

## A McGraw-Hill Publication

## PROGRAMMING METHODS



## ***YOUR CHOICE-smart either way***

- Over 140 software driven functions
- 82 x 24 or 82 x 20 screen format — software selectable
- High resolution 7 x 12 matrix characters — P-31 green phosphor
- Upper/lower case character set — plus graphics character set
- 56-key alphanumeric keyboard — plus 12-key cursor, numeric pad
- Internal editing functions — insert, delete, scroll, roll, slide, etc.
- Parallel printer I/O port
- 50 to 38,400 baud operation — programmable
- Cursor type, cursor position, print control characters, protected fields, shift inversion, dual intensity and many other features

**8212** — twelve-inch diagonal screen or **8209** — nine-inch diagonal screen



SOUTHWEST TECHNICAL PRODUCTS CORPORATION  
 219 W. RHAPSODY  
 SAN ANTONIO, TEXAS 78216 (512) 344-0241

# Cromemco accepts your challenge, Data General

Yes, Data General, we saw your ad.

So we realize you hope to win over some of our computer business.

And we can see you have reason to be pleased about your line of minicomputers. They are MINIs though.

But Cromemco produces state-of-the-art MICROcomputers.

Powerful ones.

And our micros have some outstanding advantages.

For example, Cromemco is the only microcomputer manufacturer to support a broad range of microcomputers with (a) 5-inch

double-sided, double-density floppy disk drives and with (b) 8-inch double-sided, double-density floppy disk drives AS WELL AS (c) 8-inch Winchester hard disk drives.

That means, of course, that our customers have a wide choice of disk storage capability.

## UNEQUALLED SOFTWARE SUPPORT

OK. That was one point.

Here's another: our stunning selection of software support. Cromemco is the only micro manufacturer to produce both single-user and multi-user multi-tasking computers with software like this:

### SYSTEM SOFTWARE

- CDOS (a CP/M®\* -like operating system)
- CROMIX (a UNIX-like operating system)
- RPG-II (IBM-compatible)
- COBOL
- BASIC
- FORTRAN IV
- RATFOR
- LISP
- C
- Macro Assembler

### APPLICATION SOFTWARE

- Word Processing System
- Data-Base Management
- General Ledger
- Accounts Receivable
- Accounts Payable
- Inventory

All of this is available now with more coming all the time.

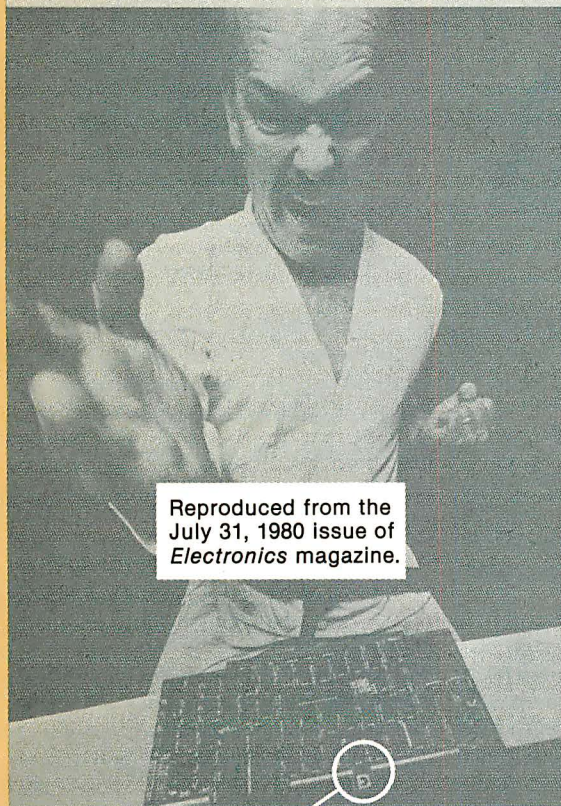
So there you are, D.G.

You can see why we know our microcomputers will stand the test.

Cromemco eagerly accepts the challenge.

\* CP/M is a registered trademark of Digital Research.

## WE'RE BUSTING THE COMPETITION'S BOARDS AGAIN.



Reproduced from the  
July 31, 1980 issue of  
*Electronics* magazine.

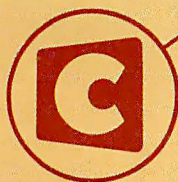
Announcing MBC/2 and MBC/3, the newest members of Data General's growing family of microNOVA™ board computers. They're the best computers on a board money can buy. You get up to 64K bytes of memory, serial and parallel I/O lines, and software support from MP/OS, our famous micro operating system. You even get supporting languages like MP/PASCAL and MP/FORTRAN IV. See for yourself.

	MBC/1	MBC/2	MBC/3	LSI/ TU/2	SRG/ BA/12
RAM Bytes	2K	8K	32K	8K	32K
PROM EPROM Bytes	4K	32K	32K	—	16K
Serial Lines	1	2	2	—	1
		ASYNC SYNC	ASYNC SYNC		
Dig I/O Lines	32	32	32	—	24
# Boards	1	1	1	2	1
Board Size	7.5x9.5	7.5x9.5	7.5x9.5	8.5x5.2	6.75x12

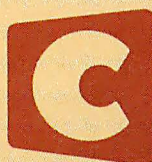
The competition will always sing the praises of their little single board computers. But from now on they'll be doing it falsetto.

Data General Corporation, Westboro, MA 01580, (617) 366-6911. microNOVA is a trademark of Data General. © Data General Corporation, 1980.

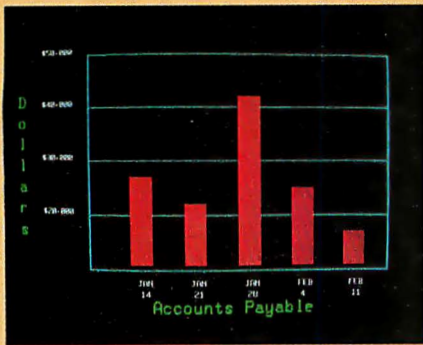
**Data General**  
Mail to: Data General Corporation, Westboro, MA 01580.  
If I don't need instant board, send complete information on the ABC product line. If I have, send a salesman ASAP.  
Tel. \_\_\_\_\_



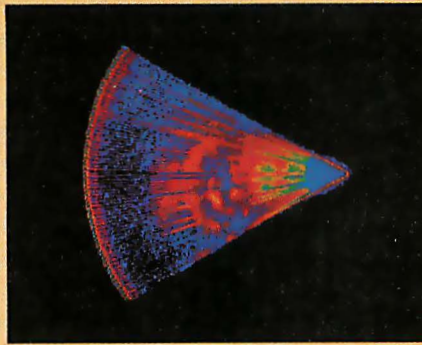
Cromemco logo on  
computer board shown  
in original ad



**Cromemco**™  
i n c o r p o r a t e d  
**Tomorrow's Computers Today**  
280 BERNARDO AVE. MOUNTAIN VIEW, CA 94043  
(415) 964-7400 • TWX 910-379-6988



Management Information Display



Ultrasonic heart sector scan



High-resolution display with alphanumerics

## Get the professional color display that has BASIC/FORTRAN simplicity

### LOW-PRICED, TOO

Here's a color display that has everything: professional-level resolution, enormous color range, easy software, NTSC conformance, and low price.

Basically, this new Cromemco Model SDI\* is a two-board interface that plugs into any Cromemco computer.

The SDI then maps computer display memory content onto a convenient color monitor to give high-quality, high-resolution displays (756 H x 482 V pixels).

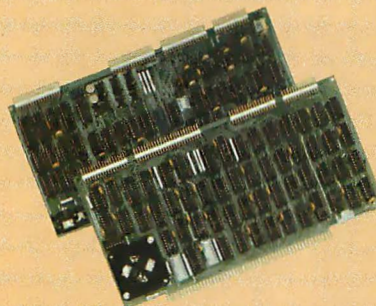
When we say the SDI results in a high-quality professional display, we mean **you can't get higher resolution than this system offers in an NTSC-conforming display.**

The resolution surpasses that of a color TV picture.

### BASIC/FORTRAN programming

Besides its high resolution and low price, the new SDI lets you control with optional Cromemco software packages that use simple BASIC- and FORTRAN-like commands.

Pick any of 16 colors (from a 4096-color palette) with instructions like DEFCLR (c, R, G, B). Or obtain a circle of specified size, location, and color with XCIRC (x, y, r, c).



Model SDI High-Resolution Color Graphics Interface

### HIGH RESOLUTION

The SDI's high resolution gives a professional-quality display that strictly meets NTSC requirements. You get 756 pixels on every visible line of the NTSC standard display of 482 image lines. Vertical line spacing is 1 pixel.

To achieve the high-quality display, a separate output signal is produced for each of the three component colors (red, green, blue). This yields a sharper image than is possible using an NTSC-composite video signal and color TV set. Full image quality is readily realized with our high-quality RGB Monitor or any conventional red/green/blue monitor common in TV work.



Model SDI plugs into Z-2H 11-megabyte hard disk computer or any Cromemco computer

### DISPLAY MEMORY

Along with the SDI we also offer an optional fast and novel **two-port** memory that gives independent high-speed access to the computer memory. The two-port memory stores one full display, permitting fast computer operation even during display.

### CONTACT YOUR REP NOW

The Model SDI has been used in scientific work, engineering, business, TV, color graphics, and other areas. It's a good example of how Cromemco keeps computers in the field up to date, since it turns any Cromemco computer into an up-to-date color display computer.

The SDI has still more features that you should be informed about. So contact your Cromemco representative now and see all that the SDI will do for you.

\*U.S. Pat. No. 4121283



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

280 BERNARDO AVE., MOUNTAIN VIEW, CA 94043 • (415) 964-7400  
Tomorrow's computers today

Circle 1 on inquiry card.

## Features

**20 Structured Programming and Structured Flowcharts** by Gregg Williams  
A technique that makes programs easier to write, understand, fix, and change.

**36 Build the Disk-80: Memory Expansion and Floppy-Disk Control** by Steve Ciarcia / Steve discusses how to use dynamic memory and floppy-disk-controller integrated circuits and presents a design that incorporates them.

**54 Three-Dimensional Computer Graphics, Part 1** by Franklin C Crow / Ways to display solid objects with the removal of hidden lines and surfaces.

**132 What Is Good Documentation?** by Jim Howard / How to write clear and effective documentation.

**166 A Beginner's Guide to Spectral Analysis, Part 2** by Mark Zimmermann  
Images can be transformed into holograms via Fourier transforms.

**262 A Simple Approach to Data Smoothing** by Fred Ruckdeschel and Janice A Krinsky / The techniques described here can aid in the interpretation of data taken from real-world situations.

**300 The New Literacy: Programming Languages as Languages** by Jon Handel  
BASIC, ALGOL, and APL are compared to the English language.

**317 Computer Music: A Design Tutorial** by Thomas P Orlofsky / A modest amount of theory provides the background for building a simple program-controlled digital tone generator.

## Reviews

**84 The Micro Matrix Photopoint Light Pen** by Stephen B Gray

**90 What's Inside Radio Shack's Color Computer?** by Tim Ahrens, Jack Browne, and Hunter Scales

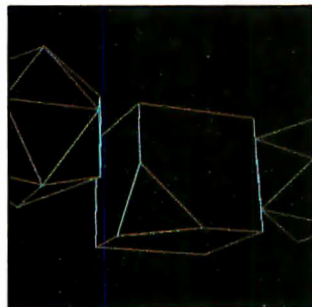
## Nucleus

- 6 Editorial: Is This Really Necessary?
- 12 Letters
- 152, 333 Programming Quickies: Computing the Determinant of a Matrix; Constellation I: An Astronomy Program
- 155 Languages Forum: A Coding Sheet for FORTH
- 164, 314, 316 BYTE's Bits
- 216, 224, 234 Technical Forum: DATALINE; Addition and Subtraction: The 1802 Versus the Z80; Build a Simple Video Switch
- 230 Desk-Top Wonders: Hunt the Wumpus with Your HP-41C
- 236 System Notes: Software Addressing Modes for the 8080
- 242 BYTELINES
- 248 Software Received
- 252 Books Received
- 254 Ask BYTE
- 308 Event Queue
- 315 Clubs and Newsletters
- 337 What's New?
- 382 Unclassified Ads
- 383 BOMB, BOMB Results
- 384 Reader Service

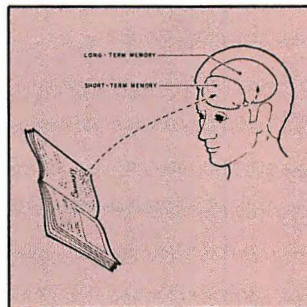
## BYTE



Page 36



Page 54



Page 132



Page 317



## Editor in Chief

**Christopher Morgan**

### Technical Editors

Richard S Shuford; Gregg Williams;  
Curtis P Feigel; Harold Nelson;  
Stan Miastkowski; Kevin Cohan; Bruce Roberts;  
Charles Freiberg, New Products Editor;  
Steve Ciarcia, Mark Dahmke,  
Consulting Editors;  
Jon Swanson, Draftsman

### Copy Editors

Richard Friedman, Chief; Faith Hanson;  
Warren Williamson; Robin M Moss;  
Anthony J Lockwood; Ann Graves

### Assistants

Faith Ferry; Debe Wheeler;  
Karen A Cilley;

### Production

Nancy Estle, Director; Christine Dixon,  
Asst Director; Wai Chiu Li;  
Holly Carmen LaBossiere; Deborah Porter;  
Sherry McCarthy, Chief Typographer;  
Debi Fredericks; Donna Sweeney;  
Valerie Horn

### Advertising

Thomas Harvey, Director; Ruth M Walsh;  
Marion Gagnon; Barbara J Greene;  
Rob Hannings

### Circulation

Gregory Spitzfaden, Manager;  
Andrew Jackson, Asst Manager;  
Agnes E Perry; Barbara Varnum;  
Louise Menegus; Bill Watson;  
Dealer Sales: Melanie Bertoni

### Marketing

Jill E Callihan, Special Projects;  
Laura Hanson

### Controller's Office

Daniel Rodrigues, Controller; Mary E Fluhr,  
Asst Controller; Karen Burgess; Jeanne Cilley

### Traffic

Mark Sandagata; N Scott Gagnon

### Receptionist

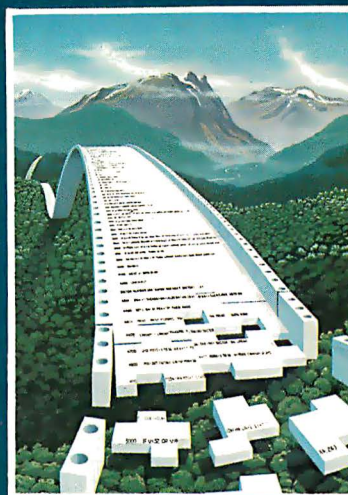
Jacqueline Earnshaw

### Publishers

Virginia Londoner; Gordon R Williamson;  
John E Hayes, Associate Publisher;  
Cheryl A Hurd, Publisher's Assistant

Officers of McGraw-Hill Publications Company: Paul F McPherson, President; Executive Vice Presidents: James E Boddorf, Gene W Simpson; Group Vice President: Daniel A McMillan; Senior Vice President-Editorial: Ralph R Schulz; Vice Presidents: Kemp Anderson, Business Systems Development; Stephen C Croft, Manufacturing; Robert B Doll, Circulation; James E Hackett, Controller; William H Hammond, Communications; Eric B Herr, Planning and Development; John W Patten, Sales; Edward E Schirmer, International.

Officers of the Corporation: Harold W McGraw Jr, President, Chief Executive Officer and Chairman of the Board; Robert F Landes, Senior Vice President and Secretary; Ralph J Webb, Treasurer.



## In This Issue

Do you have trouble making all the pieces fall in place when you are writing a new program? Robert Tinney's cover this month symbolizes the theme of programming methods. But the symbolism is only pictorial—the process of designing and putting a new program together is often much harder than assembling an intricate jigsaw puzzle. This issue includes several articles on different aspects of programming and design: "What Is Good Documentation?" by Jim Howard; "Structured Programming and Structured Flowcharts" and the editorial, "Is This Really Necessary?", both by Editor Gregg Williams; "A Coding Sheet for FORTH," by John O Bumgarner; and "A Simple Approach to Data Smoothing," by Fred Ruckdeschel and Janice A Krinsky.

BYTE is published monthly by BYTE Publications Inc, 70 Main St, Peterborough NH 03458, a wholly-owned subsidiary of McGraw-Hill, Inc. Address all mail except subscriptions to above address; phone (603) 924-9281. Address subscriptions, change of address, USPS Form 3579, and fulfillment questions to BYTE Subscriptions, POB 590, Martinsville NJ 08836. Controlled circulation postage paid at Waseca, Minnesota 56093 - USPS Publication No. 528890 (ISSN 0360-5280). Canadian second class registration number 9321. Subscriptions are \$19 for one year, \$34 for two years, and \$49 for three years in the USA and its possessions. In Canada and Mexico, \$21 for one year, \$38 for two years, \$55 for three years. \$43 for one year air delivery to Europe. \$35 surface delivery elsewhere. Air delivery to selected areas at additional rates upon request. Single copy price is \$2.50 in the USA and its possessions, \$2.95 in Canada and Mexico, \$4.00 in Europe, and \$4.50 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 BYTE, POB 372, Hancock NH 03449. 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 © 1981 by BYTE Publications Inc. All rights reserved. Where necessary, permission is granted by the copyright owner for libraries and others registered with the Copyright Clearance Center (CCC) to photocopy any article herein for the base fee of \$1.00 per copy of the article or item plus 25 cents per page. Payment should be sent directly to the CCC, 21 Congress St, Salem MA 01970. Copying done for other than personal or internal reference use without the permission of McGraw-Hill is prohibited. Requests for special permission or bulk orders should be addressed to the publisher.

BYTE® is available in microform from University Microfilms International, 300 N Zeeb Rd, Dept PR, Ann Arbor MI 48106 USA or 1B Bedford Row, Dept PR, London WC1R 4EJ England.

**Subscription WATS Line: (800) 258-5485**

Office hours: Mon-Thur 8:30 AM - 4:30 PM, Friday 8:30 AM - Noon, Eastern Time

### NATIONAL ADVERTISING SALES REPRESENTATIVES:

#### NORTHEAST (617) 444-3946

Hajar Associates  
280 Hillside Ave  
Needham Heights MA 02194

#### MIDWEST (312) 864-3467

Hajar Associates  
2405 Lawndale  
Evanston IL 60201

#### MID ATLANTIC (212) 682-5844

Hajar Associates  
521 Fifth Ave  
New York NY 10017

#### NORTHWEST (415) 964-0706

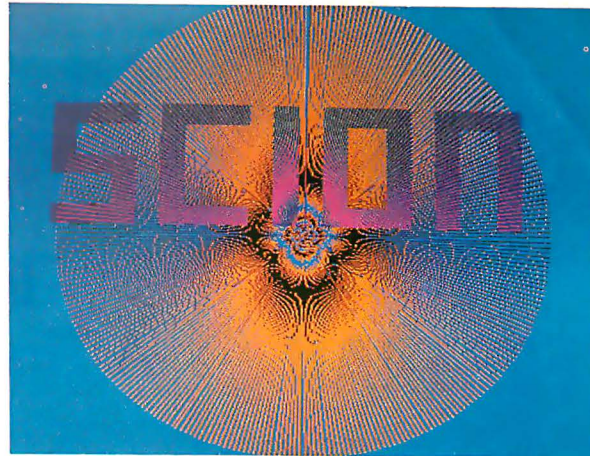
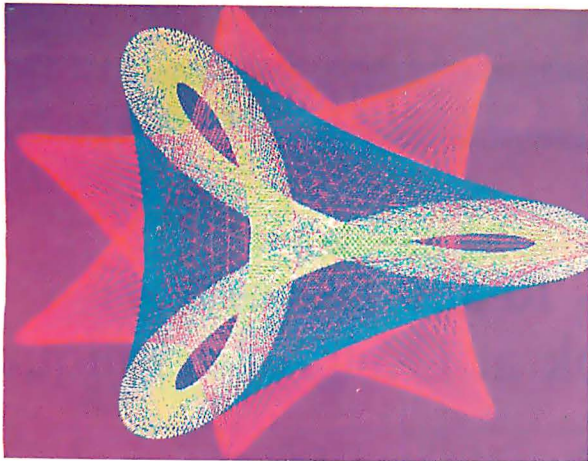
Hajar Associates  
1000 Elwell Ct, Suite 227  
Palo Alto CA 94303

#### SOUTHWEST (714) 540-3554

Hajar Associates  
3303 Harbor Blvd  
Suite K-4  
Costa Mesa CA 92626

#### SOUTHEAST (305) 886-7210

Hajar Associates  
1220 Prairie Lane  
Apopka FL 32703



"...stands well above other S-100 graphics displays in its price and performance range."

BYTE, Product Review



"...better monochromatic display..."

ELECTRONIC DESIGN,  
1981 Technology Forecast

# MICROANGELO

**HIGH RESOLUTION GRAPHICS SINGLE BOARD COMPUTER**

512 x 480 resolution black and white and vivid color displays

RS-170 composite or direct drive output

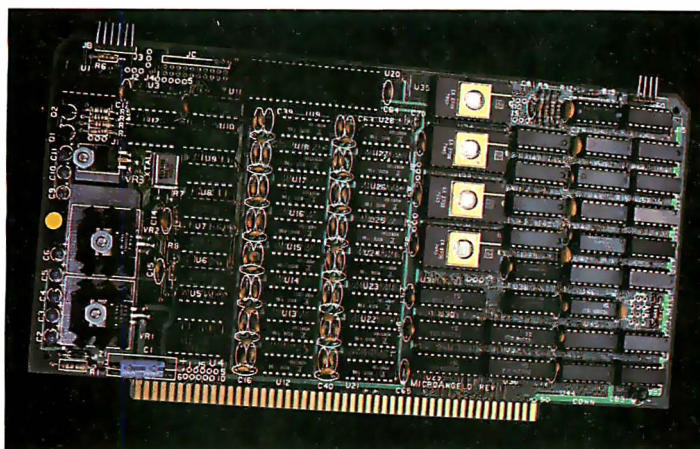
Local or external sync generation

4 Mhz Z80 microprocessor

60 hertz real-time clock

8 level interrupt tie-in

IEEE S100 bus compatible



Light pen interface

Time multiplexed refresh

4K resident Screenware™ Pak I operating system

32K RAM isolated from host address space

High speed communications over parallel bus ports

## Screenware™ Pak I

A 4K byte operating system resident in PROM on MicroAngelo™. Pak I emulates an 85 character by 40 line graphics terminal and provides over 40 graphics commands. Provisions exist for user defined character sets and directly callable user extensions to Screenware™ Pak I.

## Screenware™ Pak II

An optional software superset of Pak I which adds circle generation, polygon flood, programmable split screen for separate graphics and terminal I/O, relative coordinates, faster vector and character plotting, a macro facility, full UCSD Pascal compatibility, and more.

## And now... COLOR!!

The new MicroAngelo™ Palette board treats from 2 to 8 MicroAngelos as "bit planes" at a full 512 x 480 resolution. Up to 256 colors may be chosen from 16.8 million through the programmable color lookup table. Overlays, bit plane precedence, fade-in, fade-out, gray levels, blinking bit plane, and a highly visual color editor are standard.

**SCION**

8455-D Tyco Road • Vienna, Virginia 22180 • TWX: 710-831-9087 • (703) 827-0888

# UCSD\*

## PASCAL

## FORTRAN

### PORTABLE

Develop on a Z-80†, run on LSI-11‡, T. I. 990, 6800 or vice versa

### EFFICIENT

Structured, readable  
Speeds development X5  
Easy maintenance

### POWERFUL

Full standard Pascal plus extensions  
ANSI '77 Fortran Subset

### COST EFFECTIVE

Complete system including interpreter, screen editor, utilities, filer, assembler, and compiler.  
with Pascal \$400  
with Fortran \$450  
with Both \$600

### APPLICATIONS

#### PFAS

(Pascal File Access System)  
Keyed-ISAM in 6K user memory \$200

#### INTELLECT V1.2

A full range LISP interpreter for UCSD p-systems \$200

#### MEDOFFICE

Professional medical office software for 1 to 5 doctors. Call for pricing.

#### DATEBOOK

Appointment scheduling on your micro \$295

#### READY TO RUN ON

DEC PDP-11‡ or  
TRS-80 MODEL 11§

## PCD SYSTEMS

P. O. Box 143  
Penn Yan, NY 14527  
315-536-3734

\*TM Univ. of Calif.

†TM of Zilog

‡TM of Digital Equipment

§TM of Tandy Corp.

## Editorial

# Is This Really Necessary? A First Look at Design Techniques

Gregg Williams, Editor

Complete the following sentence:

When I start programming, the first thing I do is \_\_\_\_\_.

Some people draw flowcharts. A few adventuresome—usually foolhardy—souls type in lines of BASIC directly on their computers. Most of us start by scribbling and sketching on sheets of paper. However, is that enough? Perhaps so, if you're writing for yourself; but if anything important is at stake—time, money, or reputation—you probably need to spend more time designing.

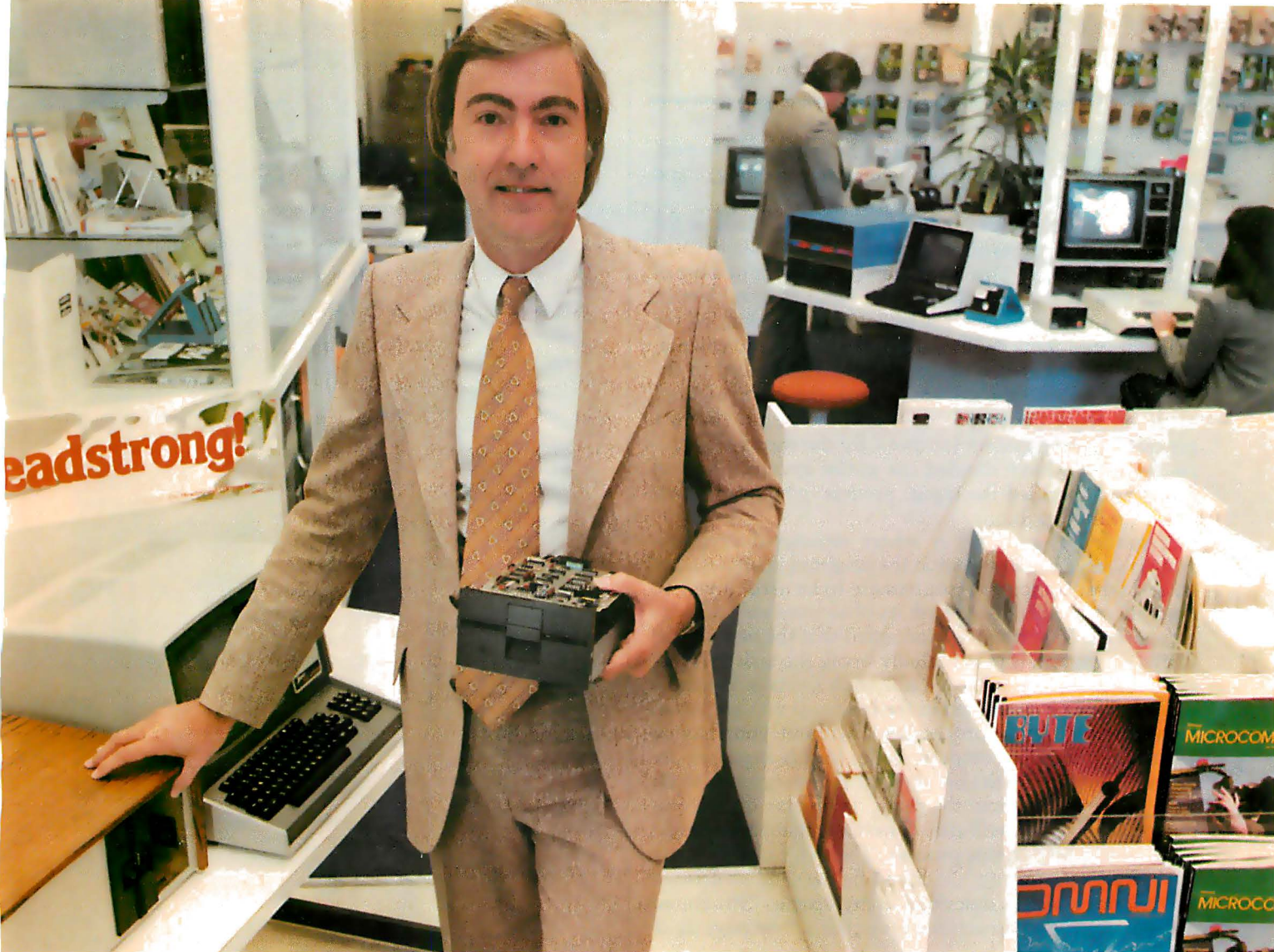
In this editorial, I'll show you what design is, why you need it, and how it works. I'll also present some new design tools (of which there are more and more every day), a design example, and a sampling of good books on design and programming. I promise to stay as far away from the concept of "structured programming" as possible. Much has been written about it elsewhere. I want to concentrate on what happens *before* you start programming.

### What Is Design?

Webster's New Collegiate Dictionary defines *design*, the verb, as "to conceive and plan." As a noun, a design is "a preliminary sketch showing the main features of something to be executed." In terms of programming, design becomes proportionately more important depending on the size of the problem: We speak of *program design* when we write a game program for ourselves, *project design* when we design and write an accounting system on an existing computer at work, and *system design* when we draft a proposal for a hardware/software combination that will implement a given set of requirements for a data base system. (Actually, "system design" is used in the literature to describe the design of anything larger than one program; but I wanted to make a distinction between project design and system design because of the widely varying amounts of work they require.)

In designing and writing programs, I've found that the point dividing system design from program design is the point at which I have specified the function of the program and its use of computer resources (eg: are records stored on disk in a random-access file and called as needed, or are they read into memory before any processing is done?). *After* this point, I am designing the program (usually a fairly straightforward—though nontrivial—process). *Before* this point, I'm making certain critical decisions that strongly influence the requirements and performance of the proposed implementation of the program. In this sense, such decisions will often need to be made even when I'm designing and writing a single program. I can then see that both *system* design and *program* design have enough in common so I can eliminate the modifier and speak simply of *design*. I can safely say then that *design is concerned with making a set of performance-related decisions and specifying the program(s) that implement them*.

(An integral part of design, of course, is *documentation*. Documentation of the overall design should be followed by documentation of the program design and its implementation. The finished documentation package, which should clarify both the organization of the system/project/program and the details of



# “For reliable data storage, you can’t beat Shugart’s Minifloppy.”<sup>TM</sup>

Raymond Schlitz, Owner—  
Computerland, San Francisco

“I sell systems my customers can depend on. That’s why most of the personal and small business computer systems sold here feature Minifloppy disk drives. I know from experience I can rely on the Minifloppy.”

Since 1976 Shugart’s Minifloppy has been used by more small computer system manufacturers than any other drive. In fact, more than half-a-million Minifloppys

have been installed. The Minifloppy looks small—but it stores a lot of data. 250 kilobytes on one side, or up to 500 kilobytes in the double-sided model. That’s about 50 pages of printed information on a single-sided Minidiskette, and twice that on the double-sided version. You’ll have plenty of storage capacity for your programs, letters, forms, or ledger entries. And you find your data fast, too, because the Minifloppy is a random access device

that eliminates the need to search for your data serially as you must with a tape cassette unit.

No matter what problem you’re solving with your computer system, you can rely on Shugart’s Minifloppy for data storage. We’re known as the Headstrong company for good reason. We’re Headstrong about reliability, quality, and value. Ask your dealer. He knows us.

## Rely on the Headstrong Company.

**Shugart**

TM—Minifloppy is a trademark of Shugart Associates.

475 Oakmead Parkway, Sunnyvale, California 94086

## Editorial

the program(s) involved, will be of immense help to you, or anyone else, during debugging, testing, and maintenance.)

To put the role of design in perspective let's look at the lifespan of a medium-sized system:

● **(System) Design:** This is the step I talk about in most of this article. It includes finding out what the problem is, devising alternative schemes to solve it, deciding on the one that (you think) will result in the "best" implementation, and filling in the design details with regard to the items that go into the system (input), the manipulations made on these items (process), and the results that are generated by the system (output). By the end of this process, you will have divided the entire system into programs and specified the input, process (what, not how), and output of each one.

● **Program Design:** This is where structured programming is used. You know what the program is supposed to do and what computer resources are to be used; now you must fill in the details of *how* its objectives are to be accomplished. It is commonly accepted that the best way to design a program is to repeatedly break the task to be accomplished into subtasks, until each subtask is simple enough to be programmed in the language you are using. Note that the design process ends without your having written *any* lines of computer code. In this step, you are simply filling in the details of what the program is to do without worrying about the particular syntax of the computer language you will use. (There are numerous design notations to help in this process. The two I like most are *structured pseudocode*, described below, and *structured flowcharts*, which is described in my article, "Structured Programming and Structured Flowcharts," on page 20 of this issue.)

● **Coding:** This is what most people call "programming," even though they are referring to the entire design/coding process. Coding is the specific act of translating a program design into the particular syntax of the computer language you are using (often called the *target language*). The more detailed the design is, the more coding becomes a rote task. The completeness of the design is determined by several factors. These are: how well you think you know the application being programmed and the computer language used, how important it is to get the program right the first time, and how many surprises (mostly of the "oops, I forgot to..." kind) you can tolerate during

### Articles Policy

BYTE is continually seeking quality manuscripts written by individuals who are applying personal computer systems, designing such systems, or who have knowledge which will prove useful to our readers. For a more formal description of procedures and requirements, potential authors should send a large (9 by 12 inch, 30.5 by 22.8 cm), self-addressed envelope, with 28 cents US postage affixed, to BYTE Author's Guide, POB 372, Hancock NH 03449.

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



## PASCAL/Z™ - Q.E.D.

Ithaca Intersystems PASCAL/Z is the most powerful CP/M™ compatible Z-80™ Pascal compiler ever . . . and here's why:

PASCAL/Z generates true Z-80 native code — ROMable and re-entrant — 5-10X faster than P-code interpreters; permits separate compilation; supports Direct File Access and variable length STRINGS; utilizes fast one-pass recursive descent organization; the macro-assembler generates relocatable object modules; and much, much more.

Complete package includes compiler, macro-assembler, linker/loader and source for the full library on one disk; with free copy of Jensen/Wirth book and complete documentation. Only \$395.00.

### IT'S DEMONSTRABLE!

Don't just take our word for it. Ask for a demonstration of these features and more today at Computerland® and other full-service computer stores.

Ithaca Intersystems Inc., 1650 Hanshaw Road  
P.O. Box 91, Ithaca, N.Y. 14850. Phone (607) 257-0190

Computerland is a registered trademark of Computerland Corporation.  
CP/M and Z-80 are trademarks of Digital Research Corp. and Zilog, Inc. respectively.  
PASCAL/Z and InterSystems are trademarks of Ithaca Intersystems Inc.

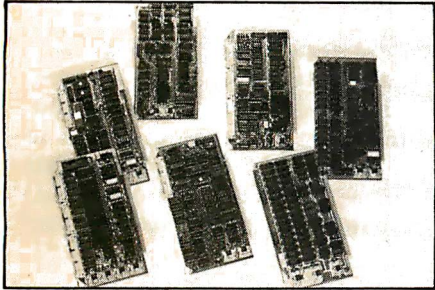
**InterSystems™**  
Ithaca Intersystems Inc.

**Micros for bigger ideas.**

# The InterSystems

## price-performance-reliability story

### now has three versions



While everyone's been busy trying to convince you that large buses housed in strong metal boxes will guarantee versatility and ward off obsolescence, we've been busy with something better. Solving the *real* problem with the first line of computer products *built from the ground up to conform to the new IEEE S-100 Bus Standard*. Offering you extra versatility in 8-bit applications today. And a full 16 bits tomorrow.

We call our new line Series II. And even if you don't need the full 24-bit address for up to 16 megabytes (!) of memory right now, they're something to think about. Because of all the performance, flexibility and economy

they offer. Whether you're looking at one of our three mainframes, at a new mainframe, expanding your present one or upgrading your system with an eye to the future. (Series II boards are compatible with most existing S-100 systems and *all* IEEE S-100 Standard cards as other manufacturers get around to building them.)

Consider some of the features: Reliable operation to 4MHz and beyond. Full compatibility with 8- and 16-bit CPUs, peripherals and other devices. *Eight* levels of prioritized interrupts. Up to 16 individually-addressable DMA devices, with IEEE Standard overlapped operation. User-selectable functions addressed by DIP-switch or jumpers, eliminating soldering. And that's just for openers.

The best part is that all this heady stuff is available *now*! In our advanced processor—a full IEEE Bus Master featuring Memory Map addressing to a full megabyte. Our fast, flexible 16K Static RAM and 64K Dynamic RAM boards. An incredibly versatile and

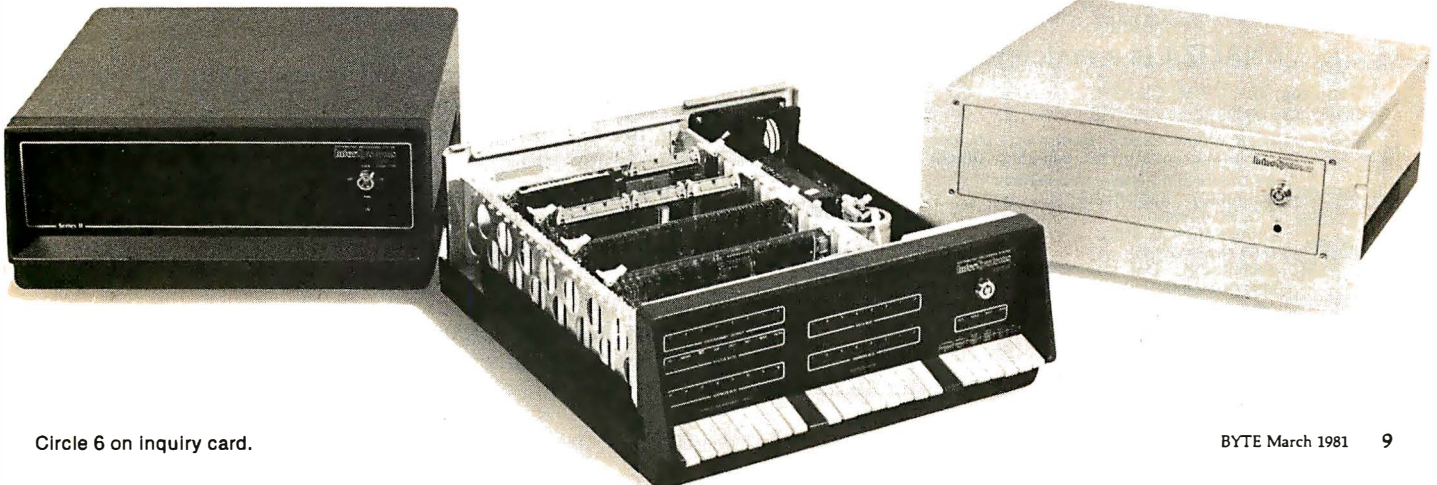
economical 2-serial, 4-parallel Multiple I/O board. Our 6-serial I/O board. Our Double-Density High-Speed Disk Controller. And what is undoubtedly the most flexible front panel in the business. Everything you need for a complete IEEE S-100 system. Available separately, or all together in your choice of DPS-1 mainframe styles.

Whatever your needs, why dump your money into obsolete products labelled "IEEE timing compatible" or other words people use to make up for a lack of product. See the future now, at your InterSystems dealer or call/write for our new catalog. We'll tell you all about Series II and the new IEEE S-100 Bus we helped pioneer. Because it doesn't make sense to buy yesterday's products when tomorrow's are already here.

Ithaca InterSystems Inc.,  
1650 Hanshaw Road/P.O. Box 91,  
Ithaca, NY 14850  
607-257-0190/TWX: 510 255 4346

**InterSystems™**  
Ithaca InterSystems Inc.

**Micros for bigger ideas.**



coding. In most informal situations (ie: when you're not programming for hire), a sketchy design provides an acceptable compromise between no design and a rigorous design.

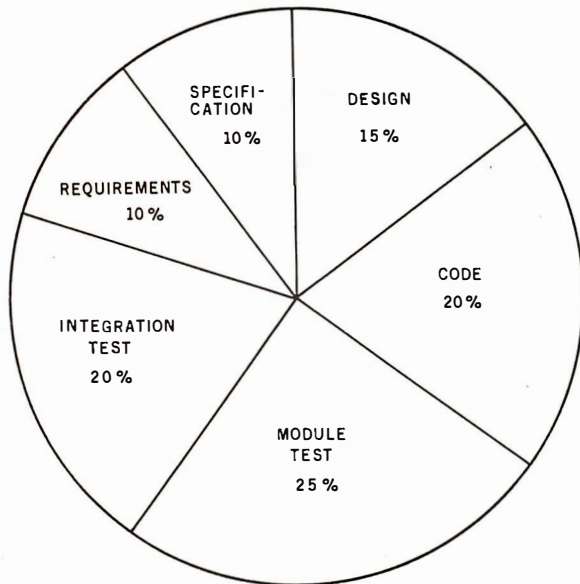


Figure 1: A pie chart giving average percentages for activities within the process of designing, writing, and testing a program. The chart does not include maintenance of the program, which is estimated to take twice as much time as design, writing, and testing.

• **Testing and Debugging:** This section is actually two intertwined processes—*testing*, the search for errors (both syntactic and logical), and *debugging*, the elimination of those errors. Most programmers estimate that this process can take as much time as both designing and coding. The results in figure 1 (by M V Zelkowitz in "Perspectives on Software Engineering," *ACM Computing Surveys*, June 1978, page 198) support this conclusion. The amount of needed debugging and testing greatly increases depending on the program's size and importance. It decreases with the amount of design and structured programming carried out before the coding. In a multi-program system, programs are first tested and debugged (labeled "module test" in figure 1), then the entire system is tested and debugged (labeled "integration test" in figure 1).

• **Maintenance:** This section applies mostly to large programs for personal use and systems that are used in a work environment. Maintenance runs the gamut from fixing the occasional (or not-so-occasional) bug, to adding new features, or to moving a system of programs to an entirely new computer system. It's been estimated that maintenance occupies up to 90 percent of a (professional) programmer's time. Fortunately, most personal computer users don't have to carry this burden.

## Why Designing Is Necessary

Whether we like it or not adventures begin only when something unexpected happens. In fantasy, adventures are always positive and exciting; in real life and in programming, they are usually unwanted, inconvenient, and sometimes costly or dangerous. Only short personal programs can squeeze by without some basic design work behind them. If the program gets longer, or if you are writing for somebody else (either friends or employers), you probably can't afford a programming "adventure." Remember that the design process includes finding and making decisions that influence the quality of a program or system. In other words, *the more important it is to write the best program, the more design you need to do.*

Here are some reasons that argue strongly in favor of well-thought-out design:

- Limited resources (eg: not enough computer memory or disk space, or a slow system response time)
- Time/money constraints (ie: the need to complete a program or system within deadline and under budget)
- The need for increased reliability
- The need for program stability and flexibility in the face of long-term maintenance

In addition to contributing to the quality and reliability of a program, design also contributes to your mental health as a programmer—you usually *save* time when you design; you eliminate all-night emergency programming marathons; the process of testing and debugging is shorter and less nerve-racking; and you're less likely to have your program "crash" at an embarrassing or crucial moment.

## Some Popular Excuses, and Rebuttals

"I don't know where to start": Read some of the books  
Text continued on page 200

# ANALIZA:

(Let your computer play psychiatrist!)

ANALIZA is a program which simulates a conversation with a psychiatrist. You are the patient, the computer becomes the doctor.

ANALIZA is based on the famous "Eliza" program from MIT some years back, but has been greatly enhanced. It provides both entertainment as well as an interesting example of Artificial Intelligence. Below is a sample:

Patient: I have feelings of paranoia  
Computer: Does it please you to have feelings of paranoia?  
Patient: No it bothers me  
Computer: Then why have feelings of paranoia?

**ANALIZA is a match for anyone.**

Requires: 48K CP/M, CBASIC2

Cost: \$35.00

CP/M Formats: 8" soft sector, 5" Northstar, 5" Microplus Mod II, Vector MZ, Superbrain DD/QD



All Orders and General Information:  
SUPERSOFT ASSOCIATES  
P.O. BOX 1628  
CHAMPAIGN, IL 61820  
(217) 359-2112  
Technical Hot Line: (217) 359-2691  
(answered only when technician is available)



**SuperSoft**

**First in Software Technology**

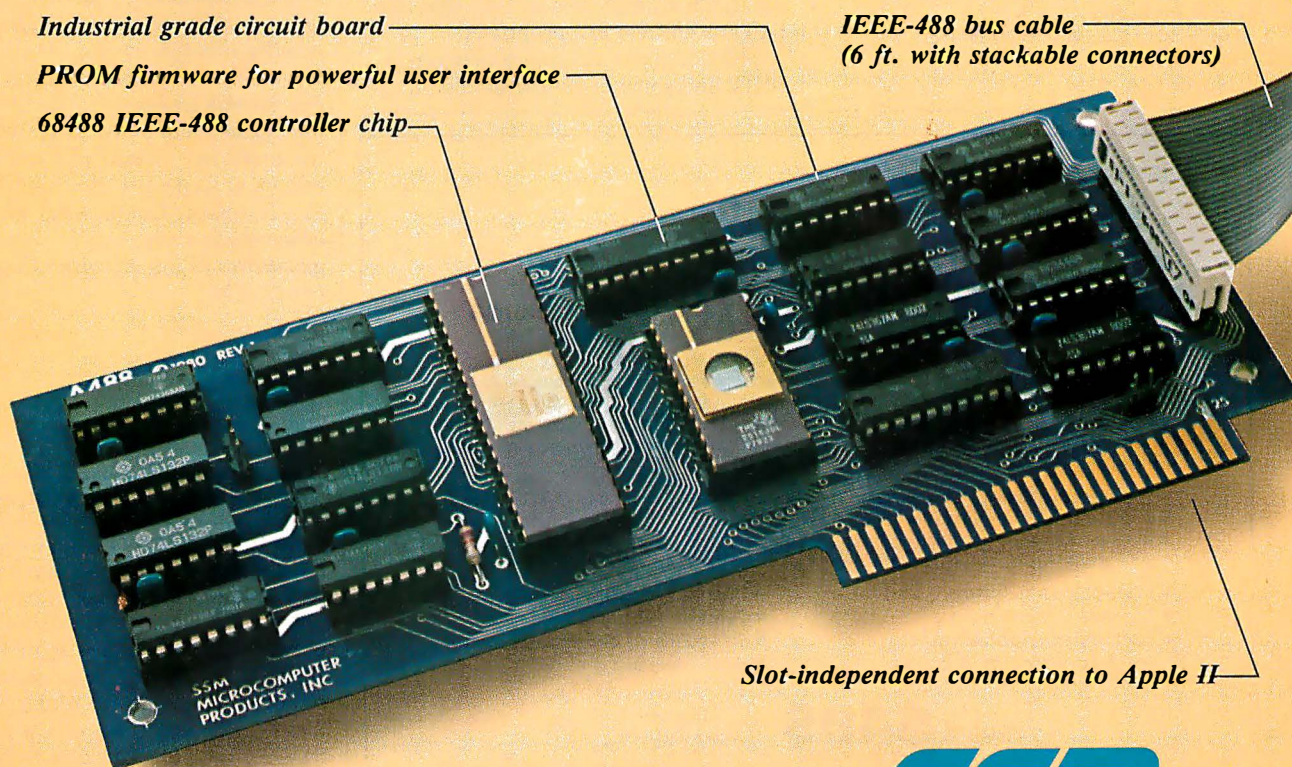
CP/M REGISTERED TRADEMARK DIGITAL RESEARCH

# Make the Apple II\* a powerful IEEE-488 Controller in a snap.

**Just plug the SSM A488 board into any Apple II\* expansion slot for a low-cost, full-featured instrumentation interface.** SSM gives the Apple II the power and versatility of a \$9,000 IEEE-488 controller. At a fraction of the price. Our board converts the Apple II into a truly sophisticated controller that programs and controls up to 15 different instruments connected together on the 488 bus.

**We make programming easy.** The 68488 chip, designed by Motorola, forms the heart of our A488. We back this chip with powerful on-board firmware to give you system control via simple string commands. The only software you need is easy-to-program Applesoft\* Basic. To develop special purpose firmware, simply replace our PROM with a RAM. With the A488, bus communications operate at top speed—without depending on software loops for timing. And like the more expensive IEEE-488 controllers, this system interfaces with more than 1200 instruments and peripherals.

**Suitable for OEMs as well as end users.** Whether you make test/measurement systems for re-sale, or simply for yourself, the SSM/Apple combo gives you top performance. As it cuts your costs. Call your local dealer or SSM today for complete details.



*SSM's A488 board expands the Apple II to a high-performance IEEE-488 controller.*

\*Registered trademarks of Apple Computer Inc.



**SSM Microcomputer Products, Inc.**

2190 Paragon Drive  
San Jose, CA 95131  
(408) 946-7400 Telex: 171171  
TWX: 910-338-2077

# Letters

## On Technical Writing

I enjoyed Chris Morgan's editorial on technical writing ("What's Wrong with Technical Writing Today?" December 1980 BYTE, page 6), but there is a sad exception to his first law: Academics can benefit from not writing clearly. I suggest a paper by J S Armstrong in the April 1980 *Interfaces*, published by The Institute of Management Sciences.

Armstrong, from the Wharton School, found that material more difficult to read was rated higher in research competence. "Management scientists gain prestige by unintelligible writing." My wife, an academic biologist, and I have seen similar hypotheses about academic publishing in computer science. (*Communications of the ACM* may be a perfect example.)

Since such "news" would only undermine the effort you folks are making at BYTE, you must keep all this a secret.

Gerald Ruderman  
Management Decision Systems Inc  
300 Third Ave  
Waltham MA 02154

In the December 1980 editorial, Chris Morgan says that "Jargon isn't intrinsically bad...."

Ha! I caught you. Jargon is intrinsically bad; it may be necessary sometimes—an evil necessity—but it's always bad. I've often wondered if those who edited BYTE were in favor of jargon. Now I know.

Like many aspects of our society, jargon has two purposes: an obvious one, and a hidden, unadmitted one. The obvious purpose is to save space, as Mr Morgan pointed out. The hidden one is to exclude outsiders from the circle of the insiders.

To use jargon in explaining the workings of a particular product would be justifiable in a manual directed toward sophisticated, knowledgeable professionals, if the product were released in a specific, well-known context. An example is all the funny words people familiar with IBM equipment always use. Such an approach in a journal like BYTE is entirely inappropriate.

The distinctive difference between BYTE and some of its less successful

competitors is that many BYTE articles, even though written in jargon, try to explain something, while too many articles in other magazines use jargon purely for the purpose of mystifying.

Jargon may have many purposes, but the rapid, effective spread of information is not one of them. If you really wish to communicate ideas, *write in English*—or some common human language.

The balance of Mr Morgan's editorial was actually quite to the point. I'd like to add, "DON'T use big concepts when small ones will do."

James Gregor Owen  
14 Ocean Dr  
Freeville NY 13068

*The December editorial apparently struck a nerve among readers, judging from the comments we received. Mr Owen raises a point I did not cover: the "high priesthood" syndrome that arises when a writer sets out to impress and mystify through jargon. At BYTE, we wage a (not always successful) battle against this philosophy, and hope that our readers will continue to tell us when we go astray. I'd also like to thank the editors at General DataComm Industries Inc, Danbury, Connecticut, and several other readers who caught some minor gaucheries in my editorial. Oh, the irony of it....CM*

Introducing

## THE BENCHMARK<sup>(TM)</sup> WORD PROCESSING SYSTEM

THE BENCHMARK software system sets new standards in word processing. First, it can be delivered to run on the CP/M<sup>®</sup> or the North Star DOS, so there may be no need to buy a special operating system. Second, it has all the features of systems costing thousands of dollars more. Third, the price is as low as, or lower than, most word processing systems.

Anyone can learn to run and use THE BENCHMARK in one day of self training. Completely self-promoting in English. THE BENCHMARK is a full capability word processor, has been thoroughly tested in an office environment and proved to meet the needs of the most sophisticated user.

- Multi-operating system
- Changes terminal drivers
- Customized to utilize all the features of terminal & printer
- Overtyping - erases, corrects
- Variable, electronic decimal tab
- Screen menus simplify operation
- Block move and get

**ONLY \$499**

plus tax  
where applicable

THE BENCHMARK is distributed by R&B Computer Systems. Dealer inquiries are invited.

**R&B Computer Systems<sup>TM</sup>**

1954 E. University  
1-800-528-7385

Tempe, Arizona 85281  
AZ-602-968-7101

THE BENCHMARK is a trademark of Metasoft Corporation  
CP/M is a registered trademark of Digital Research

## Intel's Educational Products

As the manager of Intel Corporation's Educational Products Group I would like to thank BYTE for suggesting our company as a source for blemished components. Steve Ciarcia's reply to an "Ask BYTE" letter has generated a large response from students and educators. (See "Quick and Cheap," December 1980 BYTE, page 320.) In order to help BYTE's readers to more fully benefit from our program, I would like to bring some additional information to their attention.

The Educational Products Group has the responsibility for the administration of the component kit program. To avoid delays of up to 4 weeks, all inquiries should be directed to us, not the product manager.

We no longer offer an 8080-based kit;



# Edison had over 1,800 patents in his name, but you can be just as inventive with an Apple.

Apple is the company with the brightest ideas in hardware and software *and* the best support — so you can be as creative with a personal computer system as Edison was with the incandescent bulb.

## How Apple grows with you.

With Apple's reliable product family, the possibilities of creating your own system are endless. Have expansion capabilities of 4 or 8 accessory slots with your choice of system.

Expand memory to 64K bytes or 128K bytes. Add an A to D conversion board. Plug into time sharing, news and electronic mail services. Use an IEEE 488 bus to monitor lab instruments. Add 4 or 6 disk drives — the 5¼", 143K bytes, high-speed, low-cost drive that's the most popular on the market.

## Apple speaks many languages.

Since more than 100 companies create software for Apple, you'll have the most extensive library in the personal

computer world. Want to write your own programs? Apple is fluent in BASIC, Pascal, FORTRAN, PILOT and 6502 assembly language.

There's even a series of utility programs called the DOS Tool Kit that not only lets you design high-resolution graphic displays, but lets you work wonders with creative animation.

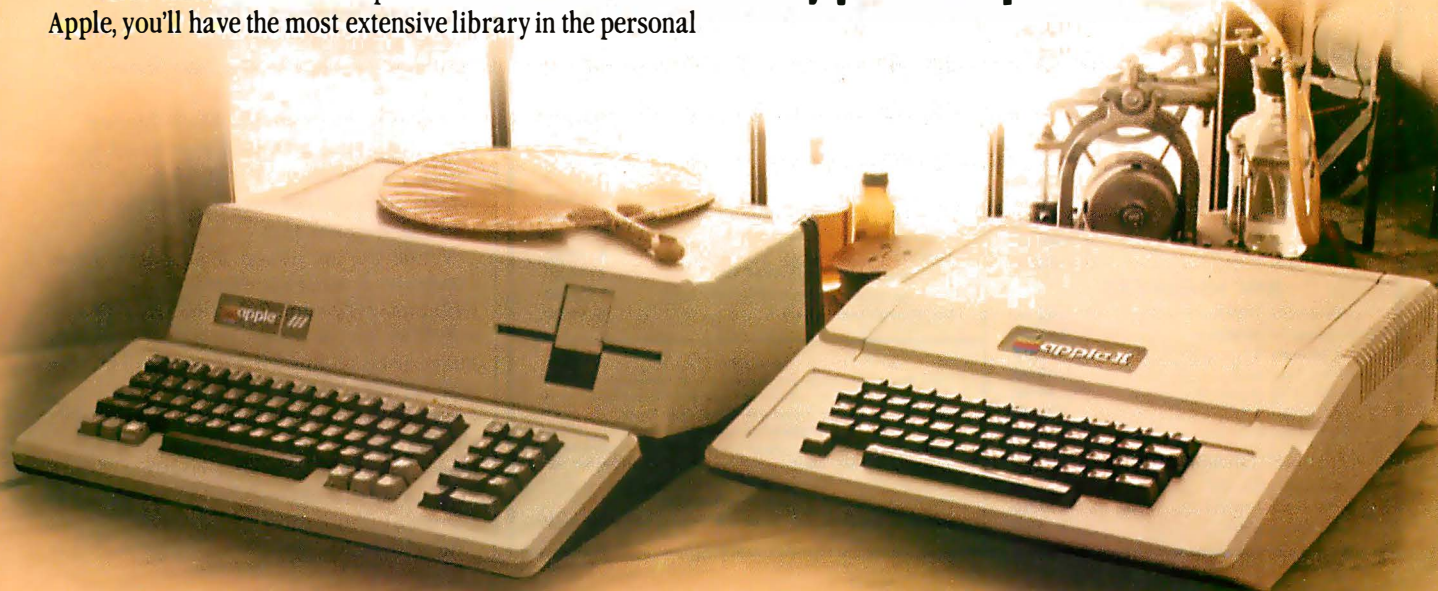
## More illuminating experiences in store.

You won't want to miss all the Apple products being introduced at your computer store all the time. Don't let history pass you by. Visit your nearest



Apple dealer or call 800-538-9696. In California, 800-662-9238. Or write: Apple Computer, 10260 Bandley Drive, Cupertino, CA 95014.

**apple computer inc.**



## Letters

instead we offer a broad line of kits based upon the 8085, 8048, 8086, and 8088 microprocessors. The 8086 and 8088 kits include a serial monitor. Kit prices range from \$35 up to \$90, and each contains enough components to construct a minimum system.

Intel is in the process of expanding the program, and we publish a quarterly magazine to let prospective members of the academic community know of these developments.

Please contact us if you would like more information on how we can help you. Our telephone number is (408) 987-5020.

Steven A Lapham  
Manager, Educational Products  
Intel Corporation  
3065 Bowers Ave  
Santa Clara CA 95051

### Intertec Responds to Criticism

In response to Mr Phillip Lemmons's letter (see "Superb Brain," October 1980 BYTE, page 22), I would like to make the following observation. We at Intertec disagree with his analysis of the situation and feel that clearing up the facts

would be a benefit to Intertec and our users alike.

Everyone must realize that nothing remains static in the computer industry. New ideas constantly emerge, resulting in a stream of new developments. The continual upgrading of technology, and the subsequent evolution of computer software and hardware, is the basis of high technology as all of us know it today. As responsible manufacturers, we feel obliged to pass on these technological advancements to our users.

As improvements are added to our products, we offer our previous customers, whenever feasible, an upgrade option at nominal cost. If the modification cannot be accomplished with a simple EPROM change, for instance, we still feel a responsibility to offer some kind of solution to our customers.

Such is the case with Mr Lemmons's "\$1500 enhancement." The modifications to which he refers involved changing the whole unit: processor module, power supply assembly, disk drives, etc. In January 1980, the SuperBrain was modified to offer even more capabilities than our advertisements claim. Therefore, had Mr Lemmons purchased this enhancement, he would, in effect, have

received a completely new unit for \$1500—half the end-user cost for the same unit.

As for the software problem Mr Lemmons referred to, we are confident that an EPROM update costing \$100 would have taken care of his problems. Mr Klein of Information Engineering sold it to him for \$150. Admittedly, Mr Lemmons may have received this update a little sooner than he would have had he purchased directly from the factory; nevertheless, the EPROM is available from us.

For an end-user price of \$2995 for our basic SuperBrain model, we think (and we have thousands of testimonials from happy SuperBrain users to support this) that Intertec offers the best price/performance ratio in the industry.

If any other BYTE readers have problems similar to Mr Lemmons's, please call our Product Services department at (803) 798-9100. Our staff of application engineers will be glad to assist you in any way possible.

At Intertec, the customer has always been (and still is) our main concern. Our phenomenal growth in recent years would not have been possible if we did not hold steadfastly to this simple management principle. We hope Mr Lemmons (and any others who may be dissatisfied with us) will understand our point of view and give us a chance to demonstrate the sincerity of all of our customer-support programs.

Denise Stevens  
Marketing Communications Manager  
Intertec Data Systems  
2300 Broad River Rd  
Columbia SC 29210

# MARK GORDON COMPUTERS

DIVISION OF MARK GORDON ASSOCIATES, INC.

P.O. Box 77, Charlestown, MA 02129 (617) 491-7505

## COMPUTERS

Atari 800 W16K .....	799.00
4K Model III .....	599.00
Model II 64K System .....	3499.00
16K Model III .....	859.00

## DISK DRIVES

40 Track 5 1/4 inch drive .....	314.00
80 Track 5 1/4 .....	544.00
4 Disk Drive Cable .....	39.00

## PRINTERS

Centronics 730 .....	599.00
Epson MX80B .....	Call for price
Centronics 737 .....	849.00
Okidata Microline 83 .....	1044.00
Integral Data 440G .....	999.00
NEC 5510 w/tractor .....	2679.00
Okidata Microline 80 .....	599.00
Diablo 630 .....	2495.00

## MISC HARDWARE

Expansion int. TRS-80(OL) .....	249.00
Novation D-Cat Modem .....	166.00
16K Memory Kit .....	41.99
Leedex Monitor .....	109.00
Printer Cable for above .....	49.00
ISO-2 Isolator .....	54.00
AC LINE FILTER .....	24.00

## STORAGE MEDIA

Scotch-box 10-5 1/4 .....	27.00
Memorex-box 10-5 1/4 .....	22.00
Plastic Storage Box .....	5.00

## OPERATING SYSTEMS

NEWDOS by APPARAT INC .....	49.00
NEWDOS+ by APPARAT INC .....	99.00
MMS FORTH DISKETTE-PRIMER .....	79.95
NEWDOS 80 .....	149.00

## DISKETTE TRS-80\*

### BUSINESS SOFTWARE BY SBSG

Free enhancements and upgrades to registered owners for the cost of media and mailing. 30 day free telephone support. User reference on request.	
Fully Interactive Accounting Package, General Ledger, Accounts Payable, Accounts Receivable and Payroll Report Generating.	
Complete Package (requires 3 or 4 drives)	\$475.00
Individual Modules (requires 2 or 3 drives)	\$125.00
Inventory II (requires 2 or 3 drives)	\$ 99.00
Mailing List Name & Address II (requires 2 drives)	\$129.00
Intelligent Terminal System ST-80 III.	\$150.00
The Electric Pencil from Michael Shrayor	\$150.00
File Management System.	\$ 49.00

## FINE PRINT

TRS-80 is a Tandy Corporation trademark. Use of above operating systems may require the use of Radio Shack TRS-DOS. Radio Shack equipment subject to the will and whim of Radio Shack.

## ORDERING INFORMATION

We accept Visa and MasterCard. We will ship C.O.D. certified check or money orders only. Massachusetts residents add 5 percent sales tax.

To order call toll-free 1-800-343-5206  
For information call 617-491-7505

The Company cannot be liable for pictorial or typographical inaccuracies.

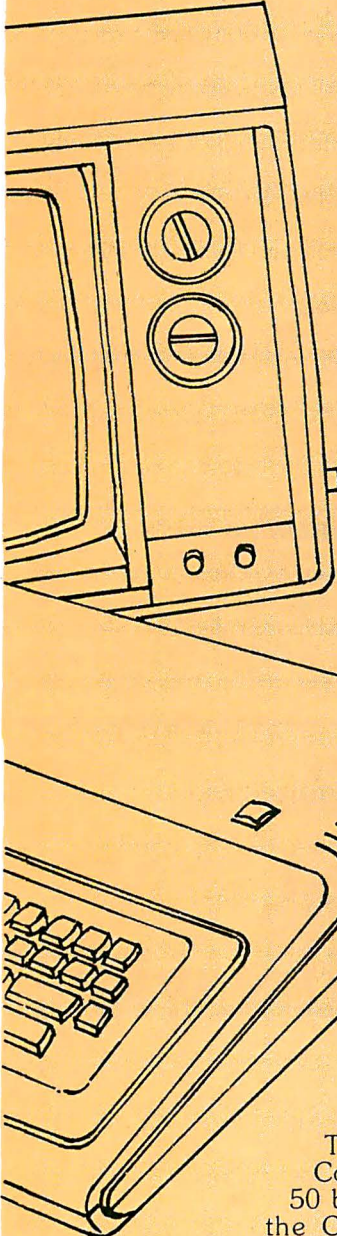
## Hurray for muSIMP

I recently purchased muSIMP/ muMATH for my Radio Shack TRS-80 Model I, so I was interested in Gregg Williams's review in the November 1980 BYTE. (See "The muSIMP/ muMATH-79 Symbolic Math System," page 324.) The version I purchased is the small, inexpensive TRS-80 version, which does not include the trace, array, and matrix packages.

While the discussion of muMATH was complete, I was disappointed that Mr Williams only touched briefly on the capabilities of the underlying muSIMP language used to implement muMATH. The introduction of a low-cost version (or any version) of LISP for the TRS-80 should be marked as a major development. muSIMP is a close cousin of LISP, and, in this light, muMATH is seen as a powerful illustration of its capabilities. The impressive achievements of muMath

# Introducing the COLOR CONNECTION™

## Plug A TRS-80\* Color Computer into the World of System-50™ Computing.



Now you can expand Tandy's exciting new TRS-80\* Color Computer using proven System-50 products. Expansion possibilities are limitless. And expansion is easy. Plug one end of the COLOR CONNECTION into the Program Pak\* connector of the Color Computer. Plug the other end into a System-50 bus motherboard. Now add the functions you want, selecting from an inventory of standard modules manufactured by competent, long-established firms — from the inventory of solid performers, like Percom Data Company.

### Mini-disk storage — today!

Available off-the-shelf for your extended system is Percom's field-proven LFD mini-disk system. The first choice of knowledgeable 680X computerists since 1977, Percom LFD mini-disk systems come complete, ready to plug in and run. File storage capacities range from 102 Kbytes for a one-drive LFD-400™ system to almost 0.6 Mbyte for a three-drive LFD- 800™ system.

### System Requirements

The COLOR CONNECTION interfaces a TRS-80\* Color Computer to a System-50 bus motherboard. Power for the COLOR CONNECTION is obtained from the computer. Power for the extended bus cards must be provided by an external source, such as Percom's System-50 Power Supply. The COLOR CONNECTION provides for disabling the computer internal memory at 8-Kbyte boundaries to prevent contention with external memory.

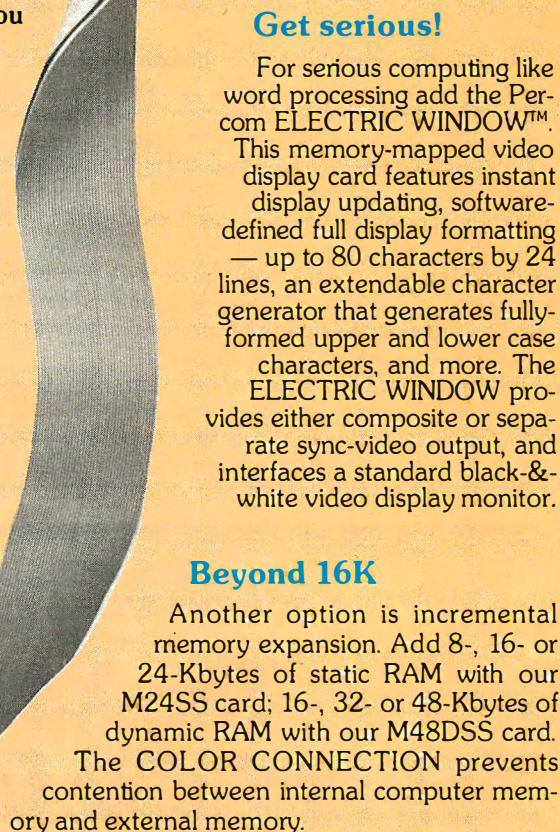
**The COLOR CONNECTION..... \$99.95**

Quality Percom products are available at Percom dealers nationwide. Call toll-free, 1-800-527-1592, for the address of your nearest dealer, or to order direct from Percom.

PRICES AND SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.  
PRICES DO NOT INCLUDE SHIPPING AND HANDLING.

™ trademark of Percom Data Company, Inc.

\* trademark of Tandy Radio Shack Corporation which has no relationship to Percom Data Company.



### Get serious!

For serious computing like word processing add the Percom ELECTRIC WINDOW™. This memory-mapped video display card features instant display updating, software-defined full display formatting — up to 80 characters by 24 lines, an extendable character generator that generates fully-formed upper and lower case characters, and more. The ELECTRIC WINDOW provides either composite or separate sync-video output, and interfaces a standard black-&-white video display monitor.

### Beyond 16K

Another option is incremental memory expansion. Add 8-, 16- or 24-Kbytes of static RAM with our M24SS card; 16-, 32- or 48-Kbytes of dynamic RAM with our M48DSS card. The COLOR CONNECTION prevents contention between internal computer memory and external memory.

### The right motherboard

Fast mini-disk storage, full-format alphanumerics and memory add-on are obvious expansion possibilities. The optional Percom System-50 Motherboard allows you to consider the less obvious. This seven-slot motherboard not only can be self-extended, but also can be extended with our 30-pin I/O motherboard. The richness of readily available peripheral interface cards provides an uncommon degree of expansion flexibility.

The System-50 (SS-50) bus community. With a TRS-80\* Color Computer and the COLOR CONNECTION, it's your world. Enjoy!

# PERCOM

PERCOM DATA COMPANY, INC.  
211 N. KIRBY GARLAND, TEXAS 75042  
(214) 272-3421

Circle 11 on inquiry card.

have overwhelmed the fact that muSIMP is a general language suitable for more than symbolic mathematics applications. The differences between muSIMP and LISP are mostly at the user interface. The input syntax and the output format have been altered to provide a congenial environment for symbolic mathematics, but internally muSIMP is LISP with only a few minor alterations (which could well be regarded as improvements over the original). These alterations are summarized in "LISP-Based Symbolic Math Systems" by David R Stoutemyer, which appeared in the BYTE LISP issue of August 1979, page 176.

At \$75 (plus another \$20 for the complete reference manual) muSIMP for the TRS-80 is a great bargain. Yet Microsoft's ads have pushed muMATH with only a passing reference to muSIMP's close relationship to LISP.

The documentation that comes with the TRS-80 version of muSIMP/muMATH does not include a number of important muSIMP functions. For example, the functions related to property lists are not even mentioned. Property-driven functions are a major component of muMATH's power and extensibility. The TRS-80 owner who wants to explore the power of muSIMP definitely

needs to purchase the full reference manual to supplement the material that accompanies the package.

The full reference manual is impressive. It includes listings of on-line tutorials apparently available with the larger CP/M version. Unfortunately, it does not specifically address the system environment of the reduced TRS-80 package. A number of system functions are not included (SAVE, LOAD, OBLIST). While the manual is extremely useful to the TRS-80 owner, it would be even more useful if it included a summary of the differences between the full CP/M version and the reduced TRS-80 version.

In short, for the TRS-80 owner who is interested in experimenting with artificial intelligence projects, muSIMP alone is worth the price of the muSIMP/muMATH package.

John R Goldin  
66 Brownell St  
New Haven CT 06511

### BYTE Saluted

I am a career Army officer. After five years of assignments outside of the data-

processing field, I have returned to that arena; however, the landscape has changed. It is covered with new technology, methods, technical terms, and jargon.

I want the world to know how useful BYTE is in overcoming the insecure feeling of operating in this new landscape. Particularly noteworthy and helpful is BYTE's editorial policy of parenthetically explaining all jargon and technical terms. While other trade journals seem to take delight in obscurity, BYTE consistently targets on clarity. I hope other publications will follow BYTE's lead. It's needed.

Keep up the good work, BYTE!

James H Powers  
Lieutenant Colonel, US Army  
Director, ADP (Automatic Data Processing)  
Support Division  
US Army War College  
Carlisle Barracks PA 17013

### Self-Replicating Code

I would like to point out the shortest self-replicating program I know of. It is written in Microsoft BASIC, as found in the Commodore PET (also known as the

A REFURBISHED "SELECTRIC" ASCII TERMINAL  
FOR THE SMALL BUSINESSMAN OR SERIOUS HOBBYIST.

# The AJ 841 I/O terminal. Now available from dealers nationwide.

Demand for our AJ 841 I/O computer terminal has been great. And now it's getting even greater. So call your local computer shop dealer right away. Supply is limited! You may never have another opportunity like this one to buy your own *professional* terminal.



### The AJ 841 features:

- Choice of serial RS 232 or parallel interface
- ASCII code
- 14.9 cps printout
- High quality Selectric printing
- Heavy-duty Selectric mechanism
- Off-line use as typewriter
- Documentation included
- 30-day warranty on parts and labor (details available on request)

### Call toll-free now

For location of your nearest AJ dealer, call toll-free:

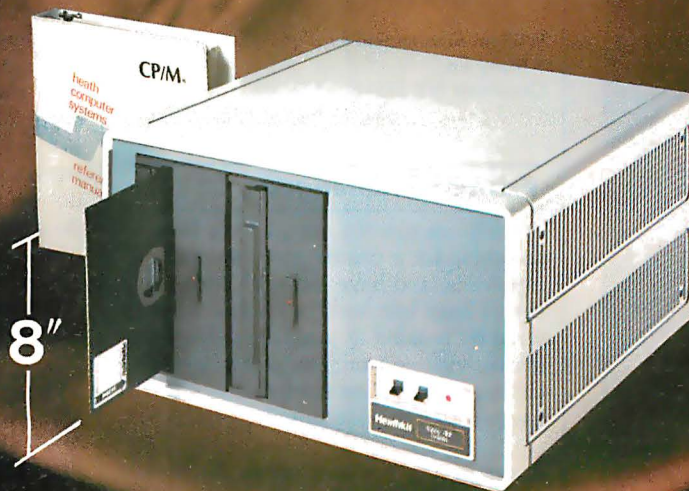
**800/538-9721**

California residents call 408/263-8520.

 **ANDERSON  
JACOBSON**

# New muscle for Heathkit Computers

*Now with new CP/M® Systems Software  
for thousands more programs...and new  
8-inch disk system for millions more bytes.*



The Heathkit All-In-One Computer now has space for 64K of addressable RAM, so you can run bigger, more complex programs.

And our new CP/M® Operating System (Standard ORG-0, Version 2.2) makes thousands of CP/M programs available to you. Heathkit systems can run more, do more, store more than ever before.

A new 8-inch double-sided, double-density disk system, with over 1 million bytes per drive, is now available for Heathkit H-89 and H-8 Computers.

The new 8-inch disk system features soft-sectored disks for IBM® compatibility. It's capable of operating in standard IBM 3740 format. And the 8-inch sys-

tem can be used in conjunction with 5¼-inch systems. **For compatibility with the rest of the industry, Heathkit Computers may just be the most flexible systems you can buy.**

All Heathkit computers and peripherals are available in money-saving, easy-to-build kit form — or completely assembled and factory tested. All are supported by the best documentation in the business and by 62 service centers throughout the U.S. and Canada. You're never out in the cold.

For complete details and prices on Heathkit computers, peripherals and software, write today for the latest Heathkit Catalog or visit your nearby Heathkit Electronic Center\*.

## VISIT YOUR HEATHKIT STORE

Heathkit products are displayed, sold and serviced at Heathkit Electronic Centers\*, located in major cities throughout the U.S. and Canada. See your white pages for the store nearest you.

\*Units of Veritechnology Electronics Corporation, in the U.S.



## Send for FREE catalog

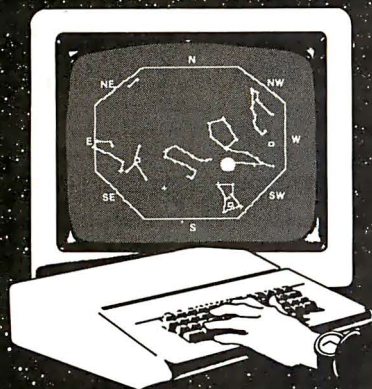
**Write to Heath Company, Dept. 334-754,  
Benton Harbor, MI 49022**

In Canada, contact Heath Co., 1480 Dundas St. E.,  
Mississauga, Ontario L4X 2R7

# Heathkit®

IBM® is a registered trademark of International Business Machines Corporation. CP/M is a trademark of Digital Research, Inc.

# THE UNIVERSE AT YOUR FINGERTIPS



**TellStar™**  
for the Apple II

Choose a date, time, and place on Earth and let **TellStar** display the Stars, Planets, Sun, Moon and fascinating Stellar Objects in High Resolution Graphics.

With interactive commands, **TellStar** enables you to easily locate and identify stellar objects. Right Ascension, Declination, Azimuth, Elevation, Rise and Set Times are presented adjusted for precession. Planetary data is calculated using Kepler's equations. Constellations are drawn before your eyes. Print High Resolution Graphics displays on a Silentype. Scientific data can be printed on any printer.

A Calculation Utility is provided for equatorial, ecliptic, horizontal, and precession conversions.

**TellStar Level I** on disk **\$39.95**

Northern Hemisphere Star Tables

**TellStar Level II** on disk **\$79.95**

Comprehensive 47 page manual

Northern Hemisphere Star Tables

Southern Hemisphere Star Tables

Messier Object Star Tables

Visit your local computer store for demonstration or write for more information.

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Zip \_\_\_\_\_



**Information Unlimited  
Software, Inc.**  
281 Arlington Avenue  
Berkeley, CA 94707  
(415) 525-9452

TellStar is a trademark of Scharf Software Services.  
Apple is a trademark of Apple Computers, Inc.

## Letters

CBM 2001). It relies on the fact that PET BASIC sees all commands the same way. In many BASICs, you can write a 1-line instruction without a line number and it will be executed when entered. But PET BASIC also allows commands like RUN or LOAD to be inserted into a program with a line number, like any instruction. The program is:

### 1 LIST

Because of the compact storing of code in the PET's memory, the program takes up only 2 bytes, one for the line number, and one for the PET's internal representation of LIST (the space between is provided by the subroutine that controls the printout of integers).

I'm currently in the 9th grade, and am fluent in BASIC. I intend to learn Pascal when the school library gets the book it just ordered.

William Sommerfeld  
3 Mary Ln  
Greenvale NY 11548

## Printers Challenged

For some months now, I have been searching for a printer that meets all of my needs, and have met with little success. I have lost hope of finding what I want by looking at magazine advertisements, visiting computer stores, and circling numbers on reader-service cards. I would like to issue this challenge:

If any printer manufacturer or distributor has a machine that fits all (and I mean all) of the requirements listed below, I will buy it, pure and simple.

- It must have some form of letter-quality printing. A fast, low-quality mode and a slow, high-quality mode would be fine. ("Letter-quality," as far as I am concerned, means lowercase letters with descenders.)
- It must be able to handle both single-sheet and fanfold paper (with either pin or tractor feed).
- It must have graphics capability. I can write the graphics software if I must, but the graphics must be real, not block graphics or plotting of Xs.
- It must have at least some minor forms control. Even a simple top-of-page for 11-inch paper would be sufficient.
- I must have some convenient way to get the printer fixed when it breaks. I live in Brooklyn; a service center any-

where in the New York City metropolitan area would be fine.

● The printer should cost \$1000 or less. The highest I am willing to go, including tax, shipping, and all the options I need, is \$1200.

Are all these requirements unreasonable? I don't think so. There are a number of printers advertised in BYTE that miss by only one or two points. For example, MPI's 88G printer does not have lowercase descenders and the closest place I could have it repaired is in Ridgewood, New Jersey; otherwise, I would have purchased it right away. The Centronics 737 has no graphics (no Centronics I know of does). Okidata's Slimline cannot handle single sheets, while their Microline has no descenders and only block graphics. The Base2 prints in dark-blue ink and can't handle single sheets either, neither can the Anadex GraphicsPLUS... and so on.

I suppose printer manufacturers have their own reasons for not including this capability or that feature in their printers, but I have a pretty good reason for wanting the features I want. I don't do just one thing with my computer, I do a whole range of things, from business writing to hobbies to simulations to music synthesis. I refuse to invest in another printer that does not help me use my computer to its greatest potential.

Bill Seligman  
667 Rugby Rd  
Brooklyn NY 11230

## Run Down

Being a Hewlett-Packard fan and owning an HP-41C, I was anxious to read Bruce D Carbrey's review of the calculator in the December 1980 BYTE. (See "A Pocket Computer? Sizing up the HP-41C," page 244.) I feel that the review was quite good and that all of Mr Carbrey's judgments were fair and realistic, especially when comparing it with Texas Instruments' TI-59.

However, I must disagree with one of Mr Carbrey's observations. He said that the typical life-span of the nonrechargeable size-N batteries is 1 to 2 months. I have had my calculator for 13 months, and I have used it a good deal during that time. Only a week ago did it become necessary to replace the original set of batteries.

Fred W Scheifele  
108 Shelly Ln  
Delran NJ 08075 ■

# Mountain Computer makes more peripherals for the Apple Computer than Anybody.

and . . . a place to put them

## INTROL X-10

Intelligent Home Controller for lights and appliances. Real-time schedules and energy conservation. Complete applications software package. Home security with random scheduler. Power usage accounting package for home energy cost control. No wiring required.

## APPLE CLOCK

Real-time and date information. Interrupts permit Foreground/Background operation of two programs simultaneously. Battery back-up. Crystal-controlled for  $\pm .001\%$  accuracy. Onboard ROM for easy access from BASICS. Supports PASCAL. Time from one millisecond to one year.

## SUPERTALKER SD200

Input/Output Speech Digitizer. Permits talking programs. I/O capability allows interactive programs with speech-prompted inputs. Use output for speech directed activities in business systems, announcements in a control-room, or sound effects in entertainment programs. Easy to use because input as well as output is under user control with special software operating system.

## ROMWRITER

Program your own EPROMs. Create your own firmware. Programs 2K, 2716 5V EPROMs. Disk software package provides easy EPROM programming. EPROMs are verified after BURN. RUN your programs from on-board socket or install them on ROMPLUS+.

## ROMPLUS+

More power for your system through firmware. Six sockets accept 2716 EPROMs or ROM equivalents. Six or any combination can be used at once. Scratch-pad RAM and two TTL connectors. Special 2K ROMs available for powerful system enhancement: Keyboard Filter ROM—COPYROM—Others coming soon.

## MusicSystem

Sophistication previously available only on experimental mini and mainframe computer synthesizers. Digital instrumental music synthesizer system. 16 voices in stereo. Instrument definitions simulate the sound of real instruments—and more. Fully programmable waveforms. Envelope Control. Composition system—sheet music input using standard music notation. Chords and multi-part scoring up to 16 voices. A true instrument that anyone with an Apple can play.

## A/D+D/A

16 channels analog to digital input. 16 channels digital to analog output. Eight bit resolution. Super-fast  $9\mu$  sec. conversion time. Monitor and output to the real world. All on one card.



## EXPANSION CHASSIS

By popular demand! Eight more slots for your Apple. Attractive sturdy enclosure. Its own heavy duty power supply. Easy to use. Address cards in Expansion Chassis the same way as in your Apple. Only one additional command to specify in Apple or in Expansion Chassis. Compatible with all Apple peripherals.



## CardReader

At last! An intelligent, high-quality device for data entry from user-marked cards. Implement BASIC programming, examination scoring, inventory maintenance and other applications requiring off-line data preparation for batch entry later. Connects to any computer having RS-232 interface. Software and cards are available for jobs in business, science and education.

MOUNTAIN COMPUTER has the most comprehensive line of Apple peripherals available. Anywhere. From anybody. We know the Apple inside and out and are committed to providing the most innovative and unique products to expand and enhance its capabilities and use. After all, we were the first company to make an Apple peripheral—except Apple Computer.

Available at Apple Dealers worldwide.



**Mountain Computer**  
INCORPORATED

300 Harvey West Blvd., Santa Cruz, CA 95060  
(408) 429-8600 TWX 910 598-4504

\*Based on Manufacturer's published catalogs—Apr. 1980  
Apple is a trademark of Apple Computer Inc.

# Structured Programming and Structured Flowcharts

---

Gregg Williams, Editor  
BYTE  
POB 372  
Hancock NH 03449

---

Structured programming—that phrase, unfamiliar to me and, I assume, to most people several years ago—is now endowed with such magical powers that most books on programming include it somewhere in their titles.

But what is structured programming? Most of us feel that it is probably good for us, like getting regular exercise or brushing our teeth after each meal. You may also think it's too complicated (not true), that it slows down programming (wrong, it usually speeds it up), or that it cannot be done unless your computer runs a language like Pascal or ALGOL (wrong again).

Simply put, structured programming is a set of techniques that makes programs easier to write, easier to understand, easier to fix, and easier to change. These techniques are simple and general and can be adapted to any computer language that has a *goto* statement—that includes BASIC, assembly language, FORTRAN, and COBOL. The purpose of this article is to show you a new form of notation that will help you write structured programs. But first, let's review structured programming.

## The Elements of Structured Programming

A structured program is like a set of notes written in outline form. The headings accompanied by Roman numerals—I, II, III, and so on—provide the overall organization. Each Roman numeral topic is broken into several component topics (A, B, and C, for example) and each of these is subdivided further (1, 2, 3, ...) and further (a, b, c, ...) as needed. Table 1

shows a problem and its solution written in this outline form.

The above example demonstrates a process known as *decomposition*: breaking a task (problem) into its subtasks. This process represents the most important concept in structured programming, ie: that a problem can be solved by repeatedly breaking it into subproblems, until *every* subproblem can be solved. If you plan this decomposition before you try to write it out in the narrow, precise, and time-consuming syntax of the target language (ie: the programming language you use to solve the problem), you will have a better chance of getting your program right the first time.

---

**It has been  
mathematically proven  
that any program can  
be written using three  
basic constructs.**

---

But how do you decide which way to break the problem into subproblems? Common sense helps. Ask yourself, "What sequence of actions and decisions would I have to make if I were doing this without a computer?"

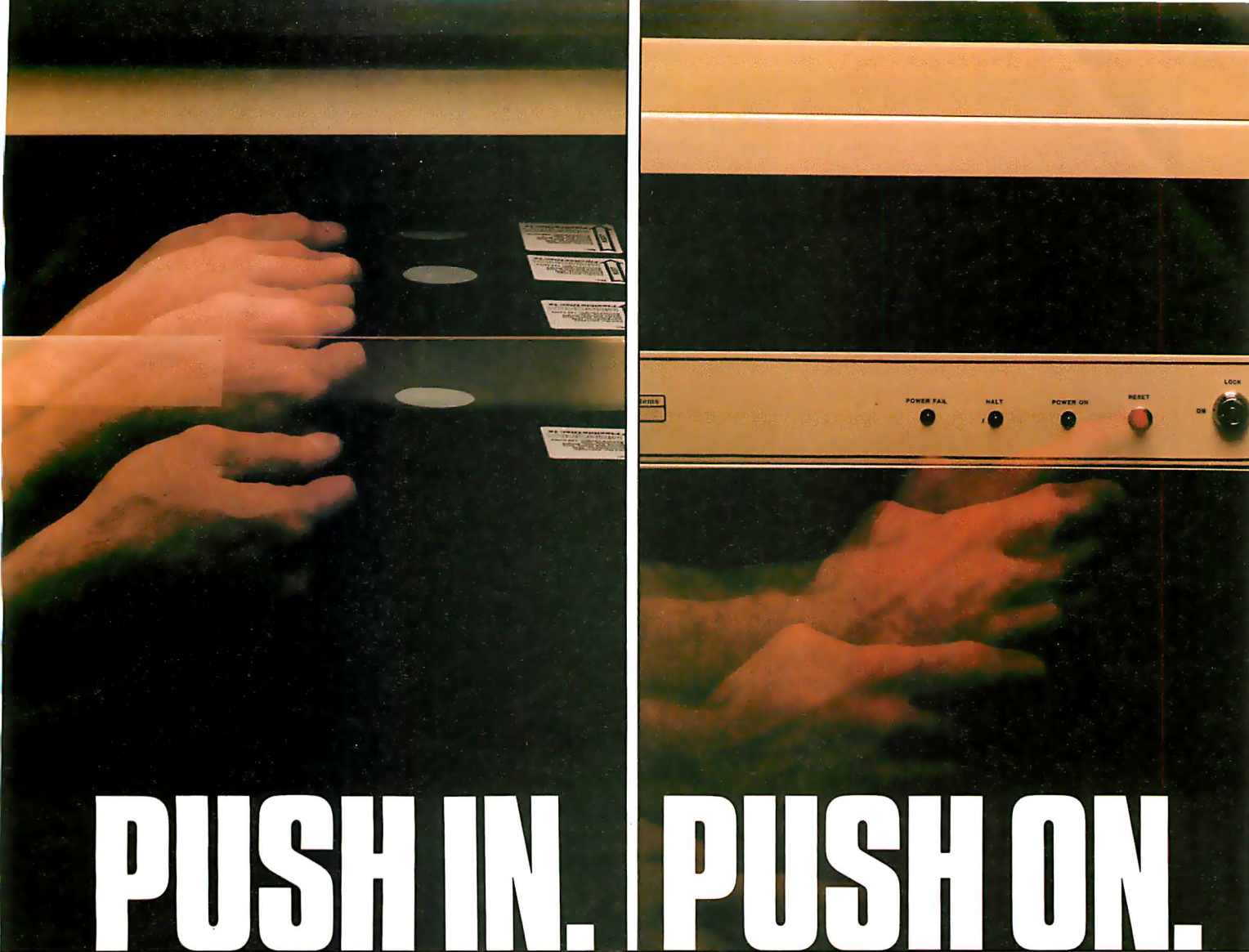
The rest of the answer comes from the literature of structured programming. It has been mathematically proven that *any* program can be written using three basic patterns, called *programming constructs* (or simply *constructs*): sequence, *if...then...else*, and *while...do*. The first construct, sequence, gives you the basic capa-

bility of breaking a task into a set of subtasks that accomplish the main task when executed sequentially.

The second construct, *if...then...else*, performs one of two subtasks, depending on the truth or falsity of a stated condition. An everyday example of this construct is given in the following sentence: "If it is raining outside, I will take my umbrella with me; if it is not, I will leave the umbrella at home."

The third and least familiar construct, *while...do*, is actually a generalized *do-loop* that repeats a set of actions (called the *body* of the loop) while a stated condition is true. You use this construct when making iced tea from a mix: "As long as (while) the mix is not completely dissolved, I will continue to stir it."

If you combine lines of code in the three ways described above, the resulting program is said to be *structured*. In most languages (BASIC, for example) you will still use *goto* statements, but they will be *restricted* to carrying your program to specific points, ie: the beginnings and ends of tasks or subtasks. Each module (subtask) in a structured program has a property known as "one-in, one-out"; that is, there is only one entrance and one exit from these modules, and no module will ever jump into the middle of another one. Instead of being like a plate of spaghetti, a program is more like a string of pearls (with each pearl containing another, smaller string of pearls, and so on); each module has a definite and unchanging position on the string. When such regularity can be counted on, existing modules can be changed or deleted, and entirely new modules can be add-



# PUSH IN. PUSH ON.

MAKING MINIS OUT OF MICROS.

**Here's the system builder's solution for successful computers and applications. Push in the CCS component. Push in the operating software. And push on with your application.** CCS systems and components are designed to go together quickly, and to keep running reliably, with a proven return rate of less than 1%.

**And you get performance.** The systems deliver hardware vectored interrupts and the capability to interleave DMA data transfers with rates as high as two megabytes per second, plus bank select memory of up to 512K bytes. This 8-bit system provides single user, multiuser, and multitasking capability with ample speed to prevent operator waiting or loss of incoming real-time data.

The systems are available with CP/M or MP/M operating systems. For real-time or multiuser applications, the CCS OASIS real-time multitasking operating system supports re-entrant programs and relocatable code modules, with



- ☐ Please have a sales representative call me.
- ☐ Please send more information on CCS Systems and Expansion Modules.

Name \_\_\_\_\_  
 Company \_\_\_\_\_  
 Address \_\_\_\_\_  
 City/State/Zip \_\_\_\_\_  
 Phone: (     ) \_\_\_\_\_



California Computer Systems  
 250 Caribbean Drive  
 Sunnyvale, CA 94086  
 (408) 734-5811

facilities for task-to-task communication, file protection, time-of-day bookkeeping, spooling, task overlay, dynamic memory management, ISAM file structures and device-independent I/O. CCS OASIS includes debug, text editing, linkage, and file sort utilities; the system supports a host of existing languages, applications, and utilities from a range of vendors.

**Powerful computer systems you can configure to your demanding requirements quickly, and with confidence.** Choose from a variety of systems. Expand with CCS board-level modules for memory, disk control, high-speed arithmetic, and I/O, plus subsystems for floppy and hard disk storage.

If you sell, install, or use computer systems, you should know more about the CCS product line. **We've got a lot more to tell. Tear out and return the coupon for more information. Or call.**

CP/M and MP/M are trademarks of Digital Research. OASIS is a trademark of Phase One Systems.

## Structured Programming: A Qualification

About a year ago, I thought that structured programming was the ultimate tool in the analysis, design, and implementation of a computer program. I had read several books on the subject, browsed through a great many more, and successfully applied the techniques to real-world problems. Many books spoke of structured design, but I saw the concept as simply the same structured programming tools applied to the earlier process of program design—that is, of transforming a situation to be solved into a set of programs that will accomplish the task. I was more wrong than right.

Through my experience with a particular programming project, I suddenly recognized a major point that I had formerly not comprehended: that structured programming does not encompass the entire process of programming. The

process of programming begins with some sort of description or specification of the program to be written. With small programs (the kind we spend most of our lives writing), this is usually enough. But as the problem gets bigger (and perhaps more ill-defined), more and more crucial design decisions must be made before you divide the problem into programs.

I also learned that certain design decisions within a given program are overlooked by the main ideas of structured programming. Structured programming is a literal-minded discipline that deals exclusively with the orderly disassembly of a problem into the series of program statements that solves it. It does this while assuming several givens: the overall algorithm to be used (eg: bubble sort or heapsort), the data structures used (eg: linked lists, arrays, or binary trees), and implementation details (eg: sequential or ran-

dom-access files, the packing of one or two characters per byte). These details, which may have a tremendous effect on the quality of the program (in such aspects as size, speed, readability, and maintainability), are factors that are evaluated and weighed in the design process.

The purpose of these paragraphs is two-fold: first, to affirm that the techniques described in this article can make a significant improvement in your skills as a programmer and that they are sufficient for many programs; and, second, to emphasize that the quality of a program can often be greatly improved by attention to the design decisions that are made in the early stages of analyzing the program design. I am including a list of particularly helpful books and articles in the references at the end of this article.

ed without problems caused by unexpected module interaction.

That is the theory of structured programming—now for putting it into practice. Figures 1 thru 3 show the three constructs (sequence, *if...then...else*, and *while...do*) in standard flowchart form and as BASIC code. (For a more detailed look at writing structured programs in BASIC, see "Applied Structured Programming," listed in the references. This article appears in an anthology that contains several other good articles on program decomposition—

sometimes called *top-down design* or *programming by stepwise refinement*—and structured programming.)

## The Origins of a New Notation

When I got my first job as a commercial programmer, I realized that I was going to have to write longer programs than I had previously written. This prompted me to adapt structured programming techniques to my work in BASIC, COBOL, and RPG II. (As it turned out, my longest program was a 35-page COBOL program that grew to 75 pages without going

out of control. I could not have done this without the rigorous use of structured programming techniques.)

As my programs grew larger, I became dissatisfied with the methods I used to plan my programs. Conventional flowcharts obscured the structure of my programs. Nassi-Schneiderman charts and Warnier-Orr diagrams were unsatisfactory for other reasons.

The best solution offered in structured programming texts was *structured pseudocode*, an informally written Pascal-like "program" that uses terse English phrases to describe the program. Listing 1 shows the structured pseudocode for the program outlined in table 1b. I used structured pseudocode extensively to outline programs but found that the details of the resulting pseudocode often obscured the overall design of the program.

In retrospect, I can see that I wanted a design notation that could do the following:

- Completely describe the algorithm to be programmed
- Provide overview and detailed documentation that was easy to read
- Not need to be redrawn every time

Text continued on page 26

Problem: Given a numeric array V with N elements, find the largest element, MAXV, and its index, MAXINDEX. These variables are related as follows:

- $1 < \text{MAXINDEX} < N$
- $\text{MAXV} = V(\text{MAXINDEX})$
- MAXV is the largest value in  $V(1), V(2), \dots, V(N)$ .

**Table 1:** A problem and its solution in outline form. The common outline form used for summarizing a body of material can also be used to give structure to the emerging design of a program. Table 1a gives a statement of the problem and table 1b gives its solution in outline form.

Solution:

I. Set problem up:

- A. Set  $\text{MAXVAL} = -9 \times 10^{20}$
- B. Set  $\text{MAXINDEX} = 0$
- C. Set  $\text{INDEX} = 1$

II. Find largest element:

- A. Set up a loop that increments the variable INDEX from the beginning to the end of the array V.

For each value of INDEX:

- 1. Compare the current array value ( $V(\text{INDEX})$ ) to MAXVAL:
  - a. if MAXVAL is equal or larger, do nothing;
  - b. if MAXVAL is smaller, replace MAXVAL with the current array value and MAXINDEX with the current index (the value of INDEX).

III. Print the largest element (MAXVAL) and its index (MAXINDEX).

# EXTRA. EXTRA.

Extra paper widths  
to 381 mm (15")

Extra alphabet selection —  
English, German, Japanese  
and Swedish

Extra sharp  
and clear  
9 x 7  
dot matrix  
print letters

Extra advantage  
of bottom or back  
paper loading

Extra  
paper-saving  
print  
compression



Now you get more extras when you pick the new dot matrix printers by C. Itoh. Choose the Comet 80-column printer and get the extra benefits of four character sizes and paper-saving print compression. Choose the Comet II 136-column printer and receive the added extra of a full-width computer size printer that accommodates paper widths to 381 mm (15").

Both the Comet and Comet II also offer the rare combination of low cost and high performance. Both models operate at an efficient 125 cps bidirectional print speed and in a 9 x 7 dot matrix.

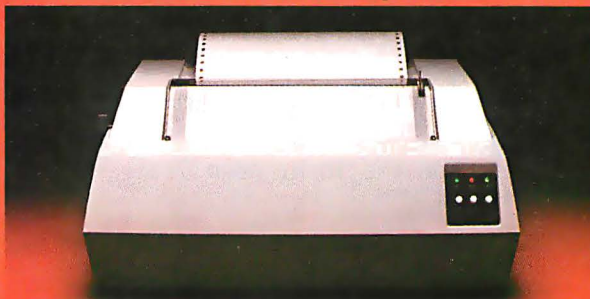
C. Itoh's Comet series has the extra advantage of a unique multilingual capability with a selection of four, different alphabets: English, German, Japanese and Swedish. Other special characteristics include a programmable VFU (Vertical Format Unit) plus

self-test diagnostics. For your operator's convenience, there's easy bottom or back paper loading, and both Comets use a standard low-cost nylon ribbon. Plus our printers already meet 1981 Class A FCC, UL, and fire safety requirements.

If all that wasn't enough, Comet and Comet II are plug-compatible with all major printers in the industry, meeting standard parallel serial interface specifications. Our printers are backed by C. Itoh's warranty and a nationwide field service organization.

And as a final, all important extra, when you choose either printer from C. Itoh you get immediate off-the-shelf delivery.

So if you want the highest quality at the best price, look into the extras the C. Itoh Comet and Comet II printers offer. You'll get a lot more than you bargained for. For more information, contact C. Itoh Electronics, Inc., 5301 Beethoven Street, Los Angeles, CA 90066; Tel. (213) 390-7778. Chicago Office: 240 E. Lake Street, Suite 301-A, Addison, IL 60101; Tel. (312) 941-1310. New York Office: 666 Third Ave., NY, NY 10017; Tel. (212) 682-0420. Dallas Office: 17060 Dallas Pkwy., No. 108, TX 75248; Tel. (214) 931-0177. C. Itoh represented in Canada by Canadian General Electric.



**C. ITOH**  
**ELECTRONICS, INC.**  
One World of Quality

# don't risk magnetic damage to EDP storage media

Many computer users have learned "the hard way" that accidental exposure to magnetic fields can erase or alter data and programs stored on disks and tapes. Such irretrievable loss can occur during media transit or storage if unprotected disks or tapes are exposed to the magnetic fields produced by motors, transformers, generators, electronic equipment, or even intense transient fields induced by electrical storms.

Data-Safe Products provide reliable, economical protection against stray magnetic field damage by shielding disks and tapes with the same high-permeability alloy used to shield cathode ray tubes and other magnetic-sensitive components. DISK\*SAFE Floppy Disk Protectors, punched for 3-ring binder, sandwich two 8" disks, or smaller mini-disks, between sheets of magnetic shielding alloy encased in the strong vinyl pockets. (Binder sent free with 10 Protectors).

## DISK\*SAFE FLOPPY DISK PROTECTORS



## TAPE\*SAFE METAL CASSETTE SHIELDS

TAPE\*SAFE Cassette Shields are constructed of magnetic alloy, with heliarc-welded seams and an easy-open hinged top. Each attractively-finished TAPE\*SAFE holds one cassette in its original plastic box. A shelved metal FILE DECK (not shown) stores up to six TAPE\*SAFES for easy access. (One free with each six TAPE\*SAFES). VISA and MasterCard telephone orders accepted. Prices below include shipping.

DISK\*SAFE Floppy Disk Protectors: 1-5, \$8.95 ea;  
6-9, \$7.95 ea; 10 or more w/binder, \$6.95 ea;

TAPE\*SAFE Cassette Shields: 1-5, \$14.95 each;  
6 or more with free FILE DECK, \$12.95 each.

TAPE\*SAFE FILE DECK: \$10.95 each.

### Data-Safe Products, Inc.

1926 Margaret St., Phila., PA 19124 • 215/535-3004

Dealer Inquiries Invited

**Listing 1:** A structured pseudocode solution of the FINDMAX problem given in the text and in table 1. Structured pseudocode is a terse, informal, Pascal-like program that helps the user design a program before writing it in a formal programming language.

Program FINDMAX:

Initialize system variables (MAXV =  $-9 \times 10^{20}$ , MAXINDEX = 0, INDEX = 1)  
While INDEX  $\leq$  N

find value of current array element (CURRV = V (INDEX) );  
if current array element (CURRV) > maximum element so far (MAXV)  
new maximum element = current element  
new maximum index = current index ( MAXINDEX = INDEX )  
endif  
increment INDEX by 1

endwhile

print MAXV, MAXINDEX

(end of program)

**Listing 2:** A BASIC implementation of the FINDMAX problem from table 1. In this program, the variable MAXINDEX has been shortened to MINDEX to distinguish it from the variable MAXV. This program is written in TRS-80 Model I Level II BASIC, and it will run on other computers that use Microsoft BASIC.

```

100 :
110 REM                                PROGRAM FINDMAX
120 :
130 REM    THIS PROGRAM TAKES AN ARRAY OF NUMBERS, V, AND
140 REM    FINDS THE LARGEST ELEMENT, MAXV, AND ITS INDEX,
150 REM    MAXINDEX, SUCH THAT:
160 REM                                MAXV = V (MAXINDEX)
170 :
180 REM    (FOR THE PURPOSES OF ILLUSTRATION, WE WILL ASSUME
190 REM    THAT THE DATA IS ALREADY IN THE ARRAY V..)
200 :
210 :
220 REM ===== MAIN PROGRAM =====
230 :
240 DIM V(12)
250 GOSUB 800: REM    --NOT PART OF ALGORITHM IN FIGURE 6; THIS
260 REM                                SUBROUTINE ENTERS DATA INTO ARRAY V
270 :
280 REM ----- BOX 1: INITIALIZATION ROUTINE -----
290 :
300 MAXV = -9 * 10E20
310 MINDEX = 0
320 INDEX = 1
330 :
340 REM ----- BOX 2: FIND LARGEST VALUE -----
350 :
360 REM -- (BEGINNING OF WHILE...DO LOOP)
370 IF INDEX > N THEN 520
380 CURRV = V (INDEX)
390 :
400 IF CURRV < MAXV THEN 440
410 MAXV = CURRV: REM -- (THIS PART EXECUTED IF FALSE)
420 MINDEX = INDEX
430 :
440 INDEX = INDEX + 1
450 :
460 REM -- (JUMP TO BEGINNING OF WHILE...DO LOOP)
470 GOTO 370
480 :
490 :
500 REM ----- BOX 3: PRINT FINAL VALUES -----
510 :
520 PRINT: PRINT "THE LARGEST VALUE IN THE V ARRAY IS:"
530 PRINT "                                V(;" MINDEX ";" ) = ";" MAXV
540 PRINT
550 :
560 END
570 REM ===== END OF MAIN PROGRAM =====
760 :
770 :
780 REM ----- SUBROUTINE TO FILL V ARRAY -----
790 :
800 DATA 12: REM -- (NUMBER OF ITEMS TO BE READ IN)
810 DATA 1, 15, -28, 3.24, -17.92, 0, 5, 1, 0, 21.4, -205, 17
820 READ N
830 FOR I=1 TO N: READ V(I): NEXT I
840 RETURN

```

# If you write software, write Digital Research.

## We can help you bring your products to market.

Independent Software Vendors (ISV's) are the key to solving the software crunch in the 1980's. To help you bring your products to market, Digital Research introduces the ISV Support Plan — designed to assist you in:

### Developing Your Product

- ☐ With the fast and powerful PL/I-80™ Programming System
- ☐ ISV Seminars covering high level applications programming

### Getting Established in Your Market

ISV Seminars cover:

- ☐ Designing a marketing strategy
- ☐ Advertising
- ☐ Writing Manuals
- ☐ Assuring software security
- ☐ Supporting and updating products

### On-Going Support Includes:

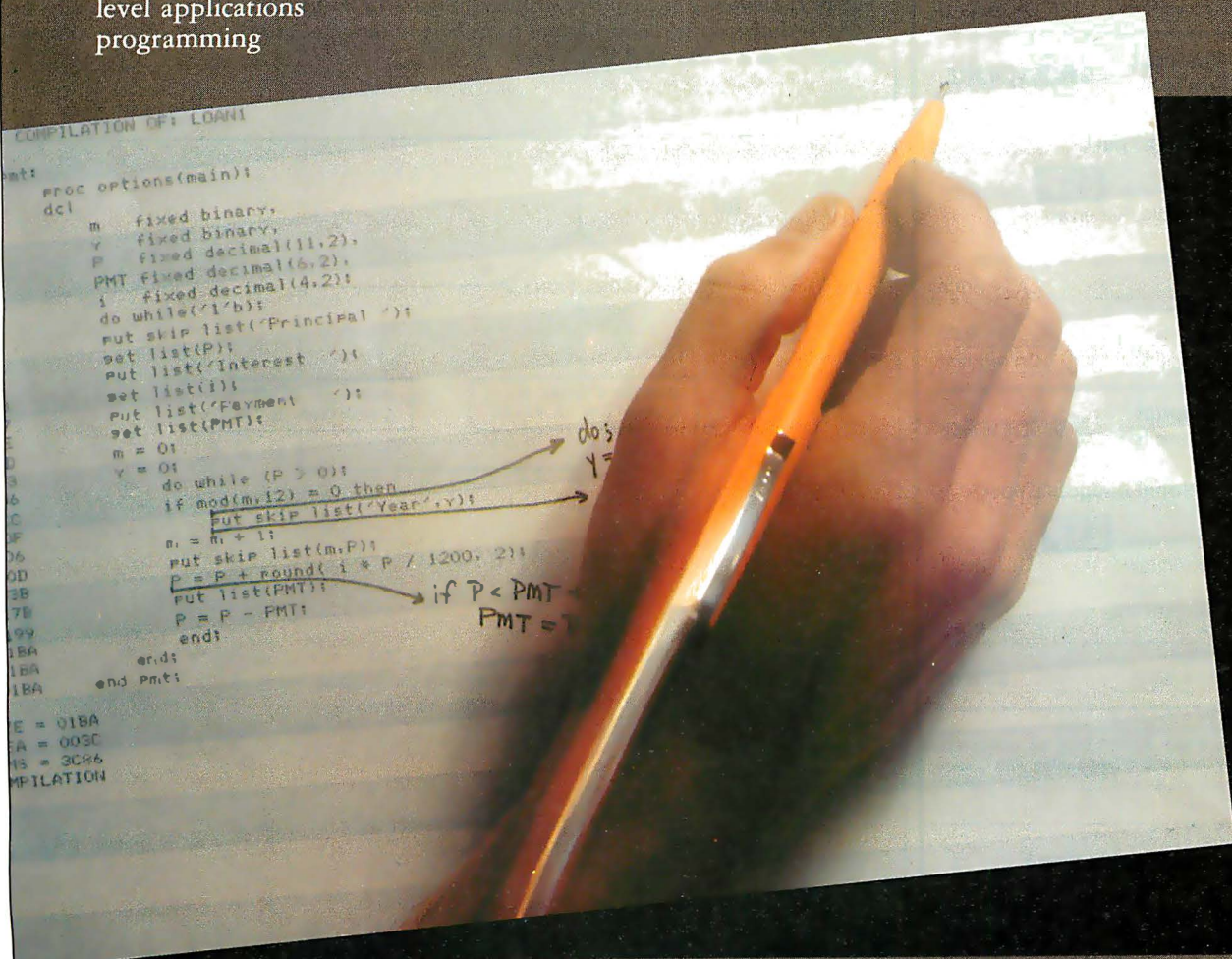
- ☐ Legal and technical information
- ☐ Distribution channels
- ☐ Printing facilities
- ☐ Free product listing in our Applications Software Catalog

All this plus the world's largest software marketplace — the CP/M® customer base.

So why do it alone? Write Digital Research. We'll send you our free brochure detailing the ISV Support Plan.

 **DIGITAL RESEARCH®**

P.O. Box 579  
Pacific Grove, CA 93950  
(408) 649-3896  
TWX 910 360 5001



# We do what they do but...

when you have



you have the best!

The best Data  
Base Systems for 




dataKEY\*

- Index sequential and relative record files
- Fast extended search/data analysis
  - (a) Fast access to specific information
  - (b) Basic statistics reported from search
- Extensive report capabilities
- Flexible sort function


Price

Diskette version  
(specify type & size).....\$99.50  
Corvus 10 Mb version.....On request

The best Business  
Data System for 



bookKEYper\*

- Fully integrated with  dataKEY
- Accounts Payable, Receivables
- General Ledger
- Transaction driven—no file size limit

Price

Diskette version  
(specify type & size).....\$450.00  
Corvus 10 Mb version.....On request

The best Personal  
Finance System for 



Personal budgetKEYper\*

- Fully integrated with  dataKEY
- Checkbook manager
- "Payables" manager
- Expenses statements

Price

Diskette version  
(specify type & size).....\$200.00

\*Our software runs with Apple II DOS 3.3, or Applesoft or Language System and is compatible with Corvus 10 Mb, 8" Sorrento Valle and 5 1/4" diskette, menu-driven, and tutorial.

TEL. (603) 465-7264



ESP COMPUTER  
RESOURCES INC.

The "full-service" computer company  
9 Ash Street • Hollis, NH 03049

Text continued from page 22:

a change was made in the flowchart

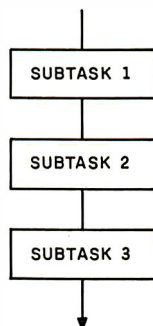
- Use a minimum of unfamiliar notation
- Be visually pleasing

This *structured flowchart* notation, which I developed over a period of several years, meets these criteria.

## Basic Constructs in Structured Flowcharting

According to the tenets of struc-

(a)

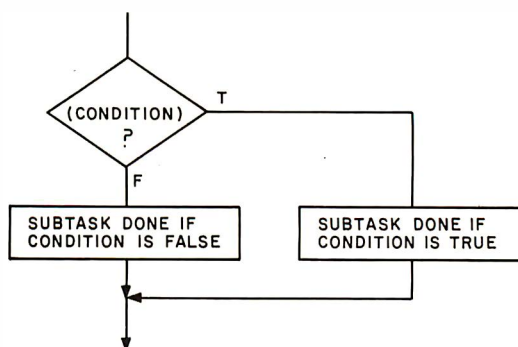


(b)

100 (BASIC statement for subtask 1)  
110 (BASIC statement for subtask 2)  
120 (BASIC statement for subtask 3)  
.  
.

Figure 1: Sequence as a control structure. Figure 1a shows how a linear sequence of subtasks is drawn using conventional flowchart notation. Figure 1b shows the equivalent sequence as a series of BASIC lines.

(a)

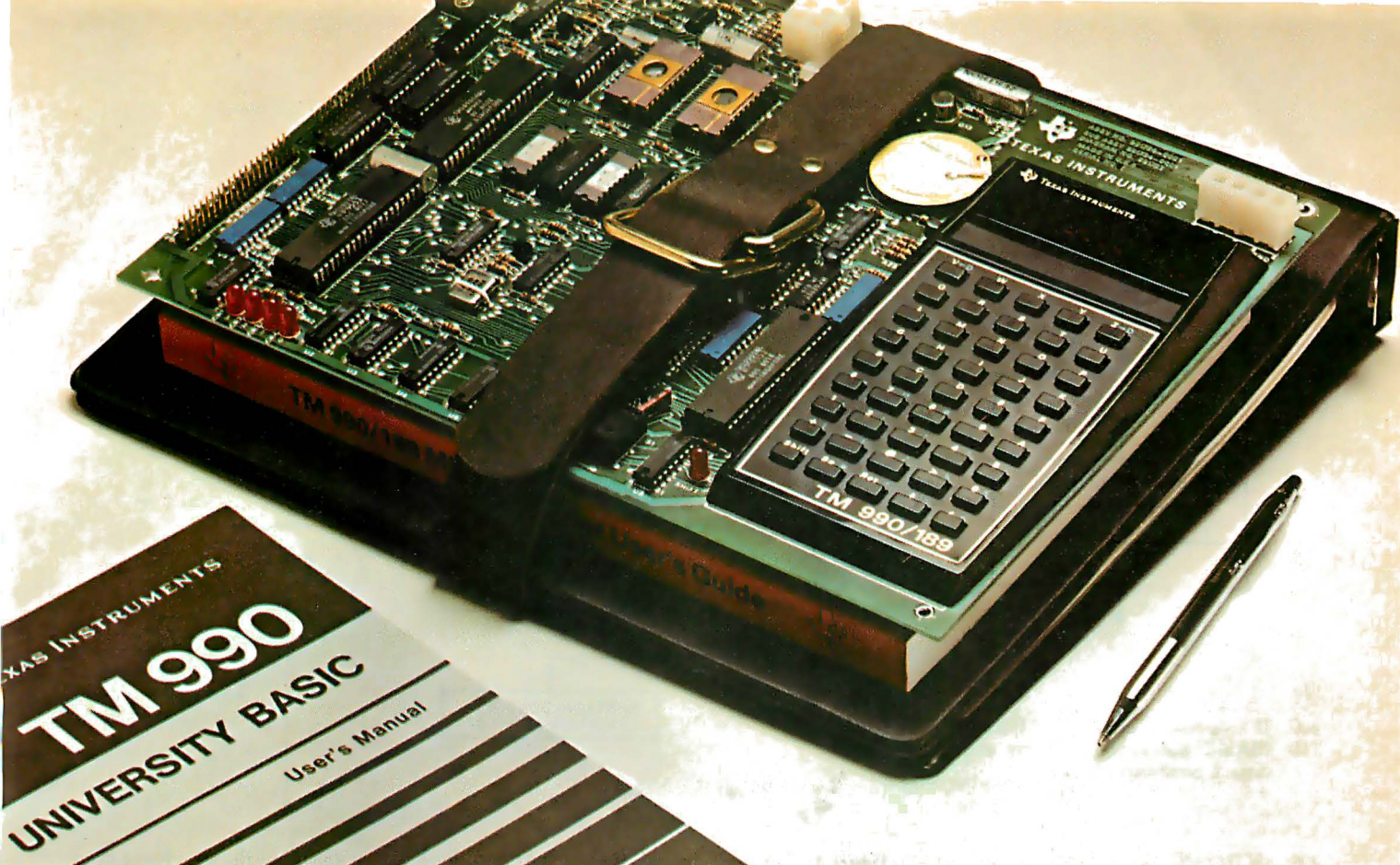


(a) CONVENTIONAL

(b)

100 IF (condition) THEN 200  
120 (BASIC statements for subtask  
done if condition is false)  
.  
.  
190 GOTO 300  
200 (BASIC statements for subtask done if  
condition is true)  
.  
.  
299 (last statement of "true" subtask)  
300 (first statement of next construct)

Figure 2: The if...then...else construct as a control structure. Figure 2a shows the conventional notation for this construct, while figure 2b shows the BASIC equivalent.



# University Basic ROM kit. Now available for TM990/189 module. On-board. Or off.

We've added another option to our TM990/189 University Module. Now, in addition to the I/O and RAM expansion kits previously offered, you can buy the TM990/189-1 module with a University Basic ROM kit on-board, and get new hardware features, too. Features like:

- 1K byte of extra RAM
- Asynchronous communication port
- Off-board CRU expansion

All for the attractive price of \$399\*.

With the TM990/469 Basic ROM kit, standard 189 modules provide "hands-on" training for students and engineers who want to learn a high-level language like Power Basic. The kit also supports a subset of the Power Basic commands and statements including SAVE and LOAD. Unique color commands such as TONE, COLOR, PATTERN and SPRITE work with TI's TMS9918 Video Display Processor. Another feature is the ability to access assembly

language routines from the University Basic programs.

When purchased separately, the ROM kit costs only \$110\*.

Of course, the standard TM990/189 is still available. And, it's still your best ticket into the microprocessor world. For maximum hands-on experience. For ease and simplicity of learning and teaching about microprocessors, hardware, and assembly language.

Outstanding features for the standard fully assembled TM990/189 stand-alone learning tool include:

- Powerful 16-bit microprocessor with minicomputer instruction set.
- 45-key alphanumeric keyboard and 10-digit, 7-segment display for easy *assembly language* programming.
- ROM-resident software
- Audio cassette interface
- Easy-to-add EIA and TTY interface
- 1K byte RAM expandable to 2K

- 4K byte ROM and 2K byte expansion EPROM socket.
- 16-bit programmable I/O controller.
- User addressable LEDs and sound indicator.

A 570-page tutorial text accompanies the TM990/189. It's a detailed guide for self-paced learning. Or, the basis for a three-hour university course. Also with the module: a 300-page user's guide.

The TM990/189 complete with tutorial text and user's guide is only \$299\*.

Order your University Module from your nearest authorized Texas Instruments distributor. For more information, send for a free copy of our newly revised brochure, CL-423B. Write to Texas Instruments Incorporated, P.O. Box 1443, M/S 6404, Houston, Texas 77001.

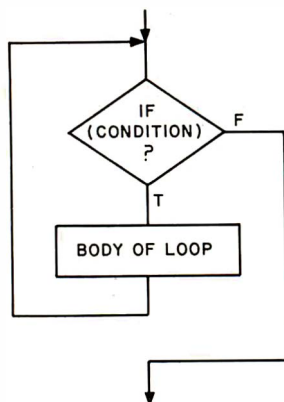


**TEXAS INSTRUMENTS**  
INCORPORATED

\* U.S. price, subject to change without notice  
© 1981 Texas Instruments Incorporated

Circle 4 on Inquiry card.

(a) CONVENTIONAL



(b)

```
100 IF (opposite of condition) THEN 300
110 (BASIC statements for body of loop,
    done if condition is true)
```

```
299 GOTO 100
300 (first statement of next construct)
```

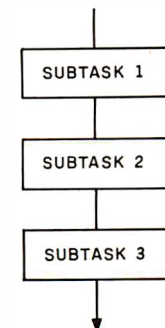
**Figure 3:** The while...do loop as a control structure. Figure 3a shows the while...do loop in conventional flowchart notation. Figure 3b shows the equivalent loop in BASIC code.

The if...then...else construct is fairly straightforward in the conventional flowchart (figure 2a). In the structured flowchart version (figure 4b), the boxes to be performed are to the right of the decision diamond, with the understanding that only one of the two boxes will be performed based on the value of the condition in the diamond. If the "else" side of the

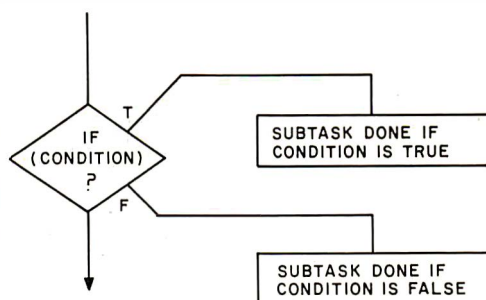
construct is not needed, the box labeled F is eliminated. In this case, if the condition does not evaluate to true, no action is performed, and control continues with the next construct following the decision diamond.

