difficult for a human to win decisively (ie: to get more than 15 points ahead) without analyzing the logic of the program. Don't spoil your friends' fun: let them play without first explaining how it works.

Unfortunately we seem to have spoiled the fun by explaining most of the game's logic in this article. If the reader will change step 9 to "4," and step 44 to "÷," the program will acquire new evasive tactics: it is now designed to outthink the readers of this article! It will also recognize much longer patterns, although it takes a bit longer to learn them. Readers can still foil the program in this mode, but the task is considerably more difficult.

Several questions of interest remain unanswered. First, what is the optimum depth for a machine to look when attempting to outguess a human? How much does it depend on who is playing? (Do 6 year olds tend to generate simpler patterns than adults?). Are there other algorithms better equipped to tackle human opponents? Are deeper or more complex programs also more interesting? What about a base 3 number guessing game such as "rock paper scissors," or a more intriguing video display? What is it that makes artificial intelligence (AI) programs so interesting in general? Psychologists and software experimenters might consider working on some of these problems.

### Implementation on Other Systems

Our program should be convertible for use on most programmable calculators with conditional branching and several memory registers. It will not work without extensive revision on some microcomputers because it requires at least 8 digit accuracy.

Watch the  $10^x$  function; it must be absolutely, not approximately, accurate for integers in the range between  $x = +4$  and  $x = -4$ . If it is not, write a routine to correct it.

Some calculators like the SR-52 do not have the required INT and FRAC functions, but these functions can be easily programmed.

Note that there is an implicit "GO TO 00, R/S" at the end of the program, since this is what the calculator does when it runs past step 49. ■

Address	Operation
01	STO + 3
02	STO + 2
03	RCL 0
04	f PAUSE
05	f $x \neq y$
06	Go To 09
07	2
08	STO - 7
09	2
10	RCL 2
11	f $x \geq y$
12	-
13	g ABS
14	RCL 5
15	x
16	STO + 4
17	8
18	RCL 3
19	f $x \geq y$
20	-
21	g ABS
22	STO 3
23	4
24	-
25	g $10^x$
26	STO 5
27	RCL 5
28	RCL 1
29	x
30	RCL 4
31	$x \geq y$
32	÷
33	g FRAC
34	RCL 1
35	x
36	f INT
37	STO 2
38	x
39	STO - 4
40	f LAST x
41	2
42	STO x 3
43	STO x 2
44	R↓
45	f INT
46	STO 0
47	1
48	STO + 7
49	RCL 7

*Listing 1: A pattern recognition program written for the HP-25 programmable calculator. The operator enters a series of binary digits and the calculator attempts to guess each one, giving itself points when successful and penalizing itself when wrong. Unless the operator enters digits that are truly random, the algorithm stands a good chance of detecting patterns in the operator's string of figures.*

Instructions for Running the Binary Guessing Game			
Step	Comments	Data	Keys
1	Key in program.		
2	Set display digits.		f FIX 0
3	Initialize.		f PRGM f REG
4	Key in values.	10 11.1001 1	STO 1 STO 4 STO 7
5	Clear stack.		f STK
6	Start program.		R/S
7	Program stops with score displayed, for opponent's guess. Enter 1 or 0. (Important: don't enter any other number or run with score displayed.)	1 or 0	R/S
8	HP-25 displays its guess, then the cumulative score: + for opponent, - for HP-25.		
9	Go to step 7.		

**Notes:** The advanced program described in the article also uses the above instructions. If you convert back to the regular version after running the advanced version, the contents of several memory registers will cause problems. To avoid this, start over at step 3 above. After changing the two steps necessary for the advanced program, remember to return to 00 to run the program. The advanced program will guess 0 for several times until it learns your style. To avoid this, try 123.0123 STO 4.



Note: We received the following letter detailing several possible changes to the BASIC language. Readers might try implementing them on their own systems if they do not already have these instructions available . . .  
RGAC.

## Amended BASIC

Robert Paul Bass II  
4827 N 63 Ln  
Phoenix AZ 85033

Having been an avid programmer for many years, I've seen many ways for "Mr Murphy" to add some of his handiwork to programs. In order to accommodate some of the beginning programmers, I felt that a new version of BASIC that incorporated some of Mr Murphy's ideas would be appropriate to help explain away some of those mistakes that we all make at some time or another. Here I present some of the new statements and functions that I would like to see in this new version of BASIC.

### Assignment

10 LET A # 4\*G Set A to any value not equal to the expression.  
20 LET B ≈ 19/T Set B approximately equal to the expression.

These are also handy for generating data to test routines that need data close to a particular value, or if any value but one can be used in a program.

### IF-MAYBE

100 IF G = 17.4 MAYBE 210

Advanced implementations of this statement could have nested conditions, ie:

110 IF G # A\*2 MAYBE 210  
THEN AGAIN 300  
OR PERHAPS 405

### Modified FOR – NEXT

200 FOR N = 0 TO ABOUT 100  
.  
.  
.  
300 NEXT N

This statement is used when one isn't absolutely sure how many times to execute a loop.

### MISPRINT and MISREAD

320 MISREAD A\$  
330 MISPRINT B,S

These are the standard input/output (IO) statements, except that they have a built in glitch generator to produce those inexplicable characters that appear in everybody's output. Caution must be exercised when both of these statements are used in one program because it is possible that the errors could cancel out.

### COMEFROM

350 COMEFROM 100

This is great for debugging programs as it allows the programmer to trace back where he should have been going.

### FUZZ Function

400 FUZZ = 39

This function tells the actual monitor program that executes the BASIC program how picky it will be regarding errors. If FUZZ=0, the program will execute correctly regardless of how many errors there are in the program. If FUZZ=99, the entire system will crash on the smallest logical or even syntactical error.

### FORGET

440 FORGET 450-560

This would be used to indicate which statements should be ignored.

### DIMENSIONLESS

10 DIMENSIONLESS A,B,C,D,E,F,G,  
H,I,J,K,L . . . .

This was designed for the theoretical mathematicians working on problems involving points, those zero dimensioned beasts. Systems using this statement should have plenty of memory, since an infinite number of DIMENSIONLESS statements are allowed (and usually needed) so that the programmer can define lines, planes and spaces.

### BLINK

500 BLINK 10 Blink for 10 seconds.

This is used primarily in demonstration

*Languages Forum is a feature which is intended as an interactive dialog about the design and implementation of languages for personal computing. Statements and opinions submitted to this forum can be on any subject relevant to its purpose of fostering discussion and communication among BYTE readers on the subject of languages. We ask that all correspondents supply their full names and addresses to be printed with their commentaries.*

programs where a visitor can see the front panel lights of the computer. When executing this statement the lights will blink in a fashion guaranteed to impress anyone who doesn't know too much about computers. With appropriate interfaces, this could be used with your Christmas tree lights next winter.

**GLITCH**

530 GLITCH

This is the most invaluable statement that the up and coming programmer can use. It will randomly choose a location in memory or in the internal registers and will change one bit of that word.

**SLOWDOWN**

650 SLOWDOWN

When entering a particularly difficult portion of a program, this statement would be used to slow down the computer so it won't stumble over the program's harder portion.

**WHOA**

720 WHOA

Same basic (no pun intended) use as the SLOWDOWN statement but it is primarily used after a series of particularly easy statements to remind the computer that the easy stuff is over and it will have to dig in again and get to work.

I hope that these suggestions for additions to BASIC will inspire some enterprising young programmer to invest a couple of man-years to develop this new version of the old language that we all know and love. Good luck — you'll need it. ■

## Pascal versus BASIC: Round 2 Includes FORTRAN

Lawrence C Andrews  
2634 Wycliffe Rd  
Baltimore MD 21234

The article "Pascal versus BASIC: An Exercise," by Allan M Schwartz (August 1978 BYTE, page 168) is a typical example of a language chauvinist using a language ineptly and then pointing to the faults in the code he has written as inherent properties of the language.

The function GCD (page 172) that he has written (leaving aside the BASIC version) has several faults, to wit:

- 1) X and Y are not declared in the Pascal version.
- 2) The FORTRAN version will develop an infinite loop if X or Y equals zero (no comment there excludes X, Y greater than zero).
- 3) The FORTRAN version *never* defines the functional value of GCD and so will not even compile in a good compiler.
- 4) There sure are a lot of GOTOS and statement numbers in his program; in particular, statement 180 is totally useless. GOTO 180 should be GOTO 120.
- 5) There is no reason to have any GOTOS. It could be written as in listing 1.
- 6) If you don't mind downward branching GOTOS (generally considered to be harmless) function GCD can be written as shown in listing 2.

As in Pascal the flow is clear and flow-charting is simple (Warnier-Orr diagrams are still better). I don't run down Pascal but I fail to see why Schwartz runs down FORTRAN just because he writes a pidgin dialect ineptly. In FORTRAN, as in Pascal, "Go to statements can fog the otherwise clear logic of a routine," as Schwartz states in his article. FORTRAN 77 with IF... THEN... ELSE statements, and zero trip counts on DO loops, removes most of Schwartz's FORTRAN objection. Anyone can write a bad program in any language. Pascal is no exception to that statement. ■

```

INTEGER FUNCTION GCD (X,Y)
INTEGER X,Y, A,B, LIM
C... X,Y .GT. 0
A = X
B = Y
LIM = MAX0 (A,P)
DO 1000 I = 1, LIM
IF (A .GT. B) A = A-B
IF (B .GT. A) B = B-A
GCD = A
IF (A. EQ. B) RETURN
1000 CONTINUE
END
  
```

*Listing 1: The GCD function written in FORTRAN with no GOTO statements.*

```

DO 1000 I = 1, LIM
IF (A .GT. B) A = A-B
IF (B .GT. A) B = B-A
IF (A. EQ. B) GO TO 2000
1000 CONTINUE
2000 GCD = A
RETURN
END
  
```

*Listing 2: A much shorter version of the GCD function using one downward branching GOTO statement.*





# The face is (becoming) familiar

No surprise...it stands out in the crowd. The quality and reliability that Industrial Micro Systems' customers have grown accustomed to is now available in our complete system. A system that will grow with your needs.

You can start with a minimum 16K, single disk system. The system shown above can be expanded to 608K-Bytes of fast RAM with three double-sided, double-density drives. And more to come.

The microcomputer industry standard CP/M™ operating system is delivered with the system. PASCAL is available. Industrial Micro Systems systems users are developing an impressive array of application software.

The system is offered in rack mount and table top versions and also in our own desk enclosure.

In addition to gaining in familiarity, the Industrial Micro Systems picture for total system products should be coming into focus for everyone. Advanced, reliable electronics...industry standard software...and functional, high quality enclosures.

Industrial Micro Systems, your source for *complete* systems. And the prices are right.

Ask your dealer to see the full Industrial Micro Systems line of products and be watching for exciting new additions soon to come from Industrial Micro Systems, 628 N. Eckhoff St., Orange, CA 92668. (714) 633-0355.

**INDUSTRIAL MICRO SYSTEMS, INC**  
The great unknown.

## Note on an Easy Programming System

Mike Brown  
POB 2263  
West Lafayette IN 47906

I have just completed reading Joseph Weisbecker's article "An Easy Programming System" (December 1978 BYTE, page 108). I was quite favorably impressed—with one minor exception. The random number facility does not seem to be very good, but could be improved with one minor modification. Regardless of what pseudorandom number generator is used, the idea is to provide a sample from a uniform distribution in the range of [0. .KK]. The technique of simply using a mask is clearly not satisfactory. If, for example, KK = 02, the range of pseudorandom numbers is [0. .2]. However, by using the mask, the possible numbers obtained are 0 and 2. It is not possible to get a 1.

There are several ways around this problem. The simplest is the rejection method in which new pseudorandom numbers are generated until one is found to be small enough. Since most pseudorandom number generation routines I have seen are fairly quick, this method would probably be satisfactory as long as KK is reasonably large.

My suggestion is a refinement of the rejection method, which will work fairly well even as KK gets small:

- Determine high order 1 bit position in KK (p). Form mask with bits 7 thru (p+1) off and bits p thru 0 on (m).
- Generate pseudorandom number in range of [0. .255] (r).
- $r2 = r \times m$ .
- If  $r2 > KK$ , go to second step. Otherwise r2 is the required pseudorandom number.

In the worst case, only an average of two random numbers will have to be picked, and verifying a good number or rejecting a bad number is a quick and easy task. ■

The **8100** by **AUH 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 DB-25 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 connections, RAM support, I/O circuitry optional  
USA DOMESTIC PRICE ONLY

## Ever wonder what it takes to win a contest ?

**In late 1978, Mullen Computer Products ran an applications contest for the Controller Board Kit. While we're congratulating the winners, you might want to see what we considered contest-winning material.**

\*\*\*\*\*

**1st PRIZE:** John D. Gill, Blountville, TN.

\*\*\*\*\*

John's application used the board as an interface between the 5V logic of an IMSAI 8080 and the 100 VDC relay logic used by a Friden Flexowriter. He included software timing tricks to avoid passing current through the relays until fully closed. We felt his entry was very practical, imaginative, used the Controller Board to good advantage, and deserved 1st place.

**2nd PRIZE:** Peter Midnight, Oakland, CA.

Peter proposed a computerized editing and synchronization system for double system sound tracks. The entry was well-thought out and novel.

**Runners-up included:** Vaughn Jupe, Carlotta, CA (satellite tracking and other amateur radio applications); Gregory Yoh, Palo Alto, CA (phase controlled waterbed vibrator); Glenn King, Topeka, KS (telephone/computer/dialing interface); Paul McKnight, Washington, DC (microprocessor controlled typewriter/computer interface); and Mike O'Brien, Colorado Springs, CO (IC testing device).

Thanks to everyone who participated in the contest, and for the uniformly high quality of the entries.

If you'd like more information on the amazingly versatile  
**Mullen Controller Board kit,**  
visit your local computer store or write us direct.

**MULLEN Computer Products**  
BOX 6214, HAYWARD, CA 94545



# 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)
- TRS-80 16K Expansion Kit. . . \$89.95
- 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.

## Midas Business Software™ Programs (disc based)

MBSI	Point of sale cash register/ inventory update	\$49.95
MBSII-1	Personal checkbook	\$29.95
MBSII-2	Small business checkbook	\$39.95
MBSIII-1	Basic mail list	\$49.95
MBSIII-2	Extended mail list	\$59.95

Forward check or money order to:  
ISDG Inc.  
312 Highgate Avenue  
Buffalo, New York 14215

Circle 181 on inquiry card.

Terminal Systems

is Dealing!

**ADM 3A**



FOR THE BEST DEAL

**Call!**



TERMINAL SYSTEMS INC.

1188 HIGHLAND STREET, NORTHWOOD, CALIFORNIA 95061

(213) 769-6772

(714) 738-4444

(415) 637-7723

(800) 423-2449

**Rely on US**

Circle 367 on inquiry card.

## PASCAL COMPUTER \$2995

Call (714) 979-9920



### MONTHLY SPECIALS

- Floppy Kit (\$100)
  - SA 801 floppy (8") & cont. . . . . \$599
- Add On Floppy Drives
  - SA 800/1 (8") floppy . . . . . \$469
  - SA 400 mini floppy . . . . . \$285
  - Pertec FD 200 . . . . . \$285
  - Pertec FD 514 . . . . . \$479
- Centronics 779 printer . . . . . \$999
- Centronics P1 . . . . . \$399
- Centronics 700/w tractor . . . . . \$1475
- Miscellaneous
  - Tarbell Controller Kit . . . . . \$185
  - CP/M Operating System/Manuals . \$89
  - 8" Verbatim Diskettes . . . . . \$3.99
  - 5" Diskettes . . . . . \$3.39
  - 16K RAM chips . . . . . \$9.75
  - Pwr Supply cabinet (mini floppy) . . \$79

**CIT** COMPUTER INTERFACE TECHNOLOGY  
Peripheral Products Division  
2080 South Grand, Grand Centre, Santa Ana, CA 92705

Circle 71 on inquiry card.

## TRS-80

MEMORY EXPANSION  
to 16K  
Each Kit **\$79**

Includes easy to follow instructions

Jumpers and 8-16K Rams

2 Sets (32K) \$165

3 Sets (48K) \$249

6 Months Guarantee

— Visa — Master Charge —

Calif. Add 6% Sales Tax

MicroComputerWorld  
Box 242  
San Dimas, CA 91773

Circle 218 on inquiry card.

## WILD & CRAZY ASSEMBLY PROGRAMMERS

The number 2 manufacturer of stand alone POS terminals needs experienced assembly programmers to help introduce 14 new software based products in 1979. Challenging assignments currently exist at all levels including applications, diagnostics and systems software development. Great benefits including yearly vacation to Europe. Starting salary 16-30K. Please call or write Dave Adams, (617) 246-2815. N.E. Recruiters, 6 Lakeside Office Park, Wakefield, MA 01880.

Collect calls accepted. Strict confidence assured. All fees, relocation and interviewing expenses assumed by company.

## TIME SERIES AND STATISTICAL ANALYSIS PACKAGE

THIS PACKAGE ALLOWS THE USER TO:

1. LOAD DATA INTO DYNAMICALLY CREATED FILES.
2. EDIT THE DATA.
3. ANALYZE THE DATA.
4. PRINT OUT AND PLOT THE DATA AND RESULTS.

SOME OF THE TYPES OF ANALYSIS INCLUDE:

1. FOURIER ANALYSIS.
2. CROSS AND AUTO CORRELATION
3. PROBABILITY AND DISTRIBUTION FUNCTIONS
4. PEAK, AVERAGE AND ROOT MEAN SQUARED
5. MEAN, VARIANCE AND STANDARD DEVIATION
6. LINEAR, EXPONENTIAL AND GEOMETRIC REGRESSION

THIS PACKAGE IS WRITTEN IN NORTH STAR BASIC AND CAN BE PROVIDED AS A LISTING OR ON A DISKETTE FOR \$125.00.

Potter's Programs  
22444 Lakeland  
St. Clair Shores, MI 48081  
Phone 313-573-8000

Circle 308 on inquiry card.

## TRS-80 Quality Software at mass-production prices!

WORD PROCESSOR: Helps prepare letters, manuals, books. Use diskette file for text, page, line control, centering, margin justification, etc. Diskette \$39 Level II, 16K vers. \$29

MAIL: Lets you enter, display, search, update, delete name & address info. Reports & labels sorted in name, state, city or zip code order. Diskette \$35

INVENTORY: Full control saves you thousands of dollars. Several reports. Diskette \$39

DISKETTE data base manager/report generator. 32K required \$49

KEY random access: blocking & hashing. DOS. \$19

SORT & LINKED-LIST. Level II. \$10 each or \$16 both.

Level I or II

Cassette data base manager (16K)	\$20
Cassette inventory control (16K)	\$20
Stock security info & analysis	\$10
Check balance	\$10
Stock & check	\$15

MICRO ARCHITECT  
96 Dothan St.  
Arlington, MA 02174

Circle 217 on inquiry card.

## APPLE II TINY BUSINESS SOFTWARE

ACCOUNTS RECEIVABLE — 100 customer accounts max, 8 transactions/month/customer (typical), month end and individual postings, automatic interest calculations. \$75.00

ACCOUNTS PAYABLE — 100 payable accounts max, 8 transactions/monthly/payable (typical), month end posting. \$75.00

PERPETUAL INVENTORY CONTROL — 100 suppliers, 900 individual inventory items, heuristic reorder procedure. \$100.00

All of these programs have random record access, easy addition and deletion of items, password protection on sensitive procedures.

MIN. REQUIREMENT 48K APPLE II, one disk  
OPT. REQUIREMENT 48K APPLE II, two disks  
These procedures for screen environment, printer options available soon.

DOCUMENTATION only for the above \$10 ea.

CHECK OR MONEY ORDER ONLY

DEALER INQUIRIES WELCOME

**CUSTOM COMPUTING SYSTEMS INC.**

204 2ND AVENUE NORTH, SARGENTON, SARGENTON, OHIO 43081 - TELEPHONE (336) 242-7008

Circle 81 on inquiry card.

## Some Contrary Opinion

Peter D. Robertson  
17047 Via Pasatiempo  
San Lorenzo CA 94580

After scanning your August 1978 BYTE, some amusing images came to mind. One was a landscape wherein 10,000 programmers sat in front of their terminals, each one saying, "Gee, if I only had Pascal, I could do this a lot easier than in lousy old BASIC. I really need Pascal." Another image was of Niklaus himself, saying, "Isn't it amazing how many fools there are who ignored Euler, but are wholeheartedly supporting Pascal?" Yet neither language has any real input/output (IO) or was meant for any real machine. Euler was, after all, the more serious effort. Pascal is only a teaching toy.

This is how I see the programming language controversy in the world of personal computing. First of all, Pascal belongs to a class of highly structured, strongly typed languages. This means that it is hard to use. All variables must be explicitly typed, and control structures must follow a rigid syntax, or else the program is garbage. For well-documented, widely distributed programs, this is "good programming practice." For personal computing, this is useless. Secondly, Pascal is difficult to learn.

I spent six months studying Pascal intensively, but even so, there are a number of subtleties and nuances of the language which escape me today. Yet it took only two weeks to master BASIC. Thirdly, Pascal was not meant to be debugged. Pascal is so good that every program you write is supposed to be correct. You just type it in, compile it, run it and move on to the next program. If it doesn't work, then hopefully your computer has PDB, the Pascal debugger program, to help you sort things out. Whereas in BASIC, every statement is (or should be) checked for errors when it is entered, not when it is interpreted. For run time errors, most BASICs allow you to print the values of variables and execute statements selectively, changing them as needed, rather than having to re-compile every time.

In short, I don't see how Pascal can ever extinguish BASIC as the language of choice for personal computing. For industrial systems programming, sure, but not for personal applications. Pascal is, after all, only a

Circle 72 on inquiry card.

## NOBODY SELLS THE BEST FOR LESS

	LIST PRICE	SPECIAL PRICE
Exidy S-100 Expansion Unit for Sorcerer	299.00	255.64
Expandor Black Box Printer	491.95	420.61
Ithaca Audio 16K Memory Upgrade for Exidy Sorcerer & TRS-80	140.00	119.70
Teletek System Central Interface	385.00	329.17
ATV Research Micro-Verter	35.00	29.92
Cromemco 32K Bytesaver Kit	195.00	166.72
Scotch 5" Diskettes (Box of 10)	65.00	45.00

### Call for our prices on:

North Star, Sanyo, Integral Data Systems, IMC, Problem Solver, SSM, Vector Graphic, Dynabyte, ECT, Oliver, Sorcerer

Subject to Available Quantities • Shipping and Insurance Extra

### WE ARE NOW AUTHORIZED DISTRIBUTORS FOR SCOTCH DATA PRODUCTS

HOURS: Monday: 12 to 6, Tuesday-Friday: 12 to 9, Saturday: 10 to 6

### Computer Lab of New Jersey

141 Route 46  
Budd Lake, New Jersey 07828  
Phone (201) 691-1984  
Prices valid thru May 15, 1979

## 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

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.



**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 ± 3 DB • Input impedance—75 Ohms • Resolution—650 lines Minimum IIN 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.

**MICRO'S SHOULD  
EARN THEIR KEEP!**

You liked Version 1 of our General Ledger, wait until you see Version 2.2! Some features include: (Version 1 owners, write for credit on Version 2.2)

*New!*

Our new "Skip-Sequential" (TM) file structure; Up to 100 (or more) custom accounts; Direct cursor control (for some video devices) or standard scrolling; Complete income statement and balance sheet with printer output; Complete audit trails; Expanded error checking; User oriented with expanded manual; much more! 16 programs totalling over 70K. Price: \$79.95

Check our documentation: \$5.00 (credited towards purchase). All programs on diskette and use North Star BASIC, IKK of free memory, 1 or more drives.

Dealer inquiries invited

**ECOSOFT**

P.O. Box 68602  
Indianapolis, IN 46268

Circle 110 on inquiry card.

**Visi  
Calc™**

**How did you ever  
do without it?**

© 1979 PS Inc.

Circle 302 on inquiry card.

**'68' MICRO  
JOURNAL™**

★ The only ALL 6800 Computer Magazine.

**CHARTER  
SUBSCRIPTION SPECIAL**

1-Year \$10.50 2 Years \$18.50  
3 Years \$26.50

OK, PLEASE ENTER MY  
SUBSCRIPTION

Bill my: M/C  — VISA

Card # \_\_\_\_\_

Expiration Date \_\_\_\_\_

For  1-Yr.  2 Yrs.  3 Yrs.

Enclosed: \$ \_\_\_\_\_

Name \_\_\_\_\_

Street \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_ Zip \_\_\_\_\_

**'68' MICRO JOURNAL™**  
3018 Hamill Road  
HIXSON, TN 37343

Circle 323 on inquiry card.

Want to stick it on your bumper?

Honk if you like "bumper bits." It's the new way to communicate with your fellow computer pros on the highways and byways of life.

Each bumper sticker is black-on-white, 4x14". \$1.95 each; 3 for \$5.

- Want to hop in and compare peripherals?
- Semiconductors are only in charge of the woodwinds
- Waiter, look at debug in my soup

Send \_\_\_\_\_ no. of: \_\_\_\_\_ a. \_\_\_\_\_ b. \_\_\_\_\_ c.  
(California residents add sales tax.)  
Mail check, cash or money order to:

**bumper-bits™**

Box 2062, Menlo Park, CA. 94025

Circle 26 on inquiry card.

WELCOME TO:

**"THE SOURCE"**

\* \* \* \* \*

- 8080/Z80 DISK-BASED DISASSEMBLER
- RUNS ON 8080/8085 OR Z80 UNDER CP/M
- SUPPORTS FULL Z80 INSTRUCTION SET
- OBJECT CODE DISASSEMBLED FROM DISK NOT FROM MEMORY
- DISASSEMBLED CODE DIRECTED TO DISK OR PRINTER
- CODED CROSS-REFERENCE TABLE
- SYMBOL TABLE
- MANY OPTIONS
- EITHER TDL MNEMONICS [TSOURCE] or MAC MNEMONICS [MSOURCE]
- AVAILABLE ON 8" SINGLE DENSITY FLOPPY OR 5" FLOPPY (CP/M FOR NORTH STAR BY LIFEBOAT)

PRICES:	TSOURCE	\$39.95	NY STATE RESIDENTS ADD 7%
	MSOURCE	\$39.95	
	BOTH	\$69.95	

MJB  
COMPUTER  
ASSOCIATES

41 Meadow Dr.  
Spencerport, N.Y. 14559

**Special for  
TRS-80 and APPLE II  
Users**

**Verbatim  
Diskettes**

MD 525-01 — Soft Sect.  
MD 525-10 — Hard Sect.  
MD 525-16 — Hard Sect.

**3 for \$10.**

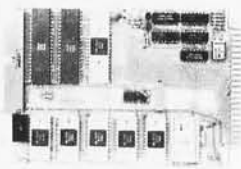
**(8" Disks — 3 for \$12)**

Check, Money Order, Visa or  
Master Charge Accepted. No COD's.



P. O. Box 327 E  
Center Valley, Pa.  
18034

Circle 101 on inquiry card.



**SINGLE BOARD COMPUTER  
\$99.50\***

with 6800 MPU, 6850 serial I/O, 2 6820 parallel I/O (32 lines), 512 RAM, socket for 2708, 2716, EROM. Interface modules for industrial control, data acquisition, lab instrumentation, on 44 pin 4½"x6½" PCB's. RAM, ROM, CMOS RAM/battery, A/D, D/A, Driver/Sensor, Serial I/O, Parallel I/O, Counter/Timer, IEEE 488 GPIB, floppy controller.