The notation for the while...do construct is not as easily derived. The conventional flowchart cannot directly express this kind of loop; it must

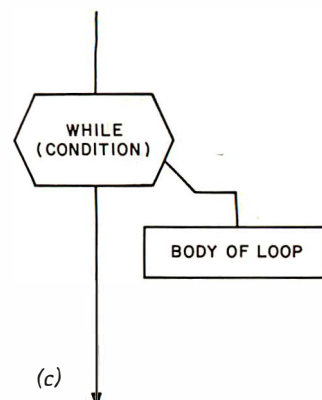
use a decision diamond and an external loop (figure 3a). The structured flowchart version (figure 4c) introduces a new symbol, a hexagon. (Actually, the hexagon is used to denote one of several kinds of loop structures; the word while makes this a while...do loop.) The box connected below and to the right of the hexagon is performed as long as the condition



(a)



(b)



(c)

**Figure 4:** The basic structured flowchart notations. Figure 4a shows the structured flowchart notation for a sequence of tasks; it is equivalent to the flowchart of figure 1a. Figure 4b shows the structured flowchart notation for the if...then...else construct (equivalent to figure 2a); note that it is the placement of the letters T and F (for true and false) that determines the conditions under which a given subtask is performed. Figure 4c shows the structured flowchart notation for the while...do construct (equivalent to figure 3a); the diagonal line leading down indicates that the condition (in the hexagon) is performed before the body of the loop.

## \* \* \* NORTH STAR USERS \* \* \*

### 8" FLOPPY SUBSYSTEM HAS DAWNED ON THE HORIZON

COMPLETE WITH MANUALS. SOFTWARE, HARDWARE FULLY INTEGRATED, READY TO RUN

\* Totally compatible with North Star hardware \* Allows use of 8" and or 5" drives \* Detailed, 80 page manual included \* Background print tasks  
\* Supports floppy files up to 4.2 MB \* Simple, plug-in operation \* Fully CP/M\* compatible \* File security \* Extensive utilities included

DMA-DOS Software ..... \$200  
Dynamic Microprocessor Associates Disk Operating System  
Tarbell Double Density Controller ..... \$420  
Cables ..... \$40

Dual Shugart 8" 800R drives in cabinet with fan  
and power supply ..... \$1,250  
Total package ..... \$1,910  
Prices and offers subject to change without notice

WE WILL PAY SHIPPING ON PREPAID ORDERS (Continental USA only). WE HAVE NO READER INQUIRY NUMBER. PLEASE WRITE OR CALL.

**JOHN D. OWENS ASSOCIATES, INC.**  
12 SCHUBERT STREET, STATEN ISLAND, NEW YORK 10305

OVERSEAS CALLERS: TWX 710 588 2844 or call (212) 448 6298 \* DOMESTIC CALLS: (212) 448 6283 (212) 448 6298 (212) 448 2913

# THE DAWN OF A NEW AGE

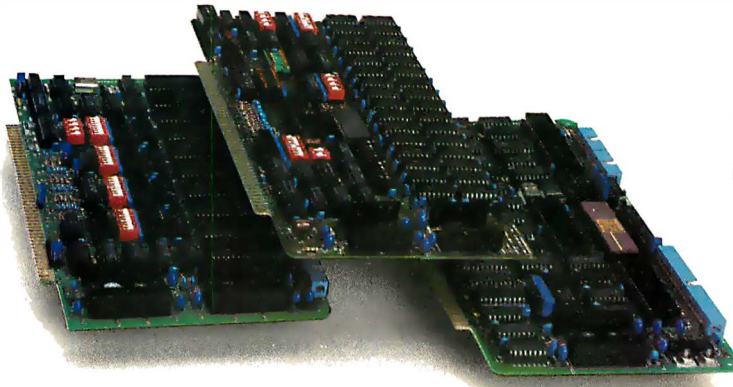
## The 2nd Generation™ is here!

MEASUREMENT systems & controls proudly introduces its new and exciting "2nd Generation" family of S-100\* compatible products. Each has been specifically designed for use with multi-user and network operating systems such as MP/M, CP/NET, and OASIS. Every product is fully tested and burned-in, comes with a 1 year guarantee, and offers you features not currently available from any other source.

**Z80 PROCESSOR BOARD** — The most powerful CPU board available today. Outstanding features include 4MHz operation, high-speed serial and parallel I/O utilizing DMA or programmed control, eight vectored priority interrupts, and a real time clock.

**MULTI-USER SERIAL I/O BOARD** — For use in expanded systems requiring up to eight additional serial I/O ports. Features include: 16 maskable

vectored priority interrupts, RS-232C interfaces with full handshake, asynchronous or synchronous operation with asynchronous baud rates to 19,200. Available in four or eight channel versions.



**DOUBLE DENSITY FLOPPY DISK CONTROLLER BOARD** — controls up to four 5¼-inch or 8-inch disk drives using IBM soft sector formats. It features 1K of on-board buffering, DMA controlled data transfers and the performance characteristics of the superior NEC 765 chip.

**64K BANK SELECTABLE MEMORY BOARD** — Features include I/O port addressing for bank select with 256 switch selectable I/O ports for the memory bank addressing. The memory is configured as four totally independent 16K software-selectable banks, with each bank addressable on any 16K boundary.

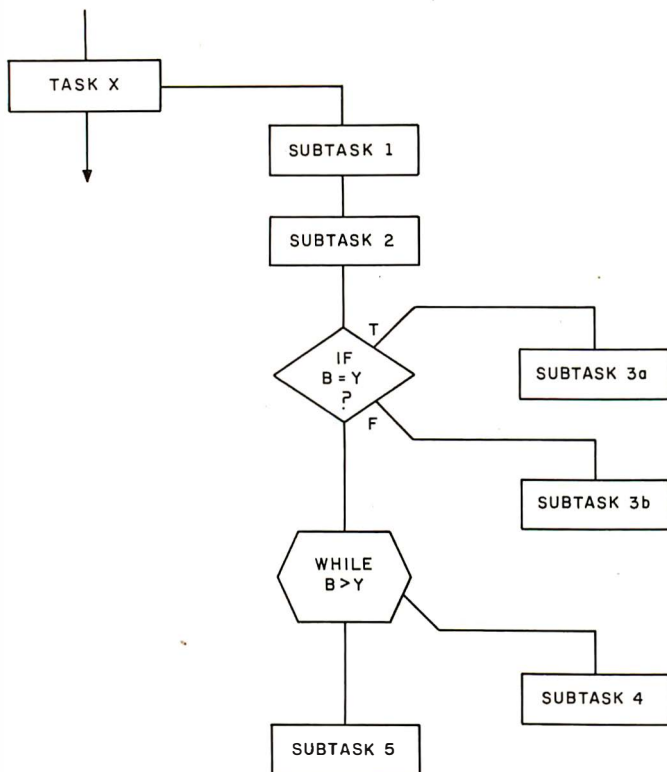
\*All products meet the new IEEE standards.

## Systems Group

A Division of MEASUREMENT systems & controls  
incorporated

*"Attractive Dealer & OEM Prices"*  
See your nearest computer dealer, or  
contact us for the complete story on  
The 2nd Generation.

1601 Orangewood Ave. / Orange, Calif. 92668  
(714) 633-4460 TWX / TELEX: 678 401 TAB IRIN



**Figure 5:** Example of the subdivision of a task. A central rule of structured flowcharts is that any box can be broken into multiple boxes that represent the necessary subtasks. Here, task X is broken into five subtasks executed in top-to-bottom order. Subtasks 1, 2, and 5 are simple subtasks. Subtask 3 is an if...then...else construct. Subtask 4 is a while...do loop.

listed in the hexagon is true. The condition is performed first (denoted by the position of the hexagon being spatially *above* the box being performed); this allows the possibility of the body of the loop being performed zero times if the condition is initially false.

The fourth and pivotal construct of this programming notation, decomposition, can best be stated as a rule: *any box representing a task can be broken into multiple boxes that represent the necessary subtasks*. The subtasks may be rectangular boxes that represent simple tasks, or they may be any other valid structured flowchart construct (if...then...else, while...do, etc). They are written top to bottom in the order of performance, with the line denoting program flow entering each subtask box from its top and exiting from the bottom.

Figure 5 illustrates the above construct. Task X is composed of five subtasks performed in numeric sequence. Tasks 1, 2, and 5 are simple subtasks. Subtask 3 is an if...then...else construct that allows either subtask 3a or subtask 3b to be per-

# ZENITH BUSINESS SOFTWARE FOR THE Z-89!

S & M Systems, Inc., the "All-In-One" Software Company is offering a full line of Business Packages for the "All-In-One" Z-89 Microcomputer

Inseq-80(TM) Business Software Systems  
Industry Standard Osborne Based: Accounts Payable/Receivable,  
General Ledger, Payroll

S & M Software: Retail Inventory Control, Invoicing,  
Manufacturers Inventory Control, Customer Mail List

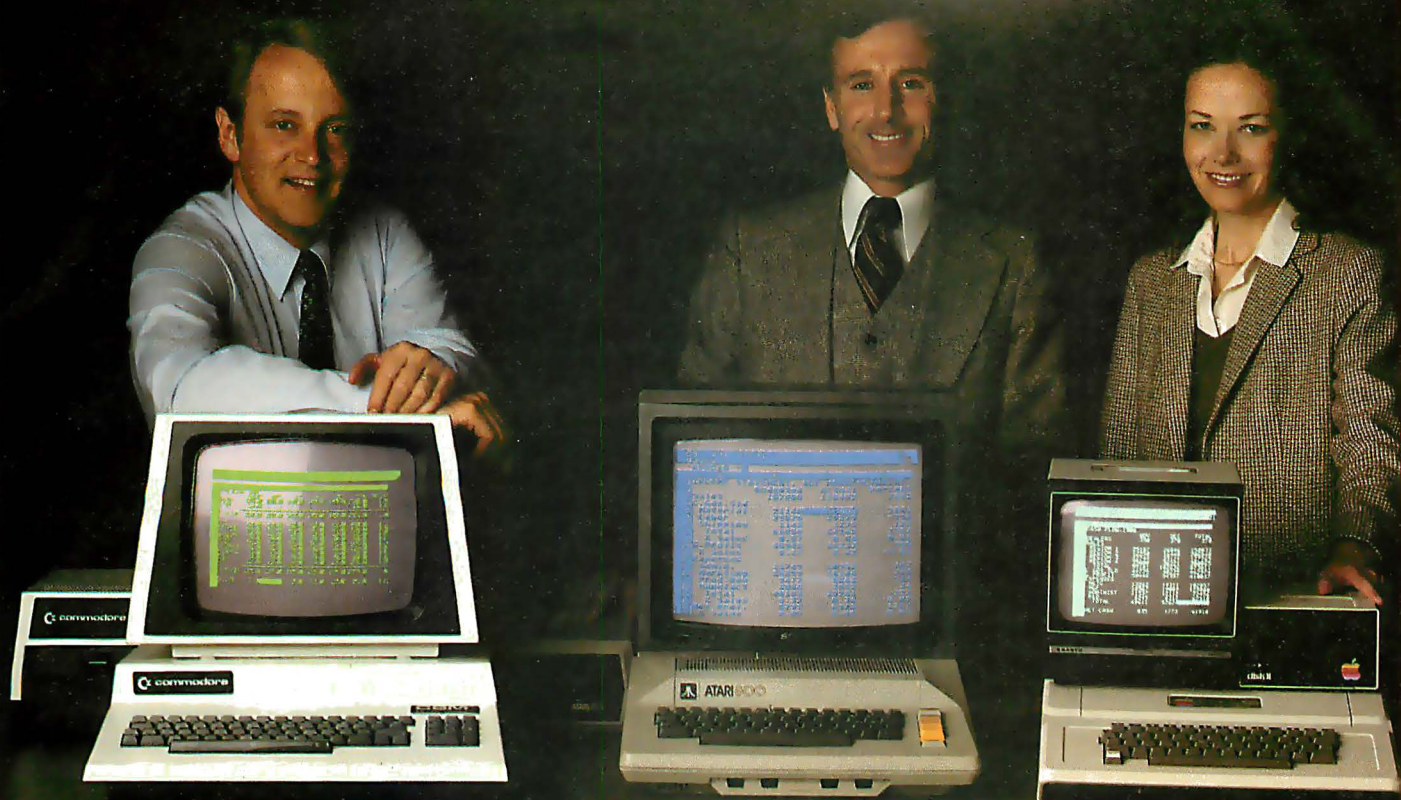
**PLUS MANY MORE!!**

All Systems have been Field Tested and are ready for shipment!  
CALL ABOUT OUR NATIONAL DEALER PROGRAM AND JOIN THE BEST  
IN SELLING THE FINEST SOFTWARE ON THE Z-80 MARKET!

**SYSTEMS ALSO OPERATE ON TRS-80 MOD I, MOD II, MOD III  
AND ALTOS MICROCOMPUTERS**

For Further Information, Contact: **S & M Systems, Inc.**  
P. O. Box 1225  
Haverhill, Massachusetts 01830

Or Dial Direct: 1-617-373-1599  
1-617-481-5231



# Time & Money. Commodore®, Atari® & Apple® users get more with VisiCalc™ software.

A financial VP in Massachusetts is cutting the time it takes to prepare month-end reports from three days to three hours.

A California company is replacing most of its time-share computer service with a personal computer and VisiCalc, saving at least \$30,000 the first year.

Thousands of other personal computer users are also sold on how VisiCalc is increasing their productivity. Besides saving time and money, they're simplifying their work and getting more information that helps them make better decisions. A typical user reaction comes from a New York dentist:

**"VisiCalc has become an integral part of my business."**

VisiCalc displays an "electronic worksheet" that automatically calculates nearly any number problem in finance, business management, marketing, sales, engineering and other areas. The huge worksheet is like a blank ledger sheet or matrix. You input problems by typing in titles, headings and your numbers. Where you need calculations, type in simple formulas (+, -, ×, ÷) or insert built-in functions such as net present value and averaging. As quickly as you type it in, VisiCalc calculates and displays the results.

**"I am extremely impressed with VisiCalc's capability, flexibility and orderly presentation of instructions."**

So writes the director of a New York corporation. He appreciates VisiCalc's powerful recalculation feature. Change any number in your model and instantly all numbers affected by that change are recalculated and new results are displayed. You can ask "What if...?" analyzing

more alternatives and forecasting more outcomes. It really increases your decision-making batting average!

When you finish, you can print a copy of the worksheet just as it appears on the screen and/or save it on diskette.

**"I like VisiCalc's ease of use."**

That response comes from a Utah businessman using VisiCalc for production forecasts, financial report ratio analysis and job cost estimating. Ease of use is VisiCalc's best-liked feature. It's designed for a non-programmer, and has an extensive, easy-to-understand instruction manual.

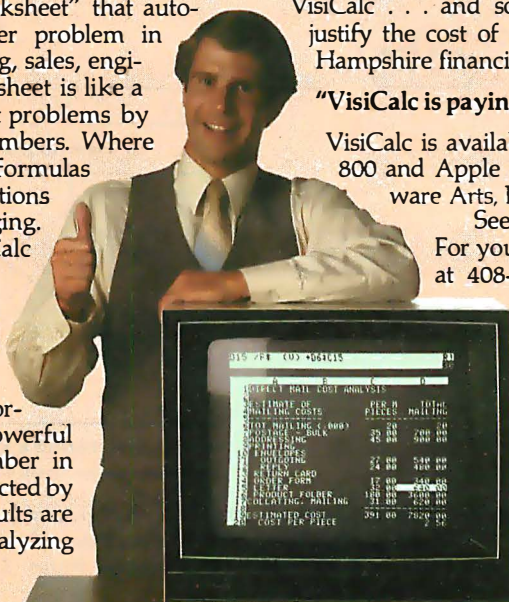
Users also like solving a wide variety of problems with VisiCalc . . . and solving them their way. VisiCalc can even justify the cost of a personal computer, according to a New Hampshire financial analyst:

**"VisiCalc is paying for itself over and over."**

VisiCalc is available for 32k Commodore PET/CBM, Atari 800 and Apple disk systems. VisiCalc is written by Software Arts, Inc.

See VisiCalc at your Personal Software dealer. For your dealer's name, call Personal Software Inc. at 408-745-7841, or write 1330 Bordeaux Drive, Sunnyvale, CA 94086.

While there, see our other Productivity Series software: Desktop Plan and CCA Data Management System. They're like time on your hands and money in the bank.



Commodore is a registered trademark of Commodore Business Machines Inc., Atari is a registered trademark of Atari Inc., Apple is a registered trademark of Apple Computer Inc.

**PERSONAL  
SOFTWARE**

Circle 22 on inquiry card.

formed. Subtask 4 is performed as long as the condition within the hexagon ( $B > Y$ ) is true. Of course, any subtask box may be further divided into its component subtasks.

Since any box can be broken into component subtasks, you can now see how this notation is used to design a program. The boxes in the leftmost column give the overall design of the program; boxes are then expanded to the right as each box (task) is divided into boxes representing the appropriate combination of subtasks. As a result, you can scan any one of several of the leftmost column of boxes for an overview of varying depths of the program design, or you can study the implementation of any major or minor subtask by concentrating on only the boxes and control structures growing to the right of the given subtask.

### An Example

The following example will il-

lustrate the process of developing a program using structured flowcharts. Using the example of table 1a, suppose you are given an array of  $N$  numbers,  $V(1), V(2), \dots, V(N)$ , and have to find the index value  $MAXINDEX$  such that the largest value in the  $V$  array is  $MAXV = V(MAXINDEX)$ . The entire structured flowchart for this problem is given in figure 6.

Cover the right three-fourths of the flowchart so that only the subtasks numbered 1, 2, and 3 are visible. This is what the "first pass" of the flowcharting effort should look like. Subtask 1 is the initialization of the problem. Subtask 2 is the determination of  $MAXINDEX$  and  $MAXV$ . Subtask 3 is the printing of these two values. Since the task in subtask 3 is simple enough to be directly accomplished in the target language (for example, BASIC), it need not be subdivided.

Subtasks 1 and 2 are developed concurrently. Subtask 2 is basically a loop that examines  $V(1), V(2), \dots, V(N)$  in turn, keeping the appropriate values for  $MAXV$  and  $MAXINDEX$  for the  $I$  elements encountered thus

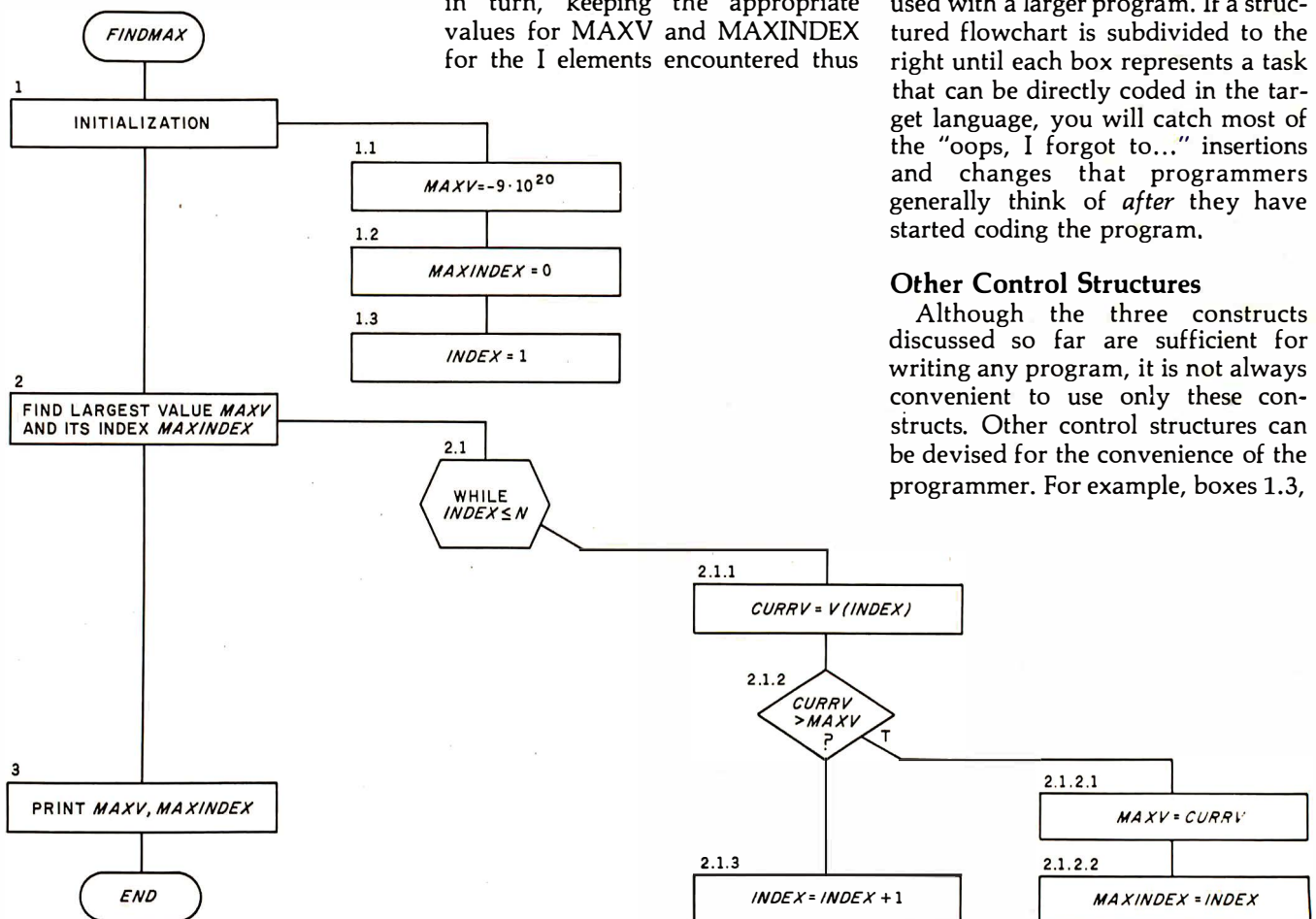
far. The values of  $MAXV$ ,  $MAXINDEX$ , and  $INDEX$  must be set (as is done in subtasks 1.1, 1.2, and 1.3). Note that this loop could have been done more easily using a do-loop; other optimizations could also have been made, but this example is given for the purposes of illustration only.

The main work for each element is done as subtask 2.1.2: if the current  $V$  element being examined (ie:  $CURRV$ ) is greater than the maximum  $V$  element so far,  $MAXV$  and  $MAXINDEX$  are set to the current array and index values, respectively. These subtasks, numbered 2.1.2.1 and 2.1.2.2, are performed only when the relationship given in the diamond of 2.1.2 is true.

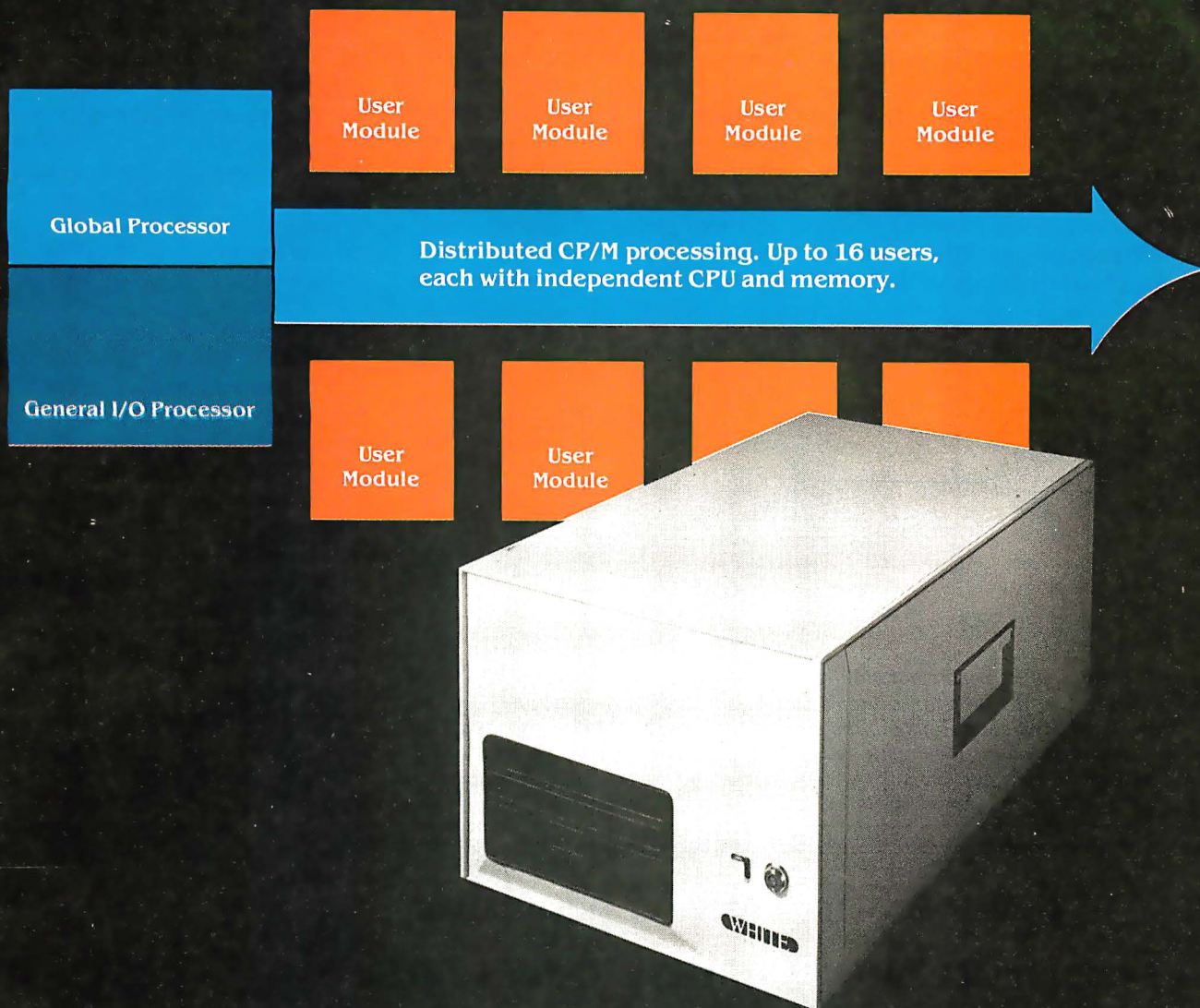
Once the structured flowchart has reached the level of detail shown in figure 6, most of the design considerations have been conceived and perfected; it is then a simple task to translate the program into BASIC (see listing 2) or any other general-purpose computer language. The benefits are more pronounced when used with a larger program. If a structured flowchart is subdivided to the right until each box represents a task that can be directly coded in the target language, you will catch most of the "oops, I forgot to..." insertions and changes that programmers generally think of *after* they have started coding the program.

### Other Control Structures

Although the three constructs discussed so far are sufficient for writing any program, it is not always convenient to use only these constructs. Other control structures can be devised for the convenience of the programmer. For example, boxes 1.3,



**Figure 6:** Structured flowchart for program *FINDMAX*. Given an array  $V$  with  $N$  elements, the problem is to find the largest element,  $MAXV$ , and its index within the  $V$  array,  $MAXINDEX$ . The numbers above each box give the sequence and level of that box in relation to the entire problem. For example, box 1 can be broken into three subtask boxes: 1.1, 1.2, and 1.3.



## How to tell if it's a White Computer.

(Users 2 through 16 — multiuser expansion with high performance through distributed processing.)

Look for a single user CP/M® system that expands to multiuser configurations economically.

Look for independent 6 MHz Z80B-based User Modules with 64K of RAM memory, each module with a port to the user terminal capable of handling baud rates of up to 38K under program selection. Look for high-speed block data transfers from user modules to the Global Processor for disk storage. That way, CP/M programs run independently for each user. Fast. And each user's station acts just like the fastest standalone system — no delays, no waiting for other users.

Look for a Z80-based Global Processor for disk and tape I/O that transfers data from disk to user modules at the data transfer rate of the peripheral device. And a controller that handles as many as 8

SMD disk drives for up to 528 megabytes of hard disk storage, plus up to four 8" floppies, *plus* optional streaming tape backup.

And look for a Z80-based General I/O Processor that supports up to eight printers — with 64K bytes of independent buffer memory.

That's part of how you tell if it's a White Computer. There's a lot more. Here's a number and address for more information.

CP/M is a registered trademark of Digital Research.  
Z80, Z80A, Z80B are registered trademarks of Zilog Corporation.



White Computer Company △ 1876 Industrial Way  
Redwood City, California 94063 △ 415 364 7570

2.1, and 2.1.3 in figure 6 can be replaced by a control structure that is available in most programming languages—a *do-loop* that varies INDEX from 1 to N. An example of the notation I have devised for this is given in figure 7a; the body of the loop is performed according to the parameters given in the hexagon.

Another well-known control structure is the *repeat...until* loop, shown in figure 7b. The position of the body

of the loop, above and to the right of its associated hexagon, is meant to signify that the body of the loop is performed *before* the condition is tested. Although the meaning of this notation does not implicitly follow from its form, it was chosen for its simplicity and consistency with the notation already developed.

Other constructs come to mind: a *case* structure, an unconditional *goto*, and two controlled *gotos*—the *restart*

(restart the innermost containing loop) and the *exit* (go to the first task after the innermost containing loop). Although I have used some of these constructs for quite some time, they are not presented here because I am not yet satisfied with the notations I have developed for them. In any case, structured flowcharts are meant to be a personal notation—you should add to and modify these constructs to fit your needs.

## Conclusions

I have found structured flowcharts helpful in designing programs. The notation is obviously intended for weakly structured languages (like BASIC), as its utility decreases when the structure of the target language increases.

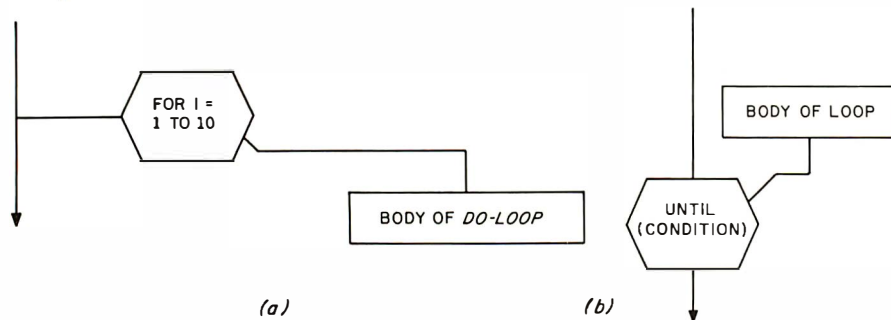
The notation is, at the moment, informal, and it should stay that way. It should be extended and modified in whatever way seems useful to you. In particular, you should use additional notation for special features of the target language (eg: global and local variables, use of a stack of intermediate computation) when applicable. If the structured flowchart is to be read by another person, however, you should define all the structures used in terms of their equivalent unstructured (conventional) flowcharts.

If the final structured flowchart is to be redrawn, you should do so with clarity in mind. Place only those boxes that help explain the overall design with the main flowchart; leave the implementation details to subordinate flowcharts.

I hope you will find this notation useful. I would appreciate your suggestions, criticism, and comments. ■

## References

1. Page-Jones, Meilir. *The Practical Guide to Structured Systems Design*. New York: Yourdon Press, 1980.
2. Ross, D T, J B Goodenough, C A Irvine. "Software Engineering: Process, Principles, and Goals." *Computer*. Institute of Electrical and Electronics Engineers (IEEE), May 1975. Also *Tutorial on Software Design Techniques*, Third Edition, P Freeman and A I Wasserman, editors. Long Beach CA: IEEE Computer Society, 1980.
3. Williams, G. "Applied Structured Programming." *Program Design*, Blaise Liffick, editor. Peterborough NH: BYTE Books, 1978.
4. *Classics in Software Engineering*, E N Yourdon, editor. New York: Yourdon Press, 1979.



**Figure 7:** Structured flowchart notation for a do-loop and a repeat...until loop. In the do-loop, figure 7a, the hexagon contains all pertinent information defining the loop, and in the form most comfortable to the user. In the repeat...until loop, figure 7b, the notation is interpreted as showing the body of the loop being executed before the condition is tested. In both cases, the box representing the body of the loop can be expanded to the right, into its component subtasks.

# If You Own a 56K CP/M Machine, Then You Should Have *Leverage*

*Leverage* is an innovative new information management system recently introduced by Urban Software Corporation. It combines a number of powerful tools, including full screen data entry, report generation, word processing, and subset extraction, into an integrated, easy-to-use package. The *Leverage* system provides many capabilities previously available only through costly custom programming, yet it is designed for use by non-programmers.

## Leverage Highlights

- Data bases are easily configured to your particular applications; prototypes for mailing lists, personnel files, appointment calendars and inventory systems are pro-

vided.

- Flexible report generator lets you define report formats such as alphabetized lists, tables, directories and schedules.
- A "Help Key" allows instant, in-context access to an on-line manual over 80,000 characters long.
- Graphic menu selection provides optimal responsiveness and ease of use.
- Written in "C," a powerful systems programming language developed by Bell Labs in conjunction with its UNIX operating system (most of UNIX is written in "C").
- Sophisticated programming techniques like hash table coding, dynamic overlays, shell sort and heap sort guarantee maximum efficiency.

*Leverage* Program . . . . \$185

Manual alone. . . . . \$ 15 (Applicable to subsequent purchase of program)

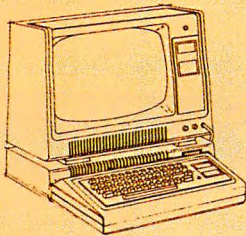
Educational rates available. UNIX is a trademark of Bell Labs, CP/M of Digital Research.

If your local dealer does not yet have *Leverage*, use the reader service card or call Urban Software for a brochure.

**Urban Software Corporation**

19 West 34th Street • New York, NY 10001 • (212) 947-3811

TRS-80\* Model I Computer Owners . . .



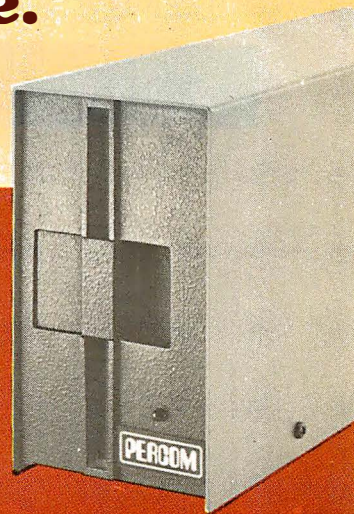
## Double-density storage. It's really here!

Here at Percom. And your authorized Percom dealers.

And double-density storage is here in a big way. Because now you can choose from *three different levels* of mini-disk systems — all *double-density rated*.

And get the storage that precisely meets your application needs.

Not to mention the service and quality that's made Percom the industry leader.



Although rated for double-density operation, all levels of Percom drives *work equally well* in single-density applications.

You can operate these drives in ordinary single-density format using TRSDOS\*, Percom OS-80™ or any other single-density operating system.

Or, you can add a Percom DOUBLER™ to your Tandy Expansion Interface and store data and programs in *either* single- or double-density format.

Under double-density operation, you can store as much as **350 Kbytes** of formatted data — depending on the drive model — on one side of a five-inch minidiskette. That's **four times** the capacity of standard 35-track Model I mini-disks, almost 100 Kbytes *more than* the capacity of the **eight-inch IBM 3740** format!

Available in 1-, 2- and 3-drive configurations in all three model lines, Percom *burned-in, fully-tested* drives start at only \$399.

### TFD-40™ Drives



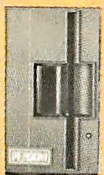
TFD-40 Drives store 180 Kbytes (double-density) or 102 Kbytes (single-density) of **formatted** data on one side of a 40-track minidiskette. Although economically priced, TFD-40 drives receive the same full Percom quality control measures as TFD-100 and TFD-200 drives.

### TFD-100™ Drives



TFD-100 drives are "flippy" drives. You store twice the data per minidiskette by using both sides of the disk. TFD-100 drives store 180 Kbytes (double-density) or 102 Kbytes (single-density) **per side**. Under double-density operation, you can store a 70-page document on one minidiskette.

### TFD-200™ Drives



TFD-200 drives store 350 Kbytes (double-density) or 197 Kbytes (single-density) on one side of a minidiskette. By comparison, 3740-formatted eight-inch disks store only 256 Kbytes. Enormous on-line storage capacity in a 5" drive, plus proven Percom reliability. That's what you get in a TFD-200.



**The DOUBLER™** — This proprietary adapter for the TRS-80\* Model I computer packs approximately twice the data on a disk track.

Depending on the type of drive, you can store up to four times as much data — 350 Kbytes — on one side of a minidiskette as you can store using a Tandy standard Model I computer drive.

Easy to install, the DOUBLER merely plugs into the disk controller chip socket of your Expansion Interface. No rewiring. No trace cutting.

And because the DOUBLER reads, writes and formats *either* single- or double-density disks, you can continue to run all of your single-density software, then switch to double-density operation at any convenient time.

Included with the PC card adapter is a TRSDOS\*-compatible double-density disk operating system, called DBLDOS™, plus a CONVERT utility that converts files and programs from single- to double-density or double- to single-density format.

Each DOUBLER also includes an on-card high-performance *data separator circuit* which ensures reliable disk read operation.

The DOUBLER works with standard 35-, 40-, 77- and 80-track drives rated for double-density operation.

**Note.** Opening the Expansion Interface to install the DOUBLER may void Tandy's limited 90-day warranty.

**Free software patch with drive purchase.** This software patch, called PATCH PAK,™ upgrades TRSDOS\* for single-density operation with improved 40- and 77-track drives.

Quality Percom products are available at authorized dealers. Call toll free 1-800-527-1592 for the address of your nearest dealer or to order directly from Percom. In Canada call 519-824-7041.

™ trademark of Percom Data Company, Inc.

Prices and specifications subject to change without notice.

™ trademark of Tandy Radio Shack Corporation which has no relationship to Percom Data Company

# PERCOM

PERCOM DATA COMPANY, INC.  
211 N. KIRBY • GARLAND TX • 75042  
(214) 272-3421

Circle 25 on inquiry card.

# Build the Disk-80

## Memory Expansion and Floppy-Disk Control

---

Steve Ciarcia  
POB 582  
Glastonbury CT 06033

---

The term "memory expansion" no longer causes the same pained expression among computer owners as it did a few years ago. Back in the "Model T" days of personal computing, it was a major undertaking, often the largest expense of setting up a personal computer system. At that time, volatile memory integrated circuits contained only a fraction of the capacity of those available today, and mass storage often consisted of slow audio cassettes.

Back in 1975, if you were adding 32 K bytes of memory to your computer you would probably have used 256 type-2102A 1 K by 1-bit static memory chips. These cost between \$2 and \$5 each, and you probably would have needed a power supply larger and heavier than the computer. Believe it or not, the 2102A was a major improvement over the previous type-1101 memories (256 by 1-bit static devices). It would have taken 1024 (1 K) of the type-1101 components to make 32 K bytes.

Since that time, memory technology has progressed by leaps and bounds, and the cost per bit has dropped considerably. Many computer manufacturers now use dynamic

rather than static memory. The result is much higher density, lower system cost, and easier after-market memory expansion on most computers.

The 64 K-byte personal computer system is more common than you would imagine. Adding another 16 or 32 K bytes of memory these days simply means plugging a few (8 or 16) integrated circuits into a memory-expansion unit or motherboard. Usually the standard power supply suffices.

Even with these advantages, using

dynamic memory is not quite as simple as it sounds. There are considerable differences between static and dynamic memory. Most people know relatively little about designing a dynamic-memory system, and even professional designers are intimidated by having to deal with multiplexing addresses, selecting bus drivers, sequencing activation of power supplies, and decoupling and noise. I don't expect that reading this article will make you into an authority on dynamic memory, but perhaps you will at least have a better understanding of it.

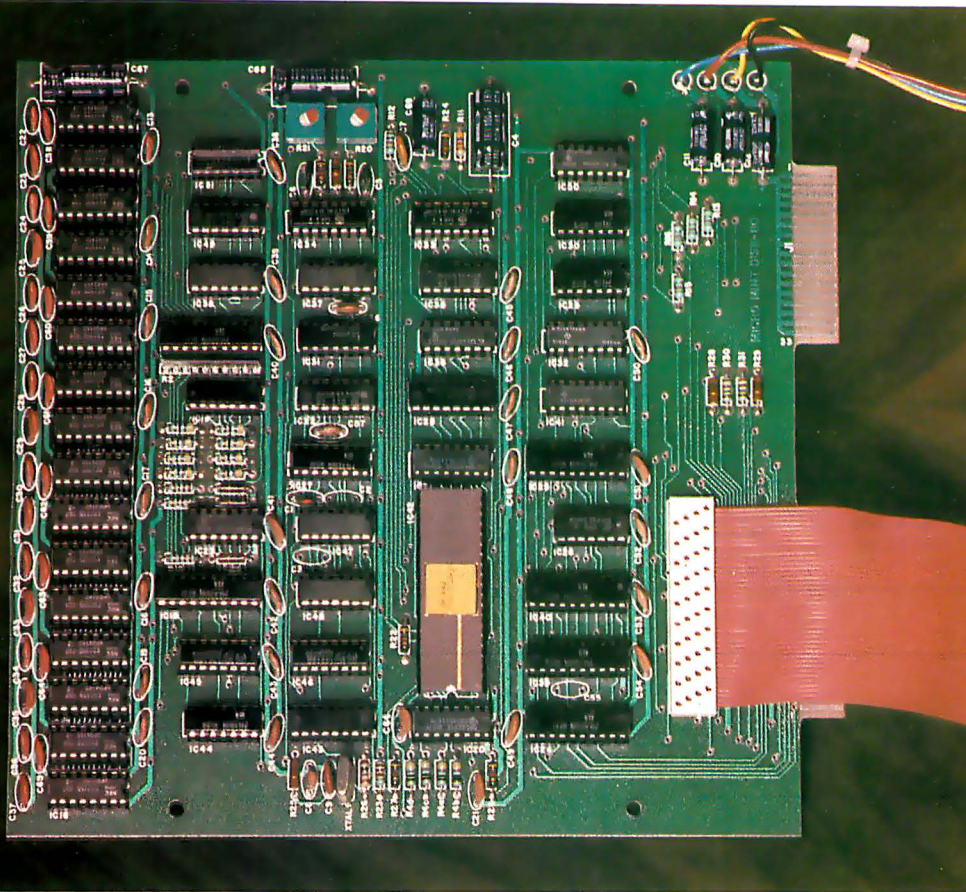
Mass-storage technology has also progressed during this same period. Displacing the audio cassette as the exclusive medium, the floppy disk and Winchester-technology hard disk have become the *de facto* storage standards.

For some time I have wanted to present articles on dynamic-memory and disk-controller integrated circuits. I have delayed chiefly because I generally prefer to present my articles as usable applications.

The three largest-selling personal computers, the Radio Shack TRS-80, the Apple II, and the Commodore



**Photo 1:** The Disk-80 mounted in its enclosure and attached to the TRS-80 Model I computer. The Disk-80 is about half the size of the Radio Shack TRS-80 Expansion Interface.



**Photo 2:** The Disk-80 printed-circuit board (circuit of figure 2). The red cable connects to the expansion connector on the TRS-80 keyboard/processor module. The 34-pin edge connector above the red cable is a 5-inch floppy-disk drive interface connector. The sixteen integrated circuits lined against the left side of the board are 32 K bytes' worth of type-4116 16 K-bit dynamic memory devices.

PET, use 16 K-bit dynamic-memory chips. Only the TRS-80 Model I requires the user to add extra memory via an external module, the TRS-80 Expansion Interface. (The TRS-80 Model III does not.)

This month's hardware project, the Disk-80, is an expansion interface for use with the TRS-80 Model I that expands the user memory and provides for the attachment and control of floppy-disk drives. Dynamic memory and a specialized floppy-disk-drive controller are used. Although this project was designed for use with the TRS-80 Model I, the elements of the systems and the principles involved are applicable to any personal computer.

### What's Inside the Disk-80?

The Disk-80, shown in photo 1, is completely hardware- and software-compatible with the TRS-80 Model I and includes hardware enhancements for increased reliability. Readers familiar with the TRS-80 Expansion Interface will note that the Disk-80 is

considerably smaller.

The keyboard/processor module of the TRS-80 Model I system is a single-board computer with memory-mapped video display and keyboard. The only provision for I/O (input/output) in the basic configuration is an I/O port for an audio-cassette recorder and a single-bit relay line for control of the recorder motor. Any user-memory expansion beyond 16 K bytes and any printer or disk I/O must be handled externally. The unit sold by Tandy/Radio Shack to perform these functions is called the TRS-80 Expansion Interface.

Figure 1 is a block diagram of the Disk-80. It attaches to the keyboard/processor unit through the 40-pin TRS-BUS connector and provides the following functions: 32 K-byte user-memory expansion, Centronics-compatible parallel printer port (full 8 bits), real-time clock, four-drive 5-inch floppy-disk controller, external data separator (used in reading floppy disks), buffered TRS-BUS connection to other peripheral devices, and power supply.

The three major functional sections are as follows:

- Memory-expansion section, which accommodates up to 32 K bytes of dynamic memory;
- Four-drive 5-inch floppy-disk controller; and
- Parallel printer port.

The activities of these sections are coordinated through a common address decoder.

The Disk-80 system is divided into two circuit boards. The main board, shown in photo 2 and outlined schematically in figures 2a, 2b, and 2c, contains everything except the power supply and the printer port. The other board, referred to as the power-supply/printer-interface board, is shown in photo 3 on page 45.

### Disk-80 Addressing

The disk controller, printer, and real-time clock are addressed as memory-mapped parallel I/O ports through IC28, a 74LS155 decoder. Eight strobe signals are produced to decode memory addresses within the range of hexadecimal 37E0 to 37EC (only six of these are used in the Disk-80) to coordinate these peripherals. Their functions are shown

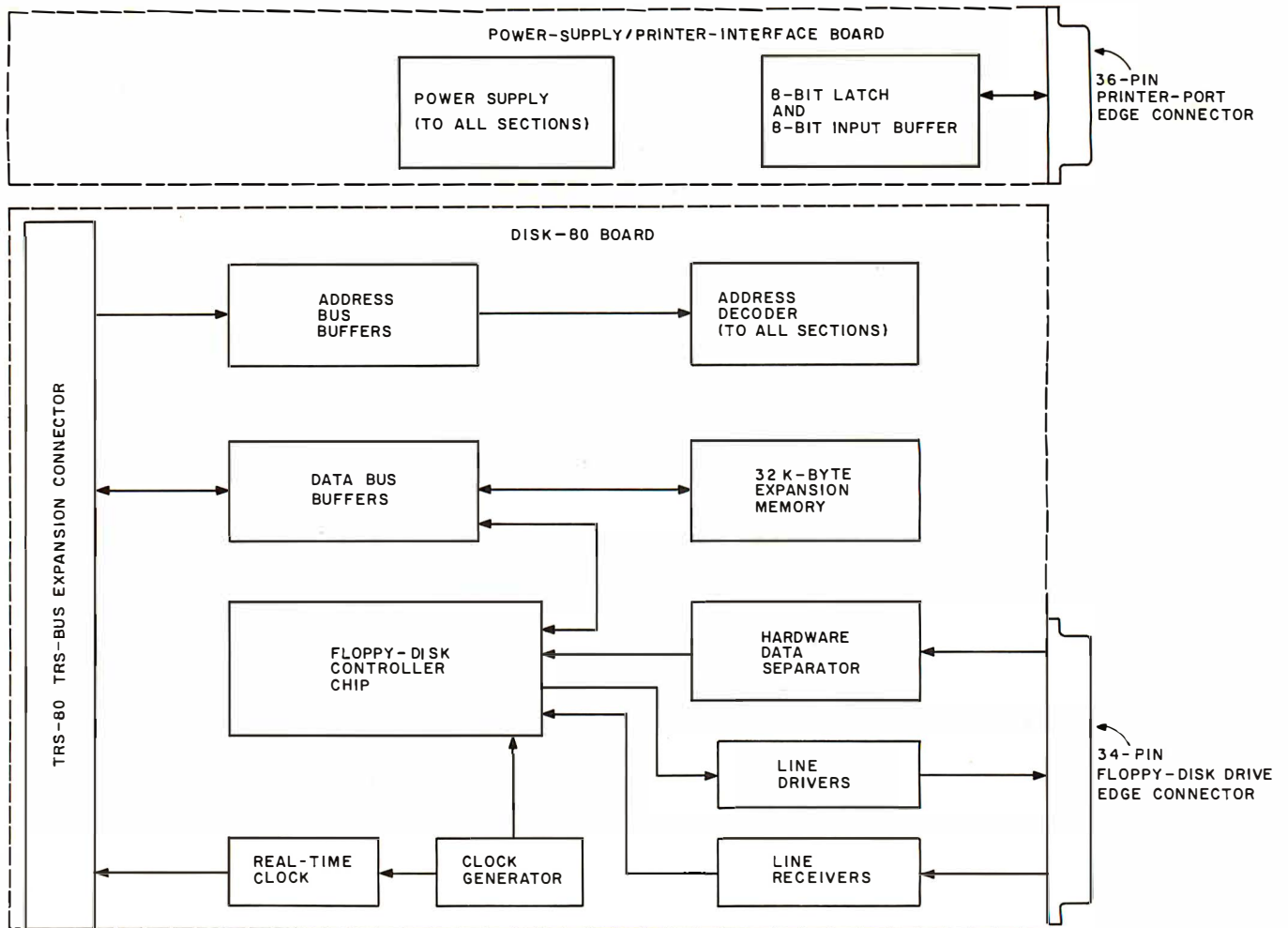


Figure 1: Block diagram of the Disk-80 expansion interface for the Radio Shack TRS-80 Model I.

## Elements of the systems presented and the principles involved are applicable to any personal computer.

in table 1 on page 44.

IC26, an eight-input NAND gate, and IC27, a 74LS139 decoder, function as memory-bank decoders. They produce two strobe signals. One, designated 32 K (or informally, 32 K enable), is the active-low enable strobe for expansion memory between hexadecimal addresses 8000 and BFFF. The second strobe, 48 K (or 48 K enable), controls the bank of memory between C000 and FFFF.

### Operation of Dynamic Memory

When designing memory systems,

it is necessary to understand both the components and the computer system. In the past, the most popular dynamic memory components were MK4096- and MK4027-type 4 K by 1-bit devices. Today the standard memory component in personal computers is the MK4116. (More recently, maximum density has increased to 64 K bits per chip. Unfortunately, these parts are expensive, about \$70 each, and are not yet generally used in personal computers.)

The 4116 is a 16 K-bit dynamic memory device. The 14 address bits required to specify one of the 16,384 cell locations that each store a single bit of data are multiplexed into seven shared pins. The timing of the signals presented to these pins is shown in figure 3 on page 45.

During execution of a Z80 memory-read or memory-write instruction, a 16-bit address is present on the processor's address bus. If the memory address is between hexa-

decimal 8000 and FFFF, the processor will try to find the addressed memory devices in the Disk-80's memory-expansion section. Decoding address lines A14 and A15 determines whether the location is in the 32 K or the 48 K memory range and enables the appropriate bank. The remaining 14 bits are multiplexed directly into the eight 4116s (one 4116 is used for each bit of the addressed byte location).

IC20 and IC21, 74LS157 quad 2-to-1-line multiplexers, apply the first 7 row-address bits to each 4116 when the MUX (multiplex) and  $\overline{RAS}$  (row-address strobe) signals are low. This latches the row address into the 4116. Next, the MUX signal goes high, applying the 7 column-address bits to the 4116, and  $\overline{CAS}$  (column-address strobe) goes low. At the conclusion of this sequence, data is either written into or read from the 4116

Text continued on page 44

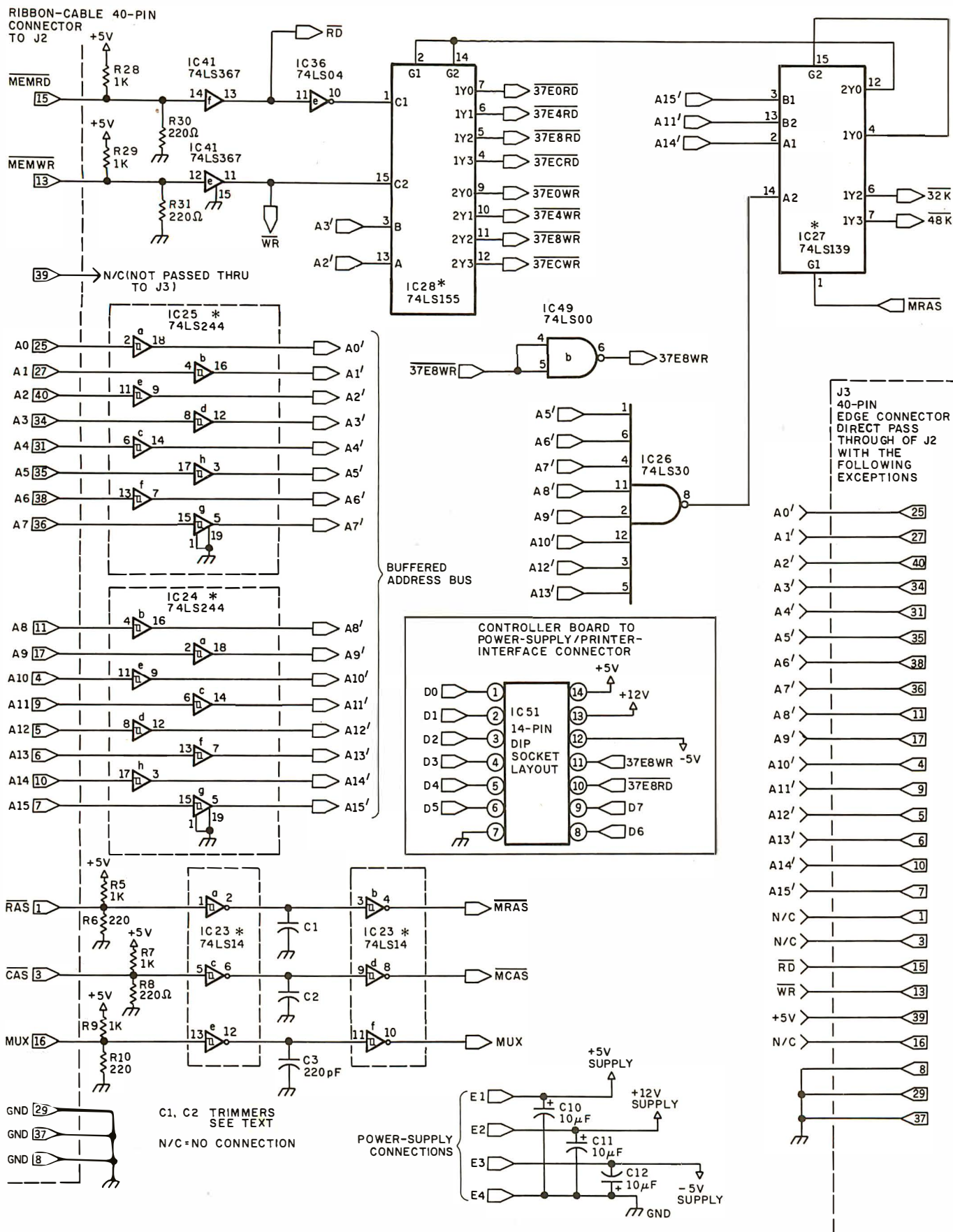


Figure 2a: Schematic diagram of the address-decoding and buffering section of the Disk-80. Figure notes are found in the text box on page 44.

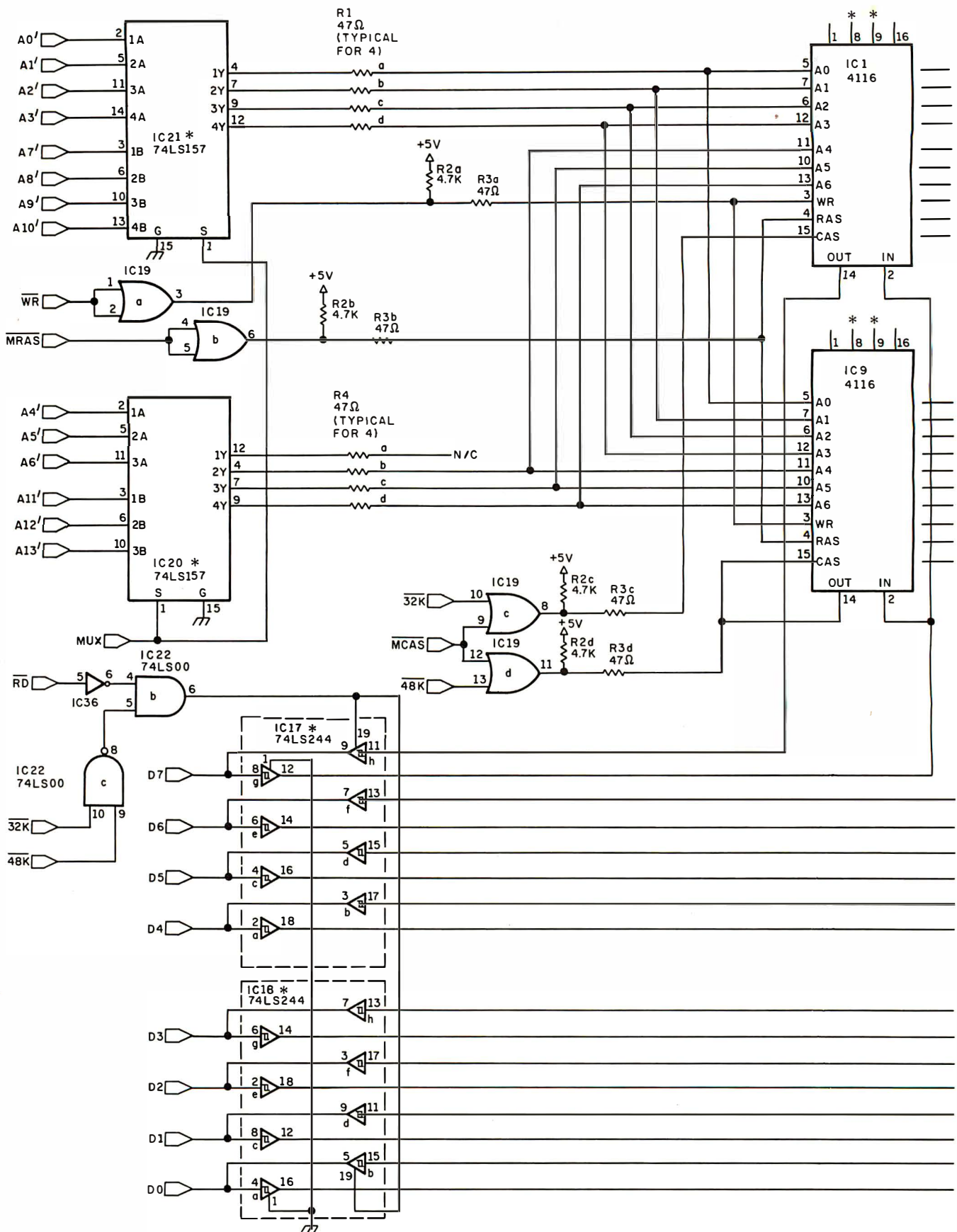
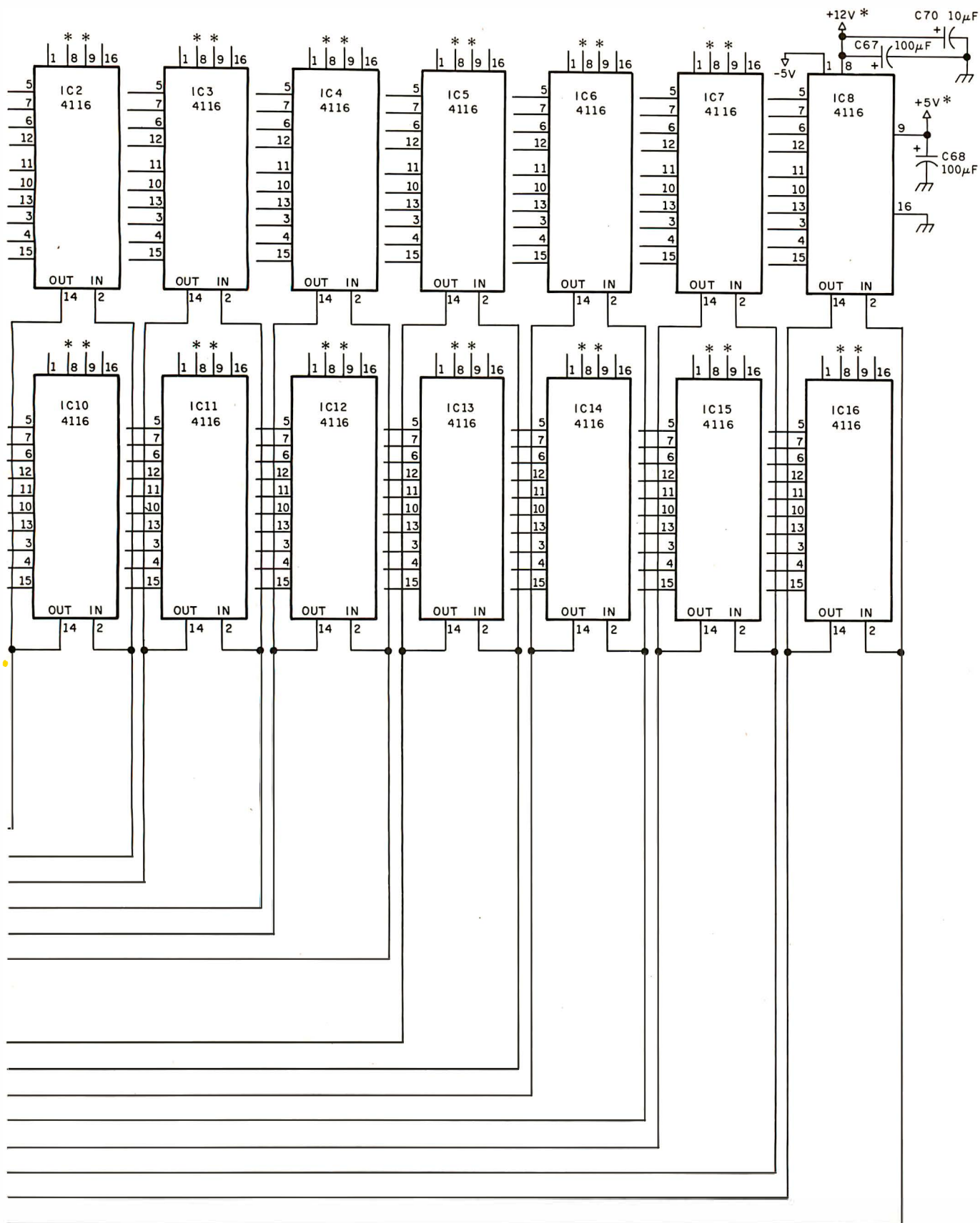


Figure 2b: The memory-expansion section of the Disk-80 module. See notes on page 44.



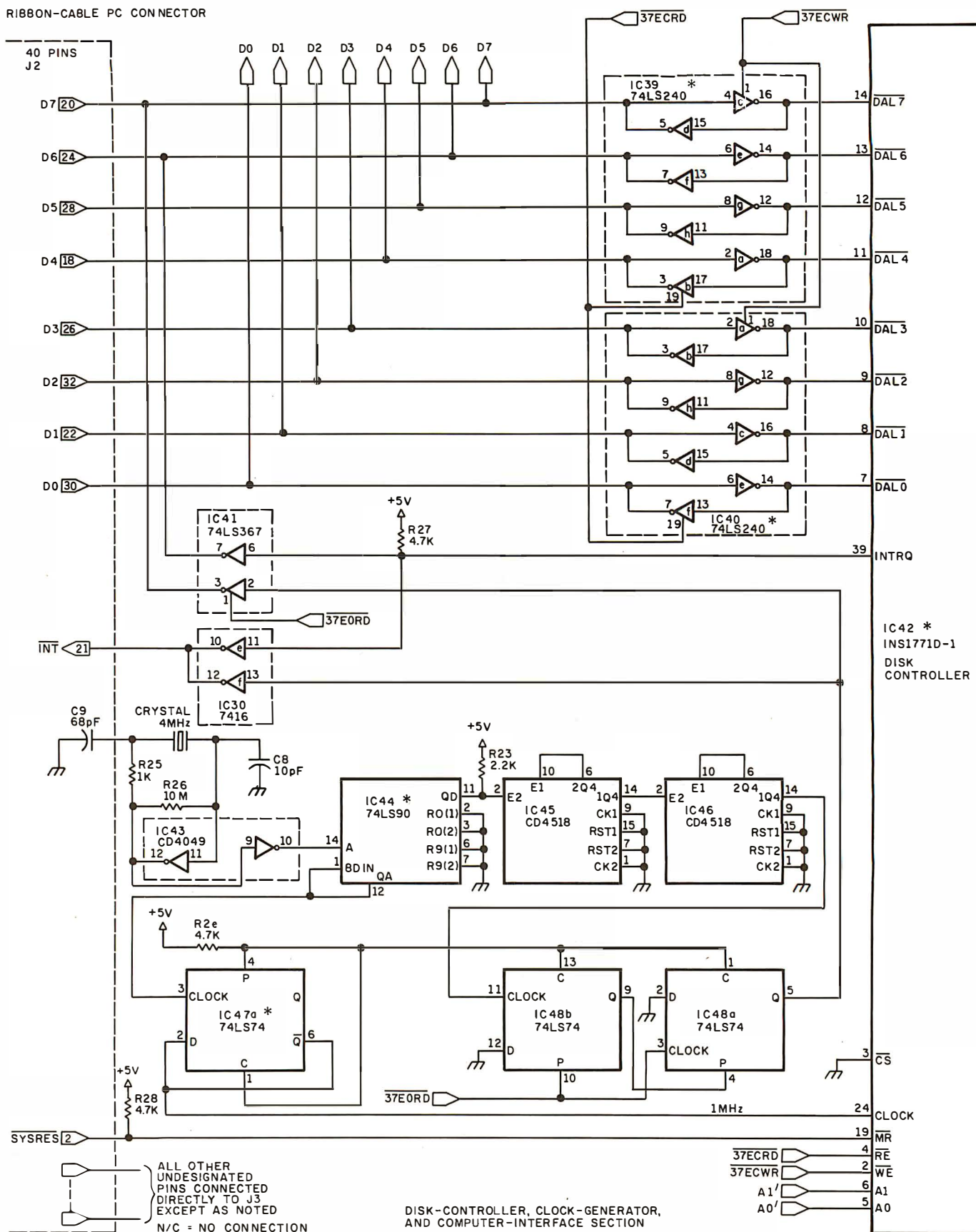
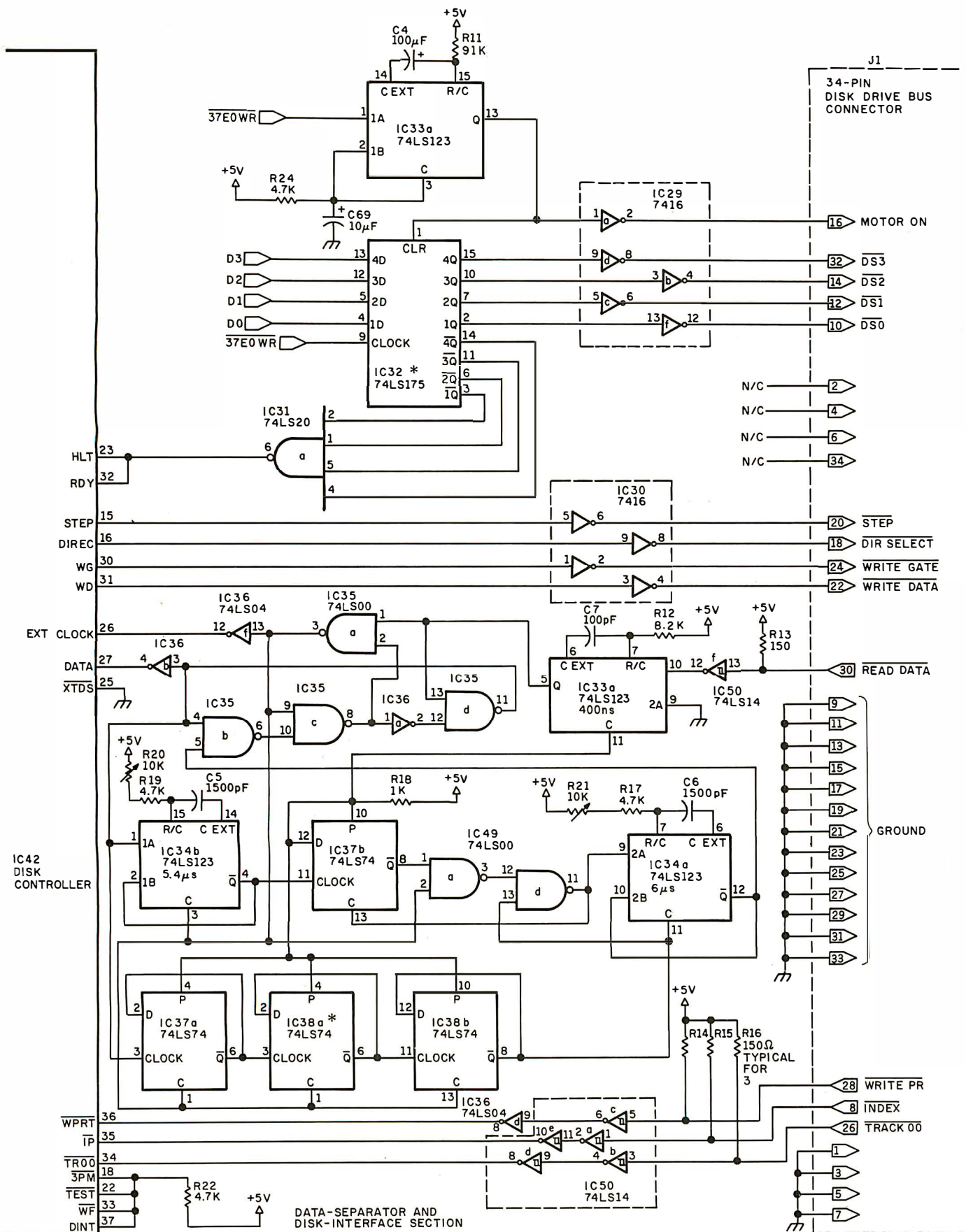


Figure 2c: Schematic diagram of the disk-controller, clock-generator, keyboard/processor-module-interface, external-data-separator, and disk-drive-interface sections of the Disk-80 expansion module. See figure notes on page 44.



Text continued from page 38:

depending upon the polarity of the Write Enable input. In turn, the Read Enable line controls the direction of data flow through the memory data buffers, IC17 and IC18, 74LS244 non-inverting octal buffers.

The MUX, CAS, and RAS signals are generated within the TRS-80 keyboard/processor module in a 3-bit shift register. Figure 4 on page 46 illustrates, in simplified logic, the derivation of these signals.

At the beginning of each read or write cycle, the Z80 microprocessor's MREQ (memory request) line is pulled low. The MREQ signal is also used by the TRS-80 as the RAS signal. The RD and WR (negative-logic read-enable and write-enable) lines are logically ORed to feed the CLR (clear) inputs and the D input of FF1, the first flip-flop in the 3-bit shift register. When either RD or WR goes low, a logic 1 is loaded into FF1 at the occurrence of the rising edge of the 10.6445 MHz master clock pulse. On the next clock pulse, the logic 1 is shifted into FF2, the second flip-flop, of which the Q output controls the MUX signal. The next clock pulse shifts the logic 1 into flip-flop FF3. The inverted Q output of FF3 is the CAS signal to memory. When the RD or WR line goes high again, the three flip-flops are cleared and the

address multiplexers are reset.

It is easy to see that multiplexing the addresses is fairly simple, especially when the signals needed are available on the 40-pin TRS-BUS connector.

Interestingly enough, Radio Shack did not use these signals in late-

production TRS-80 Expansion Interfaces. Because some of the signal pulses are very short in duration (about 200 ns) and susceptible to noise, the early-production Expansion Interfaces had to have a buffered cable to eliminate memory errors. Eventually, this arrangement was

#### Write Strokes

37E0 — disk-drive select (1 of 4)  
37E4 — not used  
37E8 — printer data out  
37EC — set disk-controller registers

#### Read Strokes

37E0 — read real-time clock/reset interrupt  
37E4 — not used  
37E8 — read printer status  
37EC — read disk-controller registers

**Table 1:** Hexadecimal memory-mapped addresses of registers used by the Disk-80 to coordinate the disk-drive controller, the printer interface, and the real-time clock.

#### Notes

1. On IC1 thru IC16 (the 4116 components) the +5 V lead on each IC should have one decoupling capacitor. One decoupling capacitor should be on every other chip for the +12 V and -5 V leads, for a total of thirty-two decoupling capacitors. Careful placement of decoupling capacitors is absolutely critical to proper operation.

2. All other places where decoupling capacitors are required are denoted by an asterisk (\*) on the diagram.

3. All capacitors are 12 V ceramic disk type unless otherwise noted.

4. All resistors are 1/4 W 5% tolerance carbon-film type unless otherwise noted.

IC Number	Type	+ 5V	GND	+ 12V	- 5V
1 thru 16	4116 (200 ns)	9	16	8	1
17	74LS244	20	10		
18	74LS244	20	10		
19	74LS32	14	7		
20	74LS157	16	8		
21	74LS157	16	8		
22	74LS00	14	7		
23	74LS14	14	7		
24	74LS244	20	10		
25	74LS244	20	10		
26	74LS30	14	7		
27	74LS139	16	8		
28	74LS155	16	8		
29	7416	14	7		
30	7416	14	7		
31	74LS20	14	7		
32	74LS175	16	8		
33	74LS123	16	8		
34	74LS123	16	8		
35	74LS00	14	7		
36	74LS04	14	7		
37	74LS74	14	7		
38	74LS74	14	7		
39	74LS240	20	10		
40	74LS240	20	10		
41	74LS367	16	8		
42	INS1771D-1	21	20	40	1
43	CD4049	1	8		
44	74LS90	5	10		
45	CD4518	16	8		
46	CD4518	16	8		
47	74LS74	14	7		
48	74LS74	14	7		
49	74LS00	14	7		
50	74LS14	14	7		
51	*				

**Table 2:** List of integrated circuits and power-wiring requirements for the Disk-80, excluding those integrated circuits found on the optional power-supply/printer-interface circuit board. The entity marked IC51 on the schematic diagram is really a connector for the 14-conductor ribbon cable running between the power-supply/printer-interface board and the disk-controller board.

replaced with a circuit in the Expansion Interface that derives the MUX and  $\overline{\text{CAS}}$  signals by sending  $\overline{\text{RAS}}$  through a delay line. Of the three original signals, only the  $\overline{\text{RAS}}$  signal, which has the longest pulse duration, is used.

If cable lengths are kept to a minimum and proper signal termination is employed, there is no good reason why any signal available from the keyboard/processor module should not be used. The Disk-80 uses a combination of active termination and Schmitt-trigger inputs to guarantee reception of all available signals.

### Memory Refreshing

So far you have heard only the good things about dynamic memory. One of the less desirable characteristics is called memory refreshing. Unlike static memory, which stores data in active bistable circuits composed of three transistors, the dynamic 4116 stores its 1s and 0s in single-transistor cells that simulate capacitors. As from a capacitor, the electrical charge that represents a bit slowly drains off unless it is "refreshed." Refreshing is accomplished by addressing all memory cells (or a required minimum of them) on a regular basis.

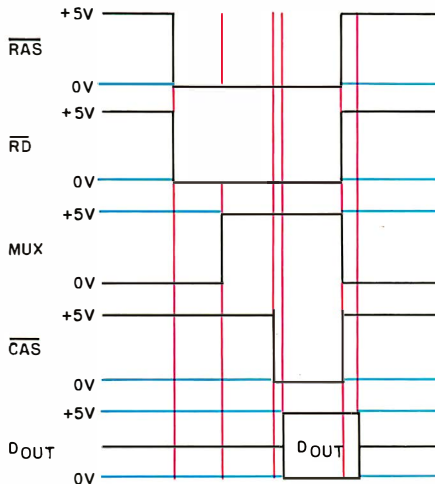
The 4116 is a  $\overline{\text{RAS}}$ -only-refresh device. Instead of addressing all 16,384 bit-cell locations, only the 128 rows are cycled. This type of refreshing uses only the  $\overline{\text{RAS}}$  signal and is achieved in less time than methods that use both row and column addressing. Because the MUX and  $\overline{\text{CAS}}$  pulses are not used, the memory is not enabled, and the refreshing does not interfere with other system operations. However, all 128 rows must be addressed at least every 2 ms to avoid loss of data.

Refresh circuits are generally binary counters that generate sequential addresses which are applied to the memory chips. The Z80 processor includes a built-in 8-bit  $\overline{\text{RAS}}$ -only refresh register. During the decoding and execution of an instruction op code, the 7 bits of the refresh register contents are placed on the low-order lines of the address bus, and the  $\overline{\text{MREQ}}$  line is strobed. In effect, the Z80 accomplishes "hidden refresh" as it executes its normal program. For more information on this capability, I refer you to the Zilog

Z80-CPU Technical Manual.

### Sequencing the Power Supply and Decoupling

Unfortunately, in addition to refreshing dynamic memory, a designer has to be concerned about sequencing the turning on of the



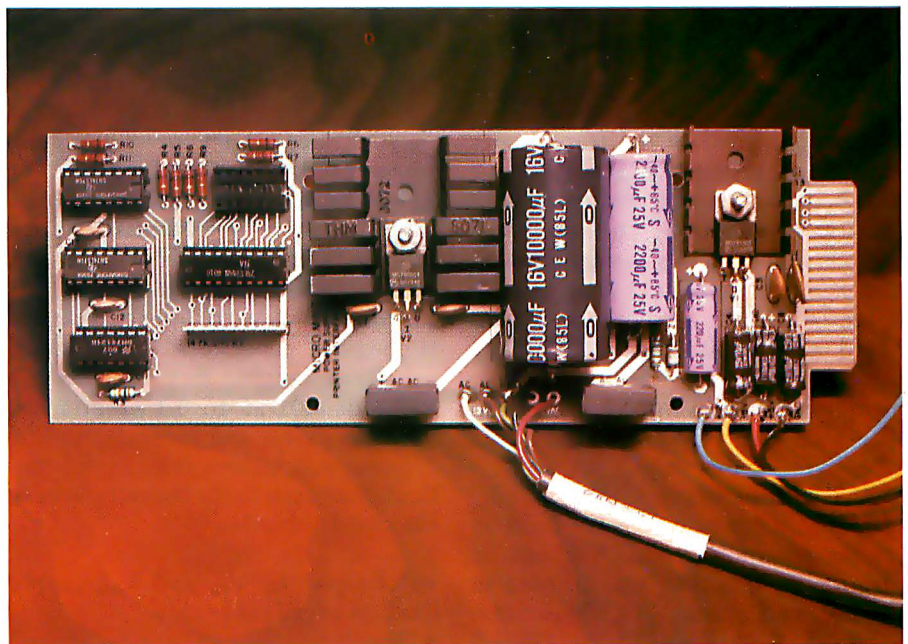
**Figure 3:**  $\overline{\text{RAS}}$ ,  $\overline{\text{CAS}}$ , and MUX timing diagram for 4116-type 16-pin dynamic-memory integrated circuit. A 14-bit address (16,384 by 1) is multiplexed into seven address pins. When MUX and  $\overline{\text{RAS}}$  are low, the row-address bits are read into the 4116. Later, when MUX is high and  $\overline{\text{CAS}}$  goes low, the column bits are read into the 4116, activating the data output for that memory cell.

power supplies. While some brands of type-4116 memory devices are more tolerant than others, the following rule must be applied: the  $-5\text{ V}$  supply ( $V_{\text{BB}}$ ) must be applied to the 4116 before the  $+12\text{ V}$  supply ( $V_{\text{DD}}$ ), and the  $-5\text{ V}$  supply must remain on until the  $+12\text{ V}$  supply has been removed. The  $+5\text{ V}$  ( $V_{\text{CC}}$ ) supply is less critical, but it is best to turn it on and off synchronously with the  $+12\text{ V}$  supply. Many dynamic-memory components have been destroyed by designers not adhering to these rules.

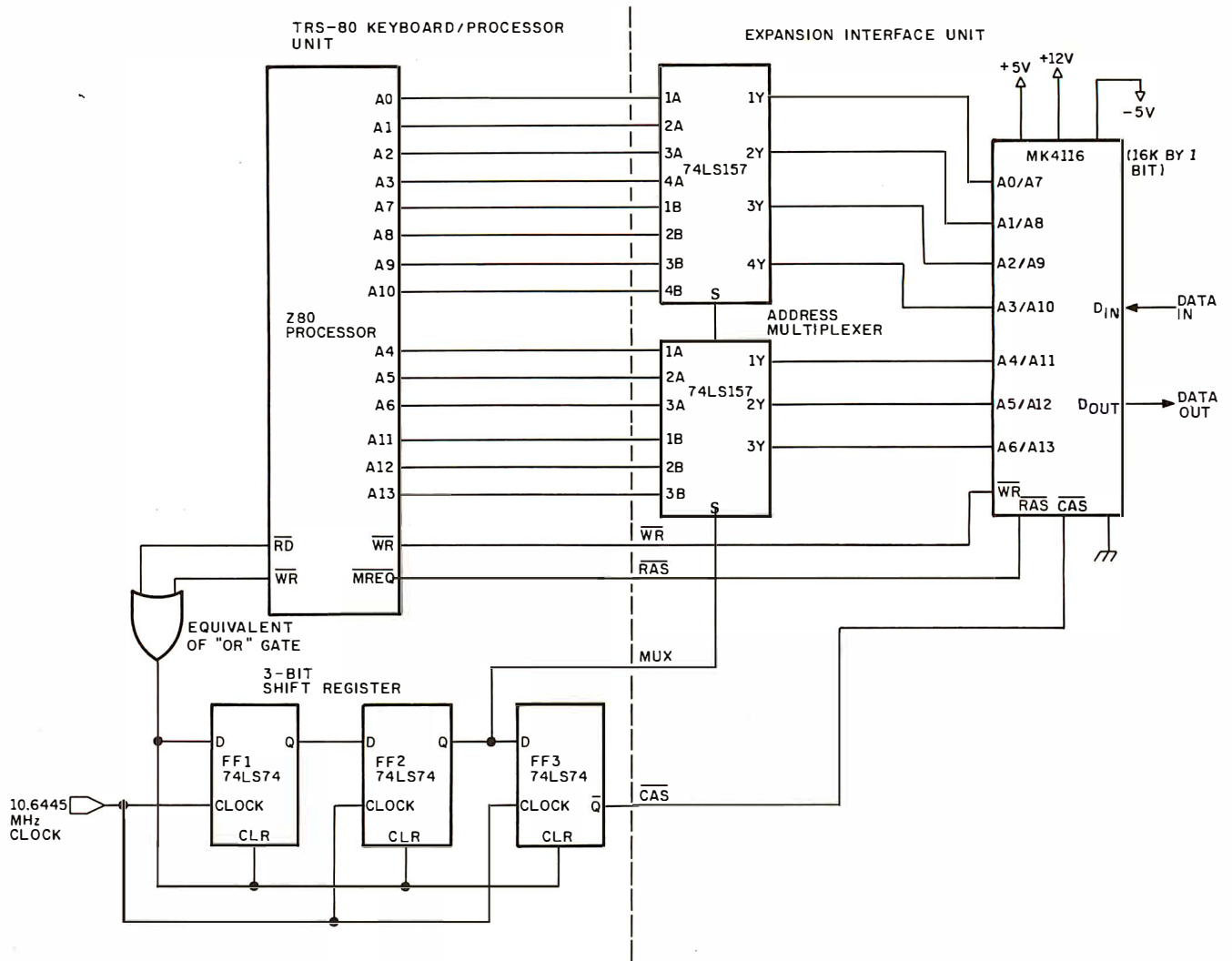
### Supplying Power

Power-supply sequencing is important because many power supplies overshoot their rated voltages when they are turned on. If  $V_{\text{BB}}$  ( $-5\text{ V}$ ) is not turned on and  $V_{\text{DD}}$  ( $+12\text{ V}$ ) overshoots to more than  $+15\text{ V}$ , the chip will blow. Applying  $V_{\text{BB}}$  first provides an extra margin to prevent device destruction. Also,  $V_{\text{BB}}$  must never go positive with respect to any other input.

The Disk-80 power supply, shown in photo 3 with the optional printer interface, meets these requirements. It is designed such that the time constants of the various sections produce a phased start-up and shutdown. This sequential operation is primarily achieved by use of filter components



**Photo 3:** The Disk-80 power supply with the parallel printer interface. The power supply provides  $1\text{ A}$  at  $+5\text{ V}$ ,  $400\text{ mA}$  at  $+12\text{ V}$ , and  $50\text{ mA}$  at  $-5\text{ V}$ , and is designed for use with dynamic memories such as the 4116 that require sequenced application of power.



**Figure 4:** Simplified schematic diagram of the internal circuitry of the TRS-80 Model I showing the derivation of the memory-refresh logic.

that are matched to the transformer impedance. Also, because I have designed it around a transformer with specific secondary voltages, the Disk-80 power supply is very efficient and produces relatively little heat. It is designed as a separate circuit board, allowing it to be used with any project requiring power for dynamic memory. It easily powers the full fifty-four-chip Disk-80, including 32 K bytes of memory.

A Centronics-compatible parallel printer port can be optionally built on the power-supply board. A schematic diagram of this port was printed in my previous article, "I/O Expansion for the TRS-80, Part 2: Serial Ports," BYTE, June 1980, page 42.

Finally, techniques of properly distributing power and decoupling transient noise voltages must be ad-

dressed. Correct layout of the components in the Disk-80 is critical. The 4116s can generate high-current transients when in operation. Resulting voltage spikes can cause data loss unless the voltage transients are minimized by properly placed decoupling capacitors (a capacitor, usually a ceramic disk type with a value of 0.01  $\mu\text{F}$  to 0.1  $\mu\text{F}$  attached between power and ground).

Some suggestions that are of particular concern in the memory area of the circuit board:

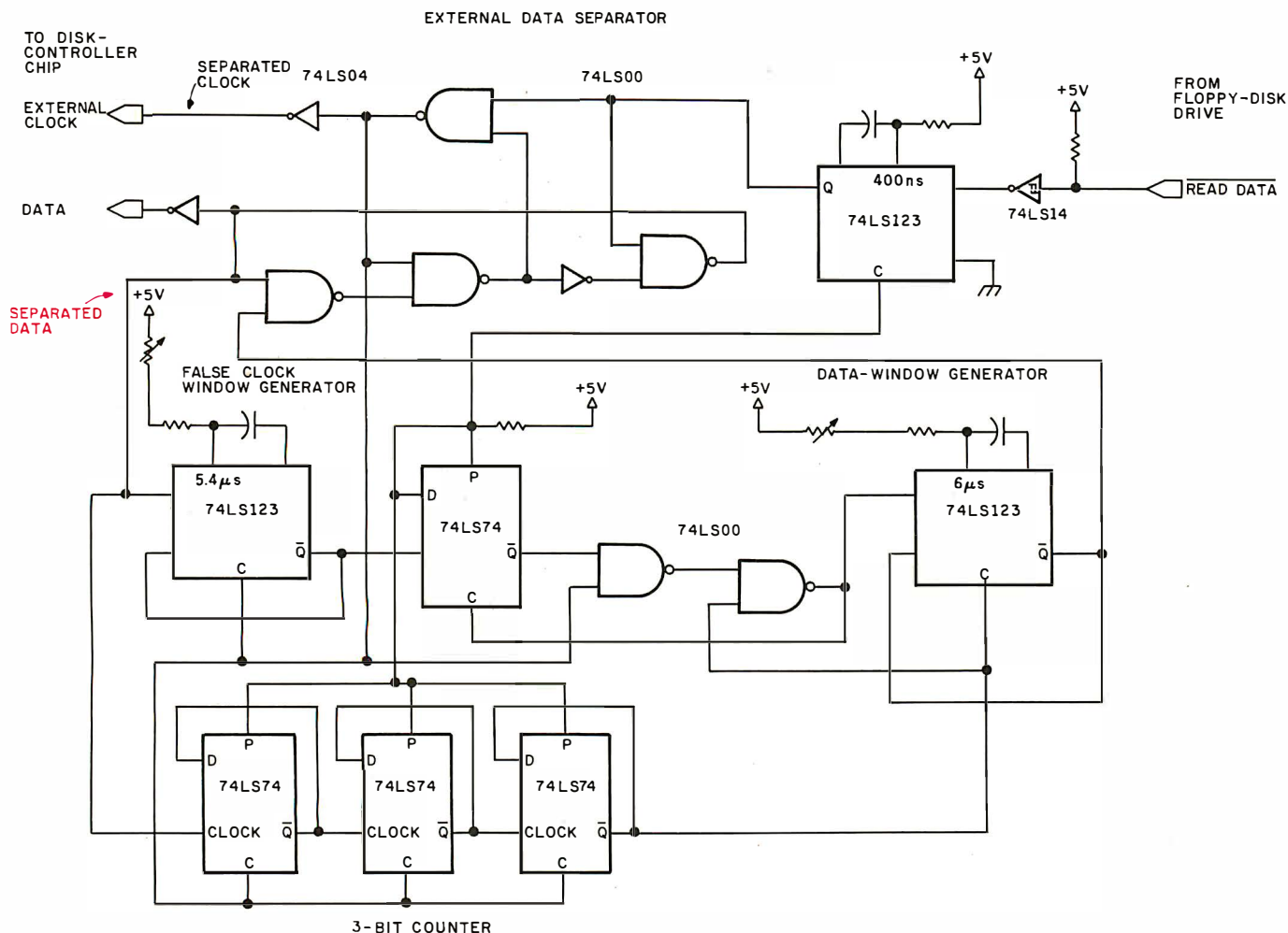
- Decouple the  $V_{BB}$  and  $V_{DD}$  supply lines on every other chip.
- Distribute larger capacitors around the board to reduce supply-voltage droop.
- Decouple  $V_{CC}$  every few chips.
- Keep signal lines short.

## Real-Time Clock

To be compatible with TRS-80 hardware, the Disk-80 contains a real-time clock. It provides an interrupt to the Z80 at a rate of 40 times a second (every 25 ms). When the NMI (nonmaskable interrupt) is enabled, the clock-produced interrupts cause the Z80 to transfer control to a specific ROM (read-only memory) address (the interrupt vector). Unless there is a user-supplied routine to be executed, the Z80 simply returns from the interrupt sequence and continues where it left off. Various disk operating systems for the TRS-80 use an interrupt-servicing routine called in this manner to increment a time-of-day clock or event timer.

## Five-Inch Floppy-Disk Controller

The Disk-80 uses an LSI (large-



**Figure 5:** Simplified schematic diagram of a 5-inch floppy-disk external data separator. The internal data separator of the FD1771 is not recommended for use in such applications. This circuit can be added to any existing TRS-80 Expansion Interface (which does not have an external data separator) to improve performance.

scale integration) floppy-disk-controller integrated circuit. This one component performs the following functions: encoding, decoding, pattern recognition, serial-to-parallel and parallel-to-serial conversion, CRC- (cyclic redundancy check) character generation, and control of the disk-drive mechanism.

Floppy-disk controllers are available from a number of manufacturers in both single- and double-density versions. Since practically all TRS-80 Model I disk software is stored in single density, the Disk-80 uses a Western Digital FD1771-B01 single-density disk-controller integrated circuit. This component is second-sourced by National Semiconductor as the INS1771D-1.

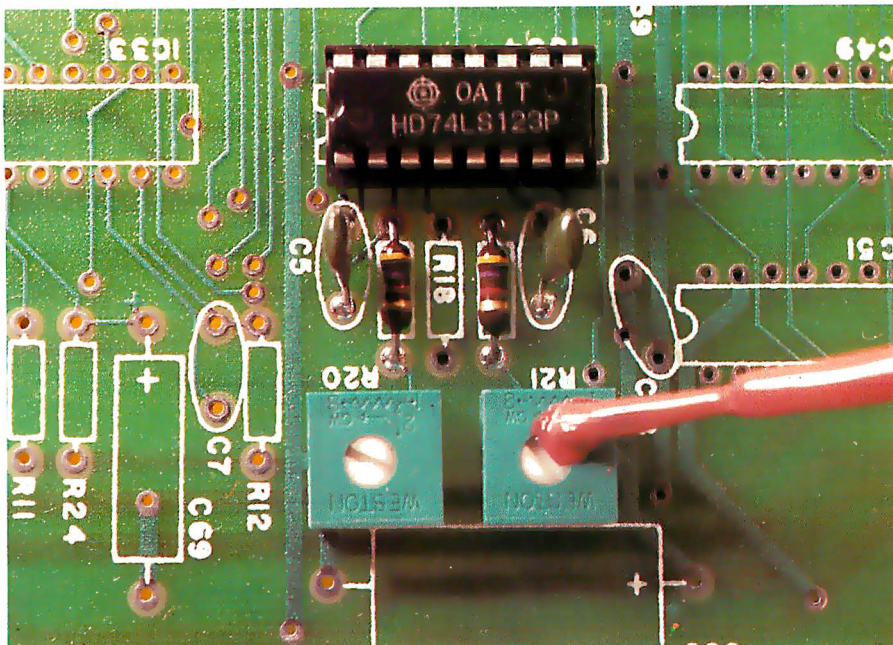
The standard single-density 5-inch floppy-disk drive stores 110 K unformatted bytes per disk distributed on thirty-five tracks (some drives can use

forty or more tracks). Using a soft-sectored format like that used in the IBM 3740 Data-Entry System, each track is divided into 16 sectors storing 128 bytes each. The total amount of data that can be stored on a disk is a function of the disk operating system and the number of tracks per disk supported by the drive itself.

The 5-inch floppy disk is rotated by a DC motor at a speed of 300 rpm. An 8-inch floppy-disk drive contains an AC synchronous motor, which spins the disk at 360 rpm. The bit density of the data is the same, but, due to the differences in rotational speed and disk diameter, the 5-inch drive transfers data at 125 kbps (thousand bits per second) as compared to the 8-inch drive's rate of 250 kbps. The 5-inch drive's lower data rate makes programmed I/O a practical transfer method. Programmed data transfer through

specific registers requires less complex hardware than DMA (direct memory access) transfer.

Drive selection is handled by IC32, a 74LS175 4-bit register, and IC33a, a 74LS123 one-shot (monostable multivibrator). Only one drive is selected at a time, and the drive motors are turned off between disk accesses. To address a particular drive, a one-of-four drive code is loaded into IC32 through the memory-mapped register at hexadecimal address 37E0. This action starts a 5-second "motor-on" timer, which is activated whenever a drive is selected. It also activates the Head Load Time (HLT) control line on the FD1771. The software takes into account the 1 second required for the motor to come up to speed and the 80 ms required for head loading. Unless another access is made to this same drive, the motor will shut off



**Photo 4:** External-data-separator section of the Disk-80 board. An external data separator is recommended when using the FD1771 disk controller with the 5-inch floppy disks. This circuit (shown in figure 5) can also be added to the Radio Shack TRS-80 Expansion Interface to improve performance. After setting the adjustment potentiometers, use nail polish as shown to lock their positions.

after 5 seconds.

The Z80 bus structure makes it relatively easy to use a floppy-disk system. All data, commands, and control for the FD1771 are handled through conventional memory-reference instructions. Eight memory-mapped ports (four in and four out) handle all the communication between the Z80 and the FD1771. The range of addresses is hexadecimal 37EC to 37EF.

The Z80 controls the FD1771 through eleven commands, which are divided into four groups:

- Type I —Commands that move the read/write head: Restore, Seek, Step, Step-in, Step-out.
- Type II —Commands that read and write data: Read sector, Write sector.
- Type III—Commands that perform status checking and formatting: Read address, Read track, Write track.
- Type IV—Force-interrupt command.

An address map of Type I, II, and III FD1771 register-access functions is shown in table 3 on page 50. The commands and data are communicated to the FD1771 by setting the appropriate logic levels on address lines A0 and A1 (pins 5 and 6 on the FD1771) and strobing either the  $\overline{RE}$  (read-enable) or  $\overline{WE}$  (write-enable) inputs (pins 4 and 2).

Many disk-control commands require a parameter such as a track or sector address. This data must first be loaded into the appropriate register in the FD1771. To send a track address, for example, the 8-bit track address is loaded into the Z80's accumulator, and a store-accumulator [LD (HL), A] instruction to the track-register port at address 37ED is executed.

Of the FD1771's sixteen control

The following items are available postpaid in the US from:

The MicroMint Inc  
917 Midway  
Woodmere NY 11598  
(516) 374-6793

Item	Ordering Description	Price
Disk-80 blank circuit board (containing no components)	Disk-80 PCB	\$48
Power-supply/printer-interface blank board	PWR/PI PCB	\$16
Power-supply only blank board	PWR PCB	\$12
INS1771D-1 disk controller chip with manual	INS1771D-1	\$24
16 K bytes (8 chips) of memory: 4116s, 200 ns prime units	16 K MEM	\$40
Power supply complete kit: PC board and parts (add \$15 for printer port and parts)	PWR Kit	\$38
Disk-80 complete kit: case, power supply, printer port, cable and 16 K memory	Disk-80 Kit	\$275
Disk-80 expansion interface: completely assembled and tested with 16 K bytes of memory and printer port	Disk-80 Assembled	\$379.95

All printed-circuit boards are solder-masked and silkscreened and come with assembly instructions. Various other components and kits are also available. Call or write for a complete price list.

New York residents please add 7% sales tax.

baZic is written entirely in Z80® code—baZic runs as much as 30% faster than North Star® BASIC. The greater execution speed is significantly advantageous for heavy number crunching, multiuser and multitasking operations.

baZic has all the features of North Star BASIC—and then some. baZic, with minor exceptions, is 100% compatible with existing North Star BASIC programs. Our new baZic runs under all Micro Mike's timesharing and hard disk operating software, including JOEDOS/JOESHARE/HDSHARE and 5SHARE.

**CHECK THESE FEATURES AT YOUR COMPUTER DEALER:**

- Takes full advantage of the Z80 instruction set
- Can be used on any Z80-based microcomputer operating under North Star DOS or CP/M® (CP/M versions available early '81)
- Supports North Star floating point board for even faster execution of compute intensive programs

- Makes Multiuser systems with floppy disks more practical
- Improves performance of Multiuser Hard Disk systems
- baZic adds functions to assist in screen formatting, as well as features to simplify programming, e.g. APPEND command/statement, ON GOSUB, cursor-addressable PRINT, etc.
- baZic, as shipped, includes 8, 10, 12 and 14 digit precisions, including both software and hardware floating point versions
- baZic is now included with Micro Mike's operating system software and applications programs

Dealers and OEM's: Special Discounts Available

For complete information, contact your North Star dealer or send \$1 to Micro Mike's for complete technical presentation.

®North Star Computers, Inc.

®Zilog, Inc.

®Digital Research, Inc.

*Micro Mike's*

Micro Mike's Inc.

905 S. Buchanan, Amarillo, Texas 79101  
806-372-3633

## Hard fact:

# \$150 package makes your Horizon® execute programs up to 30% faster!



lines, seven interface directly to the disk drive through drivers and receivers (type-7416 and 74LS14 components). The Write Data line transmits the digitized serial composite data to be written on the floppy disk. The Write Gate line enables the actual writing process. The Index input transmits the pulse from the index-hole photodetector that indicates the beginning of a track, and the Write Protect line tells the controller when a write-protected disk has been inserted into the drive. The Track 00 line is activated when the read/write head is positioned over track 00 (the outermost track) of the disk's surface. The Direction Select line defines the direction in which the head will move when the Step line is pulsed. Each pulse moves the head one track.

### An External Data Separator Is the Best Insurance

As previously mentioned, the 5-inch floppy-disk drive transfers data at 125 kbps, while an 8-inch drive transfers at 250 kbps. The difference in data rates affects the data separator's timing values as well as the clock rate used by the controller chip. The 5-inch drive requires a 1 MHz clock, while a standard 8-inch drive uses a 2 MHz clock.

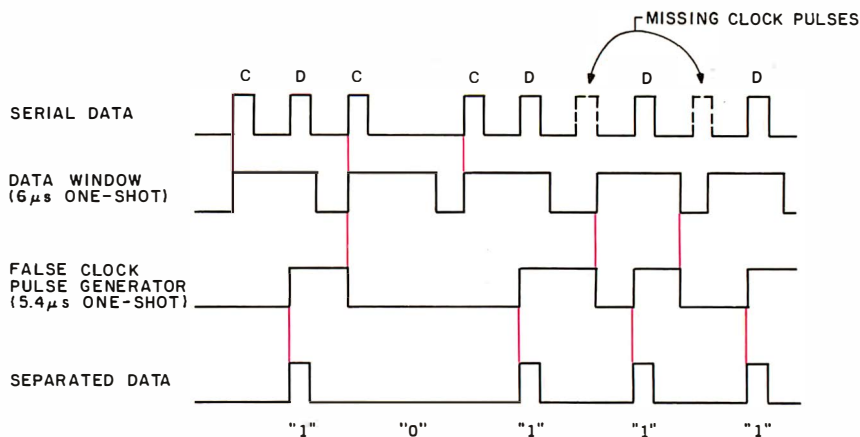
Data received from the drive's electronic circuitry is a multiplexed combination of data and clock pulses. The FD1771's internal data separator can separate the data and clock bits, but use of the FD1771's internal data separator is *not recommended where high reliability is required*. An external data separator must be added to maintain a soft-error rate better than 1 in 10<sup>8</sup>.

The internal separator operates from the 1 MHz system clock, which is not synchronous with the clock pulses of the disk data. Due to mechanical variations and other factors, sometimes a bit of data can arrive at the FD1771 at a point in time "outside the data window," that is, when the controller is not expecting it.

**[Editor's Note:** For a more detailed explanation of the importance of the data window, see "Interface a Floppy-Disk Drive to an 8080A-Based Computer" by John Hoepfner in the May 1980 issue of BYTE, page 72....RSS] The nonsynchronous data window's 1  $\mu$ s (microsecond) resolution can

Hexadecimal Memory-Mapped	A1	A0	37EC Read Enable	37EC Write Enable
37EC	0	0	Status Register	Command Register
37ED	0	1	Track Register	Track Register
37EF	1	0	Sector Register	Sector Register
37EF	1	1	Data Register	Data Register

**Table 3:** Memory-mapped addresses used by the Disk-80 to communicate with the FD1771 or INS1771 floppy-disk-controller integrated circuit. The FD1771 interacts with the Z80 processor by memory-reference instructions, not by DMA. The FD1771 can execute eleven high-level function commands.



**Figure 6:** Timing diagram illustrating the operation of the external data separator shown in figure 5 on page 47. Clock pulses are denoted by the letter C, data pulses by the letter D.

move with respect to a data bit's arrival by enough that the data bit can actually fall outside the data window. This would be interpreted as an error.

To help eliminate what has been a major problem for TRS-80 Model I disk users, the Disk-80 includes an external data separator. Neither the Radio Shack TRS-80 Expansion Interface nor the LNW Research System Expansion Board has an external data separator. Figures 5 and 6 illustrate the circuitry and function of the Disk-80's external data separator.

The external data separator places a 400 ns (nanosecond) one-shot on the Read Data line from the drive. This arrangement reduces the Read Data input pulse width from 1.2  $\mu$ s to 400 ns. When configured for external clock and data separation, the FD1771 requires pulse widths between 300 and 700 ns. The narrower the pulse width, the better the data separator's resolution.

To produce the separator's data window, a 6  $\mu$ s one-shot is triggered by the leading edge of the clock pulse. Since the time between clock pulses is

8  $\mu$ s, a data bit is expected within 4  $\mu$ s after the clock pulse's leading edge. The extra 2  $\mu$ s allow for shifts in the phase of the data or clock bits. This is all that is required to satisfy any potential timing problems. However, since we also have to be IBM 3740 compatible, more is required.

The IBM 3740 format creates a unique addressing mark by dropping three clock pulses during the address-mark clock pattern. To produce data windows during missing clock-pulse intervals, a false clock pulse is generated with a 5.4  $\mu$ s one-shot. If the 5.4  $\mu$ s one-shot times out past the expected instant of the next clock pulse, its own pulse's trailing edge triggers the other (6  $\mu$ s) one-shot, generating a data window.

A 3-bit counter distinguishes between missing clock pulses and address marks. If the data separator is already in phase, it is constantly reset by the separated clock output. When the separator encounters the address mark, the counter is incremented by a pulse on the separated data line. On the occurrence of the fourth missing

# The Brains of Men and Machines

by Ernest W. Kent

When the "Brains of Men and Machines" series of articles originally appeared in BYTE magazine, the response was immediate and enthusiastic. Now Ernest W. Kent has expanded his ideas about the brain into a full-length book.

As researchers begin to unravel the mysteries of the brain's chemical, electrical, and synaptic circuitry, their findings are becoming immediately applicable to advances in robotic behavior and computer design. **The Brains of Men and Machines** "dissects" the brain to provide new insights into computer design and artificial intelligence.

It is one of the rare books that transcends disciplinary boundaries. In it the ever increasing relationship between man and machine is freshly examined — a relationship, Professor Kent concludes, that is today being reexamined in the light of man's own neurological self-image.

Hardcover 304 pages

Call TOLL FREE: 800-258-5420  
or Mail To:



**BYTE  
BOOKS**

70 Main St.  
Peterborough, NH 03458

B3

ISBN #0-07-034123-0

Price \$15.95

Please remit in U.S. funds or draw on a U.S. Bank

Please send ☐ \_\_\_\_\_ copies of  
**The Brains of Men and Machines**

Name	Title	Company
------	-------	---------

Street	City	State/Province	Code
--------	------	----------------	------

☐ Check enclosed in the amount of \$ \_\_\_\_\_

☐ Bill Visa ☐ Bill Master Charge

Card No. \_\_\_\_\_

Exp. Date \_\_\_\_\_

Add 75¢ per book to cover  
postage and handling.



clock pulse, the data window is reset. The separator becomes in-phase again on the next true clock pulse.

Photo 4 shows the location of the false-clock and data-window adjustment potentiometers, R20 and R21, on the Disk-80 circuit board. These are the only user adjustments in the unit. The best method for setting them is to use an oscilloscope and a pulse source. With only IC34 inserted in the board and the +5 V supply on, apply a 50 to 100 kHz clock pulse first to IC34's pin 1. With a scope probe on pin 4, adjust R20 until the one-shot period is 5.4  $\mu$ s. A similar clock signal is applied to pin 9 of

IC34: that section should be set for a period of 6.0  $\mu$ s by turning R21.

### In Conclusion

The TRS-80 Model I may no longer be on the minds of the marketing moguls at Tandy Corporation, but the hundreds of thousands of Model I owners will want to keep using it. Now that you know what is inside an expansion interface, you could build one, if necessary.

Correctly assembling an expansion interface from the circuit diagrams of figure 2 is more than just making all the right connections, however. Layout, decoupling, and power

distribution are probably the most critical factors to be considered.

I had to be aware of these same considerations while I was designing the Disk-80, and I had a dilemma when it came time to build the prototype I do for every Circuit Cellar article. The Disk-80 uses fifty-four integrated circuits and 120 resistors and capacitors. The *placement* of these components is as important, in many cases, as the *inclusion* of the component.

To eliminate major troubleshooting headaches and make it easier for others to construct this interface, I went straight from my schematic diagram to a printed-circuit board, without breadboarding or wire-wrapping. Besides making it easier for me, the result is an elimination of the concern that experimenters would have about the placement of components and decoupling capacitors and the routing of signal lines. The printed-circuit boards are available from The MicroMint, at the address given in the text box on page 48. The schematic diagram of the power supply is not provided here because the correct sequential application of the voltages depends on the use of the exact transformer and components I specified; the circuit may not work with substitute components. If you really want a schematic diagram and a parts list for the power supply, send a stamped, self-addressed envelope to The MicroMint.

I hope that many of you will take this opportunity to build your own expansion interfaces. ■

### Next Month:

*Build a low-cost logic analyzer.*

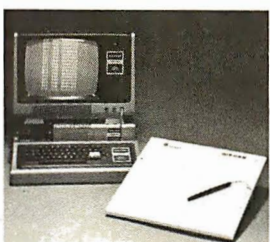
### References

1. *Z80-CPU Technical Manual*. Zilog Inc, 10460 Bubb Rd, Cupertino CA 95014, 1977.
2. Hoepfner, John. "Interface a Floppy-Disk Drive to an 8080A-Based Computer." *BYTE*, May 1980, page 72.

**Editor's Note:** Steve often refers to previous *Circuit Cellar* articles as reference material for the articles he presents each month. These articles are available in reprint books from *BYTE Books*, 70 Main St, Peterborough NH 03458. Ciarcia's *Circuit Cellar* covers articles appearing in *BYTE* from September 1977 thru November 1978. Ciarcia's *Circuit Cellar*, Volume II presents articles from December 1978 thru June 1980.

You can extend the usefulness and data entry speed of your TRS-80 by giving it the graphics and menu capabilities of the Bit Pad One digitizer.

With the Bit Pad and proper software, you can generate schematic diagrams; describe sales curves to your computer; enter alphanumeric information by merely touching printed letters on a menu, or enter order or



inventory information by merely checking boxes on printed forms.

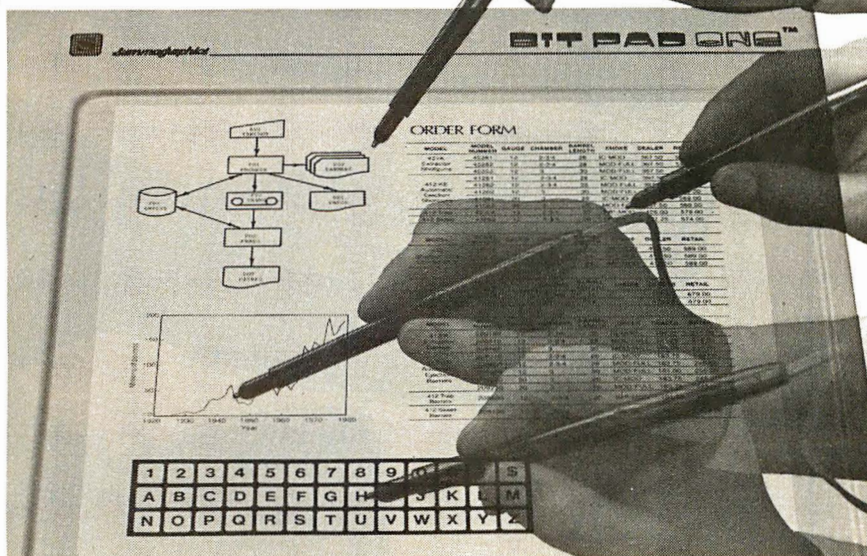
Bit Pad One, complete with stylus, specially designed plug-in TRS-80 interface and power supply cost just slightly over \$1,000.

If you don't have a digitizer, you are restricting your TRS-80's abilities. We'll gladly send you a list of distributors who have the Bit Pad One.



**Summagraphics**  
corporation  
35 Brentwood Avenue, Fairfield,  
CT 06430, (203) 384-1344

**Now, Bit Pad One™  
digitizer makes it easy to add  
graphics capability  
to your TRS-80!**



# New iSBX™ Multimodule™ boards

## Intel® introduces a whole new dimension in configuring single board computer systems.

Intel pioneered the concept of flexible microcomputer system design in 1976, with our family of iSBC™ single-board computers interfaced via the Multibus™ system bus—presently accepted as the industry standard.

Now we've extended this well-accepted concept to board-level design: A new generation of Multimodule boards interface to iSBCs via the new iSBX bus. So now you have a second design option. You can expand systems in large increments with Multibus boards. Or in smaller, more economical increments with Multimodules.

### The key to configuration flexibility

The iSBX bus—the first physical/electrical interface for direct on-board expansion of iSBC systems—assures compatibility between these systems and the emerging Multimodule product line.

Present on all future Intel single-board computers, the iSBX bus saves design time and space, and facilitates fast, easy upgrading. System performance is

also improved because Multimodules tie directly to the iSBC internal bus. Connection to the iSBX bus is made with a set of rugged connectors—one on the iSBC board, the other on the Multimodule itself.

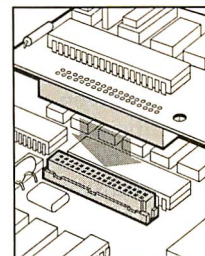
### The new Multimodule family

Multimodules represent a whole new family of plug-in expansion boards. They allow you to add a variety of special performance features to your existing iSBC system. Currently available add-ons are shown below. Soon you'll also be able to add other Multimodules for IEEE 488 GPIB control, communications, peripheral interfaces—and more.

With those modules you can now respond

economical iSBX 331 or 332 math modules.

### Three Multimodule-compatible iSBC boards



iSBX 960-5 Connector

Intel's 8-bit iSBC 80/10B, 80/24 and 88/40 single-board computers are the first of many iSBCs to offer iSBX Multimodule expansion capabilities. The

first two are improved versions of widely used iSBC boards. (See table).

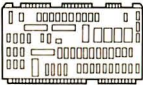
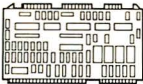




### Custom tailoring, too

For users who want to design their own Multimodule boards, Intel offers iSBX 960-5 connectors. When used in conjunction with the iSBX specifications, this set of connectors lets you create modular boards that meet your own unique requirements.

Available from Intel today are the first six iSBX Multimodules and three iSBX-compatible iSBCs. For further information, or to order, return this coupon or call your local Intel sales office or distributor. Or contact Intel at the address below.

## intel® delivers solutions.

Europe: Intel International, Brussels, Belgium.  
Japan: Intel Japan, Tokyo. United States and Canadian distributors: Alliance, Almac/Stroum, Arrow Electronics, Avnet Electronics, Component Specialties, Hamilton/Avnet, Hamilton/Electro Sales, Harvey, Industrial Components, Pioneer, L.A. Varah, Wyle Distribution Group, Zentronics.

New Multimodules and iSBX Bus-compatible iSBCs	
	<b>iSBC 80/10B Single Board Computer</b> 8080A-based microcomputer with one iSBX bus connector; 48 programmable I/O lines; one USART; timer; capacity for 1K-4K bytes RAM; up to 16K EPROM
	<b>iSBC 80/24 Single Board Computer</b> 8085A-2 based microcomputer operating at 4.8 MHz (2.4 MHz optional); two iSBX bus connectors; 48 programmable I/O lines; one USART; three programmable timers; programmable interrupt controller; capacity for 4K-8K bytes RAM; up to 16K EPROM
	<b>iSBX 311 Analog Input Multimodule</b> 8 or 16 input channels, voltage protected; 12-bit resolution; $\pm 20$ mV to 5V full scale; 20 kHz samples/sec; compatible with iCS 910 Signal Conditioning Termination Panel
	<b>iSBX 328 Analog Output Multimodule</b> 8 channels of analog output; voltage or 4-20 ma current loop; 12-bit resolution; compatible with iCS 910 Screw Termination Panel
	<b>iSBX 331 Fixed/Floating Point Math Multimodule</b> Fixed point single- (16-bit) and double- (32-bit) precision arithmetic; floating point single- (32-bit) precision functions; floating-to-fixed and fixed-to-floating point conversions; transcendental functions
	<b>iSBX 332 Floating Point Math Multimodule</b> Single- (32-bit) and double- (64-bit) precision arithmetic; compatible with proposed IEEE format and existing Intel floating point standard

quickly to new applications opportunities. Examples? For data acquisition from thermocouples and strain gauges, simply plug in the iSBX 311. For 4-20 ma current loop control, use the iSBX 328. In laboratory control applications, instead of an independent math processor, now you can choose the more

Circle 29 on inquiry card.

Please send information on:

☐ iSBX Multimodules ☐ iSBC 80/10B  
☐ iSBC 80/24 ☐ Configuration Guide

☐ Other \_\_\_\_\_  
☐ Please have a Sales Representative call.

Name \_\_\_\_\_

Title/Organization \_\_\_\_\_

Address \_\_\_\_\_

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

Phone \_\_\_\_\_

Intel Corporation, 3065 Bowers Avenue, Santa Clara, CA 95051. Telephone (408) 987-8080.

# Three-Dimensional Computer Graphics, Part 1

Franklin C Crow  
Department of Computer and Information Science  
Ohio State University  
2036 Neil Ave Mall  
Columbus OH 43210

The process of generating computer representations of three-dimensional structures has been pretty thoroughly worked out over the past fifteen years. Several books on computer graphics describe the necessary steps and commercial graphic software has been available for some time. Recently, three-dimensional graphic software has been made available even to those using microcomputers for personal or recreational purposes.

The software necessary for producing representations of simple shapes is not terribly complicated. In this article, I will try to lay out a few fundamental algorithms that can form the core of a three-dimensional graphics package. However, in order to make sense of these algorithms, considerable explanation will be necessary.

To generate an image of a three-dimensional shape, we have to have a computer-readable representation of the shape. (I will describe a couple of ways to represent shapes.) Then the data for the shape must be transformed to conform to the view of the shape that would be seen from a given point. The data must then be further transformed to fit the shape to the limits of a display surface (video display or plotter). Finally, those parts of the shape that are hidden from view, either because they exceed the limits of the display or because they are hidden by other parts of the shape, must be eliminated.

## Getting the Data

The first decision to be made when generating three-dimensional data for input to a graphics system is which coordinate system to use. A right-handed Cartesian system is most often used. Standing at the origin of such a

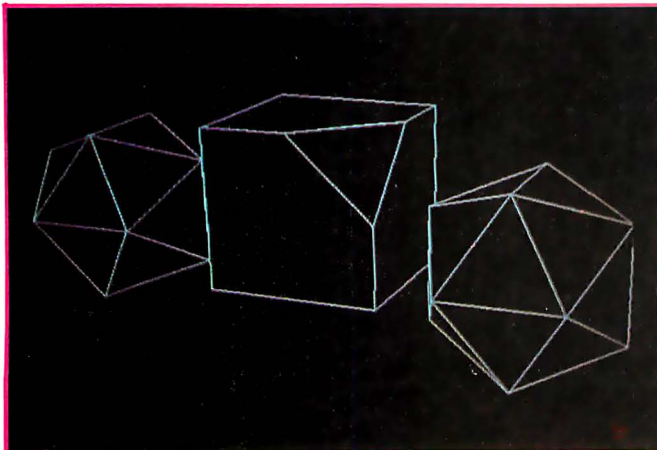
system, the  $x$  axis would go to the right, the  $y$  axis straight ahead, and the  $z$  axis straight up. If we think in terms of a small area of the earth,  $x$  would measure longitude (east positive, west negative),  $y$  latitude, and  $z$  altitude.

Points in this space can be defined as a trio of numbers giving  $x$ ,  $y$ , and  $z$  coordinates. A three-dimensional drawing of an object can then be considered a set of lines connecting points in space. An object can be described by listing all its points in the order in which we would draw them. We can then draw the object by "following the dots."

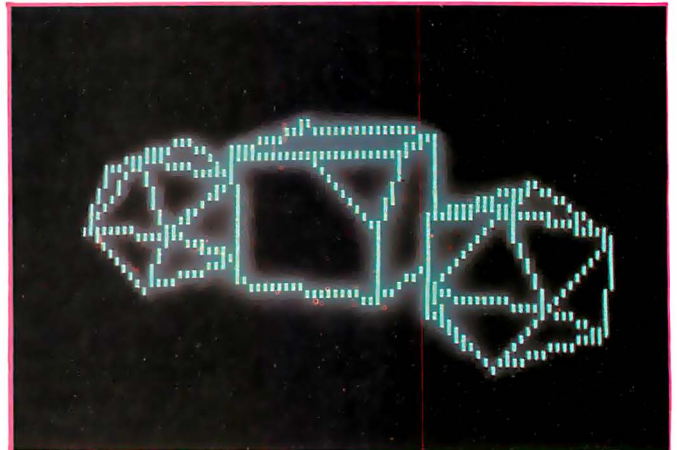
However, we rarely see drawings that are made without ever lifting pencil from paper, so we should add an indicator wherever we move to a point without drawing a line. Thus one format for describing objects consists of a list of sets of numbers. Each set contains three numbers describing a position in space and a command to draw a line to that position or just move to that position without drawing a line, a total of three numbers and a character. An example of this format can be seen in figure 1a, with the associated data given in table 1a. The Pascal procedures given in listing 1 (on page 70) read and display objects defined in this format.