\*OEM (500 piece) price

**WIRTEK Corp.**  
902 N. 9th Street  
Lafayette, IN 47904  
Phone (317) 742-6802

Circle 389 on inquiry card.

**RS232 USERS**



Low cost RS232 switch kit will allow a variety of connections. Kit contains no wires. Latest P. C. board and switching technology. Up to three devices can be switched with a turn of the knob. Ideal for connecting three driving sources to one printer, CRT, PROM Programmer, MODEM, etc.

Price \$64.95 Kit \$47.95

**GILTRONIX INC.**  
Call: 415/493-2199

Circle 144 on inquiry card.

programming language, whereas BASIC is an entire programming system. If you want to write something neat and elegant, use Pascal, but expect to spend a lot of time on it. If you want to get the job done, however, maybe BASIC isn't so bad. ■

## How To Define an OS Which Does Not Need a Wizard

James E Jones  
123 NE 2nd  
Moore OK 73160

I have noted a trend towards microcomputer operating systems which allow programs to be written without worrying about peculiar device interfaces. Nothing could please me more. IO and interrupt programming are the worst part of the transfer from large to micro. There is one disaster that must be avoided, though: the user's interface with it, when it comes, will resemble OS/360 or 370 "JCL" (Job Control Language).

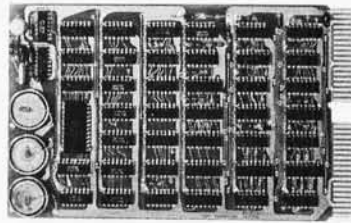
Other than the DD statement, JCL mainly presents tolerable nuisances. Indeed, it once made a perverse sort of sense. JCL is 360 macroassembler with a "/" at the beginning of each statement, and in the times when everybody used assembler and had to know the sordid details of the DCB, it was actually convenient. But in my experience, most people use high level languages now. (I'm from an academic background and probably biased. For purposes of argument, I'll even admit that FORTRAN and COBOL are high level languages.) These people, who enjoy the advantages of such languages when programming, are saddled with large amounts of machine dependent trivia when JCL time comes. Maybe it's not like having to write your own CCWs, but the user must still be concerned with many device peculiarities. (Don't tell me that's what procedures are for. Users must always fill in anything not foreseen by the procedure writer, who can't have much foresight in such cases.) Processes that are easy to think in terms of become cumbersome to write or maybe impossible.

The worst part is that in the name of upward compatibility, the user is forever stuck with it.

So what does this harangue against OS/370 have to do with us? Just this: once an operating system arises in the micro-

Circle 86 on inquiry card.

# 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.**



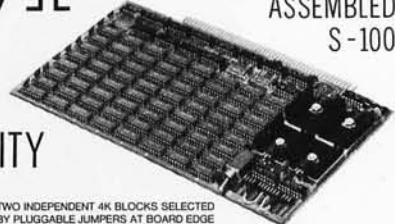
**DIGITAL PATHWAYS INC.**  
4151 Middlefield Road • Palo Alto,  
California 94306 • Telephone (415) 493-5544

*Pacific*  
DIGITAL  $\Omega$

**8KRS**

8K STATIC RAM  
ASSEMBLED  
S-100

RELIABILITY  
QUALITY  
DEPENDABILITY



ADDRESSING  
PROTECT  
BUFFERING  
LOW POWER  
WAIT STATES  
QUALITY  
GUARANTEE  
DELIVERY  
PHANTOM  
TESTING

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

**SPECIAL**

INTRODUCTORY  
PRICE  
ASSEMBLED / TESTED

450 ns  
\$149<sup>95</sup>

250 ns  
\$189<sup>95</sup>

CALIFORNIA RESIDENTS ADD 6% TAX

(714) 992-5540  
2555 E. CHAPMAN AVE.  
SUITE 604  
FULLERTON, CA 92631

*Pacific*  
DIGITAL  $\Omega$



**TERMINALS FROM TRANSNET****PURCHASE  
12-24 MONTH FULL OWNERSHIP PLAN  
36 MONTH LEASE PLAN**

DESCRIPTION	PURCHASE PRICE	PER MONTH		
		12 MOS.	24 MOS.	36 MOS.
LA36 DECwriter II .....	\$1,595	\$ 152	\$ 83	\$ 56
LA34 DECwriter IV .....	1,295	124	67	45
LA120 DECwriter III, KSR ....	2,295	219	120	80
LS120 DECwriter III, RO .....	1,995	190	104	70
LA180 DECprinter I, RO .....	1,995	190	104	70
VT100 CRT DECscope .....	1,695	162	88	59
TI745 Portable Terminal .....	1,875	179	98	66
TI765 Bubble Memory Term. . .	2,795	267	145	98
TI810 RO Printer .....	1,895	181	99	66
TI820 KSR Printer .....	2,395	229	125	84
ADM3A CRT Term. ....	875	84	46	31
QUME Letter Quality KSR. ....	3,195	306	166	112
QUME Letter Quality RO. ....	2,795	268	145	98
HAZELTINE 1410 CRT .....	895	86	47	32
HAZELTINE 1500 CRT .....	1,195	115	62	42
HAZELTINE 1520 CRT .....	1,595	152	83	56
DataProducts 2230 .....	7,900	755	410	277
DATAMATE Mini Floppy .....	1,750	167	91	61

FULL OWNERSHIP AFTER 12 OR 24 MONTHS  
10% PURCHASE OPTION AFTER 36 MONTHS

**ACCESSORIES AND PERIPHERAL EQUIPMENT**

ACOUSTIC COUPLERS • MODEMS • THERMAL PAPER  
RIBBONS • INTERFACE MODULES • FLOPPY DISK UNITS

**PROMPT DELIVERY • EFFICIENT SERVICE**

**TRANSNET CORPORATION**  
2005 ROUTE 22, UNION, N.J. 07083  
**201-688-7800**

**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

world, because of its very real advantages, there will be exactly the same pressures for its maintenance that there are for those of the dinosaurs: rewriting costs, upward compatibility, and difficulties of relearning. The first OS must be the best we know how to write, using the experiences gained from the minis and maxis.

Those who are considering writing an OS, please consider these as possible guidelines:

(1) The OS functions ought to be callable by user's programs, not restricted to the OS or some privileged set of programs. On the 370, users' programs for the most part can only read and write, unless they wish to write assembler programs to subvert the system. All other functions are performed by the OS between jobs or by mysterious, nearly unusable utilities programs. (Around here, they are called the futilities.) Users should be able to write utilities on which natural selection can work. Let only the convenient survive.

(2) The OS functions should be a clean, orthogonal, simple set that does not refer to any device perversities. Not only will such an OS be easier to use, but it would be a true standard, transportable between processors. (Consider the increased ease of communication of programs that would result.) To see how it can be done, read the July 1974 CACM paper on Unix. For heaven's sake, read at least the first three chapters of *Software Tools* by Kernighan and Plauger.

I want a system that I can use without spending all my time fighting its bureaucracy. As time goes on, there will be fewer and fewer hardware hackers, and more people raised on high level languages running on microcomputers. These people will depend on the OS written by the hackers, and it scares me to read about people thinking about IO in big system terms, with a plethora of access methods. If it's done correctly, everyone, including the hackers, will have an environment far better suited for people and working on problems instead of commas, buffers and block sizes. ■

*[Editorial Note: Buried within this letter are numerous references to acronyms which every OS/370 Job Control Language (JCL) hacker must deal with in everyday life. Being lazy, and rationalizing on the grounds of not perpetuating the mistakes, we leave the text as is, filled with references to JCL, DD statements, CCWs, DCBs, and all the other incantations of the wizards of OS. . .CH]*

# Technical Forum

## A Fix for the Dazzler

Michael A Baltrush  
New Jersey Institute of Technology  
323 High St  
Newark NJ 07102

The New Jersey Institute of Technology purchased a Cromemco Dazzler as a kit which was constructed by a student during the summer of 1977. Plugging the unit into our S-100 bus computer system, we found that it produced pretty pictures on a video monitor. But an unfortunate side effect was that our terminal printed garbage while the Dazzler was operating. An investigation revealed a pulse on the SOUT line during the time the direct memory access (DMA) transfer was taking place. Cromemco was informed of this by letter and their response was... "your serial I/O (input/output) board cannot tolerate DMA." But the problem is deeper than tolerance of an I/O board. Our S-100 system uses a Z-80 processor rather than an Intel 8080. During direct memory access on the 8080, the PHOLD (S-100 pin 74) is asserted by the peripheral and is answered with PHLDA (S-100 pin 26). The PHLDA signal appears at the leading edge of  $\phi_1$  and the address bus and data bus are floated (put in three-state output condition) at  $\phi_2$ . Thus there is a period of time between PHLDA and the floating of the buses.

During direct memory access of the Z-80, the PHOLD signal is asserted by the peripheral and is answered with PHLDA. The appearance of PHLDA signals that the address bus and data bus are floated with no delay. In use, the Dazzler controls the buses and the signals derived from the control bus. In our system the assumed delay between PHLDA and the floating of the buses does not exist. Therefore, the SOUT signal was uncontrolled during that interval and was treated as a high signal, which is the SOUT assertion level.

A fix for this problem is to take control of all the lines at the assertion of the

## NO FRILLS! NO GIMMICKS! JUST GREAT DISCOUNTS MAIL ORDER ONLY

<b>HAZELTINE</b>		<b>DIGITAL SYSTEMS</b>	
1400 .....	\$ 650.00	Computer .....	\$4345.00
1500 .....	995.00	Double Density	
Mod 1 .....	1495.00	Dual Drive .....	2433.00
<b>CENTRONICS</b>		<b>IMSAI</b>	
779-1 .....	954.00	VDP 80/1000 .....	\$5895.00
779-2 .....	1051.00	VDP 40 .....	3795.00
700-2 .....	1350.00	VDP 42 .....	3895.00
761 KSR tractor .....	1595.00	VDP 44 .....	4195.00
703 tractor .....	2195.00	16K Memory assem... ..	399.00
<b>NORTHSTAR</b>		PCS 80/15 .....	679.00
Horizon I assembled..	1629.00		
kit .....	1339.00	15% off on all other Imsai products	
Horizon II assembled..	1999.00	<b>CROMEMCO</b>	
kit .....	1599.00	System III \$1000 off ..	4990.00
Disk System .....	589.00	10% off on all other Cromemco products	
<b>TELETYPE</b>		<b>TEXAS INSTRUMENTS</b>	
Mod 43 .....	995.00	810 Printer .....	1595.00
<b>IMS</b>		<b>CENTRONICS</b>	
16K Static Memory....	459.95	Micro Printer .....	495.00

Most items in stock for immediate delivery. Factory-fresh, sealed cartons.

**DATA DISCOUNT CENTER** P.O. Box 100  
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.



PROGRAM LIBRARY

from

### CASCADE ENTERPRISES ON CASSETTE TAPE

- \* If you use Solost<sup>™</sup> or have an 8080 Sol<sup>™</sup> System, G2<sup>™</sup> Extended Basic is faster and better than others requires (15.5K) \$49.95
- \* For our 6800 users G2<sup>™</sup> Standard Basic specifically for the S.W.T.P.C.<sup>™</sup> 6800 requires (7K) \$34.95
- \* Both G2 basics are by Microsoft<sup>™</sup>
- \* We have the following games and entertainment which will run in these machines:

THE GAME TAPES ARE ONLY \$14.95 each	SOL <sup>™</sup>	SORCERER	PET <sup>™</sup>	TRS-80 <sup>™</sup>	APPLE <sup>™</sup>	S.W.T.P.C. <sup>™</sup>
G2 BEAT THE HOUSE	*	*	*	*	*	*
G2 CLINIC	*	*	*	*	*	*
G2 OUTWIT	*	*	*	*	*	*
G2 THE MARKET	*	*	*	*	*	*
G2 ADVENTURE	*	*	*	*	*	*
G2 BLOCKADE	*	*	*	*	*	*
G2 OIL TYCOON	*	*	*	*	*	*
G2 PILOT	*	*	*	*	*	*

G2 Beat the House includes Blackjack, Craps, Roulette and Slot Machine. Craps is a very big program. Ours left 3K usable in Level II 16K TRS-80<sup>™</sup>. Allows a family to play as a group against the computer.

Call us anytime except Sunday (916) 926-5154 or write

As an introductory offer—the first 500 orders get a free 10 minute blank cassette.

**CASCADE ENTERPRISES**  
Box 213  
Mount Shasta, CA 96067

Cal. Res. add 6% tax  
Bank Cards add shipping & handling \$2.00

M/C  B/A-Visa \_\_\_\_\_ Expires \_\_\_\_\_

Signature \_\_\_\_\_



Figure 1: Portion of Cromemco Dazzler circuitry which is used to control direct memory access to system memory.

The information in this technical forum was also sent by the author to the newsletter of the Amateur Computer Group of New Jersey.

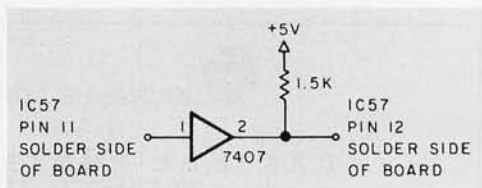
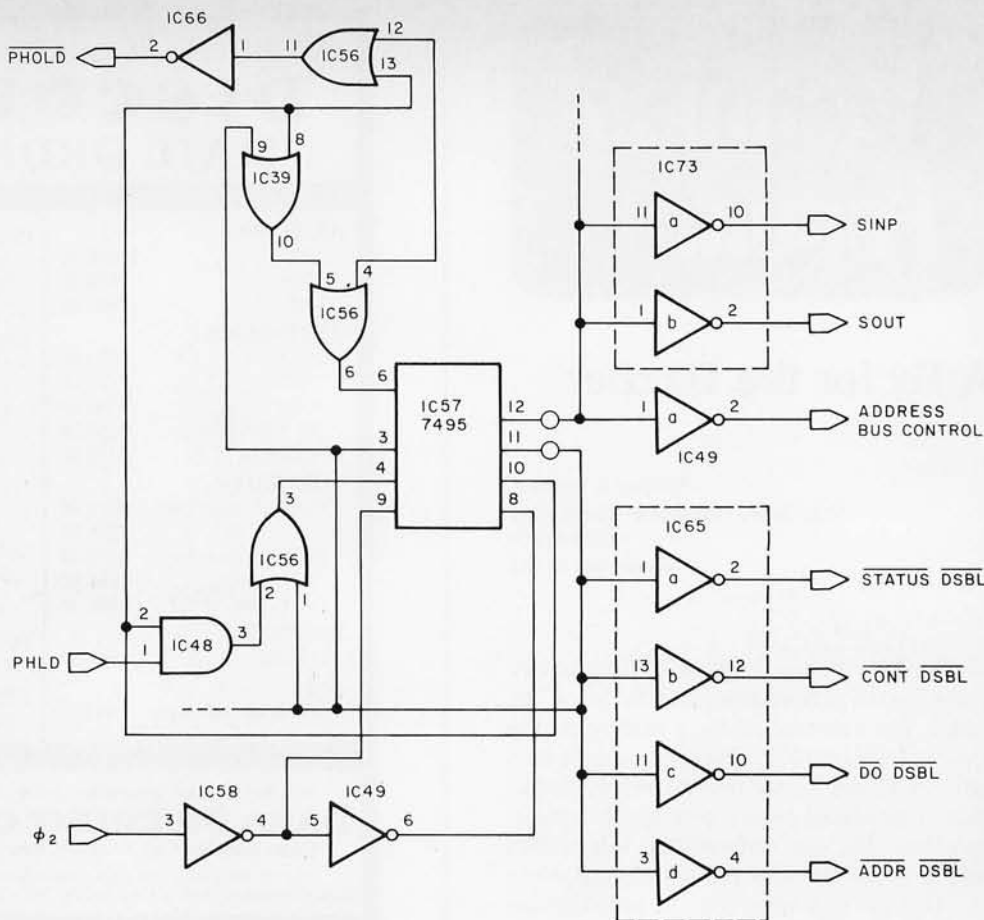


Figure 2: Addition to the Cromemco Dazzler circuit to eliminate problem-causing pulses on the author's Z-80 S-100 bus system. The fix eliminates spurious SOUT pulses that can cause garbage to be printed out on the system printer when the Dazzler is operating.

PHLDA signal. This is done by removing IC57 (a 7495), bending pin 12 straight out and reinserting IC57. This removes the effect of pin 12's output from the circuit. A signal must be supplied from pin 11 of IC57. Unfortunately, for simplicity, buffering must be used to be consistent with TTL loading rules. Fortunately, an uncommitted socket exists on board # 2. A 7407, a hex noninverting buffer with open collector output, can be mounted in this socket along with the pull up resistor. The additional integrated circuit is connected as in figure 1. ■

# DAM YOUR COMPUTER

DATA ACQUISITION MODULES by

NOW YOUR COMPUTER CAN LISTEN TO THE REAL WORLD. YOU GET 16 8 BIT ANALOG INPUTS WITH OUR AIM161.

## MEASURE - RECORD - CONTROL

- TEMPERATURE
- DIRECTION
- PRESSURE
- LIGHT LEVELS
- db
- POLLUTION CONTROLS
- DARKROOMS
- HUMIDITY
- LIGHT
- JOYSTICKS
- ENERGY CONSERVATION EQUIPMENT
- GREENHOUSES
- SPEED
- WEATHER STATIONS
- NOISE POLLUTION
- pH
- EARTHQUAKE TREMORS
- VELOCITY
- ACCELERATION
- GAMES

## AIM161 STARTER SET

- 1 - AIM161 - 16 ANALOG INPUTS 8 BITS - 100 MICROSEC
- 1 - POW1 - POWER MODULE
- 1 - ICON - INPUT CONNECTOR - 20 PINS SOLDER EYELETS
- 1 - OCON - OUTPUT CONNECTOR - 18 PINS SOLDER EYELETS

\$189.00



CONNECTICUT microCOMPUTER

150 POCONO ROAD · BROOKFIELD, CONNECTICUT 06804

(203) 775-9659

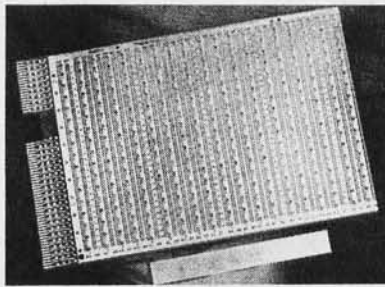


# What's New?

## 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. 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.*

## Camac Interface Board for Integrated Circuit Pluggable Wire Wrap Use



Circle 640 on inquiry card.

Camac interface boards for integrated circuit pluggable wire wrap applications are now available from Garry Manufacturing Co, 1010 Jersey Av, New Brunswick NJ 08902. The new boards are plug compatible with the Camac standard instrumentation bus. They provide 38 universal rows of 64 socket terminals per row, with ground and voltage terminals between every other row, spaced .300 inch (.76 cm). The boards will accommodate up to 125 16 pin integrated circuits or an equivalent mix of larger integrated circuits.

The new boards are available at \$2 to \$3 per integrated circuit position. ■

## Products for the PET

PET Shack Software House, POB 966, Mishawaka IN 46544 has available a line of products for the Commodore PET. Their products include a complete set of schematics of all the boards in the PET plus parts layout and identification; a complete disassembled listing of all seven read only memories

plus identified entry points and machine language monitor program listing; and a multitude of software on cassette. The schematics are priced at \$35 and the read only memory routines are \$19.95. ■

Circle 641 on inquiry card.

## Dust Covers for Computers and Terminals

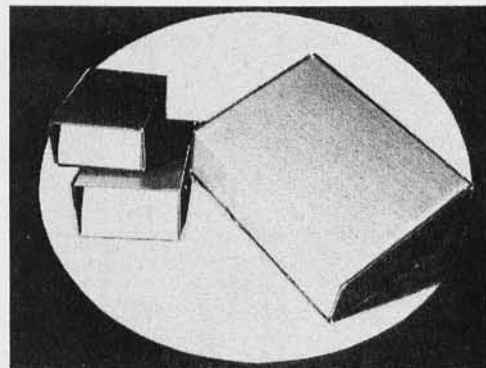


Cover Craft has recently announced a new line of high quality protective dust covers to fit all popular brands of computers and peripherals. Hundreds of sizes are available, each designed to precisely fit a specific model. Each cover is cus-

tom designed and hand cut from high quality textured flexible vinyl. All seams and edges are machine stitched for maximum strength. Contact Cover Craft, POB 555, Amherst NH 03031. ■

Circle 642 on inquiry card.

## Instrument Enclosures for Designers and Manufacturers



This S series of sloped top panels and the V series of vertical front panels provide a wide range of uses. Vertical and sloping panels are finished brushed and clear anodized. Covers are finished in hard scratch resist, baked-on black textured enamel. Rubber feet and hardware are provided. All models are of flanged construction, using .063 inch (.16 cm) 14 gauge tempered aluminum. A pre-punching option on all models is available with instructions upon request. Pricing ranges from \$4.43 to \$17.90 each in quantities of one to four. For more information contact AAK Corp, POB 7, Methuen MA 01844. ■

Circle 643 on inquiry card.



### The Computer Book Features Workbook Format

*The Computer Book* by Fred Lee is an introductory reference for readers, student and nontechnician alike, who wish to improve their understanding of the digital world. This 365 page self-teaching workbook format guide is presented in a clear, straightforward style. In addition to text on each page, the top third of each page graphically represents a memory location which includes memory and address registers

to be filled in by the reader so he or she goes through the same logical steps that a computer would follow while running a program. A sampling of the contents includes: number systems and codes, vacuum cleaners and circuits, the instruction set, programming, thumbs-on experience, assembly language, high level language, microprocessors, and microcomputers. The book is priced at \$28 and is available from Artech House, 610 Washington St, Dedham MA 02026. ■

Circle 620 on inquiry card.

### Teach Yourself How to Use BASIC



*BASIC For Home Computers* is a self-contained book for learning BASIC. The authors have used Microsoft BASIC for the MITS Altair computer; however, BASIC learned in this book will apply to any computer that understands a similar version of BASIC. This self-instructional book shows you how to read, write and understand BASIC. The material is presented in short numbered sections called frames, each of which teaches something new about BASIC and either asks a question or tells you to write a program.

Answers are given, and numerous applications and games are included. The book is priced at \$5.95 and is published by John Wiley and Sons Inc, 605 Third Av, New York NY 10016. ■

Circle 621 on inquiry card.

### Superior Electric Offers Free Stepping Motor Control Catalog



This 28 page catalog covers 16 new Slo-Syn stepping motor controls. It includes new translator and preset indexer modules, power supply modules, open chassis and buffered translators, open chassis preset indexers and completely packaged translators, preset indexers and buffered translators. Controllers drive at rates up to 5000 steps per second (1.8° steps) or 10,000 half steps per second (0.9° steps).

The catalog utilizes charts, specifications, speed versus torque curves and connection diagrams to facilitate selection of correct unit.

For this free catalog write to The Superior Electric Co, 383 Middle St, Bristol CT 06010. ■

Circle 622 on inquiry card.

### Handbook of Archer Semiconductors

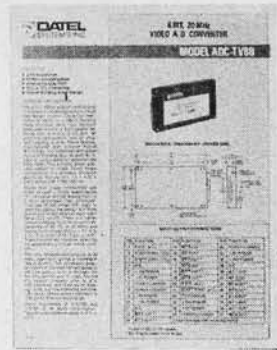


The *Semiconductor Reference Handbook* is a compilation of data on Radio Shack's line of Archer semiconductors. A cross-reference listing for replacement of transistors, diodes and other interchangeable semiconductor devices is listed at the back of the book. The total number of cross-referenced devices exceeds 46,000. These listings are computer selected and are based on analysis of the key parameters of the listed devices.

The price is \$1.95. For further information contact Radio Shack, Fort Worth TX 76102. ■

Circle 623 on inquiry card.

### Technical Brochure on Video Analog to Digital Converter



This recently published four page technical brochure by Datal Systems, 1020 Turnpike St, Canton MA 02021, details the electrical and mechanical specifications on the new video analog to digital converter Model ADC-TV8B. This converter features an 8 bit resolution, 20 MHz encoding rate, and an internal high speed sample hold. It is ideal for digital television processing and transmission, radar digitizing, and ultrahigh speed data acquisition systems. Other features in this brochure include block diagrams, timing diagrams, technical notes and applications. ■

Circle 624 on inquiry card.

### Catalog Offers Used Electronic Instruments

REI Sales Company, which sells used state of the art electronic instruments and equipment, has announced the publication of a new 20 page catalog of equipment for sale. The catalog is available free upon request.

500 different products from 76 manufacturers are listed; items available are amplifiers, analyzers, attenuators, counters, couplers, detectors, filters, generators, meters, microcomputer development systems, oscilloscopes, power supplies, recorders, synthesizers, and miscellaneous equipment.

Terms and conditions of purchase and sale prices of all items are described in this illustrated, indexed catalog, which is available from REI Sales Co, 1 North Av, Burlington MA 01803. ■

Circle 625 on inquiry card.

### Interested in Sound Recording?

*Home Recording for Musicians* by Craig Anderton is a 182 page book which explains how to make professional sounding tapes inexpensively at home. This fully illustrated book includes information on tape decks, multichanneled recorders, microphones, studio setup, tapes, mixing, noise reduction, special effects and more. A special projects section and demonstration record are included. It is priced at \$9.95 and is distributed by Music Sales Corp, 33 W 60th St, New York NY 10023. ■

Circle 626 on inquiry card.

# MEMORY SALE! have it your way . . .

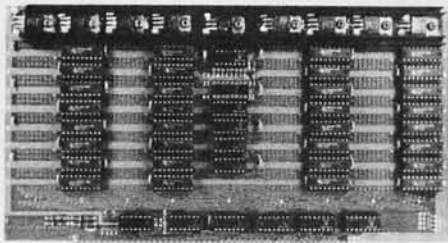
**16K \$295.00!! (450 NS)**  
**\$327.00!! (250 NS)**

**32K \$485.00!! (450 NS)**  
**\$549.00!! (250 NS)**

ASSEMBLED AND TESTED ONLY ! . . . . Check features before you buy any other memory

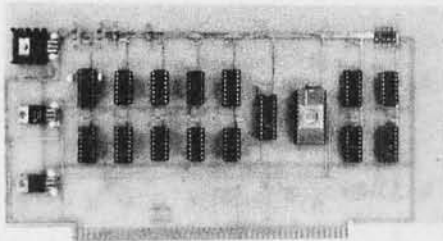
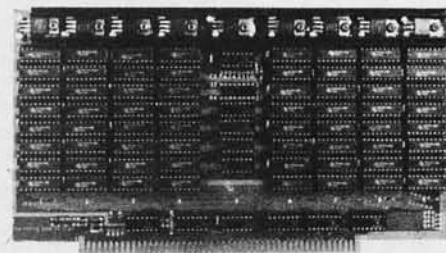
- Extended addressing allows board to exist anywhere in 1 megabyte of memory on standard S-100 bus
- LOW Power, 1.8 Amp per 16K
- 9 Regulators for perfect heat distribution
- Static, of course
- Phantom line
- Each 4K block locateable anywhere
- Fully tested and burned in for 48 hours

ADD-ON MEMORY CHIPS - \$4.95 EACH !! (TMS 4044 or MM 5257) - 8 Chips - Minimum order



← 16K

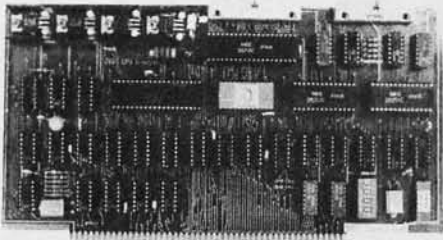
32K →



## MEMORY MANAGEMENT

**\$135.00 !!**

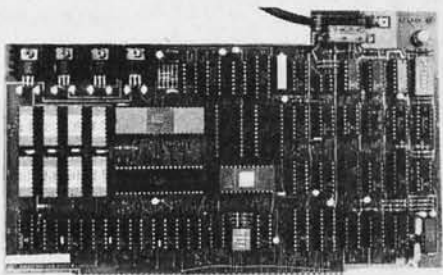
- Turn banks of memory on and off
- "Sensitize" board to 15 CPU instructions (similar to DEC System)
- Extends addressable memory space to 1 megabyte



## 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:

**DELTA PRODUCTS**  
 1653 E. 28th Street  
 Long Beach, Calif. 90806  
 Tel. (213) 595-7505

ORDER NOW !!