This format is fine if we just want to make drawings of objects that appear to be constructed of straight pieces of wire. To represent a solid object, we have to define a surface enclosing the object and therefore need another format. Surfaces are most easily represented if we define them as sets of faces, or polygons.

To define objects made of polygons, we must list the polygons individually. This can be done by listing the coordinates of each vertex (point) of the polygon in clockwise order (as seen from outside the object) around the periphery of the polygon. It is important that all polygons be described consistently since the clockwise order is useful for calculations determining which side of a polygon is facing the viewer.



**Photo 1:** High-resolution display of solid three-dimensional objects defined as sets of polygons.



**Photo 2:** Low-resolution display of the same objects as in photo 1.

# UniFLEX<sup>TM</sup>



## Multi-User

UniFLEX is the first full capability multi-user operating system available for microprocessors. Designed for the 6809 and 68000, it offers its users a very friendly computing environment. After a user 'logs-in' with his user name and password, any of the system programs may be run at will. One user may run the text editor while another runs BASIC and still another runs the C compiler. Each user operates in his own system environment, unaware of other user activity. The total number of users is only restricted by the resources and efficiency of the hardware in use.



## Multi-Tasking

UniFLEX is a true multi-tasking operating system. Not only may several users run different programs, but one user may run several programs at a time. For example, a compilation of one file could be initiated while simultaneously making changes to another file using the text editor. New tasks are generated in the system by the 'fork' operation. Tasks may be run in the background or 'locked' in main memory to assist critical response times. Inter-task communication is also supported through the 'pipe' mechanism.



## Support

The design of UniFLEX, with its hierarchical file system and device independent I/O, allows the creation of a variety of complex support programs. There is currently a wide variety of software available and under development. Included in this list is a Text Processing System for word processing functions, BASIC interpreter and precompiler for general programming and educational use, native C and Pascal compilers for more advanced programming, sort/merge for business applications, and a variety of debug packages. The standard system includes a text editor, assembler, and about forty utility programs. UniFLEX for 6809 is sold with a single CPU license and one years maintenance for \$450.00. Additional yearly maintenance is available for \$100.00. OEM licenses are also available.

## FLEX<sup>TM</sup>

UniFLEX is offered for the advanced microprocessor systems. FLEX, the industry standard for 6800 and 6809 systems, is offered for smaller, single user systems. A full line of FLEX support software and OEM licenses are also available.



technical systems  
consultants, inc.

Box 2570, West Lafayette, IN 47906  
(317) 463-2502 Telex 276143

<sup>TM</sup>UniFLEX and FLEX are trademarks of Technical Systems Consultants, Inc.

A solid object is customarily defined as a group of adjoining polygons. Since neighboring polygons share vertices along common borders, objects can be more compactly defined by first listing all the vertices belonging to the object and then listing polygons by the numbers of the vertices they use. An example of this sort of format is seen in figure 1b, with data in table 1b. The procedures in listing 2 read and display objects as a set of polygons.

Now that we know how to read and display objects, where do we get the data describing the objects? The simplest way is to dream it up. After all, much of the joy of computer graphics lies in creating imaginary worlds. Take a piece of graph paper and draw front and side views of an object you'd like to represent. Then measure the vertices of the object by counting squares from some point of origin on the paper. The front view will give you the  $x$  and  $z$  coordinates, and the side view will give you the  $y$  coordinate (see figure 2).

People who are involved in creating three-dimensional graphics generally build software to aid in designing objects. For example, a program to generate surfaces of revolution is relatively easy to write. Then shapes such as wine glasses and vases are easy to make. A surface of revolution can be defined by a sequence of points follow-

ing a path up one side of the surface. The points then sweep out a surface by rotating about a central axis. Surfaces of revolution are widely used in computer imagery.

More advanced techniques make use of high-speed interactive graphics terminals (costing \$20,000 to \$150,000) in conjunction with elaborate software to define and modify shapes. See the papers by Crow and Parent (listed among the suggested readings at the end of this article) for examples of this approach to data gathering.

### Defining a View of Some Objects

Once data describing an object is available, it is time to figure out how to look at it. In the real world, when we look at an object, what we see is determined by our viewpoint and the position of the object. How can we emulate this in an imaginary world?

We want the choice of viewing an object from any viewpoint. Therefore we must have an algorithm that will move the vertices of the object to the proper position, given a particular viewpoint. The input to this algorithm consists of two points in space: the position from which we are looking and the position at which we are looking. I will refer to these as the *eyepoint* and the *center of interest*, respectively.

In order to understand how such an algorithm works, we need to know more about how to move objects about in an imaginary world. So far I have defined an object within its own space or frame of reference. Now we would like to arrange a number of objects in a scene, each in a different position and orientation.

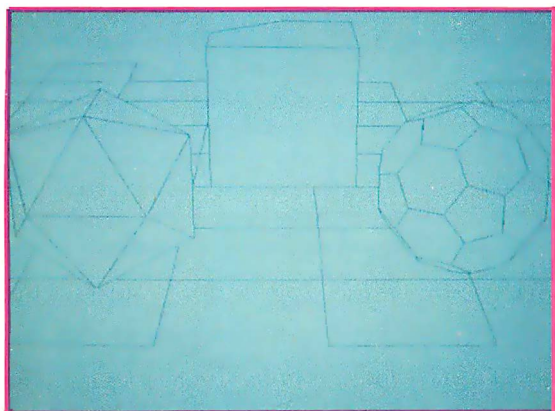
Changing the position of an object is relatively simple. Using the longitude, latitude, altitude model of space, we can move an object east by simply adding some positive number to the  $x$  coordinates of all its vertices. To move an object north, we add some positive number to all its  $y$  coordinates. To move an object up or down, we change all its  $z$  coordinates. This process is called *translation*.

Similarly, to change the size of an object we multiply all its coordinates by the same number. This is called *scaling*. To make an object twice as large in every dimension, we multiply all coordinates of every vertex by two. Thus, changing the position or size of an object is relatively straightforward. Rotating an object or combining successive operations, however, requires more sophisticated techniques.

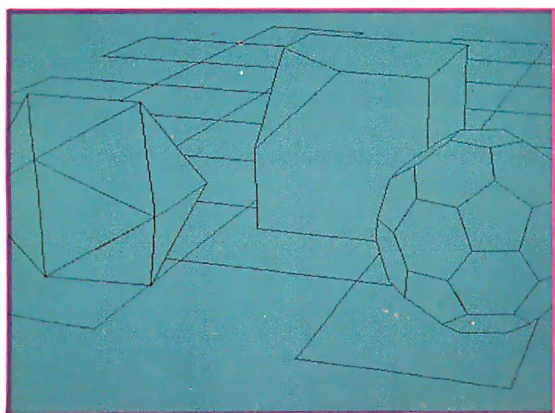
Objects can be moved about quite elegantly using techniques provided by matrix algebra. We devise a sort of template that is filled in to provide the operation desired. Filled templates, called *transformation matrices*, can then be combined to provide complicated operations.

A template, or *matrix*, consists of sixteen positions (four rows by four columns). Numbers loaded into a matrix are combined with vertex coordinates to yield updated coordinates by matrix multiplication. The first column of the matrix affects only the  $x$  coordinate and therefore contains all the numbers that define the updated  $x$  coordinate. The second column treats the  $y$  coordinate similarly, and the third column handles the  $z$  coordinate. The fourth column is for completeness, to make things more elegant. It also allows us to pull some fancy tricks such as finding the inverse of a transformation. I won't use the fourth column in this article, however.

A vertex is "transformed" by the matrix as follows: To get the new  $x$  coordinate, the old  $x$  coordinate is



**Photo 3:** Removal of hidden surfaces can be clearly observed in this display generated on a custom graphics display unit connected to a Digital Equipment VAX 11/780.



**Photo 4:** Transformation of a scene due to a change in the location of the eyepoint as well as transformation of the objects within the scene. Compare with photo 3.

## Don't play games with your company's money.

Our entry level computer system is the first step in a full range of computer products. Not the last step in a full range of computer games.

We call it VIP. The Vector Intelligent Partner. And with a price of just \$3695, you can't get more computer for your money.

VIP has all the assets and none of the liabilities of other entry level systems. It starts off with a lot more disk capacity. It has the same computational power, uses the same software as our larger systems, and can be upgraded at any time. So you avoid the expense of new hardware and software when you outgrow your current system.

You'll be able to do low cost word processing, mail list sorting, database management and accounting. You can even do software development.

VIP is perfect for salesmen, real estate brokers, insurance agents, small business owners and corporate department heads.

Because at Vector, improving your business is the best way to improve our business.

For information contact Vector, 31364 Via Colinas, Westlake Village, CA 91362. Or call 213/991-2302.



# VECTOR

## Economy Sized Computers™

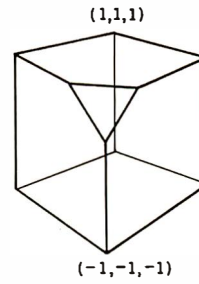
1a

m	1.0	-1.0	-1.0
d	-1.0	-1.0	-1.0
d	-1.0	-1.0	.00
d	-.00	-1.0	1.0
d	1.0	-1.0	1.0
d	1.0	1.0	1.0
d	1.0	1.0	-1.0
d	1.0	-1.0	-1.0
d	1.0	-1.0	1.0
m	-1.0	-1.0	.00
d	-1.0	-.00	1.0
d	-1.0	1.0	1.0
d	-1.0	1.0	-1.0
d	-1.0	-1.0	-1.0
m	-1.0	-.00	1.0
d	-.00	-1.0	1.0
m	-1.0	1.0	-1.0
d	1.0	1.0	-1.0
m	1.0	1.0	1.0
d	-1.0	1.0	1.0

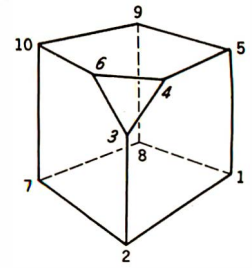
1b

	10	7	(NumPts NumPolys)		
1	1.0	-1.0	-1.0		
2	-1.0	-1.0	-1.0		
3	-1.0	-1.0	.00		
4	-.00	-1.0	1.0		
5	1.0	-1.0	1.0		
6	-1.0	-.00	1.0		
7	-1.0	1.0	-1.0		
8	1.0	1.0	-1.0		
9	1.0	1.0	1.0		
10	-1.0	1.0	1.0		
5	1	2	3	4	5
4	8	1	5	9	
4	7	8	9	10	
5	2	7	10	6	3
4	8	7	2	1	
5	5	4	6	10	9
3	3	6	4		

**Table 1:** Data for an object defined as a set of lines (table 1a) and for an object defined as a set of polygons (table 1b). In table 1a, the "m" and "d" in the first column mean "move to" or "draw to" the point with x, y, and z coordinates as given in the next three columns, respectively. In table 1b, the first line gives the number of points (10) and polygons (7) in the shape. The next 10 lines give the point number (1 thru 10) and the x, y, and z coordinates of the point. The last seven rows describe the seven polygons: the first number gives the number of points making up that polygon, and the rest of the numbers on that line give the point numbers (as described by the point description lines) that make up the polygon. Both tables 1a and 1b describe the shape shown in figure 1b.



(1a)



(1b)

**Figure 1:** Three-dimensional object displayed as a set of straight lines defined by 10 points (figure 1a) and a set of polygons defined by using the same points (figure 1b). See table 1 for associated data.

multiplied by the top number in the first column, then added to the product of the old y coordinate and the second number in the first column. The sum is then added to the product of the old z coordinate and the third number in the first column. Finally, the whole thing is added to the bottom number in the first column. The new y coordinate can be obtained by combining the second column and the old vertex coordinates in the same way. Similarly, the new z coordinate is produced using the third column. The Pascal procedure in listing 3 (on page 70) transforms a vertex.

Under the rules stated above, the bottom row of the matrix holds numbers that translate the object. A number at the bottom of the first column is added to all x coordinates to move an object east or west. Similarly, numbers at the bottom of the second and third columns affect the y and z coordinates. To scale objects, we enter the scaling factor along the top-left-to-bottom-right diagonal of the matrix. The top-left number in the matrix is multiplied by the old x coordinate to yield the new x coordinate. Similarly, the second number in the second column multiplies the y coordinate and the third number in the third column multiplies the z coordinate.

Rather than trying to explain rotations in the limited space here, I will simply illustrate how to fill in the matrix. Trying a few examples by hand should convince you that rotations work. Simple rotations are those that rotate an object about one of the axes of our space. For instance, to rotate an object about the z axis by an angle A, use the following matrix:

$\cos(A)$	$\sin(A)$	0	0
$-\sin(A)$	$\cos(A)$	0	0
0	0	1	0
0	0	0	1

Note that this matrix leaves the z coordinate unchanged, which is what we would expect from a rotation about the z axis. Furthermore, a rotation through a zero angle leaves everything unchanged since the cosine of zero is 1 and the sine of zero is 0.

I always use the convention that a positive rotation occurs in a counterclockwise direction looking in the negative direction along the axis about which you are rotating. This means that if the thumb of your right hand is pointed in the same direction as that axis, your fingers will curl in the direction of positive rotation. Keeping

# NEVER UNDERSOLD!

That's right, if you can find a lower price in this magazine for any of the items listed in this ad, we will reduce our price below our competitor's price. See each box below to determine how much EXTRA we will cut off of THEIR price if we're not lowest. Please consider the competitor's shipping charges, OUR SHIPPING IS FREE!\*

## FLOPPY DISKETTES & SUPPLIES

IF YOU CAN FIND A LOWER PRICE IN THIS MAGAZINE ON ANY OF THESE ITEMS, DEDUCT \$.50 FROM OUR COMPETITOR'S PRICE, THAT'S OUR PRICE!

### Call For Quantity Discounts

Verbatim Diskettes (box of 10)	
5 1/4" MD525-01 soft, 10 or 16	\$26.50
5 1/4" MD577-01 quad soft, 10 or 16	\$33.00
8" FD34-1000 soft	\$30.00
8" FD32-1000 hard	\$30.00
8" FD34-8000 double density soft	\$44.00
8" FD32-8000 double density hard	\$44.00

Printwheels (specify style)	
Qume or Diablo	\$6.50

Labels	
3 1/2" x 15/16" (5000 labels)	\$18.75
Other sizes and quantities	CALL

Ribbons	
Diablo Hy Type I	\$4.95
Diablo Hy Type II	\$5.25
Qume Sprint	\$3.50
Centronics Zip Pack	\$3.95
MANY OTHERS	CALL

## PRINTERS

IF YOU CAN FIND A LOWER PRICE IN THIS MAGAZINE ON ANY OF THESE PRINTERS, DEDUCT \$10 FROM OUR COMPETITOR'S PRICE, THAT'S OUR PRICE!

Epson MX 80	CALL
Okidata Microline-80	\$550
Okidata Microline-82	CALL
Okidata Microline-83	CALL
IDS Paper Tiger 445G	\$775
IDS Paper Tiger 460G	\$1193
Anadex DP-8000 (AP)	CALL
Anadex DP-9500	\$1395
Centronics 737	\$799
NEC W/Sellum Bi.Dir. Board	\$2595
Vista 25 CPS	\$1595
Qume	CALL
Diablo	CALL
Escon Interface	\$545

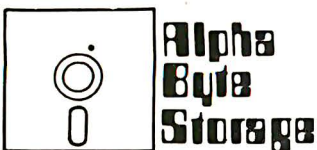
Call For Other Printers

## SOFTWARE, MODEMS & TRS-80 HARDWARE

IF YOU CAN FIND A LOWER PRICE IN THIS MAGAZINE ON ANY OF THESE ITEMS, DEDUCT 3% FROM OUR COMPETITOR'S PRICE, THAT'S OUR PRICE!

SOFTWARE	
Microsoft	
Basic Compiler	\$345
Basic-80	\$319
Fortran-80	\$399
Cobol-80	\$599
Macro-80	\$144
Pickles and Trout CP/M	CALL
Graham Dorian	CALL
Peach Tree	CALL
Magic Wand	CALL
Supersoft	CALL
PCD Pascal	\$350
Visicalc	\$124
Space Invaders	\$23
Adventure	\$26
Head cleaning kit	\$26
MODEMS	
UDS 103CP	\$175
D-CAT	\$155
CAT	\$145
TRS-80 HARDWARE	
Micropolis 77 track	SUPER SALE \$399
Lobo Drives	CALL
Matchless Drives	CALL

4636 Park Granada  
Calabasas, Ca. 91302



For phone orders CALL:  
**(213) 883-8594**

IF YOU CAN FIND A LOWER PRICE IN THIS MAGAZINE ON ANY OF THE ITEMS LISTED BELOW, DEDUCT 5% FROM OUR COMPETITOR'S PRICE, THAT'S OUR PRICE! (BUT IF YOU DON'T SEE IT, CALL FOR A PRICE—WE WILL BEAT EVERYBODY!)

## S-100 HARDWARE APPLE HARDWARE

CALIFORNIA COMPUTER SYSTEMS:	
16K Static RAM (Model 2016C)	\$349
32K Static RAM (Model 2032A)	\$599
64K Dynamic RAM (Model 2032A)	\$599
16K Static RAM (Model 2065A)	\$299
Main Frame (Model 2200A)	\$339
Floppy Disk Controller (Model 2422A)	\$339
4 Port Serial I/O (Model 2710)	\$CALL
25+2P I/O (Model 2718)	CALL
Z-80 CPU (Model 2810)	\$249
Godbout Econoram	CALL
SD Systems Versa Floppy	\$279
Expando RAM	\$CALL

Microsoft Z-80 Softcard	\$259
SSM AIO	\$165
SYMTEC Apple Light Pen	\$219
CALIFORNIA COMPUTER SYSTEMS:	
Parallel Interface (Model 7720A)	\$112
Asynchronous Serial Interface (Model 7710A)	\$149
Programmable Timer (Model 7440A)	\$149
12K ROM/PROM Module (Model 7114A)	\$75
Arithmetic Processor (Model 7811A)	\$374
Synchronous Serial Interface (Model 7712A)	\$149
GPB Interface (Model 7490A)	\$281
3 1/4 Didgit BCD A/D Converter	\$140
Centronics Printer Interface (Model 7728)	\$99
MOUNTAIN HARDWARE:	
Super Talker	\$270
ROMWRITER	\$157
INTROL/X-10	\$180
ROMPLUS+	\$162
MUSICSYSTEM	\$499
Apple Clock	\$252
Lobo Drive	\$CALL
Videx 80 X 24	\$345
Andromeda	\$189

\*FREE shipping on all orders over \$20. Visa and Master Card accepted. All never undersold offers good as supply lasts. Please add 2.00 for all COD orders. Please call for items not listed. We gladly answer any questions on all of our hardware, software, and supply needs. Quantity discounts available. School purchase orders accepted. Please remember to figure competitors shipping and handling charges when arriving at never undersold price.

Circle 32 on inquiry card.

# High Technology

We make our competition obsolete with Information Master.™

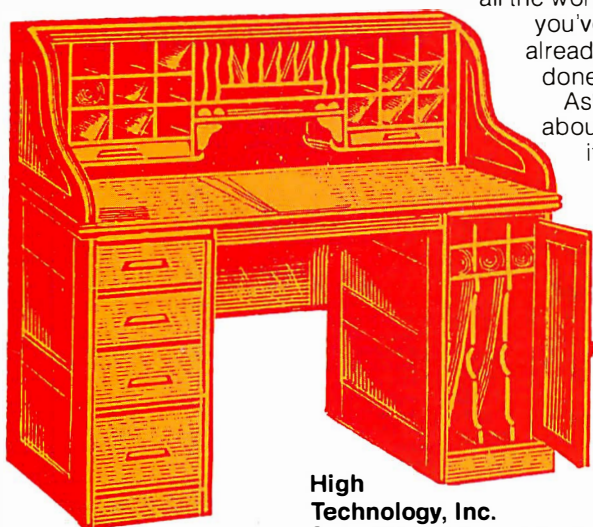
Information Master™ is the sophisticate of software packages, but it also speaks your language. Its uncomplicated English-speaking design makes it easy to learn. No programming knowledge is necessary. Put it in your Apple II\*, and you're ready to go.

High Technology's Information Master organizes and prints everything from mailing lists to stock market data. Specify what records to store, type in the information, and Information Master organizes, calculates, stores and reports. Design your own reports and labels. Information Master is revolutionary in its adaptability and comes with a simple step-by-step instruction manual. Its screen layouts are designed to show you maximum information for easy operation. Information Master is so smart it stops mistakes that our competition lets you make.

If your computer dealer doesn't have Information Master, see one who does.

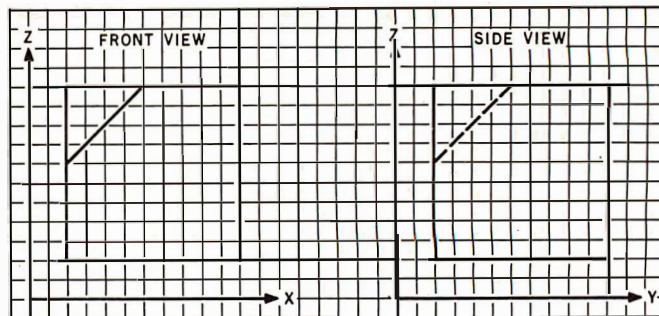
High Technology's perfect complement to Information Master, Data Master,™ allows you to change your mind months later

without redoing all the work you've already done. Ask about it!



**High Technology, Inc.**  
Software Products Division  
P.O. Box B-14665  
8001 N. Classen Blvd.  
Oklahoma City, Okla. 73113  
405 840-9900

\*Apple II is a trade name of Apple Computer, Inc.



**Figure 2:** Vertices for objects to be displayed in three dimensions may be measured from front and side views laid out on ordinary graph paper.

track of such things requires a strong sense for visualizing space. When in doubt, I sketch things with pencil and paper.

To rotate about the x axis, use the following matrix:

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos(A) & \sin(A) & 0 \\ 0 & -\sin(A) & \cos(A) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

To rotate about the y axis, use the following matrix:

$$\begin{bmatrix} \cos(A) & 0 & -\sin(A) & 0 \\ 0 & 1 & 0 & 0 \\ \sin(A) & 0 & \cos(A) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Combining these fundamental rotations results in even more interesting rotations.

Note that all transformations occur relative to the origin of the given space. Thus, to rotate or scale an object without changing its position, we must first be sure that it is centered on the origin. Therefore, a rotation or scaling "in place" (ie: without changing position) requires a translation to center on the origin, followed by rotation or scaling, then a second translation back to the original position.

Once all the objects in a scene have been transformed to the desired positions and orientations, a view from a given eyepoint in the direction of the object of interest is simulated by an additional transformation that places the object in the desired position and orientation. This simulation can be achieved by combining a few rotation matrices.

In the first step, we move everything so that the eyepoint lies at the origin of the space and the center of interest lies on the y axis, or due north. To do this, we translate the eyepoint to the origin and apply the same matrix to all the other data. The translation matrix is as follows:

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ -\text{Eye.X} & -\text{Eye.Y} & -\text{Eye.Z} & 1 \end{bmatrix}$$

where Eye.X, Eye.Y, and Eye.Z are the x, y, and z coordinates of the eyepoint.

# The Perfect Fit

The Micromodem II data communications system and the Apple II\* computer. What better combination to maximize the capabilities of your personal computer!

This popular direct connect modem can transmit data between an Apple II and another Apple II, a terminal, another microcomputer, minicomputer or even a large time-sharing computer anywhere in North America. The Micromodem II has unique automatic dialing and answer capabilities which further increases the communications possibilities between the Apple II and another computer or terminal.

You can send and/or receive messages or data when you are out of your office, home or out of town. Your branch business locations can communicate with each other regarding inventory and other matters over the phone. Or you can communicate with friends across the country. And you can access information utilities like the SOURCE for various business and personal applications.

The Micromodem II consists of two parts. One part includes the printed circuit board which holds the Micromodem II, ROM firmware and the serial interface. The board plugs directly into the Apple II providing all the functions of a serial interface card plus programmable auto dialing and auto answer capabilities. The on-board ROM firmware enables the Micromodem II to operate in any of three modes to perform different tasks-terminal mode, remote console and program control mode.

The other part of the Micromodem II datacomm system is a Microcoupler which connects the Micromodem board and Apple II to a telephone line. The Microcoupler gets a dial tone, dials numbers, answers the phone and hangs up when a transmission is over. There are none of the losses or distortions associated with acoustic couplers. The Microcoupler is compatible with any North American standard telephone lines and is FCC-approved for direct connection in the U.S. It works with standard dial phone service or Touch-tone service.

The Micromodem II is completely compatible with Bell 103-type modems. Full and half-duplex operating modes are available as well as speed selectable transmission rates of 110 and 300 bps.

Why not increase your Apple II's capabilities by outfitting it with the sophisticated Micromodem II data communications system? The Micromodem II is available at retail computer stores nationwide. For the store nearest you, call or write:

Circle 34 on inquiry card.



**Hayes Microcomputer Products Inc.**

5835 Peachtree Corners East, Norcross, Georgia 30092 (404) 449-8791

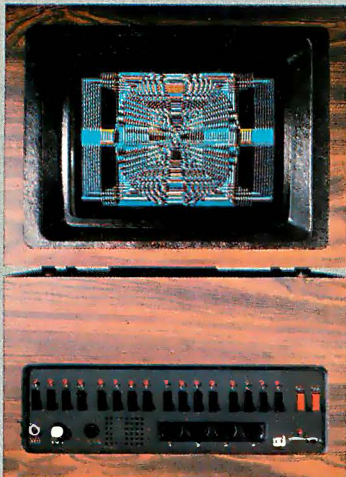
\*Micromodem II is a trademark of Hayes Microcomputer Products, Inc.

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

The Micromodem II can also be used with the Bell & Howell computer.



# Introducing Zgrass<sup>®</sup> The UV-1 Graphics System



## Computer Generated Graphics Made Simple

Zgrass is an exciting user-oriented language developed for real time interactive graphics.

Zgrass software includes a full screen text editor; point, line, box, ellipse, pattern display and fill graphics routines; full math capabilities; full string manipulation and array capabilities; both interpretive and compiled modes of execution.

- The Datamax<sup>®</sup> UV-1 is the only advanced graphics system featuring the Zgrass language.
- Using much of Bally's<sup>®</sup> commercial video game electronics, the UV-1 shares the same reputation for ruggedness and reliability.
- 64K bytes of memory (16K EPROM, 16K screen RAM, 32K user RAM).
- Z80 microprocessor; floating point math processor; custom video graphics processor; custom input/output processor with 4 A/D converters and 3 channel sound synthesizer.
- 320x202 2 bit/pixel screen; 256 display colors.
- Outputs for RGB and legal, recordable NTSC video.
- Interfaces for graphics tablet, disc drive, joystick controllers, audio tape, RS-232 ports.
- Complete CAI self teaching lesson package. Ideal for education.

EXPLORE THE WORLD OF ZGRASS<sup>®</sup> GRAPHICS.  
UV-1 by Datamax<sup>®</sup>. For more information, contact

 **datamax** Inc.  
350 NORTH ERIC DRIVE  
PALATINE, ILLINOIS 60067  
(312) 991-7410

A rotation about the z axis can now be used to move the center of interest in a northerly direction. In particular, we move the center of interest into the plane defined by the y and z axes. The angle of rotation is found by passing the center of interest through the eye-point translation matrix defined above and then applying the following formulas:

$$\cos(A) = C1.Y / \sqrt{(C1.X)^2 + (C1.Y)^2}$$

$$\sin(A) = C1.X / \sqrt{(C1.X)^2 + (C1.Y)^2}$$

where A is the angle of rotation and C1.X and C1.Y are the x and y coordinates of the translated center of interest, respectively (see figure 3).

The process of moving the center of interest onto the y axis is completed by rotating the object about the x axis, using the following formulas:

$$\cos(A) = C2.Y / \sqrt{(C2.Y)^2 + (C2.Z)^2}$$

$$\sin(A) = -C2.Z / \sqrt{(C2.Y)^2 + (C2.Z)^2}$$

where C2.Y and C2.Z are, respectively, the y and z coordinates of the translated and rotated center of interest (see figure 4).

Because all this is done with the intention of displaying the resulting coordinates on a flat surface, one more transformation is called for. It is useful to think about the display surface (video display, plotter, etc) as a space in which the x axis measures width, the y axis height, and the z axis depth. We can place our transformed coordinates into this space by interchanging the y and z axes, using the following matrix:

1	0	0	0
0	0	1	0
0	1	0	0
0	0	0	1

Given coordinates for an eyepoint and a center of interest, we can use the matrix multiply procedure to combine the above operations into a single orientation for displaying a view of the scene. The procedure in listing 4 (on pages 70 and 72) builds such a matrix. We refer to the resulting arrangement of a scene as the *eyespace*.

## Clipping

Once all the data in the scene is transformed to the eyespace, we must decide how much of the scene fits on the display. The display can be thought of as a window into an imaginary world. Things such as the size of the window and our distance from it determine what can and cannot be seen. We can use the edges of the window and the origin of the space (ie: the eyepoint) to define planes that clip parts of polygons not visible through the window (see figure 5).

The clipping window defines the *field of vision* in much the same way that the film gate and lens in a camera limit the field captured by the film. The window can be defined as a polygon corresponding to the boundaries of the display as we expect to view it. For example, if we are in the habit of looking at a 12-inch video display from a distance of 16 inches or so, the clipping window should be a rectangle about 6 inches high and 8 inches across, located 16 inches from the eyepoint.

from 廣州 to Norwich...\*



## DISCOVERY THE World Class Multiprocessor

\* From Guangzhou, China to Norwich, England. From Banphai, Thailand to Pasadena, California. A proven record of performance and reliability in installations throughout the World makes the **DISCOVERY MULTIPROCESSOR** the international choice in multiuser microcomputer systems.

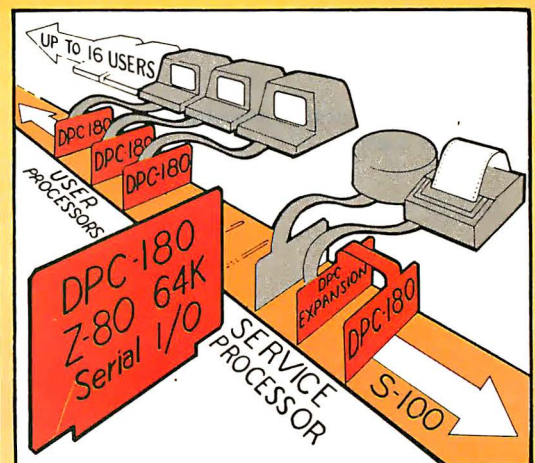
### WORLD CLASS SOFTWARE

Our Distributed Processing Operating System, **dpos/2™**, resides in the Service Processor, establishing a CP/M† environment for each user and managing access to the shared system resources. Multiuser facilities are provided for print spooling, for interprocessor communication and for private, public and shared-update files. Several processors can be employed concurrently by a single user via the enhanced batch submit facilities. And with **DISCOVERY** all CP/M compatible programs will execute without modification, thus protecting your software investment.

### WORLD CLASS HARDWARE

The ACE 64K Distributed Processing single board Computer, the **dpc-180™** gives the **DISCOVERY MULTIPROCESSOR** its unique architecture. One DPC is dedicated to each user providing exclusive use of the onboard Z-80, 64K ram and serial I/O. Shared storage is provided by an expanded DPC used as the Service Processor. Additional users can be added at any time by simply inserting additional DPC's into the standard S-100 bus — up to 16 in a single chassis!

† CP/M is a registered TM of Digital Research, Inc.



The ACE **DISCOVERY MULTIPROCESSOR** dedicates a complete, 64K Z-80 Distributed Processing single board Computer, the **dpc-180™** to each user. An expanded DPC coordinates all of the system activities.

Whatever your requirements, Whatever your language. No matter how you say it — **DISCOVERY** is THE World Class Multiprocessor.

Multiuser mainframes with 192K ram start at under \$6000. The 64K **dpc-180™** is priced at \$1395. Immediate delivery. A complete line of standard peripherals including a 26M byte hard disk subsystem can be supplied on request. Dealer and OEM inquiries are invited.

**Action Computer Enterprise, Inc.**

55 West Del Mar Boulevard, Pasadena, California 91105 USA • Cable ACEPAS Pasadena • (213) 793-2440

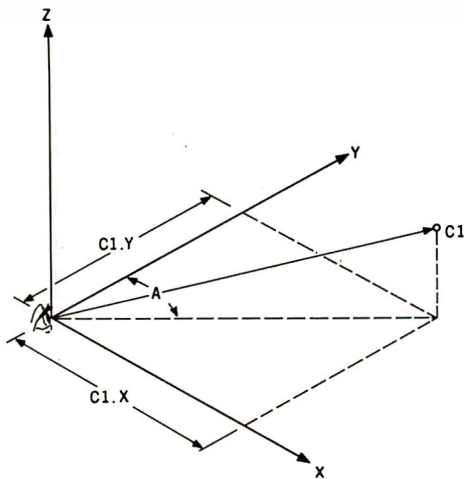


Figure 3: Graphical representation of calculating the rotational angle about the z axis in computing the eyespace matrix.

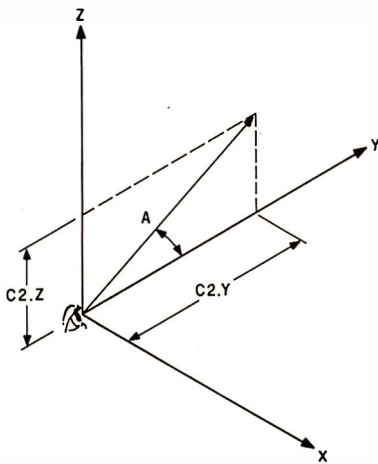


Figure 4: Graphical representation of calculating a rotation about the x axis.

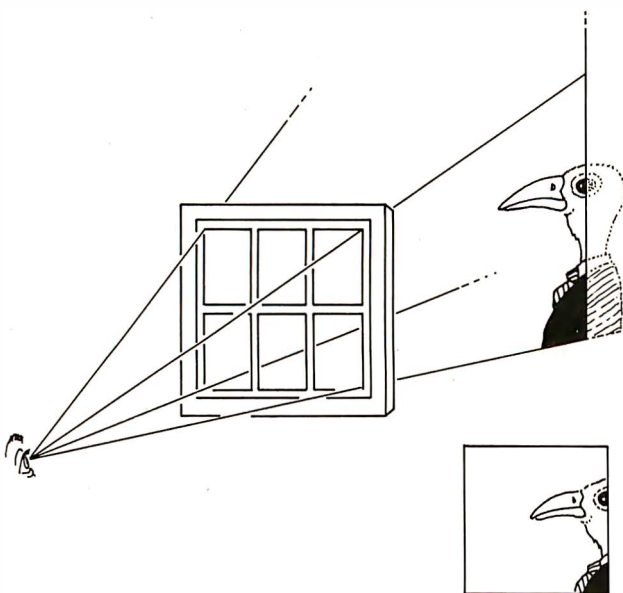


Figure 5: Representation of how a viewing window "clips" portions of polygons lying outside the pyramid defined by the window and the eyepoint.

The first step of the clipping process is to define the planes to be clipped against. Planes can be defined by four numbers, the coefficients of an equation of the following form:

$$A \times x + B \times y + C \times z + D = 0$$

We can simplify this equation somewhat since all the planes we are interested in pass through the origin. For all planes passing through the origin, the fourth coefficient,  $D$ , equals zero.

Our window can then be characterized by a sequence of sets of three numbers, each set describing one plane. Listing 5 produces the coefficients of the plane equations needed for clipping. Input is assumed to be a polygon. Each clipping plane is determined by three points: the eyepoint and the two endpoints of an edge from the input polygon. This assumes that polygon vertices are taken clockwise as seen from the eyepoint and that a "left-handed" (width, height, depth) eyespace is used.

Once we have the clipping-plane coefficients, they can be applied to all the vertices of a polygon to find out which lie inside and which lie outside the field of view. The clipping coefficients are applied to a vertex using the following formula in Pascal style:

$$\text{Distance} := Vtx.X * Clp.X + Vtx.Y * Clp.Y + Vtx.Z * Clp.Z$$

This operation (known as a vector *dot product*) yields a distance measure that tells us how far inside or outside the viewable area the vertices lie. Negative numbers indicate that a vertex lies outside, positive numbers that a vertex lies inside. If distances for all clipping planes applied to all vertices of a polygon are positive, it is completely visible. If distances for all vertices and any of the clipping planes are negative, the polygon is entirely outside the window and thus not visible (assuming the clipping window is convex). If some distances are positive and some are negative, we may have to cut the polygon into inside and outside portions.

The procedure in listing 6 takes a polygon and clips it by a set of plane coefficients stored in a second polygon array. Each plane is tested in turn against each polygon vertex. Vertices lying inside (on the positive side of) a plane are copied to a temporary polygon array. Where two adjacent vertices are found to lie on opposite sides of a plane (ie:  $D1 \times D2 < 0.0$ , meaning the signs of the distances are different), the intersection point of the clipping plane and the edge connecting the two vertices is copied to the temporary array. When all the vertices of the polygon have been clipped against one plane, the temporary array is copied back into the input array and clipped against the next plane. This process eliminates parts of polygons lying outside an unbounded pyramid emanating from the eyepoint and delimited by the window polygon.

### Displaying

Any polygon found to lie within the field of vision must be displayed. An additional transform is necessary to take the coordinates of the eyespace to the coordinates used by the display device, the "screen space." Furthermore, a division is necessary to achieve the appearance of

# It's all relative, especially your career.

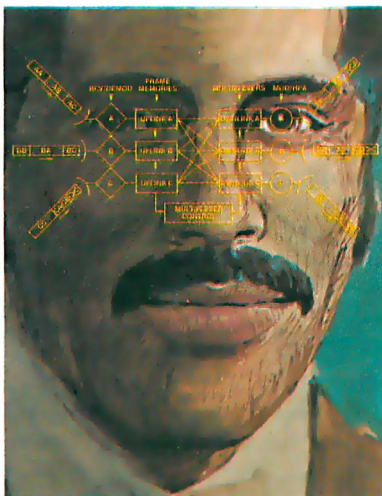


How far you go in your career is directly related to your own abilities and ambitions. At the same time, where you work is just as important. Not all companies are the same. At COMSAT, we pride ourselves on the creative latitude we offer our professionals. We don't stifle imaginations.

We encourage you to develop new skills and abilities as you work with some of the best people in their respective fields. The opportunities for self-growth and professional fulfillment are virtually unlimited at COMSAT. You'll be involved in some of the most important and exciting projects taking place in the world today, in all areas directly and indirectly related to high technology.

We're the company that pioneered the INTELSAT global communications system, which today keeps more than 100 nations in touch. And we're constantly exploring and developing new programs and applications for satellite technology.

With every new advance in space technology, COMSAT continues to lead and grow. Following INTELSAT came COMSTAR and MARISAT, two industry-leading commercial communications systems. COMSAT also is now the U.S. representative to INMARSAT,



the most recent international communications organization providing satellite communications to the maritime community. COMSAT's latest projects include telecommunications products

manufacturing, integrated CAD/CAM systems, domestic and global technical and support services, environmental monitoring, satellite-to-home subscription television. Additionally, COMSAT Laboratories performs supporting research and development in communications satellite technology and related areas.

Our rapid expansion has created numerous career openings in many diversified engineering disciplines including communications, RF system, spacecraft design, mechanical, microwave, sr. transmission systems, manufacturing, sales, test, and modem design, as well as technician-related areas and marketing.

We offer excellent salaries and benefits. If you want to know more about us, simply forward your resume, indicating your area of interest. We'll be in touch with you promptly. Write to Senior Employment Representative, Department 81-1RC, COMSAT, 950 L'Enfant Plaza, S.W., Washington, D.C. 20024.



## COMSAT

An Equal Opportunity • Affirmative Action Employer.

perspective (ie: objects in the distance should be smaller). This transform can take the form of a scaling matrix as follows:

Scale.X : = DotsAcross \* WinDist/WinWidth  
 Scale.Y : = DotsDown \* ( $\frac{4}{3}$ ) \* WinDist/WinWidth

The matrix is then:

Scale.X	0	0	0
0	Scale.Y	0	0
0	0	1	0
Middl.X	Middl.Y	0	1

In the above transform, DotsAcross is the number of dots across the display, DotsDown the number of lines on the display from top to bottom, WinDist the distance to the window in eyespace, WinWidth the width of the window, and Middl.X and Middl.Y are the  $x$  and  $y$  coordinates of the middle of the display (in screen space, usually DotsAcross/2 and DotsDown/2). The factor ( $\frac{4}{3}$ ) takes into account that the standard video display is  $\frac{4}{3}$  as wide as it is high (the *aspect ratio*). It is assumed that the window has the same proportions as the display.

Nonrectangular windows require a more careful calculation. If the maximum width of the window is less than  $\frac{4}{3}$  times the maximum height, another number must be substituted for the window width in the above calculations. That number should be the maximum of the window width and  $\frac{4}{3}$  times the window height. Of course, if we use a display with a different aspect ratio, the width of the display divided by its height should replace the  $\frac{4}{3}$ .

The procedure in listing 7 divides the  $x$  and  $y$  coordinates of each vertex by its  $z$  coordinate to achieve the perspective effect, then applies the transformation to display coordinates directly, rather than using a matrix transformation.

This completes the process of computing an image of objects with all data shown, as though the objects were made of pieces of straight wire. Next, we look at how to achieve the appearance of solid objects capable of hiding each other.

## Hidden Faces

There are two methods that allow solid objects to hide parts of themselves or other objects. The first uses the plane equation of each polygon to determine whether or not it lies on the far side of its object. If it does, the polygon is clearly hidden by closer parts of the object. The second uses a clipping procedure similar to the one described earlier to remove parts of faces that are hidden by closer faces.

In everything that follows, polygons are assumed to be convex. Restricting things in this way simplifies the task considerably at a very small increase in the cost of preparing object descriptions.

Earlier in the article, I stressed the importance of taking the vertices of all polygons in a consistent order, usually clockwise as seen from outside the object. Many objects are closed surfaces, meaning that the inside of the object can be seen only by passing through the surface. In fact, if we choose to do so, we can construct all objects as closed surfaces for display purposes.

In any event, if a polygon appears on the screen with its vertices in counterclockwise order, we must be seeing it from the inside. If we are looking at a closed surface from the inside, some other part of the surface must lie between us and the polygon in question. Therefore, when making pictures of solid objects made of closed surfaces, we can immediately reject any polygons appearing in counterclockwise order.

Earlier we used planes for clipping by evaluating the positive or negative distance from a point to the plane. Similarly, when the eyepoint lies on the positive side of the plane of a polygon, the vertices of that polygon appear in clockwise order. When on the negative side, they appear in counterclockwise order. Some of the procedures developed earlier can be used to determine whether or not a polygon "faces the eyepoint."

Three of the vertices of the polygon define a plane. Here we can use the procedure developed earlier for finding a plane defined by two window vertices and the eyepoint. Use the three points to define two lines. If the two lines are treated as direction vectors (subtract one endpoint from the other), the two vectors can be passed to the procedure, which then returns coefficients for a plane parallel to the polygon and passing through the origin. These coefficients, when used in a dot product with one vertex of the polygon, yield a number that tells us on which side of the polygon the eye lies. The function in listing 8 does the job.

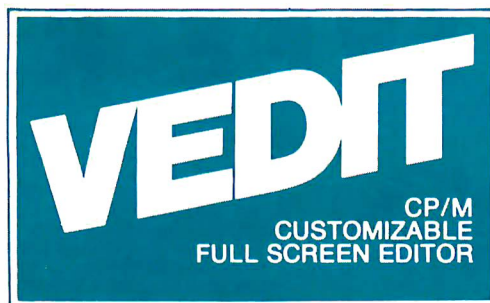
If a closed convex surface is being displayed by itself, the above process is adequate to produce the image with only visible faces shown. However, if the surface is not convex, or there is more than one object involved, further procedures are necessary.

Those polygons surviving the clipping procedure and the "eye-facing" test can be sorted by their distance from the eyepoint. We base the sort on the average of the  $z$  coordinates of each polygon in turn. If all polygons are roughly the same size, no two polygons intersect each other, and no two polygons lie close to each other in nearly parallel planes, the sort order will allow us to eliminate hidden parts of polygons. Most scenes involving separated, reasonably simple objects will conform to the above conditions.

Since the polygons must be transformed, clipped, and tested for "eye-facing" one by one, it makes sense to use an insertion sort to order the polygons displayed. A list of polygons to be displayed is built by inserting each new polygon description (number of vertices and position in vertex array) in the already sorted list of previous polygons. A binary search can be used to reduce the search time for finding the insertion point. The procedure in listing 9 implements a binary insertion sort. Note that polygon vertices are stored in an array in contiguous groups. The  $z$  coordinate of the first element of the group is used to hold the average  $z$  coordinate of the polygon for subsequent tests.

Sorting is a major part of nearly all hidden-line and hidden-surface algorithms. For a thorough discussion of sorting and other aspects of hidden-surface algorithms, see the paper by Sutherland and others listed in the suggested readings. Also see the third volume of Donald E Knuth's *The Art of Computer Programming* for a thorough treatment of sorting in general.

*Text continued on page 82*



## The best news since CP/M... customizable full screen editing

As a serious computer user you spend much of your time editing, whether it be for program development or word processing. Make the best use of your time with the help of VEDIT, an exceptionally fast and easy to use full screen editor. VEDIT is a highly refined and proven editor which is easy enough for novices to learn and use. Yet its unequalled set of features also makes it the choice of computer professionals. And because VEDIT is user customizable, it adapts to your keyboard, hardware, applications and preferences.

In VEDIT, the screen continuously displays the region of the file being edited, a status line and cursor. Changes are made by first moving the cursor to the text you wish to change. You can then overtype, insert any amount of new text or hit a function key. These changes are immediately reflected on the screen and become the changes to the file.

VEDIT has the features you need, including searching, file handling, text move and macros, plus it has many special features. Like an 'UNDO' key which undoes the changes you mistakenly made to a screen line. And a mode which allows a programmer to enter all text in lower case and let VEDIT convert the labels, opcodes and operands, but not the comments, to upper case. The screen writing is almost instantaneous on a memory mapped display or can use your CRT terminal's editing capabilities. Disk access is very fast too, and VEDIT uses less than 12K of memory. The extensive 70 page, clearly written manual has sections for both the beginning and experienced user.

### *Totally User Customizable*

Included is a setup program which allows you to easily customize many parameters in VEDIT, including

the keyboard layout for all cursor and function keys, screen size (up to 70 lines, 200 columns), default tab positions, scrolling methods and much more. This setup program requires no programming knowledge or 'patches', but simply prompts you to press a key or enter a parameter.

The CRT version supports all terminals by allowing you to select during setup which terminal VEDIT will run on. Features such as line insert and delete, reverse scroll and reverse video are used on 'smart' terminals. Special function keys on terminals such as the H19, Televideo 920C and IBM 3101, and keyboards producing 8 bit codes or escape sequences are also supported.

### *New Features and Support*

The new release includes disk write error recovery, indent and undent keys for structured programming, and the ability to insert a specified line range of another file at the cursor position. Versions for MP/M<sup>R</sup> and the Apple II<sup>R</sup> SoftCard<sup>R</sup> are now also available.

### *Ordering*

Specify the CRT version, your video board or microcomputer, the 8080/Z80 or Z80 code version, and disk format required.

Standard Package: Disk and manual.....\$110  
Manual: Price refunded with software purchase.....15

VISA and MASTER CARD Welcomed.  
Attractive Dealer Terms.

CP/M and MP/M are registered trademarks of Digital Research, Inc. Apple II is a registered trademark of Apple Computer, Inc. SoftCard is a trademark of Microsoft.

North Star ● Heath H8/H89 ● SuperBrain ● Apple II SoftCard ● Sorcerer ● TRS-80 Model I  
TRS-80 Model II ● MP/M ● Most other CP/M<sup>R</sup> Systems with CRT or Memory Mapped Displays

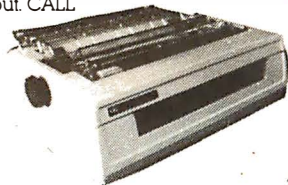
## CompuView Products Inc.

618 Louise, Ann Arbor, Michigan 48103 ● Telephone (313) 996-1299

# 10 DAY FREE RETURN

## NEC THE FIRST NAME IN LETTER QUALITY PRINTERS.

CompuMart offers beautiful print quality with NEC Spinwriter terminals. Both KSR and RO versions give unsurpassed hard copy output. CALL.



## CENTRONICS PRINTERS

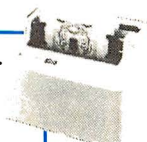
The incredible Model 737. The closest thing to letter quality print for under \$1,000.  
737-1 (Parallel Interface) — \$899.



## NEW FROM INTEGRAL DATA—THE IDS 560 PRINTER 132 column graphics printer. \$1,695

IDS 445. Priced lower than the 440 and equipped with a better print head. IDS 445 w/graphics \$894. IDS 445 w/o graphics \$795.

IDS 460 \$1,295  
The 460's features include. Correspondence quality printing, high resolution graphics capability, programmable print justification.



## Omni Printers from Texas Instruments

The 810 — List \$1895. **SALE! \$1795.**  
The 820 (Ro) Package — Includes machine-mounted paper tray and cable. A compressed print option and device forms control are standard features. \$2,155.  
The 820 (KSR) Package — Includes full ASCII Keyboard plus all of the features on the RO \$2,395.

**Dysan Diskettes** — Single side, Single density, Hard or Soft Sector \$5. ea.

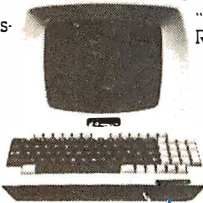
**Memorex 3401's** — 5 1/4 discs \$3.25 with hub ring for Apple \$3.50.

**Memory Integrated Circuits** — Call for qty. discounts when ordering over 50 units  
**Motorola 4116** (200 Nanosecond, Plastic) \$4.50 ea.  
**Fairchild 2114** (Standard Power, Plastic) \$4.50 ea.

**Super Selling Terminals**  
We have the following **Lear Siegler** Terminals in stock at prices too low to print — Call for quotes.

**ADM — 3A** Industries favorite dumb terminal for some very smart reasons.

**ADM — 3A + NEW** from Lear Siegler. CALL IT IS HERE! — It is the new Intermediate Terminal from Lear Siegler. Call for details



We have the following best-selling **Hazeltine terminals** in stock at prices much too low to print.

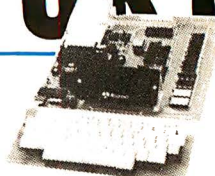
(1410, 1420, 1500, 1520, 1552)  
Call COMPU MART Now for our lowest prices ever.



## COMMODORE

COMPUMART has delivered more Commodore computers in the U.S. than any other dealer. Call us now for low prices and special deals. **NEW FOR PET.**

Visicalc (Need 32K & a disk drive) \$199. — Word Pro 1. \$29.95 — Word Pro 2. \$99.95 — Word Pro 3. \$199.95 — Word Pro 4. \$299.95.  
**Educators Take Note!** Commodore has extended its 3 for 2 deal until 6-30-81. This means that any educational institution which buys two Commodore computers will receive a third absolutely **FREE**. Call our sales department for complete details.



COMPUMART's Microflex 65 System for your AIM Includes. Adapter Buffer Module w/4-slot module stack, 8K RAM module, 16K PROM/ROM module, Asynchronous communications interface, and Power Supply \$1,299  
Call or write for our complete Microflex 65 brochure

## ROCKWELL AIM 65

Our AIM system includes: 4K AIM with BASIC interpreter assembler, Power Supply, Cassette recorder & Enclosure \$799.  
4K AIM-65 \$499.  
PL65 High Level Language \$125.  
Paper for the AIM (roll) \$2.50  
Rockwell's 4-slot Motherboard (sale) \$175.

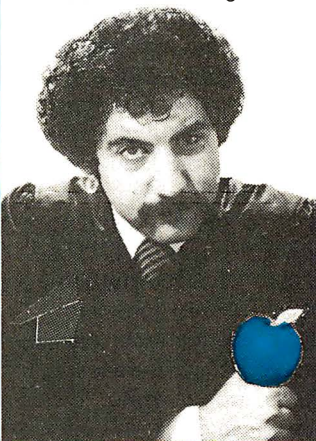
**NEW! The PMC-80.** The new computer that's software compatible with the TRS-80. Level II 16K at \$645.  
**ACCESSORIES FOR PMC — 80**  
EXP-100 S-100 Bus Expander \$410.  
Disk, Printer, RS232 I/O \$295.  
S-32K S-100 Bus 32K RAM Board for EXP-100 \$295.  
CAB-40 Cable 12" long ribbon cable for EXP-100 \$25.



Visit our giant

## ANN ARBOR STORE

1250 North Main Street  
Ann Arbor, Michigan



## SEND FOR OUR FREE CATALOG

COMPUMART stocks the complete line of **MATROX PRODUCTS**. Call for specs.

COMPUMART now offers the ENTIRE **DEC LSI-11** PRODUCT LINE. Call for prices & delivery.

**NOVATION CAT™ ACOUSTIC MODEM**  
Answer Originate, 300 Baud, Bell 108, Low Profile Design. \$179.00  
**NEW! D-CAT**  
Direct Coupler from Novation \$199.

**HP-41C Calculator** ..... \$239.00  
**Memory Modules.** For storing programs or up to 2000 lines of program memory \$29.95

"Extra Smart" Card Reader. Records programs and data back onto blank magcards. \$199.00

The Printer. Upper and Lower case. High resolution plotting. Portable Thermal operation. .... \$355.00  
Application Modules \$29.95

**NEW SUPER 41-C Systems** with Quad RAMS built-in. (Maximum memory on-board leaves slots open for Application Pacs and peripherals. The HP 41C-C \$325.00  
HP 41C-C Plus Card Reader \$495.00

HP 41C-C Plus Card Reader & Printer \$845.00  
Quad RAMS for the 41-C (Equivalent to four Memory Modules all packed into one) \$95.00



**EXCLUSIVE from CompuMart!**  
**Special Offer. Zenith Color Video Monitor for \$379!**

**NEW FROM SANYO** — Four Great Monitors at Low CompuMart Prices Sanyo's new line of CRT data display monitors are designed for the display of alphanumeric or graphic data.  
9" Sanyo Monitor \$169.  
12" Sanyo Monitor \$289.  
12" Sanyo Monitor with green screen \$299.  
13" Sanyo Color Display Monitor \$495.

## HP-85

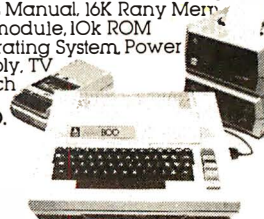
Hewlett-Packard's Personal Computer for Industry. This extremely portable computer features extended BASIC to solve your problems quickly and efficiently along with an advanced graphics system to enhance communication.

## HP-85 ACCESSORIES

We carry H.P. Peripherals (Disk Drives to Graphics Plotters) Enhancements (BASIC Training, General Statistics, Financial Decision, Math, Linear Programming \$95 ea.). HP-85 Accessories (Enhancement ROMs, ROM drawer, Overhead Transparency Kit), Supplies (Plotter Pens, Tape Cartridges), Interface Modules (HP-IB Interface, HP-IB Interconnect Cables, Serial (RS-232C) Interface Module). We can get you every HP peripheral made for the HP-85. **CALL FOR COMPLETE DETAILS & SPECS.**

## COMPUMART exclusive ATARI SPECIALS

ATARI 800 Personal Computer System — Comes with 800 operators Manual, 16K Rany Memory module, 10K ROM Operating System, Power Supply, TV Switch Box \$950.



## PERIPHERALS

Atari 410 Program Recorder \$89.95  
Atari 810 Disk Drive (\$100 off with purchase) \$699.95  
**NEW Dual Disk double density 825 Printer (Centronics 737) \$995.00**  
RS232 Interface w/Cable \$249.95  
**NEW! Light Pens \$74.95**  
**NEW! Visicalc for Atari \$199.00**  
**Educators Take Note.** Atari has extended its 3 for 2 deal until 6-30-81. Any educational institution that buys two Atari 800's will receive an Atari 400 computer absolutely **FREE**. Call our sales dept for complete details.

**IMPORTANT ORDERING INFORMATION** All orders must include 4% shipping and handling. Mass residents add 5% sales tax. Michigan residents 4% for sales tax. Phones open from 8:30 a.m. to 7:00 p.m., Mon-Fri; 11:00 a.m. to 4:00 p.m. Sat. P.O.'s accepted from Dun & Bradstreet rated companies — shipment contingent upon receipt of

signed purchase order. Sale prices valid for month of magazine date only — all prices subject to change without notice. Our Ann Arbor retail store is open 11:00 a.m. to 7:00 p.m. Tues-Fri, 10:00 a.m. to 5:00 p.m. Saturdays.

**APPLE II**

We carry the most complete inventory of Apple computers, peripherals, and software. **CALL! Our Best Selling Apple System. Save over \$250 on our most popular Apple System.** System includes a 48K Apple II, Apple Disk, DOS3.3, & Controller, and a Sup R. Mod RF Modulator.

List. \$212.00  
**COMPUMART Sale Price. \$1875.**

**SOFTWARE FROM APPLE**

Apple Plot. The perfect graphic complement for Visicalc. \$70  
Dow Jones News & Quotes \$95  
Adventure (Uses 48K) \$35  
DOS Tool Kit \$75  
Apple Fortran \$200  
Tax Planner \$120

**FROM PERSONAL software**

Visicalc \$149  
Desk Top Plan \$99  
NEW FROM MUSE  
The Voice \$39.95  
Super Text \$99.00  
Address Book \$49.95

**Miscellaneous Apple II**

**Accessories:**  
Easy Writer (80 col. need a Vindex) \$249  
Easy Mover \$49  
Easy Mailer \$69

**NEW from Apple for the Apple II.**

Dos 3.3 Convert disks to 16 sector format for 23% more storage and faster access \$60.

**NEW for the Apple II**

From MicroSoft  
16K RAM Board \$195.00  
FORTRAN \$175.00  
COBOL \$750.00  
Card Reader from Mountain Hardware \$1195.00  
Hi-Res Dump for 460 Printer from the Computer Station \$49.95

**HARDWARE ACCESSORIES FOR****APPLE**

Silentype Printer w/x face \$635  
Super Sound Generator (mono) \$159 (stereo) \$259  
Light Pen \$249  
X-IO Controller (plugs into parallel port) \$49

**Mountain Computer — Expansion accessories for your Apple**

Introl — IO System \$289  
Super Talker \$299  
The Music System \$545  
ROM plus board w/Keyboard filter \$199  
Clock Calendar \$280  
16 Channel A to D Converter \$350  
Apple Expansion Chassis \$650  
ROM Writer \$175

**From VIDEK—Video Term.**

80 Col. x 24 line, 7 x 9 Matrix plug in compatible board for the Apple II. Price \$325 without graphics EPROM. With graphics EPROM \$350.  
SSM. Serial & Parallel Apple Interface \$225  
ABT's Numeric Key Plan \$110  
California Microcomputer Keyboard \$195

**Apple III**

Space won't allow us to give you the details and specs on this already famous new computer. Call our expert sales force today for full details — they can answer any questions. We have **complete system packages in stock.** COMPUMART carries all **Apple III related software and hardware.** If you need an Apple III call COMPUMART now.



# Apple III In Stock Now for Immediate Shipment.

COMPUMART has been serving the computer needs of industry since 1971.

We stock, for immediate shipment, only those products from the finest micro-computer manufacturers.

And any product, except software, can be returned within 10 days for a full refund — even if you just change your mind.

We also honor all manufacturers' warranties. Our expert technicians will service any product we sell that cannot be better, or faster, serviced by the manufacturer's local service center.

Call us for more information on products, product configuration and service. Our phones are open Monday thru Friday, 8:30 a.m. to 7:00 p.m. and Saturday 11:00 a.m. to 4:00 p.m.



We have a staff of highly knowledgeable sales people waiting to hear from you, and to help.

Because service is what we're all about.

## 800-343-5504

In Mass. Call 617-491-2700

Circle 39 on inquiry card.



# COMPUMART

65 BENT STREET, DEPT. 114, P.O. BOX 568  
CAMBRIDGE, MA 02139

**Listing 3:** This procedure will transform the vertices of a polygon using a four-by-four matrix.

**Listing 4:** Distance and viewing angle transforms are determined by this procedure, which builds a transformation matrix based on the relationship between the coordinates of the eye-point and those of the center of interest.

*Listing 4 continued on page 72*

**Listing 2:** Procedure to display a three-dimensional object with surfaces defined as polygons.

```

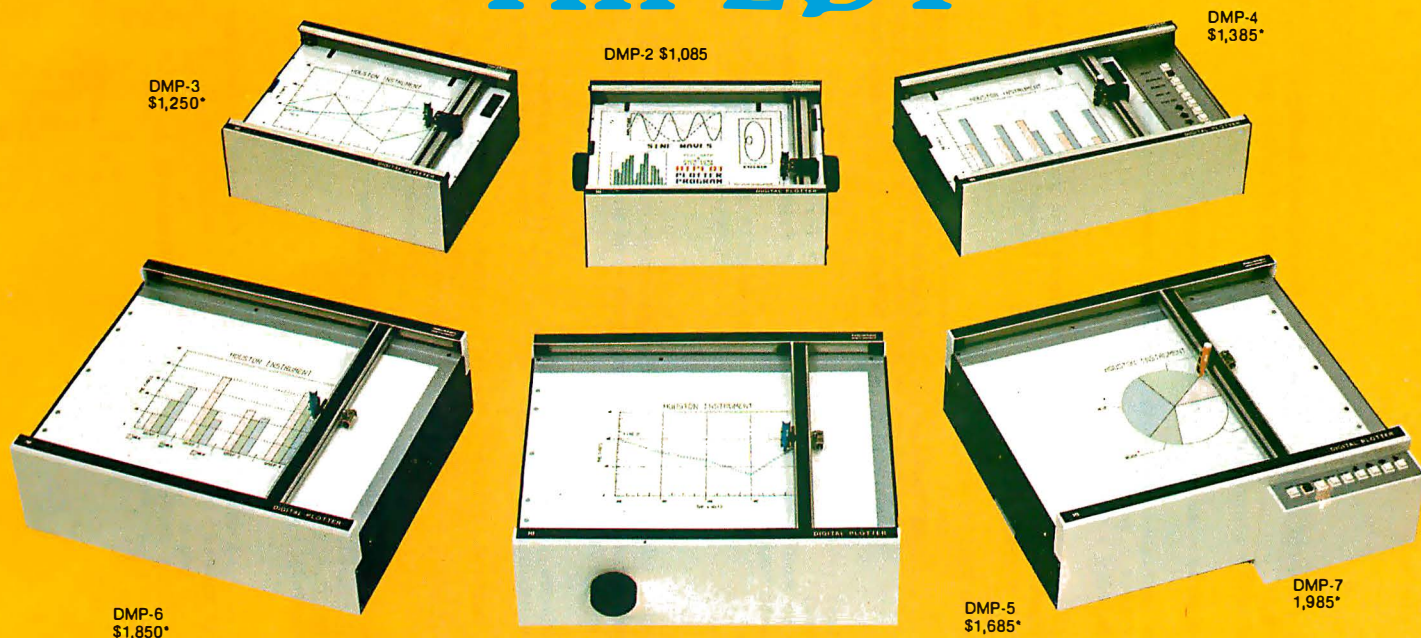
type
    Point = record X,Y,Z : real end;
    Polygon = record Start,polyVtces : integer end;

var
    Points : array [1..MaxPts] of Point;
    Polygons : array [1..MaxPolys] of Polygon;
    Vertices : array [1..MaxVtces] of integer;
    NumPts,NumVtces,I,J : integer;

procedure ReadObject( FileName : string );
begin
    reset(ObjFile,FileName);
    readln(ObjFile,NumPts,NumPolys);
    for I:=1 to NumPts do
        with Points[I] do
            readln(ObjFile,J,X,Y,Z);
    NumVtces := 0;
    for I:=1 to NumPolys do
        with Polygons[I] do
            (* initialize size of vertex array *)
            (* read in polygon descriptions *)

```

# Look what's happened to HIPLØT™



## It's grown into a complete family of quality low cost digital plotters

Yes, they are UL listed! \*\*

In just two short years, The HIPLØT has become the most popular digital plotter among small systems users. With a record like that, what can we do for an encore? WE'VE INTRODUCED A COMPLETE LINE OF HIPLØTS...with a model suited for just about every plotting application.

The HIPLØT DMP Series is a new family of digital plotters with both "standard" and "intelligent" models available with surface areas of 8½" x 11" (DIN A4) and 11" x 17" (DIN A3). For the user needing a basic reliable plotter, we have the "old standard" DMP-2 (8½" x 11") and the "new standard" DMP-5 (11" x 17"). For those needing a little more capability, there are the DMP-3 (8½" x 11") and the DMP-6 (11" x 17")—both

microprocessor controlled and providing easy remote positioning of the X and Y axes (perfect for the OEM). For those who want this intelligence plus the convenience of front panel electronic controls, we've provided the DMP-4 (8½" x 11") and the DMP-7 (11" x 17").

The "standard" plotters come complete with an RS-232-C and a parallel interface. The "intelligent" DMP plotters accept data from either an RS-232-C or Centronics data source. For the "standard" plotters, software is available from our ever expanding "Micrographic Users Group." The "intelligent" HIPLØTs use our exclusive DM/PL™ language which minimizes plot software to a fraction of that normally as-

Circle 40 for literature  
Circle 41 to have representative call  
sociated with digital plotting.

With the new DMP Series, high quality digital plotting can now be a part of your system. It just doesn't make sense to be without this valuable tool when there is a DMP plotter with the plot size, speed and capabilities that are exactly tailored to your specific needs...and your budget.

Prices for the DMP series range from \$1,085\* to \$1,985\*.

For complete information contact Houston Instrument. One Houston Square, Austin, Texas 78753. (512) 837-2820. For rush literature requests, outside Texas call toll free 1-800-531-5205. For technical information ask for operator #5. In Europe contact Houston Instrument, Rochester-laan 6, 8240 Gistel, Belgium. Telephone 059/27-74-45.

™ HIPLØT and DM/PL are Trademarks  
of Houston Instrument

**houston instrument**

GRAPHICS DIVISION OF

**BAUSCH & LOMB**



\*U.S. suggested retail prices only.  
\*\*DMP 2, 3 and 4 UL listed  
DMP 5, 6 and 7 UL listing pending

Listing 4 continued:

```

procedure MatrixMult( Mtl,Mt2 : Matrix; var Result : Matrix );
var
  I,J,K : counter;
begin
  for I:=1 to 4 do
    for J:=1 to 4 do
      begin
        Result[I,J] := 0.0;
        for K:=1 to 4 do
          Result[I,J] := Result[I,J] + Mtl[K,J]*Mt2[I,K];
        end;
      end;
    end;
  end;
  procedure Transform( Pt : Point; Mtx : Matrix; var NewPt : Point );
  begin
    NewPt.X := Pt.X*Mtx[1,1] + Pt.Y*Mtx[1,2] + Pt.Z*Mtx[1,3] + Mtx[1,4];
    NewPt.Y := Pt.X*Mtx[2,1] + Pt.Y*Mtx[2,2] + Pt.Z*Mtx[2,3] + Mtx[2,4];
    NewPt.Z := Pt.X*Mtx[3,1] + Pt.Y*Mtx[3,2] + Pt.Z*Mtx[3,3] + Mtx[3,4];
  end;
  (* Transform *)
  (* Eyespace Procedure body *)
  begin
    Ident(Eyespace);
    with EyePt do
      begin Eyespace[1,4]:=-X; Eyespace[2,4]:=-Y; Eyespace[3,4]:=-Z; end;
    Transform( CntrInt,Eyespace,C1 );
    (* translate ctr. of interest *)
    Ident(Mtx);
    with C1 do Hypotenuse := sqrt( X*X + Y*Y );
    if Hypotenuse > 0.0 then
      begin
        CosA := C1.Y / Hypotenuse; SinA := C2.X / Hypotenuse;
        Mtx[1,1] := CosA; Mtx[2,1] := SinA;
        Mtx[1,2] := -SinA; Mtx[2,2] := CosA;
        MatrixMult( Eyespace,Mtx,Eyespace );
      end;
    Transform( CntrInt,Eyespace,C2 );
    (* rotate ctr. of interest *)
    Ident(Mtx);
    with C2 do Hypotenuse := sqrt( Y*Y + Z*Z );
    if Hypotenuse > 0.0 then
      begin
        CosA := C2.Y / Hypotenuse; SinA := -C2.Z / Hypotenuse;
        Mtx[2,2] := CosA; Mtx[3,2] := SinA;
        Mtx[2,3] := -CosA; Mtx[3,3] := CosA;
        MatrixMult( Eyespace,Mtx,Eyespace );
      end;
    end;
  end;
  (* load switch between Y and Z axes *)
  Ident( Mtx );
  Mtx[2,2] := 0.0; Mtx[3,3] := 0.0;
  Mtx[2,3] := 1.0; Mtx[3,2] := 1.0;
  MatrixMult( Eyespace,Mtx,Eyespace );
end;
  (* GetEyespace *)

```

Listing 5: The field of vision for a three-dimensional display is bounded by "clipping planes," the coefficients of which are calculated in this procedure.

```

type
  OnePoly = array [1..MaxSides] of Point;

procedure GetPlanes( var Poly : OnePoly; NumPts : integer );
var
  I,LstI : integer;
  TmpPoly : OnePoly;
begin
  (* get plane equation coefficients for polygon edges *)
  LstI := NumPts;
  for I:=1 to NumPts do
    begin
      with Poly[I] do
        begin
          TmpPoly[I].X := Y * Poly[LstI].Z - Z * Poly[LstI].Y;
          TmpPoly[I].Y := Z * Poly[LstI].X - X * Poly[LstI].Z;
          TmpPoly[I].Z := X * Poly[LstI].Y - Y * Poly[LstI].X;
        end;
      LstI := I;
    end;
  end;
  for I:=1 to NumPts do
    with TmpPoly[I] do
      begin Poly[I].Y := Y; Poly[I].Z := Z; end;
    end;
  end;
  (* copy back to input polygon *)
  (* GetPlanes *)

```

Listing 6: Procedure to determine if any vertices of a polygon lie outside previously defined clipping planes; if this is so, the polygon is modified accordingly.

```

var
  Window : OnePoly
  WindowSize : integer;
  (* clipping window *)
  (* number of edges in clip window *)

function DotProd( Pt1,Pt2 : Point ) : real;
begin
  DotProd := Pt1.X * Pt2.X + Pt1.Y * Pt2.Y + Pt1.Z * Pt2.Z;
end;
  (* vector dot-product *)
  (* DotProd *)

procedure ClipIn(var Poly : OnePoly; var NumPts : counter);
var
  I,J,LstJ,TmpPts : counter;
  D1,D2,A : real;
  TmpPoly : OnePoly;
begin
  for I:=1 to WindowSize do
    if NumPts > 0 then
      begin
        D1 := DotProd( Poly[NumPts],Window[I] );
        LstJ := NumPts;

```

Listing 6 continued on page 74

# STOP PLAYING GAMES AND GET DOWN TO BUSINESS

## Corvus Transforms the Personal Computer into a Powerful Business Tool.

In business, professional offices, and schools throughout the world, thousands of Corvus intelligent peripherals bring mass storage, increased speed, and multi-user capability to a variety of microcomputers. Current applications include accounts receivable and payable, medical records, mailing lists, inventories, word processing, insurance, mathematics and science, and other large and complex files.

Corvus proven Winchester disk technology provides 10 to 80 million bytes of capacity, fully compatible with your current operating system. This is up to 500 times the capacity of a floppy disk.

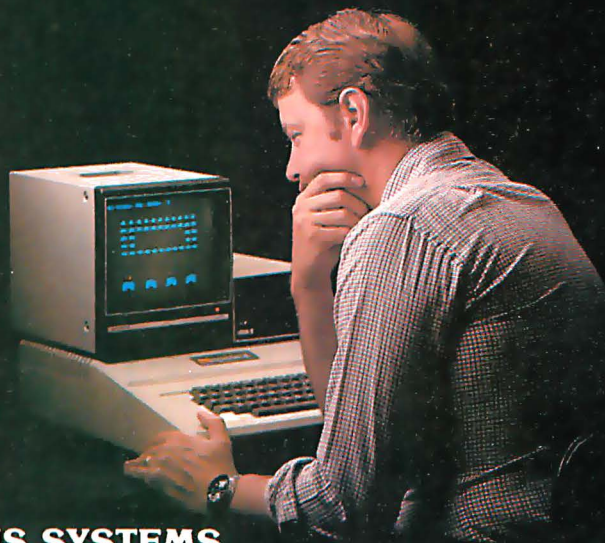
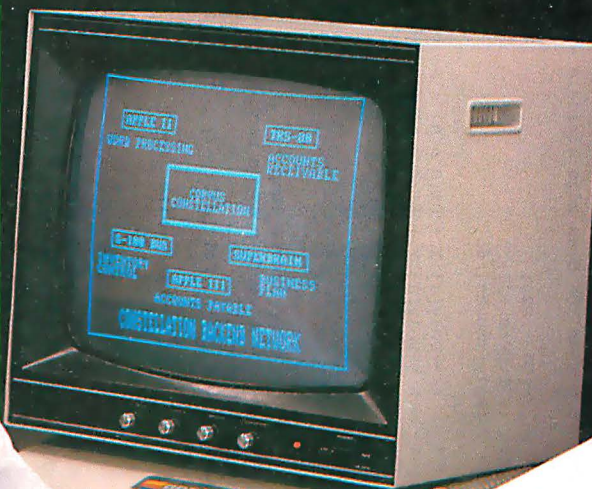
The Corvus CONSTELLATION links up to 64 computers in a state-of-the-art multi-processor network. It provides shared mass storage, pipes for inter-computer communication, and system spooling for sharing of peripherals such as printers. Performance far exceeds that of larger and more expensive networks.

Backup data protection and archival storage are provided by the Corvus MIRROR (Patent Pending), a low-cost backup using standard video cassette recorders.

Contact your local Corvus dealer for the full story about these innovative new products.

### ★ ★ CORVUS SYSTEMS

★ 2029 O'Toole Avenue  
★ San Jose, California 95131  
(408) 946-7700/TWX 910-338-0226



```

TmpPts := 0;
for J:=1 to NumPts do
  begin
    if D1 < 0.0 then (* is leading vertex inside? *)
      begin
        TmpPts := TmpPts + 1;
        with TmpPoly[TmpPts] do
          begin
            (* copy leading vertex *)
            X:=Poly[LstJ].X; Y:=Poly[LstJ].Y; Z:=Poly[LstJ].Z;
          end;
        end;
      end;
    end;
  end;
  (* if leading vertex inside *)

  D2 := DotProd( Poly[J], Window[I] );
  if D1 * D2 < 0.0 then (* does edge straddle window? *)
    begin
      A := D1 / (D1 - D2);
      TmpPts := TmpPts + 1;
      with TmpPoly[TmpPts] do
        begin
          X := A * Poly[J].X + (1.0 - A) * Poly[LstJ].X;
          Y := A * Poly[J].Y + (1.0 - A) * Poly[LstJ].Y;
          Z := A * Poly[J].Z + (1.0 - A) * Poly[LstJ].Z;
        end;
      end;
    end;
  end;
  ListJ := J;
  D1 := D2;
  end;
  (* NumPts loop *)
  (* copy polygon back to input *)
  for J:=1 to TmpPts do
    with TmpPoly[J] do
      begin Poly[J].X:=X; Poly[J].Y:=Y; Poly[J].Z:=Z; end;
    end;
  end;
  NumPts := TmpPts;
end;
(* WindowSize loop *)
(* Clipin *)

```

**Listing 7:** This procedure achieves a perspective effect by dividing the x and y coordinates of each vertex by the z coordinate.

```

procedure MakeDisplayable( var Pt : Point );
begin
  Pt.X := Scale.X * Pt.X / Pt.Z + Middl.X;
  Pt.Y := Scale.Y * Pt.Y / Pt.Z + Middl.Y;
end;

Listing 8: This Pascal function determines whether or not a
polygon will be hidden by another part of the same surface in a
three-dimensional display.

function FacesEye( Poly : OnePoly ) : boolean;
var
  TmpPt : Point;
  TmpPoly : OnePoly;
begin
  with Poly[2] do
    begin TmpPt.X:=X; TmpPt.Y:=Y; TmpPt.Z:=Z; end;
    (* make copy of second vertex *)
    (* directed vector from second to *)
    (* first vertex *)
    TmpPoly[1].X := Poly[1].X - Poly[2].X;

```

```

    TmpPoly[1].Y := Poly[1].Y - Poly[2].Y;
    TmpPoly[1].Z := Poly[1].Z - Poly[2].Z;
    (* third vertex *)
    TmpPoly[2].X := Poly[3].X - Poly[2].X;
    TmpPoly[2].Y := Poly[3].Y - Poly[2].Y;
    TmpPoly[2].Z := Poly[3].Z - Poly[2].Z;
    GetPlanes( TmpPoly, 2 ); (* get plane coefficients *)
    if DotProd( TmpPt, TmpPoly[1] ) = 0.0
    then FacesEye := false
    else FacesEye := true;
  end;
  (* FacesEye *)

Listing 9: Based on the average value of their z coordinates,
polygons are sorted by their distance from the eyepoint in this
binary insertion sort procedure.

var
  OutVtces : array [1..MaxVtces] of Point;
  OutPolys : array [1..MaxPolys] of Polygon;
  NumDisplay, NumVtxOut : integer; (* # polygons, # vertices *)

procedure InsertSort( Poly : OnePoly ; NumPts : integer );
var
  I,J,K : integer;
  AvDepth : real;
begin
  (* binary-insertion sort on average *)
  (* depth *)
  AvDepth := 0.0;
  for I:=1 to NumPts do
    with Poly[I] do
      begin
        OutVtces[NumVtxOut + I + 1].X := X;
        OutVtces[NumVtxOut + I + 1].Y := Y;
        OutVtces[NumVtxOut + I + 1].Z := Z;
        AvDepth := AvDepth + Z; (* sum depths *)
      end;
    end;
  end;
  AvDepth := AvDepth / NumPts;
  OutVtces[NumVtxOut + 1].Z := AvDepth; (* divide for average *)
  (* store vertices and find average *)
  (* depth *)
  J := 0;
  I := (NumDisplay + 1) div 2;
  K := NumDisplay;
  while (J < I) do
    if AvDepth < OutVtces[OutPolys[I].Start].Z
    then begin K := I; I := (I + J) div 2; end
    else begin J := I; I := (I + K + 1) div 2; end
  for J:=NumDisplay downto I+1 do
    begin
      OutPolys[J + 1].Start := OutPolys[J].Start;
      OutPolys[J + 1].NumVtx := OutPolys[J].NumVtx;
    end;
    OutPolys[I + 1].Start := NumVtxOut + 1; (* store new entry *)
    OutPolys[I + 1].NumVtx := NumPts;
    NumVtxOut := NumVtxOut + NumPts + 1; (* vertex count *)
    NumDisplay := NumDisplay + 1; (* polygons stored *)
  end;
  (* InsertSort *)

```

# GRAND OPENING

**SYNCHRO-SOUND ENTERPRISES  
ANNOUNCES OUR**

## **NEW MICRO-COMPUTER SYSTEMS CENTER**

We are one of the oldest, most experienced, highly dedicated  
micro-computer systems houses in the metropolitan New York area...  
the **ORIGINAL** Computer People who **KNOW** computers and offer  
you **EVERYTHING** you need in small computer systems.

**FEATURING  
CROMEMCO  
SYSTEMS**

**System 3  
System Z2H  
System Zero**

**Business application  
software available.  
Word Processing.  
Multi-tasking,  
multi-user.  
High performance  
Low Price**



Call, write or stop in  
...compare Price,  
Quality, Delivery,  
Service and you'll  
see why you don't  
have to look  
anyplace else!



**SYNCHRO-SOUND**  
ENTERPRISES, INC. THE COMPUTER PEOPLE

125 MINEOLA AVENUE, PEOPLE  
ROSLYN HEIGHTS, N.Y. 11577

516-484-1852 • PHONE ORDERS: TOLL FREE 800-221-2320

WE CARRY  
A FULL LINE OF:  
ADDS, QUME, TELETYPE,  
CROMEMCO, LEAR SIEGLER,  
SCOTCH, MAXELL, VERBATIM,  
ALPHA-MICRO, ATARI,  
TELEVIDEO, NORTHSTAR,  
INTEGRAL DATA, LIVERMORE,  
COUPLERS, HAZELTINE, TEXAS  
INSTRUMENTS, DIGITAL MICRO  
SYSTEMS AND OTHERS.

**VISIT OUR SHOWROOM  
WORKING MODELS ON DISPLAY**

**HOURS DAILY AND  
SATURDAY 10-4**

Bank Americard Master Charge



## 16K computer

DISK with CONTROLLER  
NEW DOS 3.3 \$535  
without . . . \$446  
Nearly Everything  
for Apple

APPLE II 48K

\$1199

\$1099



**WE WILL BEAT  
ANY ADVERTISED PRICES  
ON MOST ITEMS IF MERCHANDISE  
IN STOCK**

### APPLE SOFTWARE

Adventure by Microsoft . . . . .	29	DOS 3.3 Upgrade . . . . .	49
Apple Bowl . . . . .	19	Dow Jones Portfolio Evaluator . . . . .	45
Apple Stellar Invaders . . . . .	19	Fastgammon . . . . .	23
Assembler/Disassembler . . . . .	69	Forth II by Programma . . . . .	45
Applebug Debugger . . . . .	29	Fortran for Language Sys. . . . .	159
AppleGraph & Plot Sys. . . . .	59	Head-on . . . . .	25
Applepost Mailing List Sys. . . . .	44	Integer Basic Cassette Demos . . . . .	29
Applesoft Cassette Demos . . . . .	29	PASCAL Language Sys. . . . .	459
Applesoft Util. Prog. — Hayden . . . . .	29	Sargon II Chess Game disk . . . . .	34
Applewriter Word Processor . . . . .	65	Shell Games . . . . .	29
Asteroids in Space . . . . .	19	Single Disk Copy Routines . . . . .	29
Autostart ROM Pkg. . . . .	59	Space Invader . . . . .	25
Battleship Commander . . . . .	19	Star Cruiser . . . . .	24
Bill Budes Space Game Album . . . . .	39	Stellar Trek . . . . .	23
Bill Budes 3-D Graphics/Tool . . . . .	39	Sub-Logic FS-1 Flt. Sim./disk . . . . .	34
Bill Budes Trilogy of Games . . . . .	29	Sybex Apple-80 8080 Sim. . . . .	19
Cashier Retail Mgmt. Sys. . . . .	199	Tax Planner . . . . .	99
Checkbook Cassette . . . . .	19	The Correspondent . . . . .	35
Contrib. Vols. 1-5 w/man. . . . .	29	Tranquility Base . . . . .	24
Controller Bus. Pkg. . . . .	514	Visicalc by Personal Sftwe. . . . .	119
Cosmos Mission/Disk . . . . .	25	Complete Peachtree Business Package for Apple	
CCA Data Mgmt. Sftwe. . . . .	84		
3-D Animation Pack . . . . .	55		
Desktop Plan Sftwe. . . . .	79		
DOS Tool Kit . . . . .	65		

**AND MUCH MORE . . .**

### APPLE COMPUTER INTERFACE CARDS

HiSpeed Serial Int. 7710A . . . . .	145
Applesoft II Firmware Cd. . . . .	149
Centronics Interface Cd. . . . .	179
Apple Clock/Calendar Cd. . . . .	
by Mtn. Comp. . . . .	225
Comm. Cd. & DB25 Cable . . . . .	179
Integer Basic Firmware Cd. . . . .	149
Parallel Printer Cd. . . . .	139
CCS Parallel Print Cd. 7720A . . . . .	155
ROMPLUS w/keyboard filter . . . . .	165
ROMPLUS (keyboard filter extra) . . . . .	159
SSM AIO Serial/Parallel I/O Assembled & Tested . . . . .	189
Serial Interface Cd. . . . .	139

### ACCESSORIES

Apple Joystick . . . . .	47
ABT Numer. Input Keyboard A or B . . . . .	114
A/D D/A Board by Mtn. Comp. . . . .	319
Arith. Processor 7811 A or B . . . . .	339
Clear Cover for Apple Computer . . . . .	25
COPYROM by Mtn. Comp. . . . .	51
Corvus 10MByte Disk w/pwr. supp. . . . .	4395
Dan Paymar L.C. Kit 1 or 2 . . . . .	59
Extender Board . . . . .	27
GPIO by CCS model 7490A . . . . .	259
Graphics Input Tablet . . . . .	649
Hayes Micromodem* . . . . .	319
Introl X-10 Remote Control Sys. . . . .	239
Introl X-10 Controller Only . . . . .	169
M&R Sup-R-Term 80 column board . . . . .	329
Microsoft Z-80 Soft Card . . . . .	295
Novation Cat Modem . . . . .	159
Programmable Timer CCS 7440A . . . . .	159
Prototyping Hobby Card . . . . .	22
ROMWRITER by Mtn. Comp. . . . .	149
Speechlink 2000/64 Word Vocab. . . . .	215
SuperTalker Speech Synthesizer . . . . .	239
Symtec Light Pen . . . . .	214
Versa-Writer Digitizer Drawing System . . . . .	209
Videx Videoterm . . . . .	279



**CALL 1-800-854-2833  
PHONE ORDERS  
MON. - SAT. 8 to 6 P.S.T.**

AUTHORIZED  
APPLE  
SALES &  
SERVICE

**COMPUTER**



**SPECIALTIES**

DIV. OF  
COMPUTER  
METRICS  
INC.

"BEST PRINTER VALUE IN THE WORLD"  
Check our prices on THE ULTIMATE IN QUALITY

# Epson Printers

APPLE & MOST OTHER COMPUTERS

NEW! MX80  
40, 80, 132 columns

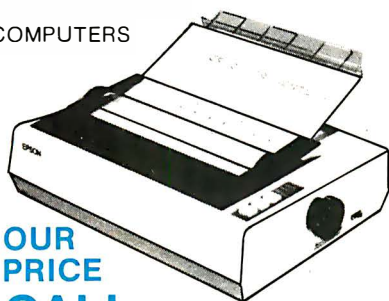
LIST ~~\$645~~

TX 80 w/Graphics

LIST ~~\$799~~

Apple Controller & Card  
& Cable

LIST ~~\$110~~



**OUR  
PRICE  
CALL**

- Most reliable small printers ever sold!
- Uses standard printed paper.
- Graphics option transfers screen image directly to paper.



**ATARI 800**  
PERSONAL COMPUTER SYSTEM

**\$737**

IF  
  
**ATARI®**  
MAKES  
IT, WE  
SELL IT

Assembler/Editor .....	45
Atari 400 Computer .....	439
Atari 820 Printer .....	429
Atari 810 Disk Drive .....	499
Atari 410 Program Recorder .....	69
Atari 16K RAM Module .....	149
Atari Basic ROM .....	45
Atari Visicalc .....	129
Basketball .....	30
Video Easel .....	30
Super Breakout .....	30
Music Composer .....	45
Computer Chess .....	30
Star Raiders .....	39
3D Tic-Tac-Toe .....	30
Joystick .....	19
Space Invaders .....	19

## PRINTERS, MONITORS, DISCS

Anadex DP8000 .....	795	Paper Tiger 440 w/Graphics .....	895	Dysan disks (pkg. 10) .....	50
Anadex DP8000AP .....	795	Paper Tiger 460 w/Graphics .....	1195	Memorex disks (pkg. 10) .....	40
Color Monitor .....	375	Silentype w/interface Cd. ....	510	Opus disks (pkg. 10) .....	35
Daisy Wheel Printer .....	1795	Sanyo 9" B&W .....	169	Televideo 912C .....	699
MPI 88T .....	595	Sanyo 15" B&W .....	259	Televideo 920C .....	749
NEC Spinwriter #5510 .....	2595	NEC Green Screen 12" .....	239	Verbatim disks (pkg. 10) .....	30

**LEEDEX VIDEO 100**  
**12" Black & White \$119**

**\* MONTHLY SPECIALS \***

**CENTRONICS 737**  
cable extra **\$737**

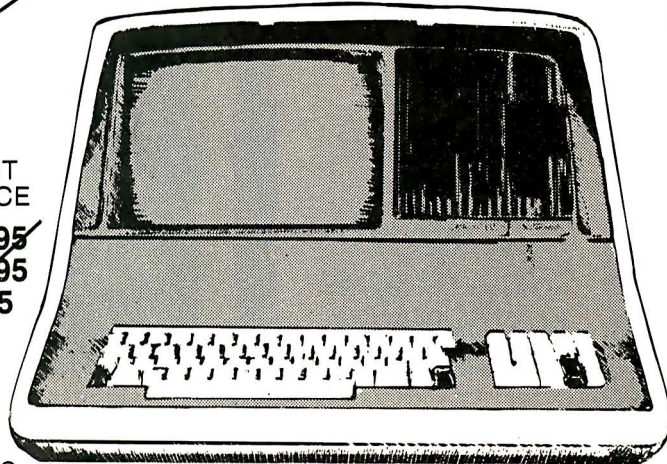
THE  
POPULAR  
INTERTEC

**SUPERBRAIN**

LIST  
PRICE

32K Double Density ~~2995~~  
64K Double Density ~~3495~~  
64K Quad. Density ~~3995~~

**OUR PRICE CALL**



LARGE STOCK OF SOFTWARE & ACCESSORIES



TO ORDER: Phone orders invited using Visa, Mastercard, or bank wire transfers. Visa & MC credit card service charge of 2%. Mail orders may send charge card number (include expiration date), cashiers check, money order, or personal check (allow 10 business days for checks to clear). Please include phone number. Include 3% (\$5.00 minimum) shipping, handling, and insurance in USA. Shipments within Calif. add 6% sales Tax. Foreign orders include 1% handling — shipped freight collect. Foreign orders over \$1000 allow 3 weeks extra and include \$25 license fee. All equipment is in factory cartons with the manufacturers warranty. Equipment is subject to price change and availability. We ship the same day on most orders. No C.O.D.s accepted. Retail store prices differ from mail order prices.



**(714) 579-0330 • MAIL TO: 1251 BROADWAY, EL CAJON, CA. 92021**

Circle 43 on inquiry card.

AUTHORIZED  
APPLE  
SALES &  
SERVICE

**COMPUTER**

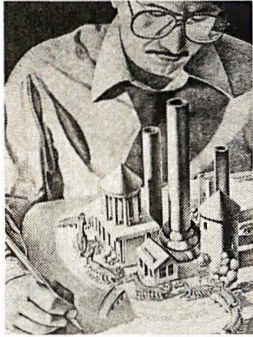


**SPECIALTIES**

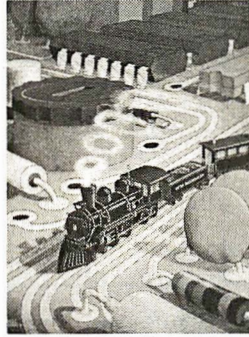
DIV OF  
COMPUTER  
METRICS  
INC.

# COLLECTOR EDITION BYTE COVERS

#1



#5



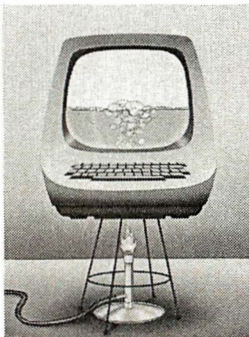
#2



#6



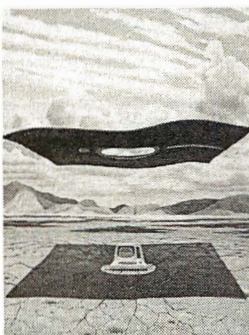
#3



#7



#4



#8



The Byte Covers shown at left are available as Collector Edition Prints. Each full color print is:

- 11" X 14" including a 1½" border.
- Part of an edition strictly limited to only 100 prints.
- Personally inspected, signed and numbered by the artist, Robert Tinney.
- Accompanied by a Certificate of Authenticity.
- Carefully packed and shipped first class.
- Priced at \$20, plus \$3 (\$6 overseas) for postage and handling. If Set 1-4 or Set 5-8 is ordered, the price for all 4 prints is only \$70.

To order, use the coupon below. Visa or MasterCard orders may call Toll Free.

Please send me the following Collector Edition Byte Covers and Certificates of Authenticity.

Qty.	Cover	Amount
___	#1-7 Bridges of Konigsberg	\$20
___	#2-Fun and Games	\$20
___	#3-Homebrew	\$20
___	#4-Software Mirage	\$20
___	#5-Computer Engineering	\$20
___	#6-Total Eclipse	\$20
___	#7-Computer Hardware	\$20
___	#8-Perspectives	\$20
___	No.'s 1-4	\$70
___	No.'s 5-8	\$70

Post. & hand. (\$3 in US, \$6 overseas) \$

Total \$

☐ I have enclosed check or money order

☐ Visa ☐ MasterCard

Card #

Expiration Date

Send my print(s) to:

Name

Address

City

State Zip

Mail this coupon to:

**robert tinney graphics**

1864 N. Pamela Dr.  
Baton Rouge, LA  
70815

FOR VISA OR MASTERCARD ORDERS  
**CALL TOLL FREE!**

**1-800-854-0562 / Ext. 910**

Calif.: 1-800-432-7257/Ext. 910

**24 HOURS A DAY! 7 DAYS A WEEK!**

# CRYSTALWARE

## Let Crystal Be Your Guide on the Road to Adventure



If you are the owner of an Apple, Pet, Atari, or TRS-80 and also have a disk drive, we have some of the finest fantasy software in the world for you. For those systems with sound capability, our games have Crystalsonics — a newly developed concept in tone generation. For Apple and Atari there are some truly superlative hires graphics. In fact, Sands of Mars offers 3-D graphics and flight simulation landing. It includes over 186 full screen hires maps of Martian terrain.

\*\*\*\*\*

We now serve over 30 countries around the world. Dealership and distributor inquiries are welcome. Special rates are available on larger orders. We have 48 hours delivery to anywhere in the continental United States. We are also looking for experienced programmers and new game software. Our royalty terms are extremely generous. If you have what you consider to be a quality product that you would like to have marketed please give us a call. If you would like to be a member of the Crystal User's Club and be eligible to receive free user contributed software, please submit a program of any type and a \$10.00 membership fee. In return you will receive a Crystal Membership Card, a copy of The House of Usher, and a year's subscription to Crystal Vision.

**HOUSE OF USHER** — Wander through a haunted house. Rooms and scenery in 15 color lo-res graphics. We offer a \$100.00 prize to the first person to solve the mystery. Over 200 monsters, objects and perils. **\$24.95**

**GALACTIC QUEST** — Crystalsonics - hires graphics - the ultimate space adventure. Vegan warships attack and fire in real time simulation. Land on and trade with over 64 star systems in 3 galaxies. Allow 6-12 hours for play. **\$29.95**

**SUMER** — Travel back through time to ancient Sumeria in the middle east. You are given 10 years as king to restore this kingdom to prosperity. Plant, war, consult the astrologers - very hard to beat! **\$19.95**

**LITTLE CRYSTAL** — Especially designed anthology for children from ages 5 to 80. Includes Mr. Music which turns your Apple into an organ of sorts, gunk where two weird monsters shoot it out and many other educational as well as entertaining programs for children. True unique addition for kids who always feel left out of Dad or Mom's computerizing. **\$39.95**

**SANDS OF MARS** — What we at Crystal believe to be the finest adventure game available to date. In addition to hires graphics and super tone routines where the user's system will support it, this game provides landing simulation, animation, and revolutionary 3-D graphics. It is the ultimate in space adventure and may take several weeks or months to play. It is the Odyssey of the Starship Herman on its maiden flight to Mars. The initial lift-off is animated and paddle controlled. The flight through space is in Hires 3-D Graphics with many animated scenarios. You must land your starship on Mars. It will lack enough fuel and supplies for a return voyage. You must lead your party through hundreds of Hires maps of Martian terrain and subterranean passages. You then will secure adequate resources for take off, navigate your ship back to earth and attempt a successful touchdown. There is a mystery buried in the ancient city of Lemuria beneath the sands of Mars. We offer a \$100.00 prize to the first space gamer to discover it. Good luck! **\$39.95**

**LASAR WARS** — Crystalsonics - hires graphics - protect the planet earth from a full scale alien invasion. Over three types of invading craft and hundreds of approach simulations. The games speaks for itself. **\$29.95**

**WORLD WAR III** — Crystalsonics - hires graphics - for you war game freaks, this is it! Iran and Iraq - nuclear missiles - hires 3 scene battlefield - demolition squads - tanks - strategy. Custom designed for two arm chair generals. Save the world from nuclear holocaust! **\$29.95**

**BENEATH THE PYRAMID** — Crystalsonics - hires graphics - brand new! Explore the pyramids and miles of winding secret tunnels beneath them. Enter at the Sphinx and find the hidden treasure chamber. All in hires with very aggressive monsters and many many perils. To win you must find the golden cat and your way out!!! **\$29.95**

For more information you may write or call:  
Crystal Computer, 12215 Murphy Avenue, San Martin, California 95046 (408) 683-0696

Circle 44 on Inquiry card.

**Listing 10:** Once sorted, polygons are checked to determine if a polygon closer to the eyepoint hides all or part of one that is farther away.

```

procedure ClipOut( Poly : OnePoly; var NumPts : integer; Place : integer );
var
  I, LstI, NumDrawn : integer;
  Pt1, Pt2 : Point;
  Drawn : boolean;

begin
  I := I - 1;
  until out or ( I = Start );
end
else begin
  (* count down for next edge *)
  (* all visible or edges exhausted *)
  (* reached end of list of closer
  (* polygons, display *)
  MakeDisplayable( Pt1 ); Make Displayable( Pt2 );
  MoveTo( Pt1.X, Pt1.Y ); DrawTo( Pt2.X, Pt2.Y );
  Drawn := true;
  (* mark as displayed *)
end;
(* ClipAfter *)
end;

(* ClipOut procedure body *)
begin
  NumDrawn := 0;
  LstI := NumPts do
  for I:=1 to NumPts do
    begin
      (* get endpoints for edge *)
      with Poly[LstI] do begin Pt1.X := X; Pt1.Y := Y; Pt1.Z := Z; end;
      with Poly[I] do begin Pt2.X := X; Pt2.Y := Y; Pt2.Z := Z; end;
      Drawn := false;
      ClipAfter( 1, Pt1, Pt2 );
      if Drawn then NumDrawn := NumDrawn + 1;
      LstI := I;
    end;
  end;
  if NumDrawn = 0 then NumPts := 0;
  (* mark as hidden if nothing drawn *)
  (* ClipOut *)
end;

(* recursively check polygons for *)
(* overlap with input edge *)
(* is polygon closer than edge in*)
(* sorted list? *)
begin
  D1 := DotProd( Pt1, OutVtx );
  D2 := DotProd( Pt2, OutVtx );
  if ( D1 = 0.0 ) and ( D2 = 0.0 )
  then begin
    Out := true;
    ClipAfter( Index + I, Pt1, Pt2 ); (* try next one *)
  end
  else if D1 < D2
  then begin
    A := D1 / (D1 - D2); (* one point visible *)
    Pt3.X := A * Pt2.X + ( 1.0 - A ) * Pt1.X;
    Pt3.Y := A * Pt2.Y + ( 1.0 - A ) * Pt1.Y;
    Pt3.Z := A * Pt2.Z + ( 1.0 - A ) * Pt1.Z;
    if D1 < 0.0
    then begin (* Pt1 visible, try next one *)
      ClipAfter( Index+1, Pt1, Pt3 );
      with Pt3 do (* go on with hidden part *)
        begin Pt1.X:=X; Pt1.Y:=Y; Pt2.Z:=Z; end;
      end
    else begin (* Pt2 visible, try next one *)
      ClipAfter( Index + 1, Pt3, Pt2 );
      with Pt3 do (* go on with hidden part *)
        begin Pt2.X:=X; Pt2.Y:=Y; Pt2.Z:=Z; end;
      end;
    end;
  end;
  (* one point visible *)
end;

```



# Suddenly Radio Shack's New TRS-80<sup>TM</sup> Color Computer is Even Better!

**New Extended Color BASIC.** Here's an advanced TRS-80 Color Computer that includes a 16K ROM Extended BASIC with advanced graphics, eight brilliant colors, and sound, for an unprecedented low price! You can draw fine lines, circles, rectangles, boxes and more with easy-to-use one-line commands. Four graphic modes with two color sets allow up to 49,152 programmable screen points (pixels). There are 255 separate tones for music or sound effects. All this on a 16K RAM machine (including video memory) loaded with the dynamic features a serious programmer demands. You get a 32x16 screen, multi-character variable names (two significant), editing, tracing, user-definable keys, 255-character string arrays, floating point 9-digit accuracy, and even machine language routines.

**Priced at Only \$599**, the TRS-80 Extended Color BASIC Computer is useful, entertaining and educational. Yet using it can be as simple as plugging in one of Radio Shack's instant-loading Program Paks. Come in and see what's already available. The computer attaches to your TV, or our own \$399 TRS-80 Color Video Receiver. For just \$24.95, you can add a pair of joysticks which add flexibility to games and video displays. A built-in serial interface lets you attach a printer or a modem. A tutorial Color BASIC instruction manual is included, of course.

**More Good News.** Extended Color BASIC is also available as an upgrade kit (\$99) for the 4K Color Computer (16K RAM required — \$119). There's a modest installation charge for each kit.



## NEW

**A Low-Cost, Direct-Connect Modem.** A convenient alternative to an acoustic coupler. The TRS-80 Modem I lets you enter the world of microcomputer communication for only \$149. Cable extra.

**Specifications.** Low-Power CMOS Circuitry. Full duplex. 300/600 baud. 103 compatible ANS/ORIG. Sensitivity: -48 dB/-43 dB. Connectors: DB25/4-pin DIN; includes interface for Model I cassette port. FCC approved.

**New TRS-80 VIDEOTEX Software** (with the modem shown below) offers Color Computer owners quick, affordable access to many kinds of information and data services. For example, our exclusive agreement with CompuServe<sup>®</sup> Information Service gets you local, national and international news, weather and sports from 11 area newspapers and the Associated Press News Service; information on over 32,000 stocks and bonds; an educational reference service; entertainment news and reviews; nationwide Electronic Mail with other users; and much more! You'll also access Dow Jones Information Services for Wall Street news, stock quotes and more.

**Only \$29.95 Buys Your VIDEOTEX Software** including a free hour on both CompuServe and Dow Jones, plus operator's manuals. Come see the new TRS-80 Color Computer, its programs and accessories, at one of our 6000 outlets today!



# Radio Shack<sup>®</sup>

A DIVISION OF TANDY CORPORATION

6000 STORES, 120 COMPUTER CENTERS AND 130 SERVICE CENTERS NATIONWIDE

Text continued from page 66:

Once the polygons are sorted, we can apply a clipping algorithm in a reversed sense. We will remove any parts of polygons lying inside a closer polygon as seen on the display. Starting with the closest polygon and working outward, each polygon will be clipped by all its predecessors. Remember, keeping things simple will require that polygons be convex. (Nonconvex polygons can always be broken into a set of convex ones.)

In order to use a polygon for clipping, its edges must be converted to clipping planes. Therefore, once any part of a polygon is determined to be visible, the entire polygon is subsequently converted to plane coefficients using the same procedure used earlier to convert the window description for clipping.

Since each polygon edge, once clipped, can be displayed without further treatment, it is easiest to clip each edge individually. This process is not as straightforward as it may seem. A polygon may clip an edge into two parts, each of which must then be subsequently clipped by the remaining polygons. Of course, any of the later polygons may further divide one of the edge fragments. This sort of situation is best handled using recursion. Therefore, the procedure given in listing 10 recursively clips a polygon by all closer polygons and flags visible polygons for use in subsequent clipping. Hidden polygons obviously need not be used to clip more distant polygons.

## Conclusion

The preceding procedures provide essentially

everything needed to display three-dimensional line drawings representing solid objects modeled by polygons. An effort has been made to make the procedures concise. This has been done at the expense of efficiency and sometimes, perhaps, even at the expense of clarity. I have assumed the availability of a display of some kind that can be used to draw lines. Most systems capable of full graphics provide software for generating lines.

In the interests of completeness, Part 2 will present a complete program incorporating the procedures described above. I have been able to use it, somewhat crudely, with a semigraphic terminal (Zenith H-19) and the UCSD Pascal system (see photo 2) and, more satisfyingly, with a 500-line raster display and a Pascal interpreter running under the UNIX operating system (see photos 1, 3, and 4; photos are on pages 54 and 56).

If you have a serious interest in three-dimensional graphics, a full understanding of what has been presented here is heartily recommended. In addition, you should consult the suggested readings listed below for more material. Many people have spent time on the problems discussed in this article and have published useful articles describing other ways to produce computer-generated three-dimensional images.

In addition to line drawing images, much computer graphics is now displayed using the features offered by raster displays. Quite realistic imagery is possible, offering a vast array of possibilities well beyond those described here. There is much work to be done in this area yet, so if you are interested, go to it! ■

## Acknowledgments

Mary Lieb handled text-editing and formatting chores. Some of the software development and all the higher-resolution computer-generated images were done on equipment supplied in part by the National Science Foundation (equipment grant # MCS 80-06322) and in part by the Ohio State University.

## Suggested Reading

Newman, W and R Sproull, *Principles of Interactive Computer Graphics*, 2nd edition, McGraw-Hill, 1978. The classic text on computer graphics—some consider it difficult, but you must read it if you are serious about the subject.

Rogers, D F and J A Adams, *An Introduction to Computer Graphics*, McGraw-Hill, 1977. A cookbook approach to the subject with many useful algorithms listed in BASIC.

Giloi, W K, *Interactive Computer Graphics*, Prentice-Hall, 1978. An introductory textbook with a somewhat different approach than that of the two books above.

Knuth, D E, *The Art of Computer Programming: Volume 3, Sorting and Searching*, Addison Wesley, 1973. A treasure trove of algorithms and analyses of algorithms—a very important book.

Sutherland, I E, et al, "A Characterization of Ten Hidden-Surface Algorithms," *ACM Computing Surveys*, March 1974. A very informative explanation of the extant hidden-surface algorithms of the time. *Computing Surveys* is available in most technical libraries.

Crow, F C, "A System for the Design of Three-Dimensional Objects," *Proceedings of the ACM National Conference*, 1977. A system for designing three-dimensional shapes involving simple curved surfaces, available from the Association for Computing Machinery, 1133 Avenue of the Americas, New York NY 10036.

Parent, R, "Three-Dimensional Object Synthesis," *Proceedings of SIGGRAPH '76*, 1976. A more comprehensive system for building three-dimensional objects. See also the proceedings of the annual SIGGRAPH conferences for the last five years or so, which contain papers describing most of the interesting work done in recent years—the best way to keep up with what's going on. Available from the Association for Computing Machinery, listed above.

# OHIO DATA

## business programs for your micro

Proforma Income Statement and Balance Sheet	\$ 50.00
Managers' Budgeting Program	\$ 50.00
Capital Investment Analysis	\$ 35.00
Depreciation Method Comparison	\$ 35.00
Histogram Formed From Set of Numbers	\$ 20.00
Simple Loan Analysis	\$ 15.00
Lease/Buy Analysis	\$ 25.00
Make-Buy Decision Analysis	\$ 15.00
Mortgage Analysis	\$ 15.00
Sales Commission Report	\$ 15.00
Sales Manager's Information System	\$150.00

In BASIC—Source Listings  
Licensing Only  
Send for Our Catalog



OHIO DATA PRODUCTS CORPORATION  
14800 Detroit Avenue • Lakewood, Ohio 44107  
Call [216] 221-9000

# When You Have To Face A Deadline



## Arm Yourself With Pascal/MT+®

You know what a monster a deadline can be if you have to face it without the proper tools. Arm yourself with an integrated set of programs, designed from the beginning for production use, all tuned to the single goal of producing reliable software. **Pascal/MT+** is a fully integrated program production system including our compiler, debugger, dis-assembler and linker.

Used by many companies, large and small, **Pascal/MT+** produces high quality reliable products in an amazingly short amount of time. Our run-time library contains all the tools needed to begin program construction immediately. **Pascal/MT+** produces efficient, small native machine code demanded by today's product developers. All of our library routines and features work exactly the same on 16-bit systems as they do on 8-bit systems so you can increase your capability without re-writing any of your software. Your production quality products demand production quality tools. Order **Pascal/MT+** now, call us today!

### Pascal/MT+ Features:

#### An International Standard:

**Pascal/MT+** conforms to the ISO Standard for Pascal, our competition doesn't even come close! A report on the performance of **Pascal/MT+** on the Pascal validation suite is included with each compiler.

#### Modular Program Compilation:

The **Pascal/MT+** modular compilation mechanism allows construction of fully coupled modules and programs allowing the modularization of large programs without any sacrifice in either space or time efficiency.

#### Efficient Native Code:

All versions of **Pascal/MT+** produce efficient, compact NATIVE OBJECT CODE. In an independent benchmark **Pascal/MT+** out-performed all other Pascal compilers on our target machines. In addition it produced the smallest final programs by including only the minimum run-time overhead necessary.

### Totally Portable:

**Pascal/MT+** has been designed from the beginning to generate code for many different microprocessors. **Pascal/MT+** programs you create today can be re-compiled to run on a more powerful machine tomorrow. All of the extended language features are present in every version of the compiler. This means you won't have to start over when the customer demands more, more and more.

### Extensions:

**Pascal/MT+** has many extensions to the Pascal language too numerous to describe in detail here. Our 160 page user's guide describes the features and gives examples of how to use them. A short summary of features is listed below: dynamic strings, BCD and Floating point reals, AMD9511 support, bit, byte and unsigned word manipulation, I/O port access, a full implementation of the NEW and DISPOSE heap and many others.

### Target Machines:

Available now ..... 8080, 8085 and Z80  
Available soon ..... 8086, 8088  
Coming ..... 68000, 6809 and Z8000

### Pricing:

8080/Z80 — \$250.00  
As of 4/7/81 — \$475.00  
Others Call  
Communication Arts, Huntington Beach, CA

### Payment Terms:

Cash, Check, UPS, C.O.D.,  
Mastercard, VISA,  
Company P.O.

See us at West Coast Computer Faire, booth 1608

**MT Micro SYSTEMS**

1562 Kings Cross Drive  
Cardiff, California 92007 (714) 755-1366

## The Micro Matrix Photopoint Light Pen

Stephen B Gray, 219 W 81 St, Apt 7C, New York NY 10024

Because it's called a *light pen*, and because of the way it *seems* to be used, many people have the incorrect impression that a light pen does something directly to the image on the video screen. In actuality, it's the other way around. A light pen contains a photodiode that detects the movement of a point of light on the video screen, determines the coordinates of that point, and branches to a specified action for that point.

For example, if you're playing tic-tac-toe, you only have to point the light pen at the square in which you want to place your X. With a scan limited to nine areas on the video screen, the photodiode detects which area you're pointing to and puts an X in that square.

### Applications

As hinted above, one of the most popular applications for the light pen is games. Instead of pressing a key, you need only point the pen. This eliminates having to memorize which key does what.

Another popular application is the fast selection of items in a screen menu. Some advanced graphics programs use light pens and menus. A screen may present a selection of shapes along one side, for example. You touch one, then touch the point on the screen where you want the computer to place the shape. Using small menus along the bottom of the screen, you control the size and rotation of the shapes to create complex subjects.

### Micro Matrix Photopoint

One of the several light pens on the market for the Radio Shack TRS-80 is the \$19.95 Photopoint from Micro Matrix, POB 938, Pacifica CA 94044. (The Photopoint is also available from Quality Software, 6660 Reseda Blvd, Suite 105, Reseda CA 91335.) The documentation notes that "The light pen allows the user to use their CRT as a programmable keyboard where your own BASIC program (or a prepackaged one) can be written to ask questions and the operator just points at the appropriate answer. No more fumbling with keyboards! The Photopoint can be used with any DOS and with any size memory (must be a Level II TRS-80)." Fortunately, the rest of the documentation is not as confusing as that first sentence.

For your \$19.95 you receive a light pen that looks like a slender felt-tip pen, with a two-part cable which connects to a 9 V battery and to your recorder. You also receive a cassette with backgammon, tic-tac-toe, Word Sampler, and a light-pen subroutine; documentation containing another game and a listing of the subroutine is also included.

## 8088 MAINFRAME CP/M86 OPERATING SYSTEM

Want to move to the new 16 bit generation of micro's? You do not want to assemble a system from board products? Finally, a complete system that only needs a Video Terminal plugged in to be on the air.

The LDP1 will get you going with your 16 bit systems quickly while not obsoleting other boards in your system. The LDP1 is a 16 bit system based on the LDP88, 8088 CPU board and the LDP72, advanced floppy disk controller. In addition you get 64 K of RAM, an 8" floppy disk, a mainframe with power supply and your choice of two different operating systems. All this for the unbelievable price of \$3499 (with 86-DOS).

### PRICES

LDP1 with 86-DOS \$3499  
LDP1 with CP/M-86 3599

	Kit	Assembled & Tested
LDP88	\$349.95	\$399.99
LDP72	219.95	274.95
S100 Prototype Board	29.95	
86-DOS	195.00	
CP/M-86	250.00	
Micro Soft Basic 86	500.00	86-DOS required
	350.00	with LDP1 and 86-DOS
PASCAL/M	250.00	CP/M-86 required

Rev. A LDP88's while they last \$275

## LOMAS DATA PRODUCTS

11 Cross Street  
Westborough, MA 01581  
Telephone (617) 366-4335

PASCAL/M is a trademark of Sorcim  
CP/M-86 is a trademark of Digital Research  
86-DOS is a trademark of Seattle Computer Products

# COMPUTER WAREHOUSE

CALL TOLL FREE **1-800-528-1054**

## ATARI

### Special 32K 800 System

800 w/32K, recorder  
star raiders, joystick..... **\$940**

800 (16K) .....	<b>\$745</b>
400 .....	<b>\$440</b>
810 Disk Drive .....	<b>\$490</b>
825 Printer .....	<b>\$710</b>
850 Interface .....	<b>\$155</b>
16K Memory .....	<b>\$ 90</b>
410 Recorder .....	<b>\$ 55</b>
830 Modern .....	<b>\$140</b>
Star Raiders .....	<b>\$ 45</b>
Software .....	<b>From \$ 10</b>

## MODEMS

Lexicon	
LEX-II .....	<b>\$115</b>
Novation	
CAT .....	<b>\$150</b>
D-CAT .....	<b>\$160</b>

## VIDEO TERMINALS

Hazeltine	
1500 .....	<b>\$848</b>
1420 .....	<b>\$795</b>
Soroc	
IQ 120 .....	<b>\$693</b>
IQ 140 .....	<b>\$1099</b>
Televideo	
912 B .....	<b>\$699</b>
912 C .....	<b>\$699</b>
920 B .....	<b>\$749</b>
920 C .....	<b>\$749</b>
Zenith - Z - 19 .....	<b>\$789</b>

## PRINTERS

Centronics	
730 Serial .....	<b>\$650</b>
730 Parallel .....	<b>\$598</b>
737 Serial .....	<b>\$854</b>
737 Parallel .....	<b>\$760</b>
Diablo	
630 .....	<b>\$2400</b>
1640 RO .....	<b>\$2860</b>
1640 KSR .....	<b>\$3236</b>
1650 RO .....	<b>\$3047</b>
1650 KSR .....	<b>\$3315</b>
Epson-MX-80 .....	<b>Call</b>
NEC	
5510 .....	<b>\$2672</b>
5520 .....	<b>\$2955</b>
Okidata	
Microline 80 .....	<b>\$420</b>
Microline 82 .....	<b>\$620</b>
Microline 83 .....	<b>\$923</b>
Qume	
5/45 RO .....	<b>\$2684</b>
5/45 KSR .....	<b>\$3081</b>
5/55 RO .....	<b>\$2863</b>
5/55 KSR .....	<b>\$3144</b>
Texas Instruments	
810 Basic .....	<b>\$1516</b>
810 Loaded .....	<b>\$1739</b>
820 KSR Basic .....	<b>\$1732</b>
820 KSR Package .....	<b>\$1916</b>



Prices & availability subject to change without notice.

## COMPUTERS

Altos .....	<b>Call</b>
Dynabyte .....	<b>Call</b>
Northstar	
HRZ II-32K D (Assm) .....	<b>\$2300</b>
HRZ II-32K Q (Assm) .....	<b>\$2665</b>
Zenith	
Z-89 48K .....	<b>\$2210</b>

## DISKETTES

Memorex	
5 1/4-10 Sector S/S D/D (Qty 10) .....	<b>\$27</b>
Scotch	
5 1/4-0, 10, 16 Sector (Qty 100) .....	<b>\$250</b>
8"-0, 32 Sector (Qty 100) .....	<b>\$260</b>

## MONITORS

APF - 9" Monitor .....	<b>\$123</b>
Sanyo - 9" Monitor .....	<b>\$147</b>

## We Buy and Sell Used Equipment

### Experienced Equipment

Centronics 779 ..	\$450	Comprint 912 ...	\$275
Teletype Model 40		Atari 820 printer ..	\$400
(New) .....	\$2750	Dynabyte 8/4 ...	\$1700
Hazeltine 1510 ..	\$650	Dynabyte 8/2	
Hazeltine 1420 ..	\$600	w/64K .....	\$2400
Centronics 730 ..	\$375	Axiom 801 HS ...	\$250

**COMPUTER WAREHOUSE**

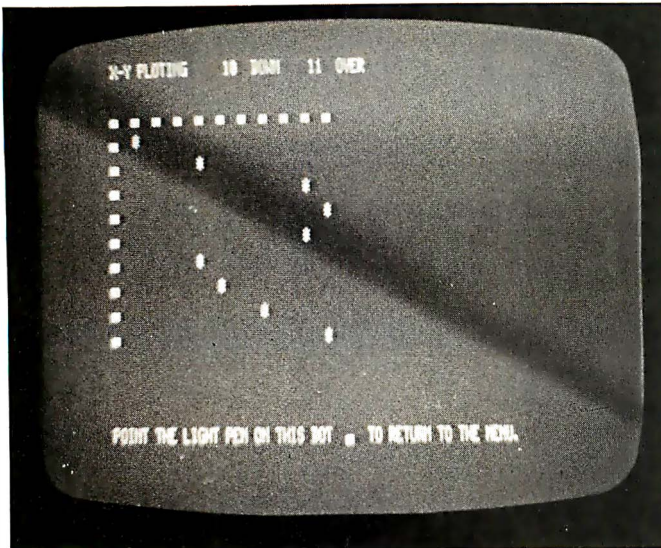


2222 E. Indian School Rd.  
Phoenix, Arizona 85016  
(602) 954-6109  
1-800-528-1054

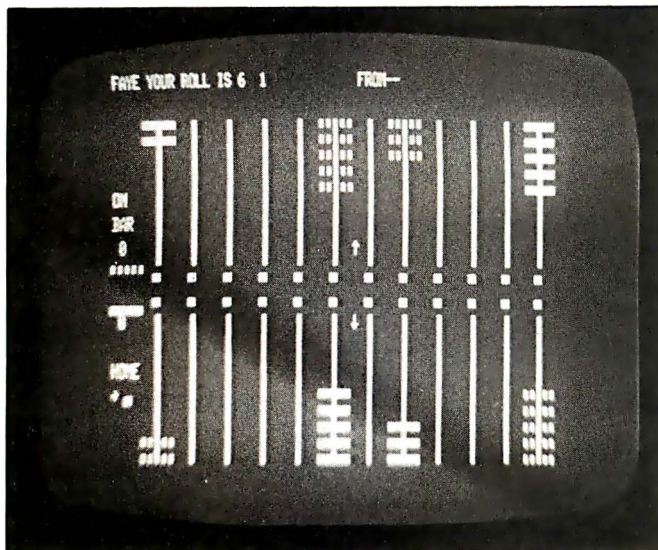
Store Hours: Tues.- Friday 10-6 MST Saturday 10-5 MST

Prices reflect 3% cash discount. Product shipped in factory cartons with manufacturers warranty. Add 2%, a minimum of \$5, for shipping and handling.