SALES  
 &  
 SERVICE

East Coast:

**DELTA PRODUCTS**  
 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



## TRS-80<sup>ES</sup> SERIAL I/O

- Can input into basic
- Can use LLIST and LPRINT to output, or output continuously
- 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
- Requires +5, -12 VDC
- 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 \$6.00, with 9' B conductor cable \$10.95 Part No. DB25P9.



3' ribbon cable with attached connectors to fit TRS-80 and our serial board \$19.95 Part No. 3CA940.

## 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  $\Omega$  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



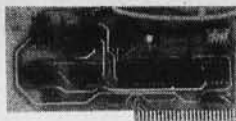
## VERBATIM MINIDISK



Box of 10

\$29.95

## APPLE II\* SERIAL I/O INTERFACE



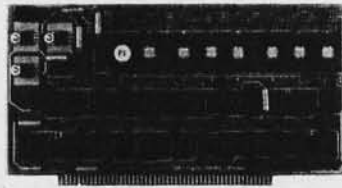
Baud rate is continuously adjustable from 0 to 30,000

- 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 electrics.
- Also watches DTR
- Board only \$15.00 Part No. 2, with parts \$42.00 Part No. 2A, assembled \$62.00 Part No. 2C

## 8K EPROM PIGEON

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 of 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.



## 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



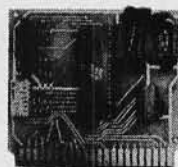
## TAPE \* INTERFACE

- 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. 111, with parts \$27.50 Part No. 111A



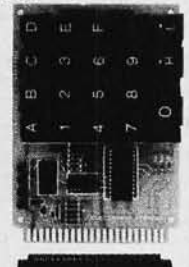
## UART & BAUD RATE GENERATOR\*

- 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



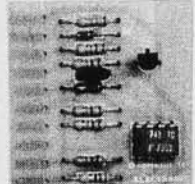
## HEX ENCODED KEYBOARD<sup>ES</sup>

This HEX keyboard has 19 keys, 16 encoded with 3 user definable. The encoded TTL outputs, B-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.



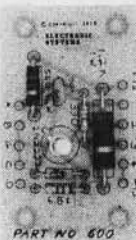
## RS-232/ TTL\* INTERFACE

- Converts TTL to RS-232, and converts RS-232 to TTL
- Two separate circuits
- Requires -12 and +12 volts
- All connections go to a 10 pin gold plated edge connector
- Board only \$4.50 Part No. 232, with parts \$7.00 Part No. 232A 10 Pin edge connector \$3.00 Part No. 10P



## RS-232/ TTY\* INTERFACE

- Converts RS-232 to 20mA current loop, and 20mA current loop to RS-232
- Two separate circuits
- Requires +12 and -12 volts
- Board only \$4.50 Part No. 600, with parts \$7.00 Part No. 600A



## WAMECO INC.

WMC 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. (Finally) AMSA1 size hex displays. Byte or instruction single step. PCBD ..... \$42.95

**MEM-1A** 8Kx8 fully buffered, S-100, uses 2102 type RAMS. PCBD ..... \$24.95, \$168 Kit

**GMB-12** MOTHER BOARD, 13 slot, terminated, S-100 board only ..... \$34.95 \$89.95 Kit

**CPU-1** 8080A Processor board S-100 with 8 level vector interrupt PCBD ..... \$25.95 \$89.95 Kit

**RTC-1** Realtime clock board. Two independent interrupts. Software programmable. PCBD ..... \$25.95, \$60.95 Kit

**EPM-1** 1702A 4K EPROM card PCBD ..... \$25.95 \$49.95 with parts less EPROMS

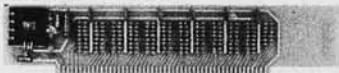
**EPM-2** 2708/2716 16K/32K EPROM card PCBD ..... \$24.95 \$49.95 with parts less EPROMS

**GMB-9** MOTHER BOARD. Short Version of GMB-12. 9 Slots PCBD ..... \$30.95 \$67.95 Kit

**MEM-2** 16Kx8 Fully Buffered 2114 Board PCBD ..... \$25.95, \$269.95 Kit

## S-100 BUS \* ACTIVE TERMINATOR

Board only \$14.95 Part No. 900, with parts \$24.95 Part No. 900A



## DC POWER SUPPLY\*

- Board supplies a regulated +5 volts at 3 amps., +12, -12, and -5 volts at 1 amp.
- Power required is 8 volts AC at 3 amps., and 24 volts AC C.T. at 1.5 amps.
- Board only \$12.50 Part No. 6085, with parts excluding transformers \$42.50 Part No. 6085A



## 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

## ACCELEWRITER DOUBLES DECWRITER SPEED

The ACCELEWRITER doubles the LA36 Decwriter's speed from 30 to 60 CPS. The ACCELEWRITER is a small molded module which plugs into the printer's logic board.

The ACCELEWRITER enables the Decwriter to print at its "catch-up" speed of 60 CPS all of the time. You must be able to program fill characters into the data stream after carriage returns.

Easy installation and easy reconnection, if ever desired. Compatible with standard Decwriter option boards. Full one-year warranty. Only \$115.00.

Please write or phone.  
Illinois residents add 5% sales tax.

Available NOW from

**LARKS ELECTRONICS & DATA**  
P. O. Box 22  
Skokie, Illinois 60077  
(312) 677-6080

Circle 205 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  
\$8.50 EACH/MIN. QTY. 8

### 4K STATIC RAMS

EQUIV. TO TMS40144-30  
300NSEC ACCESS TIME/  
CYCLE TIME FOR 4MHZ  
Z-80 OPERATION.  
\$7.50 EACH/MIN. QTY. 8  
TESTED & GUARANTEED

### QUANTITY DISCOUNTS AVAILABLE

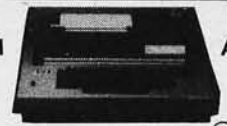
ALL ORDERS POSTPAID. U.S. FUNDS. CHECK OR MONEY  
ORDER. VISA, BA, MASTERCARD — SEND ACCOUNT NO.,  
EXPIRATION DATE, INTERBANK NO., & SIGNED ORDER.  
PHONE ORDERS: 714/633-4460

MEASUREMENT SYSTEMS & CONTROLS, INC.  
MEMORY DEVICES DIVISION, DEPT. B3  
867 NORTH MAIN ST., ORANGE, CA 92668

Circle 216 on inquiry card.

## SURPLUS ELECTRONICS

ASCII



ASCII

## IBM ELECTRIC 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

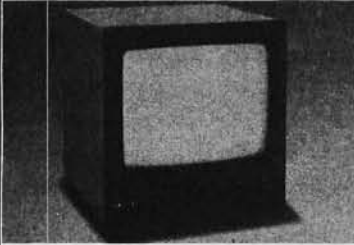
**WORLDWIDE ELECT. INC.**  
130 NORTHEASTERN BLVD.  
NASHUA, N.H. 03060

Phone orders accepted using VISA  
or MC. Toll Free 1-800-258-1036  
In N.H. 603-889-7661

Circle 395 on inquiry card.

## 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



Dakota City,  
NE. 68731

Circle 19 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, Computaker, Heuristics,  
Mountain Hardware, Summagraphics,

## MICRO MART

Microcomputers, Peripherals  
and Software

1015 NAVARRO SAN ANTONIO, TEXAS 78205  
512/222-1427

Circle 221 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 ship-  
ments.

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.

## SUPPLIES



- FLOPPY DISKS, MINI OR  
STANDARD MEMOREX OR 3M
- 3M DATA CARTRIDGES  
DC300A, DC100A
- 3M DIGITAL CASSETTES
- 3M OR MEMOREX AUDIO  
CASSETTES, C-60
- 3M DISK CARTRIDGES

### WE OFFER:

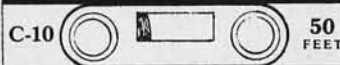
- COMPETITIVE PRICING
- IMMEDIATE DELIVERIES  
(Any Quantity)
- UNCONDITIONAL GUARANTEE

BETA BUSINESS SYSTEMS

8369 VICKERS ST., #G  
SAN DIEGO, CA 92111  
(714) 565-4505

Circle 23 on inquiry card.

## SHORT CASSETTES



List \$2.00 10 for \$7.50 50 for \$32.50

MICROSETTE CO.

777 Palomar Ave. • Sunnyvale, CA 94086

### Duplication Services

Microsette also offers professional  
duplication services for Commo-  
dore 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 ship-  
ping. Prices start at \$2.00 each in  
100 quantity.

MICROSETTE CO.

777 Palomar Ave. • Sunnyvale, CA 94086

Circle 229 on inquiry card.

## 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 address-  
able 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 6½% tax.



Advanced Memory Technology  
480 Mercury Drive, Sunnyvale, CA  
(408) 736-3864 94086

Circle 4 on inquiry card.



# MORE BRAIN FOR YOUR BUCK

COMPUCOLOR	1495.00
HORIZON-I	1395.00
SOROC IQ120	795.00
<b>SD SALES KITS</b>	
16K MEM	250.00
32K MEM	365.00
64K MEM	615.00
NEW-VIDEO BD	250.00
Z80 STARTER SET	225.00
VERSAFLOPPY	159.00
SBC-100	225.00
<b>SHUGART DRIVES</b>	
SA-400	305.00
SA-800	490.00

CROMEMCO
DYNABYTE
EXTENSYS
INDUST. MICRO
NORTHSTAR
SEALS
VECTOR GRAPHIC
TEI
MICROPOLIS
TARBELL
T.I.
IMSAI
EXIDY
NEC
QUME

D.E.C.
AXIOM
HAZELTINE
BALLY
CENTRONICS
DIABLO
RADIO SHACK

**MAIL ORDER ONLY**  
 SEND 50¢ FOR OUR  
**CATALOG & PRICES**  
 TO ORDER SEND  
 CHECK OR M.O. add  
 1% for shipping  
 Calif. res add 6% tax

AD P ICE GOOD TILL MAY 31,1979

## HOLLYWOOD SYSTEMS

9100 Sunset blvd.  
 suite 112  
 L.A. CALIF. 90069

### BECKIAN ENTERPRISES



All Prime Quality — New Parts Only  
 Satisfaction Guaranteed

**EDGE CARD CONNECTORS: GOLD PLATED.** (Not Gold Flash)  
 BODY: Non brittle, Solvent res., G.E. Valox.  
 CONTACTS: Bifurcated; Phos/Bronze: Gold over Nickel.  
 ABBREVIATIONS: S/T Solder Tail; S/E Sold. Eyelet;  
 W/W Wire Wrap 3; SW/W Short W/Wrap;

PART #	Description	Row Sp.	1-4	5-9	10-24
5010	50/100 S/T ALTAIR	.140	3.75	3.50	3.30
5020	50/100 S/T IMSAI	.250	3.95	3.75	3.50
5030	50/100 W/W IMSAI	.250	4.10	3.90	3.70
5040	50/100 S/E ALT/IMSAI	.140	5.00	4.50	4.25
5050	50/100 S/T CROMEMCO	.250	6.25	6.00	5.75
1450	IMSAI CARD GUIDES		0.16	0.14	0.12

**.100" Contact Center Connectors.**

1020	13/26 S/E Imsai MIO:	.140	2.10	1.85	1.75
1040	25/50 S/E	.140	2.95	2.75	2.50
1050	25/50 S/T	.140	3.00	2.80	2.60
1060	36/72 W/W Vector.	.200	4.80	4.60	4.30
1065	36/72 S/T Vector.	.200	4.00	3.75	3.50
1070	40/80 S/E PET	.140	4.80	4.50	4.30
1075	40/80 W/W PET	.200	5.00	4.65	4.35
1080	40/80 S/T PET	.140	4.90	4.60	4.25
1085	43/85 S/E Cos.ELF	.140	5.00	4.75	4.50
1090	43/86 S/T Cos.ELF	.140	5.10	4.85	4.60
1093	43/86 S/T Cos.ELF	.200	4.95	4.70	4.45
1095	43/86 W/W Cos.ELF	.200	5.50	5.20	4.90
	POLARIZING KEYS: For Above		0.10	0.10	0.10

**.156" Contact Center Connectors.**

1550	6/- S/E PET,Etc	.140	1.30	1.10	0.90
1560	6/12 S/T PET:N.S.C.	.140	1.35	1.15	0.95
1575	12/24 S/E PET	.140	2.15	1.95	1.75
1580	12/24 S/T PET	.140	2.10	1.90	1.70
1590	15/30 S/E GRI Keybd.	.140	2.25	2.05	1.85
1620	18/36 S/E	.140	2.40	2.20	2.00
1650	22/44 S/E KIM,VECTOR	.140	2.20	2.00	1.80
1660	22/44 S/T KIM,VECTOR	.140	2.00	1.80	1.70
1670	22/44 W/W KIM,VECTOR	.200	2.40	2.20	2.00
1690	36/72 W/W	.200	3.90	3.75	3.50
1710	36/72 S/E	.140	3.50	3.30	3.10
1720	36/72 S/T	.200	3.30	3.10	2.90
1730	43/86 S/T Mot. 6800	.140	4.40	4.15	3.90
1740	43/86 S/T Mot. 6800	.200	4.35	4.10	3.85
1750	43/86 W/W Mot. 6800	.200	4.45	4.25	4.10
	POLARIZING KEYS: For Above		0.10	0.10	0.10

**RS232 & 'D' TYPE SUBMINIATURE CONNECTORS:**

QUANTITY	1-4	5-9	10-24
DE9P Male	1.45	1.35	1.25
DE9S Female	1.93	1.80	1.70
DE110963-1	2pc. Grey Hood	1.20	1.10
DA15P Male	1.95	1.80	1.70
DA15S Female	2.80	2.60	2.40
DA51211-1	1pc. Grey Hood	1.25	1.15
DA110963-2	2pc. Grey Hood	1.22	1.10
DB25P Male	2.20	2.10	1.90
DB25S Female	3.20	3.00	2.70
DB51212-1	1pc. Grey Hood	1.30	1.20
DB51226-1A	2pc. Black Hood	1.40	1.30
DB110963-3	2pc. Grey Hood	1.35	1.25
DC37P Male	3.70	3.50	3.35
DC37S Female	4.90	4.70	4.40
DC110963-4	2pc. Grey Hood	1.95	1.85
DD50P Male	4.40	4.30	4.10
DD50S Female	4.90	4.70	4.50
DD51216-1	1pc. Grey Hood	2.30	2.10
DD110963-5	2pc. Grey Hood.	2.40	2.20
D20418-2 Hardware Sets	0.75	0.70	0.65

**I.C. SOCKETS, GOLD.**  
**WIRE WRAP 3 TURN.**  
 14 pin \$0.36 ea.  
 16 pin 0.38 ea.

**I.C. SOCKETS.**  
**Dip Solder. Tin.**  
 14 pin \$0.15 ea.  
 16 pin 0.17 ea.

**8080 PRIME**  
 \$8.00 ea.

**2708 EPROMS PRIME**  
 \$14.00 ea.

**CONNECTORS FOR CENTRONICS 700 SERIES:**

Amphenol 57-30360 For Back of Centronics '700' Series:  
 Price: \$9.00ea. 5 pcs. \$7.50ea.

**WHISPER FANS:** Excellent for Computer cabinet cooling. Extremely quiet.  
 Dim. 4-3/4" x 1-1/2" thick. U.L. Listed. 1-4 5-9 10-24  
 \$22.00 \$19.00 \$18.00

WRITE FOR LARGER QUANTITY DISCOUNTS. DEALER INQUIRIES ARE WELCOME.

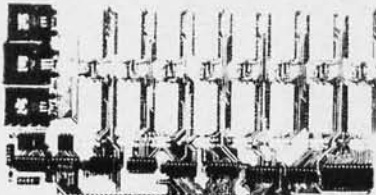
WE ARE CONNECTOR (EDGE CARD) SPECIALISTS. IF YOU DO NOT SEE WHAT YOU NEED IN THIS ADVERTISEMENT, PLEASE WRITE US. WE WILL REPLY.

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

## 16K EPROM CARD-S 100 BUSS



**\$59.95**  
KIT

OUR  
BEST  
SELLING  
KIT!

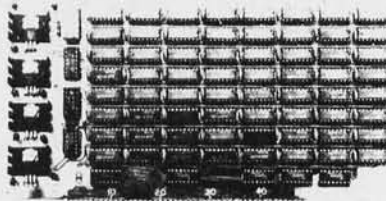
USES 2708's!

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

(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.

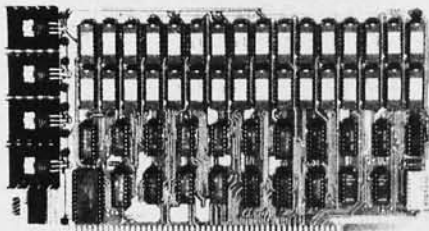
Blank PC Board w/Documentation \$29.95  
Low Profile Socket Set...13.50  
Support IC's (TTL & Regulators) \$9.75  
Bypass CAP's (Disc & Tantalums) \$4.50

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 Buss! 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.

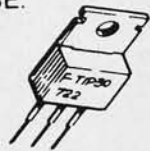
BLANK PC BOARD W/DATA—\$33

LOW PROFILE SOCKET SET—\$12  
SUPPORT IC'S & CAPS—\$19.95

ASSEMBLED & TESTED—ADD \$30  
2114 RAM'S—8 FOR \$69.95

## COMPLEMENTARY POWER TRANSISTORS

SILICON NPN AND PNP. TO-220 CASE.  
VCEO - 40V PD - 30 WATTS  
FOR AUDIO POWER AMPS, ETC



TIP29 - NPN  
TIP30 - PNP

YOUR CHOICE  
**3 FOR \$1**

## 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. VERY LIMITED STOCK!

**8 FOR \$89.95**

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

### NEW! CAR CLOCK MODULE - #MA6008

**\$6.99**  
each

Originally used by HYGAIN to indicate time and channel on an expensive C.B. Mini size, self contained module. Not a Kit. Four digits plus flashing indicator for seconds. Includes MM5369 and 3.58 MHZ crystal for super accurate time base. With hookup data.

INCLUDES CRYSTAL TIMEBASE!  
WORKS ON 12 VDC!

MFGR'S CLOSEOUT  
LIMITED QTY.

### 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**

GENERAL INSTRUMENT  
FULL WAVE BRIDGE  
4 AMP 600 PIV

3/4 IN SQUARE - WITH LUGS

**75¢ ea. 3 FOR \$2**

LOOK!

#LM-1

## LAB-BENCH VARIABLE POWER SUPPLY KIT

5 to 20 VDC at 1. AMP. Short circuit protected by current limit. Uses IC regulator and 10 AMP Power Darlington. Very good regulation and low ripple. Kit includes PC Board, all parts, large heatsink and shielded transformer. 50 MV. TYP. Regulation. **\$15.99 KIT**

## MALLORY COMPUTER

### GRADE CAPACITOR

30,000 MFD 15 WVDC

Small: 3 x 2 Inches

**\$1.99 ea. 3 For \$4.99**

New! REAL TIME  
Computer Clock Chip  
N.S. MM5313. Features  
BOTH 7 segment and  
BCD outputs. 28 Pin  
DIP. **\$4.95 with Data**

### "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! YOUR CHOICE

FND 843 Common Anode **\$1.49 ea**  
FND 850 Common Cathode **(8 for \$6.95)**

## Digital Research Corporation

(OF TEXAS)

P.O. BOX 401247 • 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)





## 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 1/2". "C" cell battery not included.

Trans-Check \$29.95 ea.

## Custom Cables & Jumpers



Part No.	Cable Length	Connectors	Price
DB25P-4-P	4 Ft.	2-DP25P	\$15.95 ea.
DB25P-4-S	4 Ft.	1-DP25P/1-25S	\$16.95 ea.
DB25S-4-S	4 Ft.	2-DP25S	\$17.95 ea.

Dip Jumpers			
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

2x2cm

- 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

## REMOTE CONTROL TRANSMITTER & RECEIVER



Can be used as remote control for TV, VCR, STEREO, etc. Includes 4 AA batteries. Transmitter uses a 1.5V battery. #RMT-100 \$19.95

## 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

8084/8085 SUPPORT DEVICES		MICROPROCESSOR MANUALS	
8084A 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 8-Directional Bus Driver	3.49		
8224 Clock Generator/Driver	3.95		
8226 Bus Driver	3.49		
8228 System Controller/Bus Driver	5.95		
8238 System Controller	5.95		
8251 Prog. Comm. I/O (USART)	7.95		
8253 Prog. Interval Timer	14.95		
8255 Prog. Periph. I/O (PPI)	9.95		
8257 Prog. DMA Control	19.95		
8259 Prog. Interrupt Control	19.95		

8080/8080 SUPPORT DEVICES		MICROPROCESSOR MANUALS	
MC6800 MPU with Clock and Ram	\$14.95	2513/2140 Character Generator (upper case)	\$9.95
MC68102P 128X8 Static Ram	5.95	2513/3021 Character Generator (lower case)	9.95
MC6821 Periph. Inter. Adapt (MC6820)	7.49	2516 Character Generator	10.95
MC6826 Priority Interrupt Controller	12.95	MM5230N 2048-Bit Read Only Memory	1.95
MC6830B 128X8 Bit ROM (MC6830-B)	14.95		
MC6850 Asynchronous Comm. Adapter	7.95		
MC6852 Synchronous Serial Data Adapt.	9.95		
MC6860 0-600 bps Digital MODEM	12.95		
MC6862 2400 bps Modulator	14.95		
MC6880A Quad 3-State Bus Trans. (MC820)	2.25		

MICROPROCESSOR CHIPS—MISCELLANEOUS		MICROPROCESSOR MANUALS	
Z800(780C) CPU	\$19.95	2101(8101) 256X4 Static	\$1.49
Z80A(780-1) CPU	24.95	1103 1024X1 Dynamic	.99
CDP1802 CPU	19.95	256X4 Static	3.95
2850 MPU	19.95	2102 1024X1 Static	1.75
8005 8-Bit MPU w/clock, RAM, I/O lines	19.95	2102 1024X1 Static	1.95
8005 CPU	19.95	2111 212 256X4 Static	4.95
TMS9900L 16-Bit MPU w/hardware, multiply & divide	49.95	2112 256X4 Static MOS	4.95
		2114 1024X4 Static 450ns	9.95
		2114-3 1024X4 Static 450ns low power	10.95
		2114-3 1024X4 Static 300ns low power	11.95
		5101 256X4 Static	7.95
		5280/2107 4096X1 Dynamic	4.95
		745200 256X1 Static Tristate	4.95
		93421 256X1 Static	2.95
		UPD414 4K Dynamic 16 pin	4.95
		TMS4027 16K Dynamic 16 pin	14.95
		MS4016 16K Dynamic 16 pin	14.95
		TMS4044 4K Static	14.95
		49N 49N 1024X4 Static	14.95
		TMS4045 16,384X1 Dynamic 350ns (house marked)	9.95
		2117 16,384X1 Dynamic	41/00

SHIFT REGISTERS		MICROPROCESSOR MANUALS	
MM520H Dual 25 Bit Dynamic	\$5.50	MS262 20X1 Dynamic	41/00
MM520H Dual 50 Bit Dynamic	5.50		
MM504H Dual 16 Bit Static	3.95		
MM506H Dual 100 Bit Static	.50		
MM510H Dual 64 Bit Accumulator	.50		
MM5010H 520512 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	.99		
2525 1024 Dynamic	2.95		
2527 Dual 256 Bit Static	2.95		
2528 Dual 250 Static	4.00		
2529 Dual 240 Bit Static	4.00		
2532 Quad 80 Bit Static	2.95		
2533 1024 Static	2.95		
3341 Flo	6.95		
74LS760 4X4 Register File (TriState)	1.95		

UART'S		MICROPROCESSOR MANUALS	
A-Y-5-1013 30K BAUD	5.95	7485 1024X4 Static	2.95
		74828T 1024 Static	2.95

## CONTINENTAL SPECIALTIES PROTO BOARDS

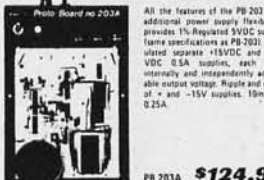
### Proto Board 203



A total ready-to-use power board with a built-in regulated, short-circuit proof power supply. Just plug in or start building! 2 extra floating 5-way binding posts for external logic. Self-tapped with power switch indicator lamp and power fuse. 24 1/2 pin DIP sockets. Active two-tone quality test. All metal construction. 9 1/2" x 6 1/2" x 2 1/2" 5 lbs.

Model Number L x W x H (Inches) Price  
 PB-6 6.0 x 4.5 x 1.4 \$15.95  
 PB-10 6.0 x 4.5 x 1.4 \$19.95  
 PB-101 6.0 x 4.5 x 1.4 \$22.95

### Proto Board 203A



All the features of the PB 203 plus additional power supply flexibility, provides 1% regulated 5VDC supply (same specifications as PB-203). Regulated separate +15VDC and -15VDC 0.5A supplies, each with internally and independently adjustable output voltage. Ripple and noise of + and -15V supplies, 10mV at 0.25A.

Model Number L x W x H (Inches) Price  
 PB-102 7.0 x 4.5 x 1.4 \$26.95  
 PB-103 9.0 x 6.0 x 1.4 \$44.95  
 PB-104 9.8 x 8.0 x 1.4 \$54.95

### BK PRECISION 3 1/2-Digit Portable DMM



Overload Protected  
 3 High LED Display  
 Battery or AC operation  
 Auto Zeroing  
 10mV 100 Ohm resolution  
 Overrange reading  
 10 meg input impedance  
 DC Accuracy 1% typical  
 Ranges: DC Voltage: 0-1000V AC Voltage: 0-1000V  
 Freq Response 50-400 Hz  
 DC/AC Current: 0-100mA  
 Resistance: 0-10 meg ohm  
 Size: 6 1/2" x 4 1/2" x 2 1/2"

Model 2800 \$99.95

### 100 MHz 8-Digit Counter



20 Hz-100 MHz Range  
 6 LED Display  
 Crystal-controlled timescale  
 Fully Automatic  
 Portable — completely self-contained  
 Size — 1.75" x 7.38" x 5.63"

Four power sources, i.e. batteries, 110 or 220V with charger 12V with auto lighter adapter and external 7.2-10V power supply

MAX-100 \$134.95

### Mini-Max 6 Digit 50MHz Frequency Counter

Guaranteed frequency range of 100 Hz to 50 MHz  
 Full 6 digit display with anti-gate 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 over-voltage protection.  
 Use 9V Battery or 110/220V power.  
 Complete with mini antenna.  
 Lightweight — Only Box.