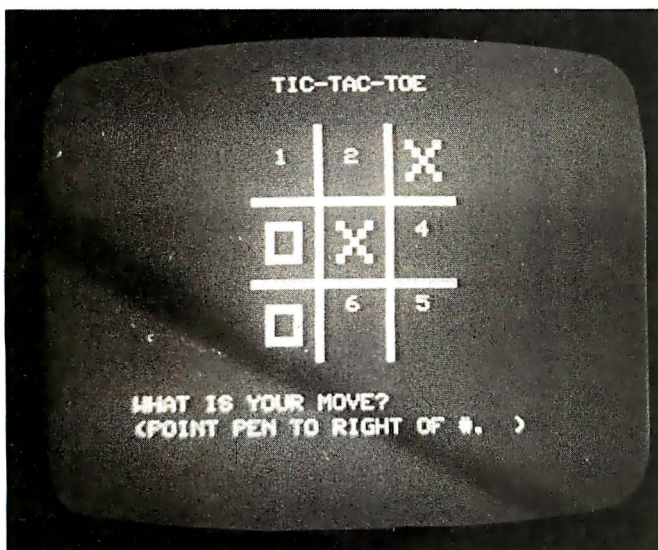
(1a)



(1b)



(1c)



**Photo 1:** Three of six demonstration programs included with the Micro Matrix Photopoint light pen: x, y plotting (1a), backgammon (1b), and tic-tac-toe (1c). The light pen requires a TRS-80 Level II with 16 K bytes of programmable memory.

## Using the Photopoint

The pen's miniature plug is connected either to your cassette recorder's auxiliary or microphone jack. When plugged into the auxiliary jack, the pen responds to graphics but not to normal text. When plugged into the microphone jack, the pen is sensitive to both text and graphics (the suggested mode for most uses).

One of the main reasons for Photopoint's comparatively low price is that it uses the amplifier in your tape recorder. To turn on the amplifier, remove any cassette from the recorder; then, while holding in the record interlock pin (at the rear of the cassette compartment), press the RECORD and PLAY buttons simultaneously. The only thing left to do is connect a 9 V battery to the battery clip, and you're set to go.

After loading the light-pen subroutine, you will see a menu from which you can choose any of six demonstration programs.

The light pen doesn't read instantly; you have to wait for the scan to pass the square you're aiming at, and then a bit longer for the software to react. One good way to get a feel for what is going on is to place a broadcast-band AM radio near the TRS-80 keyboard. You'll hear something like a "dit-dit-dit-un-pah" as the computer recognizes a flashing square. Since it can't "read" a static square, the program flashes the squares in sequence to give the photodiode a target to pick out.

The first two demonstration programs are similar, with a series of eight squares arranged horizontally (in program 1) and vertically (in program 2). When any square is touched by the light pen, the number of the square (1 thru 8) is printed on the screen. The third demonstration program uses the same principle—this time with a series of fifty blocks; the fourth scans eight randomly placed squares; and the fifth (see photo 1a) plots lines and curves by lighting an asterisk when a pair of squares along the x and y axes are touched.

The backgammon program (see photo 1b) allows you to use the light pen to roll the dice, redraw the board, or play a new game. Or, you can move by aiming the light pen at FROM and TO selection squares.

Tic-tac-toe (see photo 1c) is played with a large field and double-size characters. You play against the computer, and indicate a square by pointing the pen to the right of the number in that square.

The computer puts an X in the square you select, then an O in the square it selects. The process continues until the computer detects that the game has been won or drawn.

The fourth program on the cassette is Word Sampler. You or the computer enters a sentence. Then you point the light pen at any word, and the computer displays that word above the sentence, starting at the left margin and continuing with further words you select. Thus you can construct a new sentence by rearranging the words of the old one.

The fifth program is called Cube Chase. After you key in eight lines, you point the light pen at a white square on the screen, and the square quickly moves elsewhere.

If you plug the light pen into the auxiliary jack, remove the black plastic plug from the microphone jack, and then whistle or snap your fingers, the cube will change its position on the screen. (This works on my CTR-41, although perhaps not on some other cassette recorders.)

# The first personal computer for under \$200.

**The Sinclair ZX80.**  
A complete computer—  
only \$199.95 plus \$5.00 shipping.

Now, for just \$199.95, you can get a complete, powerful, full-function computer, matching or surpassing other personal computers costing several times more.

It's the Sinclair ZX80. The computer that "Personal Computer World" gave 5 stars for 'excellent value.'

The ZX80 cuts away computer jargon and mystique. It takes you straight into BASIC, the most common, easy-to-use computer language.

You simply take it out of the box, connect it to your TV, and turn it on. And if you want, you can use an ordinary cassette recorder to store programs. With the manual in your hand, you'll be running programs in an hour. Within a week, you'll be writing complex programs with confidence.

All for under \$200.

## Sophisticated design makes the ZX80 easy to learn, easy to use.

We've packed the conventional computer onto fewer, more powerful LSI chips—including the Z80A microprocessor, the faster version of the famous Z80. This makes the ZX80 the world's first truly portable computer (6½" x 8½" x 1½" and a mere 12 oz.). The ZX80 also features a touch sensitive, wipe-clean keyboard and a 32-character by 24-line display.

Yet, with all this power, the ZX80 is easy to use, even for beginners.



## Your course in computing.

The ZX80 comes complete with its own 128-page guide to computing. The manual is perfect for both novice and expert. For every chapter of theory, there's a chapter of practice. So you learn by doing—not just by reading. It makes learning easy, exciting and enjoyable.

You'll also receive a catalog packed with items that can make your ZX80 even more useful. Including 27 program cassettes, from games and home budgeting for just \$6.95, to Sinclair's unique Computer Learning Lab (a workbook, six cassettes with 100 lessons, and two cassettes for storing programs).

## ZX80's advanced design features.

Sinclair's 4K integer BASIC has performance features you'd expect only on much larger and more expensive computers.

- Unique 'one touch' entry. Key words (RUN, PRINT, LIST, etc.) have their own single-key entry to reduce typing and save memory space.



- Automatic error detection. A cursor identifies errors immediately to prevent entering programs with faults.
- Powerful text editing facilities.
- Also programmable in machine code.
- Excellent string handling capability—up to 26 string variables of any length.
- Graphics, with 22 standard symbols.
- Built-in random number generator for games and simulations.

Sinclair's BASIC places no arbitrary restrictions on you—with many other flexible features, such as variable names of any length.

And the computer that can do so much for you now will do even more in the future. Options will include expansion of 1K user memory to 16K, a plug-in 8K floating-point BASIC chip, applications software, and other peripherals.

## Order your ZX80 now!

The ZX80 is available only by mail from Sinclair, a leading manufacturer of consumer electronics worldwide.

To order by mail, use the coupon below. But for fastest delivery, order by phone and charge to your Master Charge or VISA. The ZX80 is backed by a 10-day money-back guarantee, and a 90-day limited warranty which can be extended by 12 months under Sinclair's extended service program for \$25.00.

**Price includes TV and cassette connectors, AC adaptor, and 128-page manual.**

All you need to use your ZX80 is a standard TV (color or black and white). The ZX80 comes complete with connectors that easily hook up to the antenna terminals of your TV. Also included is a connector for a portable cassette recorder, if you choose to store programs. (You use an ordinary blank cassette.)



The ZX80 is a family learning aid. Children 10 and above will quickly understand the principles of computing—and have fun learning.

**To order call toll free: 800-543-3000.**  
**In Ohio call: 800-582-1364.**

Ask for operator #508.  
Phones open 24 hours a day, 7 days a week.

# sinclair

Sinclair Research Ltd., 475 Main St.,  
P.O. Box 3027, Wallingford, CT 06492.

To: Sinclair Research Ltd., 475 Main St., P.O. Box 3027, Wallingford, CT 06492.

Please send me \_\_\_\_\_ ZX80 personal computer(s) at \$199.95 each (US dollars), plus \$5 shipping. (Your ZX80 may be tax deductible.) For Conn. deliveries, add sales tax.

Send me \_\_\_\_\_ Computer Learning Lab(s) at \$49.95 each.

Register me for \_\_\_\_\_ extended service program(s) at \$25.00 each.

I enclose a check/money order payable to Sinclair Research Ltd. for \$\_\_\_\_\_.

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Occupation \_\_\_\_\_ Age \_\_\_\_\_

Intended use of ZX80 \_\_\_\_\_

Have you ever used a computer? ☐ Yes ☐ No Do you own another personal computer? ☐ Yes ☐ No

BY-3-1

The explanation is simple: The TRS-80 receives its information from the Photopoint light pen through tape port 255. The program makes the recorder think the light pen is a microphone. A sudden change of impedance occurs when a scanning blip of light is detected by the pen's photodiode.

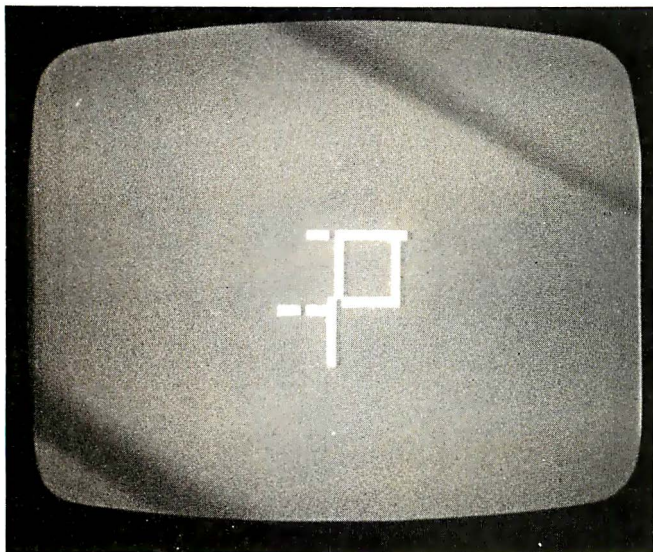


Photo 2: Quick Draw enables use of the light pen to draw or erase figures in a 48 by 64 graphic field. More complex drawing programs may be written but the manual gives no information on how to do this.

## MICROSTAT NOW AVAILABLE FOR CP/M\*

**MICROSTAT**, the most powerful statistics package available for microcomputers, is completely file-oriented with a powerful Data Management Subsystem (DMS) that allows you to edit, delete, augment, sort, rank-order, lag and transform (11 transformations, including linear, exponential and log) existing data into new data. After a file is created with DMS, Microstat provides statistical analysis in the following general areas: Descriptive Statistics (mean, sample, and population S.D., variance, etc.), Frequency Distributions (grouped or individual), Hypothesis Testing (mean or proportion), Correlation and Regression Analysis (with support statistics), Non-parametric Tests (Kolmogorov-Smirnov, Wilcoxon, etc.), Probability Distributions (8 of them), Crosstabs and Chi-square, ANOVA (one and two way), Factorials, Combinations and Permutations, plus other unique and useful features.

**MICROSTAT** requires 48K, Microsoft Basic-80 with CP/M and is sent on a single-density 8" Disk. It is also available on 5" diskettes for North Star DOS and Basic (32K and two drives recommended), specify which when ordering. The price for Microstat is \$250.00. The user's manual is \$15.00 and includes sample data and printouts. We have other business and educational software, call or write:



**ECOSOFT**  
P.O. Box 68602  
Indianapolis, IN 46268  
(317) 283-8883

\* CP/M is a registered trade mark of Digital Research.

Micro Matrix is also reportedly planning an interface for Sargon II so you can play chess using a light pen. Also planned are a number of chase games.

## PENBASIC

For \$14.95, Micro Matrix is offering Steve Bjork's **PENBASIC**, which adds ten new commands to Level II BASIC. Among the most interesting are:

- **P=&NOTE(exp)** produces a tone on the cassette output with (exp) ranging from 0 (highest pitch) to 255 (lowest pitch).
- **P=&PEN PEEK** tests to determine if the light pen is pointed at a lighted part of the display.
- **P=&PEN** performs a full screen search for the pen position. If the pen is not found, a -1 is returned; if it is found, **PRINT @ (position)** is returned.
- **P=&PEN USING** searches for the pen only at the points specified in the expression.
- **P=&PEN FOR** searches for the pen at the points defined in a one-dimensional integer array.

Using **PENBASIC**, any of the 1024 locations on the TRS-80 video display can be detected. The four-page **PENBASIC** manual explains eight of the ten commands and includes brief examples of using them within programs. The manual appears to be written for those with a good knowledge of BASIC. In fact, two of the functions aren't explained at all.

Along with **PENBASIC**, the demonstration tape contains two programs: Quick Draw and Line of Five.

**Quick Draw** (see photo 2) enables you to use the light pen to draw and erase figures in a 64 by 48 graphic field. You use related key commands to draw, erase, position the cursor, load and save to and from tape, and end the program. Turning on a square can take several seconds (sometimes longer). **Quick Draw** is described as a "simple drawing program," which hints that more complex (and, perhaps, faster) programs can be written. The manual gives no clues how to do this.

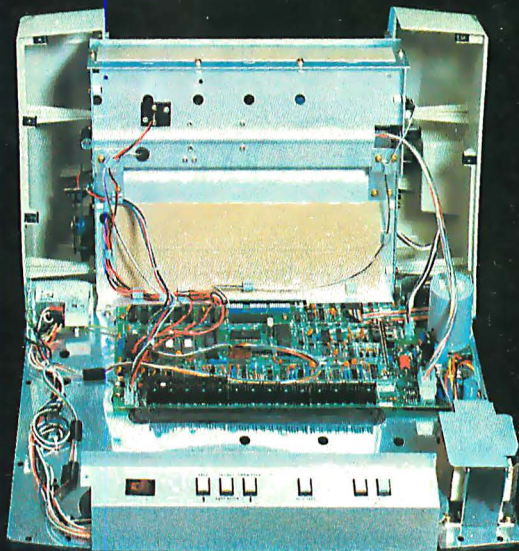
**Line of Five** is described as "the first in a series of application programs for **PENBASIC**." It's a simple game of capturing five squares in a row before the computer does. The computer plays a fairly aggressive game but can be beaten.

The Micro Matrix Photopoint light pen and **PENBASIC** make a useful package for examining light-pen applications. What makes it even more attractive is that the price is the lowest on the market. ■

### Why Can't a Light Pen Use the Raster Scan?

*The Exidy Sorcerer is probably the only home computer that can use the raster scan, according to Mike Banks, president of Micro Matrix. The Sorcerer uses the microprocessor to control the video and sets up a counter to keep track of the vertical scan. The TRS-80 has no such counter, and thus cannot ask, as the Sorcerer can, "What was the count at the moment I saw the light?" In **PENBASIC**, when the **PEN PEEK** command detects a lighted part of the display, it is merely looking to see if the tape-recorder output, at port 255, is high or low.*

# Say Ahh...



## Our New grafixPLUS™ 80-column printer opens wide for easy servicing.

Introducing the newest members of our grafixPLUS™ family—the DP-9000 Series 80/132 column printers—built on the same tradition of quality printout, solid design and low cost of ownership established by our 132/220 column DP-9500 Series.

### A Case for Serviceability

Not that it comes up often, but want to get inside? Simple. Just remove a few screws and the clam-shell case swings open exposing all major components. This easy access plus built-in self-test and minimum component count yields an MTTR of one-half hour. The 9-wire print head replacement's even simpler... two screws and it's out. Without opening the case. And without a service call.

### Performance Plus

The DP-9000 Series prints the full ASCII 96 character set, including descenders and underlining, bi-directionally, at up to 200 CPS. Number of columns can go up to 80 or 132, depending on character density—switch or data source selectable from 10 to 16.7 characters per inch. And all characters can be printed double width. The print head produces razor-sharp characters and high-density graphics with dot resolutions of 72X75 dots/inch under direct data source control.

### Interface Flexibility

The three ASCII compatible interfaces (parallel, RS-232-C and current loop) are standard, so connecting your computer is usually a matter of plug-

it-in and print. Also standard are: a sophisticated communications interface for printer control and full point-to-point communications, DEC PROTOCOL, and a 700 character FIFO buffer. An additional 2K buffer is optional.

When you're ready for a printer (or several thousand), look into the grafixPLUS DP-9000 Series from Anadex—you'll find an open and shut case for quality. Contact us today for details, discounts and demonstrations.

 **Anadex**  
...the plus in printers



...close please.

**SALES OFFICES:** San Jose, CA (408) 247-3933

Fullerton, CA (714) 871-0501 • Wakefield, MA (617) 245-9160 • Austin, TX (512) 327-5250

**ANADEX, INC.** • 9825 DeSoto Avenue • Chatsworth, California 91311, U.S.A. • Telephone: (213) 998-8010 • TWX 910-494-2761

**ANADEX, LTD.** • Dorna House, Guildford Road • West End, Woking, Surrey GU24 9PW, England • Tel: Chobham (09905) 6333 • Telex: 858762 ANADEX G

# What's Inside Radio Shack's Color Computer?

Tim Ahrens, Jack Browne, Hunter Scales  
3501 Ed Bluestein Blvd  
Austin TX 78721

The only similarity between Tandy Corporation's new Color Computer and its older brother—the original TRS-80—is the name. Even the microprocessor has been changed. In an apparent breakaway from the Z80, the Color Computer uses the Motorola MC6809E microprocessor as the workhorse of the new silver box. In fact, when we opened the enclosure, we didn't see any semiconductors that weren't made by Motorola.

The Color Computer is totally self-contained—no bulky separate power transformers—and the only cord, the one to the wall socket, has a standard three-prong connector. It can work with any color or black-and-white television set and has provisions for joysticks, a 1500 bps (bits per second) cassette interface, and an

expansion connector for preprogrammed game cartridges.

Our aim in this article is to expose the insides of the computer and show what makes it run. Using this information, you should be able to expand the Color Computer in a number of ways, with a minimum of expertise. We will also describe the graphics interface so that do-it-yourself graphics routines should be a piece of cake.

## System Hardware

Taking the cover off is simply a matter of removing seven screws and lifting the lid. Be warned, however, that Tandy takes a dim view of owners fooling around with their hardware. Opening the case voids the warranty on the machine (one of the screws lies under a paper label that gives this warning).

The first surprise is that the entire computer is built on a single printed-circuit board—including the power supply. Most of the digital circuitry lies inside an RFI (radio-frequency interference) shield—this was probably necessary to get FCC (Federal Communications Commission) Type Approval, but it also helps to give a clean display. To get a look at the parts, simply pry off the top of the shield.

There are only twenty-four DIPs (dual in-line packages) in the system and they are all made by Motorola. (The parts list is shown in table 1.) The machine comes stuffed with 4 K-byte memory circuits; but there is a simple way to change these to 16 K-byte devices and a tricky way to get 32 K bytes of on-board memory—more on this later.

While we do not yet have a schematic diagram, the block diagram in figure 1 should be sufficiently detailed to allow a thorough understanding of the system. There are four basic sections:

- the microprocessor
- the video-display circuitry
- the memory
- the other I/O (input/output) devices (keyboard, cassette, serial port, and joysticks)

The microprocessor is Motorola's advanced 8-bit machine, the MC6809E. It was designed to support today's high-level languages, including the Extended

*Text continued on page 96*

Part	Number of Pins	Quantity	Device Number	Description
MC6809E	40	1	1	Microprocessor
MC6821	40	2	2, 3	Parallel Interface Adapter
MC6883	40	1	4	Synchronous Address Multiplexer
MC6847	40	1	5	Video Display Generator
MCM68A364	24	2	6, 7	8 K-byte Read-Only Memory
MCM4027	16	8	8 thru 15	4 K-bit Programmable Memory
MC74LS138	16	1	16	3-bit Decoder
MC74LS02	14	1	17	Quad 2-Input NOR Gate
MC74LS244	20	1	18	Octal Buffer/Line Driver
MC74LS273	20	1	19	8-bit Latch
MC14050B	14	1	20	Hex Noninverting CMOS Buffer
MC14529B	16	1	21	Dual 4-Channel Analog Color-Subcarrier Modulator
MC1372	14	1	22	Quad Voltage Comparator
MLM339	14	1	23	Voltage Regulator
MC723C	14	1	24	Voltage Regulator
MC78M12	3	1	25	Voltage Regulator
MC79M12	3	1	26	Voltage Regulator
MC79M05	3	1	27	Voltage Regulator
UM1285-8	NA	1	28	ASTEC Video Modulator

**Table 1:** List of integrated circuits used in the TRS-80 Color Computer. Large-scale integration reduces the number of devices necessary to build in sophisticated capabilities, and improves reliability. All circuits used are manufactured by Motorola.

# IF YOU CAN WAIT A MINUTE, WE CAN SAVE YOU \$1,000.

**With the Starwriter™ Daisy  
Wheel 25 cps printer from C. Itoh.**

A business letter, written on a 45 cps word-processing printer, might take about two minutes to print.

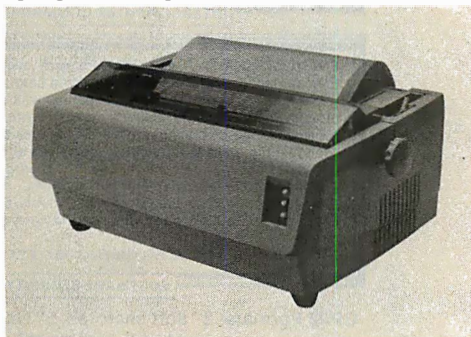
With the Starwriter, it might take closer to three.

The typical 45 cps printer retails for about \$3,000.

But the Starwriter 25 retails for about \$1,895—thus saving you about \$1,000.

And therein lies the biggest difference between the Starwriter 25 and the more expensive, daisy wheel printers.

The Starwriter 25 comes complete and ready-to-use, requiring no changes in hardware or software. It uses industry-standard ribbon cartridges, and it's "plug-in" compatible to interface with a



wide variety of systems, to help lower system-integration costs.

Using a 96-character wheel, it produces excellent letter-quality printing on three sharp copies with up to 163 columns, and offers the most precise character-placement available, for outstanding print performance.

**C. Itoh's warranty;**

3 months on parts and labor, supported by one of the best service organizations in the industry.

## \$1,000 OFF

**Leading Edge Products, Inc.,  
225 Turnpike Street,  
Canton, Massachusetts 02021**

Dear Leading Edge:  
I'd like to know more about the Starwriter, and how spending a minute can save me a grand.  
Please send me the name of my nearest dealer.

Name \_\_\_\_\_  
Title \_\_\_\_\_  
Company \_\_\_\_\_  
Street \_\_\_\_\_  
State \_\_\_\_\_ Zip \_\_\_\_\_  
Phone: Area Code \_\_\_\_\_  
Number \_\_\_\_\_

## LEADING EDGE.

Leading Edge Products, Inc., 225 Turnpike Street, Canton, Massachusetts 02021  
Dealer inquiries invited. For immediate delivery from the Leading Edge Inventory Bank™ call toll free 1-800-343-6833  
In Massachusetts, call collect (617) 828-8150. Telex 951-624

# SuperSoft's Gallery of CP/M Masterworks

## DIAGNOSTICS I: A system diagnostic package.

Tests:

- Memory • CPU (8080/8085/Z80) • Terminal • Disk • Printer

To our knowledge the CPU test is the first of its kind anywhere. Diagnostics I can help you find problems before they become serious. A good set of diagnostic routines are a must in any program library. Minimal requirements: 32K CP/M. Supplied with complete user manual: \$75.00 Manual alone: \$15.00

**DIAGNOSTICS II:** The most comprehensive set of CP/M compatible system check-out programs ever assembled. Includes all of Diagnostics I, plus:

- Every test is "submit"-able
- A complete Spinwriter/Diablo/Qume test has been added (Serial Interface only)
- Output may be logged to disk
- Expanded memory test
- Expanded terminal test
- Expanded disk test

Diagnostics II provides the next level in system maintenance.

Requires: 32K CP/M

Price: \$100.00 Manual only: \$15.00

### SYSTEM MAINTENANCE

**SUPER-M-LIST:** A complete, easy to use mailing list program package. Allows for two names, two addresses, city, state, zip and a three digit code field for added flexibility. Super-M-List can sort on any field and produce mailing labels direct to printer or disk file for later printing or use by other programs. Super-M-List is the perfect companion to TFS. Handles 1981 Zip Codes!

Requires: 48K CP/M

Supplied with complete user manual: \$75.00 manual alone: \$10.00

**TFS-Text Formatting System:** An extremely powerful formatter. More than 50 commands. Supports all major features including:

- left & right margin justification
  - user defined macros
  - dynamic insertion from disk file
  - underlining and backspace
- TFS lets you make multiple copies of any text. For example: Personalized form letters complete with name, address & other insertions from a disk file. Text is not limited to the size of RAM making TFS perfect for reports or any big job. Text is entered using CP/M standard editor or most any CP/M compatible editor.

Requires: 24K CP/M

Supplied with extensive user manual: \$85.00 manual alone: \$20.00

Source to TFS in 8080 assembler (can be assembled using standard CP/M assembler) plus user manual: \$250.00.

### TEXT PROCESSING

**UTILITIES I:** A collection of programs that you will find useful and maybe even necessary in your daily work (we did!).

Includes:

- GREP: Searches files for a specified string
- SORT: In core sort of variable length records
- CMP: Compare two files for equality
- PRINT: Formatted listings to printer
- PG: Lists files to CRT a page at a time

... plus more ...

Requires: 24K CP/M

Supplied with manual on discette: \$60.00

**UTILITIES II:** Many new programs not available elsewhere. Includes these "file" utilities:

- DIFF: Source comparator
- PR: Powerful multicolumn output formatter
- DC: Desk calculator
- RPL: Substitute strings in files

... plus more ...

Requires: 24K CP/M \$60.00

Supplied with manual on discette

### UTILITIES

**ANALIZA:** An amazingly accurate simulation of a session with a psychiatrist. Better than the famous "ELIZA" program. Enlightening as well as fun. An excellent example of Artificial Intelligence.

Requires: 48K CP/M, CBASIC2  
Cost: \$35.00

### ENTERTAINMENT

**Z8000CROSSASSEMBLER:** Supports full Z8000 syntax, segmented and unsegmented mode, full 32-bit arithmetic, hex output, listing output, "downloader".

Requires: 56K CP/M \$500.00  
1 year maintenance \$300.00  
manual alone \$ 50.00

### Z8000 too!

**SSS FORTRAN:** The SSS FORTRAN compiler is fast, efficient, and complete (full 1966 ANSI standard with extensions). The RATFOR compiler compiles into FORTRAN allowing the user to write structured code while retaining the benefits of FORTRAN. The FORTRAN supports many advanced features not found in less complete implementations, including: complex arithmetic, character variables, and functions. Complete sequential and random disk I/O are supported. SSS FORTRAN will compile up to 600 lines per minute! Recursive subroutines with static variables are supported. ROMable ".COM" files may be generated. SSS RATFOR allows the use of contemporary loop control and structured programming techniques. SSS RATFOR is similar to FORTRAN '77 in that it supports such things as:

- REPEAT...UNTIL
- WHILE
- IF...THEN...ELSE

SSS RATFOR is supplied with source code in FORTRAN and RATFOR.

System Requirements & Prices:

SSS FORTRAN requires a 32K CP/M system.

SSS FORTRAN with RATFOR: \$325.00

SS FORTRAN alone: \$250.00

RATFOR alone: \$100.00

(RATFOR sold only with valid SSS FORTRAN license)

**STACKWORK'S FORTH:** A full, extended Forth interpreter/compiler produces COMPACT, ROMABLE code. As fast as compiled FORTRAN, as easy to use as interactive BASIC.

**SELF COMPILING:** Includes every line of source code necessary to recompile itself.

**EXTENSIBLE:** Add functions at will.

Z80 or 8080 ASSEMBLER Included.

Single license, OEM licensing available.

Please specify CPU type: Z80 or 8080

Supplied with extensive user manual and tutorial: \$175.00

Documentation alone: \$25.00

**'TINY' PASCAL II:** We still call it 'Tiny' but it's bigger and better than ever! This is the famous Chung-Yuen 'Tiny' Pascal with more features added. Features include:

- recursive procedures/functions
- integer arithmetic
- CASE
- FOR (loop)
- sequential disk I/O
- 1 dimensional arrays
- IF...THEN...ELSE
- WHILE
- PEAK & POKE
- READ & WRITE
- REPEAT...UNTIL
- more

'Tiny' Pascal is fast. Programs execute up to ten times faster than similar BASIC programs. SOURCE TOO! We still distribute source, in 'Tiny' Pascal, on each discette sold. You can even recompile the compiler, add features or just gain insight into compiler construction.

Requires: 36K CP/M. Supplied with complete user manual and source on discette:

\$85.00. Manual alone: \$10.00

### PROGRAMMING LANGUAGES

**TERM:** A complete intercommunications package for linking your computer to other computers. Link either to other CP/M computers or to large timesharing systems. TERM is comparable to other systems but costs less, delivers more and source is provided on discette! With TERM you can send and receive ASCII and Hex files (COM too, with included conversion program) with any other real time communication between users on separate systems as well as acting as timesharing terminal.

- Engage/disengage printer
- error checking and auto retry
- terminal mode for timesharing between systems
- conversational mode
- send files
- receive files

Requires: 32K CP/M

Supplied with user manual and 8080 source code: \$150.00

Manual alone: \$15.00

### INTERCOMPUTER COMMUNICATIONS

**ENCODE/DECODE:** A complete software security system for CP/M. Encode/Decode is a sophisticated coding program package which transforms data stored on disk into coded text which is completely unrecognizable. Encode/Decode supports multiple security levels and passwords. A user defined combination (One billion possible) is used to code and decode a file. Uses are unlimited. Below are a few examples:

- data bases
- payroll files
- programs
- tax records

Encode/Decode is available in two versions:  
Encode/Decode I provides a level of security suitable for normal use.  
Encode/Decode II provides enhanced security for the most demanding needs.

Encode/Decode I: \$50.00 Encode/Decode II: \$100.00 manual alone: \$15.00

### SOFTWARE SECURITY

CP/M Formats: 8" soft sector, 5" Northstar, 5" Micropolis Mod II, Vector MZ, Superbrain DD/QD



All Orders and General Information:

**SUPERSOFT ASSOCIATES**

P.O. BOX 1628

CHAMPAIGN, IL 61820

(217) 359-2112

Technical Hot Line: (217) 359-2691

(answered only when technician is available)

Far East Distribution:

ASR International

3-15-8, NISHI-SHIMBASHI, MINATO-KU, TOKYO 〒105 JAPAN

(03) 437-5471

On line "Help" system provided with every program package.

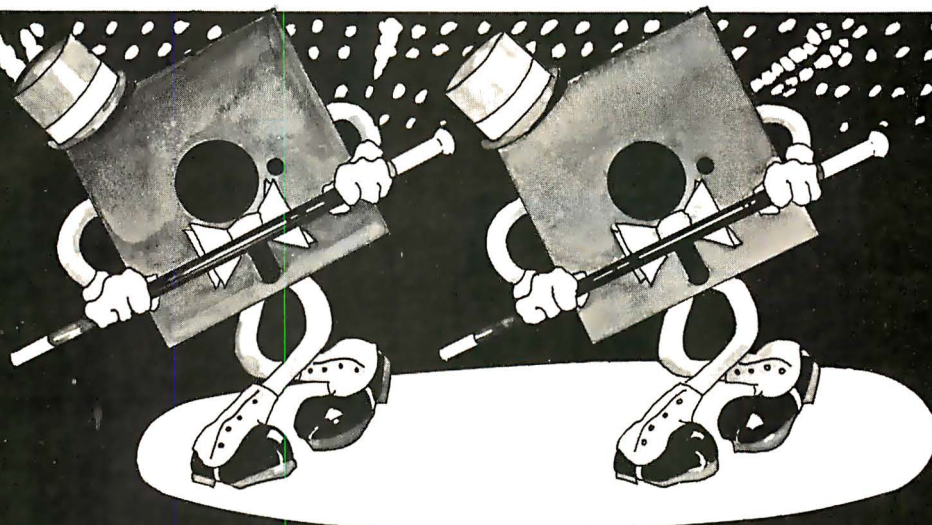
*SuperSoft*

First in Software Technology

## SuperSoft's Masterpiece of the Month



# SSS ANSI '66 STANDARD FORTRAN IV WITH RATFOR FOR CP/M



## TOGETHER AT LAST

### FEATURING

SSS FORTRAN & RATFOR are the critic's choice!

The SSS FORTRAN compiler is fast, efficient, and complete (full 1966 ANSI standard with extensions). The RATFOR compiler compiles into FORTRAN allowing the user to write structured code while retaining the benefits of FORTRAN. Together they form an incredible team!

#### SSS FORTRAN Specifics

SSS FORTRAN makes full FORTRAN IV available to microcomputers. SSS FORTRAN meets and exceeds the ANSI 1966 FORTRAN standard. The compiler supports many advanced features not found in less complete implementations, including: complex arithmetic, character variables, and functions. SSS FORTRAN will compile up to 600 lines per minute! Recursive subroutines with static variables are supported. ROMable ".COM" files may be generated.

#### FEATURES

Code generation: ROMable ".COM" files or intermediate code files (saves disk space). External routines may be called.

Data types: Byte, integer, real, double precision, complex, logical, character and varying length strings.

Operations: All standard operations plus string comparisons, assignments, and .XOR.

Constants: Hexadecimal, decimal, and character literals with features to imbed control characters.

Statements: ANSI 1966 standard with multiple statement lines, statements may end with a ":".

Controls: Map, List, and Symbol table output options.

I/O: Read, Write, Append, Rewind, Close, Delete, Rename, Search, sequential and Random I/O on disk files. Supports all CP/M devices. The User can add device handlers to use custom I/O devices.

Errors: Over 200 distinct compiler error messages, precision and illegal instruction warnings during execution.

Interrupts: FORTRAN programs may be interrupted at any time; the stack pointer is always preserved.

#### SSS RATFOR

RATFOR is a preprocessor that compiles to SSS FORTRAN. SSS RATFOR allows the use of contemporary loop control and structured programming techniques. SSS RATFOR is similar to FORTRAN '77 in that it supports such things as:

REPEAT ... UNTIL WHILE IF ... THEN ... ELSE  
Begin End Brackets Macro Defines

SSS RATFOR is supplied with *source code*. The source code is distributed in both RATFOR and SSS FORTRAN. Not only does this prevent obsolescence, but allows the user to add enhancements as desired.

#### System Requirements & Prices

SSS FORTRAN requires a 32k CP/M system. Z80 only.  
SSS FORTRAN with RATFOR: \$325.00  
SSS FORTRAN alone: \$250.00  
RATFOR alone: \$100.00  
(Sold only with valid SSS FORTRAN license)

CP/M Formats: 8" soft sector, 5" Northstar, 5" Micropolis Mod II, Vector MZ, Superbrain DD/QD

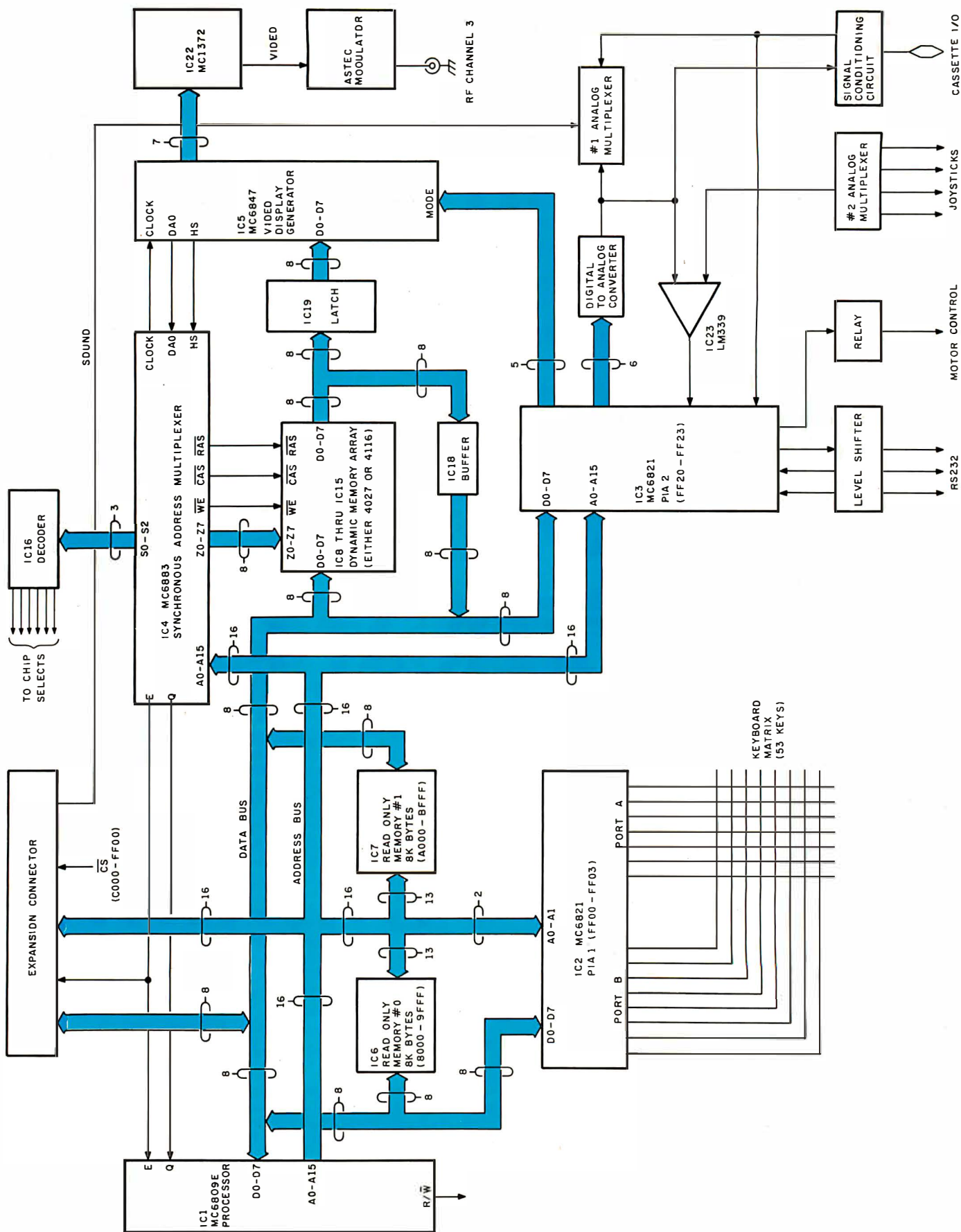
All Orders and General Information:  
SUPERSOFT ASSOCIATES  
P.O. BOX 1628  
CHAMPAIGN, IL 61820  
(217) 359-2112  
Technical Hot Line: (217) 359-2691  
(answered only when technician is available)



\*CP/M REGISTERED TRADEMARK DIGITAL RESEARCH

SSS FORTRAN is the copyright of  
Small Systems Services, Urbana, Illinois

**SuperSoft**  
First in Software Technology



**Figure 1:** Block diagram of the Radio Shack Color Computer. Although a detailed schematic diagram is not available, the connection of the main components can be readily determined. Note that the use of large-scale integrated circuits (the microprocessor, SAM dynamic-memory handler, video-display generator, and parallel port interfaces) means that a minimum number of components is necessary to build this flexible computer.

# NOW CLEANING YOUR OWN DISKETTE HEADS COULD SAVE YOU A \$40 SERVICE CALL. AND A LOT MORE.

The recording heads on your diskette drives may be dirty—and that can cause you a lot of grief. There's the serviceman you have to call when the machine doesn't perform. (You know how much service calls cost these days!) There's machine down-time. Idle data entry clerks. All the other delays a cranky machine can cause. And that service call might not even be necessary.

## **3M solves the problem in seconds—and leaves your heads** **"Computer Room Clean".**

The Scotch® head-cleaning diskette kit lets you clean the read-write heads on your 8" or 5¼" diskette drives. In just 30 seconds, without any disassembly, mess or bother, the heads can be completely cleansed of dirt, dust, magnetic oxides—all the things that can get into your machines every day. And foul them up.

Just saturate the special white cleaning pad in its jacket with the cleaning solution. Then insert the jacket into the diskette drive and turn it on. Your machine does the rest. The



heads are microscopically cleaned without wear, without abrasion.

This 3M head-cleaning diskette kit has been evaluated and approved by major diskette drive manufacturers. It's the best possible way to clean your heads without service calls or machine teardowns.

**At only \$1 per cleaning—  
it's the best insurance you  
can get.**

This fast-cleaning new Scotch kit comes with everything you need (including special fluid, applicator tip, cleaning diskettes) to handle up to 30 cleanings. That's only about a dollar a cleaning.

With the Scotch head-cleaning diskette kit, you could save yourself a lot more than just a service call. So try this remarkable kit today. For the name of



*A Scotch cleaning diskette shown  
before use, and after 15 cleanings  
of recording heads.*



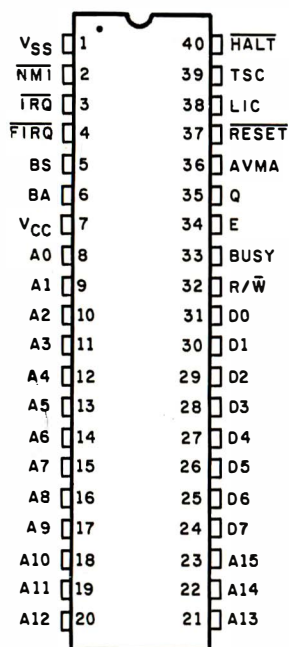
the dealer nearest you, call toll free: 800-328-1300.

(In Minnesota, call collect: 612-736-9625.) Ask for the Data Recording Products Division.

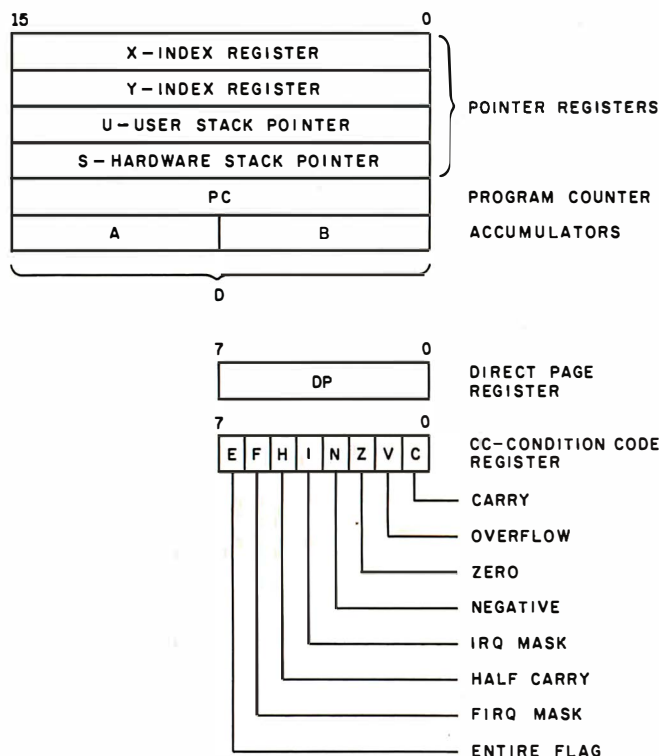
(Not yet available for Burroughs Mini-Disk II, Vydec or 96 TPI Drive.)



# 3M



**Figure 2:** Pin description of Motorola's MC6809E microprocessor. The device has several 16-bit instructions that, coupled with ease of programming and speed, make for a very powerful 8-bit processor.



**Figure 3:** Registers available in the 6809. Similar in architecture to the 6800, the 6809 has three extra registers to facilitate memory accesses: a direct page register, a user stack register, and a second index register. The instruction set is also more robust, with the addition of 16-bit add, subtract, and multiply operations.

Text continued from page 90:

BASICs now available. It has two 16-bit index registers and two 16-bit stack pointers, as well as two 8-bit accumulators that can be used as a double-precision 16-bit accumulator. It supports both position-independent code (code that can be executed anywhere in memory without reassembly) and reentrant (interruptible) code.

The video display is generated by the Motorola MC6847 VDG (video display generator). This is a 40-pin LSI (large-scale integration) part that reads from 1/2 K bytes to 6 K bytes of memory, depending on mode, to produce an analog video signal. This signal is fed to the MC1372 color-subcarrier modulator to get composite video, which is then modulated by the ASTEC video modulator to channel 3 or 4.

The Color BASIC interpreter is stored in an 8 K by 8 bit ROM (read-only memory). Its companion, Extended BASIC, comes in another ROM of the same type. The basic machine comes with only the first ROM; the extended ROM costs \$99 plus installation.

As mentioned, the computer comes with eight MCM4027 4 K-bit dynamic memory circuits. Tandy will upgrade your system to 16 K bytes by replacing these with MCM4116s (16 K-bit devices) for \$119. Or you can buy the system with 16 K bytes and the Extended BASIC ROM for \$599.

These memory circuits are controlled and refreshed by a special part, the MC6883 SAM (synchronous address multiplexer). It provides all the signals for the memory and the VDG and also provides the timing signals for the microprocessor.

The other I/O functions are all handled by parallel ports in the form of MC6821 PIAs (peripheral interface adapters). The keyboard is connected to these and is scanned and decoded in software. The serial port and cassette port are both derived from a single parallel line and are selected by software. The optional joysticks are encoded with an A/D (analog-to-digital) converter composed of a resistive-summing network hooked to a 6-bit parallel port and an LM339 comparator.

### The MC6809E Microprocessor

The third-generation MC6809E 8-bit microprocessor features several 16-bit operations. This puts it functionally between the 8- and the 16-bit processors. A description of the MC6809E signals appears in figure 2.

The programming model of the MC6809E is shown in figure 3. Three registers were added to the register set of the original MC6800:

- a direct page register
- a user stack pointer
- a second index register

There are two 8-bit accumulator registers, the A register and the B register, that are used for data manipulation and serve as holding registers for arithmetic calculations. The MC6809E has many 16-bit arithmetic operations, including additions, subtractions, loads, stores, and an 8 bit by 8 bit multiplication. The 16-bit arithmetic operations use both accumulators—with the A register treated

**"No one else gives you as many functions in a handheld DMM."**

**Now you can move up to Fluke."**

We've got great news for people who've been holding out for a high quality, high performance DMM at a moderate price: Fluke's new nine-function model D 804 is now available at select electronics supply stores.

With a suggested list price of only \$229 and features you won't find in any other handheld DMM, the D 804 is an exceptional value. Here's why.

**Logic level and continuity testing:** A real time-saver for troubleshooting passive circuits in pcb's, cables, relay panels and the like. The D 804 has a switch-selectable audible tone and visual symbols to indicate continuity or logic levels.

**Direct temperature readings in °C:** Used with any K-type thermocouple,

the D 804 delivers fully-compensated readings in °C from -20°C to +1265°C, for checking heating and refrigeration systems.

**Peak hold feature captures transients:** A short-term memory in the D 804 captures and holds peak readings.

**And more:** 0.1% basic dc accuracy, conductance, 26 measurement ranges, battery, safety-designed test leads and a one year parts and labor warranty. A full line of accessories is also available to extend the measurement capabilities of your DMM.

Ask your dealer about the powerful, versatile D 804 and the rest of Fluke's new Series D line of low-cost digital multimeters.



**From the world leader in DMM's. Now we've designed one for you.**



\*Suggested U.S. list price  
For technical data circle no.

If your dealer doesn't carry Series D Multimeters yet, call this number. We'll be happy to tell you who does. 1-800-426-9182

**FLUKE**  
®

## Efficient position-independent code can be written using the capabilities of the MC6809E.

as the most significant byte. When the A and B registers are concatenated, they are referred to as the D register.

The DP (direct page) register is one of the new registers. Its contents form the high-order byte of the address bus during instructions utilizing the direct addressing mode. This register may be changed to allow direct addressing anywhere in the 64 K-byte memory map, as compared to the MC6800, which allowed direct addressing only in the first 256 bytes of the memory map. Direct addressing uses the immediate byte of the instruction as a 1-byte pointer into a single 256-byte "page" of memory. This shortens instruction execution time because the high-order byte is furnished by the direct page register. MC6800 source code compatibility is ensured because actuation of the RESET line clears the direct page register.

The MC6809E has four 16-bit pointer registers available to the user. The U and S registers support stack-oriented instructions such as PSH and PUL. The S register is used as the hardware stack pointer to support interrupts and subroutine calls. The U register gives the designer the capability of maintaining an independent stack.

The other two registers, X and Y, are intended primarily for use as index registers, although special indexing

modes allow them to be used to maintain additional stack areas. All four pointer registers can be used as index registers, allowing indexed addressing, indirect addressing, or indexed indirect addressing. These pointer register capabilities permit the MC6809E to function efficiently as a stack processor, allowing the microprocessor to support graphics, high-level languages, and modular programming techniques.

The microprocessor's program counter, while primarily used by the processor to address the next instruction, may be referenced as an index register, thus allowing addressing relative to the program counter.

The condition code register defines the state of the microprocessor such that conditional branch instructions may be used. The condition code register also allows masking of some of the interrupts.

The register set is manipulated with the 59 instructions shown in table 2. Over 1460 different op codes are available to the programmer if all modes of the instructions are considered. However, only the 59 mnemonics must be remembered when using an assembler.

Efficient PIC (position-independent code) can be written using the capabilities of the MC6809E. The program counter can be used as a pointer to provide offsets within the program. For example, when a portion of PIC is executed, the stack addresses, peripheral addresses, and other addresses may be specified as offsets from the current program counter address.

Other key factors in effective position-independent code writing are the use of long and short relative-branch

*Text continued on page 102*

## Why Do Professionals Prefer

### BECAUSE

- Unique software • Technical support • Quick delivery • Established company • Release 2 CP/M<sup>2</sup> (some packages under UNIX<sup>3</sup> and TRSDOS<sup>4</sup>)
- Quality software • In-house expertise • Fast response • User orientation • Competitive prices
- Customer service • Verbatim<sup>5</sup> media • Onyx hardware (CP/M and UNIX versions).



### BECAUSE

Unique swift routing Cybernetics response system gives you no-nonsense technical answers that save you time. Call: (714) 848-1922.



- NEW RM/COBOL<sup>1</sup> applications:
  - Order Entry/Inventory • Receivables • Payables • General Ledger • Financial Modeling • Client Accounting—and more on the way!
- NEW CBASIC2<sup>2</sup> applications:
  - REAP (Real Estate Acquisition Programs).

**Business  
Medical  
Real Estate  
Computer Systems**

## Software from Cybernetics?

**RM/COBOL**—The new standard for microcomputer COBOL!! The only COBOL for CP/M (also on TRSDOS & UNIX) with alternate keys (multi-key ISAM), CRT screen handling, interactive debug, and the most useful Level 2 features. Compatible with RSCOBOL<sup>3</sup>—but runs faster.

Plus existing CBASIC2 packages:

- APH<sup>1</sup> (Automated Patient History)
- Osborne & Assoc.—Payroll • Payables/Receivables
- General Ledger
- NAD<sup>4</sup> (Name and Address)
- PMS (Property Management System)

**Inquire for details**

Trademarks of: <sup>1</sup>Ryan-McFarland Corp., <sup>2</sup>Compiler Systems, Inc., <sup>3</sup>Digital Research, <sup>4</sup>Bell Telephone Laboratories, Inc., <sup>5</sup>Tandy Corp., <sup>6</sup>Verbatim, Inc., <sup>7</sup>Cybernetics, Inc., <sup>8</sup>Structured Systems Group, Inc., <sup>9</sup>Small Business Applications, Inc.

And system software packages:  
MAGIC WAND<sup>8</sup> Editing/Word Processing  
CBASIC2 Compiler BASIC  
QSORT<sup>9</sup> Soft Merge Package

**TRS-80<sup>6</sup>, Model II CP/M**—The fastest Mod II CP/M with the most features. Outstanding teaching documentation for newcomers to CP/M, multiple CRT emulation, down loading package, support for CORVUS 10 Mb hard disk. Many additional user-oriented features.



Distributed in U.K. by:  
Microcomputer Applications Ltd.  
11, Riverside Court, Caversham, Reading, England  
TEL: (0734) 470425



8041 Newman Ave., Suite 208  
Huntington Beach, CA 92647  
(714) 848-1922

# C ~~AND~~ Pascal

## Efficiency ~~AND~~ Portability

## Flexibility ~~AND~~ Strong Typing

**Now you don't have to compromise!**

Whitesmiths Ltd. now offers portable language development systems for four families of computers. Approximately one thousand installations use our software.

We support complete versions of both C and Pascal, as compilers and cross-compilers. You get C automatically when you license Pascal, and you get native support with each cross-compiler. Test the software on your VAX before burning PROMs for your 68000 or 8080.

Whitesmiths Ltd. offers a variety of licensing arrangements, the simplest being a binary license for use on a single CPU. The full source code is available with internal documentation. Maintenance, training and sublicensing rights may also be obtained.

Call or write for more information.

Source Operating Systems	Target Machines			
	8080/Z80	LSI-11/PDP-11	VAX-11	M68000
<b>8080/Z80 CP/M</b>	C: \$630 Pascal: \$880	*	*	*
<b>LSI-11/PDP-11: Idris, Unix, RT11, RSX-11/M, RSTS/E, IAS</b>	C: \$1130 Pascal: \$1380	C: \$630 Pascal: \$880	*	C: \$1130 Pascal: \$1380
<b>VAX-11 Unix/V32 VMS</b>	C: \$1130 Pascal: \$1380	*	C: \$630 Pascal: \$880	C: \$1130 Pascal: \$1380
<b>M68000 VERSAdos</b>	*	*	*	C: \$630 Pascal: \$880

Idris is a trademark of Whitesmiths, Ltd. ■ Unix is a trademark of Bell Laboratories ■ CP/M is a trademark of Digital Research Company ■ VMS, RSX-11/M, RSTS/E, LSI-11, VAX, are trademarks of Digital Equipment Corporation ■ VERSAdos is a trademark of Motorola Corporation

\* Special Order

Protect your software investment.

# Whitesmiths, Ltd.

P.O. Box 1132 Ansonia Station New York, N.Y. 10023  
(212) 799-1200

## MORE FOR YOUR RADIO SHACK TRS-80 MODEL I !

- ★ **MORE SPEED**  
10-20 times faster than Level II BASIC.
- ★ **MORE ROOM**  
Compiled code plus VIRTUAL MEMORY makes your RAM act larger.
- ★ **MORE INSTRUCTIONS**  
Add YOUR commands to its large instruction set!  
Far more complete than most Forths: single & double precision, arrays, string-handling, more.
- ★ **MORE EASE**  
Excellent full-screen Editor, structured & modular programming  
Optimized for your TRS-80 with keyboard repeats, upper/lower case display driver, single- & double-width graphics, etc.
- ★ **MORE POWER**  
Forth operating system  
Interpreter AND compiler  
Internal 8080 Assembler  
(Z80 Assembler also available)  
VIRTUAL I/O for video and printer, disk and tape  
(10-Megabyte hard disk available)

# mmsFORTH

### THE PROFESSIONAL FORTH FOR TRS-80 MODEL I

(Over 1,000 systems in use)

MMSFORTH Disk System V1.9 (requires 1 disk drive & 16K RAM) ..... just **\$79.95\***  
MMSFORTH Cassette System V1.8 (requires Level II BASIC & 16K RAM) ..... **\$59.95\***

### AND MMS GIVES IT PROFESSIONAL SUPPORT

Source code provided  
MMSFORTH Newsletter  
Many demo programs aboard  
MMSFORTH User Groups  
Programming staff can provide advice, modifications and custom programs, to fit YOUR needs.

MMSFORTH UTILITIES DISKETTE: includes FLOATING POINT MATH (L2 BASIC ROM routines plus Complex numbers, Rectangular-Polar coordinate conversions, Degrees mode, more), plus a full Forth-style Z80 ASSEMBLER; plus a powerful CROSS-REFERENCER to list Forth words by block and line. All on one diskette (requires MMSFORTH, 1 drive & 16K RAM), .. **\$39.95\***

THE DATAHANDLER V1.1, a very sophisticated database management system operable by non-programmers (requires Disk MMSFORTH, 1 drive & 32K RAM); with manuals. .... **\$59.95\***

### FORTH BOOKS AVAILABLE

MICROFORTH PRIMER (comes with MMSFORTH) separately ..... **\$15.00\***  
USING FORTH — more detailed and advanced than above ..... **\$25.00\***  
THREADED INTERPRETIVE LANGUAGES—advanced, excellent analysis of MMSFORTH-like language ..... **\$18.95\***  
CALTECH FORTH MANUAL — good on Forth internal structure, etc ..... **\$10.00\***

\* — Software prices include manuals and require signing of a single-system user license. Add \$2.00 S/H plus \$1.00 per additional book; Mass. orders add 5% tax. Foreign orders add 15%. UPS COD, VISA & M/C accepted; no unpaid purchase orders, please.

Send SASE for free MMSFORTH information.  
Good dealers sought.

Get MMSFORTH products from your computer dealer or

### MILLER MICROCOMPUTER SERVICES (B3)

61 Lake Shore Road, Natick, MA 01760  
(617) 653-6136

### 8-BIT OPERATIONS

Mnemonic	Description
ABX	Add B register to X register unsigned.
ADCA, ADCB	Add memory to accumulator with carry.
ADDA, ADDB	Add memory to accumulator.
ANDA, ANDB	AND memory with accumulator.
ANDCC	AND immediate with condition code register.
ASLA, ASLB, ASL	Arithmetic shift left accumulator or memory.
ASRA, ASRB, ARS	Arithmetic shift right accumulator or memory.
BITA, BITB	Bit test memory with accumulator.
CLRA, CLRB, CLR	Clear accumulator or memory.
CMPA, CMPB	Compare memory with accumulator.
COMA, COMB, COM	Complement accumulator or memory.
DAA	Decimal Adjust A accumulator.
DECA, DECB, DEC	Decrement accumulator or memory.
EORA, EORB	Exclusive OR memory with accumulator.
EXG R1, R2	Exchange R1 and R2.
INCA, INCB, INC	Increment accumulator or memory.
LDA, LDB	Load accumulator from memory.
LSLA, LSLB, LSL	Logical shift left accumulator or memory.
LSRA, LSRB, LSR	Logical shift right accumulator or memory.
MUL	Unsigned multiply (8 bit by 8 bit = 16 bit).
NEGA, NEGB, NEG	Negate accumulator or memory.
ORA, ORB	OR memory with accumulator.
ORCC	OR immediate with condition code register.
PSHS (register list)	Push register(s) on hardware stack.
PSHU (register list)	Push register(s) on user stack.
PULS (register list)	Pull register(s) from hardware stack.
PULU (register list)	Pull register(s) from user stack.
ROLA, ROLB, ROL	Rotate accumulator or memory left.
RORA, RORB, ROR	Rotate accumulator or memory right.
SBCA, SBCB	Subtract memory from accumulator with borrow.
STA, STB	Store accumulator to memory.
SUBA, SUBB	Subtract memory from accumulator.
TSTA, TSTB, TST	Test accumulator or memory.
TFR R1, R2	Transfer register R1 to register R2.

### 16-BIT OPERATIONS

Mnemonic	Description
ADDD	Add to D accumulator.
SUBD	Subtract from D accumulator.
LDD	Load D accumulator.
STD	Store D accumulator.
CMPD	Compare D accumulator.
LDX, LDY, LDX, LDU	Load pointer register.
STX, STY, STS, STU	Store pointer register.
CMPX, CMPY, CMPU, CMPS	Compare pointer register.
LEAX, LEAY, LEAS, LEAU	Load effective address into pointer register.
SEX	Sign extend
TFR register, register	Transfer register to register.
EXG register, register	Exchange register to register.
PSHS (register list)	Push register(s) onto hardware stack.
PSHU (register list)	Push register(s) onto user stack.
PULS (register list)	Pull register(s) from hardware stack.
PULU (register list)	Pull register(s) from user stack.

Table 2: The 6809 instruction set.

## INDEXED ADDRESSING MODES

Mnemonic	Description
0, R	Indexed with zero offset.
[0, R]	Indexed with zero offset indirect.
,R+	Autoincrement by 1.
,R++	Autoincrement by 2.
[,R++]	Autoincrement by 2 indirect.
,-R	Autodecrement by 1.
,--R	Autodecrement by 2.
[,--R]	Autodecrement by 2 indirect.
n, P	Indexed with signed n as offset (n = 5, 8, or 16 bits).
[n, P]	Indexed with signed n as offset indirect.
A, R	Indexed with accumulator A as offset.
[A, R]	Indexed with accumulator A as offset indirect.
B, R	Indexed with accumulator B as offset.
[B, R]	Indexed with accumulator B as offset indirect.
D, R	Indexed with accumulator D as offset.
[D, R]	Indexed with accumulator D as offset indirect.

NOTE: R = X, Y, U, or S; P = PC, X, Y, U, or S. Brackets indicate indirection. D means use AB accumulator pair.

## 6809 RELATIVE SHORT AND LONG BRANCHES

Mnemonic	Description
BCC, LBCC	Branch if carry clear.
BCS, LBCS	Branch if carry set.
BEQ, LBEQ	Branch if equal.
BGE, LBGE	Branch if greater than or equal (signed).
BGT, LBGT	Branch if greater (signed).
BHI, LBHI	Branch if higher (unsigned).
BHS, LBHS	Branch if higher or same (unsigned).
BLE, LBLE	Branch if less than or equal (signed).
BLO, LBLO	Branch if lower (unsigned).
BLS, LBLs	Branch if lower or same (unsigned).
BLT, LBLT	Branch if less than (signed).
BMI, LBMI	Branch if minus.
BNE, LBNE	Branch if not equal.
BPL, LBPL	Branch if plus.
BRA, LBRA	Branch always.
BRN, LBRN	Branch never.
BSR, LBSR	Branch to subroutine.
BVC, LBVC	Branch if overflow clear.
BVS, LBVS	Branch if overflow set.

## 6809 MISCELLANEOUS INSTRUCTIONS

Mnemonic	Description
CWAI	Clear condition code register bits and wait for interrupt.
NOP	No operation.
JMP	Jump.
JSR	Jump to subroutine.
RTI	Return from interrupt.
RTS	Return from subroutine.
SEX	Sign extend B register into A register.
SWI, SWI2, SWI3	Software interrupts.
SYNC	Synchronize with interrupt line.

# FAST FASTER FASTEST

## IT'S YOUR CHOICE

You can sort fast using your present facilities, or you can do it faster with Racet's superb facilities, or you can use the fastest: SUPERSNAPP X. The heart of SUPERSNAPP X is a SUPER FAST in-memory sort routine that has been benchmarked against everything on the market and beats them all ... hands down.

SUPERSNAPP X is the most important component of SNAPP X EXTENDED-BUILT-IN FUNCTIONS which is a much needed set of additions to the Model II BASIC interpreter that will put time saving power at your fingertips. Let's compare (using random data) SUPERSNAPP X and Racet's GSF SORT for speed:

SORT	SUPERSNAPP X	RACET GSF
10,000 Integers	39 seconds	59 seconds
5,000 Singles	22 seconds	34 seconds
2,000 Strings	10 seconds	15 seconds

SUPERSNAPP X is guaranteed to be the FASTEST in memory SORT on the market or your money back. With it you also get these EXTENDED BUILT-IN FUNCTIONS: PEEK PEEKW POKE POKEV XDAT\$ XTIM\$ ETIM\$ FILES AND THE SPECIAL SCMD (SNAPP-COMMAND). PLUS: open "E". Set SCROLL PROTECTION. ERASE all ARRAYS in one command. Specify size and Blink rate of CURSOR. Long ERROR messages. Read from Video. Screen Read. Diskette ID's and more! If you want the FASTEST SORT on the market, you want SUPERSNAPP X. Don't waste time. Call or write today for SUPERSNAPP X. \$100.00

SNAPP, INC.  
SNAPP, INC.  
SNAPP, INC.  
SNAPP, INC.  
SNAPP, INC.

8160 Corporate Park Dr.  
Cincinnati, Ohio 45242



Call Toll Free

1-800-543-4628



Ohio residents

call collect (513) 891-4496

All products now available to run with TRSDOS 2.0.

Now available for Model III

**StackWork's**

# FORTH

A full, extended FORTH interpreter/compiler produces COMPACT, ROMABLE code. As fast as compiled FORTRAN, as easy to use as interactive BASIC.



## SELF COMPILING

Includes every line of source necessary to recompile itself.

## EXTENSIBLE

Add functions at will.

## CP/M\* COMPATIBLE

**Z80 or 8080 ASSEMBLER included**

Single license

Supplied with extensive user manual and tutorial:

\$175.00

Documentation alone: \$25.00

OEM's, we have a deal for you!

CP/M Formats: 8" soft sectored,  
5" Northstar, 5" Micropolis Mod II,  
Vector MZ, TRS-80 Mod II

Please specify CPU type.

Z80 or 8080

**All Orders and General Information:**

**SUPERSOFT ASSOCIATES**

**P.O. BOX 1628**

**CHAMPAIGN, IL 61820**

**(217) 359-2112**

**Technical Hot Line: (217) 359-2691**

**(answered only when technician is available)**



*SuperSoft*

**First in Software Technology**

\*CP/M registered trademark Digital Research

Text continued from page 98:

instructions and LEA (load effective address) instructions. The relative-branch instructions allow PCR (program counter relative) branching. When an 8-bit offset is used, control may be transferred anywhere within a 256-byte area. A 16-bit offset allows transfer of control anywhere in the entire 64 K-byte address space. The following are examples of the relative-branch instructions:

DECA           Decrement A Accumulator  
BEQ CAT       If A = 0 then go to CAT  
                 (CAT is within  $\pm 128$  bytes)

INCA           Increment A Accumulator  
LBEQ DOG      If A = 0 then go to DOG  
                 (DOG is within  $\pm 32,768$  bytes)

The LEA instructions work by calculating the effective address of an indexed instruction and storing it in the specified pointer register. This allows the programmer to use all the internal addressing hardware of the microprocessor. Below are some examples of the LEA instructions.

Instruction	Operation
LEAX 10,X	$X + 10 \rightarrow X$
LEAY A,Y	$Y + A \rightarrow Y$
LEAX D,Y	$Y + D \rightarrow X$
LEAU -10,U	$U - 10 \rightarrow U$
LEAX TABLE,PCR	(see text below)

Note how the registers may be incremented or decremented using the LEA instructions. In addition, registers may be used as offsets, as explained above. The program counter may be used as a pointer register with 8- or 16-bit signed offsets. As in relative addressing, the offset is added to the current contents of the program counter register to create the effective address.

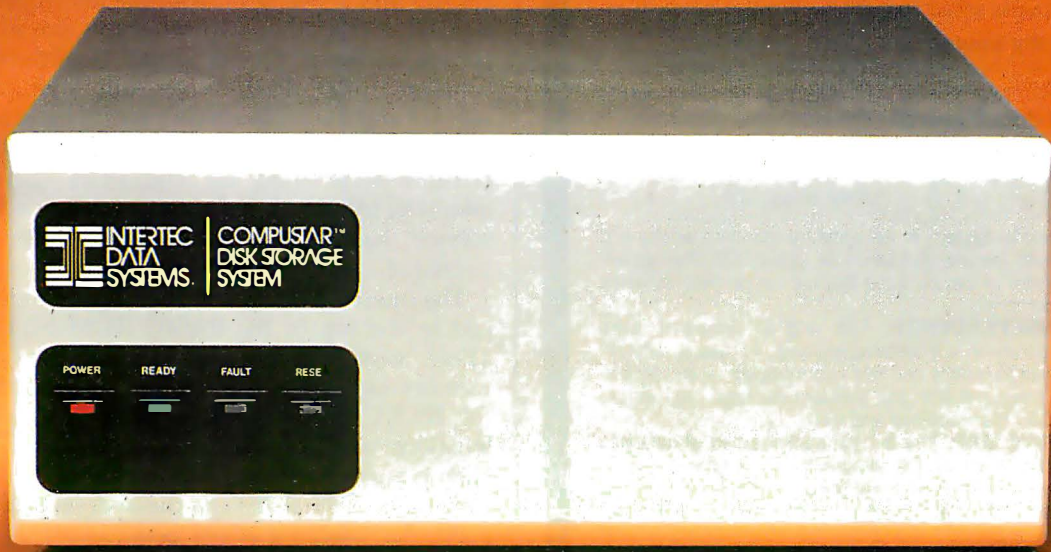
The last example calculates the offset of TABLE and adds it to the current value of the program counter register. This value is then placed in the X register. Tables related to a particular routine will maintain the same relationship after the routine is moved, since addresses are calculated when the code is executed.

Position-independent code is not without disadvantages, the major being that it generally takes 5 to 10 percent more space than nonrelocatable code. In addition, PIC usually takes 5 to 10 percent more time to execute. Typically, PIC would be used for utility programs where the run-time addresses are dynamically determined. This eliminates the need for a linking loader to perform a relocation operation. Common examples of this type of code would be machine-language utilities such as graphic routines and subroutines called by BASIC programs.

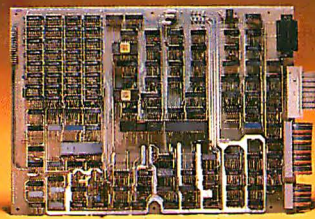
The MC6809E has several very interesting hardware features also. Referring to the signal descriptions of figure 2, note that not only does the microprocessor have 16 address lines, 8 data lines, and an R/W (read/write) line, but there are several other control lines. The MC6809E is synchronized to the video-display circuit by the two clock inputs, E and Q. These two clocks control internal operation of the microprocessor. Figure 4 shows typical timing diagrams for bus operations.

# SOLVE THE STORAGE SHORTAGE

## with ten multi-user megabytes



CompuStar's 8-inch Winchester



Intertec's exclusive 255 User Controller



CompuStar Cable Assembly

If you could think of just one way to improve our phenomenally popular SuperBrain, what would it be? More disk storage? Well, we already thought about it. And for only a few thousand dollars for a whopping 10 megabytes of lightning-fast storage, it's nothing short of another major breakthrough! From the company that wrote the book on price/performance . . . Intertec.

Our New CompuStar™ 10 Megabyte Disk Storage System (called a DSS) features an 8 inch Winchester drive packaged in an attractive, compact desktop enclosure. Complete with disk, controller and power supply. Just plug it into the Z80 adaptor of your SuperBrain and turn it on.\* It's so quiet, you'll hardly know it's there. But, you'll quickly be astounded with its awesome power and amazing speed.

The secret behind our CompuStar DSS is its unique controller/multiplexor. It allows many terminals to "share" the resources of a single disk. So, not only can you use the DSS with your SuperBrain, you can configure multiple user stations using our new series of CompuStar™ terminals, called Video Processing Units or VPU's™.

Four CompuStar VPU's are available. At prices starting at less than \$2,500. Some models are designed to operate as stand-alone microcomputers, with internal disk storage. Just like your SuperBrain. Each model features its own 64K of RAM and can be "daisy-chained" into a powerful multi-user network. Just connect one VPU into the next. Using easy-to-install cable assemblies. Connect up to 255 users in a single system. One at a time. As you need them.

Whether you need an extra 10 megabytes for your SuperBrain or an enormous multi-user network, the CompuStar™ DSS solves your storage shortage problems. Sensibly. And economically. Plus, your investment is protected by a nationwide service network with outlets in most major U.S. cities. Providing efficient on-site or depot maintenance.

Get a demonstration of this extraordinary new system today. Call or write now for the name and address of your nearest CompuStar dealer.

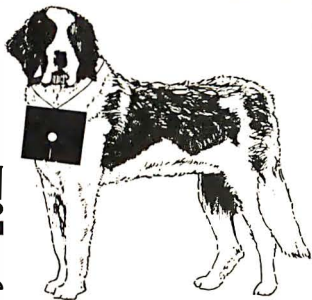


2300 Broad River Rd. Columbia, S.C. 29210  
(803) 798-9100 TWX: 810-868-2115

\*Some models require hardware/software modification.

# WE DELIVER!

**VANDATA**  
Business Software



Before you buy the programs that your company is going to depend on for its accounting, ask the following questions:

- Do I get the source code?** (Don't settle for less. You cannot make the smallest change without it.)
- Is it well documented?** (The Osborne documentation is the best.)
- Is it fully supported?** (If not, why not? What are they afraid of?)

The Osborne system is the industry standard accounting package, with literally thousands of users. We offer an enhanced version of that package that will run on most systems without recompiling.

**CRT INDEPENDENCE.** The original programs were designed to run on a Hazeltine terminal. To use a different CRT, you had to modify and test two modules — and recompile every program! With the Vandata package, you simply pick your CRT from a menu and run.

**FILE/DRIVE MAP.** The original package had all data files on the same drive as the programs. Ours allows you to dynamically specify the drive assigned to each file. In fact, you can change the drive assignments whenever you wish, to accommodate expanded file sizes or new hardware — all without recompiling!

**INTEGRATION.** The original AR and AP systems had to be changed and recompiled to feed journal entries to GL. Our installation program eliminates this hassle. It simply asks you if you want the systems integrated, and what your special account numbers are.

**SPEED.** The original programs used a binary search to access the GL account file. We use an enhanced technique that greatly cuts down on disk accesses, thus speeding up account lookups significantly in the GL, AR and AP systems.

**BUGS.** We have corrected a number of bugs in the original programs. If you find a bug in our programs, we'll fix it — and send you a \$20 reward! Our users are sent bug fixes in source form.

**MORE!** We have made many minor enhancements, and fixed many minor problems. We are committed to the ongoing support of our package. Vandata has been an independent software supplier for over seven years. Quality and support are our way of doing business.

General Ledger with Cash Journal .....	\$95
Accounts Receivable .....	\$95
Accounts Payable .....	\$95
Payroll with Cost Accounting .....	\$95
• All Four Packages (GL, AR, AP, PR) .....	\$295
Magic Wand (Super Word Processor!!) .....	\$345
Pearl Level III (best prog. tool available) .....	\$645
CBASIC-2 .....	\$110
TRS-80® MOD II CP/M® 2.2 (Pickles & Trout) .....	\$185
H89/Z89 CP/M® 2.2 (Magnolia Microsystems) .....	\$249

Formats: Std. 8", 5" NorthStar DD, TRS-80 MOD II®, H89/Z89. Manuals for GL, AR/AP, and PR are not included in price — add \$20 per manual desired (AR/AP are in one manual). CP/M® and CBASIC-2 required to run accounting software. Users must sign licensing agreement. Dealer inquiries invited.

To order call: (206) 542-8370  
or write: **VANDATA**  
17541 Stone Avenue North  
Seattle, WA 98133



CP/M® is a registered trademark of Digital Research.  
TRS-80® is a registered trademark of Radio Shack, Inc.



Three interrupt control lines,  $\overline{\text{NMI}}$ ,  $\overline{\text{FIRQ}}$ , and  $\overline{\text{IRQ}}$ , allow peripherals to request (demand!) support. Each interrupt causes the microprocessor to retrieve a vector from a specific address and use it to begin executing instructions.

The Color Computer uses  $\overline{\text{IRQ}}$  (interrupt request) and  $\overline{\text{FIRQ}}$  (fast interrupt request) to support real-time clock input (driven by the horizontal and vertical sync signal from the VDG) and to auto-start read-only memory cartridges. The  $\overline{\text{NMI}}$  (nonmaskable interrupt) input is reserved for use by the expansion port.

These interrupts function in different manners. The  $\overline{\text{NMI}}$  cannot be disabled or postponed under software control and is useful in real-time interrupt-servicing disk transfers. The other two interrupts are maskable under software control. One is "faster" than the other in that a response to an  $\overline{\text{FIRQ}}$  saves only the condition code register and the program counter on the stack. The other,  $\overline{\text{IRQ}}$ , "stacks" all the registers, as does  $\overline{\text{NMI}}$ . Separate interrupts were used for the PIAs (parallel interface adapters) to provide independent vector addresses for the service routines, thereby minimizing the software overhead.

The interrupt vectors in the Color Computer are mapped to the top of the BASIC ROM by the SAM chip. These vectors point to locations in programmable memory starting at address hexadecimal 100. On reset, the BASIC program stores jump instructions in these locations which point to the interrupt-service routines. Each jump call consists of 3 bytes: the jump extended op code (hexadecimal 7E) and the address of the routine. If a particular interrupt is not being used, all 3 bytes of its jump call would contain 00. See table 3 for a map of the interrupt-service addresses.

To define a jump call, program the 3 bytes with the required jump instruction. For example, if the SWI (software interrupt) service routine is located at hexadecimal 8000, the SWI jump call should be loaded with 7E 80 00. The following BASIC program would load the SWI jump call with this vector:

```
POKE 264,0
POKE 263,128
POKE 262,126
```

This example program defines the last byte of the jump call first, then the middle byte, then the first byte. This approach is required to prevent interrupt service until the jump call is completely defined. If the jump call was defined by starting with the first byte, an interrupt could be vectored to the wrong address. All interrupt-service routines should end with a hexadecimal 3B (Return from Interrupt op code) to restore the Color Computer to the proper state.

Two other MC6809E input-control signals used by the Color Computer are HALT and RESET. RESET is controlled by the pushbutton switch on the rear right-hand portion of the Color Computer. When the switch is pressed, RESET goes low to initiate a restart routine. The HALT input is connected to the expansion port. When HALT goes low, the MC6809E completes the current instruction, then releases the address, data, and R/W lines to the high-impedance state. This allows another device,

*Text continued on page 110*

Whatever happened to eenie, meenie, miney, mo?

I could be another Solomon...

This may put the Godfather out of business.

If only my heart would stop racing...

It must use Bayesian, weighted factor analysis, and...

Brilliant! Like a window into the future.

...a perfect gift for that urban cowgirl!

Maybe this'll help me choose a career...

I could use it to select my staff.

Would I rather have Winston's millions or Billy Joe's love?

Hmmmm... could be my ticket to the Boardroom.

Can't any of these people afford \$29.95?

Should I buy stock or commodities in this economy?



## When DecisionMaster<sup>TM</sup> speaks everybody listens.

Let's face it. We all have to make decisions. Decisions that can change our lives. Decisions that can make us happy or unhappy. Decisions that could win us fame or fortune. Now, DecisionMaster can help you make the best decisions of your life.

Use Bayesian theory to peer into the future...even if you've never heard of the Bayes' Rule. Do a complete weighted factor analysis...without knowing what one is. Use discounted cash flow to compare investment alternatives without bothering with present value tables. These and other sophisticated theories that were once the exclusive domain of professors and top business executives are *built into* DecisionMaster's algorithms...so you can use them at the touch of a key!

DecisionMaster is easy to use. It features:

- A fully documented manual developed by an authority in the field.
- A unique program-controlled cross reference system.
- A powerful formatted-screen data entry system.

You'll use DecisionMaster in hundreds of routine decisions, as well as more important ones such as • Buying a house • Changing jobs • Selecting investment • Evaluating insurance policies • Expanding product lines • Leasing vs. purchasing.

If you buy only one computer program this year, make it DecisionMaster. And when it speaks, listen.

# DECISIONMASTER<sup>TM</sup>

To order, see your software dealer or return this form with your check to: DecisionMaster, Dept. B4, 10428 Westpark, Houston, Texas 77042. Add \$1.50 for shipping and handling.

Diskette for: ☐ Apple II\* (32K) \$29.95 ☐ TRS-80\*\* (Level II-32K) \$29.95 ☐ TRS-80\*\* (Model II) \$39.95

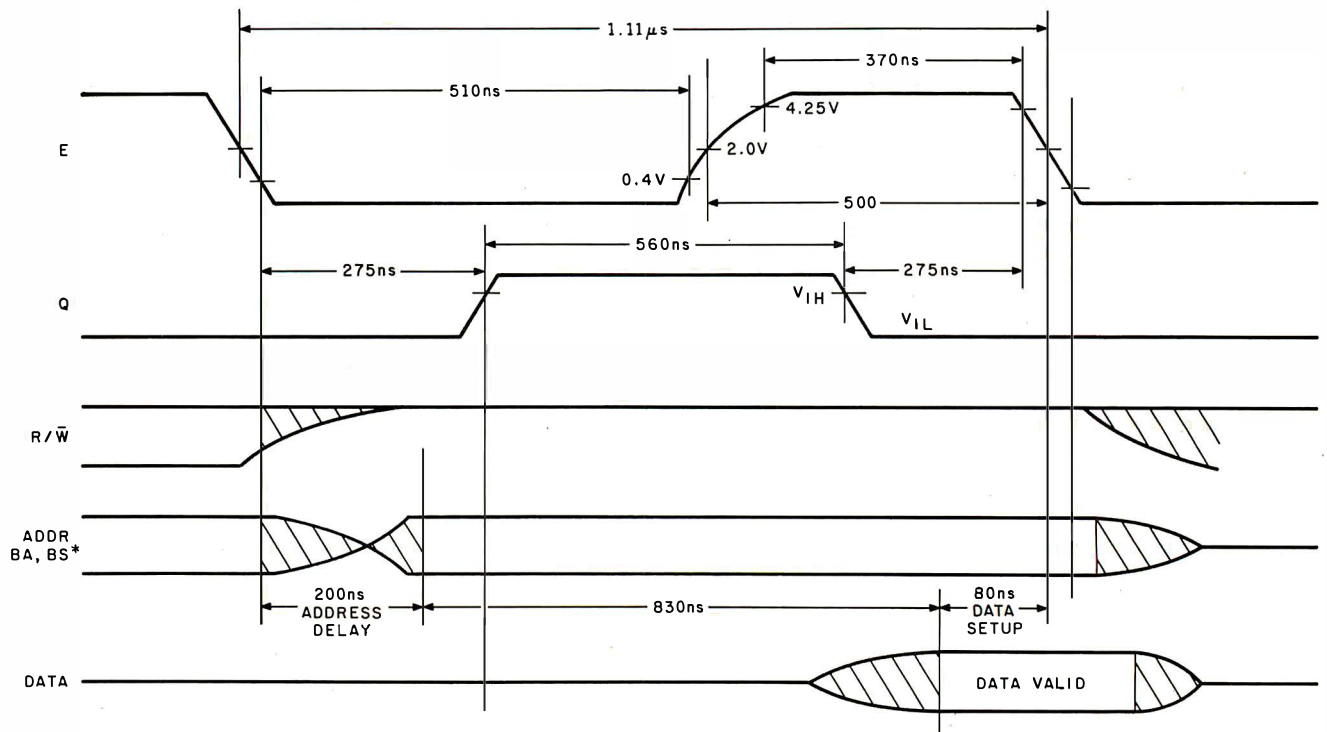
Name \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_

CHARGE by phone toll-free: 1-800-231-5768 Ext. 306  
(In Texas: 1-800-392-2348) or return this form:  
☐ VISA ☐ MasterCard Bank Code \_\_\_\_\_  
Account No. \_\_\_\_\_  
Signature \_\_\_\_\_  
Expiration Date \_\_\_\_\_

\*Apple II is a registered trademark of Apple Computers, Inc.  
\*\*TRS-80 is a trademark of the Radio Shack Division of the Tandy Corp.

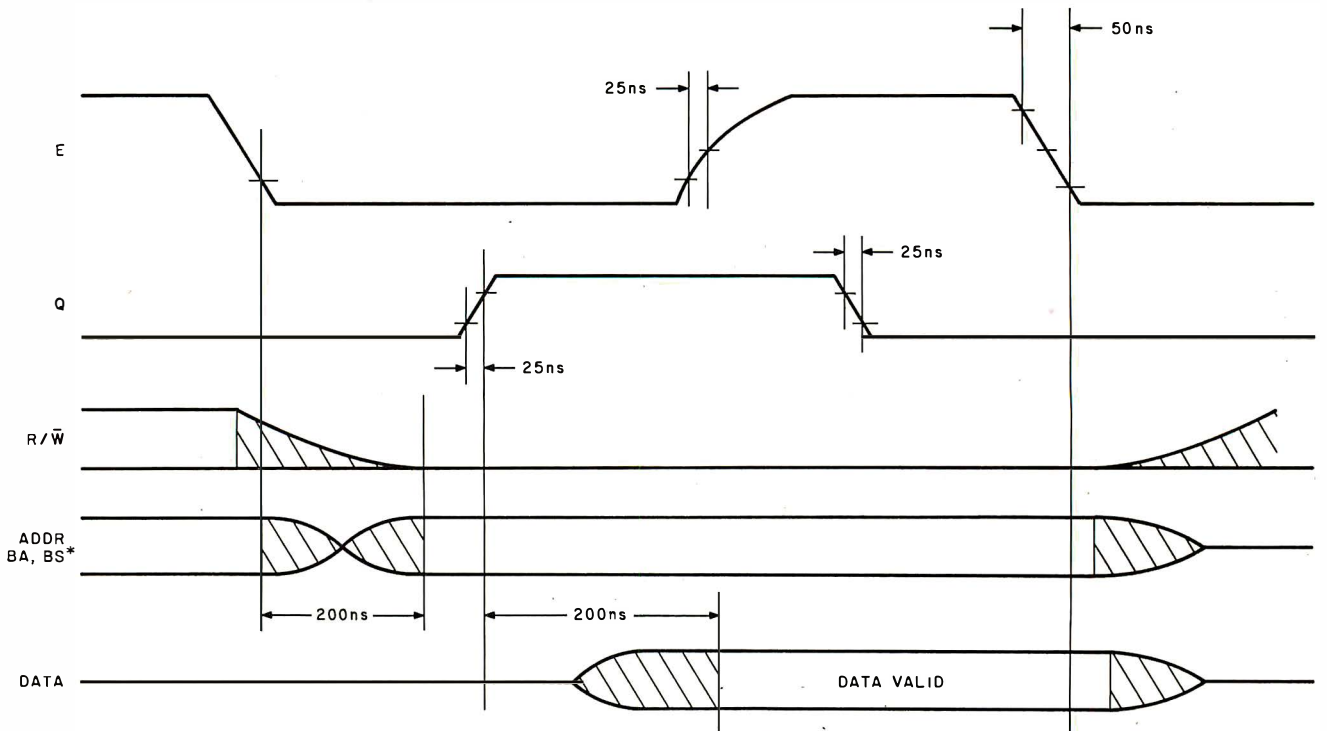
(4a)

## READ DATA FROM MEMORY OR PERIPHERALS



(4b)

## WRITE DATA TO MEMORY OR PERIPHERALS



**Figure 4:** Timing diagrams for 6809 bus operations. As with the 6800, both memory and peripherals are accessed in the same way and share the same address space. The complete instruction cycle for reads (figure 4a) and writes (figure 4b) is the same: approximately 1.1  $\mu$ s.

# the ABC's of CP/M®



## NEW! CP/M HANDBOOK MAKES CP/M EASY AS ABC

CP/M—the industry standard in operating systems: now Sybex makes it easy as ABC with a new step-by-step guide: THE CP/M® HANDBOOK (with MP/M™).

Gain a clear understanding of CP/M's basic operation, learn how to use the editor and assembler, then explore all versions of CP/M, including CDOS and multi-user MP/M.

Numerous sample programs, practical operating hints and handy reference tables make the CP/M HANDBOOK a must for anyone—from beginner to experienced programmer.

For sophisticated editing or simple copying, the new CP/M HANDBOOK gives you a hand—and makes CP/M easy as ABC.

**By Rodnay Zaks, 336 pp., Ref. C300, \$14.95**

CP/M® and MP/M™ are trademarks of Digital Research

### MAIL TO:



Dept. B31  
2344 Sixth Street,  
Berkeley, CA 94710  
Phone Orders: 415/848-8233

PLEASE SEND ☐ THE CP/M HANDBOOK \$14.95

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_

PLUS ☐ \$1.50/book UPS or ☐ 75¢/book 4th class mail  
(CA add tax)

TOTAL AMT. ENCLOSED \_\_\_\_\_

OR CHARGE MY ☐ VISA ☐ MC ☐ AM. EX.

CARD # \_\_\_\_\_

EXP. DATE \_\_\_\_\_

SIGNATURE \_\_\_\_\_

☐ PLEASE SEND ME YOUR FREE CATALOG



# FORMERLY "COMPUTERS'R'US" consumer computers

## UNBEATABLE MAIL ORDER DISCOUNTS!!

credit card users  
please read  
ordering information.

ORDER  
BY PHONE  
7 DAYS 9-6 PST

ORDERS FROM  
CALIFORNIA, ALASKA, HAWAII AND  
OUTSIDE OF U.S. (714) 698-8088

SALES INFORMATION, TECHNICAL, OR  
BACKORDERS, CALL (714) 698-0260

CONTINENTAL U.S. TOLL FREE ORDER LINE: **800-854-6654**

 **apple computer**  
Authorized Dealer

New FCC Approved  
Models. These prices  
reflect an increase in  
manufacturing costs.

**NEW!**  
CALL FOR  
AVAILABILITY  
AND PRICES.



### ACCESSORY SPECIALS

DISK II DRIVE (add-on).....	440
D.C. HAYES MICROMODEM II .....	319
GRAPHICS TABLET.....	655
INTEGER BASIC OR APPLESOFT II firmware card.....	149
SILENTYPE PRINTER with Interface card..	529

**APPLE II PLUS**  
OR APPLE II STANDARD  
**16K FOR \$1049**  
**48K FOR \$1189**  
**DISK II DRIVE \$529**  
w/controller & DOS 3.3  
**PASCAL SYSTEM \$425**  
**microsoft Z-80**  
**SOFTCARD \$299**

### APPLE II ACCESSORIES

CENTRONICS PRINTER Int. card.....	185
PARALLEL PRINTER Int. card	145
COMMUNICATION CARD w/conn. cable.....	185
HI-SPEED SERIAL Int. card..	145
DAN PAYMAR lower case kit.	55
MICROWORKS DS-65 DIGISECTOR.....	339
LAZER lower case adapter....	50
SSM AIO SERIAL/ PARALLEL kit.....	155
SSM AIO assembled & tested	190
SYMTEC LIGHT PEN SYSTEM	215
SYMTEC SUPER SOUND GENERATOR.....	225
SVA 8 INCH DISK CONTROLLER CARD.....	335
VERSA WRITER DIGITIZER SYSTEM.....	215
VIDEX VIDEOTERM 80 COLUMN CARD.....	315
VIDEX VIDEOTERM w/graphics ROM.....	335
LOBO DISK DRIVE ONLY....	385
LOBO DRIVE w/cont. & DOS 3.3.....	499
GPB IEEE-488 (1978) Int.	259
ARITHMETIC PROCESSOR CARD.....	335
SPEECHLINK 2000 (64 Word Vocab.).....	215
M&R SUP-R-MOD TV MODULATOR.....	30
CORVUS 10 MEGABYTE HARD DISK DRIVE SYSTEM w/pwr supply.....	4395
CORVUS CONSTELLATION..	595
16K MEMORY UPGRADE KIT (TRS-80, APPLE II, SORCERER.....)	60
ABT NUMERIC INPUT KEYPAD (specify old or new kybrd).	115
ALF MUSIC SYNTHESIZER....	235
BRIGHTPEN LIGHTPEN.....	32
M&R SUPER-TERMINAL 80 COLUMN CARD.....	335
SMARTERM 80 COL.....	335
<b>Mountain Computer</b> APPLE CLOCK/CALENDAR card.....	225
SUPERTALKER SD200 SPEECH SYNTHESIZER SYSTEM.....	245
ROMPLUS w/kybrd filter....	165
INTROLX-10 BSR REMOTE CONTROL SYSTEM.....	245
INTROLX-10 controller card only.....	165
ROMWRITER SYSTEM.....	155
MUSIC SYSTEM (16 voices/stereo).....	465
A/D-D/A 16 CHANNELS.....	319
EXPANSION CHASSIS (8 slots).....	555

### APPLE II SOFTWARE

VISICALC.....	120
CCA DATA MANAGEMENT..	85
THE CONTROLLER General Business System.....	519
THE CASHIER Retail Manage- ment & Inventory system	199
APPLEWRITER Word Processor.....	65
APPLEPOST MAILING List system.....	45
DOW JONES PORTFOLIO EVALUATOR.....	45
APPLE CONTRIBUTED Volumes 1-5 w/manuals..	30
DESKTOP/PLAN by DESKTOP COMPUTERS.....	85
APPLEBUG ASSEMBLER/ DISASSEMBLER.....	75
APPLE DOS TOOL KIT.....	65
PIMS Personal Information Management System.....	23
ADVENTURE by MICROSOFT.....	27
SUB-LOGIC FS-1 Flight Simulator.....	34
SARGON II Chess by HAYDEN (Cass.).....	27
FORTRAN.....	165
DOS 3.3.....	49
APPLE PLOT....	60
TAX PLANNER.....	65
SARGON II Chess on Diskette.....	32
TRILOGY OF GAMES.....	27
SPACE GAME ALBUM.....	38
SPACE INVADER (Cass.)....	18
SPACE INVADER (Disk)....	23
SYBEX APPLE-80 8080 Simulator.....	17
FORTH II by PROGRAMMA SOFTWARE.....	45
SINGLE DISK COPY ROUTINES.....	17
APPLEBUG DEBUGGER.....	27
APPLESOFT UTILITY PRO- GRAMS BY HAYDEN.....	27
The CORRESPONDENT.....	35
ASTEROIDS IN SPACE.....	19
HEAD-ON.....	25
3-D ANIMATION PACK.....	53
BATTLESHIP COMMANDER.....	23
FASTGAMMON.....	26
STAR CRUISER.....	24
TRANQUILITY BASE.....	24

More software available  
Please write us for a list.

# CONSUMER COMPUTERS' R'US

FORMERLY "COMPUTERS' R'US"

## UNBEATABLE MAIL ORDER DISCOUNTS!!

INTERNATIONAL CUSTOMERS:

**TELEX 695-000**

ANSWER "BETA" ATTENTION "CRUS"

COMING SOON...

SALES AGENTS IN:

LONDON PARIS BERLIN CAIRO RIYADH JOHANNESBURG  
HONG KONG TOKYO SYDNEY MEXICO CITY

### EXIDY



Please Call For Best Price

**SORCERER II COMPUTER**

16.32K & 48K VERSIONS AVAILABLE  
S-100 EXPANSION UNIT..... 375  
WORD PROCESSING PAC..... 179  
DEVELOPMENT PAC..... 89

### PMC-80



**THE TRS-80 'WORK-ALIKE'**  
**16K LEVEL II ONLY \$579**

Completely compatible with Radio Shack TRS-80 Level II software and peripherals. Features include: Level II Basic, Video & Ch. 3 TV output. Built in Cassette, 40 pin interface conn., 16K User RAM memory, Expandable to 48K.

For more information, please call or write.

### ATARI



**16K FOR \$799**  
**ATARI 800**

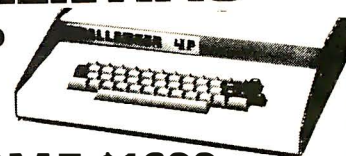
PERSONAL COMPUTER SYSTEM

400 COMPUTER.....	479
820 PRINTER (40 col.).....	459
810 DISK DRIVE.....	559
410 PROGRAM RECORDER.....	59
815 DUAL DISK DRIVE.....	1199
822 THERMAL PRINTER (40 col.).....	369
825 PRINTER (80 col. imp.).....	795
850 INTERFACE MODULE.....	175
ATARI 16K RAM MODULE.....	155
LIGHT PEN.....	65
ACOUSTIC MODEM (CAT).....	169
COMPUTER CHESS.....	35
SPACE INVADERS.....	19
STAR RAIDERS.....	49
SUPER BREAKOUT.....	35
3-D TIC-TAC-TOE.....	35
VIDEO EASEL.....	35
MUSIC COMPOSER.....	49
VISICALC DISK.....	129

### OSI

**OHIO SCIENTIFIC**

**C4P \$799**



**C4PMF \$1699**

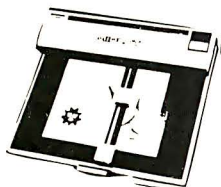


**CIP MOD II \$449**

	Cassette	Disk
SPACE INVADERS.....	19	29
SARGON II.....	30	35
FORTH.....	N/A	69
OS 65-D V3.3.....	N/A	79
MDMS PLANNER.....	N/A	100
GRAPHICS I.....	N/A	35
DAC I.....	N/A	45
ASSEMBLER/EDITOR.....	40	N/A
EXTENDED MONITOR.....	20	N/A
PASCAL & FORTRAN (4P & 8P only).....	N/A	450

When ordering please specify system.

### PLOTTERS



**\$1095 only**

**WATANABE MIPLLOT**

for more info please call or write

### VIDEO MONITORS

LEEDEX VIDEO 100.....	139
SANYO 9" B&W.....	165
SANYO 12" B&W.....	255
PANACOLOR 10" COLOR.....	329
NEC 12" HI-RES COLOR.....	875
NEC 12" LO-RES COLOR.....	399
NEC 12" GREEN PHOSPHOR(P31).....	239
TELEVIDEO 912B&C.....	698
TELEVIDEO 920B & C.....	745

### PRINTERS

ANADEx DP-8000.....	775
ANADEx DP-9500.....	1350
BASE 2.....	649
CENTRONICS 737.....	825
PAPER TIGER IDS-460 w/graphics.....	1195
PAPER TIGER IDS-440 w/graphics.....	895
NEC SPINWRITER.....	2550
TRENDCom 200.....	519
SILENTYPE W/Int.....	515
EPSON TX-80 w/graphics.....	729
EPSON MX-80 132 col.....	620
QUME SPRINT 5.....	2550

**ORDERING INFORMATION:** Phone Orders invited using VISA, MASTERCARD, AMERICAN EXPRESS, or bank wire transfers. VISA & MC credit card service charge of 2%. AE credit card service charge of 5%. Mail orders may send charge card number (include expiration date) cashiers check, money order or personal check (allow 10 business days to clear.) Please include a telephone number with all orders. Foreign orders (excluding Military PO's) add 10% for shipping all funds must be in US dollars (letters of credit permitted) Shipping, Handling and Insurance in U.S. add 3% (minimum \$4.00). California residents add 6% sales tax. Our low margins prohibit us to send COD or on purchase orders or open account (please send for written quotation.) All equipment is subject to price change and availability. Equipment is new and complete with the manufacturer warranty. We do not guarantee merchantability of products sold. All returned equipment is subject to a 15% restocking fee. We ship most orders within 2 days.

WE ARE A MEMBER OF THE BETTER BUSINESS BUREAU AND THE CHAMBER OF COMMERCE.

RETAIL STORE PRICES MAY DIFFER FROM MAIL ORDER PRICES.

PLEASE SEND ORDERS TO:

CONSUMER COMPUTERS MAIL ORDER, 8314 PARKWAY DRIVE, GROSSMONT SHOPPING CENTER NORTH, LA MESA, CA. 92041

Interrupt Source	Address of Interrupt Vector (hexadecimal)	Indirect Routine Call Address (hexadecimal)	Contents of Indirect Routine Call (hexadecimal)	
Reset	FFFE	A027	none	direct call to restart
NMI	FFFC	0109	undefined	not used
SWI	FFFA	0106	undefined	not used
IRQ	FFF8	010C	A9B3	Extended BASIC uses 894C to update real-time clock.
FIRQ	FFF6	010F	A0F6	not used
SWI2	FFF4	0103	undefined	not used
SWI3	FFF2	0100	undefined	not used

**Table 3: Interrupt vectors for Color Computer BASIC.** At the reception of an interrupt, control is transferred to a service routine via a call to an address stored near the top of the 64 K address space (occupied by the BASIC ROM). The address points to a 3-byte jump instruction (loaded into programmable memory when BASIC is initialized); that, in turn, points to an interrupt-handling routine.

Bus Available Signal	Bus Status Signal	Machine State
low	low	Normal (running)
low	high	Synchronize Acknowledge
high	low	Interrupt Acknowledge
high	high	Halt/Bus-Grant Acknowledge

**Table 4: The four possible machine states.** The Bus Available and Bus Status signals can be decoded to detect when the bus is not being used by the processor.

Text continued from page 104:

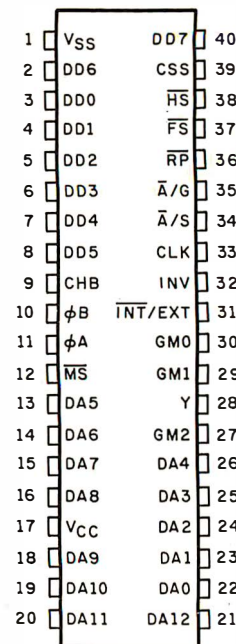
such as a DMA (direct-memory access) controller, to control the bus.

Since the microprocessor is not halted until completion of the current instruction, the external bus controller has to wait 20 bus cycles before driving the bus. This delay is required because the longest execution time for an MC6809E instruction is 20 cycles for a CWAI instruction (see table 2).

This delay could have been minimized if the BA and BS lines were brought out to the expansion port. BA and BS (Bus Available and Bus Status) indicate one of four machine states. These four states and the BA and BS signal combinations are shown in table 4.

Of the four states, the *Halt/Bus-Grant Acknowledge* is the only one pertinent to the design of the Color Computer. The *Normal* state indicates that the microprocessor is executing code. The *Synchronize Acknowledge* state, which allows the processor to be synchronized to an external event, is not required in the Color Computer. Nor is the *Interrupt Acknowledge* state, which indicates that vector fetches are occurring.

Four other MC6809E signals were ignored by the Color Computer's designers: TSC, AVMA, BUSY, and LIC. TSC (Three State Control) is used to put the buses into the high-impedance state for cycle-stealing operations.



**Figure 5: Pin description of Motorola's MC6847 Video Display Generator.** In concert with the Synchronous Address Multiplexer (see figure 6), this device interprets the contents of a block of memory to create a color display (using either an internal character generator or an external one). The output signal is converted to composite video by an MC1372, while a device built of discrete components modulates the signal to radio frequencies for reception on a standard television.

This type of operation is typically used for DMA or dynamic-memory refresh and is not needed in the Color Computer.

AVMA, BUSY, and LIC are intended primarily for use in multiprocessor systems (which the Color Computer is not). AVMA (Advanced Valid Memory Access) is the signal indication that the processor will use the bus during the next cycle. The BUSY output provides the "in-divisible" memory indication required for a "test and set" operation (operations of this type are required for efficient multiprocessor support on a common bus). LIC (Last Instruction Cycle) indicates that the first byte of an op code will be latched at the end of the present bus cycle.

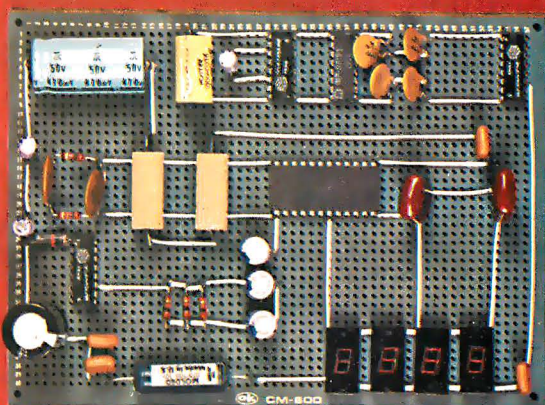
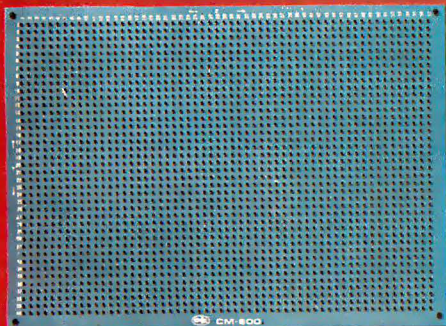
The MC6809E was the best choice of the microprocessors available for use when the Color Computer was designed. The external clock inputs allow the microprocessor to be synchronized to the video display to allow interleaved memory accesses. In addition, the power of the MC6809E instruction set allows the efficient graphics drivers supported by the Extended BASIC.

### The Video Display and the Memory Controller

The "Color" in Color Computer comes from the MC6847 Video Display Generator. This device can display information stored in memory using a variety of alphanumeric, semigraphic, and graphic modes. To understand how it works, refer to the signal description shown in figure 5. Normally the address lines DA0 thru DA12 would be connected to a block of programmable memory (usually static devices such as MCM2114s) shared with the microprocessor. Depending on the mode selected, the VDG would read the memory and, taking



# CM-600 Circuit Mount



CM-600 \$6.95\*  
RW-50 \$2.98\*

## NEW CM-600 SOLDERLESS PROTOTYPE BOARD

CM-600 is a unique system for solderless construction of circuit prototypes, useful to both engineers and hobbyists. The CM-600 is a neoprene board  $4\frac{1}{2}$ " (114mm) x 6" (152mm) with 2280 holes on .100" (2.54mm) centers. Standard components including DIP's are mounted by simply inserting leads into the holes in the long life neoprene material. Interconnections are easily made using 20 or 22 AWG (0,8 or 0,65mm) wire jumpers. Positive contact is assured by the elasticity of the hole, which compresses the leads together. To remove components or leads, simply pull out. This facilitates easy circuit changes making it ideal for breadboarding experimental circuits. CM-600 also features numbered rows and columns for easy reference.

Accessory Kit RW-50 contains 50 pcs of AWG 20 (0,8mm) insulated jumper wires of assorted lengths from  $\frac{1}{2}$ " (13mm) to 4" (100mm). Both ends are stripped and bent 90° for easy insertion. In stock directly from

**OK Machine & Tool Corporation**  
3455 Conner St., Bronx, N.Y. 10475 U.S.A.  
Tel. (212) 994-6600 Telex 125091

\* Minimum billings \$25.00, add shipping charge \$2.00  
New York State residents add applicable tax

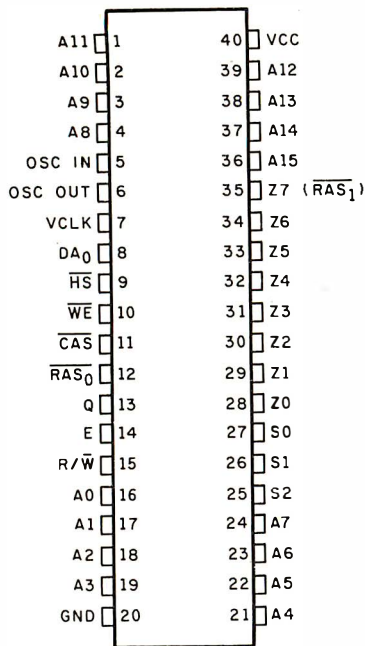


Figure 6: Pin description of Motorola's MC6883 Synchronous Address Multiplexer. This device provides the complex timing signals required by the microprocessor and for refresh of dynamic memories, as well as multiplexing addresses going into the memories. The various programmable modes of the video-display generator are provided for so that the SAM can help to refresh the video display. (This occurs during the portions of instruction cycles that the processor does not access memory.)

the information off its data lines (DD0 thru DD7), it would format and shift out video information to its companion part (the MC1372 Color Television Modulator) to be transmitted to a TV receiver.

This method of using the part is fine, but it has a few drawbacks. First, there needs to be a way to allow the microprocessor to write its output data to memory. This means that there must be three-state buffers between the microprocessor bus and the VDG bus (and logic to control them). A control pin on the VDG, Memory Select (MS), must be used to put the VDG's address lines in the high-impedance state when the processor accesses the memory.

One side effect of this is that the VDG shift registers will be filled with the data from its data bus as usual, except that the address lines are under the control of the microprocessor, and so the data that gets sent out on the video lines is incorrect. This results in "sparkles" of random color on the TV screen and can be annoying when you are trying to move your TIE fighter out of enemy gunshots!

Second, there is only one block of memory for the VDG to "look" at. In trying to implement computer animation, it would be nice to allow the microprocessor to draw one picture while another is being displayed. Then you would simply swap memory pages and, voilà, the horse moves! You can't do this with the system outlined above unless you resort to fancy hardware.

Of course, both of these problems can be overcome. We have seen it done with an entire board full of TTL (transistor-transistor logic) packages but this is expensive and not for the faint of heart. Fortunately, these problems have a solution in the form of another LSI device from—you guessed it—Motorola. The MC6883 SAM (Synchronous Address Multiplexer) is a 40-pin TTL part that marries the MC6809E and the MC6847 to some dynamic programmable memory.

### SAM, the Synchronous Address Multiplexer

The little jewel called the SAM should really interest computer experimenters. In the first place, it provides the clock signals needed by the microprocessor. The E and Q clocks are derived from the 14.31818 MHz crystal—they are normally 895 kHz—but this can be changed, as we will see. Secondly, the SAM also provides RAS (row-address strobe) and CAS (column-address strobe) signals for dynamic-memory refresh. As anyone who has tried to design a dynamic-memory board can tell you, it isn't easy; and one of the hardest things is deriving RAS and CAS and hiding the refresh cycle from the processor. The SAM does it all and could do it even without a VDG. A complete memory board could be designed around this device even if you didn't want a video display. A signal description of the MC6883 is given in figure 6.

To conserve the number of pins on a dynamic-memory circuit the address is multiplexed in 6-bit pieces (7 bits for 16 K-bit devices). The SAM takes all the microprocessor address lines, multiplexes them to the memory, and controls RAS, CAS, and WE (Write Enable). A typical read cycle is shown in figure 7.

The microprocessor puts out an address to read a location in the dynamic memory. The SAM splits this address into the row address and the column address. First the row address is presented to the memory on the output

INTRODUCING

MULTIPLE APPLICATION PROCESSING SYSTEMS

## MP/M™ USERS GROUP

Digiac Corporation, a major manufacturer and supplier of automated Educational Training Systems, is proud to announce the formation of **MAPS, a National MP/M Users Group** which will provide all MP/M users with a vehicle to exploit MP/M's benefits.

### MP/M SUPPORT PRODUCTS

Digiac is supporting MP/M with a series of exclusive S100 products:

- **Universal MP/M Support Module**
- **MP/M XIOS Configurations for popular Disk Systems**
- **MP/M Multibank Memory Module**
- **CT-80 Multi-Workstation System**

For Additional Information:  
Contact Lorraine Keckeisen  
**MAPS**  
Commercial Products Div.  
**DIGIAC CORPORATION**  
175 Engineers Road  
Smithtown, New York 11787  
Phone (516) 273-8600  
MP/M is a trademark of the Digital Research Corporation

# First compare quality. Then compare cost.

## Morrow Designs' 10 megabyte hard disk system: \$3,695.

### MORE MEMORY. LESS MONEY.

Compare Morrow Designs' DISCUS™ M26™ hard disk systems to any system available for S-100 or Cromemco machines. First, compare features. Then, compare cost per megabyte. The M26 works out to under \$200 a megabyte. And the M10 is about half the cost of competing systems.

### COMPLETE SUBSYSTEMS.

Both the M10 (8"), and the M26 (14"), are delivered complete with disk controller, cables, fan, power supply, cabinet and CP/M® operating system. It's your choice: 10 Mb 8" at \$3,695 or 26 Mb 14" at \$4,995. That's single unit. Quantity prices are available.

### BUILD TO FOUR DRIVES.

104 Megabytes with the M26. 40+ megabytes with the M10. Formatted. Additional drives: M26: \$4,495. M10: \$3,195. Quantity discounts available.

### S-100, CROMEMCO AND NORTH STAR\*

The M26 and M10 are sealed-media hard disk drives. Both S-100 controllers incorporate intelligence to supervise all data transfers through four I/O ports (command, 2 status and data). Transfers between drives and controllers are transparent to the CPU. The controller can also generate interrupts at the completion of each command ... materially increasing system throughput. Sectors are individually write-protectable for multi-use environments. North Star or Cromemco? Call Micro Mike's, Amarillo, TX, (806) 372-3633 for the software package that allows the M26 and M10 to run on North Star DOS. MICAH of

## Morrow Designs' 26 megabyte hard disk system: \$4,995.



Sausalito, CA, (415) 332-4443, offers a CP/M expanded to full Cromemco CDOS compatibility.

### AND NOW, MULT-I/O.™

Mult-I/O is an I/O controller that allows multi-terminal and multi-purpose use of S-100 and Cromemco computers. Three serial and two parallel output ports. Real time clock. Fully programmable interrupt controller. Designed with daisy-wheel printers in mind. Price: \$299 (kit), \$349 assembled and tested.

### MAKE HARD COMPARISONS.

You'll find that Morrow Designs' hard disk systems offer the best price/performance ratios available for S-100, Cromemco and North Star computers. See the M26 and M10 hard disk subsystems at your computer dealer. Or, write Morrow Designs. Need information fast? Call us at (415) 524-2101.

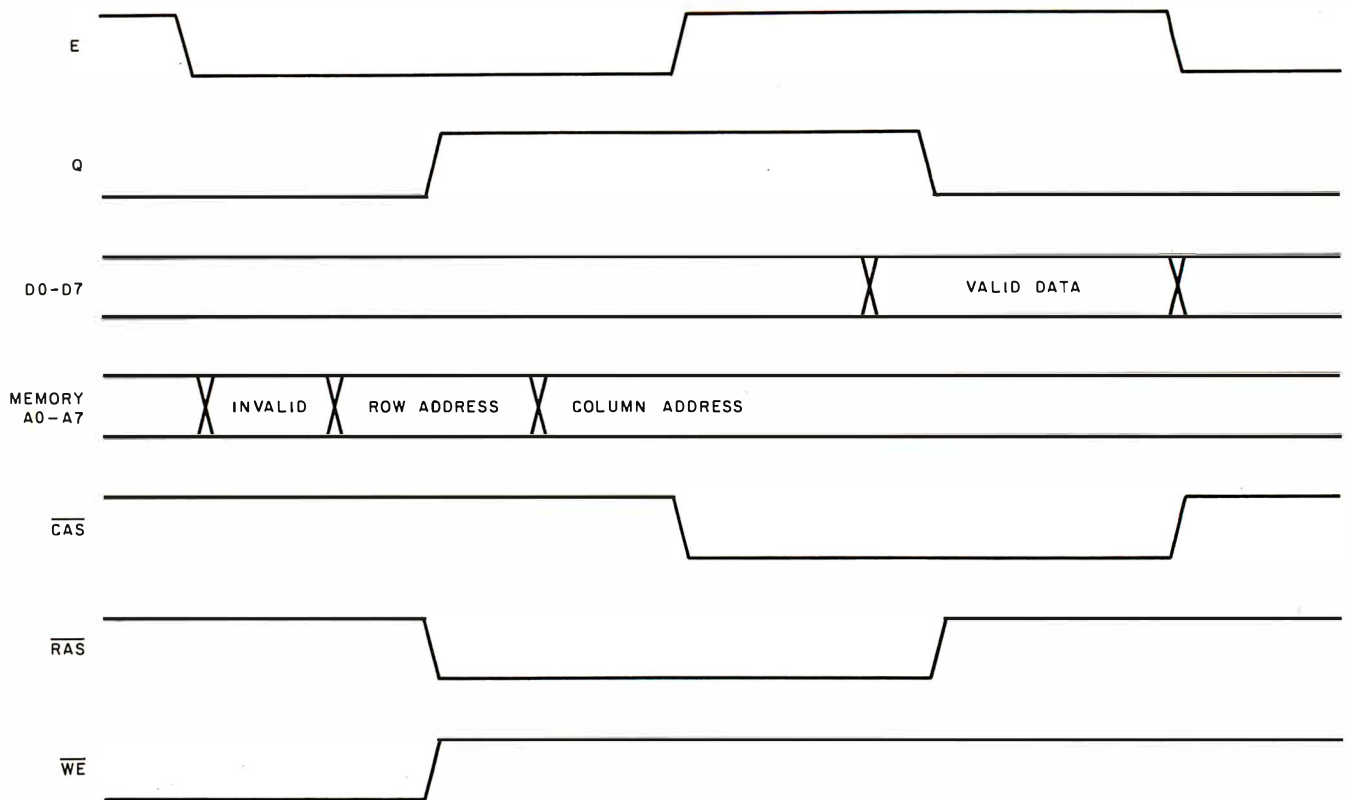
**Look to Morrow  
for answers.**

## MORROW DESIGNS

5221 Central Avenue  
Richmond, CA 94804

\*CP/M is a trademark of Digital Research Corp.  
\*Cromemco is a trademark of Cromemco, Inc.  
\*North Star is a trademark of North Star Computers, Inc.





**Figure 7:** Typical read cycle of 4116-type dynamic memory circuits. To reduce the number of pins required, the memory device interprets the address being accessed as two sets of 7 bits that come at different times over the same set of pins. The memory cells of each device are arranged in an array, and the two sets of bits define a row address and a column address. When a set of address bits is valid, either the CAS (column-address strobe) or the RAS (row-address strobe) signal is sent to latch in the respective portion of the address.

lines Z0 thru Z5, and the falling edge of RAS causes the memory to latch this part of the address into internal decoders. The SAM then puts out the column address and drops CAS. This causes the memory device to latch the column address and decodes the location in the internal memory array. The memory's stored data is then put on the data-output lines and through a buffer to the microprocessor.

Now, what about refreshing? Dynamic-memory circuits are made of small capacitor cells and, unless they are refreshed, the charge that represents the stored information will bleed off in a very short time. The memories are constructed such that merely accessing all the row addresses every 2 ms will keep the data alive. Usually this is done with counters that need only count from 0 to 63 (0 to 127 for 16 K-bit devices). The trick is to hide this from the microprocessor.

In the MC6809E, this is possible because the microprocessor needs to access memory only during the time that the E clock is high, so all that must be done is to refresh the memories when E is low. The SAM also does this little chore.

There are two differences between a system that uses 4 K-bit circuits and one that uses 16 K-bit devices. First, the MCM4116 integrated circuits have an extra address line which must be connected to the Z6 output of the SAM. Second, the refresh counters in the SAM must be programmed to put out 128 refresh addresses for the MCM4116s instead of the 64 needed for the MCM4027s.

The SAM has to be programmed to do this. How this is done will be detailed later.

In the Color Computer, the change is simple. There are only two jumpers that need to be switched to select either 4 K-bit or 16 K-bit memory devices. One of these connects the seventh address line, and one is connected to a PIA input line. Upon reset, the BASIC interpreter reads this bit and sets up the SAM for the type of memory indicated. That's all there is to it.

So what does all this have to do with the VDG? Since the VDG needs to be able to read memory to refresh the video screen, the SAM takes care of this, also. The address lines of the VDG are not connected at all in this system. Rather, the SAM is programmed into the same mode as the VDG and duplicates the timing of the VDG's address bus, except that it accesses memory to refresh the VDG during the E low time (so that the VDG accesses are transparent to the microprocessor). Since there is no possibility of a bus fight between the processor and the VDG, there is no need to deny the VDG access to the memory and the screen remains glitchless.

The full timing is shown in figure 8. The SAM usually provides memories with the address needed to access the data for the VDG to output as video. During the active display time (one frame of video) these addresses automatically refresh the memory devices. During the vertical retrace time, the SAM puts out refresh addresses. The microprocessor can access the memory at any time E is high and is therefore not affected.

# The COMPUTER FACTORY

TO ORDER CALL (212) 687-5000

## SUPERBRAIN™

INTERTEC  
DATA  
SYSTEMS  
**64K  
ONLY  
\$2995**



**32K \$2795**

More than an intelligent terminal, the SuperBrain outperforms many other systems costing three to five times as much. Endowed with a hefty amount of available software (BASIC, FORTRAN, COBOL), the SuperBrain is ready to take on your toughest assignment. You name it! General Ledger, Accounts Receivable, Payroll, Inventory or Word Processing... the SuperBrain handles all of them with ease.

### FEATURES INCLUDE:

- 2 dual-density minifloppies with 360K bytes of disk storage • A CPM Disk Operating System with a high-powered text editor, assembler and debugger.

### Model QD

720K Bytes disk storage  
and 64K RAM  
**\$3895**

### SUPER BRAIN HARD DISKS

10 Megabyte  
List \$4995  
**\$4495**

16 Fixed-16  
Removable  
**\$9995**



## NEW 96K

80 Column  
Commodore  
CBM  
Basic 4.0  
Operating  
System

- 80 column by 25 line display
- 12" CRT
- New screen editor
- Split screen processing
- Super fast string handling
- 15 additional basic commands
- Supports relative record processing

Model 8032  
32K memory

**\$1795**

**NEW!**

Model 8096  
96K memory

**Call for price**

**NEW 8050 DUAL DISK \$1795**

1 million bytes on-line storage  
and DOS 2.0 operating system

**NEW 2031 SINGLE DISK \$595**

## Commodore Computer

These low cost Commodore PET Business Computers have virtually unlimited business capabilities. Accounts Receivable, Inventory Records, Payroll, and other accounting functions.

### PET 16N & 32N COMPUTERS

- Full size keyboard
- 16 or 32,000 Bytes Memory
- Level III Operating System
- Full Screen Editor
- Upper lower case & 64 graphic characters



### PET DUAL FLOPPY DISK

- Stores 360,000 Bytes on-line
- Microprocessor controlled
- Uses single or dual sided floppies

### HI-SPEED PRINTER

- 150 characters per second • Up to 4 copies 8" wide
- Microprocessor Controlled • Prints All Graphics • Full Formatting Capability



## CORVUS

10 megabyte disk  
and mirror  
available



**Apple II PLUS for price**

A complete self-contained computer system with APPLESOFT floating point BASIC in ROM, full ASC II keyboard in a light weight molded carrying case.