MINI-MAX \$89.95

Accessories For Mini-Max

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

\$10.00 Minimum Order — U.S. Funds Only  
 California Residents — Add 6% Sales Tax

Spec Sheets — 25¢  
 1979 Catalog Available—Send 41¢ stamp

NEW 1979 Catalog

**Jameco ELECTRONICS**  
 a division of JAMES ELECTRONICS of California

MAIL ORDER ELECTRONICS — WORLDWIDE  
 1021 HOWARD AVENUE, SAN CARLOS, CA 94070  
 ADVERTISED PRICES GOOD THRU APRIL

PHONE ORDERS WELCOME  
 (415) 592-8097

## 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 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, 225 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 mounted 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**  
 (Case and 6 Cassettes)

## SUP 'R' MOD II

UHF Channel 33 TV Interface Unit  
 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**

## CASSETTE CONTROLLER

Ideal for use with the TRS 80 and others.  
 \* Plug/Jack interface to any computer system requiring remote control of cassette functions.  
 The CC100 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.

**#CC-100 \$29.50**

## 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 **\$29.95/each**

**Hexadecimal Unencoded Keypad**

19-key pad includes 1-10 keys, ABCDEF and 2 optional keys and a shift key. **\$10.95/each**



### Software Patch for SwTPC 8 K BASIC Adds Disk Data File Capability

A software patch that adds disk data file commands and functions to SwTPC's 8 K byte BASIC has been announced by PerCom Data Company Inc, 4021 Windsor, Garfand TX 75042. SwTPC 8 K byte BASIC is for microcomputers that use the 6800 processor.

The software patch is overlaid after 8 K byte BASIC has been loaded in memory. This may be done either manually or from a PerCom disk which includes the patch and a loader program. The modified BASIC takes up 10 K bytes of memory. The patch permits up to four data files to be active concurrently and files may be formatted and updated in place. Formatted files may be accessed randomly.

In addition to OPEN, CLOSE, LOAD and SAVE commands, the program features special instructions that simplify data manipulation. The software patch includes nine commands and functions.

A listing of the patch program and user instruction manual sells for \$10. A listing, manual and disk recording of the patch and patch loader sells for \$15. ■

Circle 593 on inquiry card.

### 6800 Compiler

Written in 6800 assembly language, this 3 pass compiler (on floppy disk) provides a disk based high level language for microcomputers with at least 16 K bytes of programmable memory. The new language, called STRUBAL (Structured Basic Language), features fully relocatable and linkable code. Versions of the compiler are available for iCOM FDOS-II, Smoke Signal Broadcasting DOS68 and SwTPC Flex.

The software supports a full set of scientific functions, one-dimensional and two-dimensional arrays, three data types (16 bit integer, 10 digit floating point and variable length strings), structured programming forms, string functions, embedded assembly language in the source program and common and dummy sections. Line numbers are not required in source programs. Subroutines may be separately compiled or assembled and called by named parameters.

The price of STRUBAL is \$99.95, which includes a user's manual. For further information contact Hemenway Associates Inc, 151 Tremont St, Suite 8P, Boston MA 02111. ■

Circle 594 on inquiry card.

### Software Package for 8080 and Z-80 Microcomputers

The SOS (single user operating system) package provides the user with a step between the Opus stand-alone high level languages and the Tempos multiuser/multitasking operating system. The SOS package includes: Opus/Three, the high level compiler/interpreter from ASI; Texted, an easy to use, line oriented text editor; Assembl, an 8080 assembler; Files, a diskette file manipulator; and Utilities 1, a package of 12 utilities programs.

Full upward compatibility has been retained to allow the user of SOS to access data and programs developed at lower levels; all may be used under the TEMPOS operating system as well. All floppy disks and serial device input/output (IO) is handled by SOS; a system generation routine lets the user define IO drivers as required.

The recommended hardware configuration includes an 8080 or Z-80 processor, 32 K bytes of programmable memory, one or two floppy disk drives, and terminals as required. The system typically resides in less than 10 K bytes of programmable memory.

The package is priced at \$385 and the user's manual set may be purchased separately for \$20, which is credited toward purchase of the SOS package. For more information contact Administrative Systems Inc, 222 Milwaukee, Suite 102, Denver CO 80206. ■

Circle 597 on inquiry card.

### 6502 Assembler in BASIC



The 6502 Assembler in BASIC lets you write programs in assembly language for the 6502 microprocessor and have them translated to machine language for direct execution on the PET. The assembler accepts all standard 6502 instruction mnemonics, pseudo-ops and addressing modes, and evaluates binary, octal, hexadecimal and character constants, symbols and expressions. Source programs can be read from cassette and object programs can be assembled anywhere in memory. The package includes both 1 and 2 pass versions of the assembler, a text editor and a disassembler, and a 30 page manual with PET machine language programming hints, for \$24.95. It is available from Personal Software, POB 136, Cambridge MA 02138. ■

Circle 595 on inquiry card.

### Heurikon Introduces BASIC and Disk Operating System

The Heurikon Corp, 700 W Badger Rd, Madison WI 53713, has announced the addition of Heurikon BASIC and disk operating system (DOS) to its line of MLZ-80 microcomputer products. Heurikon BASIC and DOS is a multilevel system offering two levels of concurrent operation and a disk operating system with file management. The system provides both edit and real time program areas which run concurrently. Real time programs run independently from the keyboard and program editing functions. A real time program is given highest operating priority and may be started automatically in response to external stimuli. Edit area programs will be interrupted to service real time operations. When the real time program completes a task, control is returned to the interrupted point in the edit program. New programs may be developed and tested in edit while the real time program continues to monitor external events. Heurikon BASIC and DOS file management architecture allows any number of variable length files to be cataloged on the disk.

This system is available configured to run on the Heurikon MLZ-80 microcomputer system, which is fully compatible with Intel's SBC Multibus. It can be provided on disk or in erasable programmable read only memory. ■

Circle 596 on inquiry card.

### Language Family Designed for Z-80 Computers

Designated PLZ, this family of system programming languages is implemented as a set of disk based programs that run in the RIO operating system of Zilog's Z-80 computers. Linkage to other languages such as BASIC, COBOL and FORTRAN is straightforward. PLZ permits a systematic combination of high level machine-independent modules with low level machine-dependent modules within the same program.

The high level modules utilize the procedure oriented PLZ/SYS language. PLZ/SYS blends elements of such languages as Pascal, ALGOL, PL/I, and C to provide a medium for expressing algorithms in a high level, structured fashion. PLZ/SYS requires minimal run time support.

A structured assembly language, PLZ/ASM, provides all of the low level programming capabilities necessary for the user to manage such processor resources as registers, memory, accesses and input/output (IO) operations.

Initial PLZ program implementation consists of the PLZ/SYS compiler, PLZCG code generator, Zinterp interpreter, Plink linker, PLZ/ASM translation filter, and PLZ IO package.

For more information contact Zilog, 10340 Bubb Rd, Cupertino CA 95014. ■

Circle 598 on inquiry card.

# 10-DAY FREE TRIAL

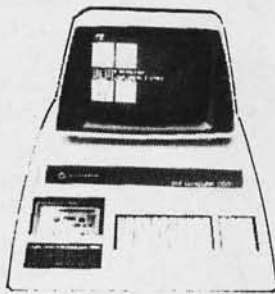
Send for our  
**FREE Catalog**

**SPECIAL SALE!**

**\$750**

**PET**  
**\$795**

- 14K ROM, 8K RAM
- Fast Microsoft BASIC
- Integral Tape & CRT
- Graphics & Lower case
- Real-time clock
- IEEE and Parallel I/O



The most computer value you can buy in a single box, the PET is a complete system. It's our most popular computer.

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
- Edu-BASIC cassette included
- 8080 Microprocessor
- 8K RAM 2K ROM

If you can't decide between a sophisticated video 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.



**MICROSOFT FREE BASIC**

For a limited time, we are offering Interact's new floating point BASIC by Microsoft free with the purchase of a 16K Interact Model 1. This saves you \$49.95 and gives you the most BASIC programming power available in a computer this size. Offer good for orders received before April 31, 1978. Please mention this ad when ordering.

**THE PET CONNECTION**

**SECOND CASSETTE FOR PET \$95**  
This peripheral from Commodore gives you the ability to use one tape deck for input and one for output to copy files, update records, etc.

- Beeper — PET controlled Deep Petunia — Play music from your PET Video Buffer — Output for second monitor Combo — Petunia Video Buffer combined \$49.95

- RS-232 Modem Interfaces for PET
- Originate Answerback DAA Modem \$320
- Dual Port RS-232 Bidirectional Interface \$280
- Single Port RS-232 Bidirectional Interface \$240
- Cabinet for above interfaces \$35
- Serial Printer Interface with case (output only) \$169

**EXIDY SORCERER**  
for \$895

- Z-80 Processor
- Full-size ASCII keyboard
- User definable characters
- Up to 32K on-board RAM
- Interchangeable ROM PACs
- 30 x 64 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 Z-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 \$1295  
16K Expansion \$299

**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



**Hazeltine 1400**

**IN STOCK NOW Only \$699.00**

Now a 5th Generation in Terminals: Immediate Delivery

- Hazeltine 1500 full of features \$1049
  - Hazeltine 1510 with buffer logic \$1149
  - Hazeltine 1520 with printer interface \$1499
- call or write for more information

**SPECIAL OF THE MONTH**

**IN STOCK NOW! \$675.00**

**32K PET**

With the trade-in of your working PET.

\$1,195.00 otherwise

**SYM-1**  
From Synertek \$269.00

- 28 Double function keys including up to 24 Special functions
- Easy-to-view 8 digit LED display
- KIM-1 hardware compatibility
- 5002 based system
- 4K byte ROM resident monitor and operating system
- Sample & hold power
- 1K bytes of 2114 static RAM for memory expansion for immediate expansion to 4K bytes
- Enhanced software
- Standard interfaces include: Audio Cassette Recorder interface with Remote Control; Full Duplex 70mA Teletype Interface; System Expansion Kit Interface; TV Computer Board Interface; CRT Compatible Interface
- 50 I/O lines in the basic system

**NOW IN STOCK — SYM BASIC \$159**

**Datel/Selectric Table-top Terminals**

- Local remote or wall switch operation
- Complete computer terminal functions
- Remote interrogation at terminal station
- Internal and remote bus interface: RS-232C, RS-400, RS-422

**\$395 \$295 \$695 \$495**  
AS IS WORKING

**CompuColor II**

- 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.

Model 3 8K RAM \$1,495.  
Model 4 16K RAM \$1,795.  
Model 5 32K RAM \$1,995.

**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 Editor for TTY, 2 cassette; 2 & 8 bit I/O ports; Expansion Conn. (try our KIMSI S-100 board)
- Both connectors totally KIM-1 compatible
- Easy Power connections \$375

Options — 4K ROM Assembler/Text Editor \$K Basic ROM

**KIM-1**  
The original fully expandable single board computer

**SALE Assembled \$169.95**  
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
- 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.

**SALE \$285 SANYO MONITOR**  
VM4209 9" quality monitor \$169

**Single board VIDEO TERMINAL by XITEK**

- 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**

**NCE/CompuMart, Inc.**

1250 North Main Street, Department BY49  
P.O. Box 8610 Ann Arbor, Michigan 48107

**10 DAY RETURN PRIVILEGE**

**(313) 994-3200**

Just say charge it! Which card?



**SUPER SALE** List \$279.95 **\$189.95**  
**S-100 MPA**  
S-100 MPA gives your PET complete control of the S-100 bus (even DMA). Get an assembled unit at kit price.

- 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)



# 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.

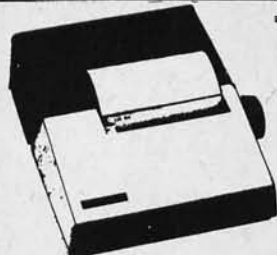
**SA801R** \$495.00  
by Shugart Single-sided 8" floppy disk drive.

**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 (S100)
  - 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**



## TRENDCOM 100 Intelligent Printer

**\$345**

Interface & Cable for TRS-80  
**\$45.00**

Interface & Cable for Apple  
**\$60.00**

- 40 character per second rate
- Low cost thermal paper
- 96 character set
- Microprocessor controlled
- Bidirectional look-ahead printing
- Quiet operation
- No external power supplies
- Only two driven parts
- High reliability
- Clear 5 x 7 characters
- Attractive metal and plastic case

## EXPANDOR'S BLACK BOX PRINTER

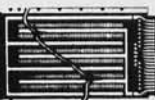
This 64-character ASCII impact printer with 80-column capability is portable and uses standard 8 1/2" paper and regular typewriter ribbon. Base, cover and parallel interface are included. Assembled and complete with manual and documentation.

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, +8v/1 amp power supply required.)

**Power Supply for TRS-80/Black Box Printer** \$49.00



## 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 str. \$12.00  
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

## 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 \$49.95

**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

Soldertail \$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 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

## 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**

## 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	13.46	11.96



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

**\$139.00**

**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
<b>8080A SUPPORT DEVICES</b>	
8212	\$ 2.90
8214	\$ 4.65
8216	\$ 2.75
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
<b>USRT</b>	
S2350	\$10.95
<b>UARTS</b>	
AY5-1013A	\$ 5.25
AY5-1014A	\$ 8.25
TR1602B	\$ 5.25
TMS6011	\$ 5.95
IM6403	\$ 9.00
<b>BAUD RATE GENERATORS</b>	
MC14411	\$10.00
14411 Crystal	\$ 4.95
<b>6800 PRODUCT</b>	
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
<b>CHARACTER GENERATORS</b>	
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
<b>PROMS</b>	
1702A	\$ 8.00
2708	\$ 9.95
2716 (5+12) TI	\$60.00
2716 (5v) INTEL	\$60.00
2758 (5v)	\$23.40
<b>DYNAMIC RAMS</b>	
416D/4116 (200ns)	\$12.50
2104/4096	\$ 4.00
2107B-4	\$ 3.95
TMS4027/4096 (300ns)	\$ 4.00
<b>STATIC RAMS</b>	
21L02 (450ns)	1-15 \$ 1.20
21L02 (250ns)	\$ 1.75
2101-1	\$ 2.95
2111-1	\$ 3.25
2112-1	\$ 2.95
<b>FLOPPY DISK CONTROLLERS</b>	
1771B01	\$39.95
1791	\$49.95
<b>KEYBOARD CHIPS</b>	
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)

<b>2MHz</b>	
Kit	\$135.00
Assembled & Tested	\$185.00
<b>4 MHz</b>	
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

The Piggy™ is here!



**SEE OUR COLOR AD IN APRIL'S BYTE**

## TEXTTOOL ZIP\*

DIP® II  
Sockets

\*ZERO INSERTION FORCE sockets

<b>PRICES:</b>	
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" 3  
HAWTHORNE, CALIFORNIA 90250  
U.S.A.

Telephone:  
(213) 679-3313  
(800) 421-5809 Continental U.S.  
(800) 262-1710 Inside California



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.

## Jade Memory Expansion Kits for TRS-80 and Apple!

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	32K	\$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:

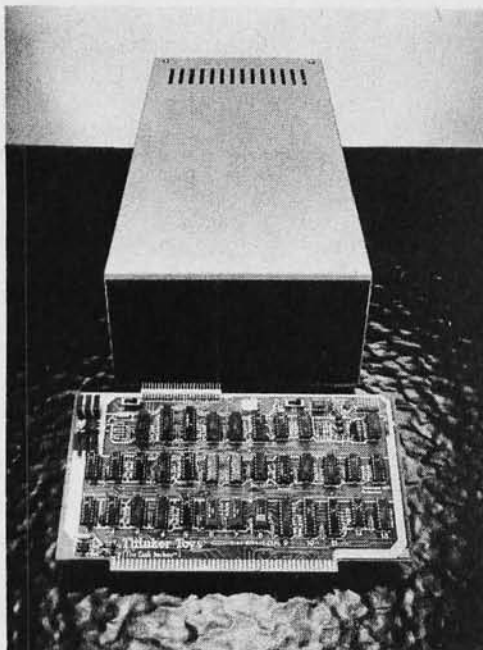
250ns \$795.00

450ns \$725.00

250ns Kit \$575.00



### Full Size Floppy Disk Memory Completely Assembled



Discus I is a full-size floppy disk memory for S-100 systems using the 8080 processor. The Discus I is sold as a complete system, assembled and tested, with all required hardware and software. Hardware included in the Discus I system includes a Shugart 800R full-size disk drive fully mounted in a custom, all metal cabinet with an independent power supply; a Disk Jockey I S-100 controller with a capacity for seven additional disk drives; and all necessary cables and connectors.

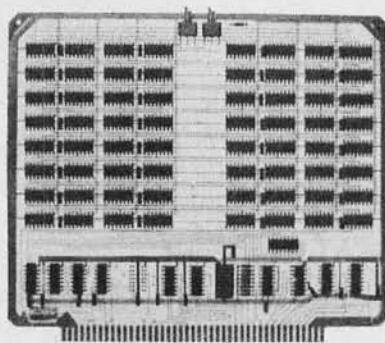
The controller offers an on board serial input and output (IO) port to which all system software has been interfaced. The IO routines can then be modified with the included system software at the user's convenience.

Software included features an integrated Disk/Ate system containing most utilities: disk operating system, file management, system debugger, text editor, batch processor and 8080 assembler. Also included is BASIC-V, a virtual disk BASIC with the ability to address up to 2 M bytes, and to accommodate a wide variety of data types including string-oriented arrays with an unlimited number of dimensions. Also included are patches for CP/M.

The Discus I system sells for \$995 plus tax and handling. For users wishing to supplement the Discus I software, several extra cost options are available. CP/M for Digital Research is available for \$70. Microsoft Extended Disk BASIC for \$199 and Disk FORTRAN for \$349 are also available. For further information, contact Thinker Toys, 1201 10th St, Berkeley CA 94710. ■

Circle 632 on inquiry card.

### Programmable Memory Board for M6800



The SME6808 is an 8 K byte by 8 bit low power static programmable memory board for microcomputer systems which utilize the M6800 bus structure. The fully assembled and tested memory board operates from a single 5 V power supply and is available in versions with either 250 ns or 500 ns access time.

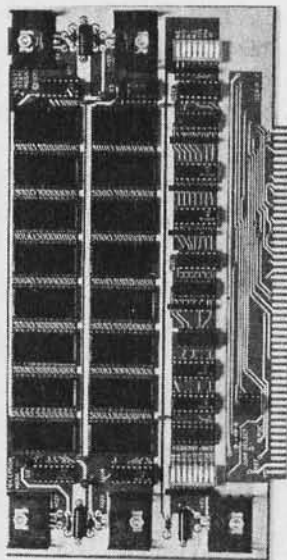
The module is organized as two 4 K byte arrays which can be independently located at any 4 K byte boundary in the 64 K byte addressing range of the system. Base address selection for each array is made via on board jumpers. Switches provided on the board allow selection of a read only mode of operation for each of the 4 K byte arrays. This permits the user to simulate read only memory for software development applications, or to protect data from being overwritten during program execution.

Slow memory circuitry can be provided with the SME6808 module. This option permits the 500 ns board to be used in applications with high speed processors or protects investments in memory as high speed processors are added to existing systems.

The price of the 500 ns board is \$324.95; the 250 ns version sells for \$399.95. Slow memory circuitry is available for either version at an additional cost of \$10. Ultra low power modules are also available. Contact American Technologies, POB 23001, Rochester NY 14692. ■

Circle 633 on inquiry card.

### Memory Board with Vector Jump



The MB-8A memory board, which uses 2708 erasable read only memories, is fully buffered, has reverse voltage protection, and includes vector jump capabilities which enable the user to jump to any 256 bit location on the board.

Features of the new board include magic mapping, which automatically disables any socket with no read only memory installed, allowing the use of additional programmable memory. The board does not require the use of a front panel. Just reset and go. The MB-8A is plug compatible with all S-100 bus mainframes and has dual-in-line package (DIP) switch selection of eight wait states.

The price of the MB-8A is \$95 from SSM, 2116 Walsh Av, Santa Clara CA 95050. ■

Circle 634 on inquiry card.

### Memory Board for S-100 Bus

PCE Electronics has announced the 16/4+1 erasable read only memory and programmable memory board for the S-100 bus. This board features accommodations for up to 16 2708 1 K word by 8 bit erasable read only memory integrated circuits, addressable in four separate 4 K byte blocks. Any block may be addressed on any 4 K byte boundary in memory and any of the 16 erasable read only memory sockets may be disabled. The erasable read only memory section is capable of generating zero to four wait states.

The programmable memory section of the 16/4+1 utilizes eight 21L02 1 K

by 1 bit static programmable memories. The 1 K byte block of programmable memory is addressable on any 1 K byte boundary in memory. Either 250 ns or 450 ns programmable memories are available with the board.

Other features of the board include complete buffering, solder mask, silk screened component location diagram, sockets for all integrated circuits and complete documentation.

The price for the board in kit form is \$130, or \$155 for an assembled and tested board. The 250 ns programmable memory circuit is \$5. For more information contact PCE Electronics, 4782 Dewey Dr, Fair Oaks CA 95628. ■

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.

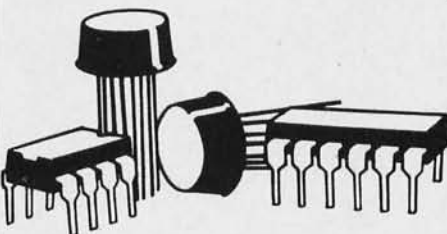
**Ithaca Audio Boards** are fully S-100 compatible, featuring gold edge connectors and plated-through holes. All boards (except the Protoboard) have fully buffered data and address lines, DIP switch addressing, solder mask and parts legend.

**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.

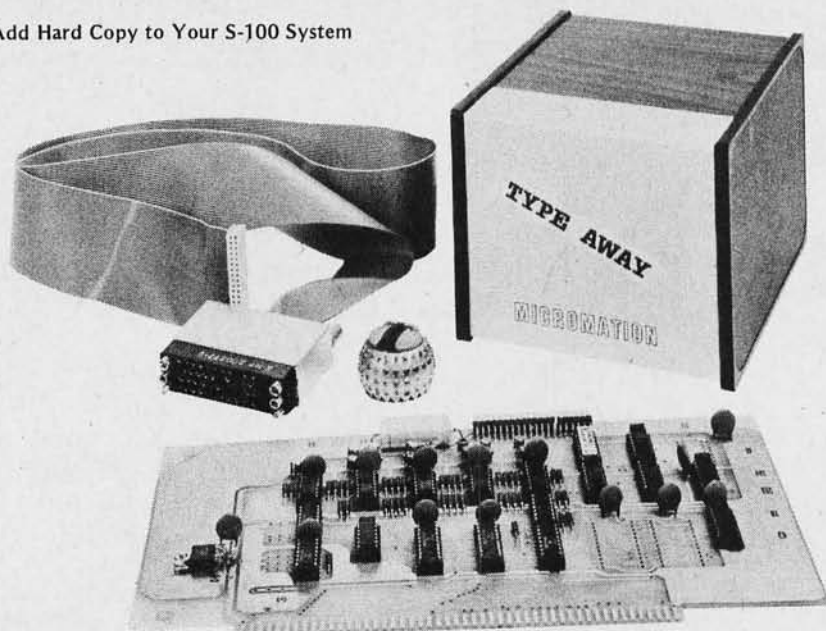
For technical assistance call or write to:

## ITHACA AUDIO

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



### Add Hard Copy to Your S-100 System



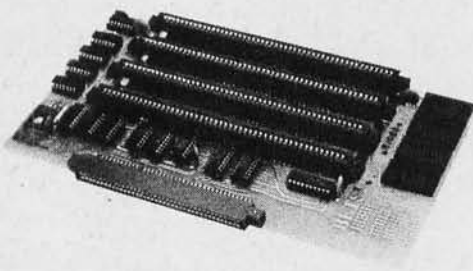
This new Selectric input and output (IO) writer interface, called Typeaway, offers an easy, economical way to add hard copy capabilities to an S-100 system. Typeaway is a complete package of everything required to interface a model 731 or 735 IO writer to an S-100 computer. The total package includes: a single S-100 compatible printed circuit board with solenoid drivers; IO ports; complete software in programmable read only memory; all the cable and connectors needed to connect a Selectric to Typeaway, including a 50 pin A connector; and a versatile DC power supply.

Typeaway can be adapted to work with any factory version of a Selectric IO writer. Software supplied in two 1702A programmable read only memories is all that is necessary to operate a Selectric IO writer as either an input or output device. All control functions and code conversions are programmed in the board's firmware.

The tested and assembled version is priced at \$350 and a kit version sells for \$275. For further information contact Micromation Inc, 524 Union St, San Francisco CA 94133. ■

Circle 570 on inquiry card.

### S-100 Expansion for Commodore's PET Computer



Forethought Products, POB 8066, Coburg OR 97401 has announced a PET to S-100 interface and motherboard named Betsi. Betsi is a single circuit board that contains all the necessary logic to interface S-100 boards to the PET.

The board attaches directly to PET's memory expansion connector and provides both interface logic and four S-100 slots on a single compact circuit board. Betsi operates with any S-100 power supply and doesn't inter-

fere with use of PET's parallel or IEEE ports.

In addition to its compatibility with most available S-100 boards, Betsi has an on board dynamic memory controller which allows it to be expanded to 32 K bytes with a single S-100 card.

The kit (which includes one S-100 connector) is priced at \$119. \$165 is the price for the assembled and tested board (which includes four S-100 connectors). ■

Circle 606 on inquiry card.

### DEC VT-52 Compatible Video

The Elite 3052A video terminal is a buffered VT-52 compatible terminal with a single page video memory. It offers formatting capability, eight levels of screen enhancements, and a detached keyboard.

The terminal displays 1920 alphanumeric characters in a 24 line, 80 character format and offers a series of features for VT-52 users that includes: an unmatched range of operating modes; host control of block transmit function in local or remote environment; communications flexibility through switch selectable EIA or 20 mA current loop interfaces; buffered support of host-to-printer data transfers; ten user function keys; 8 level video, which requires no memory address space; and 15 data transmission rates, up to 9600 bps, selectable from keyboard.

The Elite 3052A is priced at \$1700 in single quantities and \$1360 in quantities of 100. Write to Datamedia Corp, 7300 N Crescent Blvd, Pennsauken NJ 08110. ■

Circle 607 on inquiry card.



# Smart & Foxy

## Venus 2001 Video Board

Assembled and Tested \$259.95 • Complete Unit with 4K of Memory and Video Driver on Eprom assembled and tested \$339.95

kit \$199<sup>95</sup>



**OPTIONAL:** • Sockets \$10.00 • 2K Memory \$30.00 • 4K Memory \$60.00 • Video Driver Eprom \$20.00 • Text Editor Eprom (Includes Video Driver \$75.00)

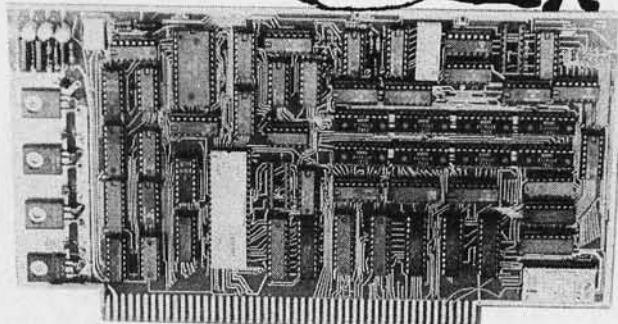
### S-100 Plug-In • Parallel Keyboard Port

On board 4K Screen Memory (Optional). On board Eprom (Optional) for Video Driver or Text Editor Software.