### Features Include:

- auto-start ROM • Hi-Res graphics and 15 color video output.
- Expandable to 48K.

Supertalker .....	\$279	Micromodem .....	\$379
Disk .....	645	Superterm (24 x 80) .....	395
Add-on Disk .....	525	Speechlab .....	229
Pascal Card .....	495	Communication Card .....	225
Business Software .....	625	Modem .....	200
Monitor .....	159	Graphics Printer .....	595
Printer Card .....	180	Graphics Tablet .....	795

**apple III**  
**IS FINALLY HERE**  
**128K RAM!!**



FOR BEST  
DELIVERY AND  
SUPPORT SEE  
IT AT THE  
COMPUTER  
FACTORY

## CLOSE OUT SPECIALS!

	List	Special
Chatsworth Card Reader for TRS-80 .....	750	450
Axiom 801 .....	495	195
Protoline PET to Centronics Interface .....	199	49
Microtronics PET/Ham Interface .....	125	49

TEXAS Instruments 99/4 \$695  
(with 13" color Monitor)

Centronics 779-2 \$895

Leedex-80 12" \$89

**Over 1000 software  
tapes, books, disks,  
on display. Come  
in and browse.**

## PRINTERS

### CENTRONICS SALE YOUR CHOICE

779-2 or 737-3

**ONLY  
\$895**

### CENTRONICS 704

- 180 cps Bi-Directional • Up to 15" Paper Width • 9 x 9 Matrix
- Upper/Lower Case • Tractor Feed • RS-232C Serial Interface

### CENTRONICS 700-9

- 60 cps • Up to 15" paper width • Tractor Feed • Parallel Interface for Apple & TRS-80 • 2 channel vertical forms! • Top of Form!

**\$1295** List \$1895

**CENTRONICS  
737 Parallel \$895**

### XEROX 1730

Letter Quality

**Special  
\$2495**

List \$2755

- 40 Cps
- Uses all 100 metal & plastic daisy wheels
- Automatic bidirectional printing
- Fewer moving parts

On Site Warranty

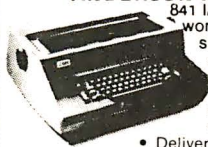
**DEALER INQUIRIES INVITED  
ON XEROX, CENTRONICS,  
SUPERBRAIN**



### ANDERSON JACOBSON

841 I/O Terminal Ideal for word processing and small businesses.

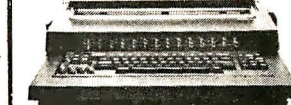
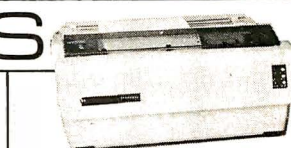
**Serial  
\$1230**



### MONITORS

SANYO 12" GREEN .....	\$355
BMC 12" GREEN .....	295
SANYO 13" COLOR .....	550
ZENITH 13" COLOR .....	395
LEEDUX 12" B&W .....	159

VR-300 .....	\$1795
(25cps Letter Quality)	
EPSON MX-80 .....	\$ 645
Paper Tiger 445 .....	795
Paper Tiger 460 .....	1295



### XYMEC HQ 1000

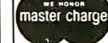
with 10, 12, 15 Pitch & Proportional Spacing

**\$2495**

- Z-80 controlled
- Up to 198 columns

Min. Credit Card Order \$75

- N.Y. residents add 8% sales tax
- Same day shipment on prepaid and credit card orders



TO ORDER CALL (212) 687-5000

Open Mon-Fri. 10-6 Sat. 11-5

**The COMPUTER FACTORY**

485 Lexington Ave., New York, NY 10017 (46th St. Lobby)

Foreign order desk — Telex 640055

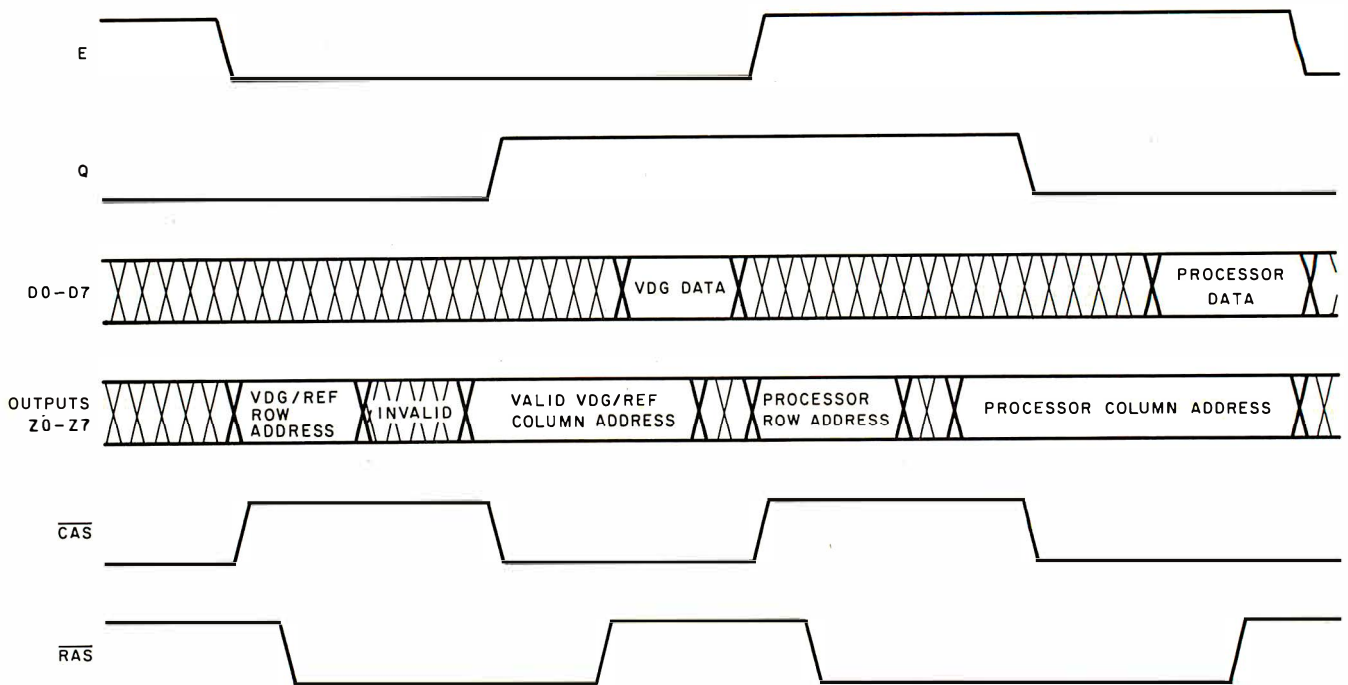


Figure 8: Diagram of a typical dynamic-memory refresh cycle. The SAM provides every dynamic memory with a signal on each row address, as required, to refresh the data contained within.

## The VDG supports one alphanumeric mode, two semigraphic modes, and eight full graphic modes.

### Programming the VDG

The VDG has 5 mode-control pins that determine how the address lines behave and how the data that is obtained from the memory is to be interpreted. In this system, these lines are connected to lines PB3 thru PB7 of PIA2. The data-output register for this device is located at address hexadecimal FF22. The microprocessor can write directly to this port to select the VDG mode. In fact, Extended Color BASIC has a statement, PMODE, to do just this.

The VDG has one alphanumeric mode (using its internal character generator or an external one), two semigraphic modes, and eight full-graphic modes. The modes and the way the mode-control pins must be programmed are shown in table 5.

The alphanumeric mode is the one used by BASIC to print on the screen. The VDG sequentially reads 512 bytes from memory for each TV frame. The data is interpreted as character codes, with the first byte corresponding to the top left corner ("home" position). There are 16 rows of 32 characters for a total of 512 characters on the screen. The character code is given in table 6.

Lowercase characters are displayed as inverted (light characters on a dark background). This is done by tying bit 6 (DD6) of the VDG to the INVERT pin. Because this bit is set in all lowercase numbers, they are inverted.

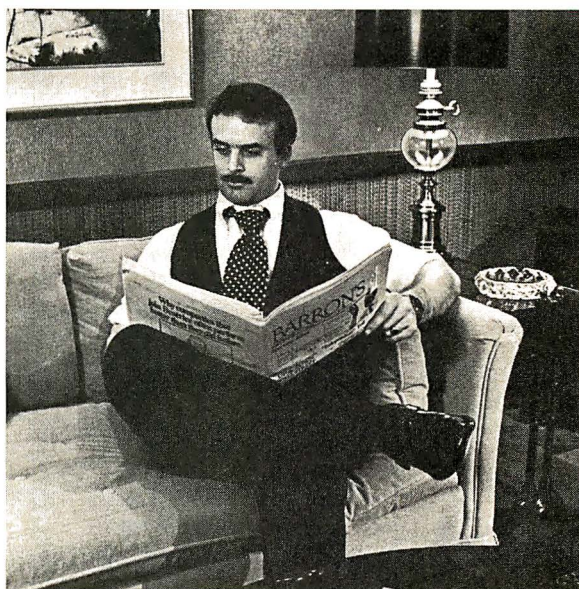
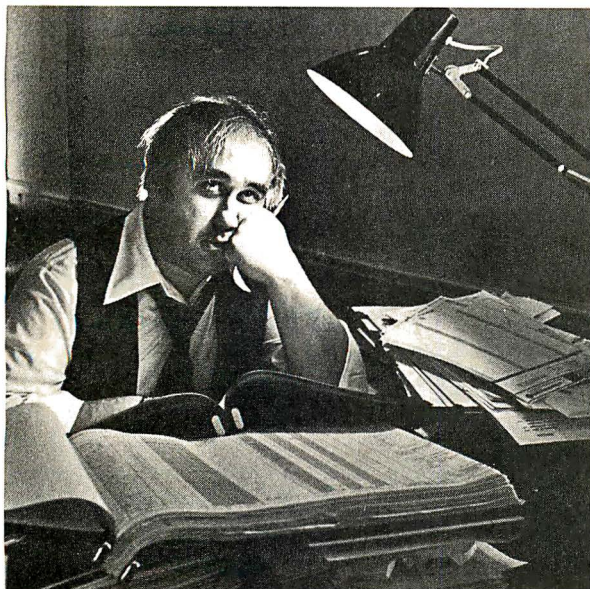
To support the SET and RESET commands in Radio Shack's Level I BASIC, data line DD7 on the VDG is connected to the alpha/semigraphic pin ( $\bar{A}/S$ ). Whenever

this bit is set, the VDG will interpret the data in the manner shown in table 5, under the semigraphic-4 mode. Instead of displaying a character, a colored block that is divided into four smaller blocks is displayed. The code in the byte read from memory determines which pattern of blocks is shown and what color it is. Using the smaller element within the block as a pixel, this gives a grid of 64 by 32 blocks, which are the dimensions of the SET and RESET commands. The other semigraphic mode is similar to this, but each large block is divided into six blocks (instead of four) and has a choice of two sets of four colors, controlled by the CSS (Color Set Select) pin. (Refer to the semigraphic-6 mode in table 5.)

The remaining eight modes are of the bit-mapped graphic type. They require 1, 1.5, 2, 3, or 6 K bytes of memory, depending on the mode. Basically, the data in memory is interpreted as pixels. In the four-color modes (1-C, 2-C, 3-C, and 6-C), each pixel is represented by 2 bits, selecting one of four colors. The set of colors is selectable by the CSS pin. In the two-color modes (1-R, 2-R, 3-R, and 6-R), each bit is mapped one-to-one on the screen. If the bit is set, the pixel is colored, and if it is not set, the pixel is black. The color set can be changed so the pixel can be either buff or green; color sets are controlled by the CSS pin. The resolution of these modes varies from 64 by 64 to 256 by 192 pixels horizontal and vertical respectively.

To use these graphic modes, you simply program the VDG by writing the mode code into the PIA output register, and write to the "screen memory" addresses. The only problem is that the VDG's address lines are not connected to any memory. As mentioned before, the SAM provides the addresses and the VDG interprets the data from the memory, so the SAM must be programmed to be in the same mode as the VDG in order to get a mean-

*Text continued on page 120*



## ***Can You Tell Which Tax Practitioner Uses Aardvark Software™?***

Aardvark Software, specializing in tax-related applications, helps you save time and energy while your clients' benefit from the most comprehensive tax programs available. Our programs are designed by CPAs with over 17 years of "Big Eight" tax experience. These programs meet or exceed the requirements of most professional tax practitioners.

Our programs run on a variety of microcomputers, including Apple, TRS-80 and Commodore.

### **Tax Preparation**

"Tax Prep" allows you to easily calculate your clients' Federal Form 1040, all lettered schedules except R & RP and the most frequently used numbered forms. Selected state forms are also available. Since this system is user-oriented even a novice can process returns immediately.

Price \$495

### **Tax Planning**

"Tax Plan" is designed to eliminate hours of work and human error in evaluating various tax alternatives for your clients. It allows you to enter a variety of income and expense items and to determine the tax effects attributable to changes in one or more items.

Introductory Price \$395

### **Depreciation**

Quickly computes current year bonus and tax preference depreciation, investment tax credit, and investment credit recapture. At your option the program will automatically switch from accelerated to straight line depreciation, when beneficial. Printed output is available in tax return and/or worksheet format.

Introductory Price \$150

### **Estate Tax Planning**

"Estate Plan" permits a comparative analysis of the Estate & Gift Tax effects of different levels of wealth and/or lifetime gift strategies. The user has the ability to input a variety of taxable estate assets and valuations.

Introductory Price \$595

Aardvark Software™ programs are fast, efficient and easy to use.  
Of course, if you enjoy working nights, weekends, holidays,...  
For more information, please write or call us.

## **AARDVARK SOFTWARE INC.**

The Microcomputer People for Professionals

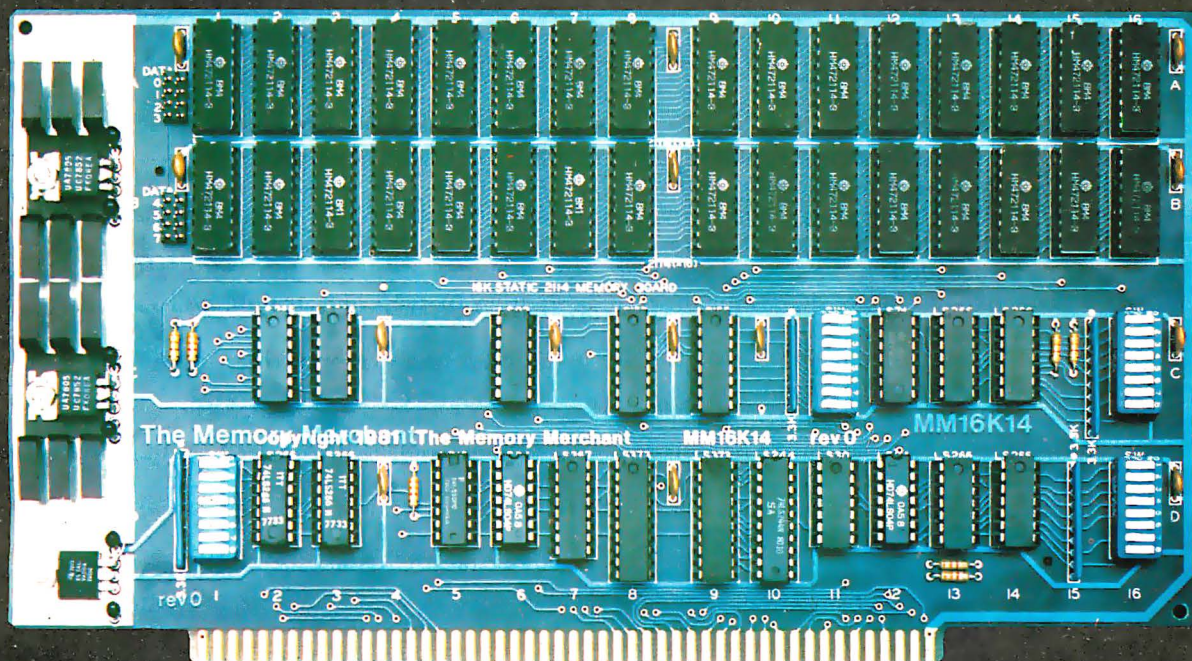
783 NORTH WATER STREET MILWAUKEE, WISCONSIN 53202 414/289-9988

MODES		VDG PINS							COLOR		TV SCREEN	VDG DATA BUS									
		MS	A/G	A/S	INT/EXT	GM2	GM1	GM0	CSS	INV	Character Color	Background	Border	Display Mode	E <sub>1</sub> E <sub>0</sub> A <sub>5</sub> A <sub>4</sub> A <sub>3</sub> A <sub>2</sub> A <sub>1</sub> A <sub>0</sub> extra ASCII code						
The alphanumeric internal mode uses an internal character generator which contains the following 5 dot by 7 dot characters: @ABCDEFGHIJKLMNORSTUVWXYZ\ ]~SP!"#\$%&'()*+ -./0123456789:;<=>?. The 6 bit ASCII code leaves 2 bits free and these may be externally connected to the mode pins A/G, A/S, INT/EXT, GM2, GM1, GM0, CSS or INV.		1	0	0	0	X	X	X	0	0	Green	Black	Black	32 characters across							
		1	0	0	0	X	X	X	1	0	Orange	Black	Black	Black	16 characters down						
The alphanumeric external mode uses an external character generator as well as a row counter. Thus, custom character fonts are graphic symbol sets with up to 256 different 8 dot by 12 dot "characters" that may be displayed.		1	0	0	0	X	X	X	0	0	Green	Black	Black	32 characters across	one row of custom characters						
		1	0	1	0	X	X	X	X	1	0	Orange	Black	Black	16 characters down						
The semigraphic-4 mode uses an internal "coarse graphics" generator in which a rectangle (8 dots by 12 dots) is divided into four equal parts. The luminance of each part is determined by a corresponding bit on the VDG data bus. The color of illuminated parts is determined by 3 bits.		1	0	1	0	X	X	X	X	X	Lx	C0	Color	64 display elements across	X C <sub>2</sub> C <sub>1</sub> C <sub>0</sub> L <sub>3</sub> L <sub>2</sub> L <sub>1</sub> L <sub>0</sub>						
		1	0	1	0	X	X	X	X	X	1	C1	C2	Black	32 display elements down						
The semigraphic-6 mode is similar to the semigraphic-4 mode with the following differences: the 8 dot by 12 dot rectangle is divided into six equal parts. Color is determined by the 2 remaining bits.		1	0	1	1	X	X	X	0	X	Lx	C0	Color	64 display elements across	C <sub>1</sub> C <sub>0</sub> L <sub>5</sub> L <sub>4</sub> L <sub>3</sub> L <sub>2</sub> L <sub>1</sub> L <sub>0</sub>						
		1	0	1	1	X	X	X	1	X	1	C1	C2	Black	48 display elements down						
The graphic 1-C mode uses a maximum of 1024 bytes of display memory in which one pair of bits specifies one picture element.		1	1	X	X	0	0	0	1	X	Lx	C0	Color	64 display elements across	C <sub>1</sub> C <sub>0</sub> C <sub>1</sub> C <sub>0</sub> C <sub>1</sub> C <sub>0</sub> C <sub>1</sub> C <sub>0</sub>						
		1	1	X	X	0	0	0	1	X	0	C1	C2	Green or Buff	64 display elements down						
The graphic 2-C mode uses a maximum of 2048 bytes of display memory in which one pair of bits specifies one picture element.		1	1	X	X	0	1	0	1	X	Lx	C0	Color	128 display elements across	L <sub>7</sub> L <sub>6</sub> L <sub>5</sub> L <sub>4</sub> L <sub>3</sub> L <sub>2</sub> L <sub>1</sub> L <sub>0</sub>						
		1	1	X	X	0	1	0	1	X	0	C1	C2	Green or Buff	64 display elements down						
The graphic 2-R mode uses a maximum of 1536 bytes of display memory in which one bit specifies one picture element.		1	1	X	X	0	1	1	0	X	Lx	C0	Color	128 display elements across	C <sub>1</sub> C <sub>0</sub> C <sub>1</sub> C <sub>0</sub> C <sub>1</sub> C <sub>0</sub> C <sub>1</sub> C <sub>0</sub>						
		1	1	X	X	0	1	1	1	X	0	C1	C2	Green or Buff	96 display elements down	L <sub>7</sub> L <sub>6</sub> L <sub>5</sub> L <sub>4</sub> L <sub>3</sub> L <sub>2</sub> L <sub>1</sub> L <sub>0</sub>					
The graphic 3-C mode uses a maximum of 3072 bytes of display memory in which one pair of bytes specifies one picture element.		1	1	X	X	1	0	0	1	X	Lx	C0	Color	128 display elements across	C <sub>1</sub> C <sub>0</sub> C <sub>1</sub> C <sub>0</sub> C <sub>1</sub> C <sub>0</sub> C <sub>1</sub> C <sub>0</sub>						
		1	1	X	X	1	0	0	1	X	0	C1	C2	Green or Buff	96 display elements down						
The graphic 3-R mode uses a maximum of 3072 bytes of display memory in which one bit specifies one picture element.		1	1	X	X	1	0	1	1	X	Lx	C0	Color	128 display elements across	L <sub>7</sub> L <sub>6</sub> L <sub>5</sub> L <sub>4</sub> L <sub>3</sub> L <sub>2</sub> L <sub>1</sub> L <sub>0</sub>						
		1	1	X	X	1	0	1	1	X	0	C1	C2	Green or Buff	96 display elements down						
The graphic 6-C mode uses a maximum of 6144 bytes of display memory in which one pair of bits specifies one picture element.		1	1	X	X	1	1	0	1	X	Lx	C0	Color	256 display elements across	C <sub>1</sub> C <sub>0</sub> C <sub>1</sub> C <sub>0</sub> C <sub>1</sub> C <sub>0</sub> C <sub>1</sub> C <sub>0</sub>						
		1	1	X	X	1	1	0	1	X	0	C1	C2	Green or Buff	192 display elements down	L <sub>7</sub> L <sub>6</sub> L <sub>5</sub> L <sub>4</sub> L <sub>3</sub> L <sub>2</sub> L <sub>1</sub> L <sub>0</sub>					
The graphic 6-R mode uses a maximum of 6144 bytes of display memory in which one bit specifies one picture element.		1	1	X	X	1	1	1	1	X	Lx	C0	Color	256 display elements across	L <sub>7</sub> L <sub>6</sub> L <sub>5</sub> L <sub>4</sub> L <sub>3</sub> L <sub>2</sub> L <sub>1</sub> L <sub>0</sub>						
		1	1	X	X	1	1	1	1	X	0	C1	C2	Green or Buff	192 display elements down						

Table 5: Video Display Generator modes.

Table 5: Video Display Generator modes.

# Low cost, high quality. An exceptional 16K memory at an exceptional price.



Our 16K Memory Merchant is the first in a series of low cost, remarkably engineered memory boards.

It's a low power 16K Static RAM (2114) with bank select logic and extended 24 bit address. Memory Merchant is compatible with 2 Mhz 8080, 4 Mhz Z80 and 5 Mhz 8085. One

of its four independent 4K blocks has "windowing capability" — any or all four of the 1K sub-blocks may be removed from the memory block. Design features include low power Schottky TTL circuitry and all inputs and outputs are fully buffered. And the Memory Merchant has been engineered to meet IEEE 696 S-100 standard specifications.

We're so confident about our Memory Merchant that we've backed it with an extended six month, no repair warranty. If the board fails, return it for an immediate replacement.

## Available through select dealers.

Dealer inquiries invited. Distributed exclusively by:



6925 5th Avenue, Suite E-411, Scottsdale, Arizona 85251  
Telephone: 602-941-0388

		Low-Order Hexadecimal Digit															
High-Order Hexadecimal Digit	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	
	0	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	1	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
	2		!	"	#	\$	%	&	'	(	)	*	+	,	-	.	/
	3	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
	4	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	5	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
	6		!	"	#	\$	%	&	'	(	)	*	+	,	-	.	/
	7	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?

**Table 6:** Codes for the characters stored in the VDG's internal character generator. The lower section contains inverse-video characters, dark characters on a light background.

Text continued from page 116:  
ingful display.

### Programming the SAM

With a SAM in the system, the memory map is pretty much fixed. The SAM directly decodes the addresses from the processor to access memory, and provides device selects for the rest of the system on the S0 thru S2 pins. These pins are decoded by a 3-to-8 decoder (74LS138) to get the active-low select signals for the rest of the system. Refer to the memory map shown in figure 9.

The reset vector and interrupt vectors at the top of the map are mapped from hexadecimal FFF2 thru FFFF to BFF2 thru BFFF. This allows these vectors to be stored in the 8 K-byte BASIC ROM beginning at address hexa-

decimal A000. The addresses of the two PIAs, the second ROM, and the off-board ROM cartridges are also shown in figure 9.

The block of addresses from hexadecimal FFC0 to FFDF are the locations of the SAM registers. The SAM is programmed and its various options selected by writing to these locations. The data is immaterial since the data bus is not connected to the SAM. Each register bit has two unique locations, an even location and an odd one. Writing to the even location will clear the register bit. Writing to the odd location will set the bit. By encoding the bits, and accessing the appropriate locations, the SAM can be programmed.

The memory map in figure 9 shows the modes and the locations associated with each. S stands for set and C for clear in the diagram. The programmable attributes include:

- VDG mode — mode of address lines during VDG refresh time.
- Display offset — the base address of the memory used by the VDG is specified here. This is the address of the pixel in the upper left-hand corner of the screen in graphic mode. Programmable in ½ K pages.
- Memory size — 4 K-bit, 16 K-bit or 64 K-bit dynamic memories or a full map of static memory and I/O.
- Microprocessor clock rate — can be set for 0.8, 1.8 MHz or address-dependent rate.
- Page — allows two 32 K-byte memory pages between hexadecimal 0000 and 7FFF.

The VDG mode bits in the SAM must be programmed to match the mode selected for the VDG on its mode pins. Table 7 shows the correspondence between the SAM and the VDG modes. If the two modes do not agree, interesting results can be obtained. Some of these "mixed" modes include graphics mixed with alphanumeric.

The VDG address offset specifies where the SAM should start the address counters. Figure 10 shows the address sent by the SAM as a function of this offset. This allows the VDG display to be "paged" through memory in 512-byte pages, allowing fast page swapping for animation, etc. On reset, BASIC will set the offset to hexadecimal 400 so all the screen output of the BASIC interpreter is at locations hexadecimal 400 thru 5FF. Try POKEing to these locations to use the alphanumeric and semigraphic modes.

The Extended BASIC supports the higher-resolution

Text continued on page 124

IBM 2770  
 IBM 2780  
 IBM 3270  
 IBM 3741  
 IBM 3780  
 IBM 3776

# 4.25

# BISYNC

# SDLC/SDMA

## Software for Your Microcomputer

8080 Z80 8086 Z8000

### WINTERHALTER & ASSOCIATES, INC.

SPECIALISTS IN DATA COMMUNICATIONS

3825 ZEEB ROAD

DEXTER, MICHIGAN 48130

313-426-3029 or

313-665-5582



# Introducing quality print at matrix speed. For only \$1295\*.

Until now, word processing output was a slow, expensive proposition. You could pay thousands for a slow, letter-quality character printer. Or give up print quality for matrix speed and price.

But that was before Paper Tiger™ 460 offered you a better choice.

The new Paper Tiger 460 is the first matrix printer with high-density dot matrix characters plus high speed. At a low price.

The secret? A unique nine-wire, staggered matrix head provides overlapping dots in both horizontal and vertical planes. The result is dense, high-quality characters you'll be proud to show off.

What's more, Paper Tiger 460 gives you a combination of features simply not available on any other printer, at any price. Like bi-directional, logic-seeking printing at speeds in excess of 150 characters per second. Micro-processor electronics, with built-in diagnostics and self-test. Proportional spacing. Automatic text justification. DotPlot™ high

**Integral Data Systems stands ready to provide performance printers ideally suited to your needs. The IDS 460, offers features**

**Automatic proportional spacing, word processing systems, plus the capability of 84 by 84 dots per inch**

Paper Tiger 460 Print Sample

resolution graphics option. RS232 and parallel interfaces. And more.

But its most important feature is high reliability. Paper Tiger 460 is designed to be tough and dependable. It has rugged, stepper-motor head and paper drives. A new rugged ballistic-type print head.

And its simple, chassis-mounted cartridge ribbon lasts up to four times longer than cassette or spool ribbons.

Paper Tiger 460 is the one printer that gives your Apple†, TRS-80,‡ or other small business computer both data processing and word processing output. At a price you can afford.

Get your paws on Paper Tiger 460, and join the tens of thousands of satisfied Integral Data Systems users. For the name of the Paper Tiger dealer nearest you. Call us toll-free: 800-258-1386. (In New Hampshire, Alaska, and Hawaii, call (603) 673-9100.) Or, write for complete specifications. Integral Data Systems Inc., Milford, New Hampshire 03055.



## Paper Tiger 460

 Integral Data Systems, Inc.

\*Suggested single-unit U.S. retail price.

†Apple is a trademark of Apple Computer Inc.

‡TRS-80 is a trademark of Radio Shack, a division of Tandy Corp.

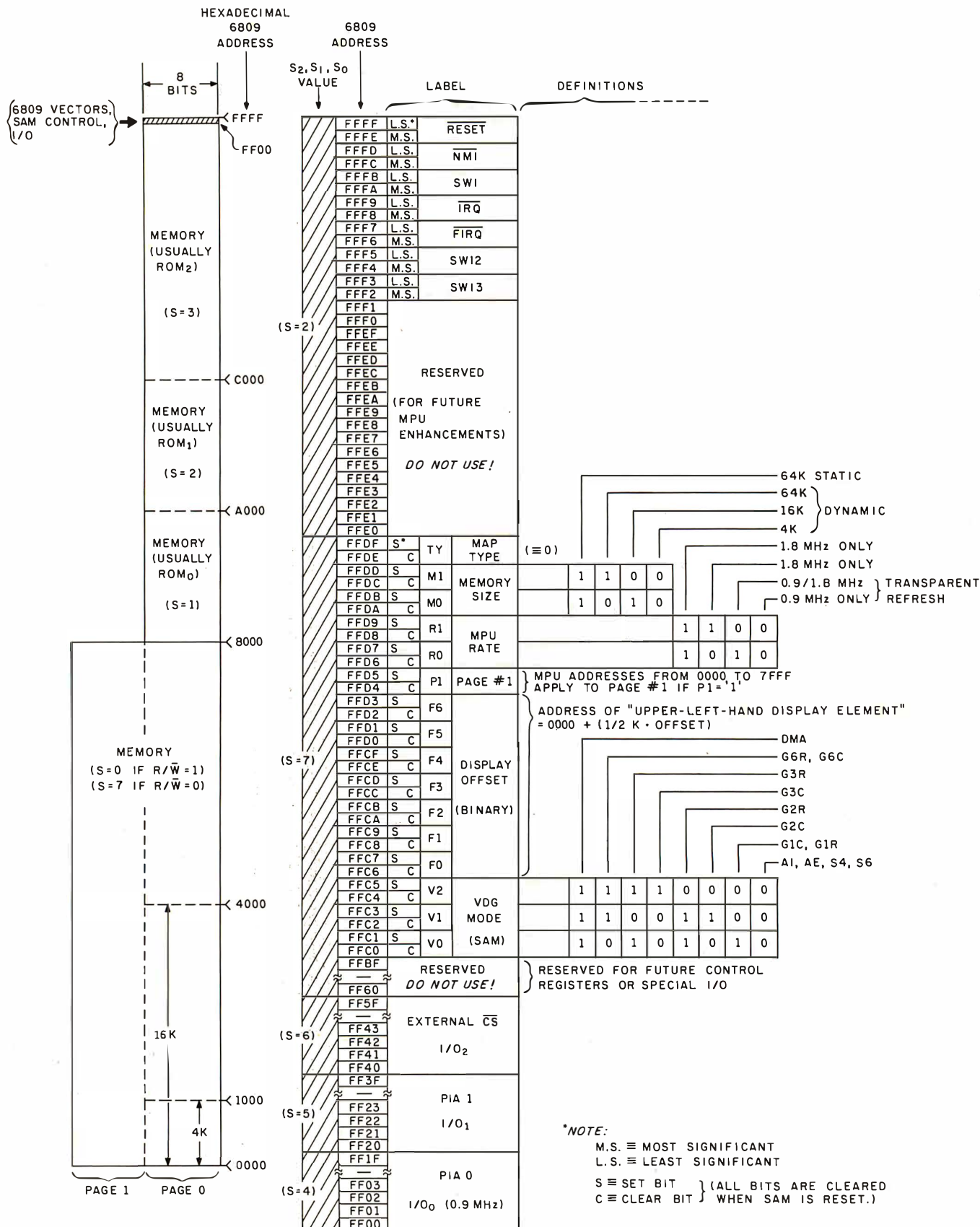


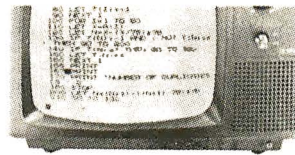
Figure 9: Memory map of the Color Computer address space. The general division of addresses is provided at the left, while the SAM programming registers and the processor-interrupt vectors are expanded at the right.

# A Microcomputer for everyone at a Micro Price

The **MicroAce** - a new generation of miniature computers  
**A COMPLETE COMPUTER for \$149.00 for 1K Kit**

Post and Packing FREE

(Add 6% Tax for Shipments inside California)



RAM (expandable to 2K on board) is roughly equivalent to 4K bytes in a conventional computer — typically storing 100 lines of BASIC. (Key words occupy only a single byte.)

The display shows 32 characters by 24 lines.

And Benchmark tests show that the MicroAce is faster than all other personal computers.

No other personal computer offers this unique combination of high capability and low price.

## The MicroAce teach-yourself BASIC manual.

If the features of the BASIC interpreter mean little to you—don't worry. They're all explained in the specially-written book *free* with every kit! The book makes learning easy, exciting and enjoyable, and represents a complete course in BASIC programming—from first principles to complex programs. (Available separately—purchase price refunded if you buy a MicroAce later.) A hardware manual is also included with every kit.

**The MicroAce Kit:**  
**\$149.00 with 1K COMPLETE**  
**\$169.00 with 2K**

Demand for the MicroAce is very high: use the coupon to order today for the earliest possible delivery. All orders will be despatched in strict rotation. If you are unsuccessful in constructing your kit, we will repair it for a fee of \$20.00, post and packing FREE. Of course, you may return your MicroAce as received within 14 days for a full refund. We want you to be satisfied beyond all doubt — and we have no doubt that you will be.

## The unique and valuable components of the MicroAce

The MicroAce is not just another personal computer. Quite apart from its exceptionally low price, the MicroAce has two uniquely advanced components: the powerful BASIC interpreter, and the simple teach yourself BASIC manual.

The unique versatile BASIC interpreter offers remarkable programming advantages:

- **Unique 'one-touch' key word entry: the MicroAce eliminates a great deal of tiresome typing. Key words (RUN, PRINT, LIST, etc.) have their own single-key entry.**
- **Unique syntax check.** Only lines with correct syntax are accepted into programs. A cursor identifies errors immediately. This prevents entry of long and complicated programs with faults only discovered when you try to run them.
- **Excellent string-handling capability** — takes up to 26 string variables of any length. All strings can undergo all relational tests (e.g. comparison). The MicroAce also has string input — to request a line of text when necessary. Strings do not need to be dimensioned.
- **Up to 26 single dimension arrays.**
- **FOR/NEXT loops nested up to 26.**
- **Variable names of any length.**
- **BASIC language also handles full Boolean arithmetic, conditional expressions, etc.**
- **Exceptionally powerful edit facilities, allows modification of existing program lines.**
- **Randomise function, useful for games and secret codes, as well as more serious applications**
- **Timer under program control.**

- **PEEK and POKE enable entry of machine code instructions, USR causes jump to a user's machine language sub-routine.**
- **High-resolution graphics with 22 standard graphic symbols.**
- **All characters printable in reverse under program control.**
- **Lines of unlimited length.**

## 'Excellent value' indeed!

For just \$149.00 (including handling charge) you get everything you need to build a personal computer at home... PCB, with IC sockets for all ICs; case; leads for direct connection to a cassette recorder and television (black and white or color); everything!

Yet the MicroAce really is a complete, powerful, full-facility computer, matching or surpassing other personal computers at several times the price.

The MicroAce is programmed in BASIC, and you can use it to do quite literally anything, from playing chess to managing a business.

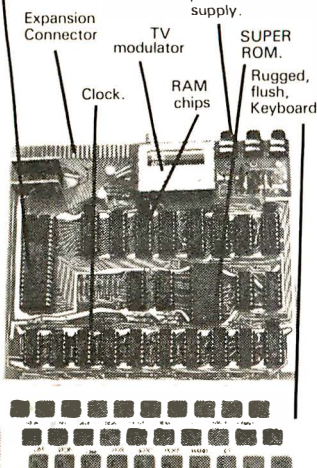
The MicroAce is pleasantly straightforward to assemble, using a fine-tipped soldering iron. It immediately proves what a good job you've done: connect it to your TV ... link it to the mains adaptor ... and you're ready to go.

## Fewer chips, compact design, volume production—more power per Dollar!

The MicroAce owes its remarkable low price to its remarkable design: the whole system is packed on to fewer, newer, more powerful and advanced LSI chips. A single SUPER ROM, for instance, contains the BASIC interpreter, the character set, operating system, and monitor. And the MicroAce 1K byte

280 A microprocessor chip, widely recognised as the best ever made.

Sockets for TV, cassette recorder, power supply.



## Your MicroAce kit contains...

- Printed circuit board, with IC sockets for all ICs.
- Complete components set, including all ICs—all manufactured by selected world-leading suppliers.
- New rugged keyboard, touch-sensitive, wipe-clean.
- Ready-moulded case.
- Leads and plugs for connection to domestic TV and cassette recorder. (Programs can be SAVED and LOADED on to a portable cassette recorder.)
- Mains adaptor of 600 mA at 9VDC nominal unregulated.
- FREE course in BASIC programming and user manual.

## JOIN THE REVOLUTION - DON'T GET LEFT BEHIND - ORDER YOUR MICRO ACE NOW!!

Send Check, Money Order or quote your Credit Card No. to:  
**MicroAce** 1348 East Edinger, Santa Ana, California, Zip Code 92705.  
**or phone** (714) 547 2526 quoting your Credit Card Number.

Quantity	Description	Unit Price	TOTAL
	MicroAce Kit 1K	\$149.00	
	MicroAce Kit 2K	\$169.00	
	Manual	\$10.00	
	1K Upgrade Kit	\$29.00	
Shipments inside California add 6% TAX		<b>TOTAL</b>	

- ☐ Amex.  
☐ Diners  
☐ Check  
☐ Money Order  
☐ Master Charge  
☐ Visa

Card No. \_\_\_\_\_

Exp. Date \_\_\_\_\_

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Mode	Video Display Generator Signals					Synchronous Address Multiplexer Signals		
	G $\bar{A}$	GM2	GM1	GM0 EXT/I	CSS	V <sub>2</sub>	V <sub>1</sub>	V <sub>0</sub>
Internal alphanumeric	0	X	X	0	x	0	0	0
External alphanumeric	0	X	X	1	X	0	0	0
Semigraphic-4	0	X	X	0	X	0	0	0
Semigraphic-6	0	X	X	1	X	0	0	0
Full graphic 1-C	1	0	0	0	X	0	0	1
Full graphic 1-R	1	0	0	1	X	0	0	1
Full graphic 2-C	1	0	1	0	X	0	1	0
Full graphic 2-R	1	0	1	1	X	0	1	1
Full graphic 3-C	1	1	0	0	X	1	0	0
Full graphic 3-R	1	1	0	1	X	1	0	1
Full graphic 6-C	1	1	1	0	X	1	1	0
Full graphic 6-R	1	1	1	1	X	1	1	0
Direct memory access	X	X	X	X	X	1	1	1

Table 7: Mode correspondence between the SAM and the VDG.

A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0
F6	F5	F4	F3	F2	F1	F0	0	0	0	0	0	0	0	0	0
MSB							LSB								

Figure 10: Mapping of the video-display refresh address. The SAM uses a 7-bit offset to determine the start of video-display memory. This allows the use of 512-byte "pages" for display refreshing, making it possible to page through memory to create fast animation effects, etc.

Text continued from page 120:

graphics and can also allocate more memory for multiple pages, up to eight. It provides graphic operations, such as LINE, DRAW, and CIRCLE, that are fast enough to allow the programming of real-time games using the joysticks as controllers.

Memory type is self-explanatory. The SAM must be programmed for the type of memory devices used in the system to produce the correct timing signals. If 16 K-bit circuits (MCM4116 or the equivalent) are used, pin 35 can be used for RAS1. This is needed to select a second bank of devices to provide 32 K bytes of memory. One way to do this on the Color Computer is to piggyback a second set of eight MCM4116s on top of the existing integrated circuits, paralleling all the pins except for the RAS pin. When this is jumpered to pin 35 on the SAM, the system then has 32 K bytes of user-programmable memory.

The microprocessor clock rate is also programmable. There are three modes, as shown in figure 9. In mode 0, the clock rate is fixed at one-sixteenth the crystal frequency. In this case, that is 895 kHz. Mode 2 gives a fixed rate of one-eighth the crystal frequency, or 1.8 MHz. This can be used with an MC68B09E, a 2 MHz version of the microprocessor. However, there are no memory or VDG addresses output in this mode, so don't use it.

Mode 1 is the most interesting. It gives a dual-rate clock of 895 kHz or 1.8 MHz depending on the address used in the bus cycle. When the processor accesses addresses from hexadecimal 0000 to 7FFF and FF00 to FF1F, the lower rate is used, allowing for slower memory and peripherals. When all other addresses are accessed, the processor runs at 1.8 MHz. Using fast ROMs will almost double the speed of the system because a majority of the microprocessor's memory references are to fetch op

codes. If you want to try this, execute the following BASIC statement:

POKE 65495,0

This will set bit R0 of the microprocessor rate register at location hexadecimal FFD7 and put the SAM into the dual-rate mode. If your microprocessor can run at the higher speed (a pretty good bet), you will see the changing-color cursor flashing about twice as fast as normal. Your BASIC programs will now run about twice as fast, too. There is one problem, though—don't try to use the SOUND, CLOAD, or CSAVE statements in this mode. The PIA used by these statements is at location hexadecimal FF20 and it will probably not run at the higher speed.

The other two registers do not apply to the Color Computer. The Map Type bit chooses a mixed programmable/read-only type of system such as the Color Computer or a fully programmable system such as a disk-based one. The Page bit allows two 32 K-byte pages of memory to be accessed between locations hexadecimal 0000 and 7FFF. This can't be done on this system.

### Keyboard Scanning

The keyboard is configured as an 8 by 7 matrix of keys. The Color Computer uses a software routine to encode the keyboard in a manner similar to that of the TRS-80 Model I. This is done by shifting a 0 through the B port of PIA IC8. The B port drives the 8 rows of the keyboard; the 7 columns are connected to the A port of IC8. The A port has internal pull-up resistors that provide a logic 1 level unless a key is depressed. When the shifted 0 occurs on the row of the closed key contact, the low level is passed to port A. By repeating the scanning procedure several times, debounced inputs are recognized.

If you need to monitor the keyboard during a program, a function (INKEY\$) is provided. The BASIC statement

A\$ = INKEY\$

will return a character if a key is closed when the function is called. An example use of this function would be to monitor the keyboard during a "Tank" game for direction

The largest selection  
of software from the  
world's largest  
software publisher.

# Product List NO. 19

Write for our catalog.

## DISK OPERATING SYSTEMS

CP/M CONFIGURED FOR:  
APPLE II  
DIGITAL MICROSYSTEMS FDC3  
DURANGO F-85  
HEATH H8 AND H89  
ICOM MICRO DISK  
ICOM 3712  
ICOM 3812  
ICOM 4511/PERTEC D3000  
INTEL MDS  
MICROPOLIS FLOPPY DISK  
MITS/ALTAIR  
MOSTEK MDX  
NORTH STAR  
OSI C3  
PRO-TECH HELIOS  
TRS-80 MODEL I  
TRS-80 MODEL II  
TRS-80 MODEL III  
ZENITH Z89  
MP/M FOR INTEL MDS

## HARD DISK INTEGRATION MODULES

CORVUS WITH APPLE II SOFTCARD  
CORVUS WITH S100 AND TRS-80  
MODEL II  
ICOM 4511/PERTEC D3000  
KONAN PLUS CDC PHOENIX  
XCOMP SM/S PLUS CDC PHOENIX  
XCOMP DFC10 FOR PERTEC D3000

## SYSTEMS TOOLS

BUG AND uBUG TRS-80 MODEL II  
DESPOOL CP/M  
DISLOG CUSTOMIZATION  
DISTEL DISK  
EDIT UNLOCK  
EDIT-80 WORD-MASTER  
FILETRAN XASM-18  
IBM/CPM XASM-48  
MAC XASM-65  
MACRO-80 XASM-68  
PASM XMACRO-86  
PLINK ZDT  
RAID Z80 DEVELOPMENT  
RECLAIM PACKAGE  
SID ZSID

## TELECOMMUNICATIONS

BSTAM BSTMS

## LANGUAGES

ALGOL-60	muSIMP
APL/V80	NEVADA COBOL
BASIC-80	PASCAL/M
(COMPILER)	PASCAL/MT
BASIC-80	PASCAL/MT+
(INTERPRETER)	PASCAL/Z
BDS C COMPILER	PL/I-80
CBASIC-2	SMAL/80
CIS COBOL	S-BASIC
COBOL-80	TINY C
FORTAN-80	W'SMITHS C
KBASIC	COMPILER
muLISP	XYBASIC

## LANGUAGE AND APPLICATIONS TOOLS

BASIC UTILITY	MDBS.RTL
DISK	M/SORT FOR
DATASAT	COBOL-80
FABS	PEARL
FORMS 2 FOR	QSORT
CIS COBOL	STRING BIT
MAGSAM III	STRING/80
MAGSAM IV	SUPER-SORT
MDBS.DRS	ULTRASORT II

## WORD PROCESSING SYSTEMS AND AIDS

MAGIC WAND	TEX
LETTERIGHT	TEXTWRITER III
MICROSPELL	WORD-STAR
SPELLGUARD	

## DATA MANAGEMENT PACKAGES

CONDOR	MDBS.QRS
HDBS	WHATSI?
MDBS	

## GENERAL PURPOSE APPLICATIONS

CBS  
SELECTOR III-C2  
SELECTOR IV

## MAIL LIST APPLICATIONS

MAILING ADDRESS (PTREE)  
MAIL-MERGE FOR WORD-STAR  
NAD  
POSTMASTER

## BUSINESS APPLICATIONS

ACCOUNTS PAYABLE (GD)  
ACCOUNTS PAYABLE (PTREE)  
ACCOUNTS PAYABLE (SSG)  
ACCOUNTS RECEIVABLE (GD)  
ACCOUNTS RECEIVABLE (PTREE)  
ACCOUNTS RECEIVABLE (SSG)  
CASH REGISTER  
GENERAL LEDGER II (CPAIDS)  
GENERAL LEDGER (GD)  
GENERAL LEDGER (PTREE)  
GENERAL LEDGER (SSG)  
GLECTOR FOR SELECTOR III-C2  
INVENTORY (GD)  
INVENTORY (PTREE)  
INVENTORY (SSG)

# It used to be that computers would do everything but spell. Now they can spell. With Microspell.



No matter what is on your word processor—a letter, presentation, thesis, manuscript—bad spelling makes a bad impression. Now you can correct spelling errors automatically with a new software system from Lifeboat. Called Microspell, it converts your microprocessor into a spelling proofreader. Microspell scans each word you write and tells you every time it finds a misspelling. Automatically, it will print alternatives, and you select the correct word. Words you're unsure of? Microspell will be your dictionary, too.

Microspell has a basic 20,000 word dictionary, and you can add to it yourself. Add technical words, create auxiliary dictionaries, special expressions, and acronyms.

Complete with full dictionary, all utilities, and a demonstration file, Microspell from Lifeboat costs \$249.

JOB COSTING (GD)  
PAYROLL (PTREE)  
PAYROLL (SSG)

## NUMERICAL PROBLEM-SOLVING TOOLS

ANALYST	STATPAK
FPL	T/MAKER
muMATH	

## OTHER SPECIALIZED APPLICATIONS

APARTMENT MANAGEMENT  
DATEBOOK  
ESQ-1  
MASTER TAX  
PROPERTY MANAGEMENT (PTREE)  
STANDARD TAX

## BOOKS AND PERIODICALS

APL—AN INTERACTIVE APPROACH  
ACCOUNTS PAYABLE & ACCOUNTS  
RECEIVABLE-CBASIC  
THE CP/M HANDBOOK  
THE C PROGRAMMING LANGUAGE  
GENERAL LEDGER-CBASIC

LIFELINES NEWSLETTER  
PASCAL USER MANUAL AND REPORT  
PAYROLL WITH COST  
ACCOUNTING-CBASIC  
STRUCTURED MICROPROCESSOR  
PROGRAMMING  
USING CP/M—A SELF-TEACHING  
GUIDE

## ACCESSORIES

DC 300 DATA CARTRIDGE  
HEAD CLEANING DISKETTE  
FLIPPY DISK KIT  
FLOPPY SAVER

*Program names and computer names are generally trademarks or service marks of the author or manufacturing company.*

*All software products have specific requirements for hardware and additional associated software (e.g. operating system or language).*

*All products are subject to terms and conditions of sale.*

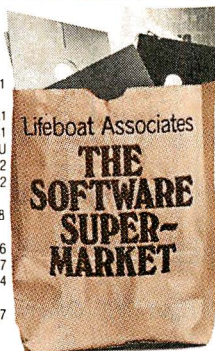
*Copyright © 1981 Lifeboat Associates. No portion of this advertisement may be reproduced without prior permission.*

# Ordering Information

COMPUTERS SUPPORTED WITH MEDIA FORMAT ORDERING CODES.											
ADD5 Multivision	RT	Digital Microsystems	A1	IMS 5000	RA	Micropolis Mod II	Q2	Research Machines 8 in	A1	TRS-80 Model I - Omikron	A1
AVL Eagle	RB	Durango F-85	RL	IMS 8000	R1	Morrow Discus	A1	Rex	Q3	8 in	
Altair 8800	R1	Dynabyte DBB/2	R1	IMSAI VDP-40	R4	Mostek	A1	SD Systems 5 25 in	A1	TRS-80 Model I -	
Altos	RG	Dynabyte DBB/4	A1	IMSAI VDP-42	R4	North Star Single Density	P1	SD Systems 8 in	A1	Shuffleboard	A1
Apple CP/M 13 Sector	RR	Exidy Sorcerer - Lifeboat	Q2	IMSAI VDP-44	R5	North Star Double Density	P2	Sanco 7000 5 25 in	RO	TRS-80 Model II	
Apple CP/M 16 Sector	RR	CP/M	Q2	IMSAI VDP-80	A1	North Star Quad Density	P3	Spacebyte	A1	TRS-80 Model III	RU
BASF System 7100	RD	Health H8 - H17/H27 disk	P4	ISC Intecolor	Q2	Nylac Micropolis Mod II	Q2	TEI 5 25 in	R3	Vector M2	Q2
Blackhawk Micropolis	Q3	Health H89 - Lifeboat CP/M	P4	8063/8360/8963	A1	Nylac Single Density	Q3	TEI 8 in	A1	Vector System B	Q2
Mod II	Q3	Health H89 + Magnolia	P7	Interlec Superbrain DOS 0.1	R7	Ohio Scientific C3	A3	TRS-80 Model I	R2	Vista V-80 5 25 in Single	R8
Blackhawk Single Density	Q2	CP/M	B2	Interlec Superbrain DOS 0.5	RJ	Onyx C8001	T2	STANDARD	RN	Dens	
CDS Versatile 3B	Q1	Helios II	B2	Interlec Superbrain DOS 3 x	RK	Perlec PCC2000	A1	TRS-80 Model I - FEC	RM	Vista V200 5 25 in Double	P6
CDS Versatile 4	Q2	ICOM 2411 Micro Floppy	R3	Interlec Superbrain QD	RS	Processor Technology	B2	Freedom	RM	Dens	
COMPAL-80	Q2	ICOM 3712	A1	Kontron PSI-80	RF	Helios II	RO	TRS-80 Model I -	A4	Zenith Z89 - Heath CP/M	P7
CSSN Backup	T1	ICOM 3812	A1	MITS 3200-3202	RC	Quay 500	RP	TRS-80 Model I - Omikron	RM	Zenith A89 - Lifeboat CP/M	P4
Cromemco System 3	A1	ICOM 4511 5440 Cartridge	D1	MSD 5 25 in	P6	RAIR Single Density	R9	5 25 in		Zenith Z89 - Magnolia	P7
Cromemco Z2D	R6	CP/M	A1	Meca Delta-15 25 in	Q1	Research Machines 5 25 in	RA			CP/M	
Delta Systems	A1	ICOM 4511 5440 Cartridge	D2	Micromation							
Digi-Log Microterm II	RD	CP/M		Micropolis Mod I							

**Lifeboat Associates, 1651 Third Avenue, N.Y., N.Y. 10028**  
(212) 860-0300 International Telex: 220501, Domestic Telex: 640693

**In Germany,**  
Intersoft GmbH, Schlossgartenweg 5,  
D-8045 Ismaning Telephone 089/966-444 Telex: 5213643 isof  
**In Switzerland,**  
Lifeboat Associates GmbH, Aegeristr. 35, CH6340 Baar,  
Telefon: 042/31 2931, Telex: 865265 MICO CH

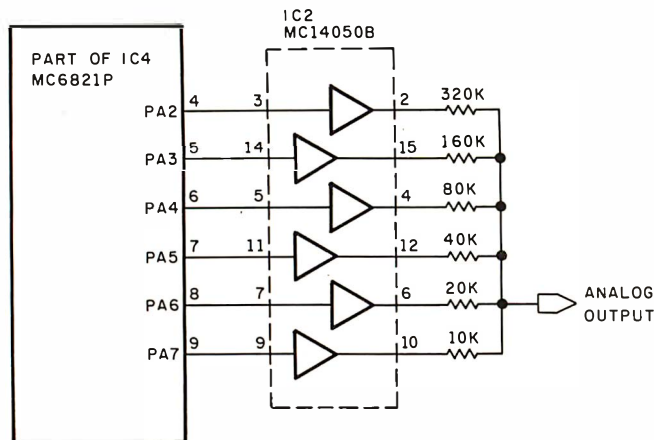


keys and a "Fire" key. This would allow you to play a "Tank" game without having a set of joysticks.

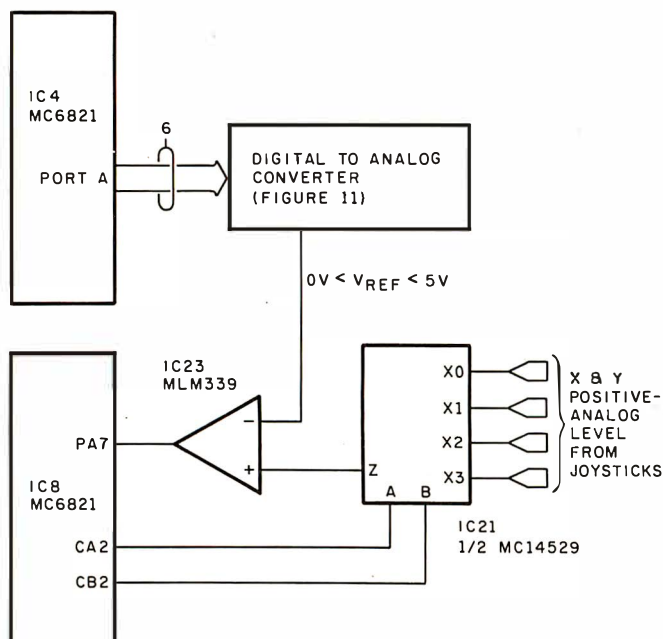
## Digital-to-Analog Converter

The D/A (digital-to-analog) converter allows the Color Computer to send analog waveforms. These signals are used for the cassette output, sound to the video modulator, and as a reference signal for A/D (analog-to-digital) conversion.

Six of the eight port A lines are configured as outputs and buffered to drive a resistive adder network for analog signal generation, as shown in figure 11. The resultant analog signal ranges from 0 V to +5 V in 78 mV steps.



**Figure 11:** Schematic diagram of the Color Computer's digital-to-analog converter. In a rather simple scheme, the output lines of a parallel port drive a resistive adding network to provide conversion. The resulting analog signals are used for recording on a cassette, providing the video modulator with sound, and also as part of the analog-to-digital converter.



**Figure 12:** Diagram for the analog-to-digital converter circuit. Also used as the joystick interface, this circuit applies the successive-approximation method (see figure 13) to change analog signals to digital form.

This type of converter is accurate to  $\pm \frac{1}{2}$  the least significant bit, or in this case  $\pm 39$  mV.

## Cassette Port

The Color Computer has a cassette port which connects to a low-cost recorder. Motor-control capability is included that allows the cassette recorder to be started or stopped as required. The motor can be turned on and off with the statements MOTOR ON and MOTOR OFF. This allows the user to fast-forward or rewind tapes without having to unplug connections to the Color Computer.

Data is output to the recorder from the D/A converter. If an oscilloscope is connected to the data-output line, pin 5 of the cassette jack, an 800 mV 1500 bps signal will be seen.

When data is loaded from the cassette recorder, the playback signal can be routed to the modulator sound input in a manner that allows you to monitor the cassette signal via the speaker of a television set. This is done with the AUDIO ON and AUDIO OFF statements.

The cassette data-output can be used for an analog output level because the D/A converter can be controlled by a user program. The motor-control relay can be used to control loads up to 6 V DC at 500 mA.

## Joystick Interface

Two joystick ports are provided which allow full x,y directional control. Each joystick has a pushbutton for use with games (eg: paddle control for the Pinball game). Each joystick consists of two potentiometers, each connected across +5 V and ground. The wiper of each potentiometer is connected to the input of an analog multiplexer controlled by PIA IC8. The voltage level from each of the four potentiometers is routed to the A/D converter to get a digital value for the position. This value will range between 0 and decimal 63. The JOYSTK(j) function returns the digital value of the joystick position.

Analog voltage levels from the joysticks are digitized using a successive-approximation technique. This is one of the more popular methods of A/D conversion. The 6-bit D/A converter is used in a feedback loop to generate a known analog signal to which the unknown analog joystick input is compared. This technique is not as fast as a flash converter, nor is it as slow as a binary counter.

Figure 12 shows the block diagram for the successive-approximation converter circuit. Figure 13 shows a flowchart for this approach. The D/A converter inputs are controlled by the microprocessor to form a successive-approximation register. The analog output is compared to the analog joystick input by the MLM339 comparator whose output is monitored by the MC6809E.

At the start of a conversion the MSB (most significant bit) of the D/A converter is turned on by the microprocessor, producing an output equal to half the full-scale value. This output is compared to the analog input and if it is greater than the joystick voltage, the microprocessor turns the MSB off. However, if the D/A output is less than the joystick voltage, the MSB remains on.

Following the trial of the MSB, the next most significant bit is turned on and again the comparison is made

# THE NEW RELIABLES

Take a look at the new industry standard in reliability.

Our warranty on all IMS International products is two years from the day a dealer sells them.

Two years.

No catches. No small print. No exceptions.

The systems we offer are some of the most advanced in microcomputer history. That gives the IMS dealer another distinct advantage in his marketplace.

There's more.

Low retail cost—well under \$10,000 complete—with the best margins and benefits in the industry. Face it, even the most impressive specifications are no replacement for profits.

Next to profits, full factory support is the second most important feature we give the IMS dealer.

Our systems are designed to meet the specific needs of

your business computer today *and* tomorrow. The price/performance comparison with competitors is one of an IMS dealer's easiest sales closes.

Tailored sales plan. National advertising backup. Point of purchase program. Protected territories. Guaranteed complete system delivery in *30 days*.

We have what you and your customer need.

The package is complete. New. Reliable.

For more information on our superior computer line and the unique dealer program that comes with it, call Fred Williams (collect) 714/978-6966, or write us:

**IMS**  
INTERNATIONAL

Box 201  
2800 Lockheed Way  
Carson City, NV 89701



between the converter's output and the joystick voltage. The same criteria apply and this bit is either kept on or turned off. This procedure of testing each bit continues four more times until the 6 bits of the D/A converter have been set to the proper level.

Once the conversion is complete the microprocessor reads the joystick output by reading port A of PIA IC4. The internal structure of port A allows a read of the port to sample the output logic levels. Now the Color Computer has the digital value for the joystick voltage. The time necessary to do this conversion is constant and does not vary with the analog voltage level.

Note that the Color Computer has an on-board A/D converter that accepts a signal between +5 V and ground and can digitize it with less than a 40 mV error. This means you can use the appropriate joystick inputs to monitor various analog voltages. The switch inputs are connected to the PIA (the left switch to IC8 pin 3, PA1; and the right switch to IC8 pin 2, PA0). You can write a program to monitor these bits for use with external devices. Figure 14 shows the connectors for the joysticks (which are not shown in the TRS-80 Color Computer Operation Manual).

### RS-232 Interface

An RS-232 interface is also provided. This allows you to connect all manner of devices to the Color Computer. The standard RS-232 Transmit Data, Receive Data, and Carrier Detect signals are provided. This is the fundamental signal subset used by most devices. Tandy sells an off-the-shelf line of printers and a modem that are readily

usable.

### Expansion Port

The expansion port provides the capability to interface almost anything to the Color Computer. Table 8 lists the pins and their functions. Note that the entire address bus is brought out. There is also a decode-defeat pin which disables the 74LS138 that decodes ROMs and peripherals. This allows the expansion port to redefine the memory map. For instance, a flip-flop could be toggled to remove the BASIC and Extended BASIC ROMs from the memory map and replace them with programmable memory. A disk-controller board could also contain 48 K bytes of memory to fill the system from address hexadecimal 0000 to FF60.

The Vector Graphic company makes a wire-wrap prototype board (part number 4609) that fits the expansion connector of the Color Computer. This allows you to build your own peripheral boards. We are working on an interface to the General Instrument "Cricket" sound generator. The output from this circuit can be routed to the video modulator through a pin on the expansion connector. If you want, you can also build your own game

## Selectric® Interface System

**E**ASILY interfaced to any IBM Selectric I, II, or III.

**S**TOP spinning your wheels. Letter quality at an affordable price.

**C**ONNECTS via Parallel or RS-232, accommodates varied handshaking.

**O**NLY \$575 to \$599. Dealer inquiries invited.

**N**EW design provides added features.





**ESCON Products, Inc.**  
12919 Alcosta Blvd.  
San Ramon, Ca., 94583  
(415) 820-1256

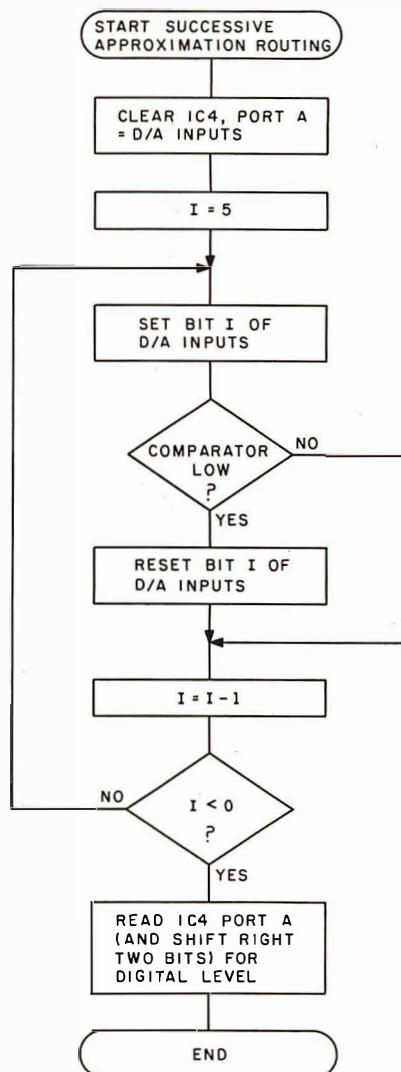
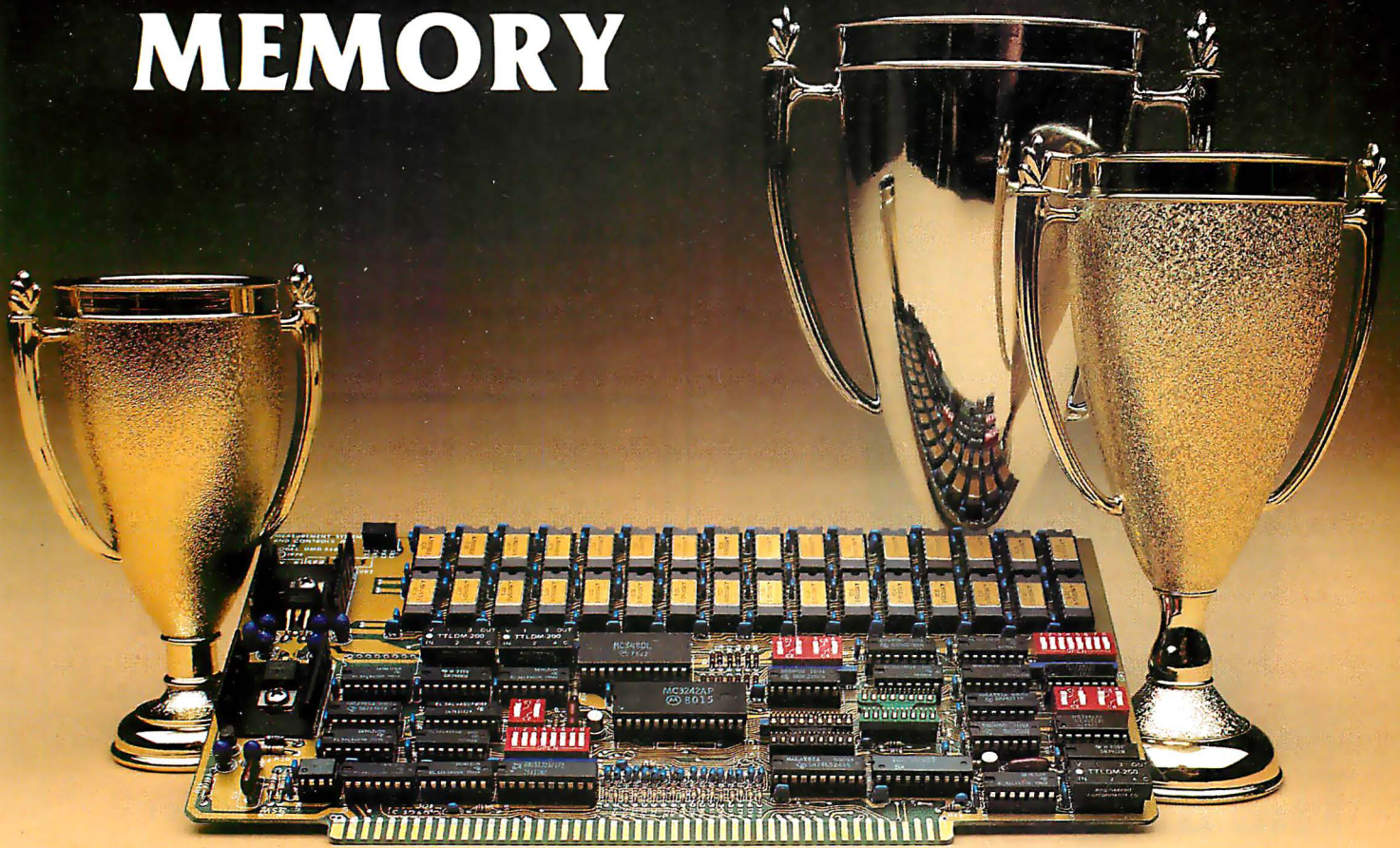


Figure 13: Flowchart of the successive-approximation algorithm used by the Color Computer.

# THE UNBEATABLE S-100 MEMORY



That's the MEASUREMENT systems & controls DMB Series of S-100 bus memory modules, fully compatible with **ALPHA MICRO, CROMEMCO, DYNABYTE, NORTH STAR, MP/M**, and most other S-100 systems.

Definitely a winner, the DMB Series is available with Bank Select (DMB6400) or without (DM6400) and utilizes industrial quality construction, provides outstanding reliability, and is backed by dedicated customer service and a one year guarantee.

The DMB6400 uses I/O port addressing for the bank select feature. A switch provides the ability to select any one of the 256 I/O ports for addressing the memory banks. The memory is configured as four totally independent 16K software selectable banks, with each bank addressable on any 16K boundary.

Outstanding features such as those listed below make the DMB series the UNBEATABLE S-100 Memory:

- Four independent 16K software selectable banks.
- Each bank is independently addressable on any 16K boundary.
- Switch selectable bank sizes — from 16K to 64K in 16K increments.
- Eight banks (512K) per I/O port for each of the 256 ports.
- Z-80 4MHz operation with no wait states using transparent refresh.
- On-board diagnostic LED's.
- Low power — 8 watts maximum.
- Reliable, tested and burned-in memory.
- IEEE S-100 compatible timing.
- One year guarantee.
- Attractive Dealer & OEM Prices.

See your nearest computer dealer, or contact us for the complete story on the UNBEATABLE S-100 Memory.

## Systems Group

A Division of MEASUREMENT systems & controls  
Incorporated

867 North Main St. / Orange, Calif. 92668 / (714) 633-4460  
TWX/TELEX: 678 401 TAB IRIN

# NEW



## The single board microcomputer that's perfect for CP/Net™

Everything you need for a network slave is built in: Z-80 processor, 64K dynamic RAM, even the console serial port. The forthcoming expansion board will add additional ports, priority interrupt control, and IEEE S-100 bus master capability for the network master processor. And MuSYS delivers all the software support you need to take advantage of CP/NET™ and the advanced MP/M™ operating system. For your multi-user system, it's the ideal way to add stations, share common resources (peripherals, programs, data bases), and increase total throughput, while maintaining hardware isolation for each user.

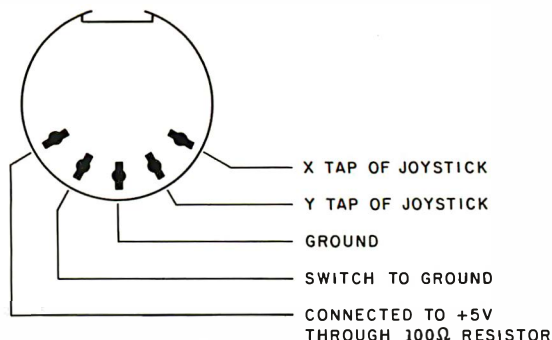
Just \$1,395 ea. Generous dealer and quantity discounts available. Call or write today for more details.

CP/Net and MP/M are trademarks of Digital Research.

# MUSYS

Multi-user Microsystems

1451 Irvine Blvd., Suite 11, Tustin, CA 92680  
(714) 730-5692. TWX: 910-595-1967  
CABLE: MUSYSTSTN



**Figure 14:** Pin designations of the Color Computer joystick connectors. The connectors will mate with a standard 5-pin DIN plug, and any signal within the A/D converter's range may be monitored under program control.

Expansion Port Pin Description			
pin	function	pin	function
1	-12 V	2	+12 V
3	HALT	4	Nonmaskable Interrupt
5	RESET	6	E
7	Q	8	CB1 of IC4
9	+5 V	10	D0
11	D1	12	D2
13	D3	14	D4
15	D5	16	D6
17	D7	18	R/W
19	A0	20	A1
21	A2	22	A3
23	A4	24	A5
25	A6	26	A7
27	A8	28	A9
29	A10	30	A11
31	A12	32	C000 thru FEFF
33	Ground	34	Ground
35	Analog In	36	FF40 thru FF5F, CS
37	A13	38	A14
39	A15	40	Decode Defeat

**Table 8:** Signals available at the expansion port.

cartridges. If you want them to auto-start like the Tandy cartridges, connect pins 7 and 8 together. This runs the Q clock into the CB1 input of PIA IC4, causing an FIRQ interrupt. The FIRQ interrupt-service routine jumps to hexadecimal C000 and starts execution. There is also a device select on pin 32 that is decoded from hexadecimal C000 to FEFF.

### Summary

We have tried to completely describe the architecture of the Color Computer and deduce the reasoning behind the design trade-offs. Tandy certainly is to be complimented on the amount of "bang for the buck"—every part is fully used and several innovative design ideas are evident. We believe that the Color Computer has the capability to surpass the Model I in sales.

In a later article we will take a detailed look at the Extended BASIC and discuss its capabilities. We are currently implementing several popular video games in BASIC. Once the algorithms are proven, we plan to convert them to machine language to increase the speed, although with the power of the Extended BASIC we may not have to. ■

# Lifelines.

## The serious publication for the serious software user.

If you care, really care, about choosing  
and using software, you need  
Lifelines.

February 1981. Vol. 1 Issue #9

### LIFELINES

- A comparison of VisiCalc\* & T/MAKER.\*
- Abstracts and catalog of a new software diskette available from The CP/M\* Users Group.
- The first in a series of articles by Osborne/McGraw/Hill on the use of their accounting packages available from The CP/M Users Group.
- A review of MACRO-80 by Microsoft highlighting its compatibility with Digital Research's MAC.\*
- A tip on how to save substantial space in your CP/M BIOS.
- Current up-to-date information on serious software for CP/M compatible computers.

\*VisiCalc is a trademark of Personal Software, Inc.  
CP/M and MAC are trademarks of Digital Research, Inc.  
The CP/M Users Group is not affiliated with Digital Research.  
T/MAKER is a trademark of P. Roizen.

Lifelines is the publication dedicated to keeping you up-to-date on happenings in the explosive microcomputer world.

Lifelines specializes in news about software for CP/M\* and similar operating systems.

**Lifelines does it** with a guarantee of high level, in-depth analysis of software uses and capabilities.

**Lifelines does it** with valuable information necessary to make intelligent software buying decisions.

**Lifelines does it** with the latest information on The CP/M Users Group.

**Lifelines does it** with thought provoking discussions on many of the more controversial issues facing computer users.

How can you live without Lifelines?

#### Subscribe Now!

\$18.00 for twelve issues: U.S., Canada, and Mexico.

\$40.00 for twelve issues: all other countries.

\$2.50 for each back issue: U.S., Canada, and Mexico.

\$3.60 for each back issue: all other countries.

All orders must be pre-paid by check to: LIFELINES, 1651 Third Avenue, New York, N.Y. 10028—Checks must be in U.S. \$, drawn on a U.S. bank. Or use your VISA or MASTERCARD. Call (212) 722-1700

### LIFELINES



# What Is Good Documentation?

---

Jim Howard  
150 Ramona Place  
Camarillo CA 93010

---

As more and more people discover the joys of owning a microprocessor the need for good documentation will continue to grow. Information will be needed at all levels, from detailed hardware and software documentation to descriptions of which buttons to push to play your favorite game.

Who will provide this information? The simple answer is that those who know will tell those who don't know. It sounds simple, but it's not. Everywhere, complaints are made about documentation—"inadequate," "erroneous," "over my head," "bad or nonexistent," and so on. All too often, companies market excellent systems with poor or sketchy documentation, resulting in unhappy customers and unsatisfactory sales.

It's a common mistake to believe that because somebody is an expert in a subject, he can explain it to others. For example, it's assumed that a professor who knows a subject inside and out can pass on this information to students. However, whether he can or cannot depends on something else besides his knowledge of the subject. It depends on his ability to put himself in the place of the users, the students, to begin where *they* are,

using their language and their knowledge level. (Of course, if there is a failure to communicate, it is the students who fail, not the professor!)

The microprocessor industry is a classic example of the communication problem. Aside from a few shining lights, microprocessor literature suffers from a bad case of "the jargons." The problem was not as serious while the technology was being pursued by only a few hobbyists, who like to work things out for themselves. Now

---

## Aside from a few shining lights, microprocessor literature suffers from a bad case of "the jargons."

---

that the public is becoming involved in large numbers, the information must adapt to the customer, not the other way around.

Many could undoubtedly do a better job of communicating if they followed a few principles. But doing

this requires conscious dedication. And, of course, it requires principles. Those principles are what this article is about.

To translate the jargon of the expert into terms meaningful to the rest of the world, we need an *interpreter*. Such an interpreter is similar to the compiler or interpreter used in computers, which translates the source language into one the machine understands. In both cases, the source language is provided by the computer expert. The machine is the user in one case, the public in the other.

### Information Design

The interpreter we require can best be referred to as *information design*. This term is better than the common term "technical writing," in that it indicates what really is required—conscious, step-by-step design. Writing is just one aspect of presenting understandable information. In fact, technical writing is similar to writing code for a computer program. If the planning and structure are sound, the writing almost takes care of itself.

There are many aspects of information design, not all of which can be

### Information Design Principles

● **Content** defines the breadth and depth of the material in a document, and is best specified by a topic diagram. Consistency and uniformity of treatment are revealed by such a diagram: One topic should not be treated in great detail and others of equal importance hardly mentioned. The breadth and depth should fit users' needs—all relevant material included, no unnecessary redundancies, and sufficient detail to allow users to understand the explanation or perform the job.

● **Organization** gives shape and

direction. The users always know where they are, where they have been, and where they are going. Indexes and headings make the organization visible to users, so that information is located easily and quickly. Material is grouped and sequenced to flow logically and naturally from one topic to another. A top-down approach is used, to provide an overall structure before confusing users with details. Introductions and summaries tie pieces together both forward and backward, and reinforce for long-term memory.

● **Format** makes the information understandable through language and illustrations. Language speaks to one half of the brain—the verbal, linear side. Simple vocabulary and short, direct sentences make for ease of understanding. Illustrations speak to the other half of the brain—the nonverbal, spatial side. Illustrations are most effective when they are near the relevant text and are keyed to it through call-outs and highlights. Working together, words and illustrations present the whole "picture" as neither can alone.

# Time is precious Why lose it?

## BATTERY SUPPORTED CALENDAR CLOCKS

PDP-11 <sup>1</sup>	TCU-100 • \$495
	TCU-150 • \$460
LSI-11/2 <sup>1</sup>	TCU-50D • \$325
Multi-Bus <sup>2</sup>	TCU-410 • \$325
EXORcisor <sup>3</sup>	TCU-68 • \$325
HP 2100	TCU-2100 • \$395
Lockheed SUE	TCU-200 • \$550
Naked Mini <sup>4</sup>	TCU-310 • \$385

If automatic and accurate date and time entry is important to your system on power-up — you need a Digital Pathways battery supported calendar clock. All Digital Pathways TCUs have on board NICAD batteries to maintain date and time during power down (typically up to



**Serial Line Clock SLC-1 • \$640**  
(RS 232 or 20mA) Microprocessor controlled.  
Auto message intercept and response.  
10 Digit display option \$190.

three months). Timing is provided by a crystal controlled oscillator. Prices are U.S. domestic single piece. Quantity discounts available.

*For more information on these timely products, contact:*

<sup>1</sup>Trademark of Digital Equipment Corp.

<sup>2</sup>Trademark of Intel Corp.

<sup>3</sup>Trademark of Motorola Inc.

<sup>4</sup>Trademark of Computer Automation Inc.



Digital Pathways Inc.  
1260 L'Avenida  
Mountain View, CA 94043  
Phone: (415) 969-7600

# DIGITAL PATHWAYS

covered here. What is necessary is that a few key principles are made clear.

The basic objective of information design is *usability*. Whatever the user intends to do—write a program, assemble a piece of hardware, learn how a system works—the documentation must serve this purpose.

Although this may sound trivial, if you're writing a technical document, it's surprising how easy it is to lose sight of this overall requirement after page 1. The presentation can become an ego trip without your realizing it. On the other hand, it's hard to go

wrong if you consistently keep the usability objective in mind.

How do we determine if a document is usable? Whatever the type of document—operator's manual, maintenance procedure, reference manual, training program—it has some *purpose*. Its purpose may be to explain a concept, describe the operation of a piece of equipment, or guide a person through an assembly procedure.

To be usable, the document must take the users from a state of incomplete knowledge about some subject to a condition of more complete knowledge. If it's a procedure, the in-

formation must guide the users through the task. In any case, the document must take them from "here" to "there."

That's what information design does: It starts where the users are and builds step by step. The information designer first asks who the users are. Then he puts himself in their place and asks, "What will they understand, with their experience? What is their technical knowledge and vocabulary? How can they best be helped?"

Next, he builds step by step. He breaks up complicated subjects into simpler parts. He leads the users gradually into new territory, helping them make their own discoveries. With each step their confidence grows and they want to learn and do more. At the end, the users know they have succeeded—and, therefore, so has the information designer.

### The Elements of Information Design

If we are going to start where the users are and build step by step, we need a plan of action. We need to decide:

- what information to include in the document
- how to organize it
- how to present it so it's understandable

We'll discuss these aspects under the headings of Content, Organization, and Format.

### Content

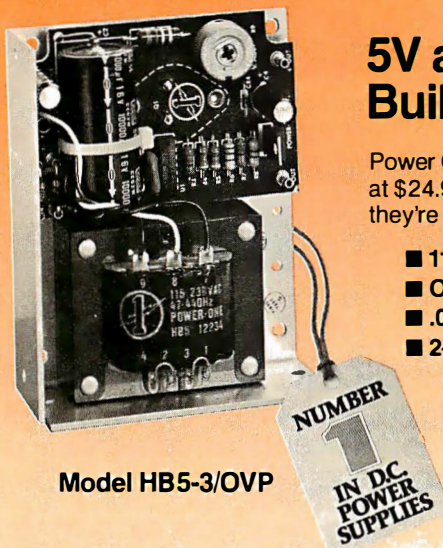
The *content* of a document is the specific technical material contained in it. This should be carefully defined by boundary lines set down by the information designer.

Content really has two aspects: what information is included (*breadth*) and what is its level of detail (*depth*). A simple example will illustrate the important difference between breadth and depth: An operator's manual for a computer system might tell you to "remove and replace the printer's print wheel as necessary." The subject of print wheel replacement is thus "covered" in the manual; that is, in terms of breadth, it is part of the content. However, the lack of "how to" details may make this information of little use to many

**FOR ALMOST A DECADE...**

**\$24.95**

**...AND STILL HOLDING**



### 5V at 3A with Built-in OVP

Power One's B Case models started at \$24.95. Over 150,000 models later, they're *still* only \$24.95!

- 115/230 VAC Input
- OVP Built-in
- .05% Regulation
- 2-Year Warranty
- 2-Hour Burn-in
- UL Recognized
- CSA Certified

Get all the details on our 105 standard open frames in our new 1981 catalog.

Model HB5-3/OVP

### IN-STOCK NATIONWIDE... FOR IMMEDIATE DELIVERY

ALA.: Huntsville, Rakes Engr. & Marketing Corp. (205) 883-9260 ARIZ.: Phoenix, PLS Assoc. (602) 279-1531 CAL.: Pasadena, A-F Sales Engr. (213) 681-5631; San Diego, A-F Sales Engr. (714) 226-8424; San Jose, Richards Assoc. (408) 246-5860 COL.: Denver, PLS Assoc. (303) 773-1218 CT.: Litchfield, Digital Sales Assoc. (203) 567-9776 FLA.: Orlando, OEM Marketing Corp. (305) 299-1000 GA.: Duluth, Rakes Engr. & Marketing Corp. (404) 476-1730 ILL.: Chicago, Coombs Assoc. (312) 298-4830 IND.: Indianapolis, Coombs Assoc. (317) 897-5424 KAN.: Overland Park, ATS (913) 492-4333 MD.: Wheaton, Brimberg Sales Assoc. (301) 946-2670; Baltimore, Brimberg Sales Assoc. (301) 792-8661 MASS.: Waltham, Digital Sales Assoc. (617) 899-4300 MICH.: Southfield, L.H. Dickelmann Co. (313) 353-8210 MINN.: Minneapolis, Engr. Prod. Assoc. (612) 925-1883 MO.: St. Louis, ATS (314) 721-4401 N.J.: Whippany, Livera-Polk Assoc. (201) 377-3220 N.M.: Albuquerque, PLS Assoc. (505) 255-2330 NY.: Roslyn Hts., Livera-Polk Assoc. (516) 484-1276; Syracuse, C.W. Beach (315) 446-9587 OHIO: Cleveland, Marlow Assoc. (216) 991-6500; Dayton, Marlow Assoc. (513) 434-5673 OKLA.: Tulsa, Advance Technical Sales (918) 743-8517 ORE.: Portland, Jas. J. Backer (503) 297-3776; Salem, Jas. J. Backer (503) 362-0717 PENN.: Pittsburgh, Marlow Assoc. (412) 831-6113 TEX.: Dallas, Advance Technical Sales (214) 361-8584; Solid State Electr. (214) 352-2601; Houston, Advance Technical Sales (713) 469-6668; Solid State Electr. (713) 772-8483 UTAH: Salt Lake City, PLS Assoc. (801) 466-8729 WASH.: Seattle, Jas. J. Backer (206) 285-1300; Radar Elec. Co. (206) 282-2511 WIS.: Milwaukee, Coombs Assoc. (414) 671-1945 EUROPE: Hanex, L.A., CAL (213) 556-3807 CANADA: Ajax, Ontario, McHugh Electronics (416) 683-1540; Montreal, Quebec, Empro Sales (514) 341-6420; Winnipeg, Manitoba, Cam Gard Supply Ltd. (204) 786-8481 CARIBBEAN: Ft. Lauderdale, FLA, Reptronics (305) 763-2856

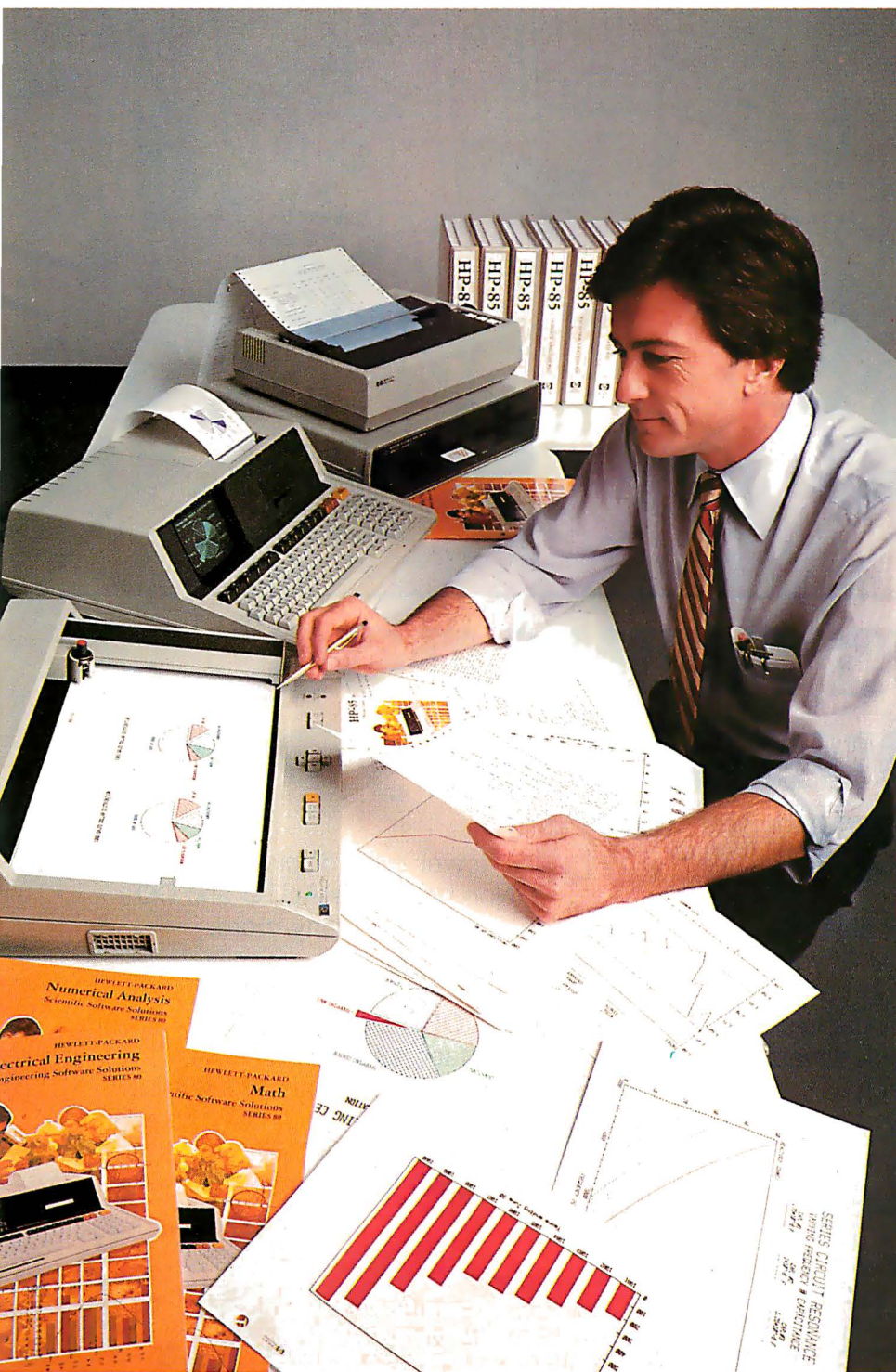
**Power-One D.C. POWER SUPPLIES**

Power-One, Inc. • Power One Drive • Camarillo, CA 93010  
(805) 484-2806 • (805) 987-3891 • TWX 910-336-1297

SEE OUR COMPLETE PRODUCT LISTING IN EEM & GOLDBOOK

Circle 73 on inquiry card.

# Meet the HP Series 80: Hewlett-Packard's new one-on-one computing systems for professionals.



**Together, you can  
analyze technical  
problems and evaluate  
solutions.  
Rapidly and accurately.**

HP Series 80 personal computing systems provide the technical solutions you require. Quickly! Easily! Inexpensively! Analysis techniques that were formerly difficult and often impossible, become part of your everyday work routine. You can evaluate functional behavior, select variable alternatives, perform cost analysis...and more...all with greater accuracy and using more variables than you thought possible.

## **SERIES 80, VISICALC™ PLUS AND YOU**

HP's VisiCalc™ PLUS is a major new software tool. It's an electronic worksheet that instantly recalculates results as you change the variables. You ask the *what-if* questions and immediately see their effects on your solution. No programming is necessary...you can become proficient with VisiCalc™ PLUS in a few hours...and then watch your horizons broaden. VisiCalc™ PLUS features many powerful functions including statistical analysis tools and the entire HP Series 80 BASIC math set. Plus graphics! Create professional presentations with curve-fitting plots, stacked or clustered bar-graphs, exploded pie-charts and line graphs, all in up to four colors, on paper or transparencies.

## **ONLY FROM HEWLETT-PACKARD**

HP Series 80 personal computing systems are part of a forty-year tradition of electronic products built to uncompromising standards of excellence. Additionally, HP Series 80 products are serviced by HP technicians and on-site service contracts are now available. We urge you to judge for yourself with a hands-on, one-on-one demonstration at your HP dealer. For locations, call TOLL-FREE 800-547-3400, Dept. 283A, except Alaska/Hawaii. In Oregon call 758-1010. Or write Hewlett-Packard, Corvallis, Oregon 97330, Dept. 283A.

611/04

HP Series 80 Personal Computers for Professionals: HP-85 (\$3250\*) and HP-83 (\$2250\*) specifications: 16K RAM expands to 32K; 32K ROM expands to 80K; CRT with integrated graphics; (HP-85 only: built-in thermal printer, cassette tape unit); Software includes VisiCalc™ PLUS, Information Management, Graphics Presentations, Surveying, Data Communications (Spring '81), Statistics, Regression Analysis, Math, Linear Programming, Waveform & Circuit Analysis, BASIC Training. HP peripherals include floppy discs, printers and plotters.

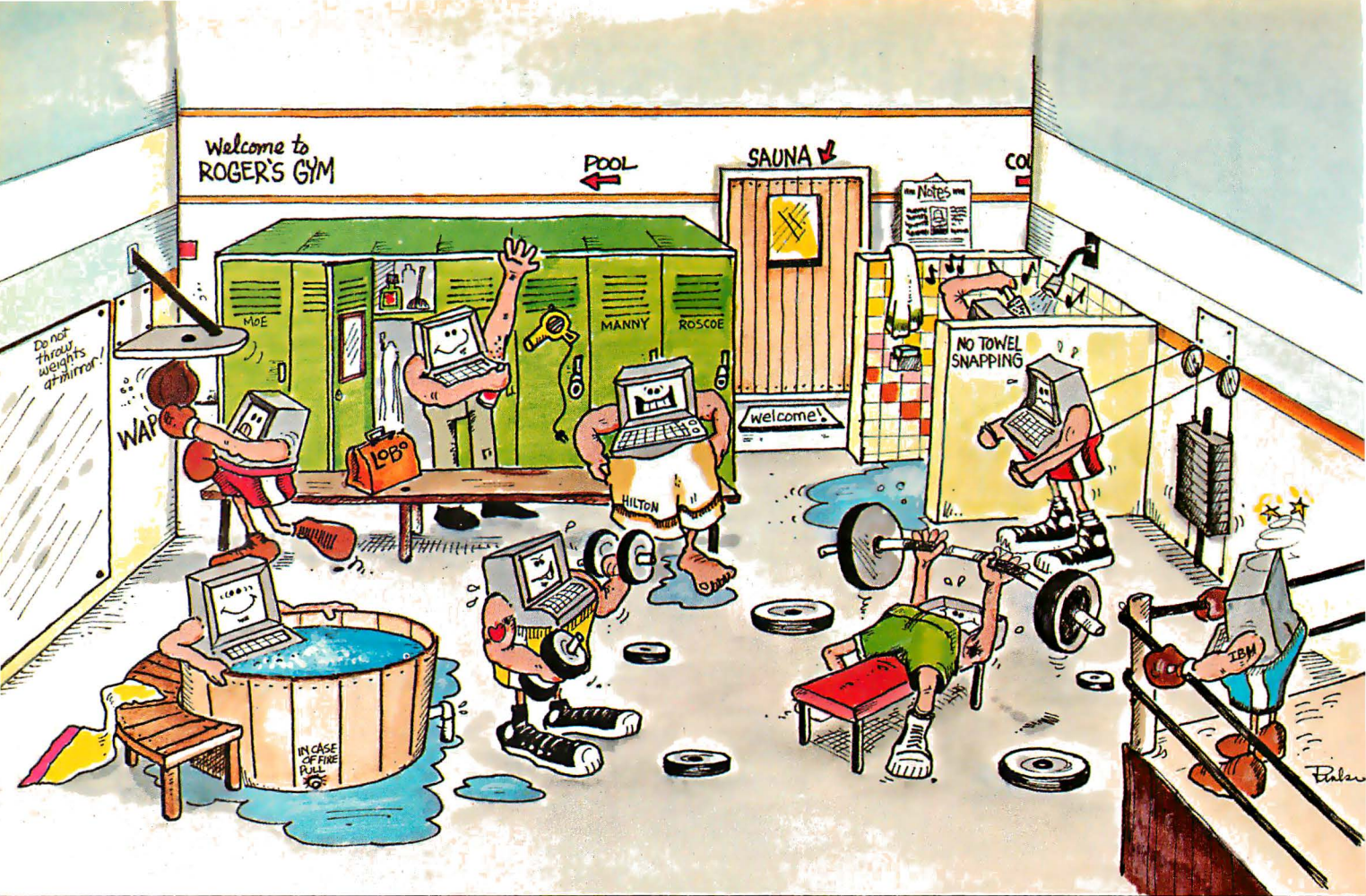
VisiCalc is a trademark of Personal Software, Inc.

\*Suggested retail price excluding applicable state and local taxes—Continental U.S.A., Alaska & Hawaii.

Circle 74 on inquiry card.



**HEWLETT  
PACKARD**



# LOBO'S NEW LDOS<sup>TM</sup> Puts muscle in your TRS-80\*

LOBO DRIVES' new LDOS<sup>TM</sup> Disk Operating System is loaded with outstanding features that will enable you to realize the full power and potential of your TRS-80\*. With LDOS, you can support up to eight drives (5¼ and 8-inch drives, double-sided drives, double-density drives, 80-track drives), including the new 8-inch and 5¼-inch Winchester fixed disk drives, in any combination.

Other LDOS muscle building features include: ISAM accessing techniques; keyboard typeahead; Graphic string packer; Dated files, Marked files; File transfer by class; Built-in

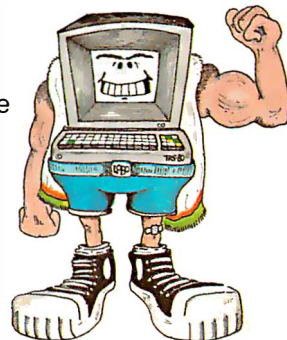
\* TRS-80 is a registered trademark of Radio Shack, a Tandy Company.

lower case display drivers; Non-breakable AUTO and DO commands, and many, many more.

LDOS is the perfect operating system to use with your LOBO DRIVES LX-50 or LX-80 expansion interface and disk drive subsystems. There's even an 800 number for instant service. To find out how you can put more muscle into your TRS-80, contact your nearest LOBO Drives dealer or call or write.

LDOS is available:

- A. Operating System Diskette with Master Reference Manual \$139
- B. Master Reference Manual Only \$25



LOBO DRIVES, INT'L  
354 South Fairview Ave.  
Goleta, CA 93117  
(805) 683-1576

Circle 71 on inquiry card.

# Expand your TRS-80\*



## With The LOBO LX-80 Expansion Interface

Now you can realize all the power and potential of your TRS-80\*, Model 1. If it's add-on memory you need, your LX-80 can accommodate up to four 5¼-inch, single- or double-density 35, 40 or 80 track mini-floppies, four 8-inch floppies (single or double sided), and up to eight Winchester fixed disk-drives (5¼", 8", 14").

LOBO's powerful new LDOS™ operating system, provided with your LX-80, allows for the use of any eight drives, in any combination, single or double density.

And there's more ... lots more. There are two parallel ports (standard), two serial

ports (optional), a keyboard ROM override switch, and a 32K memory expansion (optional). Send for a free LX-80/TRS-80 cost performance comparison chart.

For the full story on how the LX-80 can expand your TRS-80, see your nearest LOBO dealer, or write or call:

\*TRS-80 is a registered trademark of Radio Shack, a Tandy Company.



**LOBO DRIVES INT'L**  
354 South Fairview Ave.  
Goleta, CA 93117  
(805) 683-1576

Circle 77 on inquiry card.

printer users. Thus the proper *depth* of information is *not* part of the content.

A good tool to help a writer of documentation analyze breadth and

depth is a *topic diagram* (figure 1), which is an arrangement of topics in boxes at different levels, with lines joining related topics. It serves a purpose similar to that of an outline, but

provides an easier visual check on such elements as breadth, depth, and consistency of treatment.

In figure 1, topics 1 and 2 are major topics at the same level in the diagram. They might be two major components of a system, or groups of software, or procedures. Neither is a subtopic of the other and they will be treated equally in the presentation.

Subtopics are shown under each major topic: 1.1, 1.2, 1.3 under topic 1, and 2.1 and 2.2 under topic 2. These represent breakdowns of each major topic. The diagram can continue on down to further depths of subdivision and can also be extended to the left and right as additional topics are added at a given level.

We can see that the breadth of the topic diagram, particularly at the major topic level, tends to indicate the breadth of content. The depth of the diagram indicates the depth of content. While this should not be considered an infallible guide, it is useful in preliminary planning.

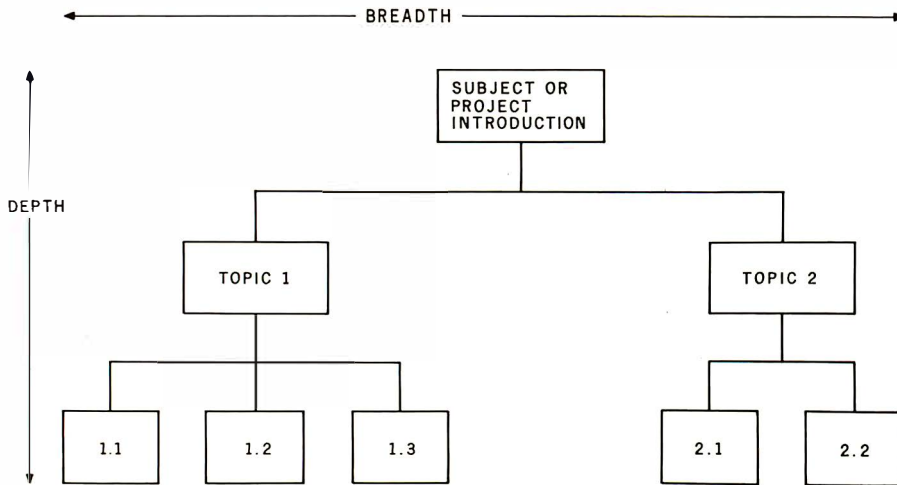
Another use of a topic diagram is that it gives an idea of *consistency* of coverage. A glance at figure 1 will tell the writer if topics at the same level are being treated with some consistency in how they are subdivided, or if one topic is being pursued to greater levels of detail than others. Without such a guide, it's easy to cover one topic in great detail and give other topics at the same level only token treatment or overlook them completely.

Definition of content is as important for what is *not* included as for what *is*. Many technical documents include irrelevant information. This can be particularly annoying in procedural documents, when users are trying to accomplish an exacting task. They want to get on with it, but are continually being interrupted with extraneous remarks that belong in some other part of the document or should be left out entirely.

Figure 2 shows a topic diagram for this article. As you can see, in addition to defining content, such a diagram shows a preliminary organization or structure.

### Organization

To proceed step by step, we need to know where we are going and a route to get there. In other words, we need structure, or *organization*. Informa-



**Figure 1:** A topic diagram is a useful tool for determining the breadth, depth and consistency of a piece of writing. Although similar in content to an outline, the topic diagram provides a clearer visual check on how topics are handled. As shown, topics 1 and 2 are major topics at the same level. Neither is a subtopic of the other and both will be treated equally when the writing is done. Subtopics represent breakdowns of each major topic. As additional topics and subtopics are added the diagram can extend downward and to the left and right.

# Choice

## GNT Makes a Tape Punch Station and a Tape Reader/Punch Combination.

Both are small, quiet, and economical.  
One of them will fit your needs exactly.



### The 4601 Combo

- Punching speed: 75 Cps  
Reading speed: up to 150 Cps
- RS-232-C serial interface
- Utilizes all types of Mylar® and paper tape
- Reliability: MTBF 100 million characters

### The 3601 Punch

- Punching speed: 50 or 75 Cps
- RS-232-C serial interface
- Utilizes all types of Mylar® and paper tape
- Reliability: MTBF 100 million characters

Contact your local dealer or call for complete specifications.



# GNT AUTOMATIC INC.

1560 Trapelo Road, Waltham, MA 02154 (617) 890-3305 Telex: 923318

**New  
from GDC**

# THE ONLY BUSINESS-FEATURED MODEM UNDER \$200

## The GDC 103J-L

The only low-cost 300 bps dial modem  
with the same features found in  
modems which support business applications  
... or your home computer.



### Features:

- Operates over all telephone lines — even lines not usable by line powered units
- Data flow indication shows transmit and receive activity
- Carrier detect indication



- Answer/Originate mode is automatically selected — no need to manually switch
- Self diagnostics with Analoop® — loops data from terminal through modem to check operation
- Same high quality as our complete line of DataComm products.

## For more information contact the experts at:

**General DataComm Industries, Inc.**  
One Kennedy Avenue  
Danbury, CT 06810  
(203) 797-0711

**U.S. Sales Offices**  
Atlanta, GA (404) 955-0682  
TWX: 810 7662256  
Boston, MA (617) 462-6181  
Chicago, IL (312) 298-4181



**General DataComm Industries, Inc.**

Cincinnati, OH (513) 748-8151  
Dallas, TX (214) 980-0803  
Houston, TX (713) 780-1480  
New York, NY (201) 445-5626  
Orlando, FL (305) 293-6817

**General DataComm Industries (Canada) Ltd.**  
104-1220 Innes Road  
Ottawa, Ontario K1B 3V3  
(613) 745-9174

San Francisco, CA (408) 998-2336  
Santa Ana, CA (714) 957-0244  
TWX: 910 595 1907  
Seattle, WA (206) 838-1861  
Washington, DC (703) 255-2882

tion must be grouped, sequenced, and related in order to be understood. Otherwise, it is merely a jumble of disordered facts or ideas—a "shopping list." If we had to learn everything by rote memory from shopping lists, we'd be in big trouble. Once a good structure is established, all kinds of details can be hung on it and they will be understood and remembered.

Organization is also what makes information in a document easily *accessible*. Accessibility depends on both the overall structure of the document and how this structure is made visible to the user through indexing and headings. If information is organized properly, the user will be able to turn quickly to the information he wants. Once there, he will be able to continue with a minimum of routing to other parts of the document.

The importance of structure or organization can be illustrated by a very simple example—a telephone book. Have you ever stopped to think how useless a telephone book would be if the names were listed randomly rather than alphabetically? The important aspects of structure or organization include indexing and headings, grouping and sequencing, routing, and introductions and reviews.

## Indexing and Headings

Indexing and headings are the means by which the organization of the document is made easily visible to users. A writer may actually have a good organization, but if it is not clear to users, it will not really have served its purpose.

*Indexing* as used here includes both the standard type of index found at the end of a document and the table of contents. The index should be set up with the idea that users will sometimes look for items alphabetically, as in a dictionary. Many items that are too small or too specific to be included in the table of contents are made accessible with a good index.

Often a table of contents can be usefully constructed in two parts: an overall table in front and more detailed tables with each major section of the document. This avoids an unwieldy table up front. Figure 3 provides an example of a two-part table of contents. The main table (on the left in the figure) would appear in the front of the document. Each major section would start with its own table of contents (on the right in figure 3) showing the more detailed headings and subheadings in the section.

A consistent set of *headings* serves to make information accessible. Headings also help users remember

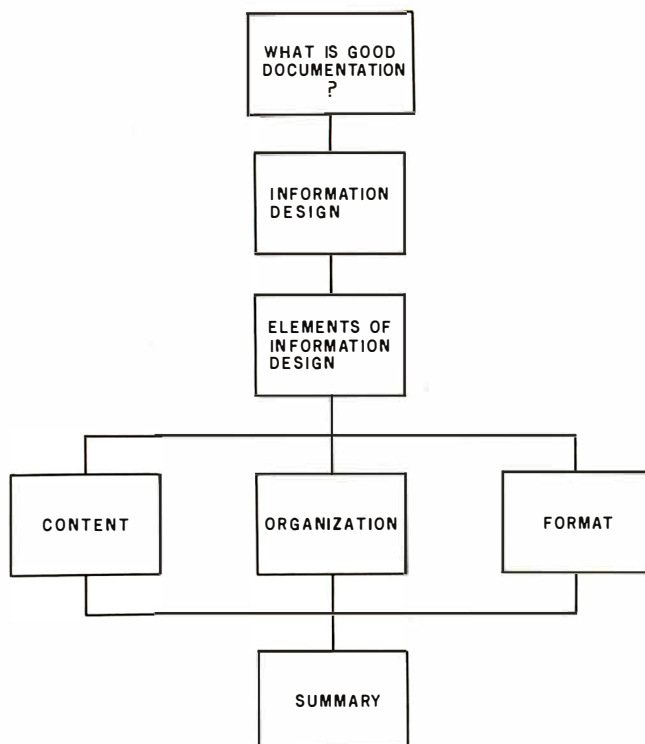


Figure 2: A topic diagram written for this article.

## Apple World

3-D ANIMATED COLOR GRAPHICS

Written in machine code.

The program made famous on national T.V.!

by Paul Lutus

APPLE WORLD turns your Apple into a sophisticated graphics system capable of creating animated three-dimensional color images, projecting them in true perspective on the screen, rotate them, move them closer, further away, and many other exciting and imaginative things.

Draws objects with 65,000 points per side.

A powerful screen-oriented text editor is included to facilitate image formation. This program was recently featured on Tom Snyder's Prime Time Saturday TV Show and is now available for sale.

APPLE WORLD'S powerful editor is so easy to use that children will love it. You can now "sketch" your dream house, boat, car, or fantasy empire. Then view it as it would be seen from 10,000 feet, or you can ZOOM in until the screen is filled with a doorknob. You could then go inside and move from room to room examining furniture placement as your screen rotates within the room. Images or specific parts of images can easily be saved to disk or printer.

Does all this sound like science fiction? You won't think so after you have visited Apple World.

**INTRODUCTORY PRICE \$59.95**

36 page manual included

**For 48K Apple II or Plus with Disk**

## 3-D Supergraphics

& 3-D GAME DEVELOPMENT SYSTEM IN COLOR

by Paul Lutus

Watch colorful butterflies, birds, fly across your Apple or Atari screen with true 3 dimensional perspective. Have rocket ships fly out at you in this incredible high speed graphics package. 3-D SUPERGRAPHICS™ is a 6502 machine language program that will interface to your Basic or machine language programs or games using simple "DOS-like" commands.

Features include:

- Simple image entry through editor
- Objects up to 256 points per side
- Uses all hi-res colors
- Allows mixed colored text & graphics for prompts and captions
- Translates on 3 axes
- Individual axis scales
- 21 different commands
- Rotate object 1.4° to 360° increments at machine speeds

**FOR 48K APPLE II OR PLUS WITH DISK II \$39.95 FOR DISK**

**FOR ATARI 800 WITH 40K MEMORY (DISK OPTIONAL)**

**\$39.95 FOR TAPE**

### OTHER SOFTWARE

#### APPLE COMPUTERS

Super Space Wars .....	\$ 9.95
States & Capitals .....	9.95
Moving Point .....	
Average .....	19.95
Stock Options .....	24.95
Finance .....	12.95
Bonds .....	12.95

#### COMMODORE PET

Stock Options .....	24.95
Finance .....	12.95
Bonds .....	12.95
Stock Analyzer .....	22.95
Mortgage .....	14.95
Space Intruders ("Best Game of 1979") .....	19.95
Jury/Hostage .....	9.95
Kentucky Derby/ .....	
Roulette .....	9.95
Alien I.Q./Tank .....	9.95
Submarine Attack .....	9.95
Battle of Midway .....	7.95
Laser Tank Battle .....	9.95
Swarm .....	14.95
Baseball .....	9.95
Super Startrek .....	14.95
PET Music Box .....	29.95
Music Composition System .....	
.....	19.95
Pearl Harbor Adventure .....	
.....	14.95
Super Gomoku .....	9.95

# Relational Query System For Management

# REQUEST™

By Ken German & Toby Zweifach

## DATABASES: You've Heard The Hype Before... The Truth IS... REQUEST DELIVERS!

### DATABASE MAINTENANCE—

- Uses sophisticated screen formatting & data entry, like on IBM 3270's!
- Generates it's own screens automatically!
- Handles records up to 4K in length, using multiple screen "Pages"!
- Automatic data compression for increased disk capacity
- Uses Superkram (See below) access method for incredibly fast access, LESS THAN .2 SECOND FOR A RECORD!
- Automatic index creation/maintenance
- Automatic maintenance capabilities
- "Goof-Proof" error handling
- Input can come from VISICALC™ or SOURCE™

### DATABASE SELECTION—

- Uses screen masks to form query
- Provides extensive search capabilities
- Search arguments can include arithmetic/boolean functions, multi-field comparisons
- Queries can generate input for automatic database maintenance
- Queries can be stored in "Query Library" and executed from menu on demand
- Any number of fields can be queried concurrently
- Query output can be routed to disk, CRT report formatter, VISICALC™ or SOURCE™

ONLY \$225

### DATABASE REPORTING—

- Automatic headlines
- Automatic field editing
- Report fields can be calculated, sub-totaled & cross-footed in any manner desired.
- Optional counter breaks may be set
- Automatic grand totals
- Automatic statistics

### REQUIREMENTS

Superkram (see below) and: Commodore Pet 32K (40 or 80 col.) and 2040/4040/8050 disk OR Apple II 48K with Applesoft or language system and 2 disk drives or CORVUS.

## SUPER KRAM™ Now With Multi-Key Capabilities For Apple & Pet

by Ken German

Since KRAM™ was introduced in 1979 it has fast become known as the quickest and most powerful access method for serious Apple and Pet users. Now, after hundreds of requests we have added MULTI-KEY, MULTI-INDEX, functions, as well as increasing processing speed.

IBM/370 users have VSAM (Virtual Storage Access Method) to provide fast, flexible keyed-access to their data. Now SUPER KRAM (Keyed Random Access Method), from United Software of America, gives Apple and Pet users the same flexibility, substantially increasing the processing power of the Apple and Pet.

Until SUPER KRAM the only "random access" capability in the Apple and Pet consisted of a crude form of "relative record" processing. While this is usable for very simple applications, it falls far short of the needs of today's business and analytical applications. Using SUPER KRAM records may be processed by any one of multiple "Key" values, which may consist of any kind of data: numbers, letters, special characters, etc. Even Apples's long-awaited DOS 3.3 doesn't have anything like this!!

KRAM™ 2.0 Only \$99.95

SUPER KRAM™ Only \$175

ATTENTION-EXISTING KRAM USERS,  
Send \$15 with original disk and ROM to United Software for improved version of Kram.

### KRAM™ 2.0 Regular Features

- Written in 6502 machine code
- Basic compatible
- Create/Open a dataset
- Put record by key
- Add & delete records by key
- Get any record by Full/Partial key
- Access by any key in as little as .2 sec. (.1 sec. with Corvus disk)
- Supports multiple disks
- Read next or previous record
- Dynamic space allocation
- Dynamic space reclamation
- Dynamic index compression
- Files never need reorganization
- Compatible with language systems

NEW IMPROVED  
KRAM™ 2.05

### SUPER KRAM'S™ Added Features

- MULTIKEY SUPPORT — Allowing simultaneous access to a KRAM file by more than one key field.
- HI-SPEED READ — This feature allows increased I/O speed up to 60% faster during processing of SUPER KRAM read next, read previous, put and delete requests.
- IMPROVED INDEX ARCHITECTURE — Allowing faster index searches and more efficient disk space utilization.
- INTEGRATED BASIC COMMANDS — Allowing SUPER KRAM™ commands to be coded in-line with Basic, providing easier usage of KRAM than ever before.
- USER-SPECIFIABLE BUFFER POOL — Allowing the user to specify how many KRAM files are allowed open at one time; will support any number of KRAM files.
- LOGICAL RECORDS (KEYS MAY BE NON-UNIQUE)—Records added to the KRAM files are immediately accessible by any of the defined keys for the file (Automatic Upgrade).
- KRAM 2.0 files are totally compatible with SUPER KRAM

**USA** UNITED  
SOFTWARE  
OF  
AMERICA  
750 3RD Avenue,  
New York NY 10017  
(212) 682-0347 Telex 640055

Look for the RED-WHITE-BLUE  
United Software Display at your local  
computer dealer, or send check or  
moneyorder, plus \$3.00 shipping to:  
**DEALER INQUIRIES INVITED**

REQUEST & KRAM are trade marks of United Software of America

where they are, which is just as important. Thus high-level headings should be repeated frequently, for example as a running head at the top of each page. Having the relevant headings always in front of the user makes the structure visible, and details are then assimilated more easily.

### Grouping and Sequencing

The overall organization of the document is established by how the content material is grouped and sequenced. Again, the topic diagram is

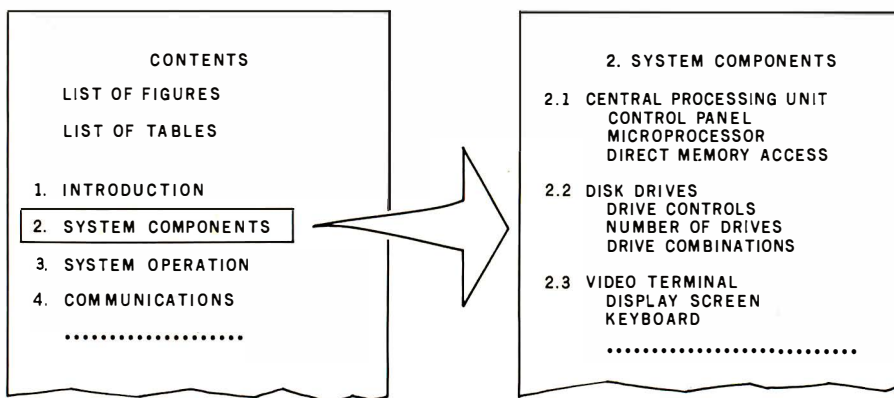
useful during the planning stages in making visible the planned organization of the document.

Whether the document is procedural or descriptive, grouping of the topics should be based on a logical pattern and the relevance of different items. For example, procedural tasks normally performed together (such as the various steps required to start up a computer system) should be grouped together. In a system description, the individual descriptions of system components

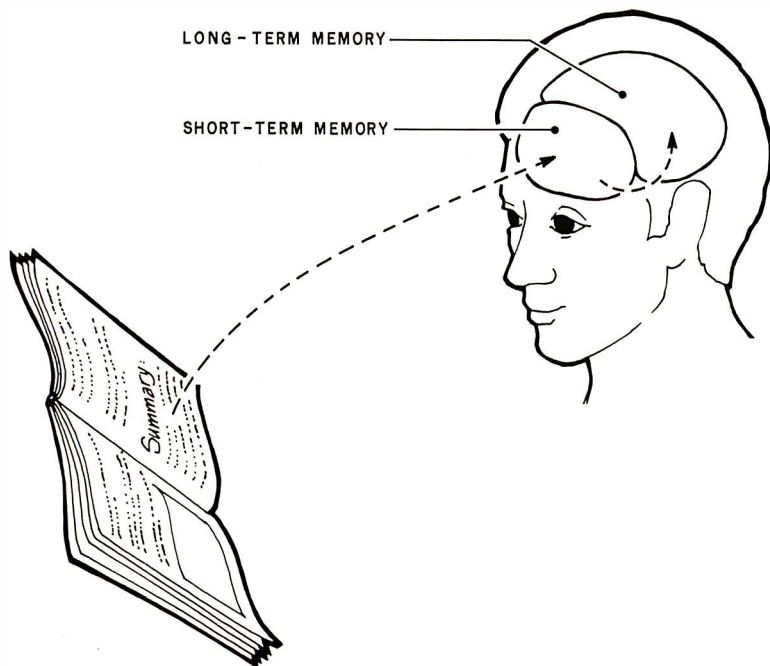
would normally be grouped together, as in the example table of contents shown in figure 3.

Sequencing is one of the most critical parts of the structure. The user is being led step by step from the known to the unknown, from the simple to the complex. Here the *top-down* structuring principle frequently used in writing computer programs also applies. The sequence should begin at the top and give the readers the big picture before engulfing them with details. It is not unusual to begin reading a document and find yourself up to your ears in technical details before you really know what's going on.

Most equipment operations and human activities have a natural or normal sequence that should be preserved in the documentation. For example, you normally gather together all the tools and supplies required for an activity before starting; therefore, this information should logically precede the activity description. It is disconcerting to have to stop in the middle of a task and run to the hardware store to buy some item.



**Figure 3:** An example of a two-part table of contents. By using an overall table in the front of the document, and a more detailed table later, an initial unwieldy table is avoided where a user would be subjected to unwanted detail.



**Figure 4:** Summaries and long-term memory. In the human brain, memory is divided into short-term memory and long-term memory. Although the capacity of long-term memory is large, all information must first pass through a short-term memory. When writing, the inclusion of summaries, reviews, and question-and-answer sections is an effective way of passing information into long-term memory.

### Routing

Once you start using a document it is inconvenient to have to refer to other parts of the document, or to other documents. The more often you are routed, and the more pages you have to thumb through to get there, the less useful the document. On the other hand, if all information is repeated at each point of need, a bulky document can result. Obviously, judgment is required in weighing these trade-offs. For example, you wouldn't want to tell a user how to solder a particular type of joint every time it came up—you would set aside a special section for this purpose. However, if a safety precaution applies to a number of different tasks in the document, it is better to accept the redundancy and repeat the precaution.

### Introductions and Reviews

A general rule is to prepare users for what is coming and to remind them of where they have been. Proceeding through a document, users may forget where they are, forget what has gone before—and decide they didn't really want to learn this anyway. Information should be

# Two proven ways to expand your TRS-80\* capability

Exatron's  
Stringy/Floppy...  
speed, capacity  
and reliability  
for only \$249.50



Exatron's Stringy/Floppy mass storage system gives you the speed, capacity and reliability of a mini-disk system at far less cost. Thousands of ES/F users agree.