### Up and Down Scrolling through Video Memory

Reverse Video, Blinking Characters.

**Display:** 128 ASC11 Characters 64 X 32 or 32 X 16 Screen format (Jumper Selectable). 7 by 11 Dot Matrix Characters.



**American or European TV Compatible (CRT Controls Programmable)**

**Dealer Inquires Invited**

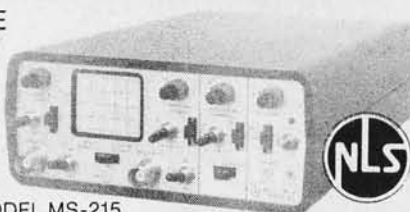
## GRAND OPENING SPECIAL!

15 MHZ DUAL TRACE

**Portable Scope**

**\$399.**

BIG PRICE BREAKTHRU



MODEL MS-215



• Battery or A.C. Operated • External and Internal Trigger • Time Base—.1 m Sec./Div. Into 21 Calibrated Ranges • 3% Accuracy • Input Impedence 1M Ohms • Complete with Input Cables, Battery and Charger.

**OPTIONAL:** • Leather Case \$45.00 • 10:1 Probe \$27.00 (2 for \$49.00) Prices Good through 5/31/79

**MS-15 Single Trace Scope \$299.**

### NLS 3 1/2 DIGIT DMM LCD Readout

SIZE: 1.3" H 2.7" W 4.0" D

• .5% Accuracy • AC-DC 1-1000V • Ohms 1K-10M • Current 1mA-1 Amp • 100% Overload Protection

**OPTIONAL:** • Leather Case \$20.00 • NiCad Battery and Charger \$16.00



MODEL LM-350

**\$139<sup>95</sup>**

### NLS 3.5 LED DIGITS

**Panel Meter**

• .5% Accuracy • Voltage Range 0-1000V

• Power: +5V 200mA • Auto Zero • Update Rate: 3 Rdg. / Sec.



MODEL PM-349

**\$52.**

### ASCII Keyboard Kit \$77.



Assembled and Tested \$93.00

• Single +5V Supply • Full ASCII Set (Upper and Lower Case) • Parallel Output • Positive and Negative Strobe • 2 Key Rollover • 3 User Definable Keys • P.C. Board Size: 17-3/16" X 5" • Control Characters Molded on Key Caps • Optional Provision For Serial Output

**OPTIONAL:** Metal Enclosure \$27.50 • Edge Con. \$2.00 • Sockets \$4.00 • Upper Case Lock Switch \$2.50 • Shift Register (For Serial Output) \$2.00

**Dealer Inquiries Invited**

### Apple II I/O Board Kit

Plugs into Slot of Mother Board

• 1 8 Bit Parallel Output Port (Expands 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 \$49.00

1 Input and 3 Output Ports \$64.00

**Dealer Inquiries Invited**

SHIPPING \$3.50 / California residents add 6% sales tax

**ELECTRONICS WAREHOUSE Inc.**

15820 Hawthorne Boulevard  
Lawndale, CA 90260  
(213) 370-5551





# HOBBYISTS! ... EXPERIMENTERS! ... ENGINEERS! ... YOU NOW HAVE A NEW HOME...BY MAIL!




**New Logic Probe Kit**

Finally... a low cost, easy to build probe kit with professional features. This inexpensive probe includes separately driven high, low and pulse indicator LEDs; 0.3 Meg input impedance; input overload protection; pulse stretching and indication for pulses as fast as 300 nanoseconds; reverse voltage protection; 0° - 50°C operating range; easy to follow assembly and operating manual; and CSC's reputation for true professional quality and reliability.

From **CONTINENTAL SPECIALTIES CORP.**  
The LPK-1 only \$19.95



**LOGIC MONITOR**

Instantly monitor logic state of all IC nodes simultaneously. Clip the LM-1 onto a 14 or 16 pin DIP IC. Faster than a scope, safer than a voltmeter, you have an instant display of the static and dynamic logic states of every node. Requires no batteries, input impedance 100K ohms, input threshold 2 V.

LM-1 \$59.95

**100 MHz 8-DIGIT FREQUENCY COUNTER**

Lab Accuracy in Shop or Field...

- Measure 20 Hz-100 Hz guaranteed, and better than 500 MHz with optional Prescaler.
- Easy reading with a 0.6" LED 8 digit display.
- Direct readout with 1 Hz resolution.
- Crystal timebase accurate to 3 ppm.

Fully automatic, rugged and operates from standard AA, rechargeable AA, or AC adapter. Batteries and AC adapter are available at extra charge to price quoted.

MAX 100 \$134.95  
PS-500 Prescaler \$59.95  
AC Adapter/Charger \$9.95

**SURPLUS BARGAINS**

**COLOR R.F. MODULATOR.** Use your television as a video monitor for computer and other uses. Assembled and pre-tuned to convert b/w or color video to channel 3. Requires 5 vdc power. **Only \$9.95.**

**12 VOLT BUZZER.** Very loud. Ideal for alarms, indicators and projects. **Only 99¢.**

**N.O. PUSHBUTTON.** Made by Stackpole. Comes with large knob, wires and connector for .025 square post. **Only 21¢.**

**OUR BEST BUY IN BREADBOARDS**

only \$2.75  
EXP 325

only \$5.50  
EXP 350

only \$9.00  
EXP 300



LM-1 \$59.95



**2 1/4" SPEAKER.** Perfect for 100's of projects. **Only 69¢.**

**UTILITY SCREWDRIVER.** Made in USA by Fleet Tools. Quality at a low price. **Only 29¢.**

**16 FT. COAX.** With moulded RCA plug on each end. Ideal for audio, video and R.F. applications. **Only \$1.49.**

**3662 UNIVERSAL "P" PATTERN D.I.P. PLUGBOARD**

Made from 1/16 epoxy glass and designed for a 44 pin connector on 156 centers.

3662 6.5" x 4.5" \$7.95  
3662-2 9.6" x 4.5" \$11.95

**8800V and 8801-1 UNIVERSAL MICROCOMPUTER/PROCESSOR PLUGBOARD**

Designed to use with S-100 bus. The 8800V includes heat sink and hardware, the 8801-1 is less power bus and heat sink.

	1.4	5.9	10.24
8800V	\$19.95	\$17.95	\$15.95
8801-1	\$14.95	\$13.46	\$11.95

**3690-12 CARD EXTENDER**

The 3690-12 has 100 contacts, 50 per side on .125 centers. The attached connector is compatible with S-100 Bus Systems.

The 3690 is 6.5" 22/4 pin on 158 centers.

3690-12 \$25.00  
3690 \$12.00

**8803 MOTHERBOARD FOR S100**

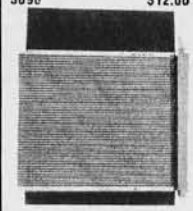
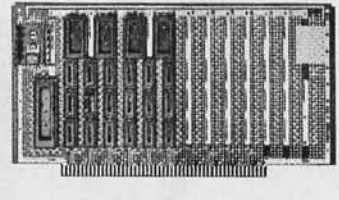
Low noise, includes capacitor and spacer kit. Circuitry for active or passive termination. Mounts eleven 100 contacts (S-100 type) connectors. Made from G-10 epoxy glass with solder plated 2 ounce copper and large buses for heavy current, compatible with MIL-STD-275 with 10°C rise. **\$29.95**

**SCR ELECTRONICS**

9533 VALLEY VIEW ST • CYPRESS, CA 90630  
(714) 527-2554  
IN ORANGE COUNTY

**STOP IN AND BROWSE AROUND...**

TERMS: HOW TO ORDER Give product heading, part number (if shown) and price. Add \$2.50 shipping and handling to all orders under \$50.00. All orders over \$50.00 will be shipped pre-paid. Minimum order is \$7.50. No C.O.D.'s, please. Calif. residents, add 6% sales tax. M.C. and VISA users, include number, expiration date and your signature. Some specials and surplus items may be in limited quantities. If supplies are exhausted, your money will be promptly refunded for those items.



**SOLDER SPECIALS**

Chemtronics Quality Solder Factory Fresh - Exceeds Mil 00-S-571

- 60/40 (.031) 21 ga. 1/2 lb. \$6.34
- 60/40 (.047) 18 ga. 1/2 lb. \$5.80
- #510 Desoldering Tool \$2.45

30 Watt Pencil Type Iron \$4.75

Imported

# 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**

**WMC inc.** WAMECO INC. 3107 LANEVIEW DR., SAN JOSE, CA 95137

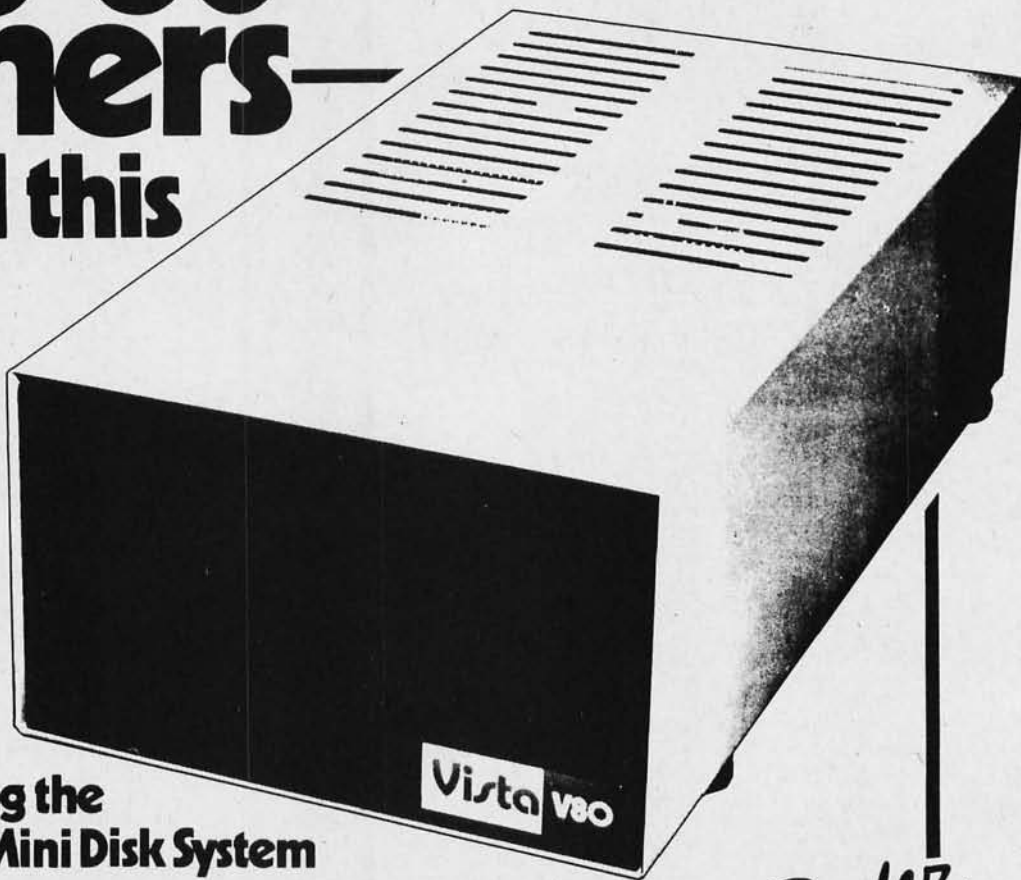




# TRS-80 Owners

Read this  
and  
save  
over

**\$100<sup>00</sup>**



## Introducing the Vista V80 Mini Disk System

- 23% MORE STORAGE CAPACITY** — Increases your usable storage capacity 23% from 55,000 to 67,800 bytes on drive one.
- FASTER DRIVE** — Electronically equal to the TRS-80 Mini-Disk System, but up to 8 times faster (Track-to-track access in 5ms for the V80 versus 40ms for TRS-80).
- DOES NOT VOID TRS-80 WARRANTY** — V80 also has 90-day warranty.
- HERE'S WHAT YOU GET:**  
Minifloppy disk drive/Power Supply/Regulator board/Compact case
- DOUBLE DENSITY FOR DOUBLE STORAGE** — The V80 will work with the Vista double-density expansion unit when available.
- SHIPPED TO YOU READY TO RUN** — Simply take it out of the box, plug it in and you're ready to run.

**PLUS MORE GOOD NEWS** — Vista has a new support team, new address, new telephone, and a new owner. Vista is now part of Advanced Computer Products.

### ALSO AVAILABLE FROM THE NEW VISTA.

Vista V-200 Double Density Mini Floppy System with S-100 Controller, CPM on 5¼", power supply & case .....\$699.00  
Vista V-250 Dual Shugart 8" Floppy System with S-100 Controller, CPM, BASIC "E", power supply & slimline case.....\$2199.00

*Dealer  
inquiries  
invited*

**Special  
Introductory  
Price:**

**\$ 395<sup>00</sup>**

# Vista

Vista Computer Company  
1320 E. St. Andrews Place, Unit I  
Santa Ana, CA 92705  
(714) 751-9201  
TWX 910-595-1565

### ASCII COMPUTER KEYBOARD

This 56 key ASCII encoded keyboard provides debounced ASCII output (7-bit parallel) and strobe. It has six non-enclosed closures to ground and requires +5V @ 150MA, -12V @ 45MA. A standard 10 pin dual readout connector is used for data and power inputs. These keyboards were manufactured for use in T.I. Silent 700 series terminals. **TESTED AND GUARANTEED.** Manufactured by Clare-Pendar.

LIMITED QUANTITY **\$59.95**

### ACOUSTIC COUPLER

This originate only coupler was manufactured for use in T.I. 735 data terminal. It is compatible with Bell 103 and 113 data sets or the equivalent. The coupler operates asynchronously to a speed of 300 baud in the full duplex mode. (Half duplex mode is easily acquired by adding one 1N914.) All signal outputs are compatible with TTL. Transmit freq. is 1270Hz. for mark and 1070Hz. for space. Receive freq. is 2225Hz. for mark and 2025Hz. for space. Unit requires ±12 volts and +5 volts for operation. Complete with schematic and all pertinent information. Fully reconditioned, calibrated, and guaranteed.

RS232 to TTL to RS232 conversion kit \$6.50. Includes P.C. board, components, and schematic.

**\$47.50**

### 4-DIGIT COUNTER

The MK5005 is a P-channel MOS four decade synchronous counter with latches, multiplexing circuits, and a read-only memory programmed for seven-segment outputs. It provides a means of counting up to 9999. 24 pin gold and ceramic package. \$9.95 (ideal for use with T.I. 4-digit display, below.)

### 4-DIGIT LED DISPLAY

Full 4-digit, .5" characters for 4-digit counter, 12 hour, or 24 hour clock. T.I. p/n TIL373, common cathode. \$2.95

### HP5082-7730 Red .3" LED common anode \$1.25, 4/54.

Send \$1.00 for our catalog and get credit on your first order.

### 12VDC MOTORS

Both the Holland and Maxon are very efficient 12VDC motors. They run on as low as 1/2V and draw 250ma with 2.8 inch torque at 5000RPM. 1 1/2" x 1-5/8" long.

Holland double shaft \$3.95 ea. Maxon single shaft \$2.95 ea.

**Austin Electronics**  
1536 E. Anderson Ln.  
Suite E  
Austin, Texas 78752

TERMS: Check or money order, NO COD. Texas residents add 5% sales tax. Overseas countries add \$5.00 for surface rates. All orders add 5% for postage. MINIMUM ORDER \$15.00.

### ZERO CROSSING DETECTOR

SN16268 by T.I. detects when line current is at its minimum for switching devices at zero current. 14 pin dip. 10/\$4.95

### 1K SHIFT REGISTER

National MM5013 in an 8 pin dip. 10 for \$4.95

### SIGNETICS N8T18A

Dual 2-input high voltage to TTL interface gate. 14 pin dip. 10 for \$2.50

### MOTOROLA MC1406L

6-Bit digital to analog converter. 14 pin ceramic. \$1.50 ea.

### MOTOROLA MC1558

Dual op amp in an 8 pin dip. 40 each 10 for \$4.50

### SHIFT REGISTER

Fairchild 3341 4X64 digital storage buffer (FIFO) \$5.95

### TMS4030 DYNAMIC RAM

4096-Bit low power (400mw) with data and 22 pin socket. These units are removed from boards, but are tested and guaranteed. \$3.95 each 10 for \$25.00

### assortments

DISC CAPACITORS: includes values from 74PF to .2MFD. 100 for \$2.95

DIPPED POLYESTER FILM 100 for \$4.95

1% PRECISION RESISTORS assortment contains a balanced inventory. 200 for \$4.95

### ELECTROLYTICS: miniature aluminum axial leads. Includes values from 1MFD/50V to 1500MFD/16V...100 for \$9.95

### TANTALUMS: values from 1MFD/10V to 39MFD/10V. 50 for \$6.95

### SLIDE SWITCHES: standard and miniature...40 for \$4.95

### POWER CORDS: includes 2 and 3 conductor, 6 to 8 ft. UL listed...6 for \$2.95

### HEAT SHRINK TUBING: 25-6" lengths in various sizes and colors. \$2.95/ass't.

### wire

#### RS-232 CABLE

7 Conductor 24GA. teflon with braid shield and white PVC jacket. (3/16" dia.) 50' for \$14.95 100' for \$25.00

#### KYNAR WIRE WRAP WIRE

Solid silver plated 30AWG available in blue, red, black, yellow, green, or white. 100' spool...\$2.50 500' spool...\$5.95 1000' spool...\$9.95

### HOOK-UP WIRE

Available in blue, red, white, black, gray, green, yellow, orange, or violet (stranded PVC)

22 GA.....200' roll.....\$3.50  
22 GA.....1000' roll.....\$12.50  
24 GA.....250' roll.....\$3.50  
24 GA.....1000' roll.....\$9.95

### POWER CORDS

1) White 2 conductor w/strain relief...3/\$1  
2) Black 2 conductor w/strain relief...3/\$1  
3) Black 3 conductor molded vinyl...\$9.95  
4) Black TV cheater cord...2/\$1

### switches

#### MINIATURE TOGGLE

C&K no. 7109 SPDT reset switch. (spring return) \$9.95ea. 10/\$7.50

#### MINIATURE TOGGLE

C&K p/n 7101 SPDT, rated 5A @ 120VAC. \$1.25 EA. 10 for \$10.00

### SLOTTED OPTICAL SWITCH

The OP800 consists of a gallium arsenide infrared LED coupled with an npn silicon photo-transistor in a plastic housing. The gap in the housing provides a means of sensing motion of opaque objects. Manufactured by OPTRON INC. \$1.98 ea.

### DIP SWITCH

10 Position Amp p/n 435166-7. Special offer at only \$1.95 each, 10 for \$15.

### REFLECTIVE SOURCE & SENSOR

T.I. TIL139 is designed for sensing applications such as line finder, batch counter, level indicator, and beginning-of-tape/end-of-tape indicators. \$2.50

### "D" SUBMINIATURE CONNECTORS (RS-232 TYPE)

DB25-P.....male.....\$2.95  
DB25-S.....female.....\$3.50  
DB25-P.....right angle male.....\$4.95  
AMP hood.....\$1.50  
DC37-P.....male.....\$3.75  
DC37-S.....female.....\$4.50  
DD50-P.....male.....\$4.50  
DD50-S.....female.....\$5.75

Screw lock assembly Cinch D20420.....\$5.00/pair  
Male screw retainer Amp 205980-1.....\$5.00/pair  
Female screw lock assembly Amp 205817-1.....\$5.00/pair

### connectors

#### TV CONNECTOR

Cinch Jones 2RP-2. Rated 125V 7A. Used as input voltage connector for TV sets. 10 FOR \$1.50  
2RP-3, 3-pin version of above. 10 FOR \$1.75

#### SCREW TYPE TERMINAL

Ideal for stereo or TV connector. 1-3/8" mounting ctrs. 20/\$1.00 100/\$3.95

### P.C. BOARD EDGE CONNECTORS

10/20 pin .125" ctrs. solder eyelet.....\$1.50  
12/24 pin .156" ctrs. dip solder.....\$1.75  
18/36 pin .156" ctrs. solder eyelet.....\$2.35  
22/44 pin .156" ctrs. solder eyelet.....\$2.75  
22/44 pin .156" ctrs. dip solder.....\$2.50  
28/56 pin .156" ctrs. solder eyelet.....\$2.95  
36/72 pin .125" ctrs. solder eyelet.....\$3.25  
36/72 pin .125" ctrs. wire wrap.....\$4.25  
43/86 pin .156" ctrs. dip solder.....\$3.95  
43/86 pin .156" ctrs. solder eyelet (used).....\$1.00  
44/88 pin .125" ctrs. solder eyelet.....\$4.25

### relays

Zestron p/n 540 reed relay, 12VDC SPST N.O. Coil resistance is 800 ohm. \$1.00 each 10 for \$7.50

Electrol p/n R4422-2 reed relay, 12VDC DPST N.O. Coil resistance is 440 ohm. \$1.50 each 10 for \$9.95

P&B p/n JRM10439 reed relay, 5VDC DPST N.O. Coil resistance is 1000 ohm. \$1.95 each 10 for \$17.50

P&B p/n JRM10440 reed relay, 5VDC SPST N.O. Coil resistance 400 ohm. \$3.95 each 10 for \$34.95

### THE AMAZING METAL

Bismuth alloy melts in boiling water. Ideal for casting small parts. 4oz. Ingot \$3.95 1lb. Ingot \$9.95

### SPEEDY BEND

Precision lead bender for 1/4 and 1/2 watt resistors. \$1.95ea.

# HOBBY WORLD

## CALL TOLL FREE (800) 423-5387

### CA, HI, AK, (213) 886-9200

### TOP QUALITY, LO-COST SPECIALS

Order by Cat No. and description.

Cat No.	Description	Price
1142	DATA CASSETTES, 10 min.	2.00
1147	DISKETTE, 5 1/4" soft sector, TRS-80	3.25
1224	SOUND ACTIVATED SWITCH, vox	.50
1226	LINE CORDS, #18, 2 cond w/ plug.	.25
1033	22uf TANTALUM, 30V axial	.15
1033	22uf TANTALUM, 10V axial	.15
1033	33uf TANTALUM, 35V axial	.30
1007	12V TRANSFORMER, 300ma, PC mount	.75
7233	1N4148 SWITCHING DIODES, full lead	.25 for 100
114112	TEXAS INST. TTL DATA BOOK	4.95
21LO2-2	250nsec 21LO2 RAM	1.50
21LO2N-2	650nsec 21LO2 RAM	.85
1291	8 POS ROCKER DIP SWITCH	1.95
1289	4 POS ROCKER DIP SWITCH	1.125
10020	1000uf 25V uprite cap.	.20
1156	TRS-80 16K MEMORY ADD-ON KIT	95.00
1199	TRS-232 PRINTER INTERFACE	3.00
1225	3" RAEDOUTS, MAN 74 equal (N574R)	.75
1117	14 PIN SOLDER TAIL SOCKETS	.19
1117	16 PIN SOLDER TAIL SOCKETS	.20
1117	24 PIN SOLDER TAIL SOCKETS	.36
1001	1N4001, 50V 1A RECTIFIER	.20 for 100
1018	51V 1 WATT ZENER	.10 for 100
1018	12V 1 WATT ZENER	.10 for 100
1034	25 AMP, 100 PIV "BLOCK" BRIDGE	1.50
1113	SOLDERING IRON, pencil type, 30W	3.50
1020	47uf 6.3V uprite lytic	1.00
1020	22uf, 250V axial lytic	.15
1167	40 COND RIBBON CABLE per foot	.50
1160	104 KIT, 2 parallel + 2 serial ports	140.00
1087	PROM PROGRAMMER 2708/16, from OAE	275.00
1154	SHUGART MINIFLOPPY DRIVE, SA400	275.00
1031	5" READOUT, CC, FND-503.	.75

### TRS-80 SOFTWARE CASSETTES

Cat No.	Description	Price
1093	SARGON CHESS, II	19.95
1041	STAR TREK II	14.95
1036	SCI FI GAME SAMPLER, I/II	4.95
1042	TAROT I/II	5.95
1179	CRIBBAGE I/II	9.95
1192	REAL TIME LUNAR LANDER II	7.95
1195	BRIDGE CHALLENGER II	14.95
1186	AIR RAID I/II	14.95
1187	PILOT I/II	14.95
1047	OTHELLO I/II	5.95
1043	SMALL BUSINESS BOOKKEEPING I/II	14.95
1051	DAILY BIRTHDAY PROGRAM I/II	5.95
1049	MICRO TEXT EDITOR I/II	9.95
1038	INVENTORY MODULAR I/II	19.95
1153	EDIT-80, text editor II (32k)	39.95

### COMPUCRUISE only \$165

Navigational computer for mobile use! Features cruise control, fuel management, trip computer, timer/counter. Warns low fuel! Compensates for tire wear; converts to metric. 44 functions! Mounts easily on dash. Easy to read bright blue digits. With installation instructions.  
Cat No. 1166

### IC MASTER Cat No. 1292 \$45

### "LIFT-IT" PC DUPLICATING KIT \$25

Copy PC patterns from magazines quickly and easily! No additional materials required. No camera needed! With 10 x 12 sheet of film. We stock all refills! with step-by-step instructions.  
Cat No. 1203

### SEND FOR FREE SPRING CATALOG FEATURING:

FACTORY FRESH, PRIME IC'S, LED'S, READOUTS, RECTIFIERS, ZENERS, TRS-80 ADD-ONS, 5-100 BOARD'S, PC AIDS, TEST EQUIPMENT, BOOKS, SOFTWARE, AND MORE!

## 19355 BUSINESS CTR DR 6B4

## NORTHRIDGE, CA 91324





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  $\mu$ P410 Protection, fully buffered KIT ..... \$299.95
- MB-8A 2708 EPROM 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.** 1/2 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    |
| MM16330 | 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.** (Finally) 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 IEE 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

**APRIL 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.



419 Portofino Drive  
San Carlos, California 94070

Please send for IC, Xistor and Computer parts list.



IMMEDIATE DELIVERY

AM81101APC	1.8	10 up	1402A	1.9	10 up
AM81102APC	\$ 4.25	\$ 3.45	1402APC	\$ 8.25	\$ 5.60
AM81111APC	3.70	2.95	1402APC	4.42	3.75
AM81112APC	4.25	3.45	1402A	5.80	5.15
AM81113APC	5.05	4.00	1402APC	4.42	2.90
AM81114APC	4.25	3.95	1402APC	5.18	4.25
AM81115APC	4.45	3.65	1404APC	4.42	2.75
AM81116APC	6.05	4.00	1404A	5.80	4.25
AM81117APC	1.05	0.84	1406	10.20	8.40
93L00PC	1.58	1.38	1407	10.20	8.40
93L00PC	1.75	1.58	AM1408LB	2.25	1.80
93L00PC	64	56	AM1488PC	1.00	0.77
93L10PC	1.50	1.31	AM1500DC	9.00	7.20
93L110PC	3.28	2.99	AM1500DC	22.80	18.00
93L11PC	2.18	1.99	1506	4.05	3.24
93L12PC	1.58	1.38	1507	4.05	3.24
93L13PC	1.48	1.29	AM1660HC	3.00	2.70
93L14PC	2.10	2.21	AM2520DM	14.40	12.60
93L15PC	1.58	1.38	AM2520PC	6.60	5.77
93L21PC	1.78	1.54	AM2504DC	11.20	9.80
93L22PC	1.10	0.96	AM2504DC	22.40	19.60
93L24PC	2.58	2.26	AM2505PC	12.34	11.67
93L25PC	3.20	2.80	AM2600	6.00	5.25
93L26PC	3.80	3.32	AM2602PC	1.50	1.31
93L27PC	4.25	3.74	AM2602PC	13.60	11.80
93L40DC	10.00	8.75	AM2814APC	5.68	4.88
93L40PC	5.50	5.09	AM2820DC	7.35	5.88
93L41PC	6.50	5.99	AM2820DC	4.42	3.54
93L42PC	1.70	1.49	AM2804PC	4.42	2.75
93L43PC	1.70	1.49	AM2804PC	3.52	2.82
96L20DC	2.40	2.10	AM2809PC	9.00	7.00
AM885LD	14.25	11.40	AM2819PC	9.00	7.00
AM885HL	13.40	10.70	AM2824DC	24.00	19.20
AM885HM	30.00	24.00	AM2812DC	21.00	13.44
AM885DC	14.26	11.40	AM2813DC	21.00	13.44
AM885HC	10.40	8.00	AM2814PC	10.60	8.40
			9312PC	6.40	5.60

**AMD LINEAR**

L385AH	\$22.50	\$18.00	LM218H	\$10.65	\$ 8.50
L385H	22.50	18.00	LM201AH	.88	.78
L387AH	1.80	1.26	LM201H	.83	.66
L387H	22.50	18.00	LM305H	1.50	1.20
LM105H	1.80	1.26	LM308AD	6.75	5.40
LM105H	4.85	3.90	LM308AH	5.10	4.00
LM105H	6.75	5.40	LM308H	1.28	1.02
LM124D	2.22	2.58	LM308H	6.8	5.44
LM211H	3.45	2.75	LM310D	4.40	3.85

**SUPER KIM - \$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**

MicroPower Timing Circuit  
Intersil's Universal Counter System  
EVALUATION KIT ICM7226EV \$ 59.95

**XR-2206KB FUNCTION GENERATOR KIT** Includes all components, PC board and instructions. \$19.95

**5% CARBON FILM RESISTORS**

1/4W \$1.69  
1/2W \$1.79  
All values from 10 $\Omega$  to 10 M $\Omega$  - 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. \$3500

ARIZONA ANCRONA	CALIFORNIA ANCRONA	CALIFORNIA ANCRONA	OREGON ANCRONA
4018 E. Broadway Tucson, AZ 85711 (602) 881-2348	11080 Jefferson Blvd. Culver City, CA 90230 (714) 390-3595	1300 E. Edinger Ave. Santa Ana, CA 92705 (714) 847-8424	1125 N.E. 82nd Ave. Portland, OR 97208 (503) 254-5541
CANADA, B.C. ANCRONA	CALIFORNIA ANCRONA	GEORGIA ANCRONA	TEXAS ANCRONA
1054 F. West 21 Vancouver, B.C. Canada (604) 243-4217	11080 Jefferson Blvd. Culver City, CA 90230 (408) 243-4217	E. Central Road Smyrna, GA 30087 (404) 261-7100	289 Richmond Houston, TX 77028 (713) 629-3489

# California Digital

Post Office Box 3097 B • Torrance, California 90503



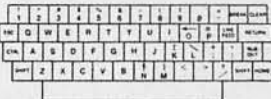
## Hazeltine 1400

cost effective  
**CRT TERMINAL**

**\$735** plus shipping

The Hazeltine 1400 Vidio 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

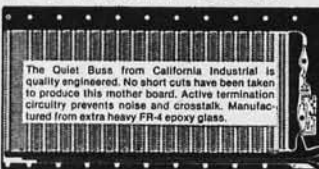


**Immediate Delivery**

## S-100 Mother Board

**Quiet Buss**

\$2995  
8803-18  
18 slot  
IMSAI



The Quiet Buss from California Industrial is quality engineered. No short cuts have been taken to produce this mother board. Active termination circuitry prevents noise and crosstalk. Manufactured from extra heavy FR-4 epoxy glass.

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 \$75.00 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

**\$395**

Qty. ft. 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 1.60 .85  
1K 1.97 1.37 .73

## Edge Connectors

**GOLD 100 PIN**  
IMSAI/ALTAIR

Imesai solder .125x.250 \$4.95 3/\$10.00  
Imesai w/w .125centers \$4.95 3/\$13.00  
Altair solderaltair .140row \$5.95 3/\$15.00

**SPECIALS**  
22/44 Kim eyelet.156" \$1.95 3/\$4.00  
25/50 solder tab .156" \$1.09 3/\$2.00  
36/72 wide post w/w.156 \$1.95 3/\$4.00



**KEYBOARD**  
The famous Sperry Univac 1710 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 fan 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 Module..... \$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** Mfg. Sug. Retail... \$1195  
PLUS SHIPPING

TEN \$41 for 50+ \$385

## Scotch CASSETTES

Certified Digital  
**CASSETTES**  
Won't drop a BIT!

**DISKETTES**  
8 inch Soft (IBM)  
8 inch 32 sector  
Mini Soft sec.  
Mini 10 sector  
Mini 16 sector

**\$550**  
CALIFORNIA INDUSTRIAL is an Authorized Dealer of Scotch Brand Data Products

## APPLE RS-232 Serial Interface \$59.95

Interfaces Apple II to Teletype or other serial printer.  
**ELECTRONIC SYSTEMS**

## DigiCAST A/V-100 R.F. MODULATOR \$2995

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 buffer & decoding chips. 1 DIP address select switch, a 5 volt regulator and more.  
WW100-Wire wrap breadboard, similar to the GP100. Allows wire wrap of all sizes of sockets in any size 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.

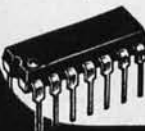
STATIC	1-31	32-99	100-5C	-999	1K+
21L02 450NS.	1.49	1.19	1.05	.95	.89
21L02 250NS.	1.69	1.49	1.45	*	*
2114 1Kx4 450	6.95	6.50	6.25	6.00	5.75
2114 1Kx4 300	8.95	8.50	8.00	*	*
4044 4Kx1 450	5.95	5.50	5.00	*	*
4044 4Kx1 250	9.95	9.50	9.00	*	*
4045 1Kx4 450	8.95	8.50	8.00	*	*
4045 1Kx4 250	9.95	9.50	9.00	*	*
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 *

**EPROMS**

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 Diablo 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**  
\$1.39 ea.  
10 50  
\$1.19 89

## CAPACITORS

**ELECTROLYTICS**  
ea. 10 50  
80,000/10v. 395 349 295  
4500/50v. \$199 135 119  
1000/15v \$55 49 45

.1 disc \$12.09 .07  
.01 disc .06 .05 .04



## DISCOUNT

## Wire Wrap Center

## IC SOCKETS

pin	Wire wrap		low profile	
	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	34 30
40	169	155 139	63	60 58

50ft. **KYNAR WIRE**  
\$98 500 1,000 11,000  
98. 515. 5105.

## MINIATURE SWITCHES

your choice  
10 50 100 1k  
\$ .98 \$ .88 \$ .73 \$ .66

## SPDT Miniature Toggle

7101 C&K ON-NONE-ON  
7107 JBT ON-OFF (mnt. ON)  
7108 C&K ON-(moment. ON)  
Rocker JBT DPDT  
Rotary 3P-4-Post.  
Push B (N.O.) \$3.95ea. 4/\$1

## DIP Switch

10 25 100 1k  
\$1.49 \$1.29 \$1.15 \$1.07 \$1.03  
specify for 8 pos.

## SPST

## 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 34 30  
40 169 155 139 63 60 58  
50ft. **KYNAR WIRE**  
\$98 500 1,000 11,000  
98. 515. 5105.



Circle 39 on inquiry card.



# ATTENTION TRS-80 & APPLE USERS

## A PRINTER FOR YOUR COMPUTER



TERMS: VISA, MASTERCHARGE, 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

**\$995<sup>00</sup>**

**MODEL 3S-80** for TRS-80  
Ready to plug into your expansion interface.

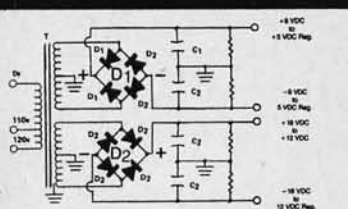
**MODEL 3S-PP**  
for computers with 8 bit serial port.

**MODEL 3S-SS**  
for computers with RS-232 port.

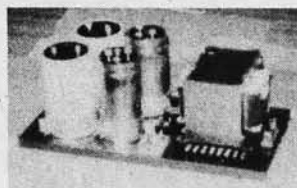
**\$1095<sup>00</sup>** for

**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



## 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
			2 x 8 Vac	2 x 14.5 Vac	2 x 25 Vac		
T <sub>1</sub>	1	0V, 110V, 120V	2 x 9A	2 x 2.5A	—	3 3/4" x 35/8" x 3 1/8"	19.95
T <sub>2</sub>	2	0V, 110V, 120V	2 x 13.5A	2 x 3.5A	—	3 3/4" x 4 3/8" x 3 1/8"	25.95
T <sub>3</sub>	3	0V, 110V, 120V	2 x 10A	2 x 2.5A	2 x 2.5A	3 3/4" x 4 3/8" x 3 1/8"	27.95
T <sub>4</sub>	4	0V, 110V, 120V	2 x 4.5A	—	2 x 4.5A	3 3/4" x 35/8" x 3 1/8"	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 W x D x H	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	18A	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.

**SUNNY INTERNATIONAL**  
(TRANSFORMERS MANUFACTURER)  
Telephone: (213) 633-8327

STORE:  
7245 E. Alondra Blvd.  
Paramount, Ca. 90723  
STORE HOURS: 9 AM-6 PM



MAIL ORDER:  
P.O. Box 4296  
Torrance, Ca. 90510

Visit our new retail location!

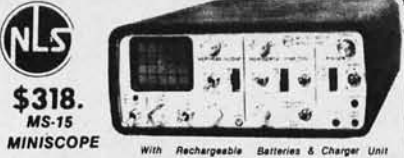
Visit our new retail location!

Visit our new retail location!



**LM3A 3 dig 1% DC**  
~~\$134.00~~ — \$120.60  
**LM3.5A 3 1/2 dig. .5% DC**  
~~\$158.50~~ — \$142.65  
**LM40A 4 dig .1% DC**  
~~\$209.00~~ — \$188.10  
**LM4A 4 dig .03% DC**  
~~\$258.00~~ — \$225.00

Rechargeable batteries and charger included  
 Measures DC Volts, AC Volts, Ohms and Current  
 Automatic polarity, decimal and overload indication  
 No zero adjustment and no full-scale ohms adjust  
 Battery-operated — NiCad batteries; also AC line operation.  
 Large LED display for easy reading without interpolation  
 Size: 1.9" H x 2.7" W x 4" D  
 Parts & labor guaranteed 1 year  
 Tilt stand option ..... \$ 3.50  
 Leather case ..... \$20.00



**\$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, ± 3%.  
 • Battery or line operation.  
 • Automatic & line sync modes.  
 • Power consumption < 15 watts.  
 • Vertical Gain — .01 to 50 Volts - 12 settings ± 3%.  
 • Viewing area 1.1" x 1.30"  
 • Case size 2.7" H x 6.4" W x 7.5" D, 3 pounds.  
 • Parts & Labor guaranteed 1 year  
 • 10 to 1.5 meg probe  
 • Leather carrying case  
 \$ 27.  
 \$ 45.  
**MS-215 Dual Trace Version of MS-15 \$ 435.**

### 3 LEVEL GOLD WIRE WRAP SOCKETS

Sockets purchased in multiples of 50 per type may be combined for best price.

	1-9	10-24	25-99	100-249	250-999
8 pin*	.40	.36	.34	.31	.27
14 pin*	.45	.39	.37	.34	.32
16 pin*	.50	.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
28 pin	1.25	1.15	1.00	.95	.90
40 pin	1.65	1.45	1.35	1.20	1.10

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

### SALE S-100 BUS EDGE CONNECTORS SALE

**\$100-WWG 50/100 Cont. 125 ctrs 3 LEVEL WIRE WRAP 025 3/8" pitch on 250 spaced rows. GOLD plated**  
 1-4 5-9 10-24  
 \$4.00 \$3.75 \$3.50

**\$100-STG 50/100 Cont. 125 ctrs DIP SOLDER TAIL on 250 spaced rows for VECTOR and MASH motherboards GOLD plated**  
 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**  
 1-4 5-9 10-24  
 \$5.00 \$4.75 \$4.50

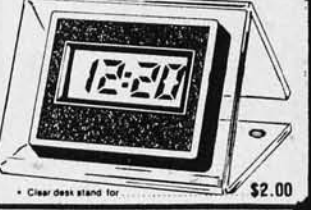
**R844 Q 22/44 Cont. 156 ctrs PIERCED SOLDER EYELET tails GOLD plated**  
 1-4 5-9 10-24  
 \$3.00 \$2.75 \$2.50

**R844 J 22/44 Cont. 156 ctrs PIERCED SOLDER EYELET tails GOLD**  
 1-4 5-9 10-24  
 \$4.00 \$3.75 \$3.50

**CG-1 IMSAI Style Card Guides \$5/100**  
 ATTN: OEM's and Dealers, many other connectors available call or 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**

• Not includes 12 tantalum capacitors for +5, +12 — 12 buses and nine sized mounting spaces.  
 • Wiring side shown. Component side bare epoxy glass with white markings for component locations.  
 • G10 epoxy glass board with 2 ounce copper, solder plated and 038 diameter holes for leads.  
 • Solder mask with solder wicking on etched circuits to avoid accidental short circuits.  
 • Mounts 11 receptacles with 100 contacts (2 rows) on 125 centers with 250 row spacing. Vector part number M881-2 or mounts 10 receptacles plus microconnectors to smaller mother board for expansion.  
 • Includes etched circuits and instructions for option of active pull-up or floating terminations.  
 • Large buses, +5V and GND (110 AMP/5), ±12V or 15V (7 AMP/5). Current ratings are per MIL-STD-275 with 10°C rise.  
 • Fits in IMSAI 8080 microcomputer as expansion 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

**3682 9.6" x 4.5"** \$10.97  
**3682-2 6.5" x 4.5"** \$9.81

**Hi-Density Dual-In-Line Plugboard for Wire Wrap with Power & Grd. Bus 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

**Gen. Purpose D.I.P. Boards with Bus Pattern for Solder or Wire Wrap Epoxy Glass 1/16" 44 pin con. spaced 156**

**3690-12 CARD EXTENDER**  
 Card Extender has 100 contacts 50 per side on .125 centers-Attached connector-is compatible with S-100 Bus Systems \$25.83  
**3690 6.5" 22/44 pin .156 ctrs. Extenders** ..... \$13.17

**3662 6.5" x 4.5"** \$7.65  
**3662-2 9.6" x 4.5"** \$11.45

**P pattern plugboards for IC's Epoxy Glass 1/16" 44 pin con. spaced 156**

**1/16 Vector BOARD**  
 .042 dia holes on 0.1 spacing for IC's

**Phenolic**

PART NO.	SIZE	1-9	10-19
64P44XXX	4.5x6.5"	\$1.56	\$1.40
169P44XXX	4.5x17"	\$3.69	\$3.32

**Epoxy Glass**

PART NO.	SIZE	1-9	10-19
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 \$65.00**

**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" bar 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 LEDU**

**LOW-PROFILE BASE** 305 PRICE: \$11.95

**STANDARD BASE** 300 PRICE: \$11.95

**VACUUM BASE** 380 PRICE: \$16.95

**IM-10A List \$89.00 SPECIAL \$56.95 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.

**2102LPC 450ns Low Power RAMS \$1.00 Ea. in lots of 25**

**2102LHPC 250ns Low Power RAMS \$1.25 Ea. in lots of 25**

**ORDER TOLL FREE 1-800-423-5633**

except CA., AK., HI., Call (213) 894-8171

**FND 503 Common Cathode**

**FND 510 Common Anode 1/2" 7 seg LED 59¢ 10/4<sup>50</sup>**

**Vector WRAP POST** for .042 dia. holes (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 April 1979**

phone orders welcome (213) 894-8171 OEM and Institutional inquiries invited.

**24 PIN DIP PLUGS WITH COVERS**

**3 / \$1.00**  
**40 / \$10.00**

Circle 312 on inquiry card.

Visit our new retail location!



Visit our new retail location!

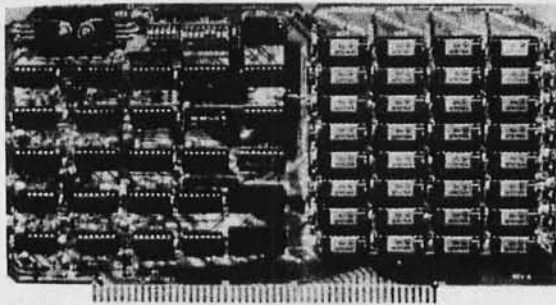
Visit our new retail location!

The EXPANDORAM is available in versions from 16K up to 64K, so for a minimum investment you can have a memory system that will grow with your needs. This is a dynamic memory with the invisible on-board refresh, and IT WORKS!

- Bank Selectable
- Phantom
- Power 8VDC,  $\pm$  16VDC, 5 Watts
- Lowest Cost Per Bit
- Uses Popular 4116 RAMS
- PC Board is doubled solder masked and has silk-screen parts layout.

## SD EXPANDORAM

The Ultimate S-100 Memory



- Extensive documentation clearly written
- Complete Kit includes all Sockets for 64K
- Memory access time: 375ns, Cycle time: 500ns.
- No wait states required.
- 16K boundaries and Protection via Dip Switches
- Designed to work with Z-80, 8080, 8085 CPU's.

### EXPANDO 64 KIT (4116)

16K	\$245.00
32K	\$310.00
48K	\$375.00
64K	\$440.00

### DISC DRIVES



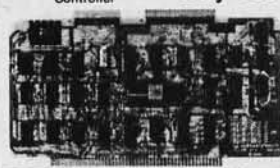
Sugart SA400 5 1/4" **\$295.00**

GSi/Siemans \*FDD100-8 8" **\$395.00**

\*equivalent to Sugart 801  
Siemens FDD 200-8 8" double-sided double density **\$599.00**

### DISC CONTROLLER SD "VERSAFLOPPY" KIT

The Versatile Floppy Disk Controller Only **\$159.00**



FEATURES: IBM 3740 Soft Sectorable Compatible, S-100 BUS Compatible for Z-80 or 8080. Controls up to 4 Drives (single or double sided). Directly controls the following drives:  
1. Sugart SA400/450 Mini Floppy  
2. Shugart SA800/850 Standard Floppy.  
3. PERSCI 70 and 277.  
4. MFE 700750.  
5. CDC 9404/9406.  
6. GSi/Siemans FDD100-8  
34 Pin Connector for Mini Floppy. 50 Pin Connector for Standard Floppy. Operates with modified CP/M operating system and C-Basic Compiler. The new "Versafloppy" from S.D. Computer Products provides complete control for many of the available Floppy Disk Drives. Both Mini and Full Size. FD1771B-1 Single Density Controller Chip. Listings for Control Software are included in price.

CONTINENTAL SPECIALTIES CORPORATION

### CSC 100MHz 8-Digit Counter



- 20 Hz-100 MHz Range
- .6" LED Display
- Crystal-controlled timebase
- Fully Automatic
- Portable - completely self-contained
- Size - 1.75" x 7.38" x 5.63"
- Four power sources, i.e. batteries, 110 or 220V with charger 12V with auto lighter adapter and external 7.2-10V power supply.

**\$134.95 Sale \$120.00**

ACCESSORIES FOR MAX 100: Mobile Charger Eliminator use power from car battery. Model 100-CLA \$3.95  
Charger/Eliminator use 110 VAC Model 100 - CA1 \$9.95

CONTINENTAL SPECIALTIES CORPORATION

### CSC SALE



### LOGIC MONITOR 1

Trace signals through all types of digital circuits. Unit clips over any DIP IC up to 16 pins. Each of its 16 contacts connects to a single-bit level detector that drives a high-intensity, numbered LED fixed activated when the applied voltage exceeds a fixed 2 V threshold. Logic "1" turns LED on; logic "0" keeps LED off. A power-seeking gate network automatically locates supply leads and feeds them to the LM-1's internal circuitry. Saves minutes, even hours in design, troubleshooting, debugging of equipment. Voltage Threshold: 2 V  $\pm$  0.2 V. Input Impedance: 100,000 ohms. Input Voltage Range: 4-15 V max. across any two or more inputs. Current Drain: 200 mA at 10 V. Size: 4" l. x 2" w. x 1.75" d. when open. Weight: 3 ozs.

CSC Model LM-1 Logic Monitor—Complete. List Price ..... **\$54.95**

CONTINENTAL SPECIALTIES CORPORATION



### LOGIC PROBES

CSC logic probes are the ultimate tool for breadboard design and testing. These hand-held units provide an instant overview of circuit conditions. Simple to use; just clip power leads to circuit's power supply, set logic family switch to TTL/DTL or CMOS/HTL. Touch probe to test node. Trace logic levels and pulses through digital circuits. Even stretch and latch for easy pulse detection. Instant recognition of high, low or invalid levels, open circuits and nodes. Simple, dual-level detector LEDs tell it quickly, correctly. HI (Logic "1"); LO (Logic "0"). Also incorporates blinking pulse detector. e.g., HI and LO LEDs blink on or off, tracking "1" or "0" states at square wave frequencies up to 1.5 MHz. Pulse LED blinks on for 1/2 second during pulse transition. Choice of three models to meet individual requirements; budget, project and speed of logic circuits.

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 ..... **\$42.70**

### Logic Probes and Digital Pulsers



MODEL LP-2 Economy version of Model LP-1. Safer than a voltmeter. More accurate than a scope. Input Impedance: 300,000 ohms. Minimum Detectable Pulse: 300 ns. Maximum Input Signal (Frequency): 1.5 MHz. Pulse Detector (LED): High speed train or single event. Pulse Memory: None.  
CSC Model LP-2 Logic Probe—Net Each ..... **\$23.70**  
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 ..... **\$66.45**



DIGITAL PULSER The ultimate in speed and ease of operation. Simply connect clip leads to positive and negative power, then touch DP-1's probe to a circuit node; automatic polarity sensor detects circuit's high or low condition. Depress the pushbutton and trigger an opposite polarity pulse into the circuit. Fast troubleshooting includes injecting signals at key points in TTL, DTL, CMOS or other popular circuits. Test with single pulse or 100 pulses per second via built-in dual control push-button; button selects single shot or continuous modes. LED indicator monitors operating modes by flashing once for single pulse or continuously for a pulse train. Completely automatic, pencil-size labelfield pulse generator for any family of digital circuits. Output: Tri-state. Polarity: Pulse-sensing auto-polarity. Sync and Source: 100 mA. Pulse Train: 100 pps. LED indicator: Flashes for single pulse; stays lit for pulse train.  
CSC Model DP-1 Digital Pulser—Net Each ..... **\$71.20**



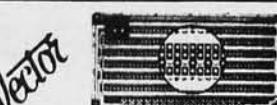
1-4	5-9	10-24
19.95	17.96	15.96



1-4	5-9	10-24
14.95	13.46	11.96



1-4	5-9	10-24
21.95	19.76	17.56



1-4	5-9	10-24
19.95	17.95	15.96



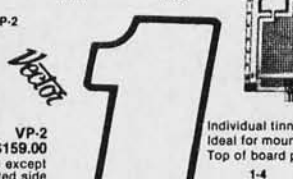
1-4	5-9	10-24
45.00	40.50	36.00

### VECTOR-PAK ASSEMBLED MICROCOMPUTER CASES

- Adjustable packaging system for S-100 bus microcomputers. Compatible with Altair 8800 and IMSAI 8080 size cards.
- Smart looking, deluxe cases unmarred by unsightly screws or fasteners.
- Finished in dark blue textured vinyl.
- Instantly accessible interiors with slip out covers.
- Removable recessed rear and front panels.
- Fully adjustable interior mounting systems for any card or card spacing within size limitations. No cutting or drilling necessary.
- Perforated bottom cover for cooler operation.



VP-1 **\$183.00**  
Shipping Weight 25 lbs.



VP-2 **\$159.00**  
Same as VP1 except cards oriented side to side.

## 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 April 1979

phone orders welcome (213) 894-8171

OEM and Institutional inquiries invited.

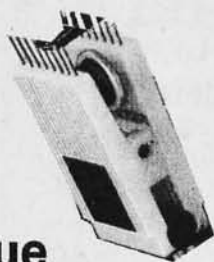
ORDER TODAY 1-800-423-5633

Visit our new retail location!

**FREE!**

16 Pin Test Clip With  
The Purchase Of  
A.C.E. BOARD

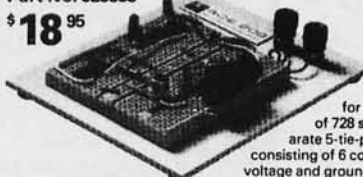
a **\$4<sup>75</sup>** Value



**ALL-CIRCUIT  
EVALUATORS**

**A.C.E. 200-K**  
Part No. 923333

**\$18<sup>95</sup>**

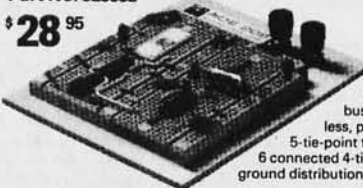


**728 SOLDERLESS PLUG-IN TIE POINTS**  
CAPACITY: UP TO 8 16-PIN DIP's  
• Two 5-way binding posts  
• Size: 4-9/16" by 5-9/16"  
• Kit form — lowest cost

This handy breadboard kit, the smallest in the ACE series, offers excellent versatility for small circuit check-out. The universal matrix of 728 solderless, plug-in tie points includes 136 separate 5-tie-point terminals and 2 distribution buses, each consisting of 6 connected 4-tie-point terminals... typically for voltage and ground. Complete assembly instructions included.

**A.C.E. 208**  
Part No. 923332

**\$28<sup>95</sup>**

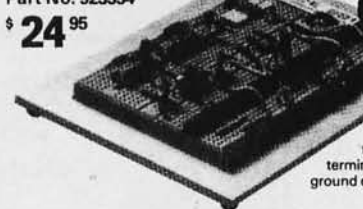


**872 SOLDERLESS PLUG-IN TIE POINTS**  
CAPACITY: UP TO 8 16-PIN DIP's  
• Two 5-way binding posts  
• Size: 4-9/16" by 5-9/16"  
• Fully assembled

Model 208, the smallest assembled board in the ACE series, has 6 more distribution buses than the 200-K. The matrix of 872 solderless, plug-in tie points is comprised of 136 separate 5-tie-point terminals plus 8 distribution buses, each with 6 connected 4-tie-point terminals. Use buses for voltage and ground distribution, reset lines, clock lines, shift command, etc.