## Here's your complete Starter System:

- ES/F Operating Manual
- Basic ES/F System (\$249.50)
- 10 Blank Wafers
- ES/F Monitor Program
- Tutorial Demo Program
- 2 for 1 Bus Connector
- Data I/O Program
- FREE 1 Year Subscription to 80-U.S., the User's Journal
- Complete Info Package
- Complete Starter Kit: \$299.50

CALL OUR FREE HOTLINE  
(800) 538-8559  
IN CALIFORNIA: (408) 737-7111

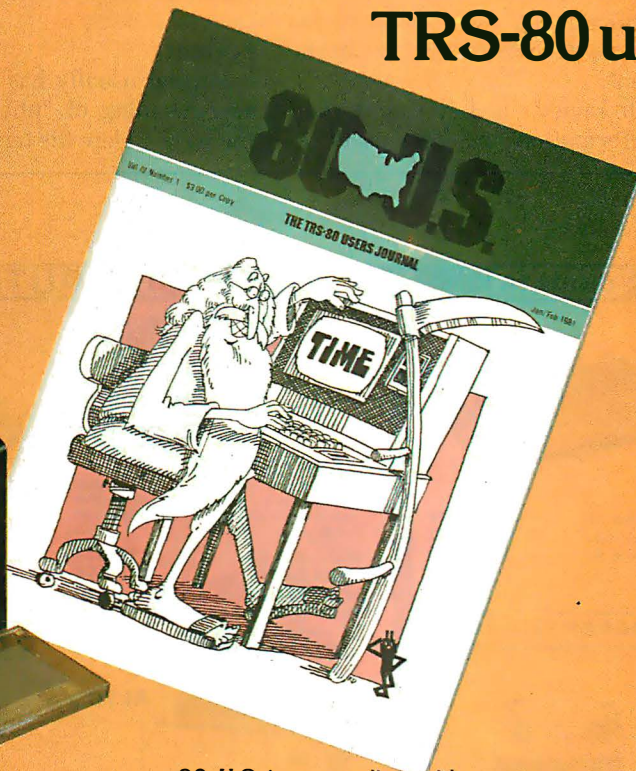
Or contact:



**exatron**  
181 Commercial Street  
Sunnyvale, CA 94086

\*TRS-80 Trademark of Tandy Co.

**80-U.S.**  
TRS-80 User's Journal  
New "How-To" info  
for the serious  
TRS-80 user



80-U.S. is expanding with more pages, programs and color with heavy emphasis on advanced TRS-80 applications...plus a regular Exatron Stringy/Floppy feature.

## Special Introductory offer \$9.95 per year

We'll send you six issues of 80-U.S. for only \$9.95...almost half the regular price. If you purchase an Exatron Stringy/Floppy System, we'll send them FREE.

**OFFER VALID UNTIL MARCH 31, 1981.**

### Send to:

**80-U.S.**

80-U.S. Journal  
3838 South Wamer Street  
Tacoma, WA 98409  
(206) 475-2219

Sign me up! I can't resist at \$9.95!

☐ Check ☐ Money Order ☐ M/C or Visa

CARD NUMBER

EXP DATE

NAME

ADDRESS

CITY

STATE

ZIP

Offer good only in the United States.

designed to help users relate backward and forward and recognize and retain key points along the way.

Further, readers need introductory instructions to help them find and use information. For example, the numbering schemes for tasks or illustrations, the use of safety symbols, notes, cautions, and warnings, and the treatment of information about tools and supplies should be briefly explained. If these instructions are backed up by consistent information presentation (see **Format** section), users will quickly learn what to expect, no matter where they are in the document.

Simple reviews at key points reinforce information and help users re-

tain it in memory. Human memory, to put it simply, consists of two parts, "short-term" and "long-term." Whereas capacity is very limited in STM (short-term memory), the capacity of LTM (long-term memory) is large indeed. The catch is that information can get to LTM only through STM. Summaries and reviews and question-and-answer sessions are effective ways of establishing information firmly in LTM. This important concept is illustrated in figure 4.

### Format

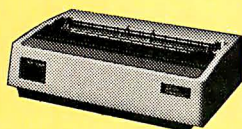
Format usually has the rather narrow meaning of "physical layout of the page." Here the term is meant also

to include the rules that govern text and illustrations—that is, how information is presented on a page.

The general rule is that language and illustrations should work together. Each is an effective way of presenting certain kinds of information, and relatively ineffective for other kinds. When combined properly, they form a powerful presentation technique.

People will readily admit that pictures can do things that words cannot and vice versa. And yet it is surprising how often we find ourselves reading words, words, words, when a visual or two would have helped the presentation considerably. Many ideas become clearer with an illustra-

### OKIDATA



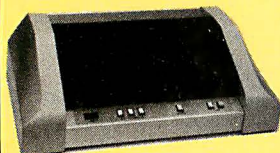
Microline 80 .....	\$499
Microline 82 .....	\$699
Microline 83 .....	\$949

### PAPER TIGERS



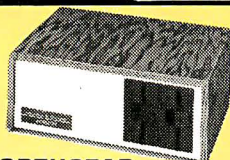
445G .....	\$749
460G .....	\$1119

### ANADIX



DP-8000 .....	\$759
DP-9000 .....	\$1199
DP-9500 .....	\$1299
DP-9501 .....	\$1299

## COMPUTERS



### NORTHSTAR

Burned and tested - backed by fast warranty service. Find out why our prices, availability and service make us the #1 source for the #1 S-100 system.

HRZ-II 64K DD .....	\$2595
HRZ-II 64K Quad .....	\$2995
HRZ-II 32K DD .....	\$2339
HRZ-II 32K Quad .....	\$2689



### ALTOS

"A reputation for reliability" ... Byte Nov. 1980. The single board based Z-80 system that grows with your business.

Single User 1 drive 64K	
ACS 8000-1S .....	\$2295
Expandable 2 drive 64K	
ACS 8000-5 .....	\$4995



### ATARI

Touch the future at an unbeatable price. Software and accessories (except drives and printers) sold only with computers.

Atari 800 w/16K .....	\$ 747
815 Dual Disk Drives .....	\$1099
Joysticks .....	\$ 14.95
410 Recorder .....	\$ 59.95
Star Raiders .....	\$ 39.95



### ZENITH

The all-in-one computer that's backed by your local Zenith/Heath service center.

Z89 w/48K 2 SIO's .....	\$2149
-------------------------	--------

### SOROC



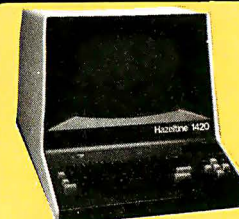
IQ120 .....	\$729
IQ140 .....	\$1159

### TELEVIDEO



912C .....	\$749
920C .....	\$769
950C .....	\$989

### TERMINALS



Hazeltine 1420 .....	\$799
Hazeltine 1500 .....	\$859
ADM3Ar .....	\$759
Pk Bantam .....	\$599
Zenith Z-19 .....	\$789

We participate in arbitration for business and customers through the Better Business Bureau of Maricopa County.



## Scottsdale Systems

6730 E. McDowell Road #103, Scottsdale, Arizona 85257

8-6 Mon.-Sat.



(602) 941-5856



Export prices slightly higher: TWX 910-950-0082 (IMEC SCOT)

### MORE PRINTERS

TI 810 Basic .....	\$1489
TI 810 VCO/Ascii .....	\$1724
TI 825 RO Basic .....	\$1160
C. Itoh Starwriter .....	\$1499
Centronics 737 .....	\$769
Datasouth DS180 .....	\$1399

Diablo 630 .....	\$2299
Epson MX-80 .....	Call
MPI 88G .....	\$669
Malibu 165 .....	Call
NEC 5510 w/Tractor .....	\$2699

### ORDERING

2% cash discount included / charge cards add 2%. Prices subject to change, product subject to availability. Arizona residents add 5%. F.O.B. Scottsdale. 0-20% restocking fee for returned merchandise. Warranties included on all products.

Mass Storage any style

nobody does it better.



**Presenting Konan's Disk and Tape Controller Boards for your S-100 system.** Konan's Disk and Tape Controller Boards allow you to dramatically increase your mass storage capabilities in a whole new way - with top quality equipment that's guaranteed reliable, yet economical.

Take your pick to suit your needs. There's the SMC-100™ storage module (SMD or CDC 9760 interface) hard disk controller...the HARDTAPE™ subsystem which offers tape and/or hard disk Winchester backup...Konan's new KNX-500™ software compatible with Alpha-Micro's AM-500\*...Konan's new SDC-100 error correcting intelligent disk controller for the Shugart Technology 5 1/4" ST506 hard disk and Shugart Associates 8" SA1000...and more to come!

\*Alpha Micro AM-500 is a trademark of Alpha Micro Systems.  
SMC-100, HARDTAPE and KNX-500 are trademarks of Konan Corporation.

Better can't be found. For exciting, but dependable hard disk and tape controller boards (and superlative I/O boards) for your S-100 computer, contact the company that's IN CONTROL.

Call Konan's direct toll-free information line: 800-528-4563.

Or write: Department B, Konan Corporation, 1448 N. 27th Avenue, Phoenix, Arizona 85009.  
TWX/TELEX 9109511552.

**KONAN**  
**KONAN**  
**KONAN**  
**in control**

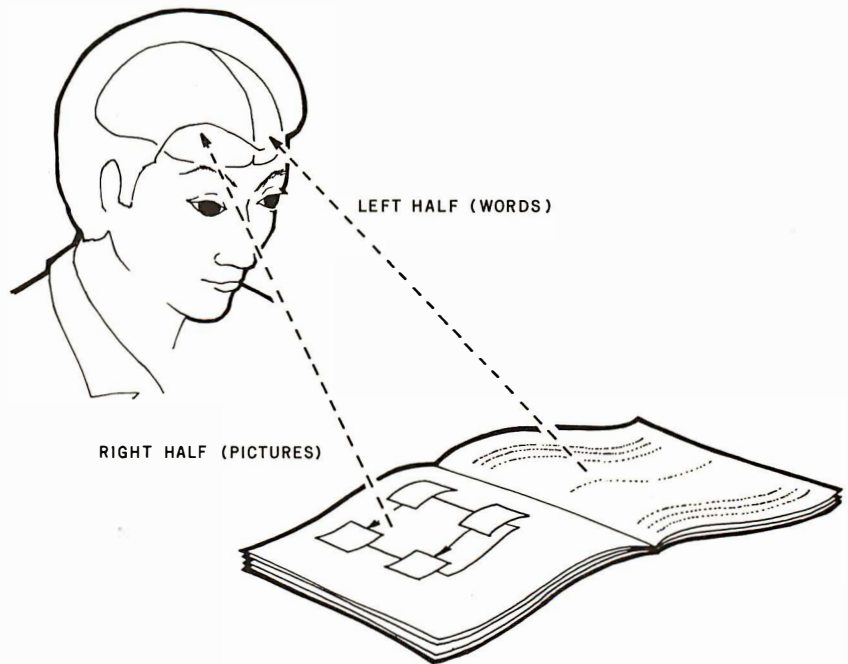


tion, and some kinds of information can hardly be communicated at all without one. If you want to tell someone what something looks like, show a diagram or a photograph.

It is known that the left and right sides of the brain are quite different. For most people, the left side is dominant and works mostly with linear, sequential logic (like a computer). It is also the verbal side and controls language.

The right side specializes in images, music, *pictures*—it deals in spatial and visual concepts, in contrast to the linear, verbal left brain. Schools, with their traditional emphasis on verbal skills, have tended to neglect the right side of the brain. People who are less adept with their left brain have suffered as a result. Einstein, for example, was a poor student in language, but had a great ability to visualize (see figure 5).

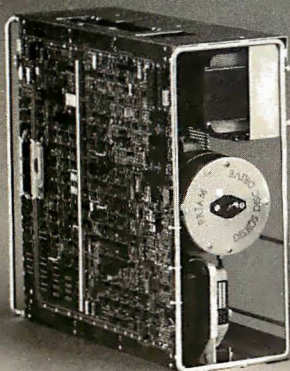
The ideal combination is words and pictures working together, each doing what it does best. In a procedure, for example, words can tell readers what to do and how to do it; pictures can tell them what it looks



**Figure 5:** The left and right sides of the human brain are very different. In most humans, the left side, which works mostly with linear and sequential logic, is dominant. The left side also controls verbal communications. The right side of the brain deals in spatial, visual, and more holistic concepts. One of the best ways of imparting information to the reader is through a combination of both words and pictures, thus enabling the reader to use both sides of the brain.

# THE HARD EDGE

## IN SYSTEM PERFORMANCE ..



CP/M registered  
TM of Digital Research



If your computer needs an edge in system performance, we recommend the **ADES S33 Winchester Disk Subsystem**. With **31 MILLION BYTES OF STORAGE** and a **CP/M 2.2 TRANSFER RATE OF 32K BYTES PER SECOND**, the S33 dramatically increases performance of any S100 computer system. With a dollar/byte price tag lower than any available subsystem, the S33 is the **HARD EDGE** you need. Call or write ADES for detailed S33 specifications and information on our expanding line of Mass Storage Controllers and Subsystems.

See us in Booth #1620 WEST COAST COMPUTER FAIR

ADAPTIVE DATA & ENERGY SYSTEMS • 2627 Pomona Blvd • Pomona, CA 91768 • (714) 594-5858

# Orange Micro

"SPECIALIZING IN PRINTERS  
AND CRT'S"

## CENTRONICS 737 (RADIO SHACK LINE PRINTER IV)

*Word Processing Print Quality*

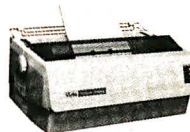


- 18 x 9 dot matrix; suitable for word processing • Underlining • proportional spacing • right margin justification • serif typeface • 50/80 CPS • 9 1/2" Pin Feed/Friction feed • Reverse Platen • 80/132 columns

CENTRONICS 737-1 ..... (List \$995) **\$780**  
CENTRONICS 737-3 ..... (List \$1045) **\$830**

## VISTA — C. ITOH

*Daisy Wheel Letter Quality*



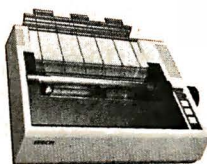
- 25 CPS (Optional 45 CPS) • Typewriter quality • Centronics parallel • RS 232 Serial (Optional) • Proportional spacing • Bidirectional • Programmable VFU • Self test • Diablo compatible • Friction feed (Optional tractors) • 136 printable columns • Manufactured by C. ITOH.

VISTA V300 (C. ITOH) ..... (List \$1895) **\$ Call**

## EPSON MX80

*Low-Priced*

*Professional Print Quality*



- 9 x 9 dot matrix • Lower case descenders • 80 CPS • Bidirectional, Logic seeking • 40, 66, 80, 132 columns per line • 64 special graphic characters: TRS-80 Compatible • Forms handling • Multi-pass printing • Adjustable tractors

EPSON MX80 ..... (List \$645) **\$Call**  
EPSON MX70 ..... (List \$495) **\$Call**

## ANACOM

*Low Cost, High Speed, Wide Carriage*

- 9 x 9 dot matrix • Lower case descenders • Wide carriage • Adjustable tractors to 16" • 150 CPS, Bidirectional, Logic Seeking

ANACOM 150 ..... (List \$1350) **\$ Call**

## ANADEx

*Dot Graphics, Wide Carriage*

- 11 x 9 dot matrix; lower case descenders • Dot resolution graphics • Bi-directional, logic seeking • Up to 200 CPS • RS 232 Serial & Parallel • Forms control • X-ON/X-OFF • Up to 6 part copy.

ANADEx 9501 ..... (List \$1650) **\$1450**

## OKIDATA MICROLINE SERIES

*TRS-80 Graphics Compatibility*



- 9 x 7 dot matrix • 80 CPS • 80, 132 columns — 64 shapes for charts, graphs & diagrams • Double wide characters • 6/8 lines per inch • Up to 3 part copy • Friction & pin feed • 200 M character head warranty

OKIDATA MICROLINE 80 ..... (List \$800) **\$579**  
OKIDATA M82 Bidirectional, Forms handling ..... (List \$960) **\$799**  
OKIDATA M83 Wide carriage, 9 x 9 dot matrix ..... (List \$1260) **\$Call**

## NEC SPINWRITER

*High Speed Letter Quality*

- 55 CPS • Typewriter quality • Bidirectional • Plotting • proportional spacing.

5510-5 RO, Serial, w/tractors ..... (List \$2995) **\$2625**  
5530-5 RO, Parallel, w/tractors ..... (List \$2970) **\$2599**

## TELEVIDEO CRT'S PRICES SLASHED!



TVI 912C  
TVI 920C  
TVI 950

Please Call Toll Free  
Prices are too low to  
advertise

QUANTITY PRICING AVAILABLE

## IDS PAPER TIGERS

*Dot Resolution Graphics, quality print*



- 7 wire printhead (445); 9 wire printhead (460) with lower case descenders • Over 150 CPS • bi-directional, logic seeking (460) • 8 character sizes; 80-132 columns • Adjustable tractors • High-resolution dot graphics • Proportional spacing & text justification (460).

IDS 445G 7 wire printhead, graphics ..... (List \$895) **\$ 795**  
IDS 460G 9 wire printhead, graphics ..... (List \$1394) **\$1150**

## PRINTERS

MALIBU 165 wide carriage, graphics, letter quality .. (List \$2495) **\$ 1975**  
QUME 5/45 typewriter quality ..... (List \$2905) **\$ 2559**

## INTERFACE EQUIPMENT

CCS APPLE PARALLEL Interface & cable ..... **\$ 150**  
APPLE II - EPSON MX80  
parallel graphics interface board & cable ..... **\$ 110**  
SSM AIO BOARD Apple Serial/parallel interface ..... (List \$225) **\$ 175**  
MICROTRONICS Atari parallel interface ..... **\$ 69**  
ATARI 850 Interface module, serial/parallel ..... **\$ 199**  
TRS-80 CABLES to keyboard or Exp. interface ..... **\$ Call**  
NOVATION D-CAT direct connect modem ..... **\$ Call**

## CALL FOR FREE CATALOG

**(800) 854-8275**  
**CA, AK, HI (714) 630-3322**

At Orange Micro, we try to fit the right printer to your application.  
Call our printer specialists for free consultation.

TELEPHONE ORDERS: Mon.-Fri. 8:30 - 5:00  
The Orange Micro Printer Store (Retail):  
Mon. -Fri. 10:00 - 6:00, Sat. till 4:00

Phone orders WELCOME; same day shipment. Free use of VISA & MASTERCARD. Personal checks require 2 weeks to clear. Manufacturer's warranty included on all equipment. Prices subject to revision.

**Orange  
Micro, Inc.**  
3148 E. La Palma, Suite E  
Anaheim, CA 92806

like and where it is. For descriptive material, words and diagrams will do a good job of explaining and describing, *provided* they are working together. When you decide to use pictures to communicate with readers, follow the flow through step by step. Don't be content with offering an occasional "amazement diagram" and a "see figure so-and-so." You can perhaps wake up the right half of the reader's brain this way, but to get it working with the left half as a unit—whole-brain learning—make the words and pictures work together.

Here are some guidelines on how to do this, discussed under the following headings: keying text to illustrations, positioning text and illustrations, and limiting information density.

### Keying Text to Illustrations

The mutual reinforcement of text and illustrations can be strengthened by keying the text to the illustration. This can be done by a liberal use of highlights and call-outs, which are "talked to" in the text.

For complicated diagrams, an indexing system can be used. An example of this common technique is shown in figure 6. Three parts of an electrical unit are designated A, B, and C in the picture on the right. These same letters are used in the text on the left to refer to these specific parts. This method can be used with fairly complex diagrams without confusing the reader. The alphabetical or numerical symbols take up little room on the diagram and can be ordered

(for example, clockwise in figure 6) to make it easy to locate any symbol.

Highlights and call-outs help the user zero in on the main items of interest in a picture. A heavy outline or shading or color, together with a call-out of the item of interest, can make the text and illustration mutually support each other and help the user relate illustration to text.

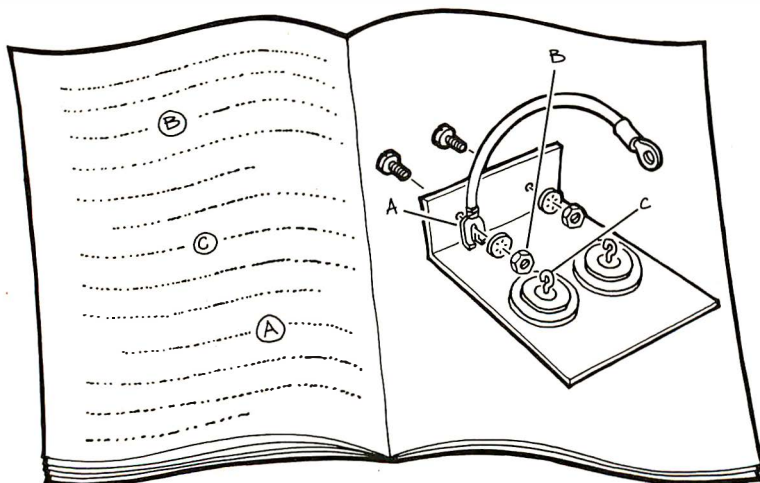
Consistent, standard nomenclature should be used in linking text to illustration, and indeed throughout the document. Information becomes less accessible and less understandable if the same item is referred to by different names.

### Positioning Text and Illustrations

Because the text and related pictures should work together, they should be positioned close together. Ideally, the user should be able to work back and forth between text and illustration without having to turn a page. While this ideal is sometimes impractical, it is usually possible to keep the illustration close to the relevant text. For important, frequently referenced figures, fold-outs are sometimes the answer.

### Limiting Information Density

Information is like food. If readers eat too fast, or too much at one time, they get indigestion. If information is presented too fast or in too large doses, readers will get confused. This is because of the limited capacity of short-term memory. Therefore, like food, information must be broken up into "bite-size" pieces to be digestible.



**Figure 6:** Keying text to illustrations. The mutual reinforcement of text and illustrations (as shown in figure 5) can be strengthened by keying the text to the illustrations through the use of highlights and call-outs which are "talked to" in the text.

## Accurate. Up-to-the-minute. Easy to read.

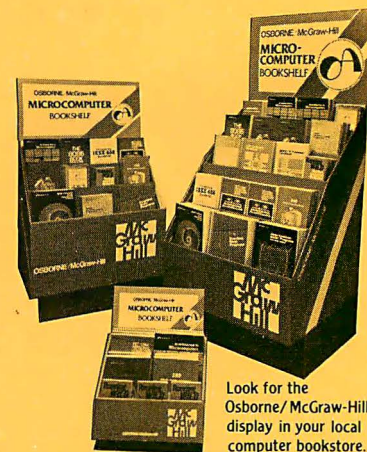
More people choose microcomputer tutorials from Osborne/McGraw-Hill than any other source. That's because Osborne/McGraw-Hill remains at the forefront of computer technology, providing the latest information — written to the most exacting standards of technical accuracy.

What's more, at Osborne/McGraw-Hill, we're dedicated to presenting complicated ideas in a clear, easy-to-read fashion.

So... whether you're just getting into computers or you're an experienced programmer — Osborne/McGraw-Hill has a best selling book to meet your needs and expand your knowledge.

It's easy to order the books you want, too. Just tear out the facing page coupon at the dotted line, check the books you want, fill in your name and address, add tax and shipping and enclose your check or money order for the appropriate amount. Or include your Visa or MasterCard number and expiration date.

Your best sellers will be rushed to you by return mail!



**OSBORNE**  
A McGraw-Hill Company  
The best microcomputer books  
money can buy.

630 Bancroft Way, Berkeley, CA 94710  
(415) 548-2805



# BEST SELLERS

## from the Microcomputer Bookshelf

### ☐ 26-8 **An Introduction to Microcomputers: Volume 0—The Beginner's Book.**

Adam Osborne. Start here if you know nothing about microcomputers. Painlessly introduces basic computer concepts and terminology to the absolute beginner. With the help of numerous illustrations, gives you a sound understanding of basic components and their operation. For any microcomputer you may have. **\$7.95**

### ☐ 46-2 **Apple II User's Guide — NEW.** Lon Poole/Martin McNiff/Steven Cook.

Complements your Apple II Owner's Manual. Properly indexed and under one cover, this comprehensive guide is the complete programming tool. Includes all special features of your Apple II computer. **\$15.00**

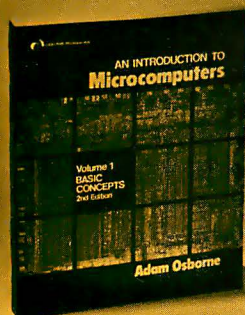
**NEW!**



### ☐ 44-6 **CP/M® User's Guide — NEW.** Thom Hogan.

Complete overview of CP/M. Describes all types of CP/M and their compatibility. Explains CP/M commands and utilities in detail. Covers programming and suggests how to optimize your system's performance. **\$12.99**

**NEW!**



☐ 34-9 **An Introduction to Microcomputers: Volume 1—Basic Concepts, second edition.** Adam Osborne. #1 best-seller! Develops a detailed picture of microcomputing processes and applications. Presents fundamental logic framework, creation and contents of a microprocessor memory, central processing unit operation and more. Discusses the most current programming techniques. Comprehensive. Up-to-date. **\$12.99**

### **ASSEMBLY LANGUAGE**

If you've never programmed in assembly language before, these books will teach you how. Each book explains assembly language microcomputer programming, describes the functions of assemblers and assembly instructions, discusses basic software development concepts, includes comprehensive coverage of the particular assembly language, and presents a large number of fully debugged, practical programming examples. Experienced programmers will find these books an invaluable reference.

☐ 10-1 **8080A/8085 Assembly Language Programming.** Lance A. Leventhal. **\$15.99**

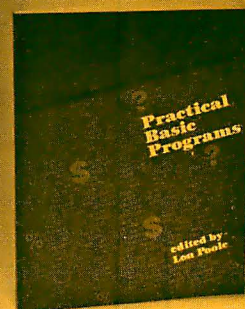
☐ 12-8 **6800 Assembly Language Programming.** Lance A. Leventhal. **\$15.99**

☐ 21-7 **Z80 Assembly Language Programming.** Lance A. Leventhal. **\$16.99**

☐ 27-6 **6502 Assembly Language Programming.** Lance A. Leventhal. **\$16.99**

☐ 36-5 **Z8000 Assembly Language Programming.** Lance A. Leventhal. **\$19.99**

☐ 35-7 **6809 Assembly Language Programming.** Lance A. Leventhal. **\$16.99**



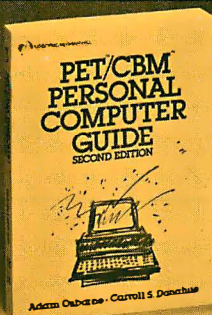
☐ 38-1 **Practical Basic Programs.** Lon Poole/etal. 40 comprehensive and fully-documented programs designed to run on most microcomputers. Especially useful in small business applications. Easy-to-follow format requires no prior programming knowledge. **\$15.99**

☐ 47-0 **Business System Buyer's Guide — NEW.** Adam Osborne. Buying a computer for business? This book helps you first define your needs and develop your unique evaluation criteria, then helps you compare your needs step-by-step with all market offerings. The most useful Buyer's Guide on the market. **\$7.95**

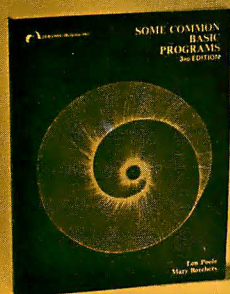
**NEW!**

### ☐ 28-4 **Running Wild — The Next Industrial Revolution.** Adam Osborne.

Calculators, digital watches, programmable microwave ovens—each day new products based on Space Race-derived technology enter our lives. What long term effects will these innovations have on our lifestyle, our jobs, our society? This entertaining and concise survey, written in anecdotal style, is readable by absolutely anyone. Complete with dramatic social and economic predictions for the coming 25 years. **\$3.95**



☐ 55-1 **PET/CBM Personal Computer Guide, second edition.** Adam Osborne/Carroll Donahue. Step-by-step guide which takes you from the "on" switch to the assembly language subroutine of your Commodore system. It's a BASIC tutorial and covers the most recent CBM products. Essential for CBM owners or those considering a Commodore machine. **\$15.00**



☐ 06-3 **Some Common BASIC Programs.** Lon Poole/Mary Borchers. These well-designed programs solve a variety of finance, math, statistics and general interest problems. Complete documentation, easy-to-use for all level programmers. 76 fully debugged programs for only **\$14.99**

☐ 40-3 **Some Common BASIC Programs — PET/CBM Edition.** Lon Poole/Mary Borchers. Check here for the Commodore version of this book. **\$14.99**

☐ 31-4 **PET and the IEEE 488 Bus (GPIB).** Eugene Fisher/C. W. Jensen. Complete description of the 488 Bus, GPIB (General Purpose Interface Bus). Detailed information on the GPIB, its lines and signals, PET-IEEE interfacing methods, hardware, sample bus transactions and more. **\$15.99**

☐ 29-2 **The 8086 Book.** Russell Rector/George Alexy. A handbook for all 8086 users. Includes basic 8086 programming instructions, a thorough analysis of the 8086 instruction set, and detailed hardware and interfacing guides. Reveals the full power of the 8086's multiprocessing capabilities. **\$16.99**

Yes! Please rush me the book titles I have checked above.



My check/money order for \$ \_\_\_\_\_ is enclosed.

Please bill my VISA/MasterCard # \_\_\_\_\_

Expiration date \_\_\_\_\_

Name \_\_\_\_\_

Address \_\_\_\_\_ Phone \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Please add:  
Tax (California residents add local tax)  
Shipping fees:  
75¢/item — 4th Class  
\$1.25/item — UPS  
\$2.50/item — Air Mail  
\$4.00/item — Foreign Orders

Mail to:  
**OSBORNE/McGRAW-HILL**  
630 Bancroft Way, Dept. B13  
Berkeley, CA 94710  
Tel. (415) 548-2805  
TWX: 910-336-7277

☐ Mail free catalog.

Good format does this.

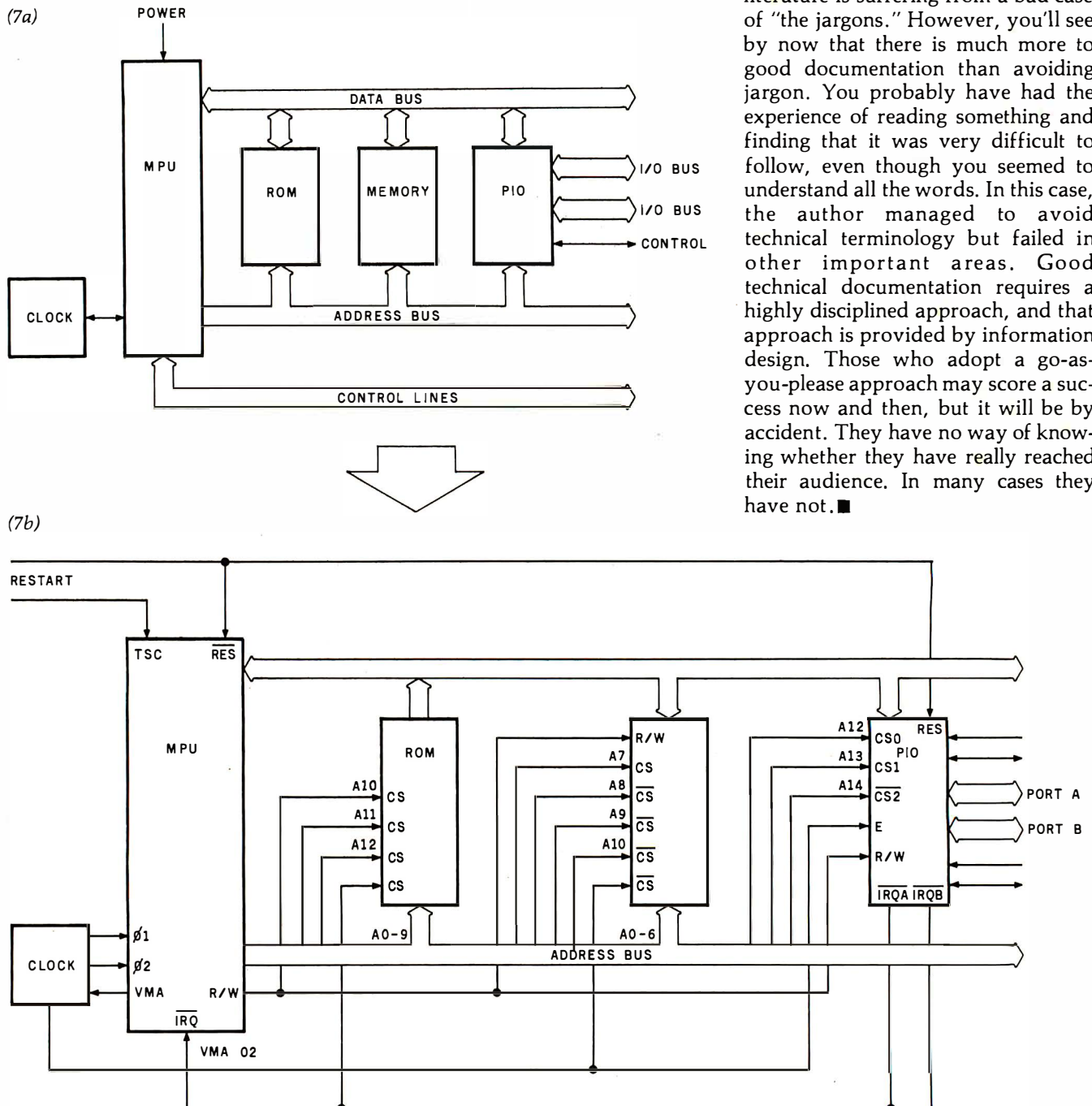
Language should be simple and direct. Only words the reader understands should be used, with new words explained as they are introduced. Explanations are easier to read and understand if sentences are short and simple, and if words have few syllables.

Illustrations should not be cluttered with unnecessary information. If they are too "busy," pictures become con-

fusing and are less useful. To avoid a profusion of details, illustrations can be used in a progression from simple to more complex. This is related to top-down sequencing. An initial overall figure can give the "big picture," which is easy to understand and serves as a beginning structure for proceeding to more detailed illustrations. In forming such progressions, it's important to preserve the relative locations of the parts of

whatever is being pictured. For example, if a simple block diagram of a microprocessor leads off the series, subsequent more detailed diagrams and schematics should show the various parts of the blocks in the same relative positions as the original block. An example is shown in figure 7. Note that the lower detailed diagram preserves the relative positions, established by the upper figure, of the major parts of the system.

Earlier we said that microprocessor literature is suffering from a bad case of "the jargons." However, you'll see by now that there is much more to good documentation than avoiding jargon. You probably have had the experience of reading something and finding that it was very difficult to follow, even though you seemed to understand all the words. In this case, the author managed to avoid technical terminology but failed in other important areas. Good technical documentation requires a highly disciplined approach, and that approach is provided by information design. Those who adopt a go-as-you-please approach may score a success now and then, but it will be by accident. They have no way of knowing whether they have really reached their audience. In many cases they have not. ■



**Figure 7:** To avoid reader confusion, illustrations should be used in a progression from less detail to more. An initial block diagram (7a) can give the overall picture before going into greater detail (7b). When forming these progressions, it's important to keep parts in the same relative positions.

# THE SOLUTION STORE <sup>SM</sup>



## ... Makes The Difference!

MicroAge Computer Stores sell solutions to your professional, business and household-management problems, not just hardware. That's what makes the MicroAge difference! From systems integration to easy-to-understand application software, research and development to warranty service and repair, systems consulting to training and installation. In all these, we offer the latest, most innovative approaches. That's why we are the forerunners ... the pioneers in the microcomputer industry.

But don't just take our word for it. Visit the MicroAge Computer Store nearest you and see the difference solutions make. We have differences you'll experience with every time and money-saving idea. The difference that will keep you satisfied now and for years to come!

**MicroAge.**  
**COMPUTER STORE**

*"Where Vision Becomes Reality"*

9530 Viscount  
El Paso, Texas  
(915) 591-3349

2710 S. Havana  
Aurora, Colorado

611 Rockville Pike  
Rockville, Maryland  
(301) 762-7585

1707 Monroe Avenue  
Rochester, New York  
(716) 244-9000

2065 El Camino Real West  
Mountain View, California  
(415) 964-7063

83 South 10th Street  
Minneapolis, Minnesota  
(612) 338-1777

24 W. Camelback  
Phoenix, Arizona  
(602) 265-0065

2591 Hamilton Road  
Columbus, Ohio  
(614) 868-1550

5742 E. Broadway  
Tucson, Arizona  
(602) 790-8959

1220 Melbourne Drive  
Hurst, Texas  
(817) 284-3413

2525 N. Scottsdale Road  
Scottsdale, Arizona  
(602) 941-8794

1490 W. Spring Valley Rd.  
Richardson, Texas  
(214) 234-5955

4550-50 E. Cactus  
Phoenix, Arizona  
(602) 996-2910

Coming soon to:  
Milwaukee,  
Indianapolis,  
and Houston.

FOR FRANCHISE OPPORTUNITY INFORMATION CALL (602) 967-1421

## Computing the Determinant of a Matrix

Brian Flynn, 1704 Drewlaine Dr, Vienna VA 22180

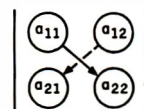
Matrix inversion is often used in solving sets of simultaneous equations and in performing multiple linear-regression analysis. But what determines whether or not a matrix can be inverted? The answer is its determinant does. More specifically, if the determinant of a matrix is 0, the matrix is singular and can't be inverted.

A Radio Shack Level II BASIC program for calculating the determinant of a matrix is presented here. The algorithm uses the upper-triangular technique and switches rows, when necessary, to insure that the determinant is always calculated, within the limits of the computing capability of the TRS-80 Model I.

A matrix is a rectangular array of numbers or variables (usually displayed in brackets). A square matrix is two-dimensional with as many rows as columns. A characteristic of a square matrix is its determinant. Determinants are defined only for square matrices, just as only square matrices are invertible. Unlike a matrix, a determinant is written as an unbracketed, single number—a lone, lorn creature such as 5, 0.03, or -1. The symbol for a determinant is sometimes *det*, but more often two parallel vertical lines:  $\begin{vmatrix} \end{vmatrix}$ . (This latter symbol is also used for absolute value. The circumstance in which  $\begin{vmatrix} \end{vmatrix}$  appears determines whether it means absolute value or determinant.)

It's relatively easy to calculate a second-order determinant, that is, the determinant of a second-order (2 by 2) matrix: tally the product of the principal diagonal elements and subtract from this the product of the off diagonal elements. The principal diagonal is the imaginary line segment running from the "northwest" corner to the "southeast" corner of the matrix. The off diagonal, on the other hand, is the one which connects the "northeast" and "southwest" corners. The process of calculating a second-order determinant is illustrated in table 1.

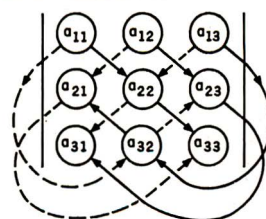
Tallying a third-order (3 by 3) determinant is a bit more difficult than tallying one of the second order. If the elements of the matrix are not too unwieldy, however, the calculation can still be made by hand without much trouble. This is shown in table 2. But for matrices of order four and higher, the business of determining the



$$\begin{vmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{vmatrix} = a_{11} a_{22} - a_{12} a_{21}$$

$$\begin{vmatrix} 2 & 5 \\ 3 & 9 \end{vmatrix} = 2 \cdot 9 - 5 \cdot 3 = 18 - 15 = 3$$

**Table 1:** The general method for evaluating a 2 by 2 matrix and an example. The elements of the principal or major diagonal are multiplied ( $a_{11}a_{22}$ ), as are the elements of the off or minor diagonal ( $a_{12}a_{21}$ ). Then the product of the off diagonal is subtracted from the product of the principal diagonal.

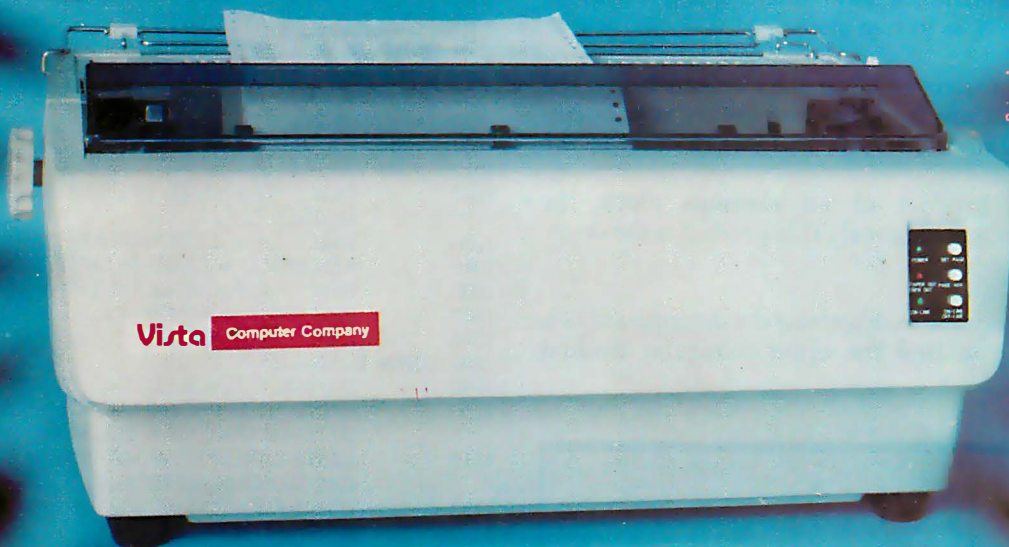


$$\begin{vmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{vmatrix} = a_{11} a_{22} a_{33} + a_{12} a_{23} a_{31} + a_{13} a_{21} a_{32} - a_{11} a_{23} a_{32} - a_{12} a_{21} a_{33} - a_{13} a_{22} a_{31}$$

$$\begin{vmatrix} 5 & 2 & 4 \\ 1 & 3 & 7 \\ 6 & 8 & 9 \end{vmatrix} = 5 \cdot 3 \cdot 9 + 2 \cdot 7 \cdot 6 + 4 \cdot 8 \cdot 1 - 5 \cdot 8 \cdot 7 - 2 \cdot 1 \cdot 9 - 4 \cdot 3 \cdot 6 = -119$$

**Table 2:** The method for evaluating a third-order determinant is an extension of the method used for second-order determinants. Note that plus signs are associated with the three products formed by solid lines, and minus signs are associated with the three products formed by dashed lines.

## When you pick a Daisy... Pick Vista's V300 Printer.



**\$1895.**

### There are Daisies! . . . And, There are Daisies! . . . But Vista has a Peach!

The Vista V300 is exactly that, a "peach" of a daisy wheel printer both from the standpoint of price and performance.

Think of it, a printer at nearly half the price (when compared to models even remotely competitive in quality) combined with the ultimate in reliability, print quality, and flexibility.

Typical Comments: "Superb print quality!", "Highly reliable.", "Definitely letter quality. . . I can't believe the price tag.", "Best use I've seen yet of LSI Technology."

But judge for yourself — look at the V300 features and keep in mind this is a letter quality printer at dot matrix prices.

- Tractor option available
- **Print Speed** — 25 CPS (Optional 45 CPS for \$2,195)
- **Print Wheel** — Industry standard 96-character Daisy Wheel (including the extended-life dual plastic wheels)
- **Service** — Prompt maintenance/service agreements available nationwide
- **Interface** — Industry standard parallel (RS232-C optional)
- **Printable Columns** — 136
- **Warranty** — 90 days parts and labor, one year parts only
- Proportional, bi-directional printing • Programmable VFU
- Extensive self-test functions • Hardware and software compatible

Vista does it again! Quality, Price and Performance with a peach of a daisy wheel printer.



**IMMEDIATE DELIVERY**  
For Further Information  
Call Toll Free (800) 854-8017

The Vista Computer Company

### AND, Vista Has a Complete V100 Word Processing System for Only \$4995!

The Vista V100 is a complete word processing system that includes:

- Exidy Sorcerer Computer, 48K
- V200E20 Disc Drive System, Double Density
- Sanyo Data Display Monitor
- Vista V300 Printer Full Character Daisy Wheel
- Wordstar, CPM™ 1.4 (Includes E Basic)
- Can also be used for Data Processing

1317 E Edinger • Santa Ana, California 92705 • 714/953-0523

™CPM is a trademark of Digital Research

## Programming Quickies

determinant can get really complicated. Indeed, calculating a fourth-order determinant one time by hand, using the popular Laplace expansion, is usually sufficient to elicit the plea, "Isn't there an easier way?"

Fortunately, there is. The upper-triangular method is a straightforward, computer-compatible technique for tallying a determinant of any order. The process, illustrated in table 3, is in two steps:

- Transform the matrix so all of the elements below the principal diagonal are 0s, using elementary row operations. Anticipate division by 0, and switch rows of the matrix to avoid it.

- Calculate the product of all elements along the transformed principal diagonal. This product is the determinant.

If you ever determine to determine the determinant of a matrix, I hope you find the upper-triangular method useful. ■

$\begin{vmatrix} 4 & 2 & 3 \\ 8 & 4 & 1 \\ 2 & 9 & 6 \end{vmatrix}$		
<p>STEP 1. TRANSFORM THE ELEMENTS OF THE LOWER TRIANGLE INTO 0s: TRANSFORM THE 8 INTO 0 BY MULTIPLYING THE ELEMENTS OF ROW #1 BY -2 THEN ADDING THEM TO THE CORRESPONDING ELEMENTS OF ROW #2.</p>		
$= \begin{vmatrix} 4 & 2 & 3 \\ 0 & 0 & -5 \\ \textcircled{2} & 9 & 6 \end{vmatrix}$		
<p>TRANSFORM THE CIRCLED 2 INTO 0 BY ADDING <math>-1/2</math> TIMES ROW #1 TO ROW #3.</p>		
$= \begin{vmatrix} 4 & 2 & 3 \\ 0 & 0 & -5 \\ 0 & 8 & 4.5 \end{vmatrix}$		
<p>TRANSFORM THE 8 INTO 0. IF THE ABOVE PATTERN WERE FOLLOWED, <math>-8/0</math> TIMES ROW #2 WOULD BE ADDED TO ROW #3. TO AVOID DIVISION BY 0, SWITCH ROWS 2 AND 3. THIS CHANGES THE ARITHMETIC SIGN OF THE DETERMINANT (LINE 4060 OF THE PROGRAM).</p>		
$= - \begin{vmatrix} 4 & 2 & 3 \\ 0 & 8 & 4.5 \\ 0 & 0 & -5 \end{vmatrix}$		
<p>STEP 1 IS NOW FINISHED SINCE THE ELEMENTS OF THE LOWER TRIANGLE ARE ALL 0s.</p>		
<p>STEP 2. TALLY THE PRODUCT OF ALL ELEMENTS ALONG THE PRINCIPAL DIAGONAL.</p>		
<p>DETERMINANT = <math>- [4 \cdot 8 \cdot (-5)] = 160</math></p>		

**Table 3:** The upper-triangular method for evaluating higher-order determinants consists of two steps: first, transform the elements of the lower triangle into 0s, then find the product of the principal diagonal.

**Listing 1:** The program for determining the determinant of a matrix.

```

10 REM CALCULATING THE DETERMINANT OF A
   REM MATRIX
20 REM UPPER TRIANGULAR METHOD
30 REM BRIAN J. FLYNN; FALL 1980
40 REM MOD 1: INITIALIZE & ENTER DATA
50 GOSUB 1000
60 REM MOD 2: CALCULATE DETERMINANT
70 GOSUB 2000
80 REM MOD 3: PRINT DETERMINANT
90 GOSUB 3000
100 GOTO 9999
1000 REM MODULE 1
1010 REM VARIABLES
1020 REM C = USED IN TRANSFORMING
   REM MATRIX
1030 REM DT = DETERMINANT
1040 REM HOLD = USED IN SWITCHING ROWS
1050 REM K = ORDER OF THE MATRIX
1060 REM SIGN = +1 OR -1
1070 REM X = MATRIX
1080 REM INITIALIZE
1090 DEFDBL C,D,H,X:SIGN=1:DT=1:CLS
1100 PRINT "THIS PROGRAM COMPUTES THE
   DETERMINANT OF A MATRIX."
1110 PRINT:INPUT "HOW MANY ROWS (COLUMNS)
   ARE IN YOUR MATRIX";K
1120 DIM X(K,K)
1130 REM ENTER DATA
1140 FOR I=1 TO K
1150 CLS:PRINT "PLEASE ENTER DATA."
1160 PRINT"ROW #";I;":"
1170 FOR J=1 TO K
1180 PRINT"COL #";J:INPUT X(I,J)
1190 NEXT J,I
1200 RETURN
2000 REM MODULE 2
2010 REM CHECK FOR 1ST-ORDER DETERMINANT
2020 IF K=1 THEN DT=X(1,1):GOTO 2180
2030 REM FILL LOWER TRIANGLE WITH 0s
2040 FOR L=1 TO K-1
2050 FOR I=L TO K-1
2060 REM AVOID DIVISION BY 0
2070 IF X(L,L)=0 THEN GOSUB 4000
2080 IF DT=0 THEN 2180
2090 C=X(I+1,L)/X(L,L)
2100 FOR J=1 TO K
2110 X(I+1,J)=X(I+1,J)-X(L,J)*C
2120 NEXT J,I,L
2130 REM TALLY PRODUCT OF PRINCIPAL DIAGONAL
   REM ELEMENTS
2140 FOR I=1 TO K
2150 DT=DT*X(I,I)
2160 NEXT I
2170 DT=DT*SIGN
2180 RETURN
3000 REM MODULE 3
3010 PRINT"DETERMINANT = ";DT
3020 RETURN
4000 REM SUBROUTINE: SWITCH ROWS
4010 FOR M=L+1 TO K
4020 IF X(M,L)=0 THEN 4070
4030 FOR Q=1 TO K
4040 HOLD=X(L,Q):X(L,Q)=X(M,Q):X(M,Q)=HOLD
4050 NEXT Q
4060 SIGN = -SIGN:GOTO 4100
4070 NEXT M
4080 REM DETERMINANT = 0
4090 DT=0
4100 RETURN
9999 END

```

## Languages Forum

# A Coding Sheet for FORTH

John O Bumgarner, 17370 Hawkins La  
Morgan Hill CA 95037

FORTH is a new programming language to most people, and, while it has many advantages over other languages, it does have an unconventional appearance. FORTH is not an intrinsically difficult language, but the unfamiliar appearance, the use of a last-in-first-out stack for parameter passing, and a unique approach to problem solving require you to reorient your thinking a bit.

When I was learning FORTH, I often used to stop and sketch the appearance of the parameter stack as I defined a "word" (portion of a program) to help me get everything in place at the right time. It helped me, the novice FORTH programmer, to have a graphic representation of what the parameter stack looked like at each step. Later, I needed to document programs, so I expanded my sketchy method and made a proper FORTH-style coding sheet that provided the graphic parameter-stack representation.

### **The need for documentation never seems to go away, so I still use the coding sheet regularly.**

Now, while I rarely need help visualizing the stack, the need for documentation never seems to go away, and so I still use the coding sheet regularly. It has occurred to me that other FORTH programmers, new or otherwise, would find it useful too.

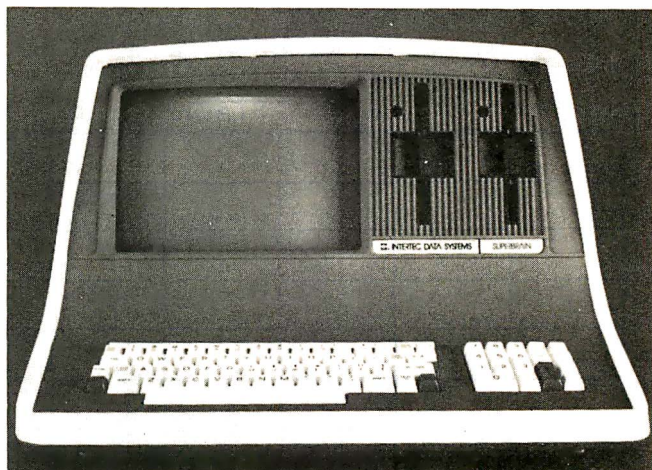
The coding sheet is shown full-sized in figure 1 and is meant to be copied for use by the reader. The form is deliberately simple to make it as flexible as possible. I have tried to strike a balance between the size of the spaces for words, the size of the spaces for stack items, and the number of stack items.

In actual practice, eight stack items on the form are sufficient because most FORTH words do not manipulate the stack outside of the range of the normal stack operators (which work from three to six words deep). In fact, a rule of thumb for good FORTH programming dictates that, if you get in a situation with the parameter stack that cannot be handled by normal stack operators, you are doing something wrong. You should stop and examine your methods to see how you can avoid the problem. In my experience, this is true; a better way results from a little thought, and it usually is simpler, to boot!

The space for words used in the definition is left a bit wide, as it is common to put short phrases on one line. This not only saves space but also allows frequently used short phrases such as fetching from or storing to a

*Text continued on page 162*

# SUPERBRAIN AND COMPUSTAR USERS' GROUP



Your users' group is here at last! We are Super ★ Star International, an independent, world-wide users' group for Intertec Data Systems' SUPERBRAIN\* and COMPUSTAR\* computers.

Our monthly magazine SUPER ★ STAR will fulfill all your computing desires. When you join our group, you will enjoy the latest: technical information, tips for beginners, special business uses, equipment reviews, the Intertec story — the people, ideas, and machines behind your computer. In every issue you'll get a free program, industry news, and software reviews.

Plus, we want your programs for our Software Supermarket, where all members can buy programs at affordable prices.

We will investigate all the accessories you have always wanted, test them, and offer them for sale at reduced prices.

With our group buying power we'll give you discounts on commercial software. And that's not all. We'll find group rates for car rentals, hotels, gifts, and more.

Super ★ Star International, with savings, service, and efficiency — we're here to win your heart.

Yearly membership fee is \$50.00 U.S., \$58.00 Canada, \$74.00 Europe and So. America, \$81.00 Australia.

Your fee may be tax deductible; consult your accountant.

Dealers are invited to contact us concerning a special dealer program. Software houses, we are interested in your programs! Send checks with your name and address, made out to:

## SUPER★STAR

SUPER ★ STAR INTERNATIONAL CORPORATION  
3722 Chestnut Place  
Denver, Colorado 80216  
(303) 623-7973

Not affiliated with Intertec Data Systems.

\*Superbrain and CompuStar are the trademarks of Intertec Data Systems.

DATE \_\_\_\_\_

LOCATION

---

WORD \_\_\_\_\_

WRITER

## VOCABULARY

[illegible]

**J.O.B.80**

**Figure 1:** A coding sheet for FORTH used to show the effect of words in a FORTH definition on the parameter stack.

22 April 80  
DATE

J. O. B.

WRITER

4th fl.

## LOCATION

EXPECT and ? DELETE

**WORD**

character input

## VOCABULARY

[illegible]

**Table 1:** An example using the FORTH coding sheet. In this example and that of table 2, FORTH words or phrases are listed in the rightmost column, reading from top to bottom. The stack area on the same line represents zero or more parameters on the parameter stack after the word or phrase has been executed; the rightmost entry in the stack area is always the top-of-stack, with entries below it on the stack listed to the left. A dash represents an empty stack. “T/F” represents a flag of either true (nonzero value) or false (zero value) pushed to top-of-stack as the result of some comparison operation. Arrows represent the flow of control due to either a loop construct or the outcome of an IF construct. Note that, in the definition of { ?DELETE }, the stack exits the definition with two values on the stack if the comparison made evaluates as false, but only one value if the comparison is true. See listing 1 for details.

# "GET A HEAD START ON TOMORROW WITH THE SOFTWARE THAT'S GOING PLACES. THE UCSD p-SYSTEM.™"

JULIE ERWIN, Director of Marketing, SofTech Microsystems



Our microcomputer software system's going places for good reasons:

We're constantly expanding and developing it. We started with UCSD Pascal,™ added FORTRAN, and we'll be introducing more in the months ahead.

We offer a total development and execution environment, from operating system and cross assemblers to screen editor.

We run on most major microprocessors today: Z80, 8080, 8085, 6502, 6800, 6809, 9900 and LSI-11.™ And because the UCSD p-System's portable, you can be sure that what you invest in software today is a good investment in tomorrow.

We're going places and gaining in popularity with microcomputer manufacturers, applications developers, and demanding end users. Get a head start on tomorrow by working with a company that knows how to develop professional quality software, and that's committed to delivering it.

Our system's available for distribution licensing or for single-copy sales. With Pascal, it costs \$350... with FORTRAN, \$400... and with both languages, \$550. Documentation sets are \$50. Phone orders are welcome, and Visa and Master Card orders are accepted. Write or call for more details.

**SOFTech**  
**MICROSYSTEMS**  
A SUBSIDIARY OF SOFTECH

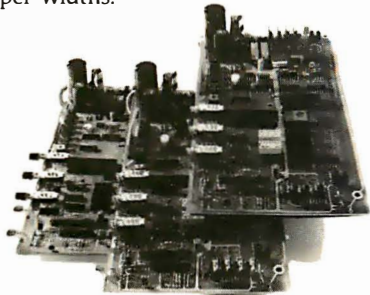
9494 Black Mountain Road, San Diego,  
CA 92126. (714) 578-6105  
TWIX: 910-335-1594

*UCSD p-System and UCSD Pascal are trademarks of the Regents of the University of California.  
LSI-11 is a trademark of Digital Equipment Corp.*

# Why is the 88G Printer the new industry leader?

## QUALITY

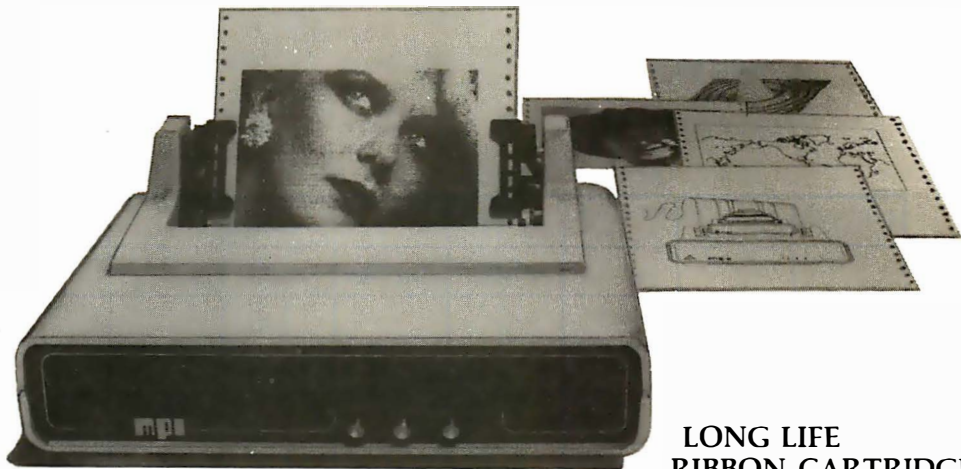
The attractive, durable 88G casework is formed from impact-resistant, flame-retardant Styron. Microprocessor controlled stepper motors provide precision control over print head and paper positioning. Computer quality tractors position paper for readability and are fully adjustable to accommodate varying paper widths.



## MICROPROCESSOR CONTROLLED INTERFACE

The microprocessor array provides the intelligence for a dual RS232 serial and a Centronics® type parallel interface. Both inputs are fully buffered to allow the 88G to receive data and print simultaneously. A 1K character buffer is standard with a 2K buffer available as an option.

The short line thruput of the 88G has been increased by incorporation of a *Quick Cancel* feature that fully utilizes the bidirectional/unidirectional printing capabilities. Built-in diagnostic and self-test capabilities allow the user to easily pinpoint system problems and a *Power On* confidence test verifies operational status of the printer each time power is applied.



## VERSATILITY

The 88G prints a full upper and lower case 96 character ASCII set with a crisp, clear 7x7 matrix in 80, 96, or 132 column formats. For text processing and correspondence applications, an 11x7, 80 column serif style matrix can be selected by switch or software command. The dual tractor/pressure-feed paper drive system allows the user to choose either pin-feed, roll, or single sheet papers up to 9.5 inches wide.

Complete forms control allows the 88G to be quickly configured for printing single or multiple-ply invoices, purchase orders, checks, or any type of preprinted form. Optional paper roll holders and single sheet feeders can be quickly attached.

The wide use range of the 88G makes it the perfect companion for business systems, data processing, RO teleprinter and terminal printer applications.

## GRAPHICS

A high-resolution, dot-addressable graphics option can be added for applications requiring plotting, printing of screen graphics, drawings, illustrations, etc. Single dot print resolution greatly extends the usefulness of the graphics capability. Selection of one of the four horizontal dot densities available customizes the graphic printout, and alphanumerics can easily be included for titling of graphs and illustrations.

## LONG LIFE RIBBON CARTRIDGE

Ribbon difficulties are minimized through use of a continuous loop cartridge with a five million character life. It is easily changed without opening the case, and without any complicated or messy threading operations.



## PRICE

Every detail is directed toward providing a heavy-duty, commercial quality printer for only \$749.00. No other printer on the market today can provide its quality, features and performance at a comparable price. The 88G is an obvious industry leader.



Micro Peripherals, Inc.  
4426 South Century Drive  
Salt Lake City, Utah 84107  
Phone (801) 263-3081

®Centronics is a registered trademark of the Centronics Data Computer Corp.

23 APR. 80  
DATE

4th fl.  
LOCATION

COUNTER  
WORD

J. O. B.  
WRITER

DATA - INPUT  
VOCABULARY

STACK						TOP	WORDS
			setup	an accumulator		-	0 VARIABLE NEGATIVE
			setup	another one		-	0 VARIABLE NON-NEG
			the name of this routine			-	: COUNTER
						0	0
			clear the		0	addr <sub>1</sub>	NEGATIVE
			accumulators			-	!
						0	0
					0	addr <sub>2</sub>	NON-NEG
						-	!
						-	BEGIN ←
			FETCH pushes a number (num) to top-of-stack			num	FETCH
					num	num	DUP
					num	num	0
			true if num < 0		num	T/F	<
						num	IF FALSE
					num	1	1
			true part		num	1	addr <sub>1</sub>
						num	NEGATIVE
						num	+!
						num	ELSE ↓
					num	1	1
			false part		num	1	addr <sub>2</sub>
						num	NON-NEG
						num	+!
						num	THEN ↓
			test for end condition (num=0)			T/F	0=
			loop until true			-	UNTIL
							;

Table 2: Another example using the FORTH coding sheet. See listing 1 for details.

**Solution \sō-'lü-shŭn\n[ME,fr.MF,fr.L solution-]  
la: An answer to a problem.**



At last there's a microcomputer designed to solve your business' problems, not create new ones. In delivery for close to three years, the MicroDaSys Millie™ is a proven hardware design that now comes with the fantastic SoftwareHows™ DBI Accounting Solutionware™ you've seen advertised -- a \$2500 dollar value alone! This is one computer that's complete when you buy it, right down to the best applications software available. There are no "required options". And we've got all the best features: Z-80, 64K, CP/M<sup>1</sup>, dual double density 8" floppies for 1MB on line storage, 82x24 CRT with special features, IBM format keyboard with numeric pad, NEC 55cps letter quality printer, S-100 bus. Also, Millie is supported by a nationwide rep network and one of the best service contracts in the business. And Millie is price competitive with much smaller computers. Why settle for less than the best? Call or write today for flyers and manuals. You'll be glad you did.

**MicroDaSys, Inc.** 2811 Wilshire Blvd., Santa Monica, CA 90403  
(213) 829-6781 TWX: 910-321-2378

<sup>1</sup> Reg.TM, Digital Research

**Listing 1:** A block of FORTH code. The FORTH words EXPECT, { ?DELETE }, and COUNTER are explained on the coding sheets in tables 1 and 2.

```

0 ( Character and data input words)
1
2 ( EXPECT accepts n ch's putting them at given address)
3 ( Use: address n EXPECT )
4 : EXPECT 0 DO KEY OVER I + C! LOOP DROP ;
5 HEX ( change base to HEX for the following word)
6 ( ?DELETE returns only T if given ch. is a DEL )
7 ( otherwise it returns the given ch. and a F on the top)
8 : ?DELETE 7F OVER = DUP IF SWAP DROP THEN ;
9 DECIMAL
10 0 VARIABLE NEGATIVE 0 VARIABLE NON-NEG
11 ( COUNTER counts the number of negative and non-negative)
12 ( numbers and exits if given a zero. FETCH supplies #'s)
13 : COUNTER 0 NEGATIVE ! 0 NON-NEG ! BEGIN
14   FETCH DUP 0 < IF 1 NEGATIVE +! ELSE 1 NON-NEG +!
15   THEN 0= UNTIL ;

```

Text continued from page 155:

variable to read better. Such condensed definitions are also useful to keep as documentation. (See table 2.)

[Editor's note: I have used John's sheet and found it very helpful in the design and documentation of FORTH words. I like to indent my entries in the "WORDS" column to show if...then...else constructs and loops. I have also been working with a similar diagram that allows a line to run across the long dimension on a page; this gives me more room for indenting FORTH words and documenting what they do....GW]

Listing 1 is an example of a typical FORTH block of code. If it were part of a bigger listing, there would be

three such blocks on one page and the page would be called a *triad*. If you wanted to see this block or edit it at your terminal, you would type { 123 LIST }. [The braces are not part of the FORTH phrase, but are the standard BYTE delimiters that isolate FORTH words that include punctuation and FORTH phrases from the surrounding text....GW]

The FORTH coding sheets show the detailed structure of each of the three words defined in block 123. The coding sheets in tables 1 and 2 show the words in great detail.

I hope that this coding sheet is of use to fellow FORTH enthusiasts. It certainly helped me learn FORTH, and allows me to produce clear documentation. ■

# “Micros aren't just for games anymore... AARDVARK gets down to brass TAX.”

AARDVARK SOFTWARE takes home computer use one practical step further with "Personal Tax," a federal income tax program designed specifically for home use.

"Personal Tax" was developed by CPA's and computer professionals. It will calculate Federal Forms 1040 and 4726, as well as schedules A, B, G and TC. The program features multiple entries for a variety of inputs (e.g. wages, dividends and charitable contributions). An indexed instruction manual and easy-to-follow input forms are included.

"Personal Tax" computes quickly and accurately, then displays or prints the totals automatically (using a standard printer inter-

face). You simply copy the totals onto your IRS forms.

This spring, use your microcomputer to simplify your taxes and file with confidence! You won't have to spend half of your refund either. The "Personal Tax" program is very affordable at only \$75.

"Personal Tax" will run on: Apple II, TRS-80 Models I and II, and OSI. Additionally, under CP/M, the program will run on Vector Graphics, North Star and Cromemco.

Minimum machine requirements:  
48K and one disk drive.

Send check or money order, or, write us for more information.

## AARDVARK SOFTWARE INC.

### The Microcomputer People for Professionals

783 NORTH WATER STREET MILWAUKEE WISCONSIN 53202 414/289-9988

B3-1

# Standard & Poor's proudly announces **STOCKPAK,** a unique software and data system to help you meet your investment goals like a Wall Street professional.

STOCKPAK not only delivers a "stand-alone" Portfolio Management System but also gives you the software for Standard & Poor's monthly Common Stock Data Service (available to TRS-80 owners on a subscription basis). With STOCKPAK and the Data Service you command one of the most powerful and versatile investment tools available.

## Here's How STOCKPAK Will Help You:

### A 900 COMPANY DATA BASE SERVICE

Monthly Data Service subscribers receive a diskette containing 30 vital financial items on 900 of the most widely traded stocks (S&P "500" and 400 NYSE, ASE and OTC issues). Accompanying this monthly diskette is an Investor's Newsletter highlighting important financial news and investment strategies, with suggestions for maximizing the usefulness of the system.

### STOCKPAK SELECTION SYSTEM

The heart of STOCKPAK is a powerful, analytical stock selection tool which enables investors to choose stocks which meet their investment criteria. For example, you may wish to select only those oil and gas stocks with price/earnings ratios of less than 7 and yields of 6% or more. Once a group of stocks has been selected, you can store it as a separate data file for continuing use.

### REPORT WRITER

You can define the report formats you would like to see on those stocks meeting your investment objectives. Hundreds of calculations and ratios that you define can be sorted, averaged or totalled, and displayed on video screen or optional printer.



### PORTFOLIO MANAGEMENT SYSTEM

Now you can effectively evaluate and manage your own stock portfolio of up to 100 securities with as many as 30 transactions for each. You can record "buy" and "sell" transactions, price and dividend information and stock splits for instant retrieval, for record keeping and tax purposes. You can measure actual performance or create hypothetical situations to help you make "buy" or "sell" decisions.

### HOW TO ORDER STOCKPAK

STOCKPAK is designed exclusively for TRS-80 users with 32K business systems with two mini-disk drives. You can obtain the basic software and sample Data Base, plus a comprehensive User's Manual from your local Radio Shack Store for only \$49.95. The STOCKPAK Monthly Data Updating Service can be ordered directly from Standard & Poor's for \$200 annually, or from the order form provided in the basic package you purchase from Radio Shack.



**Standard & Poor's Corporation**

25 BROADWAY, NEW YORK, NY 10004 (212) 248-3994/3374

# BYTE's Bits

## IEEE Committee Studies Terminals

Today's computer terminals talk, walk, listen, feel, and see. Terminal technology embraces the sciences of computers, electronics, human factors, acoustics, optics, and mechanics. The Communications Society of the IEEE (Institute of Electrical and Electronics

Engineers) has formed a Terminals Committee to focus on the science of communications terminals. The committee will complement the data-communications, computer-communications, and transmission-systems committees' activities by sponsoring workshops on special topics and by writing standards.

Technological advances have added video and game

terminals, and robots, to the ranks of terminal devices. Other areas of interest are the telecommunications networks for voice and data plus long-distance private networks, local area networks, instrumentation, and data bases. Terminals can be electrically, acoustically, or optically connected to these networks.

The first sessions sponsored by the Terminals

Committee will be held at the 1981 International Communications Conference this June. Papers will be read on recent advances in terminals and the impact of communications systems on terminals. Topics being considered for the 1981 and 1982 workshops include office-automation terminals, graphics communications, plus speech-processing and game terminals. For more information, contact Fritz Froehlich, Bell Laboratories, Rm 1D622, Holmdel NJ 07733, (201) 949-4990.

## Computer Camp

If your child is between the ages of 10 and 18, he or she can spend part of this summer learning about computers and programming and still enjoy summer camp activities. The National Computer Camp will be held in Moodus, Connecticut, July 19 thru 24 and July 26 thru 31. Children at all levels of computer experience are invited. Contact Michael Zabinski, 382 Hitching Post Dr, Orange CT 06477, (203) 795-9069.

## TEXNET—Network for TI-99/4 Users

Texas Instruments and Source Telecomputing Corporation have developed a home-information and communications service for TI-99/4 users. TEXNET is a subscription service available over telephone lines coupled to the home computer through a modem. It offers the services of The Source information utility plus a text-to-speech capability, which allows users to hear messages typed on the keyboard or transmitted over the TEXNET system. For more information on TEXNET and the TI-99/4 computer, contact Texas Instruments Inc, Consumer Relations, POB 53, Lubbock TX 79408, (800) 858-4565; in Texas (800) 858-4279. ■

**MORE THAN 50 REASONS!**

- SUPERIOR PERFORMANCE
- REMOTE SOFTWARE MAINTENANCE
- 55dB SENSITIVITY
- REMOTE CONTROL
- FCC APPROVED
- 50dB DYNAMIC RANGE
- LASER DATA
- TUNED FILTERS
- GATHERING MULTIPLE MODEM POWER-UP
- DIAL TONE DETECTOR
- FSK BINARY
- MC6860 MODEM
- MESSAGE SWITCH
- ANSWER
- FSK KEYING
- ON-LINE
- COMMERCIAL QUALITY
- PROGRAMMABLE TIMER
- SERIAL-PARALLEL
- CONCENTRATOR
- REMOTE DATA BASE
- HALF DUPLEX
- ODD PARITY
- POINT OF SALE
- ALARM
- ASYNCHRONOUS
- NO WAIT STATES
- AUTO ANSWER
- AUTO DIAL
- MULTIFUNCTION DATA TERMINAL
- 5MHZ WITH
- BAUDOT
- EBCDIC
- EVEN PARITY
- FULL DUPLEX
- ORIGINAL
- TIME SHARING
- 5-8 DATA BITS
- ALL KNOWN S-100 HARDWARE SYSTEMS INCLUDING:
- ALPHA MICRO
- POPULAR OPERATING SYSTEMS INCLUDING:
- CP/M-MP/M
- BELL-103
- IEEE S-100 (ADAPTABLE TO OTHER SYSTEMS)
- (REGISTERED TRADEMARKS OF OTHERS)
- SOME SATISFIED MM-103 USERS**
- AEROSPACE CORPORATION
- JET PROPULSION LABS
- MITRE
- NATL BUREAU OF STANDARDS
- RCA
- SANDIA LABS
- US DEPARTMENT OF JUSTICE
- WESTERN ELECTRIC
- AND UNIVERSITIES OF:
- ALABAMA
- FLORIDA
- BRIGHAM YOUNG
- JOHNS HOPKINS
- MICHIGAN
- MIT
- TEXAS
- UCLA
- WASHINGTON
- BELL TELEPHONE LABS
- LOCKHEED

**WHY BUY**

**MM-103 MODEMS**

With our unbeatable quality, low cost, one-year warranty and 24 hour a day Test Center, you won't find a better S-100 bus modem than the MM-103!

Call or write for brochure and price information:

**POTOMAC MICRO-MAGIC, INC.**  
5201 Leesburg Pike, Suite 604  
Falls Church, VA 22041  
(703)379-9660 (VOICE)  
(703)379-0303 (MODEM: 300 BAUD)

MEETS IEEE S-100 STANDARDS

**micro magic**

**AFTER ALL... ALL MODEMS ARE NOT CREATED EQUAL!**

This  
printer  
costs less  
than \$450.  
Beat that...  
if you can.



# Epson.

This is the Epson MX-70. The lowest priced dot matrix printer you can buy. Now, that in itself should make it very attractive to a lot of people. But you ain't heard the half of it.

To begin with, the MX-70 has a lot more in common with our now-famous MX-80 than just the name. Like unequalled Epson reliability. And technological breakthroughs like the world's first disposable print head. But frankly, the MX-80 packs a lot more power than some people need. So we built the MX-70 to be a no-frills printer. At a no-frills price.

But the MX-70 is still a great little printer. We give you 80 CPS unidirectional printing. Top-of-form recognition. Programmable line feed and form lengths. Plain paper printing. An easy-to-read 5x7 matrix. Self test. And an adjustable tractor feed.

That's what you'd expect

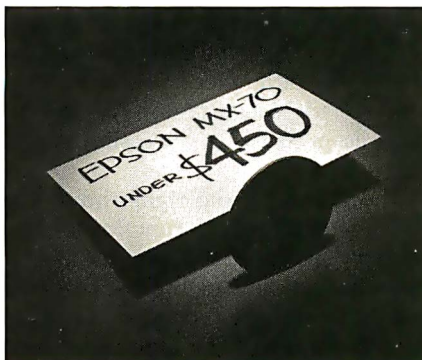
from a basic little printer. But here's something you wouldn't expect: the finest graphics package on the market today. Free.

We call it GRAFTRAX II. And it means 480 dots across the page, resolution to 60 dots per inch, and a graphic image free of the jitter and overlap that plagues other printers. You get cleaner grays and finer point resolution.

So now you've got a choice. You want more power and extra functions, you buy the MX-80.

You want a basic little printer that prints, and keeps on printing, you buy the MX-70. They're both at your dealer now.

But at this price, you'd better hurry.



**EPSON**  
EPSON AMERICA, INC.

23844 Hawthorne Boulevard • Torrance, California 90505 • (213) 378-2220

# A Beginner's Guide to Spectral Analysis, Part 2

---

Mark Zimmermann  
9410 Woodland Dr  
Silver Spring MD 20910

---

In Part 1 of this article, I introduced some of the ideas behind the Fourier transform in one dimension. Here, I will try to extend those ideas to two-dimensional space. I will introduce a few of the many uses of two-dimensional spectral analysis, with particular emphasis on image processing. The main computer program that accompanies this article (see listing 1) is a 6502 assembly-language program that performs a two-dimensional transformation on a 25- by 40-pixel image. The program is specifically adapted to run on the Commodore PET microcomputer with 8 K bytes of programmable memory, but it should be a reasonably straightforward process to modify the code to work on other comparable machines. Several floating-point arithmetic routines are used from the PET's BASIC ROM (read-only memory); a table is included that describes what each routine does, so that it may be replaced by your own arithmetical procedures if necessary.

## Components of Waves

As you will recall, the whole notion of Fourier, or spectral, analysis is to take a signal that is, for example, a function of time, and resolve it into its *components* (ie: the various frequencies that make up the whole). A chord played on a piano may produce a sound that is very complicated when plotted on an oscilloscope screen, but when the chord is Fourier analyzed, the individual notes (component frequencies) stand out.

It is mathematically possible to express any reasonable function as a sum of sines and cosines of various frequencies. The mathematical recipe for finding how much of each sine and cosine went into making the original signal is a fairly simple process that is discussed in many books (see references on page 198). Instead of going into the math here, however, I'd rather discuss the "feel" of Fourier transforming, with the objective of helping you develop some instincts about what a transform should look like and what it means.

---

**Any reasonable function may be expressed as a sum of sines and cosines of various frequencies.**

---

Figure 1 on page 168 shows several pairs of graphs. In each pair, the graph on the left represents a function of time. It could be showing, for instance, the difference between normal atmospheric pressure and the instantaneous pressure in a passing sound wave.

The graph on the right shows the Fourier transform (a function of frequency) of the graph on the left. It plots the amount of the components needed *at each frequency* to make the left-hand graph. The amount of sine wave is shown as a dashed line; the

amount of cosine wave is a solid line. The horizontal axis runs from zero frequency (where it's intercepted by the vertical axis) to high frequencies. If the amount graphed on the right goes negative, it simply means that the original signal needs to have some amount of the function —sine or —cosine added to it. In other words, the original signal contained some sine waves that were 180° out-of-phase with the standard sine wave (so there's nothing special or mysterious about having a negative amount of a given frequency component).

What kind of insights can you get by examining the graphs in figure 1? First, it's clear that any function of time which is symmetric with respect to the  $t=0$  (*vertical*) axis is made up only of cosine waves, and any function that is asymmetric with respect to  $t=0$  is made of only sines. Every cosine wave is symmetric about the origin of time, so a sum of cosines should certainly be symmetric; every sine wave is asymmetric. A function that is neither perfectly symmetric nor perfectly asymmetric requires both sines and cosines in its constituent frequencies.

A second fact which becomes apparent from a study of figure 1 is that functions of time which have some *net area* (area between the curve and the horizontal axis) always have some amount of component with zero frequency plotted in their transforms. A zero-frequency wave doesn't wave at all; it's a constant number as time goes by, like  $\cosine(0)$ . Contrariwise,

# NEECO

... Why not buy from the best?



**commodore**

4008 (8K RAM - 40 Column) .....	\$ 795
16K "B" (16K RAM - 40 Column) .....	995
32K "B" (32K RAM - 40 Column) .....	995
32K "N" (32K RAM - 40 Column) .....	1295
4032 "B" (32K RAM 4.0 Basic - 40 Column) ....	1295
4032 "N" (32K RAM 4.0 Basic - 40 Column) ....	1295
4016 "B" (16K RAM 4.0 Basic - 40 Column) ....	995
4016 "N" (16K RAM 4.0 Basic - 40 Column) ....	995
2022 Tractor Printer .....	795
4040 Dual Disk (340 2.0 DOS) .....	1295
8050 Dual Disk (1 Meg, 2.0 DOS) .....	1795
8010 IEEE Modem .....	395
CZN Cassette .....	95
PET - IEEE Cable .....	40
IEEE-IEEE Cable .....	50

## INTERTEC DATA SYSTEMS

32K Superbrain (360K Disk Storage), CP/M* .....	\$2995
64K Superbrain (360 Disk Storage), CP/M* .....	3150
64K Quad Density Superbrain (700K Disk Storage), CP/M* .....	3995

## ATARI COMPUTER SYSTEMS



ATARI 400 (8K RAM) .....	\$499.00
ATARI 400 (16K RAM) .....	630.00
ATARI 800 (16K RAM) .....	1,080.00
ATARI 410 RECORDER .....	89.95
ATARI 810 DISK DRIVE .....	599.95

NEECO also carries all  
available ATARI software

## ALTOS COMPUTER SYSTEMS

	RAM	DISK	
ACS 8000-IS	64K	250K	\$2840
ACS 8000-28	64K	500K	3500
ACS 8000-1	64K	500K	3840
ACS 8000-2	64K	1M	4500
ACS 8000-4	64K	2M	5600
ACS 8000-5	64K	1M	5990
<b>ACS 8000-6 Mul2 - Multi-User</b>			
(14.5 M-Winchester)	112K	1M	10,670
(29 M-Winchester)	112K	1M	11,870
<b>ACS 8000-6 Mul4 Multi-User</b>			
(14.5 M-Winchester)	208K	1M	11,960
(29 M Winchester)	208K	1M	13,160



**apple computer**  
Authorized Dealer



16K APPLE II+ .....	\$1330
32K " II+ .....	1430
48K " II+ .....	1530
APPLE DISK w/3.3 DOS .....	650
APPLE DRIVE Only .....	495

## APPLE III in Stock!!

128K, with Monitor and Info Analystpak ..... 4740

## EPSON PRINTER MX-80

80 Columns, 9x9 Dot Matrix Bidirectional Printing ..	\$645
Interface Cards	
8140 (RS-232) .....	\$55
8161 (IEEE 488) .....	55
8131 (Apple Card) .....	85
8230 (Apple Cable) .....	25
8220 (TRS-80 Cable) .....	35

## PROFESSIONAL SOFTWARE

WordPro I (8K) ...	\$29.95
WordPro III (40 Col.) 16K .....	199.95
WordPro III+ Enhanced Version .....	295.00
WordPro IV 80 Col., 32K .....	375.00
WordPro IV+ Enhanced Version .....	450.00

## Multi-Cluster for Commodore Systems.

Allows 3 CPU's (Expandable to 8) to access  
a single Commodore Disk.

Multi-Cluster .....

\$795 (3 CPU's)

Each Additional CPU \$199 (up to 8)

## DIABLO 630

45 CPS, Letter Quality  
RS-232 Port ..... \$2,710  
Tractor Option ..... 250



## NEC Spinwriter



5530 (Parallel) .....	\$3055
5510 (Serial) .....	3055
5520 (KSR-Serial) .....	3415
TRACTOR OPTION ...	225
55 CPS Letter Quality High Reliability	

## C. ITOH Starwriter



Serial or Parallel \$1995

FP 1500  
25 CPs,  
Letter  
Quality

# NEECO

679 Highland Avenue  
Needham, MA 02194

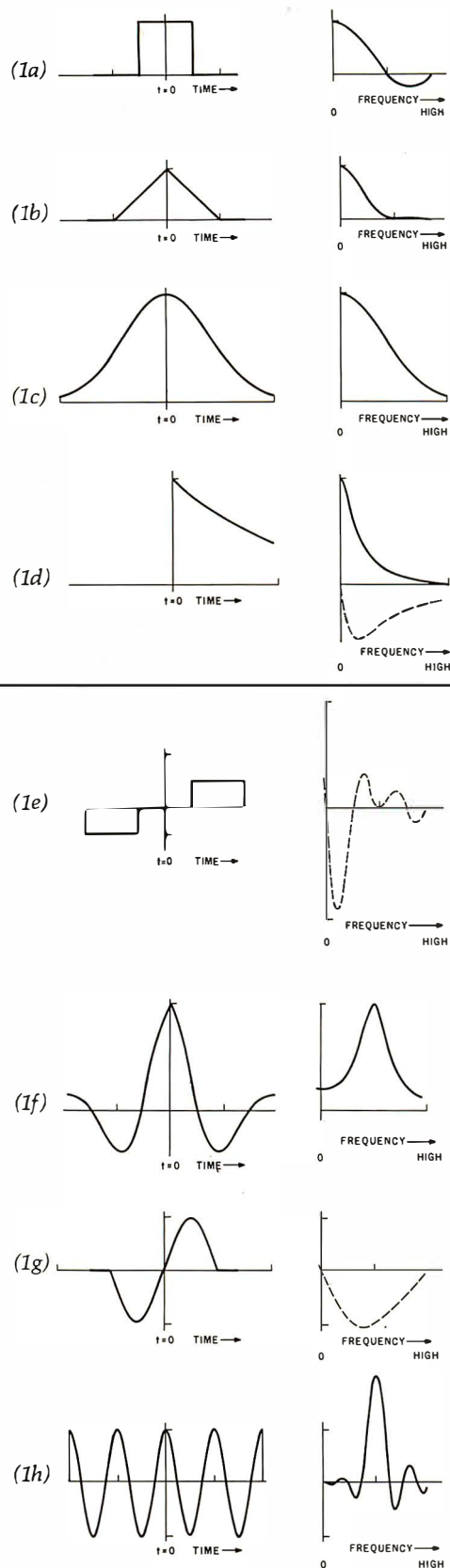
NEECO Order Lines: (617) 449-1760

MON - FRI 9:00 - 5:00

VISA/MC Accepted

Telex 951021

NEECO Order Lines: (617) 449-1760



**Figure 1:** Graphs on the right (functions of frequency) plot Fourier transforms for the specific functions on the left (functions of time), indicating the amount of each component frequency present in the original. Abrupt changes with respect to time (figures 1a thru 1d) are reflected in the transforms by the presence of higher-frequency energy. Graphs of functions exhibiting periodicity (figures 1e thru 1h) produce peaks centered on the frequency of this oscillation in the associated transform.

if a function of time has no net area, if it is positive just as much as it is negative, then its Fourier transform has no zero-frequency component. This component, in fact, is just the average value of that signal.

Let's examine several specific pairs of graphs. The transform of a square pulse (figure 1a) contains a number of low-frequency cosines (to build up the area under the pulse and create the flat-topped sections which obviously change little with time), but in addition, a fair amount of high-frequency cosine energy is required to make the square pulse. A triangular pulse of the same area has similar low-frequency requirements, but needs fewer higher-frequency waves (see figure 1b). A Gaussian (bell-shaped) curve requires very little high-frequency contribution to make its smooth function of time (see figure 1c).

This correlation between "abruptness" and high frequencies in the Fourier transform is, in fact, quite general. Functions that change abruptly with time, like the square wave, or that have a lot of fine detail (the sharp edges), are not composed only of low-frequency, slowly changing waves; the jumps require a lot of high frequencies to define them. As a square wave becomes narrower and narrower, more and more high frequencies are necessary: a falling body's thud, if replayed at a high enough speed, can sound like an abrupt gunshot. Signals that don't have sudden jumps, like those represented in the triangular graph, can be made using fewer high-frequency components, but the sharp corners where the slope of the triangle's sides changes still require high-frequency sinusoids. Smooth curves like the Gaussian, where there isn't much detail, require the least amount of high frequencies.

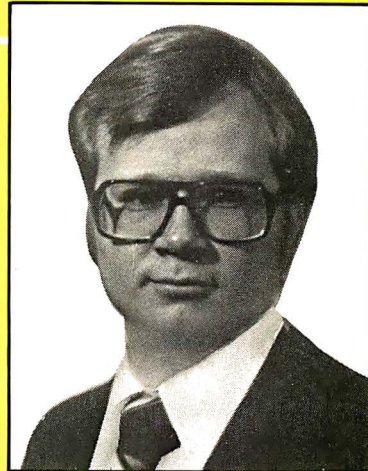
Finally, look at the graphs in figures 1e thru 1h. The functions of time (on the left) all show some sort of *periodic* behavior. Their transforms all reveal this by a peak at or near the frequency of oscillation. The more cycles of oscillation that the temporal function goes through, the sharper the peak in *frequency space*. This effect is not just mathematical—you can hear it. A heavily damped bell that rings for very few cycles produces an abrupt note

# Thinking of Data Base for Your Small System?

## Check these results from MDBS:

Leonard Overton, President of LS Business Systems, reports:

"The MDBS data base system is now the foundation for our future application products. This is because MDBS helps us to produce more flexible applications... quicker. System design changes are made easily. Time required for loading and debugging is greatly reduced."



## Check these features and support:

### MDBS is more complete—

- ✓ Network and hierarchical data structures
- ✓ Non-procedural query language
- ✓ Host language support including: BASIC, COBOL, FORTRAN, PASCAL, PL/I
- ✓ Data base recovery
- ✓ Data base restructure utility
- ✓ Available for popular Z-80, 8080, 6502, 8086 and Z-8000 based systems

### MDBS has complete documentation—

- ✓ DBMS Guide and Primer for fundamentals
- ✓ MDBS systems documentation

### MDBS has complete service and support, including—

- ✓ System updates and enhancements
- ✓ Training
- ✓ Phone consultation
- ✓ Newsletter

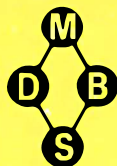
So if you're thinking of data base, check with us.  
Use the coupon below...or better yet, give us a call today.

Setting standards of excellence for data base software...worldwide.

**Micro  
Data Base  
Systems, inc.**

Market Square, Box 248  
Lafayette, Indiana 47902  
317-448-1616

Dealer/distributor/OEM inquiries invited.



YES, please send me more information on the remarkably flexible MDBS Data Base System.

Name \_\_\_\_\_ Title \_\_\_\_\_  
(Please print)

Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ (State) \_\_\_\_\_ (Zip) \_\_\_\_\_

Phone \_\_\_\_\_

**MAIL TO:** Micro Data Base Systems, Inc.  
Dept. B  
P. O. Box 248  
Lafayette, IN 47902

**Listing 1:** The 6502 machine-language program 2DFT performs two-dimensional Fourier transform of images on the Commodore PET's video display. SINTAB is a table of  $\sin(x)$  for  $x=0, \pi/20, 2\pi/20, \dots$ , thru  $19\pi/20$ , in PET floating-point notation (5 bytes per number). Numbers may be scaled up or down for normalization; one good choice is to divide each sine by the square root of 32. ROWSXRMD is a table of transformed rows from the screen, beginning with row 0, frequency 0, real (cosine) transform, then row 0, frequency 0, imaginary (sine) transform, then row 0, frequency 1, real transform, then imaginary, and so on, ending with row 24, frequency 20, imaginary transform.

```

DOROWS: LDA #18           ;enter here to transform rows of screen data
        STA ROWCOUNT    ;do 24+1 rows (all of them)
        LDA #C0
        STA ROW0         ;point to bottom row of screen
        LDA #83
        STA ROW0+1
        LDA #FB
        STA ANS0         ;point to bottom of answer area for storage
        LDA #1F
        STA ANS0+1
LOOP1:  JSR ROWTRANSFORM
        DEC ROWCOUNT
        BMI DONE         ;DONE = RTS instruction, to return to BASIC control
        SEC
        LDA ROW0
        SBC #28          ;back up to prior row (40 elements/row)
        STA ROW0
        BCS OVER1
        DEC ROW0+1
OVER1:  JMP LOOP1
DONE:   RTS

ROWTRANSFORM: LDA #64      ;number in FREQ is 5 times frequency (5 bytes/number)
LOOP2:  STA FREQ          ;initially set to maximum frequency...count down to 0
        LDA #C3
        STA POINT        ;set pointer for sine (imaginary part) transform
        JSR ONEFREQ
        JSR STOREIT
        LDA #91
        STA POINT        ;set pointer for cosine (real) transform
        JSR ONEFREQ
        JSR STOREIT
        LDA FREQ
        SEC
        SBC #5           ;decrement frequency being analyzed for
        BPL LOOP2        ;do all frequencies 0-20 inclusive
        RTS

STOREIT: LDX ANS0
        LDY ANS0+1       ;setup for PET utility subroutine
        JSR DAA6         ;store P at X+256Y
        LDA ANS0
        SEC
        SBC #5           ;move answer pointer back to a free space
        STA ANS0
        BCS OVER2
        DEC ANS0+1
OVER2:  RTS
ONEFREQ: LDA #27
        STA COLNUM       ;set column counter to maximum = 39
        LDX #5
        LDA #0
LOOP3:  STA MYACC-1,X     ;MYACC is 5 adjacent page zero locations
        DEX              ;clear them out here
        BNE LOOP3
TOP:    LDY COLNUM
        LDA (ROW0),Y     ;get screen character at current row & column
        TAY
        LDA #0
        JSR D278         ;convert integer 256A+Y to floating in P
        LDY #STABPG      ;point to page of sine table
        LDA POINT        ;256STABPG+POINT points to a sine to be multiplied in
        JSR D8FD         ;(sine)*P is calculated and stored in P
        LDY #0
        LDA #MYACC       ;point to MYACC, my accumulator's 5 bytes
        JSR D73C         ;(MYACC)+P is put into P
        LDY #0
        LDX #MYACC
        JSR DAA6         ;(P) gets rounded & transferred to 256Y+X (my acc.)
        DEC COLNUM
        BMI DONE        ;quit when all columns done
        LDA POINT
        SEC
        SBC FREQ         ;move pointer a distance FREQ through table
        BCS OVER3
        ADC #C8          ;work modulo 200, to stay on table
OVER3:  STA POINT
        JMP TOP

```

Listing 1 continued on page 174

without a well-defined musical pitch. A tuning fork that rings for thousands of cycles makes a clear, precise tone.

Contemplation of some graphs of Fourier-transform function-pairs can lead to a number of other useful insights. The illustrations in figure 1 were adapted from Ron Bracewell's excellent book, *The Fourier Transform and Its Applications* (see references), which is worth looking at for further inspiration.

## Adding a Dimension

Many signals, like sound, or light from a star, are essentially one-dimensional, and the techniques discussed above and in the earlier part of this article are immediately applicable to them. But there are other, extremely interesting signals which are two, three, or more dimensional when they arrive. Rather simple extensions of the concepts involved in one-dimensional spectral analysis will allow multidimensional signals to be transformed, analyzed, and manipulated. I'll discuss the two-dimensional case because problems with more dimensions can be attacked by completely analogous methods.

What function does a two-dimensional Fourier transform serve? For one thing, it can help solve many three-dimensional problems which have translational symmetry; that is, problems in which one of the three spatial dimensions can be trivially factored out. An obvious example is a system like a coaxial cable, or a cylindrical waveguide, where everything looks the same as you move along the length of the device. Two-dimensional Fourier transforms can give the electrical characteristics of such systems. To some extent, problems involving thin layers like the Earth's atmosphere can be dealt with using two-dimensional transforms.

If that were all, a few people might play around with two-dimensional spectral analysis, but it wouldn't be a huge industry. However, there's another class of problems that are of overpowering interest. These problems are in the field of imaging, or remote sensing. Ever since evolution came up with the first rudimentary eye-spots, creatures have been using electromagnetic radiation to probe their environments. With the development of lenses that form a two-

Text continued on page 178

# A \$175 Program That Makes Your Microcomputer Worth Its Weight In Gold.



The Denver Software Company has developed, with the assistance of a Big Eight accounting firm, a financial package for microcomputers which accommodates the needs of both the very small-businessman and the household budget manager, and costs far less than you would imagine.

The FINANCIAL PARTNER™ contains all essential accounting functions, and yet is easy to use. It also has built-in flexibility: Programming expertise and valuable time are not needed to get the FINANCIAL PARTNER™ ready to use. And most important, this is a complete package, containing the programs, language, operating system, and supplies.

The beauty of the FINANCIAL PARTNER™ is that you don't have to be a professional bookkeeper or accountant to use it. Controller Jim Vogt says, "It is one

of the simplest accounting systems I have ever worked with, and it has a great ability to produce timely and accurate financial statements for small business or home use." All the necessary "how-to" is detailed in a well-written, step-by-step reference manual.

The FINANCIAL PARTNER™, which operates from menu selections, collects and organizes information for all of the standard categories: Assets, liabilities (including accounts payable), normal living expenses, deductible expenses (including all six deductions for personal Federal Income Tax returns), earned income (for both the wage earner and the

self-employed), and other income and expenses.

The provided chart of accounts is tailored for most users, but it can easily be modified by adding new accounts or changing descriptions. The FINANCIAL PARTNER™ generates standard financial reports—including a detail trial balance, income statement, and balance sheet—as well as batch proof listings, check register, vendor payable reports, and chart of accounts reports.

**The FINANCIAL PARTNER™ is available for Apple, Atari, Commodore, Ohio Scientific, Texas Instruments, Radio Shack, Zenith, and most other microcomputers.**

Minimum hardware requirements are: 48 K RAM, 140 K on-line storage, 40 x 24 or 80 x 24 display device, and almost any 80-column printer (optional).

The FINANCIAL PARTNER™ is available from your local dealer or you can direct inquiries to:

**THE DENVER SOFTWARE COMPANY**

MANUFACTURERS OF MICROCOMPUTER SOFTWARE



36 Steele Street, Suite 19 • Denver, Colorado 80206  
Dealer inquiries welcome. 303 321-4551.

# When you buy from TSE-HARDSIDE you're always a winner!

## NINE GAMES FOR PRE-SCHOOL CHILDREN

by George Blank  
16K. S-80 . . . . . \$9.95

## KEYBOARD VIDEO PRINTER EXTENDER (KVP)

by Lance Micklus  
C/16. S-80 . . . . . \$19.95  
C/4. S-80 . . . . . \$14.95

## RPN CALCULATOR

by Russell Starkey  
C/16. S-80 . . . . . \$9.95

## STBO-UC

by Lance Micklus  
4/M. S-80 . . . . . \$24.95

## ST-BOD SMART TERMINAL

by Lance Micklus  
C/16. S-80 . . . . . \$49.95  
C/32. S-80 . . . . . \$79.95

## STAD

by Paul Van der Eijk  
16/M. S-80 . . . . . \$24.95

## CCA-DM

Personal Software  
C/S-80 . . . . . \$74.95

C/Apple . . . . . \$99.95

## DESK TOP PLANNER

Personal Software  
D/Apple . . . . . \$99.95

## MONTY

Personal Software  
C/S-80 . . . . . \$24.95

C/Apple . . . . . \$27.95

D/S-80 . . . . . \$27.95

D/Apple . . . . . \$27.95

## LEVEL III BASIC

Microsoft  
C/S-80 . . . . . \$49.95

## MUMATH

Microsoft  
C/S-80 . . . . . \$74.95

## EDITOR-ASSEMBLER

Microsoft  
C/S-80 . . . . . \$29.95

## SCREEN MACHINE

Softape Inc.  
C/Apple . . . . . \$19.95

D/Apple . . . . . \$29.95

## APPLE TALKER

Softape Inc.  
C/Apple . . . . . \$15.95

## DUNGEON CAMPAIGN

Synergistic Software  
D/Apple . . . . . \$17.50

C/Apple . . . . . \$14.95

## WILDERNESS & DUNGEON CAMPAIGN

Synergistic Software  
D/Apple . . . . . \$32.50

## WILDERNESS CAMPAIGN

Synergistic Software  
C/Apple . . . . . \$17.50

D/Apple . . . . . \$19.95

## ODYSSEY

Synergistic Software  
D/Apple . . . . . \$29.95

## SUPER NOVA

Big Five Software  
C/S-80 . . . . . \$14.95

## GALAXY INVASION

Big Five Software  
C/S-80 . . . . . \$14.95

## HELLFIRE WARRIOR

Automated Simulations  
D/S-80 . . . . . \$29.95

D/Apple . . . . . \$29.95

C/S-80 . . . . . \$24.95

## STARFLEET ORION

Automated Simulations  
C/S-80 . . . . . \$19.95

C/Apple . . . . . \$19.95

D/Apple . . . . . \$17.95

C/Pet . . . . . \$17.95

D/S-80 . . . . . \$24.95

D/Apple . . . . . \$24.95

C/S-80 . . . . . \$19.95

C/Apple . . . . . \$19.95

C/Pet . . . . . \$19.95

## VISCALC

Radio Shack  
D/S-80 . . . . . \$95.00

## 3 D GRAPHIC

Seabass Computing  
C/Atari . . . . . \$29.95

## HI-RES MYSTERY HOUSE

On Line Systems  
D/Apple . . . . . \$32.95

## HI-RES WIZARD & PRINCESS

On Line Systems  
D/Apple . . . . . \$24.95

## 3 MILE ISLAND

Musa Software  
D/Apple . . . . . \$39.95

## BEST OF MUSE

Musa Software  
D/Apple . . . . . \$39.95

## GLOBAL WAR

Musa Software  
C/Apple . . . . . \$17.95

D/Apple . . . . . \$24.95

## PINBALL

Acorn Software  
C/S-80 . . . . . \$14.9

D/S-80 . . . . . \$20.9

## DUEL-N-DROIDS

Acorn Software  
D/S-80 . . . . . \$20.9

C/S-80 . . . . . \$14.9

## PIGSKIN

Acorn Software  
C/S-80 . . . . . \$9.95

## SUPER SCRIPT

Acorn Software  
D/S-80 . . . . . \$29.9

## MIDWAY CAMPAIGN

Avalon Hill  
C/S-80 . . . . . \$15.0

C/Apple . . . . . \$15.0

C/Pet . . . . . \$15.0

## PLANET MINERS

Avalon Hill  
C/S-80 . . . . . \$15.0

C/Apple . . . . . \$15.0

C/Pet . . . . . \$15.0

## MORLOC'S TOWER

Automated Simulations  
D/S-80 . . . . . \$19.95

D/Apple . . . . . \$19.95

C/S-80 . . . . . \$14.95

C/Apple . . . . . \$14.95

C/Pet . . . . . \$14.95

## TEMPLE OF APSHAI

Automated Simulations  
C/S-80 . . . . . \$24.95

C/Pet . . . . . \$24.95

D/S-80 . . . . . \$29.95

D/Apple . . . . . \$29.95

## DATESTONES OF RYN

Automated Simulations  
D/S-80 . . . . . \$19.95

D/Apple . . . . . \$19.95

C/S-80 . . . . . \$14.95

C/Apple . . . . . \$14.95

C/Pet . . . . . \$14.95

## FORTE

Softape Inc.  
C/Apple . . . . . \$19.95

## SUPER TEXT II

Musa Software  
D/Apple . . . . . \$150.00

## THE VOICE

Musa Software  
D/Apple . . . . . \$39.95

## U-DRAW II

Musa Software  
D/Apple . . . . . \$39.95

## APPILOT II EDU-DISK

Musa Software  
D/Apple . . . . . \$99.95

## BEST OF BISHOP

Softape Inc.  
D/Apple . . . . . \$39.95

## EDITOR ASSEMBLER

Hayden Software  
D/Apple . . . . . \$49.95

## SUPER APPLE BASIC

Hayden Software  
D/Apple . . . . . \$39.95

## NUKEWAR

Avalon Hill  
C/S-80 . . . . . \$15.00

C/Apple . . . . . \$15.00

C/Pet . . . . . \$15.00

## B-1 BOMBER

Avalon Hill  
C/S-80 . . . . . \$15.00

C/Apple . . . . . \$15.00

C/Pet . . . . . \$15.00

## NORTH ATLANTIC CONVOY

Avalon Hill  
C/S-80 . . . . . \$15.00

C/Apple . . . . . \$15.00

C/Pet . . . . . \$15.00

## INTRODUCTION TO PROGRAMMING IN BASIC

Atari  
C/Atari . . . . . \$19.95

## 3 D TIC TAC TOE

Atari  
C/Atari . . . . . \$39.95

## TINY COMP

by David Bohlike  
D/32. S-80 . . . . . \$24.95

## STAR TREK

by Lance Micklus  
C/16. S-80 . . . . . \$14.95

## APL80

by Phelps Gates  
D. S-80 . . . . . \$39.95

C. S-80 . . . . . \$14.95

## TRS-80\* MEMORY

DIAGNOSTIC  
by Dave Stambaugh  
D/16. S-80 . . . . . \$24.95

KRIEGSPIEL II

by Ron Petkin  
C/16. S-80 . . . . . \$14.95

UP PERISCOPE

by Ron Petkin  
C/16. S-80 . . . . . \$14.95

X-WING II

by Chris Freund  
C/16. S-80 . . . . . \$9.95

## OLYMPIC DECATHLON

Microsoft  
C/S-80 . . . . . \$24.95

D/S-80 . . . . . \$24.95

## BASIC COMPILER

Microsoft  
D/S-80 . . . . . \$195.00

## ADVENTURE MICROSOFT

Microsoft  
C/S-80 . . . . . \$29.95

C/Apple . . . . . \$29.95

## A.L.D.S.

Microsoft  
D/S-80 . . . . . \$95.00

## FORTRAN

Microsoft  
D/S-80 . . . . . \$95.00

## NEWDOS 80

Apparat  
D/S-80 . . . . . \$149.95

## Z80 ZAP

Quality Software Distributors  
C/S-80 . . . . . \$29.95

## HIGHER TEXT

Synergistic Software  
D/Apple . . . . . \$35.00

## HIGHER GRAPHIC

Synergistic Software  
D/Apple . . . . . \$24.95

## MODIFIABLE DATA BASE

Synergistic Software  
D/Apple . . . . . \$79.50

## MAILING LIST DATA BASE

Synergistic Software  
D/Apple . . . . . \$34.50

## PROGRAM LINE EDITOR

Synergistic Software  
D/Apple . . . . . \$40.00

## BISMARCK

Strategic Simulations  
C/S-80 . . . . . \$49.95

D/S-80 . . . . . \$59.95

D/Apple . . . . . \$59.95

## INVASION OF ORION

Automated Simulations  
D/S-80 . . . . . \$24.95

D/Apple . . . . . \$24.95

C/S-80 . . . . . \$19.95

C/Apple . . . . . \$19.95

C/Pet . . . . . \$19.95

## ADVENTURELAND

Adventure International  
C/S-80 . . . . . \$14.95

C/Apple . . . . . \$14.95

PIRATE'S COVE

Adventure International  
C/S-80 . . . . . \$14.95

C/Apple . . . . . \$14.95

MISSION IMPOSSIBLE

Adventure International  
C/S-80 . . . . . \$14.95

C/Apple . . . . . \$14.95

MYSTERY FUN HOUSE

Adventure International  
C/S-80 . . . . . \$14.95

C/Apple . . . . . \$14.95

## SARGON II

Hayden Software  
D/S-80 . . . . . \$34.95

D/Apple . . . . . \$34.95

C/S-80 . . . . . \$29.95

C/Apple . . . . . \$29.95

## AIR TRAFFIC CONTROLLER

Sensational Software  
C/S-80 . . . . . \$9.95

C/Apple . . . . . \$9.95

## SUPER INVASION

Sensational Software  
C/Apple . . . . . \$19.95

SPACE WAR/SUPER

INVASION

Sensational Software  
D/Apple . . . . . \$29.95

DATA FACTORY

Micro Lab  
D/Apple . . . . . \$100.00

DOGFIIGHT

Micro Lab  
D/Apple . . . . . \$29.95

## CHESS

Atari  
C/Atari . . . . . \$39.95

## STAR RAIDERS

Atari  
C/Atari . . . . . \$15.95

## SUPER BREAKOUT

Atari  
C/Atari . . . . . \$39.95

## EDITOR ASSEMBLER

Atari  
C/Atari . . . . . \$15.95

VIDEO EASEL

Atari  
C/Atari . . . . . \$39.95

INVESTMENT PORTFOLIO

Small Systems Software  
C/S-80 . . . . . \$49.95

WALL STREET CHALLENGE

Image Computer Products  
C/Atari . . . . . \$14.95

## WARPATH

by Ron Petkin  
C/16. S-80 . . . . . \$14.95

## MAGIC PAINTBRUSH

Mark Polczarski  
D/32 /A ROM . . . . . \$29.95

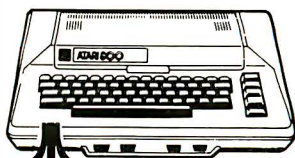
TRS-80 Model II, 64K RAM	\$3599.00	(#26-4002)
TRS-80 Model III, 16K RAM	\$919.00	(#26-1062)
TRS-80 Model III, 48K RAM	\$1039.00	(#26-1062+)
TRS-80 Model III, 48K RS232, 2-drives	\$2299.00	(#26-1063)
TRS-80 COLOR Computer, 4K RAM	\$359.00	(#26-3001)
TRS-80 COLOR Computer, 16K RAM	\$399.00	(#26-3001+)
TRS-80 COLOR Comp. 16K, Ext. BASIC	\$529.00	(#26-3002)
APPLE II PLUS, 48K RAM	\$1119.00	(#47-203)
ATARI 400, 8K RAM	\$439.00	(#36-400)
ATARI 400, 16K RAM	\$499.00	(#36-401)
ATARI 800, 16K RAM	\$829.00	(#36-800)
ATARI 800, 48K RAM	\$1089.00	(#36-802)



**TRS-80\***  
**COLOR COMPUTER**  
**4K \$359.00**  
**16K with extended**  
**BASIC \$529.00**

**TRS-80\***  
**MODEL III**

**16K \$919.00**  
**48K with two drives \$2299.00**



**ATARI 800**  
**\$829.00**

**ATARI 400**  
**\$439.00**

**ATARI®** **16K RAM \$119.50**  
**AXLON 32K RAM \$259.00**

**APPLE II<sup>+</sup>**  
**48K \$1119.00**



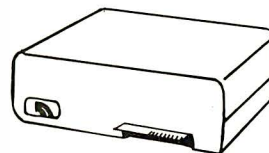
SUP-R-MOD RF Modulator	\$34.95	(#47-100)
APPLE II Disk Drive w/controller	\$579.00	(#47-004)
MICROSOFT Z-80 SoftCard	\$279.00	(#47-80)
MICROSOFT RAMCard	\$169.00	(#47-81)
PASCAL Language Card	\$469.00	(#47-PAS)
Mountain Computer ROMWriter	\$169.00	(#47-MH003)
Mountain Computer ROMPlus+ w/Filter	\$189.00	(#47-MH007)
Mountain Computer Expansion Chasis	\$609.00	(#47-MH024)
CCS Arithmetic Processor	\$399.95	(#47-7811C)
CCS Calendar/Clock Module	\$125.00	(#47-7424A)
KURTA Graphics Table w/Interface	\$659.00	(#47-1000)
VERSAWRITER	\$239.00	(#47-1100)
ALF AM II Music Synthesizer	\$189.00	(#47-1200)
NEC 12" Monochrome Monitor	\$239.00	(#5-200)

## LYNX

### MAKES YOUR COMPUTER A WHOLE NEW ANIMAL

LYNX is more than a telephone coupler. LYNX is a one-piece total telephone linkage system for TRS-80 Level I or Level II or APPLE II computers. No RS-232 required for true originate/answer direct-connect telephone operation. DOS-compatible EMTERM terminal software is furnished on cassette.

TRS-80 Model-I (Level I or Level II), 4K	\$229.00	(#19-80)
APPLE II or APPLE II PLUS, 16K min	\$239.00	(#19-85)



## DISK-80

- Disk Controller (up to 4 drives)
- Data Separator
- Incl. 16K of RAM
- Provision for an additional 16K RAM
- TRS-BUS Connector for future expansion
- ONLY \$369.00

## PRINTERS

EPSON MX-70	\$449.00	(#9-MX70)
EPSON MX-80	\$519.00	(#9-MX80)
OKIDATA Microline 80	\$499.00	(#9-80)
OKIDATA Microline 82	\$669.00	(#9-82)
OKIDATA Microline 83	\$999.00	(#9-83)
OKIDATA Slimline 300	\$3795.00	(#9-300)

**TERMS:** Prices and specifications are subject to change. HARDSIDE accepts VISA & MASTERCARD, Certified checks and Money Orders; Personal checks accepted (takes 3 weeks to clear). HARDSIDE pays all shipping charges (within the 48 states) on all PREPAID orders OVER \$100.00. On all orders under \$100 a \$2.50 handling charge must be added. COD orders accepted (orders over \$250 require 25% deposit) there is a \$5.00 handling charge. UPS Blue Label, and Air Freight available at extra cost.

\*TRS-80, APPLE and ATARI are trademarks of Tandy, Apple Computer Co., and Warner Communication, respectively.

   
**TSE-HARDSIDE**  
6 South St. Milford, NH 03055 (603) 673-5144  
**TOLL FREE OUT-OF-STATE 1-800-258-1790**

**If you're looking for  
the best prices  
in the U.S.A. on**



## TRS-80<sup>®</sup> MICROCOMPUTERS

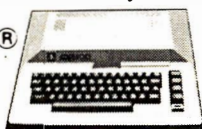
We have consistently offered the TRS-80 line at savings **up to 20%**, which means you can save \$150 to \$1500 by buying directly from Computer Discount of America.

**TRS-80 Model II, 64K System,  
with disc drive only \$3385.00**

Other TRS-80 Model II, or Model III computers and systems, Color Computers, and Pocket Computers are in stock at similar savings.

Our savings are as big on expansion interfaces, printers, diskettes — everything for your TRS-80 System.

**ATARI<sup>®</sup>**  
MICROCOMPUTERS



We have the full line of ATARI personal computers and systems, including Models 400 and 800.

The computers, accessories, and hardware are brand new, in factory sealed cartons, and carry a full factory warranty.

Most models are in stock for immediate delivery (usually within 7-10 days), and a price quote is as near as your phone.

So if you're looking for the **best prices in the U.S.A.**, for microcomputers and accessories, call Computer Discount of America, Inc., West Milford, New Jersey 07480. 201-728-8080. **NO TAX ON OUT-OF-STATE SHIPMENTS.**

**TOLL FREE 800-526-5313**

**Computer  
Discount  
of America**

Authorized TRS-80 dealer, store B-282.

*Listing 1 continued:*

```

DOCOLS: LDA #14                ;enter here to transform and display 20*2 columns
        STA COLNUM
LOOP4:  LDA #3C                ;60/5=12 is maximum frequency which can be shown
        STA FREQ              ;begin at 12 and do frequencies through -12
        JSR FTC&D             ;fourier transform column & display
        DEC COLNUM
        BPL LOOP4
        RTS                    ;when finished, go back to BASIC control

FTC&D:  LDA COLNUM
        CLC
        ADC #D3
        STA RDISP             ;point to screen address of right-hand column to
        LDA #83                ;be displayed (zero at center)
        STA RDISP+1
        LDA #13
        SEC
        SBC COLNUM
        STA LDISP             ;point to left-hand display column
        LDA #80                ;(column 20 is only displayed on right...see below)
        STA LDISP+1
        LDA COLNUM
        ASL A
        STA ADRS              ;temporary storage for multiplication 10*COLNUM
        ASL A
        ADC ADRS
        ADC #2E
        STA STASH             ;now we have 10*COLNUM
                                ;and now accumulator points to low byte of the real
                                ;part of the last ROWSXFRMD table entry for this column
LOOP5:  STA ADRS
        LDA #1F
        STA ADRS+1            ;high part of end of ROWSXFRMD table address in 8K PET
        LDA #91
        STA POINT             ;pointer set for cosine transform of real part of data
        JSR COLXFRM           ;returns answer in MYACC and in P
        LDX #5
LOOP6:  LDA MYACC-1,X
        STA COSACC-1,X        ;transfer answer to COSACC on page zero, 5 bytes
        DEX
        BNE LOOP6
        LDA #1F
        STA ADRS+1            ;reset data pointer before doing sine transform
        LDA STASH             ;stash holds result of low byte address calculation
        CLC
        ADC #5
        STA ADRS              ;add 5 to get to point to imaginary part of data
        LDA #C3
        STA POINT             ;there is never a carry
        JSR COLXFRM           ;point setup for sine transform of imag. data
        LDY #0
        LDA # COSACC
        JSR D95E               ;transfer COSACC to S
        JSR D728               ;calculate S-P and leave result in P
        JSR DADE               ;copy P to S
        LDA #0
        STA SGNCOMPR          ;set sign comparison (address BE) to +
        LDA B0                 ;must call PET subroutine with (B0) in A
        JSR D900               ;(P)*(S)=(P)*#2 is calculated and left in P
        LDY #0
        LDX # COSACC
        JSR DAA6               ;transfer P to COSACC
        LDA #1F
        STA ADRS+1
        LDA STASH
        STA ADRS              ;point to real data again
        LDA #C3
        STA POINT             ;setup for sine transform of real data
        JSR COLXFRM
        LDX #5
LOOP7:  LDA MYACC-1,X
        STA SINACC-1,X        ;transfer answer to SINACC on page zero
        DEX
        BNE LOOP7
        LDA #1F
        STA ADRS+1
        LDA STASH
        CLC
        ADC #5
        STA ADRS              ;point to imaginary data
        LDA #91
        STA POINT             ;and do cosine transform
        JSR COLXFRM
        LDY #0
        LDA # SINACC
        JSR D73C               ;add (SINACC)+(P) and store in P
        JSR DADE               ;copy P to S
        LDA #0
        STA SGNCOMPR

```

*Listing 1 continued on page 176*

# Xerox proudly announces paper you can't copy on.

It isn't your average 8½" X 11".

Actually it's more like 33000" X 147⁄8". And while your copier won't know what to do with it, your computer or word processor will.

Now you can feed your computer printer or word processor high-quality Xerox Computer Forms.

Stock forms that are available in combined volume discounts, so you can conveniently order them together with copier paper, and save on both. And forms that are backed by our money-back quality guarantee.

For more information on how to order, make excellent use of this paper. And send in the coupon.

I'd like more information on how I  
can save on Xerox Computer Forms.  
Send to: Xerox Corporation,  
P.O. Box 24, Rochester, N.Y. 14601.

Name \_\_\_\_\_

Title \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_

Zip \_\_\_\_\_

Tel. \_\_\_\_\_

B-3-81

**XEROX**

XEROX® is a trademark of XEROX CORPORATION.



**NEW****for****CP/M®****Software Tools That Work**

- proven
- cost-effective
- thousands in use

Available in standard 8-Inch format for most CP/M systems, and 5-Inch CP/M and HDOS formats for Heath/Zenith systems.

Written by computer professionals who demand the same high standards in their microcomputer software as they get on bigger machines, these programs have built a reputation for quality, reliability, and performance. The HDOS versions are sold by Heath/Zenith dealers nationwide as well as through independent distributors internationally.

Programs available on standard 8" CP/M, 5" Heath CP/M and HDOS disks:

**Programming Languages**

C/80  
C Compiler .....\$39.95  
RATFOR  
Fortran language extension ..\$39.95  
LISP/80  
LISP interpreter .....\$39.95  
UVMAC/Z80  
Macro assembler for Z80 ....\$29.95  
UVMAC/8080  
Macro assembler for 8080 ..\$29.95

**Word Processing & Utilities**

TEXT  
Text formatter .....\$34.95  
PACK/CRYPT  
File compression/encryption..\$24.95

Available for the H89, H8, and Z89 in Heath 5" CP/M and HDOS formats only:

**Graphics & Word Processing**

PIE  
Full screen text editor .....\$29.95  
ED-A-SKETCH  
Full screen graphics editor ...\$29.95

**Utility Programs**

CATALOG SYSTEM/UTILITIES  
(HDOS only)  
Catalog disk library; file  
dump, compare, etc. ....\$19.95  
REACH (HDOS only)  
Modem and file transfer ....\$19.95

**Entertainment**

AIRPORT  
Real time action game .....\$19.95  
INVADERS  
Action video game .....\$19.95  
MYCHESS  
Chess champion .....\$34.95

ORDERING INFORMATION: Specify program name and disk format. Check program listing above for format availability. Add \$2/order (\$3/order for 8" disks) for first class postage and handling. CA residents add 6% sales tax.

***The Software Toolworks™***

Walt Bilofsky, Prop.  
14478 Glorietta Drive  
Sherman Oaks, CA 91423  
(213) 986-4885

Dealer inquiries invited.