**A.C.E. 201-K**  
Part No. 923334

**\$24<sup>95</sup>**

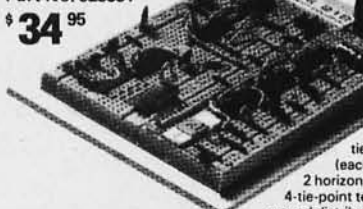


**1,032 SOLDERLESS PLUG-IN TIE POINTS**  
CAPACITY: UP TO 12 14-PIN DIP's  
• Two 5-way binding posts  
• Size: 4-9/16" by 7"  
• Kit form

Here's the larger of the two kits in the ACE series... for larger circuit-building capacity. The matrix is 1032 solderless, plug-in tie points comprised of 192 separate 5-tie-point terminals and 2 distribution buses, each with 9 connected 4-tie-point terminals. Buses are typically used for voltage and ground distribution. Assembly instructions included.

**A.C.E. 212**  
Part No. 923331

**\$34<sup>95</sup>**



**1,224 SOLDERLESS PLUG-IN TIE POINTS**  
CAPACITY: UP TO 12 14-PIN DIP's  
• Two 5-way binding posts  
• Size: 4-9/16" by 7"  
• Fully assembled

Model 212 is identical with the 201-K kit except that it has more distribution buses for greater flexibility. The universal matrix of 1224 solderless, plug-in tie points consists of 192 separate 5-tie-point terminals, 6 vertical distribution buses (each with 9 connected 4-tie-point terminals) and 2 horizontal distribution buses (each with 6 connected 4-tie-point terminals). Buses can be used for voltage and ground distribution, reset & clock lines, shift command, etc.



**BREADBOARD JUMPER WIRE KIT**

Each kit contains 350 wires cut to 14 different lengths from 0.1" to 5.0".

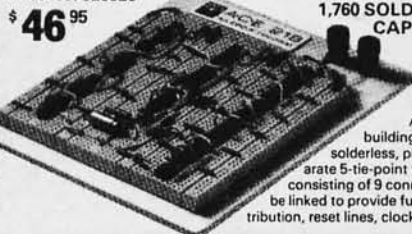
Each wire is stripped and the leads are bent 90° for easy insertion.

Wire length is classified by color coding. All wire is solid tinned 22 gauge with PVC insulation. The wires come packed in a convenient plastic box.

**JK1 923351 ..... \$10.00**

**A.C.E. 218**  
Part No. 923326

**\$46<sup>95</sup>**

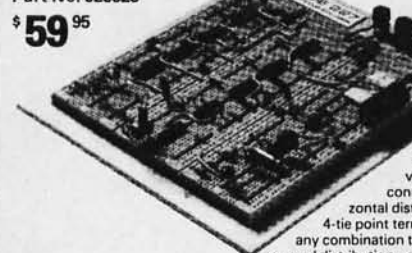


**1,760 SOLDERLESS PLUG-IN TIE POINTS**  
CAPACITY: UP TO 18 14-PIN DIP's  
• Two 5-way binding posts  
• Size: 6-1/2" by 7-1/8"  
• Fully assembled

This intermediate breadboard in the ACE series provides even greater circuit-building flexibility. The universal matrix of 1760 solderless, plug-in tie points is comprised of 288 separate 5-tie-point terminals and 10 distribution buses each consisting of 9 connected 4-tie-point terminals. Buses may be linked to provide functions such as voltage and ground distribution, reset lines, clock lines, shift command, etc.

**A.C.E. 227**  
Part No. 923325

**\$59<sup>95</sup>**

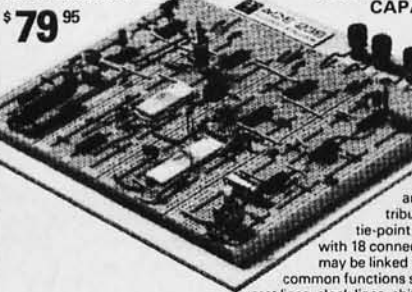


**2,712 SOLDERLESS PLUG-IN TIE POINTS**  
CAPACITY: UP TO 27 14-PIN DIP's  
• Four 5-way binding posts  
• Size: 8" by 9-1/4"  
• Fully assembled

Model 227 has greater capacity for components and more buses than the 218. The universal matrix of 2712 solderless, plug-in tie points is comprised of 384 separate 5-tie-point terminals, 24 vertical distribution buses (each with five connected 5-tie-point terminals) plus 4 horizontal distribution buses (each with 12 connected 4-tie-point terminals). Buses may be linked together in any combination to provide functions such as voltage and ground distribution, reset and clock lines, shift command, etc.

**A.C.E. 236**  
Part No. 923324

**\$79<sup>95</sup>**



**3,648 SOLDERLESS PLUG-IN TIE POINTS**  
CAPACITY: UP TO 36 14-PIN DIP's  
• Four 5-way binding posts  
• Size: 10-1/4" by 9-1/4"  
• Fully assembled

Model 236, the largest in the ACE series, offers the user virtually unlimited circuit-building flexibility. The universal matrix of 3,648 solderless, plug-in tie points is comprised of 512 separate 5-tie-point terminals, 32 vertical distribution buses (each with five connected 5-tie-point terminals) plus 4 horizontal buses (each with 18 connected 4-tie-point terminals). These buses may be linked in any combination to provide unique or common functions such as voltage and ground distribution, reset lines, clock lines, shift command, etc.

**HICKOK LX303**

ALL THE MOST WANTED FEATURES AT A MOST WANTED PRICE . . .

**\$74<sup>95</sup>**

**100mV DC F.C. Sensitivity 19 Ranges and Functions**

**Big 1/2" High LCD Display.**  
Use Indoors or Out  
**200 Hour 9V Battery life**  
Auto Zero, Polarity,  
Overrange  
Indication

Here is the handful of accuracy you've been waiting for. Handsomely encased. Compact. Efficient. Only 8 ounces. Hickok's exciting, new LX 303, 1 1/2 digit Mini-Multimeter with high quality components, one year guarantee and rugged Cyclocac® case offers features previously found only in expensive units . . . at a price under \$75.00! So why wait any longer? The amazing LX 303 is here, NOW! Another American made test equipment breakthrough from Hickok.



Removable cover stores test lead set furnished as part of the unit.



- Available Accessories
- BC-3 115V AC Adapter \$7.50
  - CC-3 Deluxe Padded Vinyl Carrying Case \$7.50
  - VP-18 400 Ohm Probe Adapter \$14.95
  - VP-40 400V AC Probe \$24.50
  - CS-1 10 Amp Current Shunt \$14.95



**SPECIFICATIONS:**  
DC VOLTS (5 RANGES): 0.1mV to 1000V; Accuracy ± 0.5% rdg ± 0.5% f.s.; Input Imped: 10MΩ; Max. Input: 1kV except 500V on 200mV range.  
AC VOLTS (40Hz to 5kHz): 0.1V to 600V; Accuracy: ± 1.0% rdg ± 0.5% f.s. (-2dB max. at 5kHz); Max. Input: 600V.  
RESISTANCE (6 LOW POWER RANGES): 0.1Ω to 200MΩ; Accuracy: ± .05% rdg ± 0.5% f.s. (± 1.5% rdg on 20MΩ range); Input protected to 120VAC all ranges.  
DC CURRENT (6 RANGES): .01nA to 100mA; Accuracy: ± 1.0% rdg ± 0.5% f.s.  
DIMENSIONS AND WEIGHT: 5-7/8" x 3-3/8" x 1-3/4", 8 oz.; POWER: 9V battery (not included) or Hickok AC adapter; READ RATE: 3/sec.

**PRIORITY ONE ELECTRONICS**

16723B Roscoe Blvd. Sepulveda, CA 91343

Terms VISA, MC, BAC, check, Money Order, L.O.D., U.S. Funds Only. LA 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 April 1979

Send for our latest brochure

phone orders welcome (213) 894-8171

OEM and Institutional inquiries invited

**ORDER TODAY**  
1-800-423-5633

Visit our new retail location!

Visit our new retail location!



## TRS-80 USERS

"The Wait is finally over"

### ACT - I Software

- Computerized Home Money Management System.
- Save time and gain budget control.
- Take the work and worry out of money management.
- Weekly, Monthly, & Annual totals for Income, Payments, Taxes & Interest.
- Checking account maintenance including 5 week projected check balance.
- EASY TO USE, ON ONE CASSETTE, 16K, Level II.
- ACT - 1 Monthly Newsletter keeps you up to date.
- Software, Documentation & User Instructions.

For Information:

**THE PROGRAMMING SHOP**  
260 Sheridan Ave  
Palo Alto, CA 94306

Circle 306 on inquiry card.

## AURORA, IL. AREA FARNSWORTH COMPUTER CENTER

1891 N. Farnsworth Ave.  
At the E-W Tollway  
Aurora, IL.

Ph. 312-851-3888

Personal & Business  
Microcomputers, Peripherals

- Apple
- Cromemco
- North Star

APPLE II 16K RAM \$1195.00

Including

20 FREE PROGRAMS

• Add on Memory \$150.00

Weekdays 12 to 8, Sat. 10 to 5

Circle 132 on inquiry card.

## ★—Star Base Aries—★

In order to dock your space shuttle with Star Base Aries™ you must monitor and alter range, linear velocity, life support, angle of attack and fuel. This accurate real time simulation is currently available in a high resolution graphic format for the Apple II (16K tape \$15.00, disc \$18.00). Also available for the TRS-80 Level I (\$10.00). Please specify. Forward check or money order to:

ISDG Inc.  
312 Highgate Avenue  
Buffalo, New York 14215

(N.Y. State residents add 7% sales tax)  
ALLOW 6 WEEKS FOR DELIVERY



Circle 182 on inquiry card.

## THE FRUGAL FRONT PANEL Series PCB's

5-100 DISPLAY-SENSE BOARD - Kit \$89.95, Board/Data \$29.95

• On Board or Remote DATA/ADDRESS/STATUS LED'S & SENSE

• Buffered, Gold Edge Contacts, Silkscreen, Soldermasked PCB

REMOTE HEX PANEL - Kit \$69.95, Board/Data \$22.95

• Six 7 Segment Hex Displays for DATA & ADDRESS

• Six Status LED'S, Eight SENSE & Two AUX Switches

• Cables Included for use with DISPLAY SENSE Board

• SPECIAL \$149.95 for both HEX PANEL & DISPLAY-SENSE

REMOTE BINARY PANEL - Kit \$64.95, Board/Data \$22.95

• For Front Panel Mounting of LED'S and Switches

• 30 LED'S, Octal Format, Two AUX & Eight SENSE Switches

• Cables Included for use with DISPLAY SENSE Board

• SPECIAL \$144.95 for both BINARY PANEL & DISPLAY-SENSE

## COMPUTER CANOPY DUST COVERS

• Attractive, Heavy Duty Upholstery Vinyl, Textured Walnut Standard

• For TRS-80 Keyboard \$9.95 For APPLE II \$12.95

• For H-8, H-11, Horizon, Integrand 8000: \$14.95

• For PET, ADM-3, H-9, ACT IVD, Hazeltine 1500/1510/1520: \$16.95

Add \$1.75 shipping per item; excess will be refunded. Add \$1 for COD's.

Texas add 5% tax. M.C., VISA, M.O. & COD Welcome

CHECK WITH YOUR LOCAL COMPUTER STORE FOR AVAILABILITY



Digital Dynamics, Inc.

Department #  
Post Office Box 27243  
San Antonio, TX 78227

Circle 87 on inquiry card.

## CROMEMCO

Less 20%

System II - System III

## NORTHSTAR

Less 15%

Horizon & Boards

Sara Tech Electronics, Inc.

P.O. 692

Venice, FL 33595

(813) 485-3559

Circle 317 on inquiry card.

## It's sub LOGIC for graphics!

The best \$100 graphic  
display boards!

MATROX ALT-256

(256 x 256 resolution)

MATROX ALT-512

(512 x 256 x 1 or  
256 x 256 x 2 resolution)

And the best graphics  
software for support!

The engineering  
& graphics  
people

(217) 367-0299

sub LOGIC  
Box V, Savoy, IL 61874

Call 8 to 6 Monday thru Saturday

Circle 357 on inquiry card.

## WEB ASSOCIATES

NEW!  
for your  
TRS-80™

GET UNSTUCK!  
with  
TBUFF™

Please state recorder  
Make, Model and  
Mfg. Code (inside  
Batt. comp't.)

STOP YOUR  
CASSETTE WHEN  
IT SHOULD WITH TBUFF™ \$12.95 ea.

Is the "sticking" relay problem preventing  
your TRS-80™ recorder from stopping when it  
should?

If so, simply plug our miniature TBUFF™ in  
line with your REMOTE cable between your  
TRS-80™ and the recorder and stay unstuck  
forever!

Dealer inquiries invited  
Club discounts available



Send check or money order to:  
**WEB ASSOCIATES**  
P.O. Box 60-BA Monrovia, CA 91016  
(California Residents add 6% tax)

Circle 385 on inquiry card.

## FLOPPY DISK REPAIR



- PerSci and Shugart
- Quick turnaround
- Factory trained on PerSci



National Computer Service

7501 Sunset Blvd

Hollywood CA 90046

213-851-2226

Circle 270 on inquiry card.

## WORD PROCESSING

MICRO FILE MK IIA

Demo Unit — One Only  
Original retail price \$8,755

Extended BASIC  
Assembler  
Document Processor  
Editor  
Letter Writer  
Complete Documentation

Reduced for Quick Sale \$5,495

SUNNY COMPUTER STORES, INC.  
University Shopping Center  
1238A S. Dixie Hwy.  
Coral Gables, FL 33146  
(305) 661-6042

Circle 361 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) . \$399<sup>00</sup>
- VP-1 COMPUTER/VIDEO INTERFACE KIT (3 BOARDS) . . . . . \$599<sup>00</sup>
- ASSEMBLED 8K MEMORY BOARD (OPTIONAL) . . . . . \$235<sup>00</sup>

**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. (OV PROTECT) \$75.00

### C/MOS (DIODE CLAMPED)

4001	-18	4010	-37	4050	-35	74C74	-45
4002	-18	4020	-90	4053	-110	74C83	-15
4006	-95	4021	-90	4055	-125	74C86	-40
4007	-18	4022	-90	4066	-70	74C93	-75
4009	-37	4023	-18	4068	-45	74C151	140
4010	-37	4024	-75	4071	-15	74C150	105
4011	-18	4025	-18	4072	-21	74C161	105
4012	-18	4027	-37	4076	-95	74C174	105
4013	-29	4028	-80	4520	-70	74C175	105
4014	-15	4029	-95	74C00	-22	74C192	120
4015	-75	4030	-33	74C02	-22	74C193	120
4016	-29	4035	-97	74C06	-22	74C901	48
4017	-105	4042	-65	74C10	-27	74C902	48
4018	-90	4049	-35	74C73	-65	74C914	120

### PRINTED CIRCUIT BOARD

4-1/2" x 6-1/2" SINGLE SIDED EPOXY BOARD 1/16" thick, unetched \$5/2.60

**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 3/52.00

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 connector.

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

8130	-2.95	8834	-2.25
8131	-2.95	8837	-2.25
8T380	-2.25	8838	-2.25
8830	-2.95		

### Silicon Power Rectifiers

PRV	1A	3A	12A	50A	125A	240A
100	06	14	30	80	370	5.00
200	07	20	35	115	425	6.50
400	09	25	50	140	6.50	9.50
600	11	30	70	180	8.50	12.50
800	15	35	90	230	10.50	16.50
1000	20	45	110	275	12.50	20.00

SAD 1024 a REDICON 1024 stage analog "Bucket Brigade" shift register. \$14.95

1N 4148 (1N914) 15/\$1.00

RS232 DB 25P male \$2.25  
DB 25S female \$2.95  
HOODS \$1.00

### REGULATORS

323K -5V 3A	\$.575	34K -12, 15 or 24 V.	\$.110
309K	\$.110	340T -5, 6, 8, 12	\$.110
723	\$.50	320T	15, 18 or 24V \$1.10
5, 12, 15 or 24	\$.110	78 MG	\$.135
		79 MG	\$.135

### TRANSISTOR SPECIALS

2N6233-NPN SWITCHING POWER \$ 1.95  
MRF-8004 a CB RF Transistor NPN \$ .75  
2N3772 NPN Si TO 3 \$ 1.00  
2N154G PNP GE TO 3 \$ .75  
2N4908 PNP Si TO 3 \$ 1.00  
2N5086 PNP Si TO 92 4 \$ 1.00  
2N3137 NPN Si RF \$ .55  
2N3919 NPN Si TO 3 RF \$ 1.50  
2N1420 NPN Si TO 5 3/\$ 1.00  
2N3767 NPN Si TO 66 \$ .70  
2N2222 NPN Si TO 18 5 \$ 1.00  
2N3055 NPN Si TO 3 \$ .50  
2N3904 NPN Si TO 92 6/\$ 1.00  
2N3906 PNP Si TO 92 6/\$ 1.00  
2N5296 NPN Si TO 220 \$ .50  
2N6109 PNP Si TO 220 \$ .55  
2N3638 PNP Si TO 5 5 \$ 1.00  
MPSA 13 NPN Si . . . . . 4/\$ 1.00

### TTL IC SERIES

7400	-15	7448	-68	74153	-81
7401	-15	7449	-58	74154	-84
7402	-15	7450	-68	74155	-88
7403	-15	7451	-18	74157	-85
7404	-15	7452	-25	74158	-85
7405	-15	7453	-28	74159	-85
7406	-18	7454	-28	74162	-80
7407	-18	7455	-45	74163	-85
7408	-27	7456	-30	74164	-85
7409	-24	7460	-21	74165	-85
7410	-18	7461	-25	74170	1.88
7411	-18	7462	-87	74171	-85
7412	-18	7463	-87	74172	-75
7413	-36	7464	-42	74173	-75
7414	-60	7465	-43	74177	-75
7415	-25	7466	-43	74178	-85
7416	-22	7467	-43	74179	-85
7417	-22	7468	-43	74180	-85
7418	-18	7469	-43	74181	-1.90
7419	-25	7470	-43	74182	-1.00
7420	-30	7471	-43	74183	-1.00
7421	-22	7472	-43	74184	-1.00
7422	-38	7473	-28	74185	-1.00
7423	-18	7474	-30	74186	-1.00
7424	-22	7475	-40	74187	-1.00
7425	-22	7476	-40	74188	-1.00
7426	-22	7477	-40	74189	-1.00
7427	-22	7478	-40	74190	-1.00
7428	-22	7479	-40	74191	-1.00
7429	-22	7480	-40	74192	-1.00
7430	-22	7481	-40	74193	-1.00
7431	-22	7482	-40	74194	-1.00
7432	-22	7483	-40	74195	-1.00
7433	-22	7484	-40	74196	-1.00
7434	-22	7485	-40	74197	-1.00
7435	-22	7486	-40	74198	-1.00
7436	-22	7487	-40	74199	-1.00
7437	-22	7488	-40	74200	-1.00
7438	-22	7489	-40	74201	-1.00
7439	-22	7490	-40	74202	-1.00
7440	-18	7491	-40	74203	-1.00
7441	-18	7492	-40	74204	-1.00
7442	-18	7493	-40	74205	-1.00
7443	-18	7494	-40	74206	-1.00
7444	-18	7495	-40	74207	-1.00
7445	-18	7496	-40	74208	-1.00
7446	-18	7497	-40	74209	-1.00
7447	-18	7498	-40	74210	-1.00

### DATA CASSETTES 1/2 HR \$ .95

14 pin headers 3/\$1.00

MM 53B7AA new clock chip which will directly drive LSI'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 P-DPDT CENTER OFF \$ 1.85  
MSD 206 P-DPDT CENTER OFF \$ 1.85  
LEVER SWITCH \$ 1.85

### Full Wave Bridges DIP SOCKETS

PRV	2A	6A	25A	8 PIN .17	24 PIN .35
100			1.30	14 PIN .20 <td>28 PIN .40</td>	28 PIN .40
200	.75	1.25	2.00	16 PIN .22 <td>40 PIN .60</td>	40 PIN .60
400	.95	1.50	3.00	18 PIN .25	
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

### TANTULUM CAPACITORS

.22UF 35V 5/\$1.00	6.8UF 35V 4/\$1.00
.47UF 35V 5/\$1.00	10UF 10V \$2.25
.68UF 35V 5/\$1.00	22UF 25V \$ .40
1UF 35V 5/\$1.00	15UF 35V 3/\$1.00
2.2UF 20V 5/\$1.00	30UF 5V 5/\$1.00
3.3UF 20V 4/\$1.00	33UF 20V \$ .40
4.7UF 15V 5/\$1.00	47UF 20V \$ .35
	68UF 15V \$ .50

### 74LS SERIES LINEAR CIRCUITS

74LS00	-31	74LS128	-94	LM 101	-75
74LS01	-31	74LS129	-94	LM 301/748	25
74LS02	-31	74LS130	-94	LM 307	-30
74LS03	-31	74LS131	-94	LM 308	-75
74LS04	-34	74LS132	-97	LM 311	-75
74LS05	-34	74LS133	-97	LM 318	-1.20
74LS06	-34	74LS134	-97	LM 324	-70
74LS07	-34	74LS135	-97	LM 339	-1.10
74LS08	-34	74LS136	-1.21	LM 338	-70
74LS10	-31	74LS137	-1.21	LM 370	-1.15
74LS11	-31	74LS138	-1.21	LM 377	-1.60
74LS12	-31	74LS139	-1.21	LM 380	-95
74LS13	-31	74LS140	-1.21	LM 382	-1.25
74LS14	-31	74LS141	-1.21	LM 3256	-80
74LS15	-31	74LS142	-1.21	LM 380	-95
74LS16	-31	74LS143	-1.21	LM 382	-1.25
74LS17	-31	74LS144	-1.21	LM 382	-1.25
74LS18	-31	74LS145	-1.21	LM 382	-1.25
74LS19	-31	74LS146	-1.21	LM 382	-1.25
74LS20	-31	74LS147	-1.21	LM 382	-1.25
74LS21	-31	74LS148	-1.21	LM 382	-1.25
74LS22	-31	74LS149	-1.21	LM 382	-1.25
74LS23	-31	74LS150	-1.21	LM 382	-1.25
74LS24	-31	74LS151	-1.21	LM 382	-1.25
74LS25	-31	74LS152	-1.21	LM 382	-1.25
74LS26	-31	74LS153	-1.21	LM 382	-1.25
74LS27	-31	74LS154	-1.21	LM 382	-1.25
74LS28	-31	74LS155	-1.21	LM 382	-1.25
74LS29	-31	74LS156	-1.21	LM 382	-1.25
74LS30	-31	74LS157	-1.21	LM 382	-1.25
74LS31	-31	74LS158	-1.21	LM 382	-1.25
74LS32	-31	74LS159	-1.21	LM 382	-1.25
74LS33	-31	74LS160	-1.21	LM 382	-1.25
74LS34	-31	74LS161	-1.21	LM 382	-1.25
74LS35	-31	74LS162	-1.21	LM 382	-1.25
74LS36	-31	74LS163	-1.21	LM 382	-1.25
74LS37	-31	74LS164	-1.21	LM 382	-1.25
74LS38	-31	74LS165	-1.21	LM 382	-1.25
74LS39	-31	74LS166	-1.21	LM 382	-1.25
74LS40	-31	74LS167	-1.21	LM 382	-1.25
74LS41	-31	74LS168	-1.21	LM 382	-1.25
74LS42	-31	74LS169	-1.21	LM 382	-1.25
74LS43	-31	74LS170	-1.21	LM 382	-1.25
74LS44	-31	74LS171	-1.21	LM 382	-1.25
74LS45	-31	74LS172	-1.21	LM 382	-1.25
74LS46	-31	74LS173	-1.21	LM 382	-1.25
74LS47	-31	74LS174	-1.21	LM 382	-1.25
74LS48	-31	74LS175	-1.21	LM 382	-1.25
74LS49	-31	74LS176	-1.21	LM 382	-1.25
74LS50	-31	74LS177	-1.21	LM 382	-1.25
74LS51	-31	74LS178	-1.21	LM 382	-1.25
74LS52	-31	74LS179	-1.21	LM 382	-1.25
74LS53	-31	74LS180	-1.21	LM 382	-1.25
74LS54	-31	74LS181	-1.21	LM 382	-1.25
74LS55	-31	74LS182	-1.21	LM 382	-1.25
74LS56	-31	74LS183	-1.21	LM 382	-1.25
74LS57	-31	74LS184	-1.21	LM 382	-1.25
74LS58	-31	74LS185	-1		



### Special Sale!

DATA TERMINAL  
PRINTER **\$399**

We Buy-Sell-Trade all brands &  
models of Data Processing  
Equipment.



USB-330 10/30 CPS Impact  
Printing Tractor Feed 132 Print Positions  
10-Key Pad

Nearly a million dollars in inventory  
Call for price quotes

**214/357-5725**

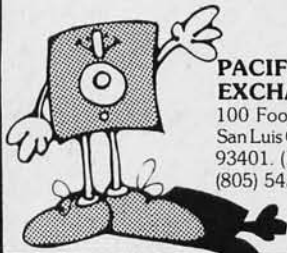


**U.S. BROKERS CO.**  
A Division of CM Corp.  
2636 Walnut Hill Lane  
Suite 347  
Dallas, Texas 75229

Circle 379 on inquiry card.

## Memorex Floppy Discs

Lowest prices. **WE WILL NOT  
BE UNDERSOLD!** Buy any  
quantity 1-1000. Visa, Mastercharge  
accepted. Call free (800)235-4137  
for prices and information. All  
orders sent postage paid.



**PACIFIC  
EXCHANGES**  
100 Foothill Blvd.  
San Luis Obispo, CA  
93401. (In Cal. call  
(805) 543-1037.)

Circle 293 on inquiry card.

## The first microcomputer shopping guide!

Computer Data Publishing  
P.O. Box 598  
Cleveland, Ohio 44107  
(216) 221-5440

## Companies...

Do we have your product information?

Circle 54 on inquiry card.

## Unclassified Ads

FOR SALE: TI TM990/100M-1 microcomputer board with TIBUG monitor in read only memory, 256 words of programmable memory, TM990/103 microterminal, TM990/511 extender board and all documentation. It is a great little machine. I just don't have time to build a system around it. List price is over \$750. It's yours for \$550 postage paid. W H Ganoe, 1634 E Drachman, Tucson, AZ 85719.

FOR SALE: Like new 33ASR. Purchased new and seldom used, \$850. 101C data set (110 bps modem) very nice, \$200. CCU to interface 33ASR with 101C, \$100. All three \$1,000. Joe Turtle, POB 147, Corunna MI 48817, (517) 743-4607 after 6 PM.

SCHOOL SALE TO RAISE MONEY: Two Mohawk Data Sciences super compact card readers model SCCR 6002 (6 2/3 cards per second), two A B Dick videojet ink-jet printers model 9600 (250 characters per second, with parallel interface). Both appear to be working and are hardly used. Also selling three Micro Systems Inc Micro 810 computers. They are microprogrammable, 220 ns, with teletypewriter interface and a combined total of 16 K core memory. The Berkeley High School Technology Club is selling these to raise money for projects, activities, etc. Any reasonable offer considered. Contact Eric Martinot, 2206 B Jefferson Av, Berkeley CA 94703, (415) 849-2663.

FOR SALE: Heath microprocessor course and trainer. Includes all accessories, instructions, and course examination. \$200. A Alberto, 634 Blvd East, Weehawken, NJ 07087, (201) 864-1472.

HELP: For ND-812/BR-2412 users. Is there any existing users group for the ND-812 or BR-2412 minicomputer; or are there any other individual users of these orphaned systems who would like to communicate for mutual support? Write or phone: Bill Hunt, 237 South Blvd, Oak Park IL 60302, (312) 366-0194.

FOR SALE: Altair 8800 microcomputer with 28 K memory; has 3 P+S, cassettes user tape system board, VDM, 16 K read only memory board with monitor, 1 K board for stack, and keyboard. Asking \$1400. Larry Belmontes Jr, 1762 Yale St, Corpus Christi TX 78416, (512) 855-2687.

WANTED: Drawings, schematics and pin out data to interface a Sycor Inc. Model 303 Key-Cassette to a microcomputer. Will pay for documentation. Jim Cook, 11451 Olson Dr, Garden Grove CA 92641.

FOR SALE: Prolog read only memory programmer with UV light eraser. Program, copy, read, or edit 1702 UV read only memories. Excellent condition in attache case. Cost \$2000. Sell for \$640. Bill Fujitsu, 1506 Sandcastle Dr, Corona del Mar, CA 92625.

FOR TRADE: Texas Instruments Silent 700 portable terminal, model number 725. Perfect working condition and clean. Want to trade for used Dacwriter II or video type terminal. Will consider sale outright. Mark Jay Hunt, 3040 Vista-monte Dr, San Jose CA 95118, (408) 265-7799 nights.

FOR SALE: Digital Group Z-80 system; 34 K; four Phidecks; keyboard; monitor; dress cabinets for all; all software (MaxiBASIC, Business BASIC, Assembler, Startrek, Chess, etc). Must sell - any reasonable offer accepted. John Case, 6703 Timberhill, San Antonio TX 78238, (512) 681-7504.

FOR SALE: TV camera parts; 7735A, Vidicon tube brand new \$30; 16 mm lens \$10; deflection and focus coil \$18; video amplifier \$5; and other miscellaneous goodies. Schematics available. Everything I have for \$45 plus shipping. S Stoddard, 12 Kathy Dr, Poquoson VA 23662, (804) 868-7682.

FOR SALE: Disk and tape drivers from GE-115 computer system plus disk packs and other parts. Also Teletype ASR33, \$500; Dura Mach-10 needs considerable work or good for parts, \$100; Altair 2-SIO board, \$100; XY plotter with 10 by 15 inch (25.4 by 38.1 cm) plotting bed, \$200; 72 CPS paper tape reader, \$25; 3M microfiche viewer/printer, \$100. Will consider trades. SASE for more information. Don Bailey, 19 Shaker Rd, Concord NH 03301.

FOR TRADE: 8080 FORTRAN MITS disk version for 8080 COBOL or MITS timesharing BASIC. Manuals included. K R Roberts, 10560 Main St, Suite 515, Fairfax VA 22030, (703) 378-7366, (703) 591-6008, (703) 691-0277.

FOR SALE: January thru December 1978 BYTE (volume 3) complete, mint condition, unopened. These 12 issues are yours for \$15 (includes fourth class shipping). Send check or money order to John Burnet, 10324 S Prospect Av, Chicago IL 60643.

FOR SALE: Two Solid State Music 4 K Static programmable memory boards from a working (and lovable) Altair 8800, asking \$80 each or both for \$150. Also have a working Digital Group TVC-F (video interface and audio cassette tool). It lists for \$195, but it's yours for \$130. Dale Morris, 4334 N Quincy, Kansas City MO 64117.

FOR SALE: Tektronix 535A scope with H wide-band preamp and M 4 trace plug-ins, \$400 plus shipping. Tektronix TM503 instrument module enclosure and two blank modules, new, \$200. MFE digital cassette drive, model 205, four cassettes with clock track and documentation, \$120. J A Titus, POB 242, Blacksburg VA 24060, (703) 951-9030.

FOR SALE: Three SD Sales 4 K static programmable memory boards, fully operational, with all documentation. 500 ns access, data read at PDBIN! All three shipped promptly for certified funds of \$180 (that's less than 1.5¢ per bit!). W Howard Adams, 1590 S Krameria St, Denver CO 80224, (303) 756-4052.

KIM USERS: Powerful console input monitor (CIM) lets you enter, edit, and execute programs from ASCII encoded keyboard on BASIC KIM. CIM modes are: address, program, text, data, increment, decrement, and execute. Complete documentation included for \$16.50 postage paid. Add \$5 for CIM cassette. E R Kittlaus, POB 2175, Seal Beach, CA 90740.

FOR SALE: BYTE issue numbers 1 thru 16 in mint condition for best offer. Dave Babcock, 107 SE Jay, Pendleton OR 97801.

FOR SALE: Panasonic 8 1/2 inch diagonal black and white video monitor with UHF type connectors. \$50 or best offer. Charles Baumer, 5055 W Drummond Pl, Chicago IL 60639, (312) 637-0414.

HALF PRICE SALE: Factory wired IMSAI 8048 Control Computer with 2 K programmable memory installed. New condition, runs perfectly, fully documented. \$190 via UPS. H A Chinn, 757 Bolanos Ct, Port Charlotte FL 33952, (813) 625-2032.

FOR SALE: Partially assembled SwTPC CT-64 terminal kit. Keyboard and video terminal completed and working with sockets for all integrated circuits. \$250. Allan J Hogue, RR 2, Norwalk IA 50211, (515) 462-3220.

### NEW UNCLASSIFIED POLICY

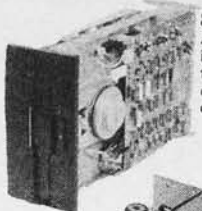
Readers who have equipment, software or other items to buy, sell or swap should send in a clearly typed notice to that effect. To be considered for publication, an advertisement must be clearly noncommercial, typed double spaced on plain white paper, contain 75 words or less, and include complete name 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.

**Electrolabs**  
 POB 6721, Stanford, CA 94305  
 415-321-5601 800-227-8266  
 Visa, American Express, Master

**Low Profile Socket Spectacular!!!**  
 Featuring a kind of "Mexican Handshake" principle, these sockets will NOT let your IC's vibrate out!! In 8,14,16,18,20,22,24,28 & 40 Ict/pin 1000+ :.75/pin, 20,000+ :.65/pin



**8" Siemens FDD120-8 Drive**  
 All Siemens's options included in this drive which can be configured hard or soft and single or double density. (Others give only stripped unit) \$425.00

**"Power One" Model CP206 Floppy Power Unit.** For two drives going full-out, and possibly more on less severe service. 2.8A@24V, 2.5A@5V, 0.5A@-5V. Beautiful quality. \$99.00

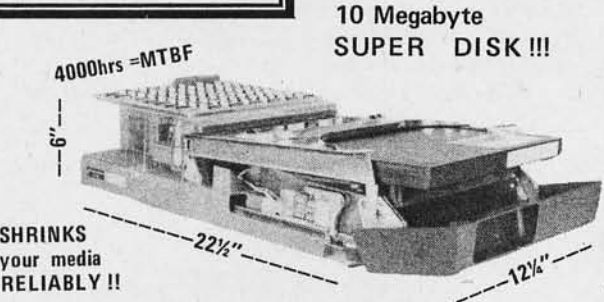
**DISKETTES (Standard)**  
 8" Boxed 10 \$39.00  
 5 1/4" Boxed 10 \$34.95

**Tarbell ("It Works") Interface**  
 (Includes cable set for 2 drives) \$265.00 BUT ONLY \$219.00 with purchase of two drives.

**Cable Kits 10'** with 50 cond. cable and connectors and also Molex connectors and power cable: For one drive: \$27.50 For two drives: \$33.95, and for three drives: \$38.95

**CABINETS** for FDD120 and 801R Drives, or CP206 power supply. Matte finish in mar resistant black epoxy paint. Stacking type design. \$29.99

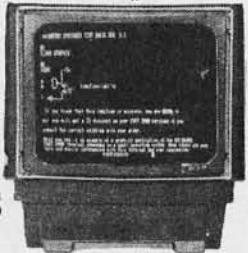
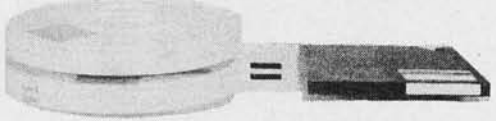
**Used Sylvania 12" Video Monitors.** Composite video 15mhz, 115vac, 50/60hz New Tube. As shown \$109 OEM style without case: \$99, Anti-glare tube option add \$12. Specify p4 or p39



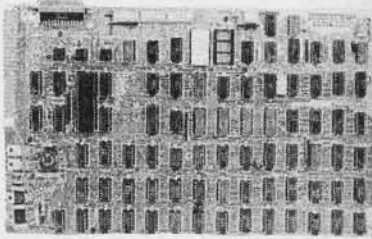
**NEW PRODUCT RELEASE !!!**

**SHRINKS your media RELIABLY !!**

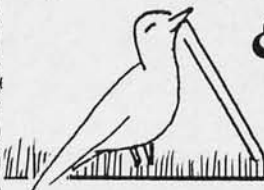
**NEW Breakthrough In Size, Weight (39lbs) Power (125W) Performance (3600rpm) and cost effectiveness (10 MBy and controller for \$6750.00) For PDP-11, LSI-11 AND S-100 machines**



**ESAT200B (Bi-Lingual) 80X24 Communicating Terminal**  
 Scrolling, Full Cursor, Bell, 8X8 matrix, 256 addressable characters 110-19,200 baud, etc, etc ..... This terminal has been purchased by many agencies, universities & companies. Fully stand-alone, it is the only dual font terminal of any kind for less than \$2500. Supplied complete and fully guaranteed: (many graphics applications) \$349.00



**Early-bird Specials...**



**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 . \$650.00
- **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

- **DIABLO HYTYPE I Model 1200 Printer Mechanism:** used, complete and operational. Requires power supply, case & mCPU interface. 15 day return privilege - no other warranties. LIMITED QUANTITY! . . . . . \$750.00  
 -6' Ribbon cable & connector for printer Main Logic PCB . . . . . \$10.00  
 -14-pin Winchester connector & 18" power supply cable . . . . . \$5.00  
 -"As-is" spare printer PCB's for parts (Logic, Heat Sink, Control): ea. \$20.00
- **NEW TAPE DRIVE CONTROLLER for Microcomputer:** POS Version II tape drive controller is now available, permitting the 8080 or Z-80 owner to read and write standard IBM NRZ1 format tapes (as well as ASCII tapes) with the Ampex Model TMX tape drive described below. Controller is sold only with tape drive, comes complete with connector cables to CPU and software listing in 8080 assembly language (specify 2MHz or 4MHz system.)  
 -Ampex TMX tape drive (used) with Version II Controller . . . . . \$1500.00
- **AMPEX MODEL TMX TAPE DRIVE:** Ideal for microcomputerist who wants backup mass storage or access to IBM-type systems via standardized 2400 series 1/2" mag tape. Specs: 9-track, NRZ1 standard, 800 BPI, 12"/sec., 1200 ft. reels (11 megabyte capacity.) Drive is like new & comes with 8-bit CPU controller diagram (requires only 11 I/C's) & mCPU interface instructions: Prices: Drive & Documentation. . . . . \$750.00  
 Controller & cable for mCPU, assembled & tested . . . . . \$250.00
- **DIGITAL CASSETTE DRIVE** (from GTE/IS Terminal): 1800 baud, 6"/sec; AC motor; fwd/revnd circuitry plus tape head, no read/write electronics \$25.
- **FORMS TRACTORS,** Moore Variable width "Form A-Liner" for print terminals:  
 a) Model 565P for 15" Carriage IBM Selectrics (new) . . . . . \$50.00  
 b) Model K81 for QUME or DIABLO Hytype I or II printers (new): . . . . . \$90.00
- **POWER SUPPLIES** for Disk Drive, mCPU, tested under load shown:  
 -No. 519 (w/fan & AC cord): +5V reg., ±12V reg., +24V, @5A (10 lb.) . . . \$29.95  
 -LAMBDA No. LMEE5 w/OV protect: +5V reg. @ 25A (35 lb.) . . . . . \$59.95

**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.



# 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.
1	Aaron Associates 234	95	DRC (CA) 235	211	Microware 206	319	Michael Shroyer Software 155
2	Administrative Systems 165	100	DRC (TX) 255	231	The Micro Works 173		Shugart 6, 7
4	Advanced Memory Technology 253	101	DISKS Etc 244	232	Micro World 33	323	'68' Micro Journal 244
3	AJA Software 235	102	Doubleday & Company 231	230	Mikos 270	333	Small Business Computers Magazine 232
5	Alladin Automation 15	105	Echo Design & Development 192	233	Minicomputer Accessories 232	327	Ed Smith's Software Works 227
8	Ancrona 270	108	Eclectic Corp (Div of TANO Corp) 49	236	Mini Computer Suppliers Inc 225	328	Smoke Signal Broadcasting 39
12	Apparat, Inc 196	110	Ecosoft 244		* MJB Computer Associates 244	321	Software 80 159
15	Apple Computer 5	115	Electrolabs 279	255	Morrow/Thinker Toys 30, 31	325	Software Dynamics 235
19	ATV Research 253	120	Electronic Control Tech 169	265	mpi 209	335	SSM 25
20	Austin Electronics 269	125	Electronic Systems 252	267	Mullen Computer Boards 241	340	Solid State Sales 277
22	Base 2 133	130	Electronics Warehouse 265	270	National Computer Service 276	330	Soroc Technology Inc 35
30	Beckian Enterprises 254	131	EMM/Semi Inc 229	278	National Multiplex 137	350	Southwest Technical Products Corp CII
23	Beta Business System 253	132	Farnsworth Computer 276		* NCC '79 Personal Comp Festival 181	351	Speakeasy Software 64
35	Bits Inc 156, 183, 187, 189	134	Federal Communications Corp 172	279	NCR Corp 73	352	Stirling Bekdorf 199
26	"Bumper Bits" 244	136	FMG Corp 130	281	NEECO 142	353	Structured Systems Group CIII
31	Business Applications Software 235	140	Garvey, Martin & Sampson 227	282	NEECO 143	357	Sub Logic 276
32	Buss/Charles Floto 221	144	Giltronics 244	280	Netronics Research 205	358	Summagraphics Corp 47
*	BYTE Back Issues 227	150	Godbout Electronics 141	287	Netronics Research 207	361	Sunny Computer Systems 276
36	BYTE Books 87, 93-96, 103, 105, 112	151	GRT 131		* New England Recruiters 242	354	Sunny International 272
*	BYTE Subscriber 221		* Hayden Book 200	283	Newman Computer Exchange 259	356	Sybox Inc 198
*	BYTE WATS Line 215	159	H & E Computers 211	285	North Star Computers 19, 63	355	Synchro Sound 99
37	California Computer Systems 13	160	Heath Company 17		* NRI Schools (Electronics Div) 65	359	Synergetics 215
39	California Digital 271	170	Hobby World 269	290	Ohio Scientific CIV, 36, 37	349	System Design Lab 219
42	Camelot Direct 127	174	Hollywood Systems 254	286	OK Machine & Tool 115	348	TANO Corp 119
44	Cascade Enterprises 247	176	Houston Instruments 29		* onComputing 81	360	Tarbell Electronics 51
45	Central Data 197	172	HUH Electronics 241		* Oregon Software 228	363	Technical Systems Consultants 97
47	Chrislin Industries 190	178	Independent Business Systems 16	292	Osborne & Associates 161	367	Terminal Systems 242
49	Circle Enterprises 221	171	Industrial Micro Systems 240		* Owens Associates 209	368	3/M Company 21
53	Computer Age 108	180	Innotronics 203	294	Pacific Digital 245	364	3 S Sales Inc 153
54	Computer Data Publishing 278	179	Integrand 230	293	Pacific Exchanges 278	366	3 S Sales Inc 272
70	Computer Enterprises 233	175	Interactive Microware Inc 223	296	Pacific Office Systems 279	365	Tiny C 52
68	Computer Factory (MA) 163	181	Interactive Sys Design Group 276, 242	297	PAIA Electronics Inc 196	371	Tora System Limited 242
*	Computer Factory 147	177	International Elec Equip 164	298	Parker Brothers 245	370	Total Information Services 225
71	Computer Interface Technology 242	183	Intertec Data Sys Corp 45	301	Per Com Data 56, 57	374	TransNet Corp 246
72	Computer Lab of NJ 243	190	Ithaca Audio 76, 77, 263	302	Personal Software Inc 148, 149, 244		* Trenton Computer Festival 189
75	Computerland 8, 9	195	Jade Co 260, 261	303	Pet Shack Software House 216	326	TRS-80 Software Exchange 139
66	Computer Mart of NJ & PA 108	200	Jameco Electronics 256, 257	305	Phone I 41	375	TSA Software 215
*	Computer Plus Inc 243	201	Jim-Pak 75	307	Potomac Micro-Magic Inc 219	304	University Microfilms 101
73	Computerware 187	205	Larks Electronics & Data 253	308	Potter's Programs 242	379	U S Brokers 278
74	Computhink 23		* Lifeboat Associates 82, 83	312	Priority I 273, 274, 275	382	US Robotics 140
*	Conley Graphics 230	202	Mad Hatter Software 151	300	Processor Technology 42, 43	380	Vanguard Systems Corp 109
78	CT Micro Computer 195	203	Mad Hatter Software 225	306	The Programming Shop 276	381	Vector Electronics 217
79	CT Micro Computer 209	209	Maxell Tape 71	309	PRS 89	383	Vector Graphics Inc 113
83	CT Micro Computer 248	215	Measurement Sys & Controls 121	310	Quality Software 228	386	Video World 209
76	Cover Craft 246	216	Measurement Sys & Controls 253	311	Quest Electronics 267	378	Vista Computer Co 268
77	Creative Software 204	217	Micro Architect 242	314	Radio Shack Authorized Sales Ctr 253	384	VR Data 203
80	Cromemco 1, 2	218	Microcomputer World 242	329	RCA (PA) 179	387	Wameco 266
81	Custom Computing 242	219	Micro Diversions 59	322	RCA Solid State 61	385	Web Associates 276
85	Cutting Edge of Technology 53	220	Micro Focus Ltd 123	324	Reston Publishing Company 222	388	Western Digital Corp 86
82	Cybernetic Micro Systems Inc 229	222	Micro-Mail 179	315	Rochester Data 222	389	Wintek 244
91	Data Discount Center 247	221	Micro Mart 253	316	S-100 Inc 215	390	World Power Systems Inc 68, 69, 78, 79
93	DataSearch 225	223	Micromation Inc 174, 175	317	Sara-Tech Electronics 276	395	Worldwide Electronics 253
88	Data Speed 125	204	Micro Mike's 234	331	S C Digital 233	397	X Comp 231
90	Datec 171	224	Micro Products Unltd 244	318	Scelbi Computer Consulting Inc 211	400	Xitex 134
89	Delta Products 251	229	Microsette 253		* Scientific Research 107	401	Xitex 135
87	Digital Dynamics 276	228	Microsoft 91	313	SCR Electronics 266	398	XL Computer Products 227
86	Digital Pathways 245	226	Microtronix 117	320	Semionics 208		

\*Correspond directly with company.

## BOMB— BYTE's Ongoing Monitor Box

Article No.	ARTICLE	PAGE
1	Ciarcia: The Toy Store Begins at Home	10
2	Campbell: Cross-Pollinating the Apple II	20
3	Zimmermann: Simulation of Physical Systems	26
4	Buskirk: Sources of Numerical Error	46
5	Smith: Smart Memory	54
6	Dahmke: A Simulated View of the Galaxy	66
7	Hinrichs: Marsport Here I Come	84
8	Meushaw: The Standard Data Encryption Algorithm	110
9	Gorney: Queuing Theory	132
10	Costas: Cryptography in the Field, Part 2	144
11	Soderstrom: Life Can Be Simple	166
12	Grappel: An Easy Way to Calculate Sines and Cosines	170
13	Arp: The Power of the HP-67 Programmable Calculator, Part 2	176
14	Cline: An Introduction to Microprogramming	210
15	Chester: A Digital Alphanumeric Display	218
16	Johnson: Microcomputer Time-sharing	224
17	Blodgett: A Binary Guessing Game	236

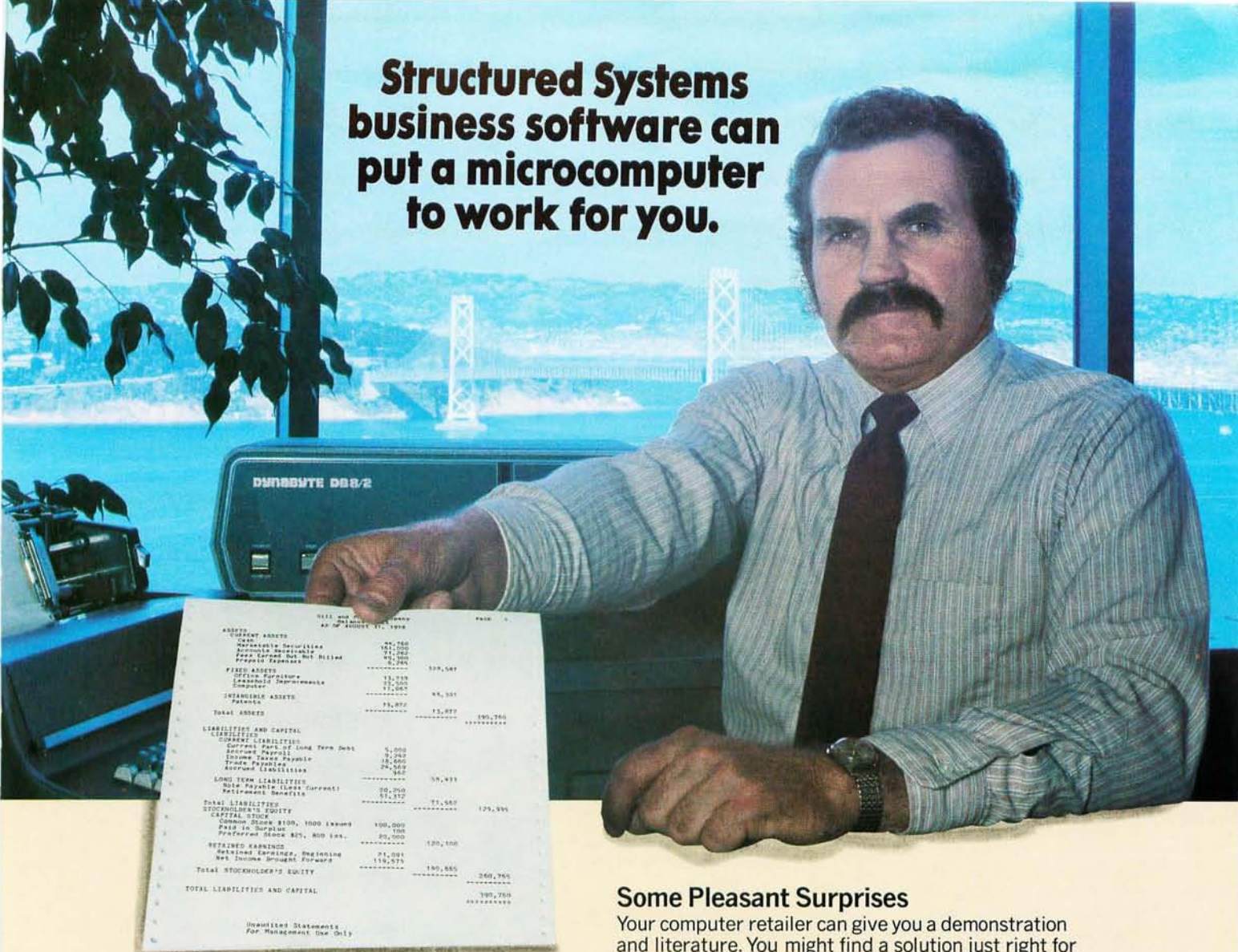
### Innovations and Home Security Top BOMB Scores

The January 1979 BOMB put a variety of topics at the top of our list. The first place prize of \$100 goes to Joel Boney and Terry Ritter for "A Microprocessor for the Revolution: The 6809" (page 14). The second place prize of \$50 went to Steve Ciarcia for "Build a Computer Controlled Security System for Your Home, Part 1 (page 56).

The third place article was "History of Computers: The IBM 704," by Keith Reid-Green (page 190). Fourth place was Part 4 of "Creating a Chess Player," by Peter Frey and Larry Atkin (page 126). ■



# Structured Systems business software can put a microcomputer to work for you.



1988 Year End Financial Summary  
As of August 31, 1988

<b>ASSETS</b>		
<b>CURRENT ASSETS</b>		
Cash	44,000	
Marketable Securities	140,000	
Accounts Receivable	21,000	
Prepaid Insurance	40,000	
Prepaid Expenses	20,000	
		325,000
<b>FIXED ASSETS</b>		
Office Furniture	14,700	
Equipment	11,000	
Computer	11,000	
		36,700
<b>INTANGIBLE ASSETS</b>		
Patents	10,000	
		10,000
<b>TOTAL ASSETS</b>		407,700
<b>LIABILITIES AND CAPITAL</b>		
<b>LIABILITIES</b>		
Current Port. of Long Term Debt	5,000	
Income Taxes Payable	20,000	
Trade Payables	20,000	
Accounts Payable	20,000	
		65,000
<b>LONG TERM LIABILITIES</b>		
Note Payable (Less Current)	20,000	
Retirement Benefits	10,000	
		30,000
<b>TOTAL LIABILITIES</b>		95,000
<b>STOCKHOLDERS' EQUITY</b>		
<b>CAPITAL STOCK</b>		120,000
Common Stock \$100, 1000 Shares	100,000	
Paid in Surplus	20,000	
Preferred Stock \$25, 800 Shares		0
<b>RETAINED EARNINGS</b>		120,000
Retained Earnings, Beginning	21,000	
Net Income Brought Forward	119,000	
<b>TOTAL STOCKHOLDERS' EQUITY</b>		260,700
<b>TOTAL LIABILITIES AND CAPITAL</b>		407,700

Financial Statements  
For Management Use Only

## Some Pleasant Surprises

Your computer retailer can give you a demonstration and literature. You might find a solution just right for your business with "off the shelf" prices and delivery times. Or we will be happy to send you literature direct, including a list of our dealers and compatible hardware. Write us, or call.

SSG's general accounting, data inquiry, mailing, and communications software packages are bringing real computer power to hundreds of businesses right now. They are ready to go to work for your business.

## The Honest-To-Business \$12,000 Computer\*

Our software will power DYNABYTE, CROMEMCO, IMSAI, NORTHSTAR, ALTOS, MICROMATION, DIGITAL SYSTEMS, or other Z-80 or 8080 based computers through your General Ledger, Accounts Receivable, and Accounts Payable. And maintain a conversational data-base query system, store and print your mailing list and labels, produce and edit correspondence, address it from your mailing list, and more. The price for a total system—hardware and SSG software—ranges from \$8,000 to \$14,000.

## Real Business Computing

Our Business Software packages are designed to be up and running and working for you in a matter of hours. Without expensive reprogramming, technical staff additions, or costly trial-and-error. Our quality is high, our documentation practically self-instructive. The applications are flexible and extensive, designed to meet and exceed the requirements of most small to medium businesses. Real computer solutions at microcomputer prices.



The SSG product line includes these outstanding packages:

General Ledger	LETTERIGHT Letter Writer
Accounts Receivable	NAD Mailing System
Accounts Payable	QSORT Sorting System
CBASIC-2	WHATSI? Data/Query System

## Structured Systems Group INCORPORATED

5204 Claremont Oakland, California 94618 (415) 547-1567

\* Complete prices will vary with equipment and software selected. Required: 8080 or Z-80 based computer running a CP/M or CP/M-compatible disk-based operating system. Your retailer or SSG can advise on specifics. (CP/M is a product of Digital Research.)



# 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-based 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