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

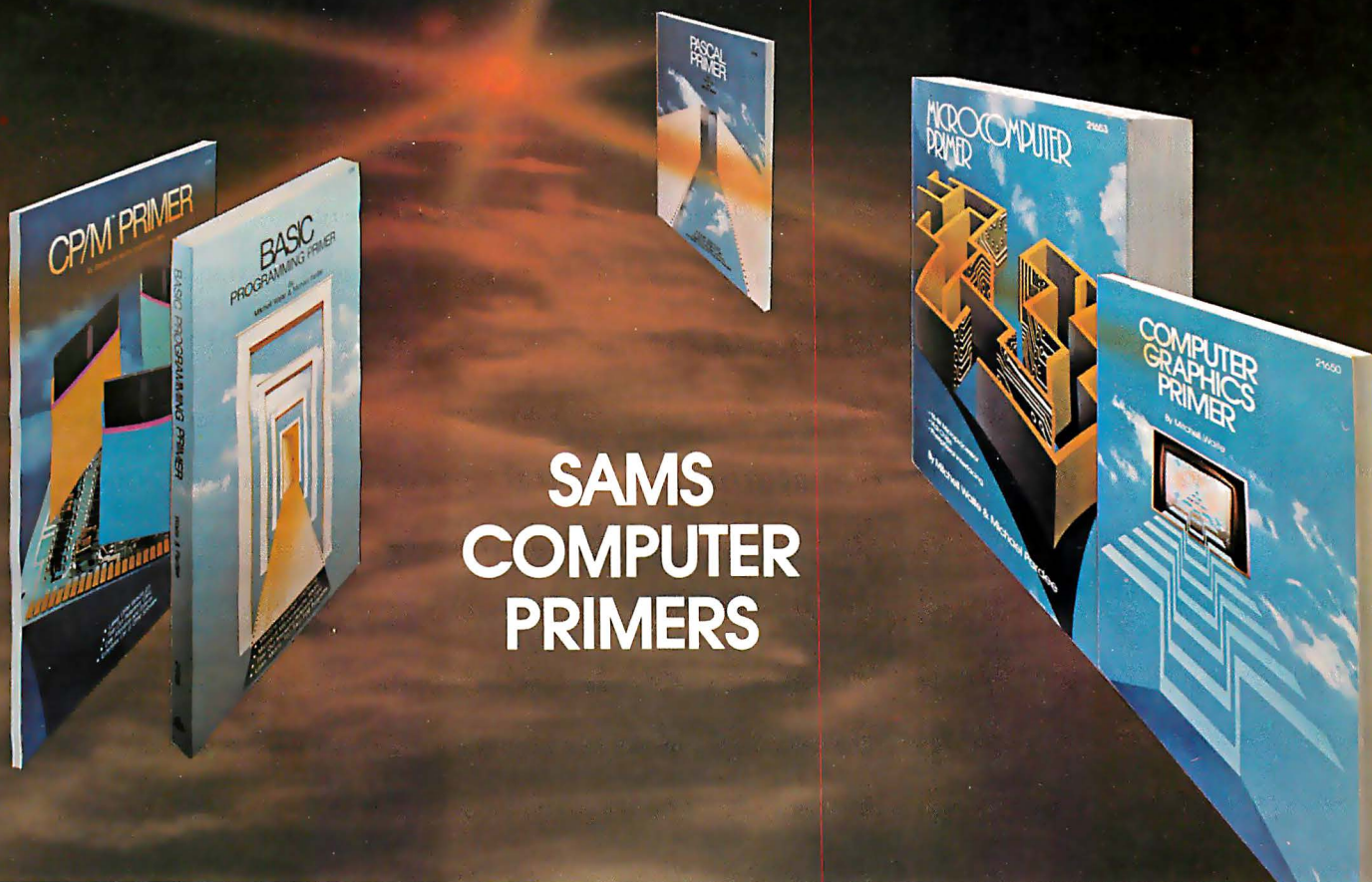
**Listing 1 continued:**

```

LDA B0
JSR D900          ;square of P is now in P
LDY #0
LDA #COSACC
JSR D73C          ;(COSACC)+(P) is in P
JSR DE24          ;SQR(P)...now we have fourier amplitude to be plotted!
LDA B0            ;must avoid overflow, so check exponent of answer
CMP #89
BCS LIMITER       ;take branch if result is bigger than 255
JSR D0A7          ;convert P to an integer in B3,B4
LDA B4            ;but B3 is zero, by limiting process
JMP OVERLTD
LIMITER: LDA #FF   ;replace overflow by 255
OVERLTD: LDY #0
          STA (RDISP),Y ;display it on the screen!--first, right column
          TAX
          LDA RDISP
          SEC
          SBC #28      ;subtract 40 to point to previous row
          STA RDISP
          BCS OVER4
          DEC RDISP+1
OVER4:    LDA COLNUM
          CMP #14      ;check column number, and don't plot column
          BEQ OVER5    ;number 20 (no room on screen!)
          TXA
          STA (LDISP),Y ;plot result in left column here
          LDA LDISP
          CLC
          ADC #28      ;add 40 for next row
          STA LDISP
          BCC OVER5
          INC LDISP+1
OVER5:    LDA FREQ
          CMP #C4      ;see if we've reached frequency of -12 yet...
          BEQ DONE2
          SEC
          SBC #5        ;decrement frequency
          STA FREQ
          LDA STASH
          JMP LOOP5     ;go back and do it again at new frequency
DONE2:    RTS
COLXFRM:  LDA #0
          LDX #5
          STA MYACC-1,X ;clear out MYACC's 5 bytes
          DEX
          BNE LOOP8
          LDA #19
          STA ROWNUM
          LDY ADRS+1
          LDA ADRS
          JSR DA74      ;transfer column member pointed to by ADRS to P
          LDY #STABPG   ;point to sine table page
          LDA POINT
          JSR D8FD      ;(sine)*P in P
          LDY #0
          LDA #MYACC
          JSR D73C      ;(MYACC)+(P) in P
          LDY #0
          LDX #MYACC
          JSR DAA6      ;(P) to MYACC
          DEC ROWNUM
          BEQ DONE2    ;return when all 25 are done
          LDA POINT
          SEC
          LDX FREQ
          BMI NEGFREQ   ;must handle movement of pointer carefully
          SBC FREQ
          BCS OVER6
          ADC #C8        ;work modulo 200, stay in table
OVER6:    STA POINT
          JMP NXTADR
NEGFREQ:  SBC #C8
          CMP FREQ
          BCC OVER7
          SBC FREQ
          JMP OVER6
OVER7:    LDA POINT
          SEC
          SBC FREQ
          JMP OVER6
NXTADR:   LDA ADRS
          SEC
          SBC #D2        ;back up 210 to previous column member
          STA ADRS
          BCS OVER8
          DEC ADRS+1
OVER8:    JMP LOOP9

```

# SHORTEN THE JOURNEY TO KNOWLEDGE.



## SAMS COMPUTER PRIMERS

The popular Sams series of Computer Primers provide a working knowledge of computers without being dry and complex. The Primer Books guide you through the subject at an easy pace. Your journey to understanding is short, exciting, and fun. The Sams Primers offer good graphics ... a good balance of data ... an upbeat, positive style ... and are organized so that you can read them straight through like a novel.

### CP/M<sup>™</sup> PRIMER,

by Mitch Waite and Stephen Murtha. A non-technical discussion of CP/M disk operating systems for 8080 and Z-80-based microcomputers. No. 21791. \$11.95.

### PASCAL PRIMER

A complete guide to the hottest new language in computers by Mitch Waite and David Fox. No. 21793. \$16.95.

### COMPUTER GRAPHICS PRIMER

An easy-to-understand guide to creating drawings, plans, maps, and schematics on a computer monitor. By Mitch Waite. No. 21650. \$12.95.

### MICROCOMPUTER PRIMER

(Second Edition)

Up-to-date facts on popular microcomputers. Don't buy a computer without reading this book by Mitch Waite and Michael Pardee. No. 21653. \$11.95.

### BASIC PROGRAMMING PRIMER

A valuable guide to BASIC, today's most widely used microcomputer language. By Mitch Waite and Michael Pardee. No. 21586. \$10.95.

# Sams Books®

Mail To: Howard W. Sams & Co., Inc.  
4300 West 62nd Street • P.O. Box 7092  
Indianapolis, IN 46206

SAVE 10% ON ORDERS OF \$20 OR MORE!

			Quantity
CP/M Primer	No. 21791	\$11.95	_____
PASCAL Primer	No. 21793	\$16.95	_____
Computer Graphics Primer	No. 21650	\$12.95	_____
Microcomputer Primer	No. 21653	\$11.95	_____
BASIC Programming Primer	No. 21586	\$10.95	_____
		Amount of order \$	_____
		Deduct 10% if order is \$20 or more \$	_____
		Add local sales tax where applicable \$	_____
		Shipping & handling costs \$	2.00
		Total amount of order \$	_____

\_\_\_ PAYMENT ENCLOSED \_\_\_ CHECK \_\_\_ MONEY ORDER

\_\_\_ VISA \_\_\_ MasterCard Interbank No. \_\_\_\_\_

Account No. \_\_\_\_\_ Expiration Date \_\_\_\_\_

Name (print) \_\_\_\_\_

Signature \_\_\_\_\_

Address \_\_\_\_\_

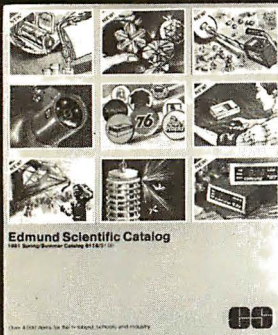
City \_\_\_\_\_

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

CALL TOLL-FREE 1-800-428-3696 FOR THE NAME OF YOUR  
LOCAL SAMS BOOK OUTLET OR TO ORDER BY PHONE.  
Offer expires 6/30/81. AD071

# Free!

## Edmund Scientific Catalog



OUR  
40th  
YEAR!

### Explore With Us!

Over 4,000 unusual and intriguing products are in this FREE 1981 catalog. Our new products for work and leisure will peak your curiosity and make you eager to try them yourself.

### What's Your Interest?

It's all here—Astronomy, Microscopy, Lasers, Alternate Energy, Weather, Binoculars, Magnets, Magnifiers, Lab Equipment, Biofeedback, Unique Lighting, Scientific Living—and more! Discover a new interest or add sparkle to an old one.

### Don't Delay!

Our **FREE** 112-page, colorful 1981 catalog is your guide to unique, exciting products. You'll find what you're looking for and more in **Edmund Scientific's World Of Science**

☐ **Yes!** Rush me your FREE Catalog so I can explore Edmund Scientific's World of Science ... Today!

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_  
State \_\_\_\_\_ Zip \_\_\_\_\_

### Clip and Mail Coupon to

Edmund Scientific  
Dept. 3016 KH06 Edscorp Bldg.  
Barrington, N.J. 08007

*Text continued from page 170:*

dimensional image on the retina, remote sensing took a giant step forward.

When conditions are good, the images that develop on photographic plates or inside vidicons (television-camera tubes) can be used just as they are. But often, noise or other interference makes the original image low-quality. When astronomers look up, or spy satellites look down, they want to squeeze every possible bit of information out of their sensors, to "milk" every photon. That's one major reason for all the progress in image analysis and two-dimensional signal processing that has been made in the past few decades.

## Advantages of transforming a visual image into the frequency domain overcome all the limitations of the photographic medium.

The advantages of transforming a picture into the frequency domain, where the elements of the image that vary periodically are gathered and grouped together, are numerous, just as were the advantages of analyzing a one-dimensional signal in frequency space (as discussed last month in Part 1). By working digitally inside a computer, you overcome all the limitations of the photographic medium. It's easy to enhance or mute contrasts, to intensify edges of objects (high-spatial frequencies) or to take out distracting large-scale brightness variations (low-spatial frequencies). The wonderful images that come back from NASA's planetary probes are automatically processed by these kinds of techniques before anyone sees them.

If, after all this build-up, you're expecting to hear that the two-dimensional Fourier transform is an arcane, incomprehensible mathematical process, I'm sorry, but I have to disappoint you. To take a two-dimensional transform, you merely need to choose a pair of perpendicular coordinate axes ( $x$  and  $y$ ). First do a one-dimensional Fourier transform in the

$x$  direction, and then do a one-dimensional transform on the result of that, in the  $y$  direction. That's all there is to it!

### The 2DFT Program

The 6502 assembly-language program in listing 1 performs two-dimensional Fourier transforms. The program takes as its input data the contents of the Commodore PET microcomputer's video-display screen: 1000 numbers, arranged in 25 rows of 40 integers, each one in the range 0 thru 255. The results of the transformation are displayed on the screen. Only the amplitude of the transform is shown; all phase information (whether the wave is sine, cosine, or a mixture) is suppressed.

I'd like to take a little time now to describe how the program works, and the choices and compromises I had to make in implementing it. This discussion should help you if you need to adapt 2DFT to run on a different microcomputer, and it should also be a useful starting point for modifications and improvements of my program. After the discussion, I'll return to the uses of the program, the insights that you can achieve by playing around with it, and the fascinating topic of holography, and how to do it with this program.

First, concerning the fundamental algorithm used to do the transforms: as mentioned above, a true two-dimensional Fourier transform results after you perform separate one-dimensional transformations on each row of a matrix, and then perform separate one-dimensional transformations on each resulting column of data. 2DFT does that. The routine DOROWS finds the amount of cosine phase necessary at each frequency, as well as the amount of sine. Those numbers are stored in memory for each row. Then, the routine DOCOLS does the same thing for each column of stored half-transformed data, and puts the amplitude of each resulting frequency-space point onto the screen. The amplitude is simply the square root of the sum of the squares of the cosine component and the sine component (like finding the hypotenuse of a right triangle).

To do the one-dimensional row and column transformations, DOROWS and DOCOLS call subroutines ROWTRANSFORM and COL-

# Software for the Apple II and Apple II Plus\*

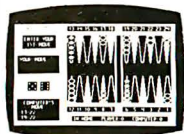


## ASTEROIDS IN SPACE™

By Bruce Wallace

An exciting space action game! Your space ship is traveling in the middle of a shower of asteroids. Blast the asteroids with lasers, but beware — big asteroids fragment into small asteroids! The Apple game paddles allow you to rotate your space ship, fire its laser gun, and give it thrust to propel it through endless space. From time to time you will encounter an alien space ship whose mission is to destroy you, so you'd better destroy it first! High resolution graphics and sound effects add to the arcade like excitement that this program generates. Runs on any Apple II with at least 32K of RAM and one disk drive.

On Diskette - \$19.95



## FASTGAMMON™ By Bob Christiansen.

Sound, hi res, color, and musical cartoons have helped make this the most popular backgammon playing game for the Apple II. But don't let these entertaining features fool you — FASTGAMMON plays serious backgammon. Runs on any Apple II with at least 24K of RAM.

Cassette - \$19.95 Diskette - \$24.95

## ASTROAPPLE™ by Bob Male.

Your Apple computer becomes your astrologer, generating horoscopes and forecasts based on the computed positions of the heavenly bodies. This program offers a delightful and stimulating way to entertain friends. ASTROAPPLE produces natal horoscopes (birth charts) for each person based on his or her birth data. Any two people may be compared for physical, emotional, and intellectual compatibility. The program is written in Applesoft BASIC with machine language subroutines. It requires either RAM or ROM Applesoft and at least 32K of memory.



Cassette - \$14.95 Diskette - \$19.95



## FRACAS™ by Stuart Smith.

A fantastic adventure game like no other! Up to eight players can participate in FRACAS at the same time. Journey in the land of FAROPH, searching for hidden treasure while warding off all sorts of unfriendly and dangerous creatures. You and your friends can compete with each other or you can join forces and gang up on the monsters. Your location is presented graphically and sound effects enliven the battles. Save your adventure on diskette or cassette and continue it at some other time. Both integer BASIC and Applesoft versions included. Requires at least 32K of RAM.

Cassette - \$19.95 Diskette - \$24.95

**BENEATH APPLE MANOR™** by Don Worth. Descend beneath Apple Manor into an underground maze of corridors, rooms, and secret passages in quest of rich and powerful treasures. The dungeon complex consists of many floors, each lower level more dangerous than the last. If you can reach the lowest level, you may even find the ultimate object of your quest, the fabled golden apple of Apple Manor. Strategy is extremely important as you deal with a variety of monsters, each with its own characteristics. Written in integer BASIC with machine language subroutines. Requires integer BASIC and at least 16K of RAM on cassette or 32K of RAM on diskette.



Cassette - \$14.95 Diskette - \$19.95

## BATTLESHIP COMMANDER™ by Erik Kilk and Matthew Jew.



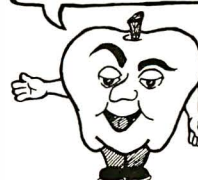
A game of strategy. You and the computer each start out by positioning five ships of different sizes on a ten by ten grid. Then the shooting starts. Place your volleys skillfully — a combination of logic and luck are required to beat the computer. Cartoons show the ships sinking and announce the winner. Sound effects and flashing lights also add to the enjoyment of the game. Both Applesoft and integer BASIC versions are included. Requires at least 32K of RAM.

Cassette - \$14.95 Diskette - \$19.95

## BABBLE™ by Don Worth.

Have fun with this unique software. You write a story, entering it as a BABBLE program. As you write the story you specify certain words to be selected by the computer or entered from the keyboard at execution time. Run the program and watch BABBLE convert your story into an often hilarious collection of incongruities. The ways in which BABBLE can entertain you are limited only to your imagination. You can compose an impressive political speech or write poetry. You can plan a dinner menu. You can even form images on the screen or compose musical tunes with the help of BABBLE. The cassette version requires at least 16K of RAM and the diskette version requires at least 32K of RAM. BABBLE is written in machine language and runs on any Apple II computer.

MY SISTER'S PENCIL SHARPENER LOVES YOUR ANTEATER, AND THE CRABGRASS IS ATTACKING THE FRIENDLY MATADOR.



## BABBLE

Cassette - \$19.95 Diskette - \$24.95

## LINKER

### LINKER by Don Worth.

Turn your Apple II or Apple II Plus into a powerful and productive software development machine with this superb linking loader/editor package. LINKER does the following and much more:

- Dynamically loads and relocates suitably prepared machine language programs anywhere in RAM.
- Combines a main program with subroutines. You can assemble a subroutine once and then use it with as many main programs as you wish.
- Produces a map of all loaded routines, giving their location and the total length of the resulting module.
- Contains a library of subroutines including binary multiplication and division, print text strings, delay, tone generator, and random number generator.

Linker works with virtually any assembler for the Apple II. Requires 32K of RAM and one disk drive.

Diskette - \$49.95  
Manual Only - \$19.95



## QUALITY SOFTWARE

6660 Reseda Blvd., Suite 105, Reseda, CA 91335

(213) 344-6599

Now exclusive distributors for products from The Software Factory, Newhall, California  
\*Apple II and Apple II Plus are trademarks of Apple Computer, Inc.

**WHERE TO GET IT:** Call us at (213) 344-6599 for the name of the Quality Software dealer nearest you. If necessary you may order directly from us. Mastercard and Visa cardholders may place orders by telephone. Or mail your check or bankcard number to Quality Software, 6660 Reseda Blvd., Suite 105, Reseda, CA 91335. California residents add 6% sales tax. **SHIPPING CHARGES:** Within North America orders must include \$1.50 for first class shipping and handling. Outside North America the charge for airmail shipping and handling is \$5.00. Pay in U.S. currency.



# SAVE

## on add-ons for APPLE® & TRS-80®

NEW TOLL FREE ORDER NUMBER



### SAVE ON APPLE II 16K

**FREE** MEMORY  
UPGRADE KIT TO 48K WITH  
PURCHASE OF APPLE II 16K

**\$1195**

### THE MICROCONDUCTOR™

the ultimate data base manager  
for your TRS-80® and Apple® **\$299**

The MICROCONDUCTOR™ is not just a file manager but a true Data Base Management System suitable for both the novice and professional users.

**DATA FILES**—No limit on the number of records a file can have.

**FIELDS**—Any type (string, integer, single, double). Eight entry modes (including defaults, counting, and suppress).

**REPORTS**—Four ways to generate reports. Total numeric column(s). Print on any paper in any format (statements, labels, etc.).

**SORT**—Any field(s) (i.e., multiple-key sort). Any size file, numeric or ASCII. Ascending or descending.

**MAINT.**—Command anticipation. Record duplication. Direct access and sequential search.

**UPDATING/MERGING**—Add, subtract, multiply, divide fields. Combine results from previous calculations. Test for any condition and take action.

TRS-80® MODEL I .....	<b>\$249</b>
APPLE® .....	<b>\$299</b>
TRS-80® MODEL II .....	<b>\$399</b>

#### INTRODUCTORY OFFER SAVE \$300 LIST \$949



**Okidata  
Microline 80**  
**\$639**

Patch for  
Apple Graphics **\$89**

**EPSON PRINTER**  
w/interface cord & cable ..... **\$699**

Language System .....	<b>\$449</b>
Z-80 SoftCard .....	<b>\$309</b>
Micromodem .....	<b>\$349</b>
The Source .....	<b>\$100</b>

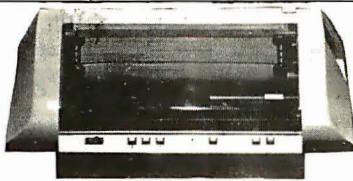
<b>NEW SANYO MONITORS</b>	
9 inch B/W .....	<b>\$209</b>
12 inch B/W .....	<b>\$279.50</b>
12 inch green phos. ....	<b>\$309</b>

<b>MTI APPLE 8" DISK SYSTEM</b>	
• One SA800R Floppy	<b>\$1425</b>
• 1 Drive Chassis & Power Supply	
• Controller, Cable and DOS	
<b>SUP-R-MOD II</b> .....	<b>\$24.95</b>
<b>ABT KEY PADS</b> .....	<b>\$99.00</b>

**MONTHLY SPECIAL  
DISK DRIVE  
FOR APPLE**  
w/Controller (3.3)  
**\$569**

### Printers

Silentype .....	<b>\$549</b>
Centronics 779 .....	<b>\$1,069</b>
Base 2 .....	<b>\$649</b>
Centronics 737 .....	<b>\$839</b>
Centronics 702-9 .....	<b>\$1,995</b>
Malibu .....	<b>\$2,093</b>
Spinwriter .....	<b>\$2,549</b>
Daisy Wheel .....	<b>\$1,779</b>



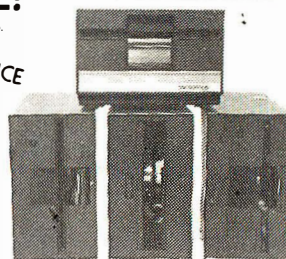
Anadex 9500 ..... **\$1,549**

### DISK DRIVE SALE!

Complete with power supply and chassis.

**TF-3** **CLEARANCE SPECIAL**  
**SHUGART SA400**  
**\$299**

- ★ Per ec FD200, 40 track... **\$379**
- ★ TF-5 MPI B51, 40 track... **\$359**
- ★ TF-7 Micropolis, 77 track... **\$579**



**Disk Expansion System**  
**SAVE \$113**

2 Shugar SA400, one 2-drive cable,  
1 Expansion Interface 32K,  
and 1 35-track DOS+

**SPECIAL PRICE ONLY \$1,149**

NEWDOS+ 40 track .....	<b>\$110</b>
NEWDOS+ 3.5 track .....	<b>\$99</b>
D-Car .....	<b>\$199</b>
Head Cleaner .....	<b>\$19.95</b>
AJA Business Pkg. ....	<b>\$359</b>
The Source .....	<b>\$100</b>
Basic Compiler .....	<b>\$195</b>
Mail List .....	<b>\$60</b>

### NEWDOS80

A new enhanced NEWDOS for the TRS-80®

The most powerful Disk Operating System for the TRS-80® designed for the sophisticated user and professional programmer who demands the ultimate.

NEWDOS/80 is the planned upgrade from NEWDOS 2.1. Some of the features are:

- New BASIC commands for files with variable record lengths up to 4095.
- Mix or match drives. Use .35, 40 or 80 track 5" disk drives or 8" disk drives, or combo.
- Security boot-up for BASIC or machine code application programs.
- New editing commands.
- Enhanced RENUMBER that allows relocation.
- Command chaining.
- Device handling for routing to display and printer simultaneously.
- DFG function; striking of D, F and G keys allows user to enter a mini-DOS without disturbing program.
- Compatible with NEWDOS & TRSDOS.
- Machine language Superzap/80 2.1 utilities

**\$149**

#### NEW FOR TRS-80®

**TF-8 80 TRACK DISK DRIVE**  
by MPI

Double your capacity.  
Single head mini floppy.  
More than 200K bytes of  
storage. Complete with  
power supply and chassis.

**\$639**

**TF-9 DUAL 80 TRACK DISK DRIVE**  
by MPI

Quadruple your capacity.  
400K bytes of storage (like  
having 4-40 track drives in  
one unit). Complete with  
power supply and chassis.

**\$789**

**BARE DRIVES AVAILABLE  
CALL FOR DISCOUNT PRICE**



**MICROCOMPUTER  
TECHNOLOGY  
INCORPORATED**

Order Desk Only 800-854-7222  
Telex #678401TAB IRIN

3304 W. MacArthur  
Santa Ana, CA 92704  
(714) 979-9923

ALL PRICES CASH DISCOUNTED  
FREIGHT FOB FACTORY  
ASK FOR FREE CATALOG

®Registered Trade Mark of Apple® and Radio Shack.



TRS-80® Model III Owners . . .

# Why Wait?

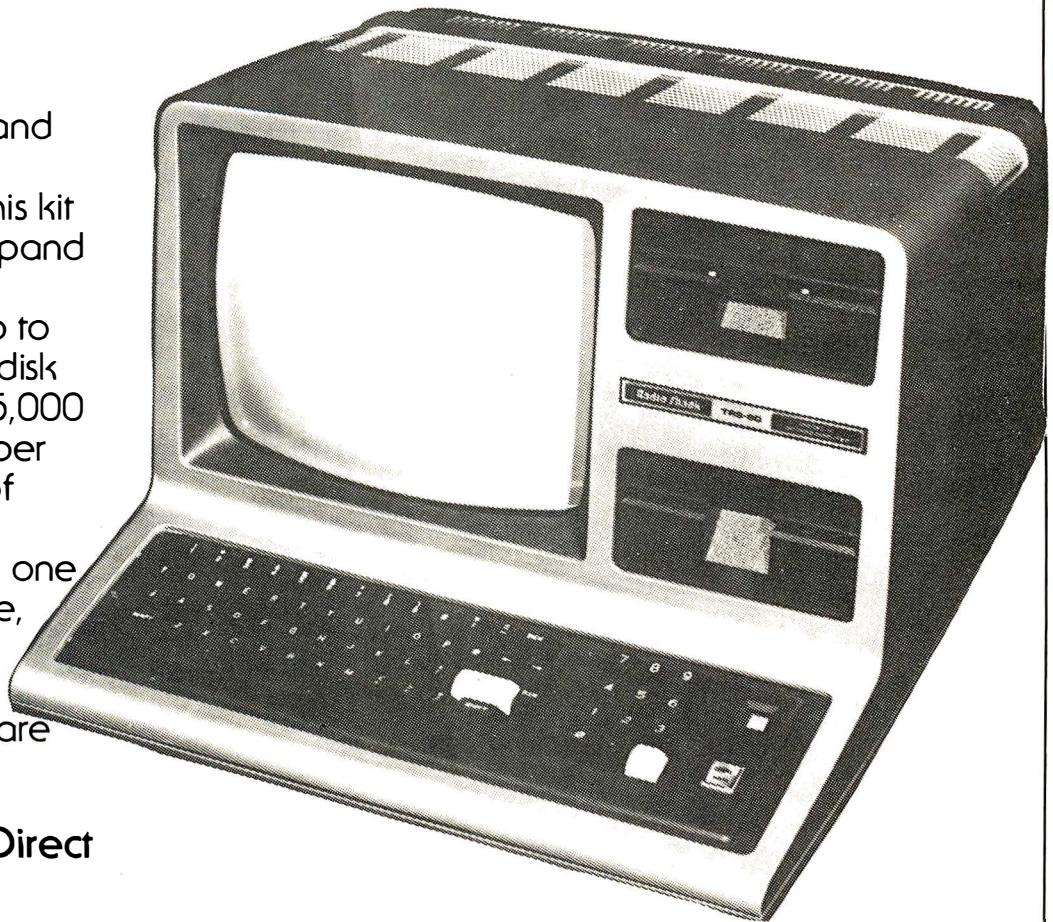
## Expand Your System Now

New low cost internal disk kit available to expand your storage capability. With this kit now you may expand your Model III computer with up to four MTI 40 track disk drives, giving 175,000 bytes of storage per drive for a total of 700K.

The kit includes one 40 track disk drive, controller, power supply, cables, mounting hardware and installation documentation.

**Manufacturer Direct  
Price**

**ONLY \$699**



### COMPLETE SYSTEMS AND COMPONENTS AVAILABLE\*

#### MTI MODEL III SYSTEMS

16K RAM, Model III Basic ..... \$899  
2-Disk, 48K ..... \$1949  
System Cover ..... \$6.95

\*Uses MTI Disk Drives  
and Memory.

#### MTI DISK DRIVES FOR MODEL III

##### Internal Kits

Disk Drive 1 ..... \$699  
Disk Drive 2 ..... \$279

##### External Add-on Kits

Disk Drive 3 ..... \$379  
Disk Drive 4 ..... \$359

Model III DOS & Manual ..... \$21.95

16K RAM Kit ..... \$59

RS-232 Serial Interface ..... \$95



### MICROCOMPUTER TECHNOLOGY, INC.

3304 W. MACARTHUR, SANTA ANA, CA 92704

★ PHONE (714) 979-9923 ★ TELEX #678401TAB IRIN

Order Desk Only 800-854-7222

® TRS-80® IS A REGISTERED TRADEMARK OF TANDY CORPORATION



ALL PRICES CASH DISCOUNTED  
FREIGHT FOB FACTORY  
ASK FOR FREE CATALOG

XFRM, respectively. These simply use the old, classical, straightforward method of calculating a Fourier transform—no fast-Fourier-transform subtleties!

I've avoided talking about the mathematical mechanism for moving from ordinary space to the frequency domain in these articles so far, because there are ample technical references which explain such matters in great detail, and because the calculation tends to get in the way of the real substance of the subject, especially in an introduction such as this one. Here, let me just say that the transforms are accomplished by multiply-

ing each row (or column) element by a sinusoidally varying factor, and adding up the results of those multiplications at each frequency. To find out how much cosine phase at frequency  $f$  is in a given row, multiply each row element  $r(x)$  by  $\cos(2\pi fx)$  and sum those products for the whole length of the row. The amount of sine wave is found by multiplying  $r(x)$  by  $\sin(2\pi fx)$  and summing those results. You can unite the cosines and sines into a set of complex numbers, with the cosines making the real parts and the sines the imaginary parts. Then, usual complex-number algebra helps keep track of how to add and subtract

components during the transformation process.

None of this is anything for a non-mathematically inclined person to worry about; it's just a recipe for the machine to follow in order to crank out the answers. There's no more need to follow the details of the process than there is to follow the details of how your pocket calculator computes exponentials or logarithms. In ten or twenty years, as the power of computers grows and their cost shrinks, there will probably be single-keyword instructions to perform Fourier transforms, just as most machines now have EXP and LOG routines available. Some people will still work with the nitty-gritty, low-level algorithms and procedures, just as some engineers work with individual transistors today. But most human work will be done using higher-level languages, where it's easier to invent new concepts and prove theorems. Machines will handle the low-level dirty work.

Besides the specific algorithm I chose to use, some other important decisions went into the design of 2DFT. First, to avoid all danger of arithmetic overflow and underflow, I use floating-point procedures except at the final stage where the results of the transformation are displayed. At that point, the floating numbers are converted into fixed-point integers and any results greater than 255 are truncated to equal 255. (There are never any negative results because the square root of the sum of the squares is always positive or zero.)

To save program space and avoid the headaches of writing my own routines, I call the floating-point procedures in the PET's BASIC ROM. Table 1 is a list of hexadecimal addresses of the entry points to these routines, and includes short descriptions of what each routine does and how to call it. (Driven by my need for machine-language floating-point capabilities, I found the locations of these subprograms, and I don't think that there can be anything wrong with PET owners using the subroutines in their programs, as I've done. I should also note, however, that Commodore and Microsoft may change the addresses given in table 1 in future production of PETs and other machines.)

A second important choice that was made in the design of 2DFT was

S	P	Contents	S=e	P = - $\pi/2$
B8	B0	exponent + 80	82	81
B9	B1	fractions MSB	AD	C9
BA	B2	frac. byte 2	F8	0F
BB	B3	frac. byte 3	54	DA
BC	B4	fraction LSB	59	A2
BD	B5	sign	00	FF
BE		sign comparison	FF	
BF		roundoff byte	00	
0000		USR(P)		
CED6		S OR P		
CED9		S AND P		
D264		FRE(P)		
D285		POS(P)		
D349		STR\$		
D5C4		CHR\$		
D5D8		LEFT\$		
D604		RIGHT\$		
D60F		MID\$		
D654		LEN		
D663		ASC		
D685		VAL		
D6E6		PEEK		
D728		S - P		
D73C		JSR D95E, then S + P		
D73F		S + P		
D7AC		normalize P		
D8BF		LOG(P)		
D8FD		JSR D95E, then S * P		
D900		S * P		
D95E		[A + 100Y]—S, separating sign, set sign comparison, return with (B0) in A		
D9E4		S / P		
DA74		[A + 100Y]—P, separating sign		
DAA6		roundoff(P)—[X + 100Y], merging sign		
DACE		S—P		
DADE		P—S, with rounding		
DAE1		P—S, without rounding		
DAED		roundoff(P)		
DAFD		SGN(P)—A		
DB0B		SGN(P)		
DB2A		ABS(P)		
DB9E		INT(P)		
DE24		SQR(P)		
DE2E		S I P		
DEA0		EXP(P)		
DF45		RND(P)		
DF9E		COS(P)		
DFA5		SIN(P)		
DFEE		TAN(P)		
E048		ATN(P)		
Conversions: D0A7 P—integer in B3,B4 [100B3 + B4]				
D278 integer in A,Y [100A + Y] — P				

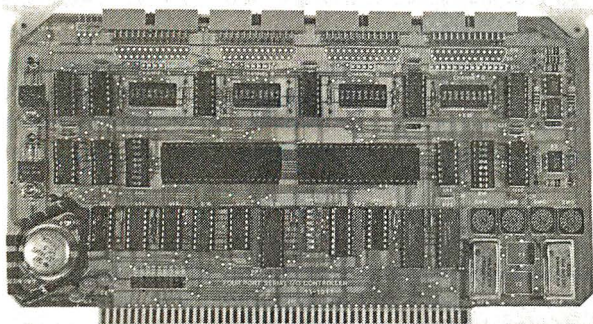
Note: +, -, \*, /, and ! must be called with S in B8 thru BD, sign comparison set to (B5) XOR (BD), and (B0) in A

Constants in floating (merged sign) notation:

E024	$1/4$
DDE3	$1/2$
E01A	$\pi/2$
CDBC	$\pi$
E01F	$2\pi$

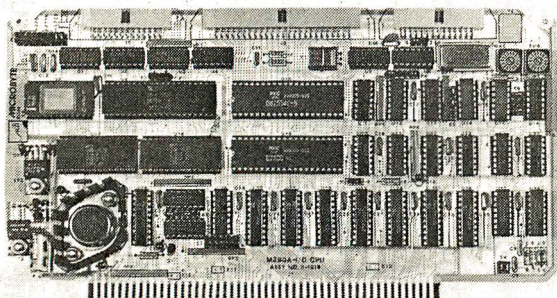
**Table 1: Entry points for Commodore PET ROM functions, including floating-point subroutines that are utilized directly by the author's program.**

# MICROBYTE INTRODUCES PROFIT FOR YOUR BOTTOM LINE



## 4 PORT I/O

- Quad RS-232C Serial Ports, One 20mA Current Loop Port
- Fully IEEE S-100 Bus Compatible
- Asynchronous Communications with Z80A-Dart(TM) or Synchronous Communications with Z80A-SIO(TM)
- Full Set of Modem Control Signals, including RI (Ring Indicator)
- Easily Configurable to Any Type of Terminal Interface
- I/O Servicing Environments: (1) Polled; (2) Bus Vector; (3) Z80 Mode 2 Vector
- Off-Board Interrupt Daisy Chain Capability
- Special Receive Conditions: (1) Framing Error; (2) Parity Error; (3) Receiver Overrun Error
- Baud Rates Selected Individually from 50 Baud to 300K Baud
- 72 Hour Burn-In



## Z-80A/I-O

- A complete single board Z-80A CPU with serial/parallel interface
- Fully compatible with the proposed IEEE S-100 Bus Standard
- Z-80A CPU (4MHz version of the Z-80)
- 158 instructions—superset of and upward compatible from the 8080's 78 instructions
- Up to 4K of on board Eprom with optional Z-80 monitor program — 1K(2708), 2K(2716) or 4K(2732)
- Full vectored interrupt capability
- 2MHz or 4MHz operation is jumper selectable
- Selectable auto-wait state insertion for extending M1\*, MREQ\*, IORQ\* and/or on board ROM
- Dual RS-232 serial I/O ports using the Z80A-DART with individual baud rate selection (16 baud rates from 50-19,200 baud)
- Up to 24 bit parallel I/O port—fully programmable Intel 8255A
- Up to 8 separate counter/timers using 2 Z-80A CTC

## MICROBYTE

1198 E. Willow St., Signal Hill, CA 90806 • (213) 595-8571

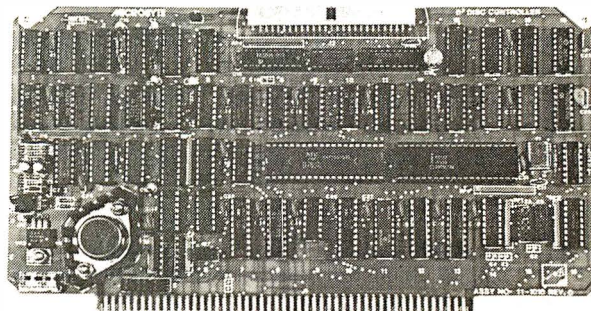
☐ Please send me information on becoming a Microbyte dealer.

☐ Please send info on the Microbyte \_\_\_\_\_

Name \_\_\_\_\_

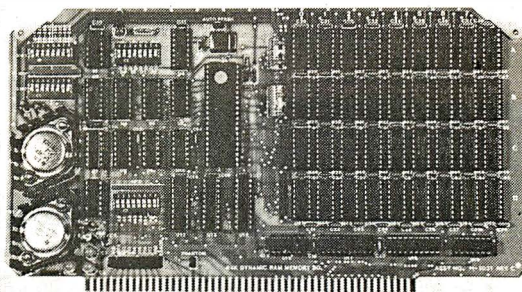
Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_



## DISK CONTROLLER

- DMA to within 16M byte of memory
- State-of-the-art NEC765 LSI Controller
- IEEE-S100 compatible
- DMA arbitration allows use of multiple boards within a system
- PLL data recovery for totally reliable operation
- Write pre-comp switched at mid-disc for reliable double density operation
- Supports up to four (4) drives
- Power On, Power Off or Reset deselects drives to avoid damaging files
- Drive deselect Time Out, deselect drives not in use
- Single or double sided operation
- Single density/double density operation
- 8" standard drives
- Separate VCC supply for data recovery to eliminate possible noise problems



## 64K DYNAMIC RAM BOARD

- Fully S-100 bus compatible/Alpha Micro compatible
- 64K x 8 bit dynamic RAM
- Low power: + 8VDC @ 700 ma  
+ 16VDC @ 100 ma  
- 16VDC @ 25 ma
- Built-in-parity with LED indicator and vector interrupt
- Memory addressable in four 16K banks
- Hidden refresh
- Gold contacts for high reliability
- 72-hour Burn-in
- Memory mapped via DIP switch
- Built-in programmable write-protect
- Programmable control port for parity and bank control

It takes more than an initial low price to make an S-100 board a profit generator for a dealer. It takes a total **value cluster** from the manufacturer — a **value cluster** that includes:

★	<i>Products</i>	★
★	<i>Price</i>	★
★	<i>Quality</i>	★
★	<i>Pre-sale Service</i>	★
★	<i>Post-sale Service</i>	★
★	<i>Commitment</i>	★

MICROBYTE has the products — from memory boards to complete S-100 systems, and we offer the rest of the value cluster — call today for the whole story on how you can become a Microbyte dealer.

to use the same scales for the horizontal and vertical axes in the Fourier transform. This is not as obvious a choice as it might seem. Because the video display screen isn't square, it might seem to be better to squeeze the vertical scale, so that as many high frequencies could be plotted in the vertical direction as are plotted horizontally. The resulting distortion would be perfectly acceptable math-

ematically, but it would make the pictures harder to look at and might be responsible for some mistaken notions on the part of naive viewers. Additionally, choosing different scales for horizontal and vertical transformations would require the use of a different set of sines and cosines for each dimension.

I chose instead to make the scales in the frequency domain equal. The re-

quired sines and cosines are stored in a table (on PET memory page STABPG, in listing 1); a pointer moves through the table, allowing the transformation subroutines to read off the trigonometric functions with a minimum amount of computational overhead. The effect of making the scales equal in both directions is that instead of using a 25- by 40-pixel (picture-element) screen, the program is really transforming a 40 by 40 image. The extra 15 rows are presumed to be filled with zeroes before every transformation. After transforming, the high frequencies that fall outside the bounds of the video screen are not calculated. (This is not a devastating loss; as you may have heard, you can cut off and throw away part of a hologram and still reconstruct the whole original image from the remaining fragment. The only cost is a loss of resolution and sharpness in the reconstructed image. More on this later.)

The third significant choice I made in writing 2DFT was to display the amplitude of the Fourier transform: the square root of the sum of the squares of the sine and cosine components. A photographic plate has a sensitivity that is proportional to the light energy which falls in any given area. Taking the square root adds mathematical complexity and computational time to the transformation process. On the other hand, the square-root operation makes it a lot easier to look at and interpret the transform results on the video screen. It prevents almost all overflows because any number between 0 and 65,535 is mapped into the range 0 to 255 automatically. The cost in time is an additional 10% or so, which is acceptable for the benefits that result. Finally, the nonlinearity of the square root turns out not to interfere much with the holographic process, in my experiments.

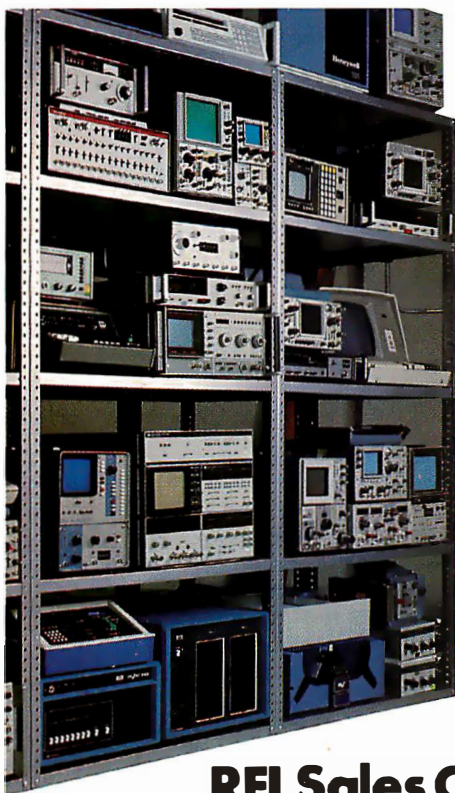
The video-character generator used in the PET is capable of storing a number between 0 and 255 in each of the thousand screen locations, but for human viewing, this kind of a display isn't very good. In the BASIC driver program which calls and controls 2DFT, I've included short routines to convert the screen contents to and from a "density plot," where each pixel on the display is filled with a character with brightness propor-

**Listing 2:** This program calls 2DFT and helps translate its results to a form more easily viewed by a human. A picture can be drawn on the screen, using the usual cursor-control characters. Hitting the exclamation-mark key turns the picture into a form that 2DFT can read, where each cell has in it a number (from 0 thru 255) proportional to the magnitude of the image at that cell. The quote key turns the numbers back into a "density plot" where the brightness of each cell is proportional to its magnitude.

```

5  REM**POKE 135,6 BEFORE RUNNING TO PROTECT MACHINE-LANGUAGE 2DFT PROGRAM
10  DATA 32,58,59,103,106,118,225,245,244,229,160:FOR I=1 TO 10:READ G$:NEXT
20  PRINT "HIT -RETURN- TO TRANSFORM SCREEN"
30  PRINT "  -QUOTES- TO MAKE DENSITY PLOT"
40  PRINT "  - ! -- TO TURN DENSITY TO NUMBERS"
100 GET AS:IF AS="" GOTO 100
110 I=ASC(AS):IF I=13 GOTO 200
120 IF I=34 GOTO 800
130 IF I=33 GOTO 900
140 PRINT AS;:GOTO 100
200 SYS(1536):SYS(1713):GOTO 100
800 FOR I=32768 TO 33767:A=PEEK(I):POKE I,G$(A/25):NEXT:GOTO 100
900 FOR I=32768 TO 33767:A=PEEK(I):B=10:FOR J=0 TO 9:IF A-G$(J) THEN B=J:J=9
910 NEXT:POKE I,25*B:NEXT:GOTO 100
920 REM**POKE 135,32 WHEN FINISHED TO REGAIN ACCESSIBILITY TO ALL MEMORY

```

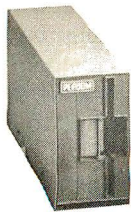


**Thousands  
of  
"like new"  
products  
with  
money back  
guarantees.**

**REI Sales Company  
(800) 227-8409**

In California (213) 993-7368, (415) 968-8845 or (714) 879-0561

# Big Savings for SS-50 Bus Computerists



## LFD-400 Mini-Disk System

**\$459.95**

The choice of knowledgeable 680X computerists since 1977 • Proven clock-data separation circuitry and other superior design features • Reliable hard-sector diskette formatting • Stores up to 102 Kbytes of formatted data on 40 tracks • Comes complete with 4-drive controller, drive assembly, 6800 or 6809 ROM disk operating system, interconnecting cable and comprehensive users manual • Add-on drives cost only \$399.95 each. Circle 109

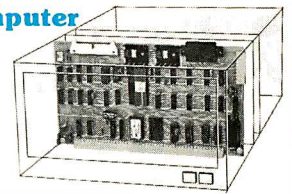
**Save  
\$140!**

REGULAR \$599.95

## SBC/9 Single-Board Computer

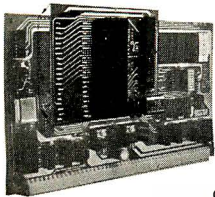
**\$139.95**

A computer or a fully compatible SS-50 bus MPU card • Interchangeable 6802 or 6809 processor • Extendable 1-Kbyte ROM monitor • Parallel and serial I/O ports — selectable, full-range bit rate generator for serial I/O • Extendable addressing • On-card 1-Kbyte RAM • Provision for additional EPROM • On-card voltage regulator circuits Circle 110



**Save  
\$60!**

REGULAR \$199.95



## 6809 MPU Upgrade Adapter

**\$39.95**

Upgrades 6800 MPU cards to 6809 processing power • Configured for SWTP MP-A2 MPU card but may be used with other MPUs • Plug-in installation requires no trace cutting or soldering — easy to restore MPU to original configuration • Assembled and tested • Includes user instructions • 6809 ROM operating system, PSYMON/A2, for use with the 6809 MPU Adapter — \$69.95. Circle 111

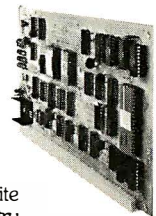
**Save  
\$30!**

REGULAR \$69.95

## The ELECTRIC WINDOW

**\$169.95**

Memory-mapped instant display updating • Software-defined display formats • Expandable 128-symbol character generator — characters are fully formed and feature true baseline descenders • On-card display RAM can be remapped • Video output can be composite or separate sync-video • Voltage regulation circuitry included on card. For an application review of the ELECTRIC WINDOW; see Peter Stark's comments on page 87 of the January 1981 issue of Kilobaud/MICROCOMPUTING. Circle 112



**Save  
\$80!**

REGULAR \$249.95

# Percom Price-Slashing, Profit-Zapping Fifth Anniversary Sale!

After five years of solid accomplishments, it's time to celebrate. So we've slashed prices for a gigantic 5th anniversary sale. Now, for a limited time, you can get Percom design and Percom quality at enormous savings. But don't wait. Sale ends April 30th and quantities are limited to stock on hand.

**Save \$100.00 on fully assembled, tested and burned-in RAM cards! Hurry, regular prices in effect after April 30th.**

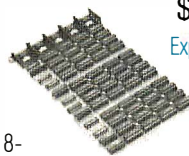
These RAM cards feature 1-Mbyte extended addressing; buffered data, address and control lines; and, on-card voltage regulation. Cards are fully tested and burned-in. User manuals include 6800 & 6809 diagnostic memory test programs.

### M24SS 24-Kbyte STATIC RAM CARD

**\$399.95 REGULAR \$499.95**

**Save  
\$100!**

Memory is organized as three independent 8-Kbyte blocks. Each block may be located at any 8-Kbyte boundary of a 64-Kbyte address space • Also



available in 8- and 16-Kbyte versions at regular prices. 8-Kbyte RAM expansion kit includes extra RAM chip, plus sockets and other parts. Kit price is \$139.95. • Uses 2114L RAM chip. Circle 113

### M48DSS 16-Kbyte DYNAMIC RAM CARD

**\$399.95 REGULAR \$499.95**

**Save  
\$100!**

Expandable to 48 Kbytes • Memory is organized as three independent 16-Kbyte blocks. Each block may be located in any of the four 16-Kbyte zones of a 64-Kbyte address space • Special "map-out" strapping can be used to depose any 8-Kbyte block from upper 32-Kbyte memory • Uses type 4116 RAM chips • 16-Kbyte RAM expansion kit includes extra RAM chip, plus sockets and other parts. Kit price is \$99.95. Circle 114

### Watch for the COLORAMA-50!

This soon-to-be-announced color VDG card for the SS-50 bus features eleven colorful display formats in 2 to 8 colors, plus 2-color alpha-numerics; full graphic resolutions from 64X64 pixels to 256X192 pixels; memory-mapped instant display control; low-cost modulator option for TV interface; 1-Mbyte extended addressing; cassette I/O option; and, operating software. Introductory price is only \$219.95.



PERCOM DATA COMPANY, INC.  
211 N. KIRBY GARLAND, TEXAS 75042  
(214) 272-3421

PRICES AND SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.  
PRICES DO NOT INCLUDE SHIPPING AND HANDLING.

COLORAMA-50, ELECTRIC WINDOW, LFD-400, PSYMON and SBC/9 are trademarks of Percom Data Company, Inc.

### Nobody supports the SS-50 bus like Percom

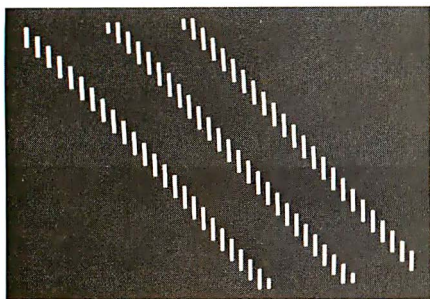
Our field-proven software for 680X computers includes monitors, operating systems, drivers, editors, assemblers, debuggers and high-level languages like Super BASIC — our popular extended disk BASIC interpreter.

Some of the other hardware products available include versatile prototyping cards in both 30- and 50-pin versions, extendable 50-pin motherboards and 30-pin I/O card motherboards. Function cards, prototyping cards and motherboards are optionally available with gold-plated bus connectors. Also, most function cards are available in 86-pin, EXORciser bus compatible versions.

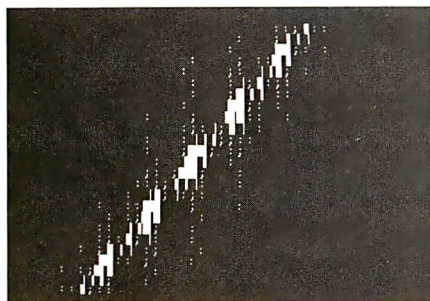
Quality Percom products are available at Percom dealers nationwide. Call toll-free, 1-800-527-1592, for the address of your nearest dealer, or to order direct from Percom.

EXORciser is a trademark of Motorola Corporation.

(a)



(b)



**Photo 1:** Photo 1a shows a simple image of low-frequency components present along the length of the stripes. Perpendicular to the stripes, strong periodicity occurs at frequencies that are multiples of the spacing frequency. The resulting transform is shown in photo 1b.

tional to the number formerly stored in that cell (see listing 2). The density-plot display uses only eleven distinct symbols, so it's as if the 8 bits stored in each screen location have been truncated to about  $3\frac{1}{2}$  bits. The loss of precision is not severe, and the density plots are much easier to look at and understand than the raw data.

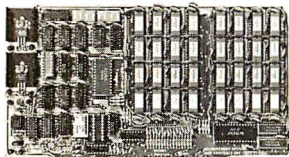
### Experimenting with 2DFT

As I have implemented it, the 2DFT program takes about 4 minutes to do a single complete two-dimensional Fourier transform of the contents of the PET's screen and display the results. (It runs faster if the input data contains many zeroes, since the floating-point multiplication routine in the PET knows how to multiply by zero quite rapidly!) The columns of the answers are plotted as soon as they are calculated. After a computation, 5250 bytes of PET memory are left containing the results of the row transformations in floating-point notation (5 bytes per number). Because the input data was a set of strictly real numbers, fifty of the sine components are always exactly zero (two zeroes per row), and so there are

1000 independent numbers in memory—precisely as many independent numbers as there were cells on the screen. This is not coincidental; the Fourier-transformation process "conserves information," so it had to turn out that way.

For your first experiments, and to confirm that the program is working correctly, I recommend that you transform simple pictures. A good test is a picture made up of parallel stripes (see photo 1). The picture, like a picket fence, has only low-frequency components present in the direction along the length of the stripes. Perpendicular to the stripes, there is a strong periodicity, at frequencies which are multiples of the fundamental spacing frequency. Logically, the transform should be a series of bright spots running along a line perpendicular to the original stripes.

Another good test is to transform a sharp spike—a picture with only one cell illuminated. Such a sharp point is made up of equal amounts of sine waves at all frequencies and in all directions. Thus, the result of transforming a spike should be a



#### 64K BYTE EXPANDABLE RAM

DYNAMIC RAM WITH ONBOARD TRANSPARENT REFRESH GUARANTEED TO OPERATE IN NORTHSTAR, CROMEMCO, VECTOR GRAPHICS, SOL, AND OTHER 8080 OR Z-80 BASED S100 SYSTEMS • 4MHZ Z-80 WITH NOWAIT STATES.

- ★ SELECTABLE AND DESELECTABLE IN 4K INCREMENTS ON 4K ADDRESS BOUNDARIES.
- ★ LOW POWER—8 WATTS MAXIMUM.
- ★ 200NSEC 4116 RAMS.
- ★ FULL DOCUMENTATION.
- ★ ASSEMBLED AND TESTED BOARDS ARE GUARANTEED FOR ONE YEAR AND PURCHASE PRICE IS FULLY REFUNDABLE IF BOARD IS RETURNED UNDAMAGED WITHIN 14 DAYS.

	ASSEMBLED / TESTED
64K RAM	\$595.00
48K RAM	\$529.00
32K RAM	\$459.00
16K RAM	\$389.00

#### S100 MAINFRAME AND CARD CAGE

- ★ W/ SOLID FRONT PANEL . . . \$239.00
- ★ W/ CUTOUTS FOR 2 MINI-FLOPPIES . . . \$239.00
- ★ 30 AMP POWER SUPPLY . . . \$119.00
- ★ 8 SLOT MOTHERBOARD . . . \$149.00
- ★ 19 SLOT MOTHERBOARD . . . \$199.00

#### 16K MEMORY EXPANSION KIT ONLY \$58

FOR APPLE, TRS-80 KEYBOARD, EXIDY, AND ALL OTHER 16K DYNAMIC SYSTEMS USING MK4116-3 OR EQUIVALENT DEVICES.

- ★ 200 NSEC ACCESS, 375 NSEC CYCLE
- ★ BURNED-IN AND FULLY TESTED
- ★ 1 YR. PARTS REPLACEMENT GUARANTEE
- ★ QTY. DISCOUNTS AVAILABLE



#### VISTA V-200 MINI-FLOPPY SYSTEM

- ★ S100 DOUBLE DENSITY CONTROLLER
  - ★ 204 KBYTE CAPACITY FLOPPY DISK DRIVE WITH CASE & POWER SUPPLY
  - ★ MODIFIED CPM OPERATING SYSTEM WITH EXTENDED BASIC
- \$695.00**

**BETA**  
COMPUTER DEVICES

1230 W. COLLINS AVE.  
ORANGE, CA 92668  
(714) 633-7280

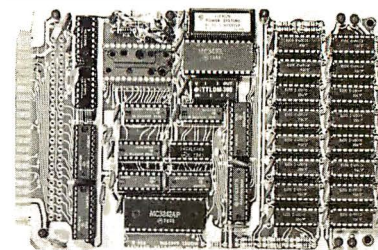
Calif. residents please add 6% sales tax. Mastercharge & Visa accepted. Please allow 14 days for checks to clear bank. Phone orders welcome. Shipping charges will be added to all shipments.

#### 32K BYTE MEMORY

RELIABLE/COST EFFECTIVE EXPANDABLE RAM FOR 6502 AND 6800 SYSTEM—AIM 65-KIM\*SYM\*PET\*S44-BUS

- ★ PLUG COMPATIBLE WITH THE AIM-65/SYM EXPANSION CONNECTOR BY USING A RIGHT ANGLE CONNECTOR (SUPPLIED) MOUNTED ON THE BACK OF THE MEMORY BOARD.
- ★ MEMORY BOARD EDGE CONNECTOR PLUGS INTO THE 6800 S 44 BUS.
- ★ CONNECTS TO PET OR KIM USING AN ADAPTOR CABLE.
- ★ RELIABLE—DYNAMIC RAM WITH ON BOARD INVISIBLE REFRESH—LOOKS LIKE STATIC MEMORY BUT AT LOWER COST AND A FRACTION OF THE POWER REQUIRED FOR STATIC BOARDS.
- ★ USES +5V ONLY, SUPPLIED FROM HOST COMPUTER.
- ★ FULL DOCUMENTATION. ASSEMBLED AND TESTED BOARDS ARE GUARANTEED FOR ONE YEAR AND PURCHASE PRICE IS FULLY REFUNDABLE IF BOARD IS RETURNED UNDAMAGED WITHIN 14 DAYS.

ASSEMBLED WITH 32K RAM	\$395.00
& WITH 16K RAM	\$339.00
TESTED WITHOUT RAM CHIPS	\$279.00
HARD TO GET PARTS (NO RAM CHIPS)	
WITH BOARD AND MANUAL	\$109.00
BARE BOARD & MANUAL	\$49.00



PET INTERFACE KIT—CONNECTS THE 32K RAM BOARD TO A 4K OR 8K PET. CONTAINS: INTERFACE CABLE, BOARD STANDOFFS, POWER SUPPLY MODIFICATION KIT AND COMPLETE INSTRUCTIONS. . . . \$49.00

U.S. PRICES ONLY



## NEW LOCATION

1198 E. Willow Street  
Signal Hill, CA 90806

Toll Free (800) 421-7701 Outside Calif.  
(213) 595-6431 Inside Calif.

### ATARI 800 (NEW 16K VERSION)

- COMPUTER CONSOLE • OPERATORS MANUAL
- ATARI BASIC 8K RAM • RF MODULATOR
- 57 FULL STROKE • POWER SUPPLY
- ALPHANUMERIC KEYS • ADDED OPTIONS
- PLUS 4 FUNCTION KEYS • JOYSTICKS
- INVITATION TO PRO • EDUCATION ROM
- GRAMMING CASSETTE (NO CHARGE)

CALL FOR PRICE

10% OFF SOFTWARE WITH PURCHASE

### ATARI OPTIONAL ACCESSORIES

- MODEL #810 DISK DRIVE SYSTEM
- MODEL #820 40-COL. DOT MATRIX PRINTER
- MODEL #822 40-COL. THERMAL PRINTER
- MODEL #825 80-COL. DOT MATRIX PRINTER
- MODEL #830 ACOUSTIC MODEM
- MODEL #850 INTERFACE MODULE
- MODEL #CX853 16K RAM MODULE

CALL FOR PRICE & AVAILABILITY

### ORDERING INFO

Name, address, phone,  
Ship By: UPS or Mail  
Shipping Chrg. Add \$2.50 up to  
5 lbs. (UPS Blue)  
U.S. Mail Add \$1.50 (U.S. Only)  
(\$25.00 Minimum Order)

### ATARI SOFTWARE & ACCESSORIES

- BASKETBALL ROM \$30.00
- SUPER BREAKOUT ROM \$30.00
- STAR RAIDERS ROM \$45.00
- CHESS ROM \$30.00
- VIDEO EASEL ROM \$30.00
- MUSIC COMPOSER ROM \$45.00
- 3D TIC TAC TOE ROM \$30.00
- JOYSTICKS \$18.00
- PADDLE CONTROLS \$18.00
- #410 CASSETTE RECORDER \$60.00

ASK ABOUT NEW SOFTWARE

### TERMS

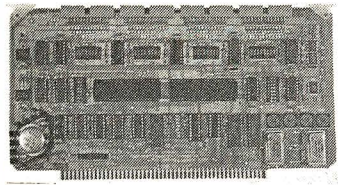
We Accept Cash, Check, Money  
Orders, Visa & Master Charge  
(U.S. Funds Only)  
Tax: 6% Calif. Res.  
COD's & Terms Available on  
Approval (School PO's Accepted)

### SPECIAL OF MONTH

**4116's** (200 NS)  
(APPLE, TRS-80, HEATH, ETC.)

**8 for \$30.00**

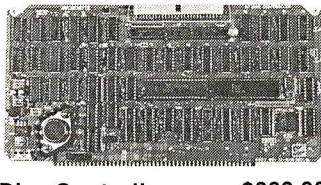
- 16-49 pcs. 3.60
- 50-99 pcs. 3.40
- 100-499 pcs. 3.25
- 500 Up 2.95



**I/O Board** \$289.00  
Assembled & Tested

#### MICROBYTE

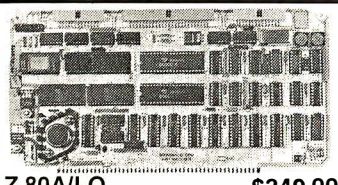
- Quad RS-232C Serial Ports, One 20mA Current Loop Port
- Fully IEEE S-100 Bus Compatible
- Asynchronous Communications with 280A DART/Mini; Synchronous Communications with 280A SIO/DTU
- Full Set of Modem Control Signals, including RI (Ring Indicator)
- Easily Configurable to Any Type of Terminal Interface
- I/O Servicing Environments:
  - (1) Poled; (2) Bus Vector; (3) 280 Mode 2 Vector
- Off Board Interrupt Daisy Chain Capability
- Special Receive Conditions:
  - (1) Framing Error; (2) Parity Error; (3) Receiver Overrun Error
- Baud Rates Selected Individually from 50 Baud to 300K Baud
- 72 Hour Burn-In



**Disc Controller** \$389.00  
Assembled & Tested

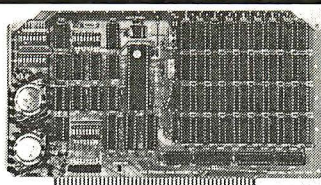
#### MICROBYTE

- DMA to within 16M byte of memory
- State of the art 16C705 LSI Controller
- IEEE S-100 compatible
- DMA arbitration allows use of multiple boards within a system
- PLL data recovery for totally reliable operation
- Write pre-comp switched at mid-disc for double density operation
- Supports up to four (4) drives
- Power On, Power Off or Reset de-selects to avoid damage to drives not in use
- Single or double sided operation
- Single density/double density operation
- 8" standard drives
- Separate VCC supply for data recovery to eliminate possible noise problems



**Z-80A/I/O** \$349.00  
Assembled & Tested  
Optional Monitor Program \$50.00

- A complete single board Z80A CPU with serial/parallel interface
- Fully compatible with the proposed IEEE S-100 Bus Standard
- 280A CPU (4MHz version of the Z80)
- 158 instructions—Superset of and upward compatible from the 8080's 78 instructions
- Up to 16K on-board EPROM with optional 280 monitor program — (K12708, 2K12716 or 4K12732)
- Full vectored interrupt capability — 8 bit with MINI (1 bit)
- 2MHz or 4MHz operation is jumper selectable
- Selectable auto-wait state insertion for extending M1\*, MREQ\*, I/O\*, and/or on-board ROM
- Dual RS-232 serial I/O ports using the 280A-DART with individual baud rate selection (from 50-19,200 baud)
- Up to 24 bit parallel I/O port—fully programmable Intel 8255A



**64K RAM Board**  
Assembled & Tested Call for Price

#### MICROBYTE

- Fully S-100 bus compatible
- 64K x 8 bit dynamic RAM
- Low power:
  - +5VDC @ 700 ma
  - +16VDC @ 100 ma
  - 16VDC @ 25 ma
- Built-in parity with LED indicator and vector interrupt
- Memory addressable in four 16K banks
- Hidden refresh
- Gold contacts for high reliability
- 72-hour Burn-In
- Memory mapped via DIP switch
- Built-in programmable write-protect
- Programmable control port for parity and bank control
- Alpha-Micro Compatible

### MICROPROCESSORS

- 8080A ..... 2.50
- Z80A ..... 10.00
- Z80 CTC ..... 8.95

### REGULATORS

- 320T5 ..... .80
- 320T12 ..... .80
- 340T5 ..... .70
- 340T12 ..... .75
- 78L12 ..... .25

### LO-PRO SOCKETS

- |        | 1-99 | 100 Up |
|--------|------|--------|
| 14 PIN | .10  | .09    |
| 16 PIN | .12  | .11    |
| 18 PIN | .15  | .13    |
| 20 PIN | .23  | .21    |
| 24 PIN | .26  | .24    |
| 28 PIN | .30  | .28    |
| 40 PIN | .40  | .38    |
- (BURNDY/TIN SOLDER TAIL)

### RS-232 CONNECTORS

- |                 | 1-9  | 10-24 | 25 Up |
|-----------------|------|-------|-------|
| DB25P           | 2.90 | 2.75  | 2.40  |
| DB25S           | 3.80 | 3.70  | 3.60  |
| Data Phone Hood | 1.25 |       |       |

### COMPONENTS

- 74LS240 ..... 1.35 ea.
- 74LS241 ..... 1.25 ea.
- 74LS244 ..... 1.25 ea.
- 74LS373 ..... 1.50 ea.
- 74LS374 ..... 1.50 ea.
- 8T245 ..... 1.65 ea.

### 2114 L-2/200 NS

- 1-16 \$3.85 ea.
- 17-49 \$3.65 ea.
- 50-99 \$3.40 ea.
- 100-499 \$3.15 ea.
- 500 Up \$2.95 ea.

### 2708/450 NS

- \$5.95 ea.
- or
- 8/\$44.00

### 2716/5 VOLT

- \$10.00 ea.
- 450 NS./Major Mfg.

### CAPACITORS

- .1 @ 12 Volts Ceramic 9¢ ea.
- OR
- 100/8.00

### S.D. SYSTEMS

- EXPANDORAM I**
  - 16K \$249.00
  - 32K \$275.00
  - RAM BOARD 48K \$299.00
  - KITS 64K \$325.00
- EXPANDORAM II**
  - 16K \$260.00
  - 4 MHz DYNAMIC 32K \$285.00
  - RAM BOARD 48K \$310.00
  - KITS 64K \$335.00
- SBC-100 KIT** \$299.00  
2.5 MHz/Z-80 CPU  
WITH SERIAL & PARALLEL I/O PORTS
- SBC-200 KIT** \$325.00  
4 MHz/Z-80 CPU  
WITH SERIAL & PARALLEL I/O PORTS
- VDB-8024 KIT** \$380.00  
80x24 I/O MAPPED VIDEO BOARD  
WITH KEYBOARD I/O

### S-100 PRODUCTS

- VERSAFLOPPY I KIT** \$250.00  
DISK CONTROLLER FOR  
8" & 5 1/4" DRIVES  
S-100 BUS COMPATIBLE
  - VERSAFLOPPY II KIT** \$350.00  
NEW DOUBLE DENSITY  
DISK CONTROLLER FOR  
8" & 5 1/4" DRIVES
  - PROM-100 KIT** \$210.00  
S-100/EPROM PROGRAMMER  
FOR 2708, 2716, 2732, 2758 &  
2516(TI)
- ALL BOARDS ARE AVAILABLE  
(ASSEMBLED & TESTED)  
CALL FOR PRICE & DELIVERY  
(SYSTEM SOFTWARE)  
AVAILABLE UPON REQUEST

### QUME DT-8 DISK DRIVE

- Double-sided/Single-Double Density
  - IBM-compatible/1.2 Mbytes/Disk
  - Fast — 3 ms. Track to Track
  - 154 Tracks/Daisy Chain 4 Drives
  - ISO Standard Write Protect
  - Programmable Door Lock
- CALL FOR PRICE & DELIVERY

### MICROBYTE D<sup>2</sup> FLOPPY DISK SYSTEM

- (2) QUME DT-8, DMA S-100 CONTROLLER, POWER SUPPLY, CABINET, ASSEMBLED & TESTED WITH CABLE.
- LESS CONTROLLER \$2095<sup>00</sup>

### MONITORS DISK DRIVES

- Leedex 100**  
12" B&W \$129.00
- Sanyo VM5012**  
12" B&W \$240.00
- Sanyo DMC 6013**  
13" Color \$450.00  
IN STOCK
- SA801R**  
SHUGART  
8" sgl.-sided  
sgl./dbl. density  
CALL FOR  
PRICE &  
DELIVERY

### CALIFORNIA COMPUTER SYSTEMS

- MODEL 2016 16K STATIC RAM BRD.
- 2032 32K STATIC RAM BRD.
- 2065 64K DYNAMIC RAM BD.
- 2116 16K STATIC RAM BD.
- 2200 MAINFRAME
- 2400 MINI-8100S
- 2422 DISK CONTROLLER
- 2501 MOTHERBOARD
- 2710 4-PORT SERIAL I/O
- 2718 2 SER. PORT & 2 PAR.
- 2720 4-PORT PARALLEL I/O
- 2802 6502 CPU BOARD
- 2810 Z-80 CPU BOARD
- 5400 MINI-8100
- 5416 THE-8100

CALL FOR PRICE  
& DELIVERY

(SOFTWARE AVAILABLE)

### APPLE SOFTWARE

- BY EDU-WARE
- COMPU-MATH (FRACTIONS) \$29.95
- COMPU-MATH (DECIMALS) \$29.95
- COMPU-READ \$19.95
- EDU-PAK I, CONTAINS  
COMPU-READ, PERCEPTION  
STATISTICS \$35.00

### ENTERTAINMENT

- TERRORIST \$24.95
- WINDFALL \$16.95
- NETWORK \$16.95
- SPACE \$24.95
- PRISONER \$24.95

ALL SOFTWARE IS ON DISK.  
PLEASE CALL IF YOU  
HAVE ANY QUESTIONS.

### PRINTERS

- CENTRONICS 737-1
- ANADIX DP8000
- ANADIX DP9500
- ANADIX DP9501
- TEXAS INST 810
- BASE 2 800 MST

CALL FOR  
PRICE  
&  
DELIVERY

### DISKETTES

- |                        | Part #   | Price<br>Box of 10 |
|------------------------|----------|--------------------|
| Verbatim 5 1/4" (soft) | MD525-01 | \$26.50            |
| Scotch 5 1/4" (soft)   | 744-0    | \$33.00            |
| Scotch 5 1/4" (10-sec) | 744-10   | \$33.00            |
| Scotch 5 1/4" (16-sec) | 744-16   | \$33.00            |
| Memorex 5 1/4" (soft)  | 3421     | \$24.00            |
| Scotch 8" DS (soft)    | 743-0    | \$49.95            |

### MODEMS

- NOVATION CAT  
300 BAUD, AUTO  
ANSWER/ACOUSTIC  
\$149.00 ea.
- NOVATION D-CAT  
300 BAUD/DIRECT  
CONNECT  
\$169.00 ea.  
(OPTIONAL RS232  
CABLE \$22.00)
- LIVERMORE  
LIV-STAR 20M/300 BAUD  
RS232, ACOUSTIC,  
AUTO ANSWER, ETC.  
\$159.00

screen with equal intensities in every cell.

One of the first things that you should discover when experimenting with 2DFT is that the absolute location of a picture on the screen doesn't matter. Shifting a picture changes the phases of the sines and cosines that go into making that image, but it does not change the amplitude of the frequency spectrum of that picture. Because only the amplitude and not the phase is displayed, two pictures which differ only by some shift should give the same transforms. (This insensitivity to shifts is one reason for the usefulness of Fourier transforms in pattern-recognition problems!)

Another thing to notice about 2DFT is the relative overall intensity of a picture and its transform. This intensity, of course, is somewhat arbitrary, since by multiplying each element of the transform's sine table by some constant, the whole transformed picture gets multiplied by the square of that constant. (The constant shows up squared because the sine table is used two times, once to transform the rows and once for the columns.)

If none of the transformed image was lost because of the nonsquare screen, it would be possible to adjust the constant that multiplies the sine table so that the sum of the squares of the pixels *before* a transform equals

the sum of the squares *after* transforming. The multiplier is  $1/\text{SQR}(L)$ , where  $L$  is the length of a side of the square screen.

In my implementation of 2DFT, I tried multiplying every element of the sine table by  $1/\text{SQR}(32)$  and have found it to work well. Thirty-two is a reasonable mean value between the length of a row and the length of a column. The exact choice of the constant isn't critical unless you want to be able to read off quantitative mathematical transformation results. For experimental purposes, any value that keeps the picture elements from growing too bright or too dim is acceptable.

An obvious quality of the transfor-

# INTRODUCING 24-HOUR

When you need a program and you need it yesterday, call The Software Express Service.



Where can you get the most-wanted micro-computer programs? How can

you tell which ones are best for you? How can you get instant service on programs for word processing, accounting, budgeting, engineering, inventory control, patient management... and more?

## Call The Software Express Hotline.

You can place an order right now. Simply dial-up Westico's 24-hour computer (300 baud). Ask for a quick review of program descriptions and place your order immediately.

We're a new, high speed service staffed with technical experts who can provide programs for individuals and companies who are serious about the business of microcomputing. After you've acquired your program, our technical service and support team will remain just a phone call away.

We do your searching for you.

You could lose valuable time

searching for programs and still not find the one that's right for your particular needs. Or, you can order the perfect program from The Software Express Service. We've tried and tested hundreds of programs. We have what will work for you — whether you're a doctor, lawyer, accountant, engineer, scientist, surveyor, store owner, manufacturer, dealer, consultant or programmer.

## 24-Hour Software Express Service.

Take advantage of Westico's 24-Hour Software Express Service to any town or city covered by Federal Express, U.S. Express Mail, or other 24-hour delivery service. Simply dial-up our computer, call us or send a Telex and your program will be sped to you overnight. For regular service, you'll receive your program promptly by UPS. In the age of the computer, it shouldn't take ages to get what you want.

**WESTICO**  
**The Software Express Service**

25 Van Zant Street • Norwalk, Connecticut 06855  
(203) 853-6880

mations produced by 2DFT is that they are symmetric about a cell near the center of the video screen. The cell around which everything seems to revolve is the (0,0) cell, the center of the frequency domain. It contains the sum of all of the cells in the untransformed picture multiplied by any factors that were chosen for the sine table. It's also the cell which is most likely to suffer from an overflow problem because all of the pixels in each original image were positive numbers and add together to make a large zero-frequency total. (2DFT displays overflows as a character of maximum brightness, for the number 255.) The rest of the transformed image is symmetric

about the central cell, in the sense that each cell contains the same number as the cell an equal distance away on the opposite side of the middle.

This follows mathematically from the fact that the original image was entirely real, with no imaginary (complex-number) part. You can think of it as just a convention, if you like; to avoid sharp edges which might cut off parts of a picture, we have plotted "negative frequencies" as if they had the same energy as the corresponding positive frequencies.

It works out then that you can think of the opposite edges of the screen as being joined, so that something moving off the screen at

the right-hand side comes in automatically at the left edge. (Between the top and bottom edges, there are 15 unseen lines, however, in order to make the imaginary screen square.) Because there are an even number of columns, one column on each side of the central (zero) column is not duplicated. That column is plotted as the rightmost one on the screen.

It's a good idea to take some time now to draw pictures on the screen, transform them, and try to develop some instincts about what the transforms tend to look like. Many of the results from one-dimensional Fourier analysis carry over to two dimensions. For example, we noted that an

# SOFTWARE EXPRESS SERVICE.

**CP/M™ programs for TRS-80 Model II, Vector Graphic, iCom, Cromemco, North Star, Micropolis, Ohio Scientific and more.**

	Software & Manual	Manual alone*	System Require- ments
<b>ACCOUNTING</b>			
GENERAL LEDGER <i>Peachtree</i>	\$550	\$40	A,D,I,L
ACCOUNTS RECEIVABLE <i>Peachtree</i>	550	40	A,D,I,L
ACCOUNTS PAYABLE <i>Peachtree</i>	550	40	A,D,I,L
INVENTORY CONTROL <i>Peachtree</i>	650	40	A,D,I,L
PAYROLL <i>Peachtree</i>	550	40	A,D,I,L
CLIENT WRITE-UP <i>Peachtree</i>	990	40	A,D,I,L
PAS-3 MEDICAL <i>Artificial Int.</i>	500	40	A,C,I
PAS-3 DENTAL <i>Artificial Int.</i>	500	40	A,C,I
PROPERTY MANAGEMENT <i>Peachtree</i>	990	40	A,D,I,L

<b>PROFESSIONAL TIME ACCOUNTING</b>			
PTA <i>Asyst Design</i>	595	40	A,C,I
ESQ-1 Legal <i>Micro Info.</i>	1495	50	A,C,I,L
ESQ-1 Legal Demo <i>Micro Info.</i>	75	50	A,C,I,L
DATEBOOK <i>Organic</i>	295	25	A,I,O

<b>TEXT PROCESSING</b>			
WORDMASTER <i>MicroPro</i>	145	25	A,K,L
WORDSTAR <i>MicroPro</i>	450	40	A,F,K,L
WORDSTAR MAIL-MERGE <i>MicroPro</i>	575	40	A,F,K,L
WORDSEARCH <i>Keybits</i>	195	40	A,F
TEXTWRITER <i>Organic</i>	125	20	A,F

<b>PLANNING &amp; ANALYSIS</b>			
MINIMODEL <i>Financial Plan.</i>	495	50	A,C,I,L
STATPAK <i>NW Analytical</i>	500	40	A,D,I

<b>TELECOMMUNICATIONS</b>			
ASCOM <i>DMA</i>	125	10	A,T

<b>DATA MANAGEMENT</b>			
CBS <i>DMA</i>	395	40	A,F,K
MAGSAM IV <i>Micro Appl.</i>	295	25	A,C,F,K
SELECTOR IV <i>Micro Ap, Inc.</i>	395	25	A,C,G,K
PRISM/IMS <i>Micro Appl.</i>	495	55	A,C,F,K

<b>DEVELOPMENT TOOLS</b>			
BASIC-80 <i>Microsoft</i>	325	25	A,F,L
BASIC COMPILER <i>Microsoft</i>	350	25	A,F,L
S-BASIC <i>Micro Ap, Inc.</i>	295	25	A,F
NEVADA COBOL <i>Ellis</i>	150	25	A
PL/I-80 <i>Digital Research</i>	500	35	B,F,L,P
CBASIC <i>Compiler Systems</i>	120	15	A
PASCAL/M <i>Sorcim</i>	175	20	A,G
PASCAL/MT+ <i>MT Microsys. terms</i>	250	30	A

	Software & Manual	Manual alone*	System Require- ments
<b>MISCELLANEOUS</b>			
SUPERSORT I <i>MicroPro</i>	\$225	\$25	A,L
SURVEYOR <i>Peachtree</i>	550	40	A,D,I,L

## SYSTEM REQUIREMENT CODES

All software has specific requirements for proper operation such as computer type, equipment configuration and support software.

Check the following codes for system requirements to be certain your system will accept the software offered.

- (A) CP/M version 1.4 or higher.
- (B) CP/M version 2.0 or higher.
- (C) CBASIC-2.
- (D) MBASIC version 4.51.
- (E) BASIC-80 version 5.0 or higher.
- (F) 48K memory or greater.
- (G) 56K memory or greater.
- (H) 64K memory.
- (I) Business system: 48K memory, 200K dual disk drives, cursor addressable terminal, and 132 column printer.
- (K) Cursor addressable terminal.
- (L) signed license required for shipment.
- (O) specify 8080, Z80, or CDOS.
- (P) give CP/M serial number.
- (T) serial port and modem.
- (Z) Z80 CPU.

## HOW TO ORDER

Choose any of 4 ways to order:

- Write Westico, Inc., 25 Van Zant Street, Norwalk, CT 06855.
- Call (203) 853-6880.
- Telex 643-788.
- Dial-up our 24-hour computer (300 baud) (203) 853-0816.

Specify prepaid, C.O.D., Master Charge, or VISA. (Please give credit card number and expiration date.)

Specify disk format: North Star Single or Double, Micropolis Mod I or Mod II; 8" single density, or Ohio Scientific.

Prices do not include shipping and C.O.D. In CT add 7 1/2% sales tax.

\*Manual price will be credited against later purchase of software.

CP/M is a trademark of Digital Research.

Z80 is a trademark of Zilog, Inc.

PASCAL/M is a trademark of Sorcim.

PASCAL/MT+ is a trademark of MT Micro Systems.

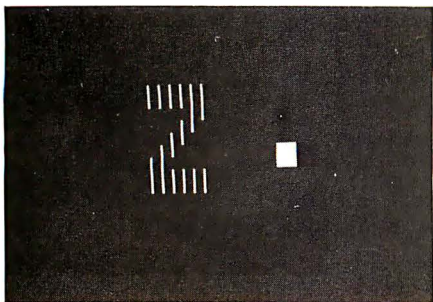
PEACHTREE is a trademark of Retail Sciences, Inc.

S-BASIC is a trademark of Topaz Computing.

SELECTOR IV is a trademark of Micro-Ap, Inc.

Copyright © 1981 Westico, Inc.

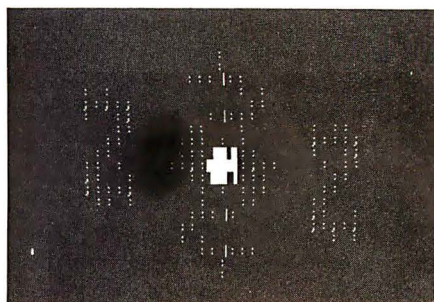
(2a)



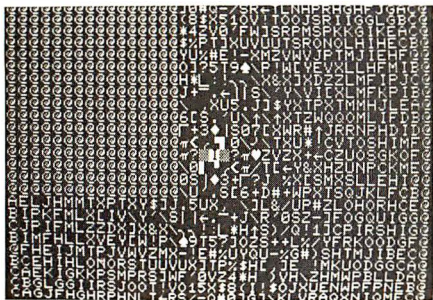
(2b)



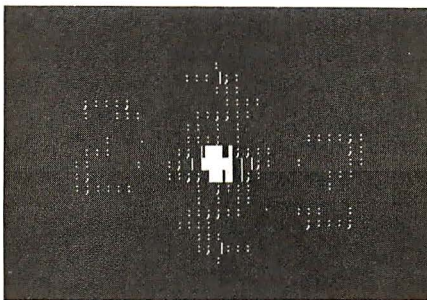
(2c)



(2d)



(2e)



**Photo 2:** This sequence illustrates some of the properties of the holographic transformations as done by the 2DFT program. Photo 2b is the hologram produced from the simple image in 2a. In 2c, the image is reconstructed from the hologram. Note the mirror duplication of the original image and the spreading of the reference spot due to the cut-off of high vertical frequencies by 2DFT's algorithm. A substantial portion of the hologram is zeroed in photo 2d (indicated by the @ symbol), giving the reconstructed image in photo 2e. This reconstruction is fainter and "noisier" than photo 2c, but no part of the overall image is missing.

image with very fine detail (sharp spikes or narrow lines) in one dimension requires many high-frequency sinusoidal waves to define it; the same is true for two-dimensional pictures. A picture that repeats only a few times across the screen width will have strong low-frequency components in it (components that show up in frequency space near the central zero-frequency cell), while a picture that repeats many times across the screen will have strong components at the higher frequency of repetition. (In your experiments, don't forget

that you're not seeing the highest vertical frequencies, which fall outside the screen's height.)

You should realize that even though the program uses horizontal and vertical axes to do the mathematical transform, those axes are artificial and not part of the initial or final picture. So, if you're looking at an image which has strong structure trending along a line from northwest to southeast, feel free to tilt your head and define your own personal axes in such a way as to make the image and its transform easier to think about.

### Holography and Very-Long-Baseline Interferometry

One of the most exciting and valuable developments of technology in the past thirty years has been that of holography. *Holograms* can store information at densities far greater than normal photography, and with far better immunity to noise and loss of data from scratches, dust, etc on the film. An equally exciting develop-

## HARDWORKING SOFTWARE DISSAX/TXTBOOK/FRMFLEX

**HARDWORKING**

**DISSAX/** A cunning, two-pass Z80 disassembler that produces print output and directly assembleable source output from COM files or memory blocks. **DISSAX** is a sophisticated cross-referencing tool that puts references where they belong, as line comments, not in a separate output section. Requires 32K CP/M. Manual \$5 / Object \$75 / Source \$150.

**TXTBOOK/** Formatting software for document preparation, technical and theses presentation, plus mass mailings. You and **TXTBOOK** are in total control of pagination, margination, and titling, with choice of several footnote styles, automatic table of contents generation, easy insertion of text from external files, and more. Requires 32K CP/M and CBASIC2. Manual \$15 / Object \$100 / Source \$200.

**FRMFLEX/** Three programs that create a series of fixed and/or editable fields with separate CRT input and printer output formats. Thus, your pesky business forms and unusual tabular formats are filled precisely and automatically with simple linear entry of data! The only system of its kind, with unlimited application, **FRMFLEX** allows complete filled/unfilled forms entry, updating, editing, and creative flexibility. Requires 32K CP/M CBASIC2 and CRT with addressable cursor. Manual \$20 / Object \$175 / Source \$350.

CBASIC2 is a trademark of Compiler Systems, Inc.

Manual prices applicable to purchase of software.

Delivered by CEEXEC on 8" single density soft sector disks.



Discount for purchase of all three programs.  
Manual \$30 / Object \$300 / Source \$600

California residents add 6 1/2 % sales tax.

Response guaranteed to all inquiries concerning application to mini/main frame computers.

CP/M is a registered trademark of Digital Research



San Francisco INC.

211 Sutter Street, Suite 300. S.F. 94108. 415-981-4724

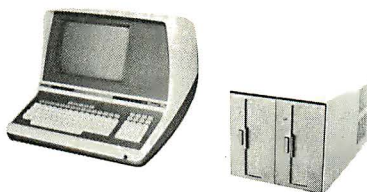
# Configurability...

**64K MINI**



**(8 SLOT S-100)  
SINGLE USER**

**64K TWIN MINI + 10M 5 1/4 HD**



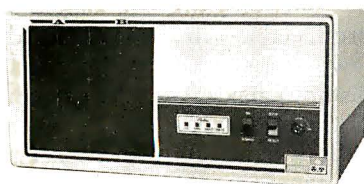
**(8 SLOT S-100)  
DRIVE EXPANSION**

**DUAL PROCESSOR**



**LINKED USERS**

**64K - 1 & 2MB FLOP**



**CONVENTIONAL SINGLE USER**

**64K - 10MB - 1MB FLOP**



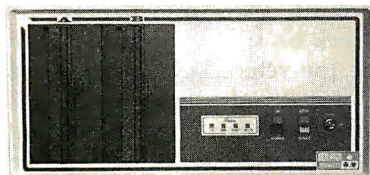
**SINGLE USER - HARD DISK**

**35MEG - 17MEG TAPE**



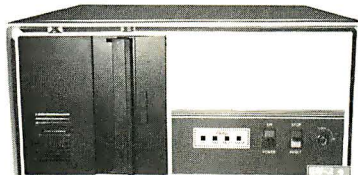
**SINGLE USER - LARGE DATA BASE**

**128K - 2MB - FLOP**



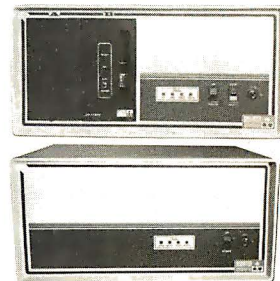
**TWO USER MP/M®**

**256K - 10MB - FLOP**



**2 - 4 USER MP/M®**

**35-70MEG - 17MEG TAPE**



**2 - 8 USER MP/M®**

**5X 64K - 10MB - 1MB FLOP**



**DRIVELESS SLAVE NETWORK**

**5X 64K - 35MEG - 17MEG TAPE**



**MINI DRIVE SLAVE NETWORK**

**35-150MEG - 17-75 MEG TAPE**



**16 USER NETWORK CP/NET®**  
with 8 Levels of Host Background Tasking

**...Means;**

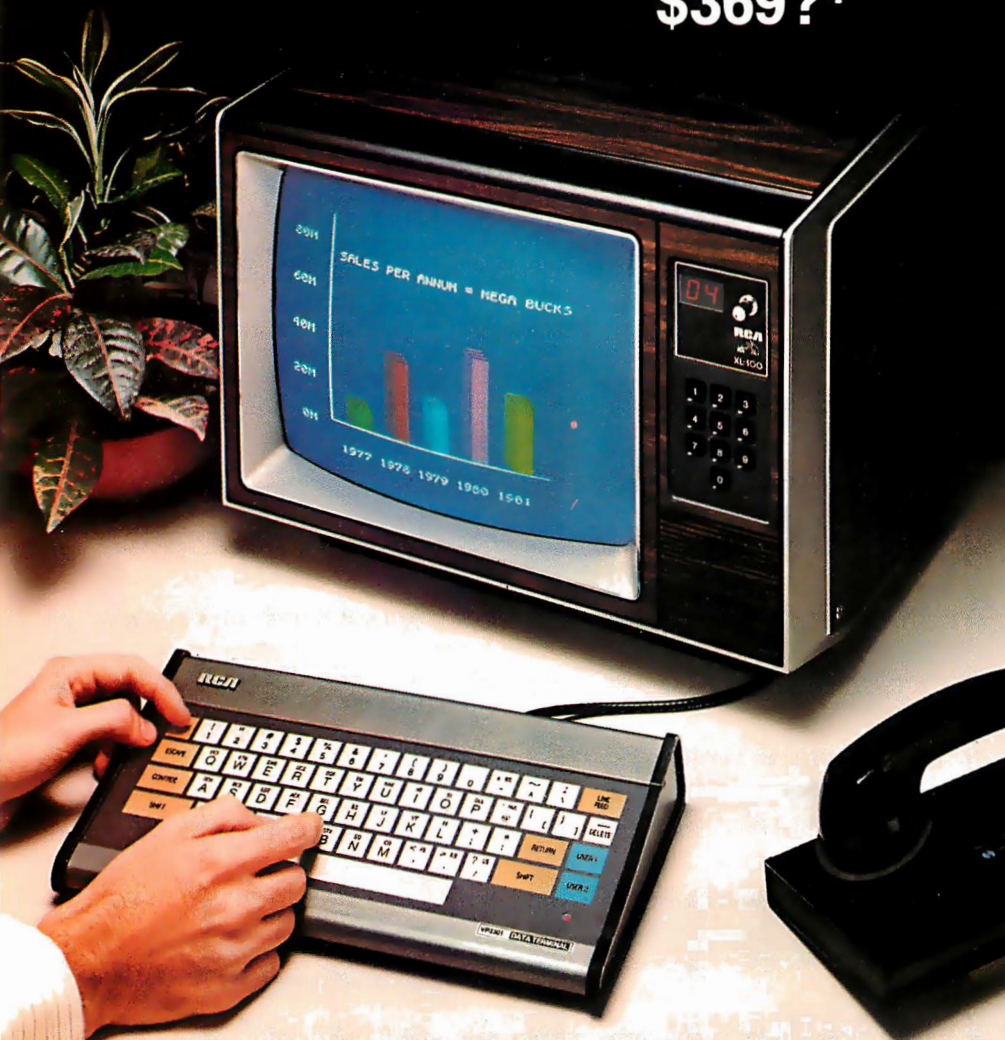
- ★ *More Add-On Sales,*
- ★ *Less Duplicate Inventory.*
- ★ *Less Hassle from the Competition,*
- ★ *More "Yes" Answers to your Customers.*

Emulation Available on ALL Systems:  
IBM3780, 2780, 3741, 2770 and  
IBM3270, 3271 and 3276,  
PDP-11, RSTS-E, TOPS  
on Deck 10 & 20  
and VAX

SOLD ONLY  
THRU DEALERSHIPS  
MP/M, & CP/NET ARE REG. TM OF DIGITAL RESEARCH INC.



# What can you honestly expect from an interactive data terminal that costs only \$369?\*



Well, to begin with, color graphics.

RCA's VP-3301 has unique color-locking circuitry that gives you sharp, jitter-free color graphics and rainbow-free characters.

Plus much more: Microprocessor control. Resident and programmable character set. Reverse video. State-of-the-art LSI video control. 20 and 40 character formats. RS232C and 20 mA current loop. Six baud rates. Eight data formats. ASCII encoding. Light-touch flexible-membrane key switches for reliability and long life. CMOS circuitry and a spill-proof, dust-proof keyboard for hostile environments.

The VP-3301 can be used with a 525-line color or monochrome monitor or a standard TV set through an RF modulator.\*\* It serves a wide variety of industrial, educational, business and individual applications including communication with time sharing and data base networks such as those provided by Dow Jones News/Retrieval Service, CompuServe and Source.

All this—for the low price of \$369. And it's made by RCA. So get the whole story about the surprising VP-3301 today. Write RCA MicroComputer Marketing, New Holland Avenue, Lancaster, PA 17604. Order toll-free: 800-233-0094.

ment in modern astronomy has been the discovery of what's called very-long-baseline interferometry, or VLBI. In a VLBI observation, radio telescopes thousands of kilometers apart look at the same object. The signals which they receive are combined, and by this combination, give a resolving power equal to that of a single telescope as large as the separation between receivers—a telescope as large as the Earth, in some cases!

Even working at wavelengths very long compared to optical light, VLBI techniques enable astronomers to see objects that are hundreds or thousands of times smaller than the largest optical telescopes can resolve. The vast increase in astronomical information-gathering capability has produced new insights during the last few years concerning the structure of distant galaxies and the early history of the universe.

Both holography and VLBI rely on the same secret: the two-dimensional Fourier transform. Using the 2DFT program presented here, it's easy to make and reconstruct one type of hologram, the "Fourier-transform hologram," which is most useful for storing and retrieving two-dimensional information. (Holograms to record three-dimensional objects work on similar principles. See some of the references for more information.) It's also easy to use this program package to experiment with and learn about some of the interferometry problems that radio astronomers face.

Briefly, the results of a very-long-baseline-interferometry observation consist of a map of the object in the sky—a map not in the usual sense, but of the frequency domain. As the Earth's rotation moves the radio-telescope antennas relative to the stars, the signals that the telescopes receive sample different points in the Fourier-transformed plane. With enough observations, using enough antennas, reasonably complete coverage of this transformed map can be achieved.

The big problem in VLBI is to deduce what the astronomical object looks like before transforming. If information about the relative phases of points in the frequency domain were available, it would be possible to unambiguously invert the observations and produce a picture of the object.

# RCA

\*\*Model VP-3303 with built-in RF modulator—\$389.

\*Suggested user price. Monitor and modem not included.  
Circle 119 on inquiry card.

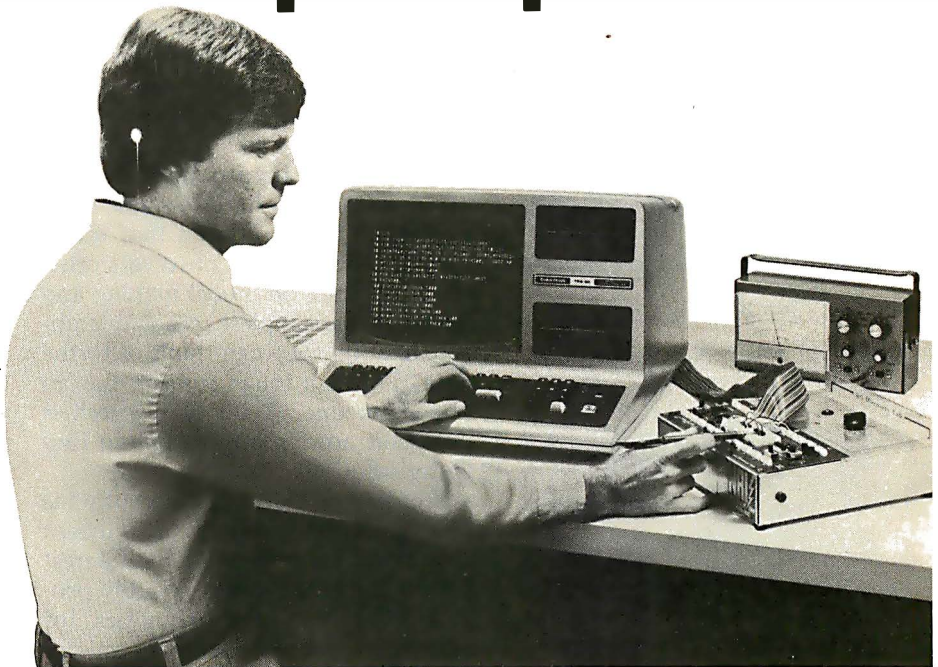
# Now NRI takes you inside the new TRS-80 Model III microcomputer to train you at home as the new breed of computer specialist!

**NRI teams up with Radio Shack advanced technology to teach you how to use, program and service state-of-the-art microcomputers...**

It's no longer enough to be just a programmer or a technician. With microcomputers moving into the fabric of our lives (over 200,000 of the TRS-80™ alone have been sold), interdisciplinary skills are demanded. And NRI can prepare you with the first course of its kind, covering the complete world of the microcomputer.

## **Learn At Home in Your Spare Time**

With NRI training, the programmer gains practical knowledge of hardware, enabling him to design simpler, more effective programs. And, with advanced programming skills, the techni-



cian can test and debug systems quickly and easily.

Only NRI gives you both kinds of training with the convenience of home study. No classroom pressures, no night school, no gasoline wasted. You learn at your convenience, at your own pace. Yet you're always backed by the NRI staff and your instructor, answering questions, giving you guidance, and available for special help if you need it.

## **You Get Your Own Computer to Learn On and Keep**

NRI training is hands-on training, with practical experiments and demonstrations as the very foundation of your knowledge. You don't just program your computer, you introduce and correct faults...watch how circuits interact...interface with other systems...gain a real insight into its nature.

You also build test instruments and the NRI Discovery Lab, performing over 60 separate experiments in the process. You learn how your trouble-shooting tools work, and gain greater understanding of

the information they give you. Both microcomputer and equipment come as part of your training for you to use and keep.

## **Send for Free Catalog... No Salesman Will Call**

Get all the details on this exciting course in NRI's free, 100-page catalog. It shows all equipment, lesson outlines, and facts on other electronics courses such as Complete Communications with CB, TV and Audio, Digital Electronics, and more. Send today, no salesman will ever bother you. Keep up with the latest technology as you learn on the latest model of the world's most popular computer. If card has been used, write to:



**Training includes new TRS-80 Model III microcomputer, solid state volt-ohm meter, digital frequency counter, and the NRI Discovery Lab with hundreds of tests and experiments.**

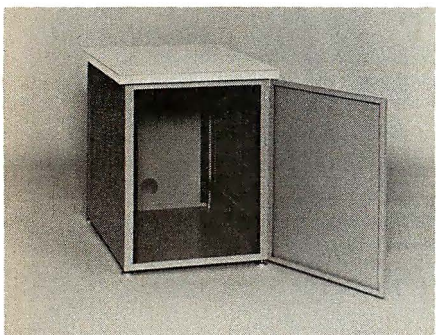
(TRS-80 is a trademark of the Radio Shack division of Tandy Corp.)



## **NRI Schools**

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

# GET IT OFF THE FLOOR



Now that you have a shiny new computer terminal, what are you going to put it on? Computer Furniture and Accessories makes a variety of furniture for a wide range of computer applications. In combinations of six widths, three depths, and three heights. With "L" shaped returns, Micro shelves, data shelves, RETMA mounting, and printer stands. With optional drawers, doors, CRT turntables, and casters. Sizes, shapes and colors designed to fit your office or computer room environment. Reasonably priced and shipped from stock.

Call CF&A. We'll get your system up where you can really put it to use.

## CF&A

**Computer Furniture and  
Accessories, Inc.**  
1441 West 132nd Street  
Gardena, CA 90249  
(213) 327-7710

## The secret of holography and its sophisticated ability to retain information is the two-dimensional Fourier transform.

Unfortunately, VLBI can't (as of today) produce enough phase information. The astronomers have to look at an image in Fourier-transformed space which contains only amplitude information, just like the image that the 2DFT program produces. In some cases, it's not too hard to guess what the object that produced that transform looked like, but observers often must fall back on model making and try to fit the simplest reasonable approximation they can think of to the data. This is a tough subject, but an important one. A lot of research is going on now in an attempt to find better solutions.

Fourier-transform holography is also a subject for vigorous current research. One reason for the interest is that holograms could possibly provide huge, ultra-fast memories for computer systems. Ordinary microfilm is a very inefficient way to record data. It fails to take advantage of the information-storage ability of high-resolution photographic film, and if the bit density is pushed up, the microfilm technique becomes unacceptably vulnerable to film defects, dust particles, etc. Conventional photographic methods are too highly localized for each bit that is written—it's like trying to transmit information over a noisy phone line without a decent error-detection and correction code!

A hologram, on the other hand, shares many of the best properties of sophisticated error-preventing techniques. Each bit of the original record is spread out over the entire holographic image. A speck of dust can't clobber a particular bit; all it can do is add a slight overall noise to the recovered analog signal, and even that noise can be entirely removed by a simple digitizing process. If half of a photograph is cut off and thrown away, half of the picture is lost forever. If half of a hologram is removed, the *whole* picture is still there! The sharpness of the picture is

reduced, but no particular region is lost at all.

How can a hologram work? Photographic film records only the intensity, not the phase, of the light that hits it. The secret is simple: put a phase reference into the original object that is being holographed! This phase reference is just a bright, pointlike spot in the original. When transformed, the bright spot by itself turns into a constant signal over the whole frequency versus space plane because (as mentioned above) a sharp spike is made up of equal amounts of sinusoids at all frequencies.

This constant background signal provides a reference against which the sines and cosines of the other parts of the original object can interfere, constructively and destructively. The background provides the reference phase; the rest of the Fourier-transformed image adds and subtracts relative to that background, and so an intensity recording (as on a photographic plate) includes enough phase information to allow the original image to be reconstructed.

The reconstruction algorithm is simple: just do another Fourier transform of the hologram to return to ordinary space! Mathematically, if phase information is recorded, the operation of Fourier transforming is its own inverse, like the operation of inverting is for numbers. The reconstructed image comes back twice, symmetrically situated about the central zero-frequency spike, but it's easy to mask off one of the two images if necessary.

The 2DFT program is quite capable of taking simple holograms and reconstructing them. Because the transformation is done on a 40 by 40 grid, but only the central 25 rows of forty elements are kept and displayed, some of the high vertical frequencies in the original image will be lost. (That explains the vertical spreading of some of the reconstructions, especially noticeable in the central region.) It's best not to try to recover images with too much fine detail. If the original is made of lines at least two cells thick, it usually comes back quite recognizably.

Note that the bright pointlike spot that provides the reference phase should be brighter than the rest of the original image being transformed; otherwise, the rest of the image tends to act as a (poor) reference phase for

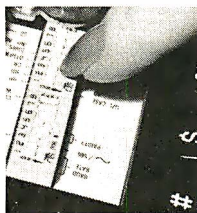
# The new 1421 by Hazeltine:

## It can wear many faces.



Looks can be deceiving. The new Hazeltine 1421 is more than a terminal — it's a Hazeltine terminal that does the work of three. The Hazeltine 1421 works with software designed for the Hazeltine 1420, the ADDS 580, or the Lear Siegler ADM-3A. You select the protocol you need with a convenient switch.

So, even if your software was designed to run with someone else's terminal, you can now enjoy the advantages of Hazeltine's



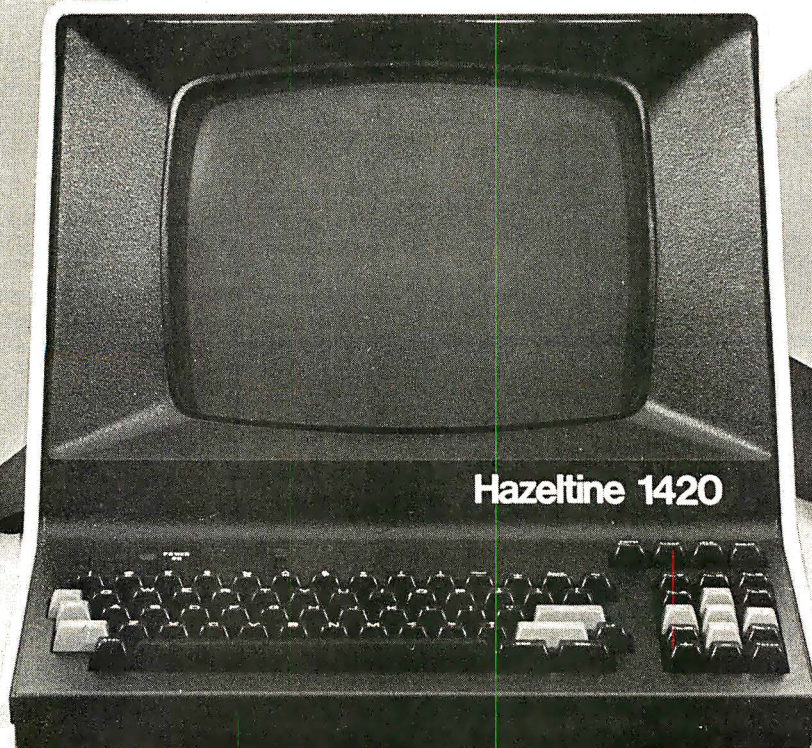
advanced features, newer technology, and the industry's most comprehensive, two-year warranty.

Getting to know the Hazeltine 1421 is easy. For the name of your nearest Hazeltine distributor, call toll-free (800) 645-5300. In New York State, call (212) 752-3377.

Hazeltine Corporation, Computer Terminal Equipment, Greenlawn, NY 11740 (516) 549-8800  
Telex: 96-1435

Hazeltine and the Pursuit of Excellence

**Hazeltine**  
Answers for the



# H & E COMPUTRONICS INC.

...EVERYTHING FOR YOUR TRS-80™...

\* TRS-80™ is a trademark of the Radio Shack Division of Tandy Corporation

*Currently Available*

## MOD-II PROGRAMS

★ All orders processed within 24-Hours

★ 30-Day money back guarantee on all TRSDOS Software

★ Add \$2.00 for shipping in UPS Areas

★ Add \$3.00 for C.O.D. or NON-UPS Areas

★ Add \$4.00 outside U.S.A., Canada & Mexico

★ We will match any bonafide advertised price in any of the Major Computer Magazines

ALL SOFTWARE

LISTED HERE

WORKS WITH TRSDOS\*

(1) **ELECTRIC PENCIL** (Michael Shrayor Software)... Complete word processor with extensive editing and printer formatting features...\$325 (STANDARD TRSDOS VERSION)...\$350 (DIABLO, NEC OR QUME TRSDOS VERSION).

(2) **GENERAL LEDGER, ACCOUNTS RECEIVABLE, ACCOUNTS PAYABLE, INVENTORY CONTROL, INVOICING AND PAYROLL** (Small Business Systems Group)...an extensive business system for the serious user...can be used one module at a time or as a coordinated system...\$225...per module...\$1299 for the complete system.

(3) **GENERAL LEDGER, ACCOUNTS RECEIVABLE, ACCOUNTS PAYABLE, INVENTORY CONTROL, AND PAYROLL** (Compumax)...a complete user oriented business system...can be used one module at a time or as a coordinated system...\$140 per module...\$995 for the complete system.

(4) **MOD-II UTILITY PACKAGE** (Racet Computers)...adds important utilities to TRSDOS...copy files selectively...faster and more accurate file copying...repair bad directories...displays sorted directory of all files on 1 to 4 disk drives...SUPERZAP...change disk ID...and more...\$150.

(5) **ADVENTURE #1-#9** (Scott Adams - Adventure International)...a series of games formally only available on the large computers...your goal is to work your way through a maze of obstacles in order to recover a secret treasure or complete a mission...the package includes all 9 Adventures written by Scott Adams...\$99.95.

(6) **GSF** (Racet Computers)...Generalized Subroutine Facility...a series of super fast machine language utilities that can be called from a BASIC program (no machine language knowledge required)...sorts 1000 items in under 5 seconds...allows PEEK and POKE statements...move data blocks...compress and uncompress data...works under TRSDOS...\$50.

(7) **DSM** (Racet Computers)...Disk Sort Merge...sorts and merges large multiple diskette files on a 1 to 4 drive system...NOT AN IN MEMORY SORT...can actually alphabetize (or any other type of sort) 4 disk drives worth of data...sorts one complete disk of information in 10 minutes...information is provided to use DSM with the RS MAILING PROGRAM...works under TRSDOS...\$150.

(8) **RSM** (Small Systems Software)...a machine language monitor and disassembler...can be used to see and modify memory or disk sectors...contains all the commands found on the Model-I version plus some additional commands for the MOD-II...works under TRSDOS...\$39.95.

(9) **BLINK BASIC LINK FACILITY** (Racet Computers)...Link from one BASIC program to another saving all variables...chain programs without losing variables...\$50.

(10) **BASIC CROSS REFERENCE UTILITY** (Racet Computers)...lists all variables and strings used in a program (with the line numbers in which they appear)...lists all GOTO's and GOSUB's (with the line numbers in which they appear)...searches for any specific variables or strings (with the line number in which they appear)...\$50.

(11) **DEVELOPMENT PACKAGE** (Racet Computers)...SUPERZAP (to see, print or change any byte on a diskette)...Disassembler and MOD-II interface to the

**MICROSOFT EDITOR ASSEMBLER PLUS** including uploading services and patches for Disk I/O...assemble directly into memory...save all or portions of source to disk...dynamic debug facility (ZBUG)...extended editor commands...\$125.

(12) **HARD/SOFT DISK SYSTEM** (Racet Computers)...The software essential to interface any of the popular large hard disk drives...completely compatible with your existing software and files...allows up to 20 megabytes of storage (and larger)...directory expandable to handle thousands of files...\$400.

(13) **CAMEO HARD DISK DRIVE CONTROLLER**...coming soon (November 1?)

(14) **HARD DISK DRIVES**...coming soon (Nov. 1?)

(15) **H & E COMPUTRONICS, INC. SHARE-A-PROGRAM DISKETTE #1**...works under TRSDOS...a collection of programs written by MOD-II owners...programs include data base management...a word processor...mail system...mortgage calculations...checkbook register...and many others...\$8 (add \$3 postage outside of the United States, Canada and Mexico)...FREE if you send us a diskette containing a program that can be added to the SHARE-A-PROGRAM DISKETTE.

(16) **WABASH CERTIFIED DISKETTES**...\$39.95 (per box of 10).

(17) **FLIP SORT DISKETTE STORAGE TRAY**...Stores 50 diskettes...comes complete with index-dividers, tilt plates and adjustable spacing...\$44.95.

(18) **MASTER PAC 100**...100 essential programs...BUSINESS...PERSONAL FINANCE...STATISTICS...MATH...GAMBLING...GAMES...includes 125 page manual and 2 diskettes...\$99.95.

(19) **BUSINESS PAC 100**...100 essential business programs...INVENTORY CONTROL...PAYROLL...BOOKKEEPING SYSTEM...STOCK CALCULATIONS...CHECKBOOK MAINTENANCE...ACCOUNTS RECEIVABLE...ACCOUNTS PAYABLE...includes 125 page manual and two diskettes...\$149.95.

(20) **EDITOR ASSEMBLER** (Galactic Software Ltd.)...the first user oriented Editor Assembler for the MODEL II and was designed to utilize all the features of the MODEL II. It includes innovative features for ease of coding and debugging and complete documentation (over 120 pages)...works under TRSDOS...\$229.00.

(21) **BASIC COMPILER** (Microsoft)...changes your source programs into machine language...increases program execution by 3-10 times...\$395.

(22) **MAIL/FILE SYSTEM** from Galactic Software Ltd. stores 2,500 names per disk. No sorting time is required since the file is automatically sorted by first and last name plus Zip Code on input. Retrieve by any combination of 19 user codes. Supports an 11 digit alphanumeric Zip. Supports a message line. Comes complete with user-oriented documentation (100-page manual). Allows for company name and individual of a company and complete phone number (and extension)...works under TRSDOS...\$199.00.

(23) **INCOME TAX PAC**...Professional income tax package...most forms and schedules...output to video or line printer...automatic memory storage of all information...data can be loaded from diskette, changed and edited...built in errorchecking...\$199.95.

(24) **COMPUTER GAMES** (SBSG)...Mean Checker Machine, Star-Trek III, Concentration, Treasure Hunt, Banco, Dog Star Adventure...\$74.95.

(1) **CP/M** (Lifeboat Associates)...an alternative operating system for the MOD-II that allows MOD-II owners to use any of the hundreds of programs available under CP/M...\$170.

(2) **CP/M HANDBOOK**... (Sybex)...a step-by-step guide to CP/M...takes the reader through each of the CP/M commands...numerous sample programs...practical hints...reference tables...\$13.95.

(3) **GENERAL LEDGER, ACCOUNTS RECEIVABLE, ACCOUNTS PAYABLE, INVENTORY CONTROL, AND PAYROLL** (Peachtree Software)...requires CP/M and MICROSOFT BASIC...professional business systems...turn key operation...can be used as single modules or as a coordinated system...\$500 per module...\$2500 for the complete system.

(4) **WORD-STAR**...The ultimate word processor...a menu driven word processing system that can be used with any printer. All standard word processing commands are included...plus many unique commands only found on WORD STAR...requires CP/M...\$495.

(5) **MAIL LIST MERGE**...An add on package that allows the user to send form letters (created on WORD-STAR) to any compiled mailing list (using any CP/M based MAIL program such as the PEACHTREE MAIL PROGRAM)...requires CP/M, WORD STAR and any CP/M based mail program...\$150.

(6) **SELECTOR III** (Micro-Ap)...complete data management system...user defined fields and codes...manages any list defined by the user...includes additional modules for simplified inventory control, accounts receivable and accounts payable...requires CBASIC-2...\$295.

(7) **SELECTOR IV** (Micro-Ap)...the ultimate data management system...all features use the SELECTOR III plus...data file format conversions...full page report formatter...computations...global search and replace...hard disk compatible...data/text merging...\$550.

(8) **GLECTOR** (Micro-Ap)...add on package to the SELECTOR...general ledger that allows the user to define a customized chart of accounts...\$350.

(9) **CBASIC-2**...a non-interactive BASIC used for many programs that run under CP/M...allows user to make more efficient use of disk files...eliminates the use of most line number references...require on such programs as the SELECTOR...\$120.

(10) **MICROSOFT BASIC**...an enhanced version of the MICROSOFT BASIC found on TRSDOS...adds commands such as chaining (allows the user to LOAD and RUN a new program without losing the variables currently in memory)...long variable length file records, WHILE/WEND and others...can be used with the BASIC COMPILER to speed up programs (3-10 times faster execution)...\$325.

(11) **MASTER TAX** (CPAids)...professional tax preparation program...prepares schedules, A, B, C, D, E, F, G, R/PP, SE, TC, ES and forms 2106, 2119, 2210, 3468, 3903, 2441, 4625, 4726, 4797, 4972, 5695 and 6521. Printing can be on readily available pre-printed continuous forms, on overlays, or on computer generated IRS approved forms. Maintains client history files...interactive with CP/Aids General Ledger...\$995.

(12) **GENERAL LEDGER II** (CPAids)...designed for CPA's...stores complete 12 month detailed history of transactions...generates financial statements, depreciation, loan amortizations, journals, trial balances, statements of changes in financial position, and compilation letters...includes payroll system with automating posting to general ledgers...prints payroll register, W2's and payroll checks...\$450.

(13) **ELECTRIC PENCIL** (Michael Shrayor Software)...Complete word processor with extensive editing and printer formatting features...\$275 (Standard printer version)...\$300 (DIABLO, NEC or QUME version).

(14) **BASIC COMPILER** (Microsoft)...changes your source programs into machine language...increases program execution by 3-10 times...\$395.

\* (CP/M IS A REGISTERED TRADEMARK OF DIGITAL RESEARCH)

ALL PROGRAMS

LISTED HERE

REQUIRE CP/M\*

COMPUTRONICS  
MATHEMATICAL APPLICATIONS SERVICE™

50 N. PASCACK ROAD  
SPRING VALLEY, NEW YORK 10977



24 HOUR  
ORDER  
LINE

(914) 425-1535



NEW TOLL-FREE  
ORDER LINE  
(OUTSIDE OF N.Y. STATE)  
(800) 431-2818

**NEW!!!**  
**MOD-II NEWSLETTER**  
**\$12/year (or 12 issues)**

Circle 122 on Inquiry card.

# THE ORIGINAL MAGAZINE FOR OWNERS OF THE TRS-80™\* MICROCOMPUTER

SOFTWARE  
FOR TRS-80™  
OWNERS

# H & E COMPUTRONICS INC.

MONTHLY  
NEWSMAGAZINE  
FOR TRS-80™  
OWNERS

## MONTHLY NEWSMAGAZINE Practical Support For Model I, II & III

- PRACTICAL APPLICATIONS
- BUSINESS
- GAMBLING • GAMES
- EDUCATION
- PERSONAL FINANCE
- BEGINNER'S CORNER
- NEW PRODUCTS
- SOFTWARE EXCHANGE
- MARKET PLACE
- QUESTIONS AND ANSWERS
- PROGRAM PRINTOUTS
- .... AND MORE

### PROGRAMS AND ARTICLES PUBLISHED IN OUR FIRST 12 ISSUES INCLUDE THE FOLLOWING:

- A COMPLETE INCOME TAX PROGRAM (LONG AND SHORT FORM)
- INVENTORY CONTROL
- STOCK MARKET ANALYSIS
- WORD PROCESSING PROGRAM (FOR DISK OR CASSETTE)
- LOWER CASE MODIFICATION FOR YOUR VIDEO MONITOR OR PRINTER
- PAYROLL (FEDERAL TAX WITHHOLDING PROGRAM)
- EXTEND 16-DIGIT ACCURACY TO TRS-80™ FUNCTIONS (SUCH AS SQUARE ROOTS AND TRIGONOMETRIC FUNCTIONS)
- NEW DISK DRIVES FOR YOUR TRS-80™
- PRINTER OPTIONS AVAILABLE FOR YOUR TRS-80™
- A HORSE SELECTION SYSTEM\*\*\*ARITHMETIC TEACHER
- COMPLETE MAILING LIST PROGRAMS (BOTH FOR DISK OR CASSETTE SEQUENTIAL AND RANDOM ACCESS)
- RANDOM SAMPLING\*\*\*BAR GRAPH
- CHECKBOOK MAINTENANCE PROGRAM
- LEVEL II UPDATES\*\*\*LEVEL II INDEX
- CREDIT CARD INFORMATION STORAGE FILE
- BEGINNER'S GUIDE TO MACHINE LANGUAGE AND ASSEMBLY LANGUAGE
- LINE RENUMBERING
- AND CASSETTE TIPS, PROGRAM HINTS, LATEST PRODUCTS COMING SOON (GENERAL LEDGER, ACCOUNTS PAYABLE AND RECEIVABLE, FORTRAN-80, FINANCIAL APPLICATIONS PACKAGE, PROGRAMS FOR HOMEOWNERS, MERGE TWO PROGRAMS, STATISTICAL AND MATHEMATICAL PROGRAMS (BOTH ELEMENTARY AND ADVANCED) . . . AND

**FREE\***



**WORD PROCESSING PROGRAM** For writing letters, text, mailing lists, etc., with each new subscriptions or renewal.

**LEVEL II RAM TEST** Checks random access memory to ensure that all memory locations are working properly.

**DATA MANAGEMENT SYSTEM** Complete file management for your TRS-80™.

**CLEANUP** Fast action Maze Game.

**ADVENTURE** Adventure #0 by Scott Adams (From Adventureland International).

\* All programs are supplied on cassette (add \$3 for Diskette Version - add \$5 for modified Mod-II Version).

**FREE**

SEND FOR OUR NEW 48 PAGE SOFTWARE CATALOG (INCLUDING LISTINGS OF HUNDREDS OF TRS-80™ PROGRAMS AVAILABLE ON CASSETTE AND DISKETTE). \$2.00 OR **FREE** WITH EACH SUBSCRIPTIONS OR SAMPLE ISSUE.

H & E **COMPUTRONICS**  
MATHEMATICAL APPLICATIONS SERVICE™

50 N. PASCACK ROAD  
SPRING VALLEY, NEW YORK 10977

ONE YEAR SUBSCRIPTION \$24 .....

TWO YEAR SUBSCRIPTION \$48 .....

SAMPLE OF LATEST ISSUE \$ 4 .....

START MY SUBSCRIPTION WITH ISSUE .....

(#1 - July 1978 • #7 - January 1979 • #12 - June 1979 • #18 - January 1980)

NEW SUBSCRIPTION ..... RENEWAL .....



**24 HOUR  
ORDER  
LINE**  
**(914) 425-1535**



**NEW TOLL-FREE  
ORDER LINE**  
(OUTSIDE OF N.Y. STATE)  
**(800) 431-2818**

CREDIT CARD NUMBER \_\_\_\_\_ EXP. DATE \_\_\_\_\_

SIGNATURE \_\_\_\_\_

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_ CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_

\*\*\* ADD \$6 YEAR (CANADA, MEXICO) - ADD \$12 YEAR AIR MAIL - OUTSIDE OF U.S.A., CANADA & MEXICO \*\*\*

# TEXAS INSTRUMENTS INCORPORATED



Stock market programs, oil field calculations, real estate software, and data for insurance rates are some of the many programs originally written for the TI 59/58 calculator and then converted to a custom Solid State Software™ module. Companies or individuals can permanently store up to 5000 program steps of their unique software in this nonerasable module.

The services at American Micro range from shipping finished modules created from submitted formulas or programs to renting and selling the emulator software system that enables onsite development.

## COSTS

Programs less than  
1000 steps ..... \$26/module  
Programs between 1000 and  
2000 steps ..... \$36/module  
Programs between 2000 and  
5000 steps ..... \$48/module

Minimum order is 250 modules



the bright spot. Also note that some errors come in due to overflow and truncation, as only 8 bits of the hologram are recorded on the display. If you want to, you can turn the holographic display of numbers into a density-plot image for inspection—but the resulting truncation to about  $3\frac{1}{2}$  bits means still more noise in the reconstructed image.

It's quite educational to delete a few points (or a sizable fraction) of the hologram, and still see the entire original picture be reconstructed from the remaining fragment. (It may be desirable to change the density-plotting gray-scale factors in some cases, as the image reconstructed from a partially removed hologram is fainter than the usual result.) These are only a few suggestions—try inventing experiments of your own!

A final word about very-long-base-line interferometry: if it is known that the astronomical object under observation contains a bright, pointlike source in or near itself, it is possible to completely reconstruct a map of the original source. The bright spot acts as a phase reference for the radio astronomers. In fact, what they're reconstructing is just a Fourier-transform hologram—but on a galactic scale!

## Further Work

After a program is written, it's always possible (and sometimes profitable) to go back and see how it could have been done differently, and perhaps better. The 2DFT program is no exception; I have several ideas for improvements and modifications, some of which you may wish to try. First, now that I know not to be afraid of cutting off parts of the holographic image, I've wondered whether a 64- by 64-cell transform would be the best step up. Since the dimensions are powers of two, it would be possible to use the fast-Fourier-transform algorithm and save time by at least a factor of 6 (the logarithm of 64 to the base 2) over the slow method. I also think that it might be worthwhile to use fewer bits during the transform, since overflows haven't been as deadly as I feared before starting the project. Perhaps integer arithmetic with 1 or 2 bytes for the numbers would work; it would certainly save space and time over the 5-byte floating-point meth-

ods that are used by the PET's firmware algorithms. (BASIC integer operations on the PET are actually done almost entirely in floating-point arithmetic; the only benefit of integers that I know of is to save memory in large arrays.)

I've seen comments about 1-bit Fourier transforms in some references. If that is a reasonable technique, you could use the  $\frac{1}{4}$ -cell graphics capabilities of the PET screen to display 50- by 80-pixel transformed images.

Finally, there must be a better way to find the amplitude of the transformed data than to take the square root of the sum of the squares of the sine and cosine parts. (The PET's floating-point square-root algorithm simply raises the argument to the  $\frac{1}{2}$  power, by taking a logarithm, multiplying, and exponentiating. It's not overly fast!) Perhaps a little table lookup could get a fast square root with sufficient accuracy for display purposes.

There are surely other improvements to be made on 2DFT. But as it is, it has provided me with a powerful learning tool. I've developed a more intuitive understanding of holography and the Fourier-transform process than I ever had before...and it's been fun! I hope you enjoy it as much. ■

## References

1. Beasley, M J. *Lasers and Their Applications*. Taylor & Francis Ltd, 1976.
2. Bracewell, Ron. *The Fourier Transform and Its Applications*. New York: McGraw-Hill, 1965.
3. Cathey, W Thomas. *Optical Information Processing and Holography*. New York: John Wiley & Sons, 1974.
4. Cohen, Marshall H. "High-Resolution Observations of Radio Sources." *Annual Reviews of Astronomy and Astrophysics*, volume 7, 1969.
5. Collier, Robert J, Christoph B Burckhardt, and Lawrence H Lin. *Optical Holography*. Academic Press, 1971.
6. DeVelis, John B and George O Reynolds. *Theory and Applications of Holography*. Reading MA: Addison-Wesley, 1967.
7. Gabor, Dennis. "Holography, 1948-1971." Lecture given on the acceptance of the Nobel Prize in physics, 1971. Reprinted in *Laser Devices and Applications*, edited by Ivan P Kaminow and Anthony E Siegman, IEEE Press, 1973.
8. Ryle, M. "Radio Telescopes of Large Resolving Power." Lecture given on the acceptance of the Nobel Prize in physics, 1974. Reprinted in *Reviews of Modern Physics*, volume 47, number 3, July 1975.

# Who will be first with the software of the future?

It could be you and Hughes Ground Systems.

Today Hughes warning systems form rings around the world. From Norway to Turkey, Hughes sonar, radar, communications, computers and displays form interactive systems serving whole countries — all dependent on advanced systems and software that you could help develop.

From undersea to outer space, there's really no limit to your career in software at Hughes.

And to facilitate your work, we've assembled a division comprised solely of software engineers. We've created the world's newest, most sophisticated software environment. You'll work with your own terminal on a fully interactive software development system that includes graphics aides

and simulation support for software design.

And if you're qualified, we'll show you an incomparable career path to the top of the field. It's all at Hughes, with 1,500 projects and a backlog of over \$5 billion.

Who will be first with the software of the future? It could be you and Hughes.

At Hughes Ground Systems, we'll introduce you to people, ideas and jobs that could change your world. And maybe ours.

Call or send resume to:

Hughes Aircraft Company  
Ground Systems Group  
Dept. B-3  
P.O. Box 3310  
Fullerton, CA 92634  
(714) 732-4942

Software opportunities vastly beyond the ordinary:

Software and Systems Test Engineers

Software Systems Engineers

with experience in:

Systems Software

Tool Development & Graphics;

AED Language and

CAPS 6 Computer

Software Development

Environment Engineers

with experience in:

Programmers Workbench/

UNIX/C Language

Group Heads and Programmers

with experience in:

Sonar or Torpedo Technology;

Software Development

Environment Area;

Utilities, Executive, Displays,

Operational Support;

Air Defense;

Real-Time Systems/Executive

Controls/Diagnostic Applications;

Operating and Data Management

Systems/Navy and Army

Systems/Communication Systems

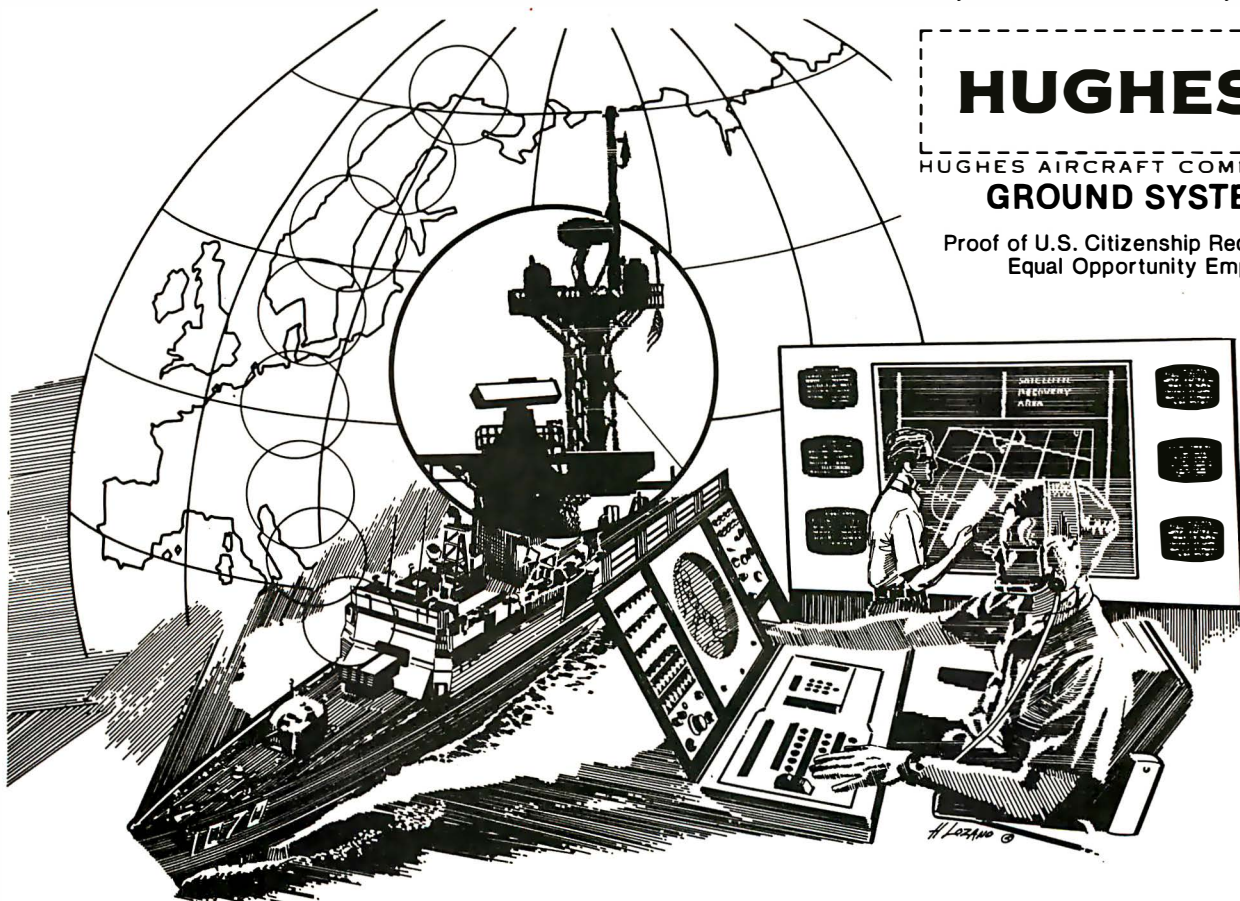
## It could be you and Hughes Ground Systems.

# HUGHES

HUGHES AIRCRAFT COMPANY

## GROUND SYSTEMS

Proof of U.S. Citizenship Required  
Equal Opportunity Employer



## UCSD PASCAL™ SOFTWARE

### PFAS Key File Access System

A fast and professional package that enables you to read records randomly by key in less than half a second on floppy disk systems. Some other features are:

- \*Wildcard search
- \*No overflow files
- \*No record length limit
- \*No file reorganization needed
- \*6K or less of program code
- \*Real-time record and key deletion with recovery of space
- \*Sequential access by key
- \*No file size limit
- \*Uses B + tree for file index
- \*Maximum key length of 248 bytes

PFAS is \$200

A version requiring less memory and does not have wildcard searches or deletes is \$125. Documentation is \$15\*.

### POST-HASTE The Mailing List Program

Post-Haste is indexed using PFAS for fast record retrieval and may contain in excess of 40,000 records when the disk space is available. Post-Haste also offers:

- \*3 lines of address, each 35 characters long.
- \*Ability to handle foreign addresses.
- \*Print lists to 80 or 132 character printers.
- \*Print 1, 2, 3, or 4-up labels.
- \*Retrieve records by full or partial name.
- \*Update files with screen oriented input.
- \*50 character user definable field.
- \*Select records using complex select criteria.
- \*Sort selected records with up to 6 fields.

Post-Haste is \$100

Documentation is \$15\*.

™ Regents of the University of California

\* The price of documentation can be applied toward purchase price of package.

**C. J. Wigglesworth Software**  
**P.O. Box 755**  
**Cardiff-by-the-Sea, CA. 92007**  
**Dealer Inquiries invited**

## Editorial

Text continued from page 10:

listed at the end of this editorial.

*"It looks like too much trouble":* Most of the things you'll need to do are easy and make sense. After a while, they will become so natural that you'll wonder how you ever did without them.

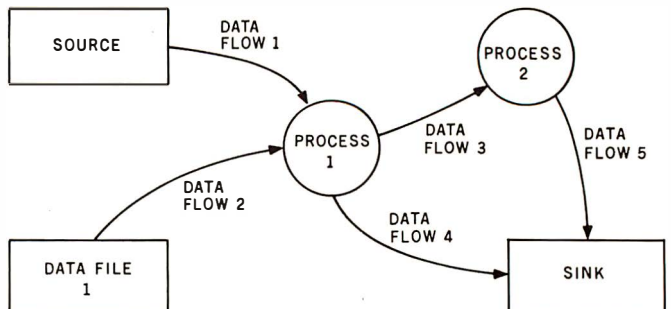
*"I don't have the time to spare—I'm on a tight deadline":* You have time to debug, don't you? And you have time to fix that bug that appears six months after you wrote the program. Actually, the techniques of design (which include structured programming during the program design and implementation) take up less time due to decreased time in testing, debugging, and maintenance. In fact, what you're doing is spending more time in design (doing it right) and less time in testing and debugging (finding and fixing what you didn't do right the first time).

*"It takes all the fun (or mystery) out of programming":* This is a difficult question to answer because there's an element of truth in it. But what do you mean by "fun"? If you mean surprises or adventure, you're right—there's less of that because you know more of what is going to happen before you start coding; on the other hand, there's less frustrating debugging. There's less exultation when a program *finally* works—but there's also quite a bit of pride in the knowledge that it will *stay* working. Proper design takes some of the mystery out of programming. Programming becomes a skill, but it is *designing* that becomes the art.

Finally, if you are programming for a living, haphazard programming may be "fun," but can you *afford* such fun? Untraceable bugs and unreliable programs decrease your productivity and your effectiveness. Can you and your company afford that?

### Some Design Tools

The following briefly describes three design tools that have been available for at least five years. *Data flow diagrams* (DFDs) are usually used on large projects, although they can help clarify your thinking on simpler ones. They force you to clarify what information is being manipulated and how it "flows" through the project. On a level of design several steps closer to coding, *structure*



**Figure 2:** An example of a data flow diagram (DFD). The circles represent processes (or actions) we are interested in within a system. The boxes represent external systems. The parallel lines represent data files (often called data stores), and the lines represent groupings of data that are transformed by the process.

# Volume II Ciarcia's Circuit Cellar

Steve Ciarcia, described as a "technological treasure," is BYTE's most popular writer. His innovative circuit designs are ingenious, timely, practical, easy-to-build, and—they work.

**Ciarcia's Circuit Cellar, Volume II** is more than a series of hardware designs: it is a ready reference and workbook of related projects, now available as a single source.

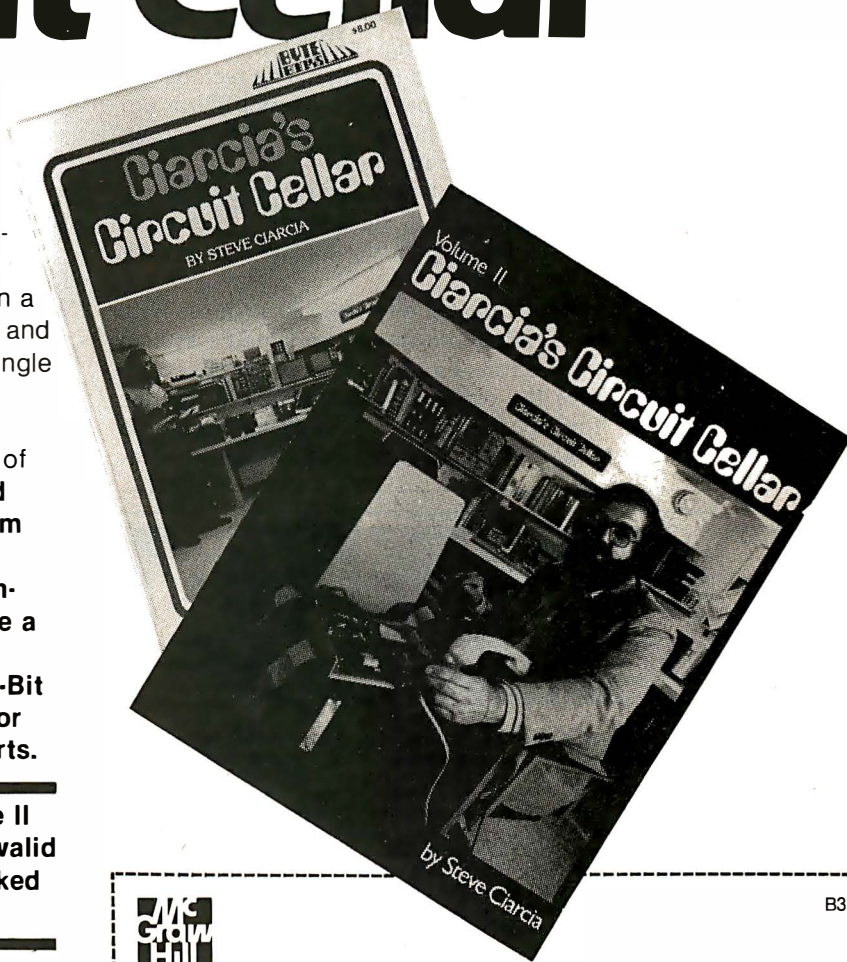
**Volume II** features 19 articles, including 14 that were voted by BYTE's readers as the best articles of the month, such as: **Build a Computer-Controlled Security System**, **Communicate On a Light Beam** (laser communications), **Anyone Know the Real Time?** (real-time clocks), **The Intel 8086**, **Add Non-volatile Memory to Your Computer**, **Computerize a Home** (AC remote control from your computer), **A Computer-Controlled Wood Stove**, **Ease Into 16-Bit Computing** (The Intel 8088), and **I/O Expansion for the Radio Shack TRS-80: Parallel and Serial Ports**.

**Special offer: Buy both Volume I and Volume II now and get Volume I for one-half price. Offer valid through April 15th. All orders must be postmarked by that date.**

**Volume I** contains a collection of more than a year's worth of the popular series Steve writes for BYTE magazine. Included are six winners of BYTE's On-going Monitor Box (BOMB) award voted by the readers as the best articles of the month: **Control the World** (a four-channel digital-to-analog converter for controlling appliances and other devices); **Memory Mapped I/O**; **Program Your Next EROM in BASIC**; **Tune In and Turn On** (a computerized wireless AC control system); **Talk To Me** (add a voice to your computer); and **Let Your Fingers Do the Talking** (a touch panel for your video display).

Buy these books at your favorite computer bookstore or direct from BYTE.

**Use our toll-free number (1-800-258-5420) and order your copies today.**



B3

Please send ☐ \_\_\_\_\_ copies of **Ciarcia's Circuit Cellar, Volume I**, \$8.00  
 Please send ☐ \_\_\_\_\_ copies of **Ciarcia's Circuit Cellar, Volume II**, \$12.95  
 Please send ☐ \_\_\_\_\_ special offer—the complete set of  
**Ciarcia's Circuit Cellar, Volumes I & II**, \$16.95  
 (Hurry-offer expires April 15, 1981)

Name \_\_\_\_\_ Title \_\_\_\_\_ Company \_\_\_\_\_

Street \_\_\_\_\_ City \_\_\_\_\_ State/Province \_\_\_\_\_ Zipcode \_\_\_\_\_

☐ Check enclosed in the amount of \$ \_\_\_\_\_  
☐ Bill Visa ☐ Bill Master Charge  
 Card No. \_\_\_\_\_ Exp. Date \_\_\_\_\_  
 Add 75¢ per book to cover postage and handling.



70 Main Street  
 Peterborough, New Hampshire 03458

charts are hierarchical models of a system that emphasize the tasks and subtasks to be performed and the data that passes among them. Finally, on the lowest level of design before coding, *structured pseudocode* is an informal English-like coding that allows you to experiment with implementing the logic of a program without being bothered with the narrow grammar of a particular computer language. Although I'll give an example and a short explanation of each method, you should refer to some of the books described at the end of this editorial for further details.

An example of a *data flow diagram* is given in figure 2. The circles represent processes we are interested in (actions being performed, *not* states of the system), and the arrows represent some grouping of data that is being transferred from one activity to another. The rectangular boxes represent other systems that interact with our systems but that are not of interest to us. If the arrows lead out of these boxes, they are called *sources*; if the arrows lead in, they are called *sinks*. The two parallel lines represent data files (also called "data stores") that store information for later use; depending on the file, arrows may go in both directions.

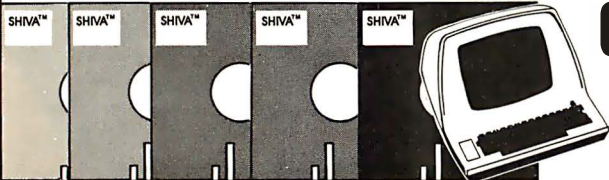
Data flow diagrams are usually used in groups, with one diagram representing the interaction of the system with external systems (one circle interacting with several boxes) and each of the other diagrams representing one circle from a "higher" diagram. For example, figure 3a shows an overview DFD of (a simplified version) the in-

teraction between the BYTE editorial department and the rest of the world. Figure 3b shows an expansion of the single circle in figure 3a. Further data flow diagrams can be used (if needed) to subdivide a given process.

When a set of DFDs covers several levels, the circles in the subordinate diagram reflect the identity of the parent circle. For example, the processes (circles) in a diagram representing process 1 of figure 3b ("log in and schedule manuscripts") would be numbered 1.1, 1.2, 1.3, and so on; similarly, subordinate processes of 1.3 would be labeled 1.3.1, 1.3.2, 1.3.3, and so on.

A data flow diagram is useful only when it meets certain criteria. Although I can't give all the dos and don'ts, the following points are helpful: First, take care that circles represent *meaningful* data transformations and arrows represent *meaningful* collections of data. For example, "read card deck" is not a meaningful transformation, but "classify incoming orders" is.

Second, with one exception, the inputs and outputs to a given diagram must be the same as those for the single process the diagram represents in the next higher diagram. This rule makes sense, and checking diagrams for compliance often alerts you to some data flow you've ignored. The one exception to this rule is that arrows for rejected data on one level are not shown in the next higher level (for example, see "manuscripts with no name or return address" coming out of process 1 in figure 3b); the reason for this convention is to avoid cluttering up the diagrams.



## OMEGA RESEARCH™

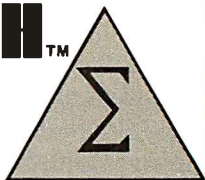
presents **SHIVA™**

**MULTI-USER**

S-100 OR  
NOW 8 OR

**MULTI-TASKING**

APPLE II  
16 BIT!!!



The world-famous **SHIVA™** Multi-User Real-Time Multi-Tasking Virtual Operating System with its unique **VIRTUAL-PERSONALITY™** disk-resident library of interface routines and Virtual R.A.M. mapping is now available in two versions: **SHIVA™ 1.2** for 8-bit C.P.U.'s and **SHIVA™ 1.6** for 16-bit processors. **SHIVA™ 1.2** pioneered the high-powered Virtual Operating System (VOS) for microprocessors with its user-reconfigurable Virtual R.A.M. assignment for up to 16-users or real-time tasks. Now **SHIVA™ 1.6** continues **Omega Research™**'s commitment to non-obsolescence and system superiority by extending **SHIVA™** into the 16-bit world of the 80's. **SHIVA™ 1.6** syntax is upward-compatible with **SHIVA™ 1.2**, allowing **SHIVA™** users to recompile **SHIVA™ 1.2** programs to run under **SHIVA™ 1.6** easily, so users may purchase **SHIVA™ 1.2** now, and move up to a 16 bit processor later as their needs dictate with no fear of "software obsolescence." **SHIVA™ 1.6** is upward compatible with CP/M or CDOS files and programs through its **VIRTUAL-PERSONALITY™** disk-resident subroutines, supports hard disks as well as single or double-density floppies, features Logon and password protection, and features executive shell commands similar to UNIX in structure and versatility. **SHIVA™** interfaces currently to Microsoft Basic, Cobol, and Fortran; C; C++; UCSD Pascal Programs; Pascal/M; CBASIC-2; APL; ALGOL-60; LISP; PL/I; MAC; and new interfaces are continually in development to keep **SHIVA™** users State-of-the-Art.

**SHIVA™ 1.2** is available for 8080, 8085, 6800, 6502, and Z80-BASED SYSTEMS INCLUDING CROMEMCO, NORTHSTAR, VECTOR GRAPHIC, SWTP, DIGITAL GROUP, ALTOS, IMS, APPLE II, ITHACA INTERSYSTEMS, and TELETEK disk controllers. 6809 C.P.U. version is in development.

**SHIVA™ 1.6** is available for 8086/8088/ and Z8000-2 based systems, with versions in development for 68000 based systems.

Both **SHIVA™** versions 1.2 and 1.6 provide full disk utilities for all users. **SHIVA™ 1.6** upgrades are available to registered **SHIVA™ 1.2** users within one year of purchase of **SHIVA™ 1.2** for half the current list price. **SHIVA™** — The State-of-the-Art in microprocessor operating systems.

**SHIVA™ 1.2**


R.A.M. addressing to 1.048 megabytes on a Z80A-based system	
Minimum system R.A.M. (single user):	4K
Additional R.A.M. per user:	2K
Maximum # of users or tasks:	16
Maximum # of physical and logical drives:	128
R.A.M. Bank capacity:	16-64K
Banks (1.048 megabytes)	
System prices:	\$400.00

**SHIVA™ 1.6**

R.A.M. addressing to 128 megabytes on a Z8000-2 system	
Minimum system R.A.M. (single user):	4K
Additional R.A.M. per user:	2K
Maximum # of users or tasks:	16
Maximum # of physical and Logical drive:	256
R.A.M. Bank Capacity:	16-8
megabyte banks (128 megabytes)	
System prices:	\$650.00

Complete Documentation Included: Documentation available separately for \$50.00. (Applicable to later purchase of **SHIVA™** system)  
Signed license agreement must be returned prior to all shipments.

CP/M is a trademark of Digital Research • CDOS is a trademark of Cromemco, Inc. • UNIX is a trademark of Bell Laboratories  
**SHIVA™**, **VIRTUAL-PERSONALITY™**, and **OMEGA RESEARCH™** are trademarks of **OMEGA RESEARCH™**.



## OMEGA RESEARCH™

P.O. Box 479, Linden, Ca. 95236 (209) 334-6666

9 am to 5 pm  
Mon. - Fri.

# The Zenith Microcomputer.

## Engineers

### Compare the positions.

#### MEMORY PRODUCTS

Systems interfacing for state-of-the-art memory devices.

#### FIRMWARE

Development of real time code for a wide variety of microprocessor based products.

#### MECHANICAL

Design of large volume mechanical systems using high technology materials.

#### DISPLAYS

Development of high resolution alphanumeric and graphic CRT monitors and interfaces.

#### I/O DEVICES

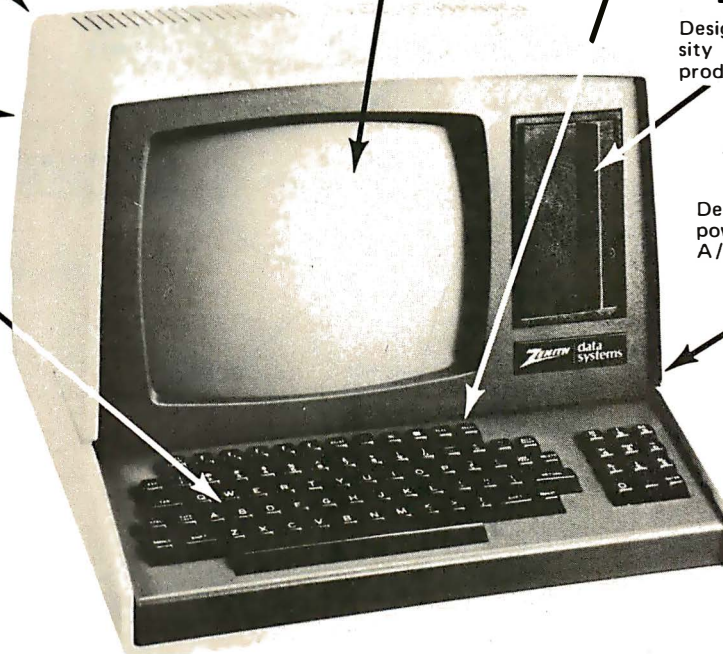
Design of interfaces for keyboards, printers, communications networks.

#### DISK PRODUCTS

Design of systems for high density fixed and flexible disc products.

#### ANALOG POWER SYSTEMS

Design of analog/switching power supplies, RF interfaces A/D-D/A converters.



## Then compare the opportunities.

In terms of project challenge, state-of-the-art technology and ground floor potential, you'll find the opportunities at Zenith Data Systems incomparable. For example, take the Zenith Data Systems Z89 microcomputer... with dual Z80 microprocessor control, 64K of user RAM, 100K storage built-in, 12" diagonal CRT... only one of the new microcomputer, peripheral and software products we've developed.

**Pure Innovation... Solid Zenith Quality  
AND JUST THE BEGINNING!**

Join us in the forefront of one of our most innovative phases. You'll find corporate wide impact and mobility, exceptionally stimulating project oriented environment and the incomparable lifestyle of St. Joseph, Michigan.

Housing is still affordable here, a year-round resort area, just 90 miles from Chicago. Compare it all... then CALL COLLECT, or send a resume in complete confidence to:

**Mike Wakefield  
616/982-3673**

**ZENITH** | data  
systems

*A Wholly Owned Subsidiary of Zenith Radio Corporation  
Hilltop Road / St. Joseph, MI 49085*

*An Equal Opportunity Employer m/f/h*

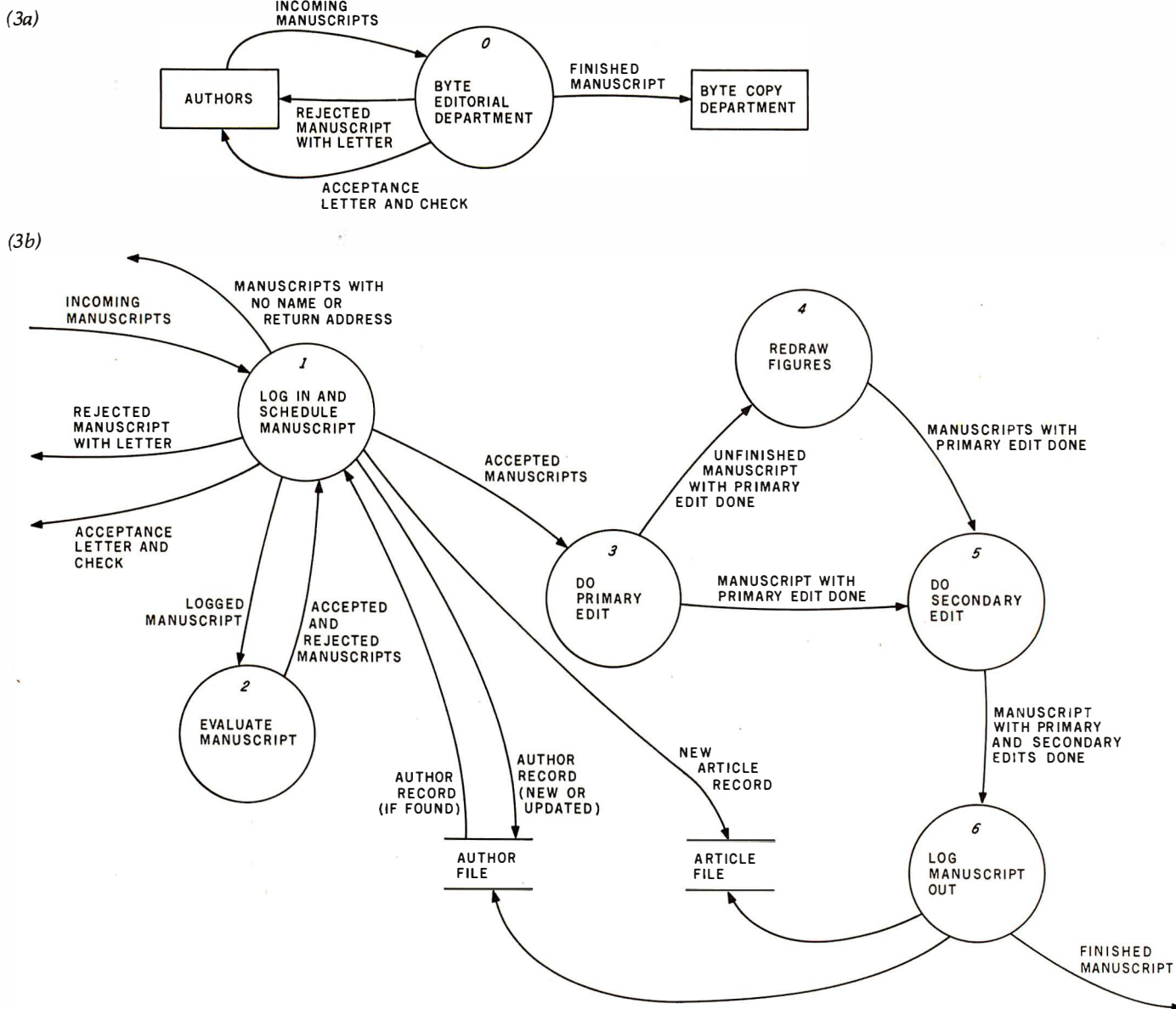


Figure 3: Overview and detailed data flow diagrams. Figure 3a shows an overview data flow diagram of the interaction of the BYTE editorial office with the rest of the world. Figure 3b is a detailed data flow diagram showing the workings of circle 0 in figure 3a. (The system shown has been simplified for purposes of illustration.)

## \$GOLD DISK\$ CP/M® Compatible Z-80 Software

AVAILABLE FOR ALL 8-5" SS-SD IBM FORMAT SYSTEMS INCLUDING TRS-80®, NORTHSTAR, SD SYSTEMS, ALSO AVAILABLE ON 5" DOUBLE DENSITY SUPERBRAIN™

### GREAT LOOKING LETTERS & REPORTS! REPORT WRITER

TAKE THE AGONY OUT OF TERM PAPER WRITING  
AUTO FOOTNOTING, TABLE SPACING, HEADINGS  
NO RETYPING TO INCLUDE CHANGES, CORRECTIONS  
ALWAYS PROFESSIONAL LOOKING LETTERS, FORMS  
SIMPLE MULTI-LETTER PRINTING  
LEFT AND RIGHT JUSTIFICATION  
SIMPLE TO LEARN, EASY TO USE

**\$42.00**  
PPD

### UN-CAN YOUR CANNED SOFTWARE! Z-80 DISASSEMBLER

FEEL COUPED UP WITH YOUR CANNED SOFTWARE?  
OUR Z-80 DISASSEMBLER RECREATES ASSEMBLY  
LANGUAGE SOURCE FILES FROM ABSOLUTE CODE  
ENABLING USERS TO EASILY TAILOR PROGRAMS TO  
MEET THEIR SPECIFIC NEEDS. THE  
PRECONDITIONER ALLOWS THE  
DISASSEMBLER TO DECODE ASCII.

**\$72.00**  
PPD

CREDIT CARDS: FREE 24 HR ORDER  
PHONE, WE'LL CREDIT INVOICE, ONE  
DAY SERVICE, CHECKS, M.O.'S: TEN  
WORKDAY HOLD. CA. RES: ADD TAX.



BOWER-STEWART & ASSOCIATES  
P.O. BOX 1389  
HAWTHORNE, CA. 90250  
(213) 676-5055



STATE SYSTEM & CONTROLLER,  
ALLOW TIME FOR SURFACE MAIL.  
TRADEMARKS: "DIGITAL RESEARCH,"  
"RADIO SHACK," "INTERTEC."

# QUALITY DISK SOFTWARE

## BACKED BY ON-GOING APPLICATIONS SUPPORT

from SPECTRUM SOFTWARE

### APPLE II (A)

#### HOME FINANCE PAK I: Entire Series \$49.95 (A) (T)

**CHECK REGISTER AND BUDGET:** This comprehensive CHECKING ACCOUNT MANAGEMENT SYSTEM not only keeps complete records, it also gives you the analysis and control tools you need to actively manage your account. The system provides routines for BUDGETING INCOME AND EXPENSE, AUTOMATIC CHECK SEARCH, and BANK STATEMENT RECONCILING. CRT or printer reports are produced for ACTUAL EXPENSE vs BUDGET, CHECK SEARCH DISPLAY RECONCILIATION REPORT and CHECK REGISTER DISPLAY by month. Check entry is prompted by user-defined menus of standard purposes and recipient codes, speeding data entry and reducing disk storage and retrieval time. Six fields of data are stored for each check: amount, check no., date, purpose, recipient and TAX DEDUCTIBLE REMINDER. CHECK SEARCH routines allow searching on any of these data fields. Routines are also provided for CHECK SORT by date and check no., DATA EDITING and Report Formats. Up to 100 checks/mo. storage ..... \$39.95

**SAVINGS:** Account management system for up to 20 separate Savings accounts. Organizes, files and displays deposits, withdrawals and interest earned for each account. Complete records shown via CRT or printer ..... \$14.95

**CREDIT CARD:** Get Control of your credit cards with this program. Organizes, stores and displays purchases, payments and service charges for up to 20 separate cards. Use for credit cards or bank loans. CRT or printer reports ..... \$14.95

#### UNIVERSAL COMPUTING MACHINE: \$49.95 (A)

A user programmable computing system structured around a 50 row x 50 column table. User defines row and column names and equations forming a unique computing machine. Table elements can be multiplied, divided, subtracted or added to any other element. User can define repeated functions common to row or column greatly simplifying table setup. Hundreds of unique computing machines can be defined, used and stored, and recalled, with or without old data, for later use. Excellent for sales forecasts, engineering design analysis, budgets, inventory lists, income statements, production planning, project cost estimates-in short for any planning, analysis or reporting problem that can be solved with a table. Unique curser commands allow you to move to any element, change its value and immediately see the effect on other table values. Entire table can be printed by machine pages (user-defined 3-5 columns) on a 40 column printer.

#### COLOR CALENDAR: \$29.95 (A)

Got a busy calendar? Organize it with Color Calendar. Whether it's birthdays, appointments, business meetings or a regular office schedule, this program is the perfect way to schedule your activities. The calendar display is a beautiful HI-RES color graphics calendar of the selected month with each scheduled day highlighted in color. Using the daily schedule, you can review any day of the month and schedule an event or activity in any one of 20 time slots from 8:00 A.M. to 5:30 P.M. Your description can be up to 20 characters long. The system will also print out hard copies on your minimum 40-column printer.

#### BUSINESS SOFTWARE: Entire Series \$159.95 (A) (T)

**MICROACCOUNTANT:** The ideal accounting system for small businesses. Based on classic T-accounts and double-entry booking, this efficient program provides a ledger journal for recording posting and reviewing up to 1,000 transactions per month to any one of 300 accounts. The program produces CRT and printer reports covering:

Transaction Journal	Balance Sheet
Accounts Ledgers	Income and Expense Statement

Includes a short primer on Financial Accounting. Requires 48K Ram ..... \$49.95

**UNIVERSAL BUSINESS MACHINE:** This program is designed to SIMPLIFY and SAVE TIME for the serious businessman who must periodically Analyze, Plan and Estimate. The program was created using our Universal Computing Machine and it is programmed to provide the following planning and forecasting tools.

CASH FLOW ANALYSIS	SALES FORECASTER
PROFORMA PROFIT & LOSS	SOURCE AND USE OF FUNDS
PROFORMA BALANCE SHEET	JOB COST ESTIMATOR
REAL ESTATE INVESTMENT	INVENTORY ANALYSIS

Price, including a copy of the Universal Computing Machine . . . . \$89.95

### TRS-80 (T)

**BUSINESS CHECK REGISTER AND BUDGET:** Our Check Register and Budget programs expanded to include up to 50 budgetable items and up to 400 checks per month. Includes bank statement reconciling and automatic check search (48K) ..... \$49.95

#### ELECTRONICS SERIES: Entire Series \$259.95

**LOGIC SIMULATOR: SAVE TIME AND MONEY.** Simulate your digital logic circuits before you build them. CMOS, TTL, or whatever, if it's digital logic, this program can handle it. The program is an interactive, menu driven, full-fledged logic simulator capable of simulating the bit-time response of a logic network to user-specified input patterns. It will handle up to 1000 gates, including NANDS, NORs, INVERTERS, FLIP-FLOPS, SHIFT REGISTERS, COUNTERS and user-defined MACROS. UP to 40 user-defined random, or binary input patterns. Simulation results displayed on CRT or printer. Accepts network descriptions from keyboard or from LOGIC DESIGNER for simulation ..... \$159.95 (A) (T)

**LOGIC DESIGNER:** Interactive HI-RES Graphics program for designing digital logic system. A menu driven series of keyboard commands allow you to draw directly on the screen up to 15 different gate types, including 10 gate shape patterns supplied with the program and 5 reserved for user specification. Standard patterns supplied are NAND, NOR, INVERTER, EX-OR, T-FLOP, JK-FLOP, D-FLOP, RS-FLOP, 4 BIT COUNTER and N-BIT SHIFT REGISTER. User interconnects gates just as you would normally draw using line graphics commands. Network descriptions for LOGIC SIMULATOR generated simultaneously with the CRT diagram being drawn. \$159.95 (A)

**MANUAL AND DEMO DISK:** Instruction Manual and demo disk illustrating capabilities of both programs ..... \$29.95

#### MATHEMATICS SERIES: Entire Series \$49.95 (A)

**STATISTICAL ANALYSIS I:** This menu driven program performs LINEAR REGRESSION analysis, determines the mean, standard deviation and plots the frequency distribution of user-supplied data sets. Printer, Disk, I/O routines ..... \$19.95

**NUMERICAL ANALYSIS:** HI-RES 2-Dimensional plot of any function. Automatic scaling. At your option, the program will plot the function, plot the INTEGRAL, plot the DERIVATIVE, determine the ROOTS, MAXIMA, MINIMA, INTEGRAL VALUE ..... \$19.95

**MATRIX:** A general purpose, menu driven program for determining the INVERSE and DETERMINANT of any matrix, as well as the SOLUTION to any set of SIMULTANEOUS LINEAR EQUATIONS. .... \$19.95

**3-D SURFACE PLOTTER:** Explore the ELEGANCE and BEAUTY of MATHEMATICS by creating HI-RES PLOTS of 3-dimensional surfaces from any 3-variable equation. Disk save and recall routines for plots. Menu driven to vary surface parameters. Hidden line or transparent plotting ... \$19.95

#### ACTION ADVENTURE GAMES: Entire Series \$29.95 (A)

**RED BARON:** Can you outfly the RED BARON? This fast action game simulates a machine-gun DOGFIGHT between your WORLD WAR I BI-PLANE and the baron's. You can LOOP, DIVE, BANK or CLIMB and so can the BARON. In HI-RES graphics. .... \$14.95

**BATTLE OF MIDWAY:** You are in command of the U.S.S. HORNETS' DIVE-BOMBER squadron. Your targets are the Aircraft carriers, Akagi, Soryu and Kaga. You must fly your way through ZEROS and AA FIRE to make your DIVE-BOMB run. In HI-RES graphics ..... \$14.95

**FREE CATALOG:** All programs are supplied on disk and run on Apple II w/Disk & Applesoft ROM Card & TRS-80 Level II and require 32K RAM unless otherwise noted. Detailed instructions included. Orders shipped within 5 days. Card users include card number. Add \$1.50 postage and handling with each order. California residents add 6 1/2% sales tax. Foreign orders add \$5.00 postage and handling.



**SPECTRUM SOFTWARE**

142 Carlow, P.O. Box 2084  
Sunnyvale, CA 94087

**FOR PHONE ORDERS: (408) 738-4387  
DEALER INQUIRIES INVITED.**



Third, data flow diagrams should show the logical flow of data, not its physical flow in an existing system—a DFD is not a flowchart. For example, circle 1 in figure 3b should not be labeled "Karen," even though she logs all incoming manuscripts.

In conclusion, the data flow diagram is a planning tool used in the early stages of design. It can clarify the flow of data in either an existing or a proposed system. You'll probably draft many versions of a data flow diagram before you arrive at a satisfactory version—this is a normal and unavoidable consequence of your increased understanding of the system and the improvements you are making in its design.

It's particularly important to use data flow diagrams when you are working for someone other than yourself (for example, a partner or client) because DFDs give you an easily understood document from which the other person can contribute *at an early stage in the design process*. This early feedback can often prevent costly backtracking in the later stages of system implementation.

### The Structure Chart

Structure charts are used later in the design process, when you know what a system (or program) is to do but want to organize the design and interaction of modules. Structure charts can be used to design either a single program or a system of programs; if you are designing a system, a finished structure chart will suggest logical ways in which to group the modules of the system into programs.

In a structure chart (see figure 4), rectangular boxes represent modules that perform a given action. The organization of the modules is determined by the arrows interconnecting them; the one being pointed to is *used* by the one doing the pointing to carry out its task. The modules communicate in much the same way as people do in a military hierarchy: the higher (calling) modules are organizers, sending orders to the ones below; the lower (called) modules are workers, performing their tasks (often calling modules that they command) and reporting back to their superiors. However, in this situation, it is the data that is transmitted up and down between modules. The structure chart records this movement. The arrow that begins with an outline circle represents data being passed (eg: an employee record, a part number), and an arrow beginning with a filled-in circle represents a logical flag (eg: transaction-valid or invalid-account-number flag).

Figure 5 is an example of a structure chart at work. The task being illustrated (top box) is the writing of an (imaginary) order for a final article payment to a BYTE author. Note that the data can pass both up and down, depending on the situation, but that logical flags almost always pass yes/no-type control information *up* to a calling module. The vertical lines on the box "get valid article record" (in the second row of figure 5) indicate that it is a library module that can be used as is from an existing library of routines.

A structure chart shows the subdivision of a system into modules, the hierarchy of those modules, and the data that passes among them. It does *not* imply anything about the method used to implement a module, nor does it imply a left-to-right execution sequence for modules on

the same row. Again, the main benefit of structure charts is the clarity of design they produce. Creating the structure chart forces you to be precise about what needs to be done. Once completed, the structure chart gives you the opportunity to find logical design flaws and to check for overall completeness. As with the data flow diagram, you'll probably write several versions of the structure chart before you get one that will satisfy you; but, in doing so, you'll create a design that will lead to a much better system or program.

### Structured Pseudocode

Structured pseudocode is used only after you've passed the boundary from system design to program design. By the time you're ready to use structured pseudocode, you have already specified the function of the program and some of its implementation details. Writing structured pseudocode is like writing a program for an imaginary machine that understands English-like phrases; it is a "test run" for the real thing, coding the actual program in the strict grammar of BASIC, FORTRAN, or some other computer language. Structured pseudocode tells *what* is to be done, the *order* it is done in, and *how* it is done. Once the structured pseudocode has been written, studied, and rewritten to your satisfaction, you can easily code your computer program from the pseudocode.

Listing 1 gives a short example. The hypothetical task is to find the lump-sum payment for an article from a lookup table, given the classification number of the desired article (which is the key field of the lookup table). We'll assume that the lookup table has two fields, a classification number and a payment amount, and that a sequential search of the table is made to find the appropriate line.

Listing 1 shows what's being done more clearly than an equivalent BASIC (or even Pascal) program because it's not concerned with rigorously expressing the algorithm in the narrow (and therefore less meaningful) grammar of the computer language. Still, since the pseudocode follows (or should be written to follow) the style of the target language, writing the actual program is simply a matter of expanding the lines of pseudocodes to take care of all the necessary details. For more information on con-

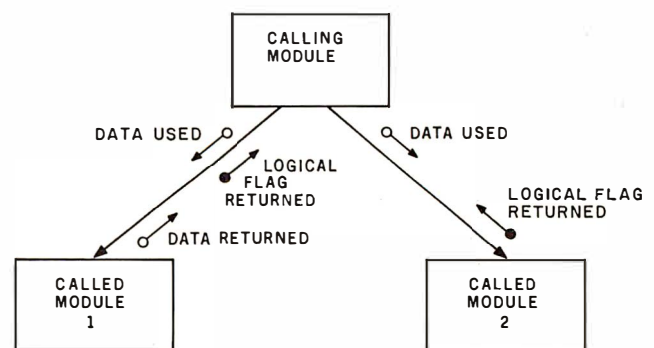
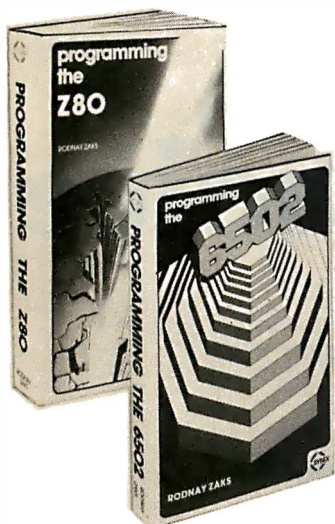


Figure 4: An example of a structure chart. The boxes represent modules that perform specified actions, with the higher boxes pointing to the subordinate boxes that they use. An arrow with an outline circle represents a grouping of data, while an arrow with a filled circle represents a logical flag that transmits the results of some yes/no-type evaluation.

# Go with McGraw-Hill's



**TAKE ANY 3 BOOKS  
FOR ONLY \$1<sup>00</sup> EACH**  
when you join the  
**COMPUTER PROFESSIONALS'  
BOOK CLUB** (values up to \$75.00)\*

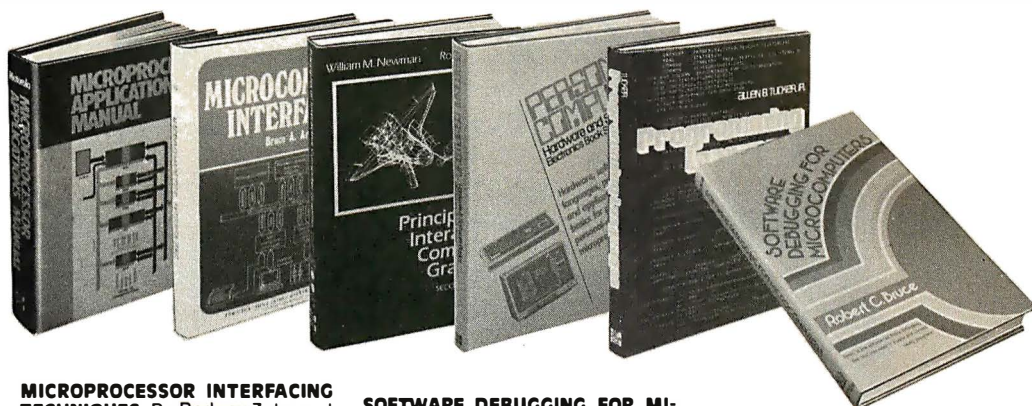


**MICROPROCESSOR APPLICATIONS MANUAL.** By Motorola Semiconductor Products, Inc. 720 pp., illus., 8½ x 11 format. With nuts-and-bolts practicality, this manual by the Motorola people (who should know) gives you detailed applications information on microprocessors. Assumes no prior knowledge on your part about MPUs.

435/278 \$42.50  
(Counts as 2 of your 3 books)

**PROGRAMMING LANGUAGES.** By Allen B. Tucker, Jr. 439 pp., illus. Gives you not only the principles of design but the applications of six major programming languages. Shows you their strengths and weaknesses in solving various representative "benchmark" problems.

654/158 \$23.95



**MICROPROCESSOR INTERFACING TECHNIQUES.** By Rodney Zaks and Austin Lesea. 3rd Ed., 456 pp., 405 illus. With the availability of LSI interface chips and the easy-to-follow guidelines in this text, designing an entire system can be almost simple!

582050-1 \$25.00  
(Counts as 2 of your 3 books)

**SOFTWARE DEBUGGING FOR MICROCOMPUTERS.** By Robert C. Bruce. 351 pp., illus. Takes you through the fundamental methods for finding errors, glitches, and faults in programs... goes on to techniques for tracking down and exterminating program bugs... then combines these techniques into a complete debugging plan.

582075-7 \$18.95

**SOFTWARE ENGINEERING.** Edited by Randall W. Jensen and Charles C. Tonies. 580 pp., illus. Oriented toward real applications in industry, this book provides an integrated treatment of the true foundations of effective project management. A dependable guide for designing better programs, implementing them more efficiently, and protecting them from theft or misuse.

788/367 \$27.50  
(Counts as 2 of your 3 books)

**PROGRAMMING THE Z80.** By Rodney Zaks. 624 pp., with diagrams, tables, and exercises. This book describes all concepts in simple yet precise terms—building progressively towards more complex techniques. You'll find an extensive chapter on advanced data structure manipulations, including lists, tables, binary trees—even hashings and other algorithms.

582049-8 \$14.95

**THE BYTE BOOK OF PASCAL.** Edited by Blaise W. Liffick. 340 pp., illus. Up-to-date Byte articles on the subject—from a general introduction to system hardware—from top experts in the field. Includes two versions of a Pascal computer, one written in BASIC and the other in 8080 assembly language.

789/673 \$25.00  
(Counts as 2 of your 3 books)

**COMPUTER DICTIONARY AND HANDBOOK.** By Charles and Robert Sippl. 624 pp., illus. This handy reference/guide defines and explains a wide range of computer procedures, products, problems, and applications. Appendixes provide a state-of-the-art guide to essential computer concepts.

582079-X \$29.95  
(Counts as 2 of your 3 books)

**MINICOMPUTER SYSTEMS: Organization, Programming, and Applications.** By Richard H. Eckhouse, Jr. and L. Robert Morris. 2nd Ed., 491 pp., illus. Updated, revised, and expanded, this is a book for every systems programmer, systems designer, computer scientist, and application specialist who wants to know more about microcomputer hardware, software, and design.

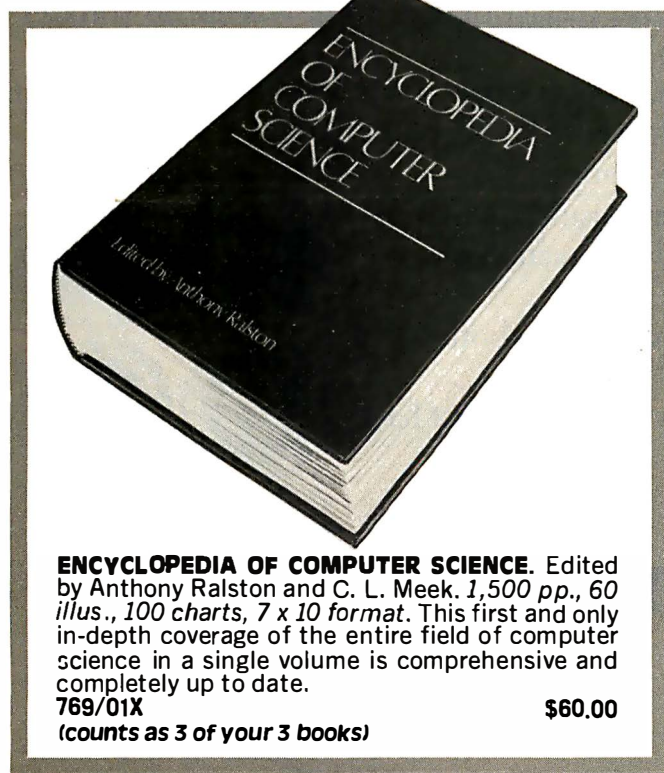
787/026 \$21.95

**AUTOMATIC DATA PROCESSING HANDBOOK.** Edited by The Diebold Group. 976 pp., 269 illus. Written by a staff of internationally recognized authorities on ADP, this comprehensive handbook explains systems, programming and the languages, communications processes, and the design and installation of today's computers.

168/075 \$44.95  
(Counts as 2 of your 3 books)

**THE GIANT HANDBOOK OF COMPUTER PROJECTS.** By the Editors of 73 Magazine. 504 pp., 217 illus. Solid, simple, and above all fun! This outsized book shows you how to build computer equipment from scratch—computer games, a bionic clock, a computer-controlled thermometer, and much more.

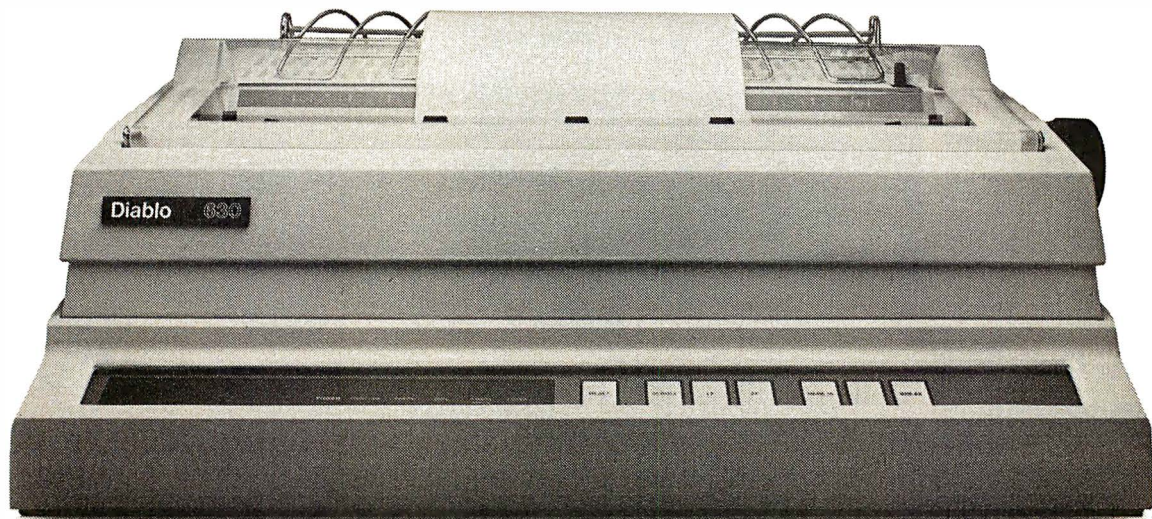
582012-9 \$15.95



**ENCYCLOPEDIA OF COMPUTER SCIENCE.** Edited by Anthony Ralston and C. L. Meek. 1,500 pp., 60 illus., 100 charts, 7 x 10 format. This first and only in-depth coverage of the entire field of computer science in a single volume is comprehensive and completely up to date.

769/01X \$60.00  
(counts as 3 of your 3 books)

# If you want a choice in print wheels, there's only one choice in printers.



The Diablo 630.

It's the only printer that lets you use either metal or plastic print wheels. So you can choose the print wheel that's just right for the job.

The 630 works as well with a 96-character plastic daisy print wheel as it does with an 88-, 92-, or 96-character metal daisy print wheel. In over 100 different type styles.

Every 630 has fewer moving parts than competitive printers, which makes it more reliable. And it offers unsurpassed print quality. Compatibility with Diablo supplies. And bi-directional printing capability.

The 630 is the only printer in the world that uses both metal and plastic wheels.

So if you want to change your print wheels, you'll just have to change your printer.

To a Diablo 630 printer.



## Diablo Systems

## XEROX

# EXPERIENCE!



**MICROPROCESSOR PROGRAMMING AND SOFTWARE DEVELOPMENT.** By F. G. Duncan. 320 pp., with diagrams, tables, and index. Tracks through the subject with thoroughness and clarity. The detailed discussion is based on the Motorola 6800, Intel 8080 and 8085, and Zilog Z80—with much of the material more generally applicable.

582069-2 \$28.00  
(Counts as 2 of your 3 books)

**MICROCOMPUTER INTERFACING.** By Bruce Artwick. 352 pp., 117 illus. In this up-to-date, complete design guide you'll find the detailed descriptions and explanations necessary to enable you to select, build, and interface microcomputer systems to virtually all applications. Advanced interface devices and methods are thoroughly examined and illustrated.

789/436 \$21.95

**ELECTRONIC GAMES: Design, Programming, and Troubleshooting.** By W. H. Buchsbaum and R. Mauro. 335 pp., 338 illus. Information you need to design, program, and troubleshoot electronic games is right here in this widely popular hands-on guide.

087/210 \$21.50

**PRINTED CIRCUITS HANDBOOK.** Edited by C. F. Coombs, Jr. 2nd Ed., 634 pp., 595 illus. Covering the subject of printed circuits from the design's idea to final acceptance, this enormously well-received work includes double-sided plated boards through printed boards and also the major variations such as multilayer and flexible circuits.

126/089 \$32.50  
(Counts as 2 of your 3 books)

**PRINCIPLES OF INTERACTIVE COMPUTER GRAPHICS.** By William M. Newman and Robert Sproull. 2nd Ed., 544 pp., illus. Now in a revised, updated second edition, this volume has long been THE standard source of information for designers!

463/387 \$26.95  
(Counts as 2 of your 3 books)

**PERSONAL COMPUTING: Hardware and Software Basics.** Electronics Book Series. 224 pp., 175 illus., 8½ x 11 format. Gives you comprehensive guidance to the present state of the art in personal computers—an overall survey of the technology and methods available to perform various tasks, facts about the work others are doing—and just how they are doing it.

191/514 \$19.50

**PROGRAMMING THE 6502.** By Rodney Zaks. 2nd Ed., 388 pp., illus., softbound. This second edition has been increased by almost 100 pages. Formulas, diagrams, tables, and practical examples on almost every page make its contents easy to grasp.

582048-X \$12.95

**BIT-SLICE MICROPROCESSOR DESIGN.** By John Mick and Jim Brick. 398 pp. All in one place—the crucial information you've been needing about the 2900 family of bit-slice microprocessor components. This remarkable "first" designs right before your eyes not just one but two complete 16-bit machines!

417/814 \$18.50

Be sure to consider these important titles as well!

**MICROPROCESSORS / MICROCOMPUTERS SYSTEM DESIGN.** By Texas Instruments, Inc. 637/58X \$24.50

**DATA BASE DESIGN.** By G. Wiederhold 701/30X \$25.95  
(Counts as 2 of your 3 books)

**HANDBOOK OF MICROCIRCUIT DESIGN AND APPLICATION.** By D. F. Stout & M. Kaufman 617/961 \$34.50  
(Counts as 2 of your 3 books)

**SOFTWARE PSYCHOLOGY: Human Factors in Computer and Information Systems.** By B. Shneiderman 789/797 \$24.95

**INFORMATION RETRIEVAL SYSTEMS: Characteristics, Testing and Evaluation, 2/e.** By F. W. Lancaster 582000-5 \$22.95

**ANALOG SYSTEMS FOR MICROPROCESSORS AND MINICOMPUTERS.** By P. H. Garrett 786/496 \$18.95

**DATA BASE COMPUTERS.** By O. H. Bray & H. A. Freeman 582042-0 \$19.95

**MICROPROCESSOR ARCHITECTURE AND PROGRAMMING.** By W. F. Leahy 784/612 \$24.50

**16-BIT MICROPROCESSOR ARCHITECTURE.** By T. Dollhoff 582003-X \$24.95

**ELECTRONICS DICTIONARY, 4/e.** By J. Markus 404/313 \$24.50

\* If you join now for a trial period and agree to purchase four more books—at handsome discounts—over the next two years. (Publishers' prices shown)

## Why YOU should join now!

- **BEST BOOKS IN YOUR FIELD**—Books are selected from a wide range of publishers by expert editors and consultants to give you continuing access to the latest books in your field.
- **BIG SAVINGS**—Build your library and save money too! We guarantee savings of at least 15% off publishers' list prices on every book. Usually 20%, 25%, or even higher!

• **BONUS BOOKS**—You will immediately begin to participate in our Bonus Book Plan that allows you savings between 70–80% off the publisher's price of many books.

- **CONVENIENCE**—14 times a year you receive the Club Bulletin FREE, fully describing the Main Selection and alternate selections, together with a dated reply card. If you want the Main Selection, you simply do nothing—it will be shipped automatically. If you want an alternate selection—or no book at all—you simply indicate it on the regular reply card and return it by the date specified. You will have at least 10 days to decide. If because of late mail delivery of the Bulletin you should receive a book you do not want, just return it at the Club's expense.

As a Club member, you agree only to the purchase of four more books over a two-year period.

## MAIL THIS COUPON TODAY

McGraw-Hill Book Clubs  
Computer Professionals' Book Club  
P.O. Box 582, Hightstown, New Jersey 08520

Please enroll me as a member and send me either the ENCYCLOPEDIA OF COMPUTER SCIENCE, billing me only \$3.00, or any three other books, billing me only \$1.00 each, plus local tax, postage, and handling. If not satisfied, I may return the books within 10 days and my membership will be canceled. I agree to purchase a minimum of four additional books during the next two years as outlined under the Club plan described in this ad. Membership in the Club is continuous but cancelable by me any time after the the four-book purchase requirement has been fulfilled.

- ☐ Check here if you want ENCYCLOPEDIA OF COMPUTER SCIENCE (769/01X).
- ☐ Check here if you prefer three other volumes, and indicate below by number the books you want.  
A few expensive books (noted in the description) count as more than one choice.

Orders from outside the U.S. must be prepaid with international money orders in U.S. dollars.

Name

Address

City/State/Zip

Corporate Affiliation

This order subject to acceptance by McGraw-Hill. All prices subject to change without notice. Offer good only to new members. A postage and handling charge is added to all shipments.

P39491

verting structured pseudocode to BASIC, see my article, "Applied Structured Programming," in the book *Program Design: Programming Techniques, Volume I* (listed at the end of this editorial).

At this point I'd like to break my earlier promise and say a few good words about structured programming, which is the design philosophy behind structured pseudocode. Structured programming asserts that any program can be written as a combination of three programming structures: a sequence of events, one of two events chosen by the value of a condition (the *if...then...else* construct), and an event repeated as long as a condition is true (the *while...do* construct). Structured programming goes hand-in-hand with *top-down design* (also called *programming by stepwise refinement*), which says that you solve a programming problem by breaking it into subproblems and continually subdivide these subproblems until each one can be easily coded. This process results in manageable, modular programs that are easy to understand, debug, modify, and maintain. The importance of such advantages cannot be overemphasized, especially if you program for a living.

## Some Good Books

You will find the following books helpful if you're interested in structured programming, program design, or system design. The first books deal primarily with structured programming and program design, while the latter ones go deeper into long-range design.

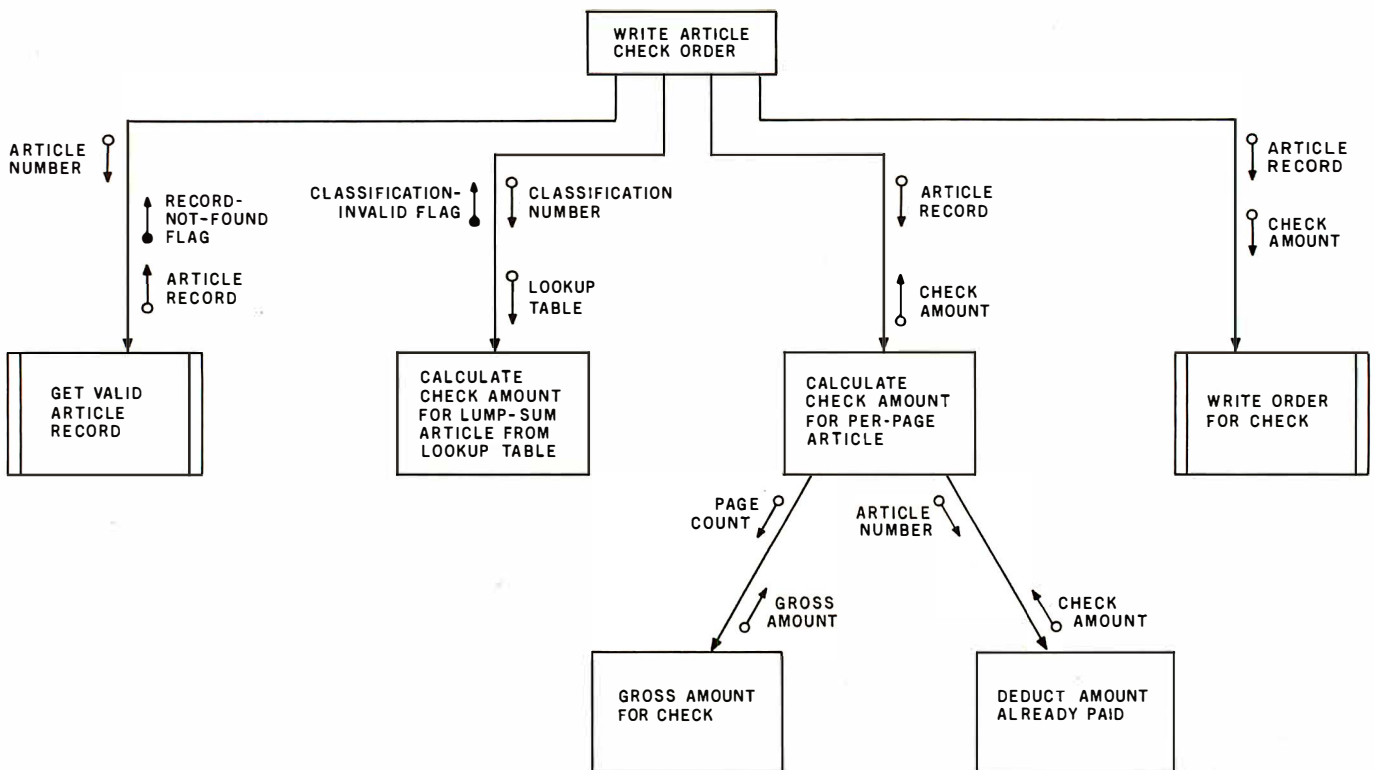
*Programming Proverbs* by Henry F Ledgard (Hayden Book Company, Rochelle Park NJ, 1975): This is a

friendly, but thorough, folk classic on methodical programming. It contains 26 proverbs with examples and some additional material on top-down design, and it can be read and understood by almost everyone with some programming experience. The languages used in the examples are ALGOL 60 and PL/I. The author, along with several coauthors, has tailored the same material for different books that emphasize FORTRAN, COBOL, BASIC, and Pascal. The titles are: *FORTRAN (or COBOL or BASIC or Pascal) with Style: Programming Proverbs*. All are published by Hayden Book Company.

*The Elements of Programming Style, Second Edition* by Brian W Kernighan and P J Plauger (McGraw-Hill, New York NY, 1978): Written in the style of Strunk and White's *Elements of Style* (the English language style book), it is slightly more formal and not as folksy as *Programming Proverbs*. It covers its material more methodically than *Programming Proverbs* does.

*A Collection of Programming Problems and Techniques*, by H A Maurer and M R Williams (Prentice-Hall, Englewood Cliffs NJ, 1972): I've always enjoyed leafing through this book because of all the tidbits of information it possesses. It includes such diverse information as the Ackermann function, algorithms involved with reverse Polish notation, and information on generating magic squares and solving simultaneous equations by the Gauss-Seidel method. An excellent book for problem ideas if you're teaching programming or need a short, nontrivial problem to illustrate a point.

*Software Debugging for Microcomputers*, by Robert C Bruce (Reston Publishing Co, Reston VA, 1980):



**Figure 5:** Another example of a structure chart. The (hypothetical) action illustrated is the generation of an order for a check for final payment to a BYTE author for an article. The vertical bars on the first and last boxes in the middle row represent predefined modules that can be used in different situations.

# dBASE™ II vs. the Bilge Pumps.

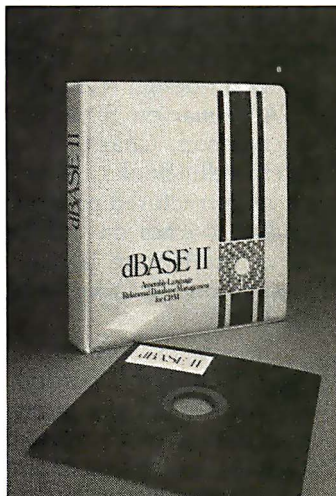
by Hal Pawluk

We all know that bilge pumps suck.

And by now, we've found out—the hard way—that a lot of software seems to work the same way.

So I got pretty excited when I ran across **dBASE II**, an assembly-language relational Database Management System for CP/M. It works! And even a rank beginner like myself got it up and running the first time I sat down with it.

If you're looking for software to deal with your data, too, here are some tips that will help:



## Tip #1: Database Management vs. File Handling:

Any list or collection of data is, loosely, a data base, but most of those "data base management" articles in the buzzbooks are really about file handling programs for specific applications. A real Database Management System gives you data and program independence (no reprogramming when data changes), eliminates data duplication and makes it easy to turn data into information.

## Tip #2: Assembly Language vs. BASIC:

This one's easy: if you're setting up a DBMS, you're going to be doing a lot of sorting, and Basic sorts are s-l-o-w. Run a benchmark on a Basic system like S\*-IV against a relational DBMS like **dBASE II** and you'll see what I mean. (But watch it: I've also seen one extremely slow assembly-language file management system.)

## Tip #3: Relational vs. Hierarchal & Network DBMS.

CODASYL-like hierarchal and network systems, around since the 1960's, are being phased out on the big machines so why get stuck with an old-fashioned system for your micro? A relational DBMS like **dBASE II** eliminates the pre-defined sets, pointers and complex data structures of a CODASYL-type DBMS. And you don't need to be a programmer to use it.

## dBASE II vs. everything else.

**dBASE II** really impressed me.

Written in assembly language (with no need for a host language), it handles up to 65,000 records (up to 32 fields and 1000 bytes each), stores numeric data as packed strings so there are no round-off errors, has a super-fast multiple-key sort, and supports ISAM based on B\* trees.

You can use it interactively with English-like commands (DISPLAY 10 PRODUCTS), or program it

(so when you've set up the formats, your secretary can do the work). Its report generator and user-definable full screen operations mean that you can even use your existing forms.

And if all this makes your mouth water, but you've already got all your data on a disk, that's okay: **dBASE II** reads your ASCII files and adds the data to its own database.

Right now, I'm using **dBASE II** with my word processor for budgeting, scheduling and preparing reports for my clients.

Next come job costing, time billing and accounting.

## An Unheard-of Money-Back Guarantee.

**dBASE II** is the first software I've seen with a full money-back guarantee.

To check it out, just send \$700 (plus tax in California) to Ashton-Tate, 3600 Wilshire Blvd., Suite 1510, Los Angeles, CA 90010. (213) 666-4409. Test **dBASE II** doing your jobs on your computer for 30 days. If, for some strange reason, you don't want to keep it, send it back and they'll refund your money.

No questions asked.

They know you don't need your bilge pumped.

# Ashton-Tate

©Ashton-Tate 1980

Although this book has little to do with structured programming or design, I mention it because of its thorough treatment of debugging techniques. If you're interested in such debugging techniques as forcing, block debugging, snapshots, and patching, you should read this book.

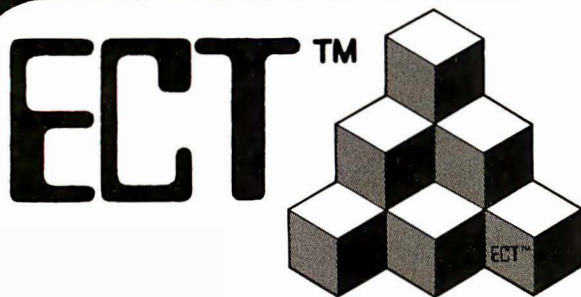
**Listing 1:** *Structured pseudocode for a routine to find a value from a lookup table. The lookup table contains two fields, classification-number and check-amount, and this routine finds the appropriate check-amount by matching a given classification number to the classification numbers in the table. A sequential search is used, starting at the top of the table. If a classification-number match is made, the check-amount needed is the check-amount entry in the same line, and the error-flag (for the information of the calling routine) is cleared. If no match is made, check-amount is set to zero and the error-flag is set.*

```
while not-at-end-of-file and match-not-found
  compare classification number of current line with classification
  number sought
  if the two are equal
    check-amount sought is check-amount field in current line
  else
    add 1 to table-index
  endif
endwhile
if no-match-found
  set error-flag
else
  check-amount = 0
  clear error-flag
endif
return (to calling routine)
```

*Program Design: Programming Techniques, Volume I*, edited by Blaise W Liffick (BYTE Books, Peterborough NH, 1978): This book contains new material and articles reprinted from BYTE. Subjects include "Top-Down Modular Programming;" "Some Words About Program Structure" (both by Albert D Hearn); "Applied Structured Programming" (by me); "Decision Tables: How to Plan Your Programs" (by Thomas G Bohon), and several other helpful articles. My only regret is that several articles include what are called "Warnier-Orr diagrams," a program design technique I do not recommend.

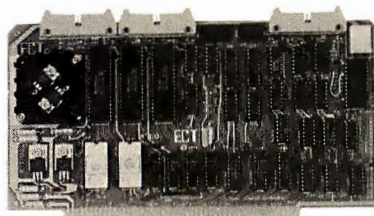
*A Primer on Structured Program Design*, by Gary L Richardson, Charles W Butler, and John D Tomlinson (Petrocelli Books, New York NY, 1980): This book covers structured programming and program design, but it also touches on the larger elements of system design. One nice feature is that it briefly lists several different design tools in order to help you choose the one you like best.

*Classics in Software Engineering*, edited by Edward Nash Yourdon (Yourdon Press, New York NY, 1979): I cannot say enough good things about this book. It is a compilation of all the pivotal papers in the fields of structured programming (both theory and practice), program and system design, and other related fields. Not only is it extremely convenient to have these articles gathered together, it's also the only way most people will ever see them (since many of the articles appeared in the proceedings of computer conferences as many as 15 years ago). By reading the articles (and the excellent introduc-



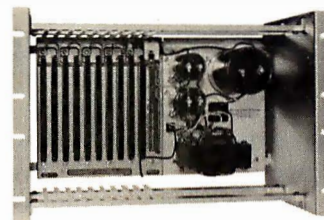
## Building Blocks for Microcomputer Systems, Dedicated Controllers and Test Equipment.

### R<sup>2</sup>I/O S-100 ROM, RAM & I/O BOARD



ECT's R<sup>2</sup>I/O is an S-100 Bus I/O Board with 3 Serial I/O Ports (UART's), 1 Parallel I/O Port, 4 Status Ports, 2K of ROM with the 8080 Apple Monitor Program and 2K of Static RAM.

**\$295.00**



### RM-10 S-100 RACK MOUNT CARD CAGE

ECT's RM-10 is a rack mount 10 slot Card Cage with Power Supply, consisting of an ECT-100 rack mount Card Cage (19"W x 12.25"H x 8"D), the MB-10 Mother Board (with ground plane and termination) all 10 connectors and guides and the PS-15A Power Supply (15A @ 8V, 1.5A @ ± 16V).

**\$295.00**

**Specializing in Quality Microcomputer Hardware**  
Industrial • Educational • Small Business • Personal

Card Cages, Power Supplies, Mainframes, CPU's, Memory, I/O, OEM Variations

**ECT™ ELECTRONIC CONTROL TECHNOLOGY** (201) 686-8080  
763 Ramsey Ave., Hillside, NJ 07205

# PMC-80 Expanded



## Use all standard peripherals and existing software

When you buy PMC-80 you get hardware and software compatibility with the most popular microcomputer system in the world—that means thousands of disk and cassette based programs and all kinds of peripherals are instantly available!

PMC-80 has configurations that give the computer enthusiast a way to grow from a STARTER system in affordable increments. Begin at a low \$675 for the basic 16K level II system and grow to the complete 48K memory system pictured above with two floppy disks for less than \$3000.

FASTLOAD option inputs short programs as fast as "disk" from ordinary,

standard format cassettes. Fast, reliable and economical!

PMC-80 COMMUNICATOR option provides interface to modems and parallel port printers. Take your pick of peripherals for communication with electronic bulletin boards and low cost timeshare services via phone lines from your home or business.

PMC-80 EXPANDER option provides the most powerful configuration with a total of 48K memory, provision for 4 mini-floppies, printer interface, RS-232C communications interface, plus a slot for the popular S-100 boards.

Sold through computer stores.

## Personal Micro Computers, Inc.

475 Ellis Street, Mountain View, CA 94043

(415) 962-0220

# GET THE SOFTWARE THAT'S GOING PLACES. THE UCSD p-SYSTEM.™

You want a copy of the exciting software system that's going places. Professionals everywhere are using the UCSD p-System. Now, you can have it. The UCSD p-System offers: a complete software development system, your choice of languages, and a portable system that runs on your microcomputer today and tomorrow. Send in the coupon below and join the pros today. Phone orders accepted with Visa or Master Card.

Yes, I want the software system that's going places—the UCSD p-System. Here's my order:

UCSD p-System\* (Version IV.0) including documentation:

- ☐ with UCSD Pascal™ Compiler. . . . . \$500.00
- ☐ with FORTRAN-77 Compiler. . . . . \$500.00
- ☐ with UCSD Pascal and FORTRAN-77. \$750.00
- ☐ BASIC Compiler Add-On. . . . . \$150.00
- ☐ Assemblers Package (cross-assemblers)  
for Z-80, 6502, 6800, 6809,  
8080, 9900, Z8, PDP-11™/  
LSI-11™. . . . . \$250.00
- ☐ Complete UCSD p-System with UCSD Pascal  
Documentation Set. . . . . \$50.00
- ☐ Send me more information (general)
- ☐ Send distributor information
- ☐ Send information on the availability of systems for the  
6800, 6809, and/or 9900 processors

My system has: (check only one)

- ☐ CP/M® Version I.4
- ☐ CP/M Version II.0 with 128-byte sectors
- ☐ 8080 or Z80 processor without CP/M (requiring some  
assembly language programming)
- ☐ 6502 processor (requiring some assembly language pro-  
gramming)
- ☐ PDP-11 with ☐ RX01 ☐ RX02 (check one)
- ☐ LSI-11 with ☐ RX01 ☐ RX02 (check one)

NOTE: (pertaining to two items above) For availability of RK05 and RL01 disk drivers, contact SofTech Microsystems.

\*System requires 48K contiguous RAM. Software is shipped on 8-inch floppy disks, and can be transferred to other formats.

- ☐ Check or money order enclosed ☐ Ship C.O.D.  
(U.S. orders only)

Calif. and Mass. residents must add applicable sales tax. For foreign shipping charges, contact SofTech Microsystems.

Ship to: \_\_\_\_\_

Address: \_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_

Zip: \_\_\_\_\_ Phone: \_\_\_\_\_

Allow six weeks for delivery.

**SOFTech**  
**MICROSYSTEMS**  
A SUBSIDIARY OF SOFTECH

SofTech Microsystems, Inc.  
9494 Black Mountain Road  
San Diego, CA 92126  
Ph: 714/578-6105  
TWX: 910-335-1594

(UCSD p-System and UCSD Pascal are trademarks of the Regents of the University of California. CP/M is a registered trademark of Digital Research Corporation. LSI-11 and PDP-11 are trademarks of Digital Equipment Corporation.)

## Editorial

tions to each article, written by Mr Yourdon), you can see how the key ideas in the field formed and grew. The highly theoretical article, "Flow Diagrams, Turing Machines, and Languages with Only Two Formation Rules," by C Bohm and G Jacopini, contains the theoretical rigorous proof that *any* program can be written using only sequence, choice (*if...then...else*), and iteration (*while...do*). Although I don't have the room to list all the articles in this 424-page book (most of which are remarkable in some way), I must mention "The Humble Programmer," by Edsger Dijkstra; "Revolution in Programming: An Overview," by Daniel McCracken, and the monumental "Structured Programming with go to Statements," by Donald Knuth.

*The Practical Guide to Structured Systems Design*, by Meilir Page-Jones (Yourdon Press, New York NY, 1980): This is a very readable book explaining the latest design techniques. I enjoyed reading it, and I referred to it constantly while writing this editorial. It covers the three techniques discussed above, as well as several I didn't have room for (the concept of a "data dictionary," for one), and it is greatly enhanced by the inclusion of a complete case study of a system designed using the methods given in the book. The book concentrates on the *design* process and talks only briefly of structured programming and program design. Also, it presents much the same material as the next two books (which come before it chronologically), with a slight reduction in complexity and a slight increase in readability. I recommend that you read this book first.

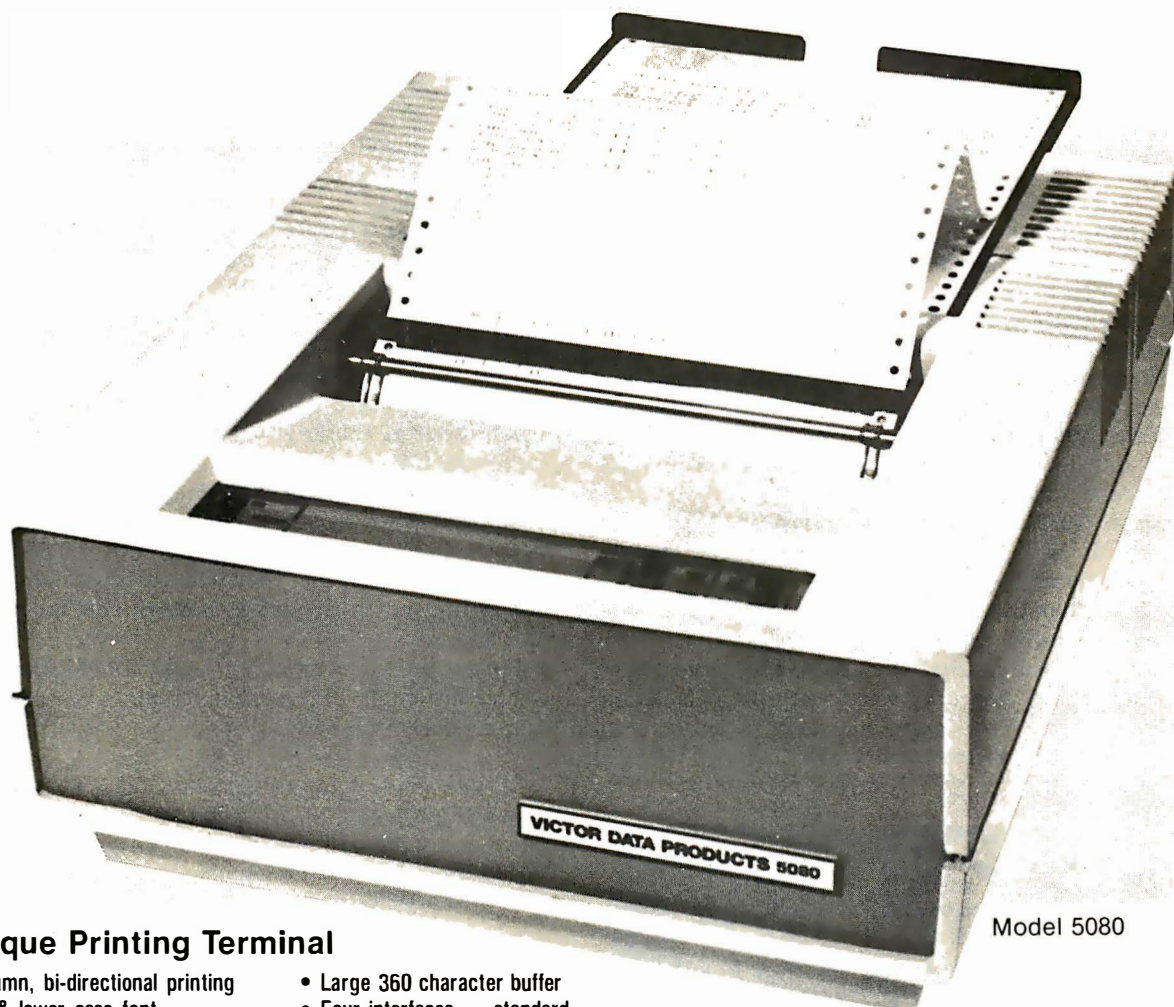
*Structured Analysis and System Specification* by Tom DeMarco (Prentice-Hall, Englewood Cliffs NJ, 1979): This book covers much the same material as the preceding book, but it treats the subjects covered more rigorously and a bit more formally. It also addresses the special problem of modeling and designing very large systems that don't yet exist.

*Structured Design: Fundamentals of a Discipline of Computer Program and Systems Design*, by Edward Yourdon and Larry C Constantine (Prentice-Hall, Englewood Cliffs NJ, 1979): This book is the parent of the two just described (the first publication of this book was in 1975, and the authors of all three books come from the same school of design). Because it was written to describe its design techniques for the first time, the notation used is a bit cluttered (compared to the streamlined design used in the last two books), but this book is easily the most comprehensive and the most theoretical; it attacks the problem of program design on the broadest level. Particularly important are the ideas of *coupling* and *cohesion* among program modules, each of which have separate chapters in the book.

## Conclusions

If I had to give you one word to associate with the concept of design, that word would be *forethought*. Design is *forethought*—it's as simple as that. Few people would say that they program without *forethought*, but programming at the keyboard (or with a coding sheet) without design is the same as playing the piano without sheet music—more improvisation than rendition. So the question is no longer, "Is this really necessary?" It's "can you afford not to?" ■

# VICTOR... Number 1 in Impact Matrix Printing!



Model 5080

## A Unique Printing Terminal

- 80 column, bi-directional printing
- Upper & lower case font
- Full graphics — 480 columns per line
- Top of form & horizontal tabs
- True 100 cps throughput
- Bi-directional friction and sprocket paper feed
- Large 360 character buffer
- Four interfaces — standard parallel & RS232 & TTY & IEEE-488
- Baud rate switch selectable
- Self-test
- UL/CSA approved
- Intelligent shortest path head return

The Model 5080, shown above, is a heavy-duty printing terminal offered for sale at most competitive prices. Only \$995 in single quantity! This printer has been designed to conform to the most stringent computer specifications, including software on/off control, status feedback signals and a busy signal should you fill our extra large buffer. Don't delay, order now to insure early delivery!

Victor has delivered more than 700,000 industrial, quality matrix printers. These are terminals, mechanisms, and heads designed to solve your problems. Products that are backed by a strong application engineering staff, worldwide service and 50 years of Victor pride in product.

## VICTOR DATA PRODUCTS

Subsidiary of Walter Kidde & Company, Inc.

### KIDDE

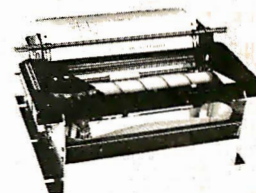
3900 North Rockwell Street, Chicago, Illinois 60618 Telephone: 312-539-8200

GREAT BRITAIN — DATAPLUS, 0242-30030 GERMANY — BDT, (07 41) 8041 ITALY — C.A.I., 23.63.851  
SPAIN — CETA, 254 6607 SWITZERLAND — ERNI, 01 833 33 33 CANADA — MUNRO, (416)676-1042  
FRANCE — METROLOGIE, (1) 791 44 44 SOUTH AFRICA — EAGLE, 45-1421  
SINGAPORE — OG, 917788 or 918592 HONG KONG — GILMAN, 3-427144

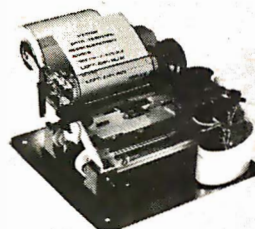
## A Complete Line of Impact Matrix Printers



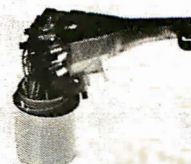
Model 5010



Model 80



Model 130



Model 129

## DATALINE

Daniel S Hunt, 829 Presidio Dr, Costa Mesa CA 92626

There is a certain pleasure in writing assembly-language subroutines for my Microsoft BASIC system; however, the dismal tedium involved in hand-converting object code into BASIC data statements is unmatched.

There are alternatives: one method is to put the object code into a data file and read it into memory for execution by the program. The disadvantage with this method is that one must keep a separate file for what is in essence a subroutine. Besides, the file may be lost in a backup operation or during insouciant copying of the BASIC code to another disk.

My solution for this problem was to write DATALINE. DATALINE is a BASIC program that takes freshly assembled object code and moves it into DATA statements so that the code can be integrated with the BASIC mainline source code.

This program assumes that you are able to move object code into a memory area protected from BASIC. If you do not have the ability to move blocks of object code in this way, the concatenation routine can be joined with an

algorithm to read a .COM file character by character.

To use DATALINE, load the object code into an area protected from BASIC. The program will prompt you for the load address, length of the program in 64-byte segments, a file name, and a starting line number. It peeks the object code byte by byte and concatenates a string conversion of each byte to a line composed of line number, "DATA ", plus appropriate spaces and commas between each byte value. Eight bytes are put on each data line. The line is filed serially, and it appears to BASIC to be a program file saved in "A" mode. You can merge the data lines with your BASIC program by using the MBASIC MERGE command.

This program includes one of my most used library routines. This is a procedure that takes a hexadecimal-value input at the keyboard and converts it to decimal representation which can be used in PEEK and POKE statements. As the MBASIC 5.1 interpreter is intolerant of integer overflow, the conversion is to single-precision floating-point base 10, rather than integer. While integer conversion is possible, the extra speed gained in the exercise is not worth the extra code or the increased complexity.

If your BASIC is an older version of Microsoft, merely reduce the length of the variable names where your interpreter rejects one here.

**Listing 1:** Written in Microsoft BASIC, this short routine takes the drudgery out of writing assembly-language subroutines for BASIC programs. The program rewrites object code as BASIC DATA statements, as shown in listing 2.

```

10 REM *** MBASIC DATALINE WRITER ***
100 '
110 '-----
120 '      Written by Daniel S. Hunt, April 25, 1980
130 '      MBASIC 5.1 INTERPRETER / Sol-20
140 '-----
150 WIDTH 64
160 PERSE = &HCOD5 : 'SOLOS CLEAR SCREEN CALL
170 CALL PERSE:PRINT:PRINT
180 PRINT "---- MACHINE CODE / DATA LINE WRITER ----":PRINT
190 INPUT "Enter hex base address of object code ",HXIN$
200 GOSUB 350 : ' CONVERT HEX STRING TO REAL DEC.
210 DBASE = BASETEN
220 INPUT "Routine length in 64-byte segments ",PAGES :
    LENGTH = PAGES * 64
230 INPUT "Enter name of data statement file ",DFILE$
240 OPEN "O",1,DFILE$
250 INPUT "Enter line number of starting data statement ",LNUM
260 LASTBYTE = DBASE + (LENGTH - 1)
280 GOSUB 570 : 'CREATE DATA LINES
290 CLOSE
310 '
320 '
330 REM --- CONVERTS HEX INPUT STRING TO DECIMAL ---
340 '
350 CUME = 0
360 HDAT$ = "0123456789ABCDEF"
370 CHARPOS% = LEN(HXIN$)
380 FOR I% = 1 TO LEN(HXIN$)
390     ADDER = 0
400     FOR J% = 1 TO LEN(HDAT$)
410         IF MID$(HXIN$,I%,1) = MID$(HDAT$,J%,1) THEN
            ADDER = J% - 1

```

# 800-323-1780\*

## NCE's HOTLINE FOR SAVINGS

- **Ribbons for:** Diablo, Qume, IBM, Wang, NEC, All Data Printers and Typewriters.
- **Printwheels, Elements and Thimbles.**
- **Magnetic Media:** Floppy disks, mini-floppy, Tape, Packs and Cassettes.
- Disc storage systems, Quietizers, Anti-static mats, Ink rolls and much more.
- **Terminals and accessories.**

• TO ORDER •

Phone orders invited, using credit cards. Or send check, cashiers check or money order that draws on a U.S. bank. Please add 3% (\$5.00 Minimum) for handling, shipping and insurance. Illinois residents add 5 1/2% sales tax. **Mall order pricing only. Catalog mailed upon request.**

### DISKETTES

- 100% Certified
- 2 Year Warranty
- 10 Million Passes
- Human Engineered
- EZ View Box
- The Best Disk Available Today.

	Box of 10
5 1/4" (Soft Sector)	29.95
5 1/4" (10 Sector)	29.95
5 1/4" (16 Sector)	29.95
8" Single Side-Single Density	32.50
8" Single Side Reversible	52.50
8" Single Side Double Density	50.00
8" Double Sided Double Density	52.50



"Run With The Thoroughbreds"  
Satisfaction Guaranteed

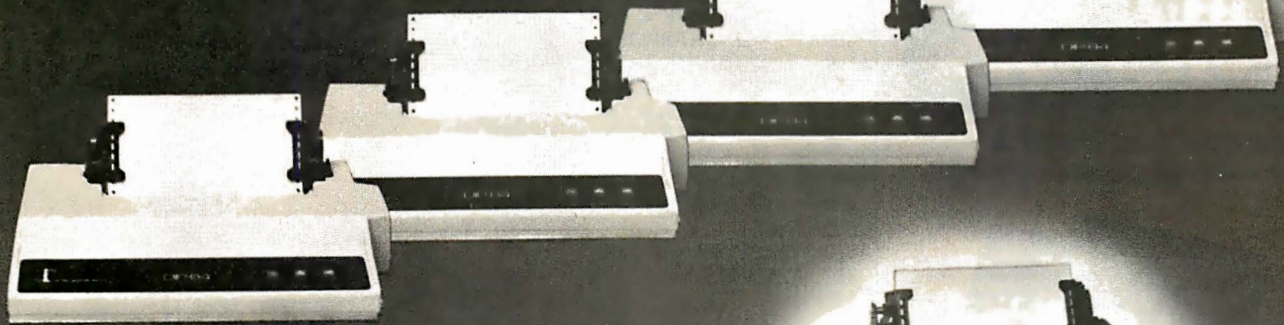
NCE Supply Corp.  
915 W. Liberty Drive  
Wheaton, IL 60187

Phone: 800-323-1780 Toll Free  
\* 312-682-0001 Within Illinois

TELEX 724389ATT NCE  
• Distribution Worldwide •



DIP-84  
PRINTER



DIP-82  
PRINTER

DIP-85  
PRINTER

# Hi-Q<sup>\*</sup> Printers

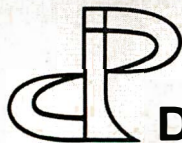


DIP-81  
PRINTER  
**\$499<sup>00</sup>**  
RETAIL

- 100 CPS Bidirectional
- 100% Continuous Duty Cycle
- High Performance
- Low Profile for Desk Top Installation

- Low Cost
- 100 Million Character Print Head
- Stylish, Measures 15" wide, 9" deep & 3.5" high
- Human-Engineered for Ease of Service

*\*High-Quotient of performance to cost.*



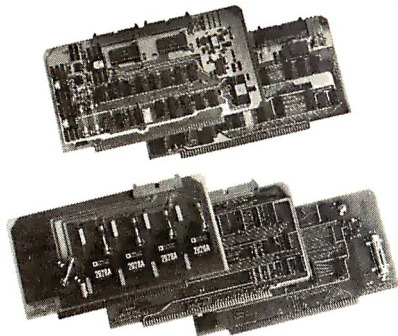
**DIP, inc.**

**DISTRIBUTOR/DEALER INQUIRIES INVITED**

745 Atlantic Avenue, Boston, MA 02111 • (617) 482-4214

# TOUGHEST BOARDS IN TOWN FOR S-100's

**Monitor and control  
in wicked environments.**



Want to put your S-100 system to work in the world of computerized monitoring and process control?

Dual Systems has all the boards it takes to do the job in the toughest factory environments. All are designed to function dependably in the real world of industrial control. All operate with Cromemco, North Star and other S-100 systems.

**A/D board.** 12-bit precision. 32 single-ended inputs. Or 16 differential inputs. 25  $\mu$ s conversion time. Vectored interrupt. \$635. Or \$725 with 1 to 1000 gain transducer amplifier. Works with our thermocouple compensation board and our 4-20 mA input boards as well.

**D/A board.** Four independent channels. 12-bit precision. Input is binary or 2's complement. Compatible with all existing I/O mapped software. \$495. Drives our amplifier board which outputs 4-20 mA.

**CMOS RAM board.** On-board battery back-up preserves data a year. 200 ns read/write time. Runs at 4 MHz. 8K bytes \$590. 16K bytes \$990.

**CMOS clock board.** On-board battery back-up keeps clock running a year. New LSI chip carries date, hours, minutes and seconds. Read or write directly from I/O port. Vectored interrupt. \$250.

We also provide complete main-frame systems. OEM and dealer inquiries are invited.

Contact Dual Systems Control Corp., Dept. B, 1825 Eastshore Hwy., Berkeley, CA 94710. Phone (415) 549-3854.

## DUAL

**THE NEW RELIABLES**

## Technical Forum

*Listing 1 continued:*

```

420 NEXT
430 ' { CASE CHARPOS% OF }
440 IF CHARPOS% = 4 THEN
      CUME = CUME + (ADDER * 4096)
450 IF CHARPOS% = 3 THEN
      CUME = CUME + (ADDER * 256)
460 IF CHARPOS% = 2 THEN
      CUME = CUME + (ADDER * 16)
470 IF CHARPOS% = 1 THEN
      CUME = CUME + ADDER
480 ' { END CASE }
490 CHARPOS% = CHARPOS% - 1
500 NEXT
510 BASETEN = CUME
520 RETURN
530 '
540 '
550 '---CONVERTS OBJECT CODE TO BASIC DATA LINES---
560 '
570 FOR I = DBASE TO LASTBYTE STEP 8
580 LNUM$ = STR$(LNUM) + " "
590 DATL$ = LNUM$ + "DATA "
600 FOR J = 0 TO 7
610 BYTE = PEEK(I+J)
620 '
630 IF J = 7 THEN
      BYTE$ = STR$(BYTE)
    ELSE
      BYTE$ = STR$(BYTE) + "" + CHR$(44) + ""
640 '
650 DATL$ = DATL$ + BYTE$
660 NEXT
670 PRINT DATL$ : ' TO CRT
680 PRINT #1, DATL$ : ' TO FILE
690 LNUM = LNUM + 10
700 NEXT
710 RETURN
999 END

```

**Listing 2:** A "verification run" of DATALINE in a CP/M operating-system environment shows that assembly-language object code is converted into DATA statements for embedding in a BASIC program.

A>asm qtab.aax

CP/M ASSEMBLER — VER 1.0

```

; ROUTINE TO INITIALIZE TAB STOPS ON QUME
;
; ***** ASEG *****
; ***** DECLARATIONS *****
9000 = CACHE EQU 9000H ; ROUTINE ORIGIN
00F8 = SERSTAT EQU 0F8H
00F9 = SERDAT EQU 0F9H
0040 = SDR EQU 40H
0080 = STBE EQU 80H
001B = ESC EQU 27D
0020 = SPC EQU 32D
000D = CR EQU 13D
000A = LF EQU 10D
0009 = HT EQU 09H
0001 = ONE EQU 01H
000F = SI EQU 15D
000E = SO EQU 14D
000A = NUMTBS EQU 10D
;
9000 ORG CACHE
;
; BEGIN MAIN PROGRAM*****
INIT:
9000 210000 LXI H,0000H ;ZERO REGISTER SO THAT
9003 39 DAD SP ;VALUE PASSED TO H = SPC
;SETTING
9004 226890 SHLD OLDSTK ;SAVE OLD STACK POINTER
;ADDRESS

```

*Listing 2 continued on page 222*

**ΩMEGA**  
SALES  
CO.

**"WHOLESALE COMPUTER PRICES"  
DIRECT TO THE PUBLIC**

East Coast: 12 Meeting St., Cumberland, RI 02864  
West Coast: 3533 Old Conejo Rd., #102, Thousand Oaks, CA 91320



Intertec Superbrain  
32K Ram - \$2449  
64K Ram - \$2649



NEC spinwriter  
5510-5530 - \$2449



Apple II - 16K, 48K  
Call for Price



Epson MX-80 - \$599



Diablo 630 - \$1995  
(with tractor feed) \$2195



Televideo  
912 B or C — \$699  
920 C — \$769

**PRODUCT SPECIAL  
of the MONTH!!**



**Products are  
NOW  
IN  
STOCK  
AT  
ΩMEGA  
Sales  
Co.**

**Atari 800 16K - \$749  
32K - \$849**

**Atari 850 Interface Module \$159  
Atari 825 Printer \$695**

**Okidata  
Microline 80 -  
525**

Centronics - Ltd. quan.	
730-3	\$ 525
737-1	\$ 625
704-9	\$1250
730-1	\$ 525
753	\$1750
703-9	\$1550

**ΩMEGA OFFERS THE BEST DELIVERY AND PRICE ON:**  
APPLE • ATARI • TRS-80 Model II • INTERTEC •  
DIABLO • EPSON • HEWLETT—PACKARD • SOROC •  
COMMODORE • NEC • QUME • CENTRONICS

**CALL TOLL FREE FOR ΩMEGA'S PRICE!  
EAST COAST: 1-800-556-7586**

ΩMEGA sells only quality merchandise to our customers.  
ΩMEGA will try to match any current advertised price with similar purchase conditions.  
Before you buy anywhere else — be sure to call ΩMEGA Sales Co.  
WEST COAST: 1-805-499-3678 EAST COAST: 1-401-722-1027



**Telex: 952106**

ΩMEGA ships via UPS, truck, or air. COD's.  
Visa, Mastercharge accepted, with no service charge.



*Accurate...  
and Lightning Fast!*



## the CompuPro Disc Controller Board is here.

Speed? The **CompuPro Disc Controller Board** has properly implemented DMA (direct memory access), with arbitration, and fully conforms to all IEEE 696/S-100 specifications. Runs with 6 MHz Z80s\* as well as 8080, 8085, and 8088 CPUs.

Versatility? Controls single or double sided disc drives, 5" or 8" discs (including 96 track high density minifloppies), single or double density (soft sector).

Reliability? Uses industry-standard, third generation controller chips and the same design excellence that is a part of every **CompuPro** product.

**We weren't going to put out another me-too disc controller board. . .and we didn't.**

**CompuPro**<sup>TM</sup>  
OAKLAND AIRPORT, CA 94614

from

**GODBOUT**  
ELECTRONICS  
(415) 562-0636

\*Z80 is a trademark of Zilog

Call (415) 562-0636, 9 AM to 5 PM PST, for the name of your nearest **CompuPro** retailer.

# the CompuPro Systems Approach:

## High Performance, High Throughput.

Unlike "all-in-one" computers, **CompuPro's** modular S-100 systems are amazingly flexible machines that are ideal for high level industrial, commercial, and scientific applications. Full conformance to all IEEE 696/S-100 specifications ensures well integrated systems performance, as well as freedom from obsolescence in the years to come.

All **CompuPro** products meet the most demanding mechanical and electrical standards, accept the highest possible clock speeds for maximum throughput, and are backed with one of the best - if not the best - warranties in the business (1 year limited warranty on all products, 2 year limited warranty with board exchange program for boards qualified under the Certified System Component program).

When you're looking for a computer, there are lots of choices. But when you need a precision machine that is built for the future as well as the present, the choice narrows down to the most experienced name in the S-100 business: **CompuPro**.

## NEW! COMPUTER ENCLOSURE 2

**Introductory price: \$795** (specify rack mount or desk top version)

Now it's easy to move up to an expandable S-100 system. . **COMPUTER ENCLOSURE 2** is ready to accept boards the minute it's unpacked. Fused, constant voltage power supply provides +8A at 25 Amps (!), +16V at 3 Amps, and -16V at 3 Amps. Also includes 20 slot shielded/active terminated motherboard, dual AC outlets on rear, heavy-duty line filter, circuit breaker, quiet ventilation fan, reset switch, and black anodized front panel (desktop version includes textured vinyl painted cover). Rack mount version includes slides for easy pull-out from rack frame.

Also available: **COMPUTER ENCLOSURE 1**. Same as above, but less power supply and motherboard. \$289 desktop, \$329 rack mount.

## SYSTEM SUPPORT 1 MULTIFUNCTION BOARD

**\$295 Unkit, \$395 A/T, \$495 CSC**

This multi-purpose S-100 board provides your computer with the most needed system support functions - at less cost than buying numerous single function boards. Includes sockets for 4K of extended address EPROM or RAM (2716 pinout), 1 socket with battery backup; crystal controlled month/day/year/time clock with BCD outputs; optional high speed math processor (9511 or 9512); full RS-232 serial port; three 16 bit interval timers (cascade or use independently); two interrupt controllers service 15 levels of interrupts; power fail indicator with provision to switch CMOS memory to battery backup; and comprehensive owner's manual with numerous software examples. Conforms fully to all IEEE 696/S-100 standards.

Want to make your S-100 system more versatile? **System Support 1** is the answer. (Add \$195 to the above prices for the optional 9512 math processor.)

## NEW LOWER PRICE ON 16K MEMORY EXPANSION-8 RAMS/\$35

Just what you would expect from the memory leader: top quality, low power, high speed (200 ns) 16K dynamic RAMs, backed up with a 1 year limited warranty. Expand memory in TRS-80\*-I, -II and -III computers (Color model too) as well as machines made by Apple, Exidy, Heath H89, newer PETs, etc. Add \$3 for two dip shunts plus TRS-80\* conversion instructions. Limited quantity.

## S-100 HIGH PERFORMANCE MOTHERBOARDS

Actively terminated, fully shielded motherboards handle clock speeds up to 10 MHz. Unkits have edge connectors and termination resistors pre-soldered in place for easy assembly.

20 slot motherboard with edge connectors - Unkit **\$174**, A/T **\$214**

12 slot motherboard with edge connectors - Unkit **\$129**, A/T **\$169**

6 slot motherboard with edge connectors - Unkit **\$89**, A/T **\$129**

## OTHER S-100 BUS PRODUCTS

Active Terminator Board.....\$34.50 Kit  
Memory Manager Board.....\$59 Unkit, \$85 A/T, \$100 CSC  
Mullen Extender Board.....\$59 Kit  
Mullen Relay/Opto-Isolator Control Board.....\$129 Kit, \$179 A/T  
Spectrum color graphics board.....\$299 Unkit, \$399 A/T, \$499 CSC  
2708 EPROM Board (2708s not included).....\$85 Unkit, \$135 A/T, \$195 CSC  
Interfacer 1 (dual RS-232 serial ports).....\$199 Unkit, \$249 A/T, \$324 CSC  
Interfacer 2 (3 parallel + 1 serial port).....\$199 Unkit, \$249 A/T, \$324 CSC

\*LEGAL CORNER: Z80A is a registered trademark of Zilog; TRS-80 is a trademark of the Tandy Corporation; PASCAL/M is a trademark of Sorcim; CP/M is a registered trademark of Digital Research.

## HIGH SPEED S-100 CPU BOARDS 8 BIT CPU Z

Like many others, we claim full conformance to IEEE 696/S-100 specifications; unlike many others, we'll send you the timing specs to prove it. CPU Z includes all standard Z-80A\* features along with power on jump, on-board fully maskable interrupts for interrupt-driven systems, selectable automatic wait state insertion, provision for adding up to 8K of on-board EPROM, and 16/24 bit extended addressing. Works with 6 MHz CPUs; supplied with 4 MHz CPU. **\$225 Unkit, \$295 A/T, \$395 CSC.**

## 16/8 BIT CPU 8085/88

The only board that bridges the 8 bit world of the present and the 16 bit world of the future. By using an 8088 CPU (for 16 bit power with a standard 8 bit bus) in conjunction with an 8 bit 8085, CPU 8085/88 is downward compatible with 8080/8085 software, upward compatible with 8086/88 software (as well as Intel's coming P-Series), designed for professional-level high speed applications, and capable of accessing 16 megabytes of memory. . .while conforming fully to all IEEE 696/S-100 standards (timing specs available on request).

Looking for a powerful 8 bit CPU board? Looking for a powerful 16 bit CPU board? Then look at CPU 8085/88, the best of both worlds.

Prices: **\$295 Unkit, \$425 A/T** (both operate at 5 MHz); **\$525 CSC** (with 5 MHz 8085, 6 MHz 8088). Owner's manual available separately for \$5.

## 8 BIT CPU 8085

This is a single 8 bit processor version of the above board, and may be easily upgraded to full 16 bit operation at a later date. **\$235 Unkit, \$325 A/T, \$425 CSC.**

## SOFTWARE

### 8088/8086 MONITOR-DEBUGGER: \$35

Supplied on single sided, single density, soft-sector 8" disc. CP/M\* compatible. Great development tool; mnemonics used in debug conform as closely as possible to current CP/M\* DDT mnemonics.

### PASCAL/M\* FROM SORCIM: \$175 COMPLETE

PASCAL - easy to learn, easy to apply - can give a microcomputer with CP/M\* more power than many minis. We supply a totally standard **Wirth PASCAL/M\* 8"** diskette and comprehensive manual. Specify Z-80\* or 8080/8085 version.

## S-100 MEMORIES

CompuPro memories feature fully static design to eliminate dynamic timing problems, full conformance to all IEEE 696/S-100 specifications, high speed operation (4/5 MHz Unkit, 10 MHz A/T and CSC), low power consumption, extensive bypassing, and careful thermal design.

	Unkit	A/T	CSC
8K RAM 2A.....	\$159	\$189	\$239
16K RAM 14 (extended addressing).....	\$279	\$349	\$429
16K RAM 20-16 (extended addressing and bank select).....	\$319	\$399	\$479
24K RAM 20-24 (extended addressing and bank select).....	\$429	\$539	\$629
32K RAM 20-32 (extended addressing and bank select).....	\$559	\$699	\$799
128K RAM 21-128 (extended addressing).....	n/a	n/a	\$2795

Most **CompuPro** products are available in Unkit form, Assembled/Tested, or qualified under the high-reliability **Certified System Component (CSC)** program (200 hour burn-in, more). **Note:** Unkits are not intended for novices, as de-bugging may be required due to problems such as IC infant mortality. Factory service is available for Unkits at a flat service charge.

**TERMS:** Prices shown do not include dealer installation and support services. Call res add tax. Allow at least 5% shipping; excess refunded. Orders under \$15 add \$2 handling. VISA® and Mastercard® orders (\$25 min) call our 24 hour order desk at (415) 562-0636. Include street address for UPS delivery. Prices are subject to change without notice.

**FREE CATALOG:** Want more information? Then send for our free catalog. For fast 1st class delivery, add 41 cents in stamps; foreign orders add \$2 (refundable with order).

**CompuPro™**

OAKLAND AIRPORT, CA 94614

division of

**GODBOUNT**  
ELECTRONICS

(415) 562-0636

**COMPUPRO PRODUCTS ARE AVAILABLE AT COMPUTER STORES  
WORLD-WIDE. . .CALL (415) 563-0636 FOR THE STORE NEAREST YOU.**

## SPECTACULAR OFFERS

BASF "FLEXIDISK" ...  
Superior Quality data  
storage medium.  
Certified and guaranteed  
100% error free.



SINGLE SIDED-SINGLE DENSITY

5 1/4" or 8" Diskettes ..... 10/\$24  
5 1/4" or 8" Vinyl Storage Pages ..... 10/\$5

MAXELL-DISKETTES  
The best quality  
diskette money can buy.  
Approved by Shugart  
and IBM.



Sold only in boxes of 10

5", 1 side ..... \$3.30  
8", 1-side ..... \$4.25  
5", 2-side ..... \$3.90  
8", 2-side ..... \$5.60

ALL MAXELL DISKETTES ARE DOUBLE DENSITY

LIBRARY CASE...  
3-ring binder album.  
Protects your valuable  
programs on disks  
Fully enclosed and  
protected on all sides.  
Similar to Kas-sette storage box.



Library 3-Ring Binder ..... \$6.50  
5 1/4" Mini Kas - sette/10 ..... \$2.49  
8" Kas-sette/10 ..... \$2.99

DISKETTE DRIVE HEAD CLEANING KITS  
Prevent head crashes and  
insure efficient, error-  
free operation.



5 1/4" or 8" ..... \$19.50

SFD CASSETTES  
C-10 Cassettes ..... 10/\$7  
(All cassettes include box & labels)  
Get 8 cassettes, C-10 sonic and  
Cassette/8 library album for  
only ..... \$8.00  
(As illustrated)



HARDHOLE  
Reinforcing ring of  
tough mylar protects  
disk from damage



8" Applicator \$4 5 1/4" Applicator \$3  
50/8" Hardholes \$8 5 1/4" Hardholes \$6

VISA • MASTERCARD • MONEY ORDERS  
CERTIFIED CHECK • FOR PERSONAL CHECKS  
ALLOW TWO WEEKS • C.O.D. REQUIRES A 10%  
DEPOSIT • CAL. RES. ADD 6% SALES TAX  
MIN \$2 SHIPPING & HANDLING • MINIMUM  
ORDER \$10 • SATISFACTION GUARANTEED  
OR FULL REFUND  
Write for our free catalog

# ABM PRODUCTS

631 B ST.  
SAN DIEGO, CA 92101  
(714)235-6602

## Technical Forum

Listing 2 continued:

```

9007 317A90      LXI      SP,STKTOP      ;SET UP LOCAL STACK
;
;
;MAIN:
900A 215190      LXI      H,PMODE      ;THIS PUTS QUME IN PRO-
;GRAM MODE
900D CD4190      CALL     SCAN      ;READ SERIES LINE AND SEND
;IT
;
;TAB0: ;ACTUAL MESSAGE LOAD BEGINS HERE
9010 B7          ORA      A          ;CLEAR FLAGS
9011 1E0A        MVI      E,NUMTBS  ;SETS FOR CARRIAGE WIDTH
;
;TAB1:
9013 215790      LXI      H,TAB8SP
9016 CD4190      CALL     SCAN
9019 216090      LXI      H,SETTAB
901C CD4190      CALL
    
```

A>asm qtab.aaz  
CP/M ASSEMBLER — VER 1.0

907A  
003H USE FACTOR  
END OF ASSEMBLY

A>type qtab.hex  
:1090000021000039226890317A90215190CD419011  
:10901000B71E0A215790CD4190216090CD41901DFF  
:10902000C21390215490CD4190216390CD41903155  
:109030006890C30000DBF8E680CA3590C979D3F99F  
:10904000C9B77EFE24C84FCD3590CD3D9023C34196  
:10905000901B0E241B0F24202020202020202024C1  
:069060001B31240D0A245F  
:0090000070

A>ddt qtab.hex  
SID VERS 1.4  
NEXT PC END  
9066 9000 677F  
#q0

A>b:  
B>basic dataline  
BASIC Rev. 5.1  
[CP/M Version]  
Copyright 1977, 78, 79, 80 (C) by Microsoft

Created: 14-Jan-80  
5595 Bytes free

---MACHINE CODE / DATA LINE WRITER---

Enter hex base address of object code 9000  
Routine length in 64-byte segments 2  
Enter name of data statement file bytes.dat  
Enter line number of starting data statement 5000  
5000 DATA 33, 0, 0, 57, 34, 104, 144, 49  
5010 DATA 122, 144, 33, 81, 144, 205, 65, 144  
5020 DATA 183, 30, 10, 33, 87, 144, 205, 65  
5030 DATA 144, 33, 96, 144, 205, 65, 144, 29  
5040 DATA 194, 19, 144, 33, 84, 144, 205, 65  
5050 DATA 144, 33, 99, 144, 205, 65, 144, 49  
5060 DATA 104, 144, 195, 0, 0, 219, 248, 230  
5070 DATA 128, 202, 53, 144, 201, 121, 211, 249  
5080 DATA 201, 183, 126, 254, 36, 200, 79, 205  
5090 DATA 53, 144, 205, 61, 144, 35, 195, 65  
5100 DATA 144, 27, 14, 36, 27, 15, 36, 32  
5110 DATA 32, 32, 32, 32, 32, 32, 32, 36  
5120 DATA 27, 49, 36, 13, 10, 36, 0, 0  
5130 DATA 0, 0, 0, 0, 0, 0, 0, 0  
5140 DATA 0, 0, 0, 0, 0, 0, 0, 0  
5150 DATA 0, 0, 0, 0, 0, 0, 0, 0

Ok■

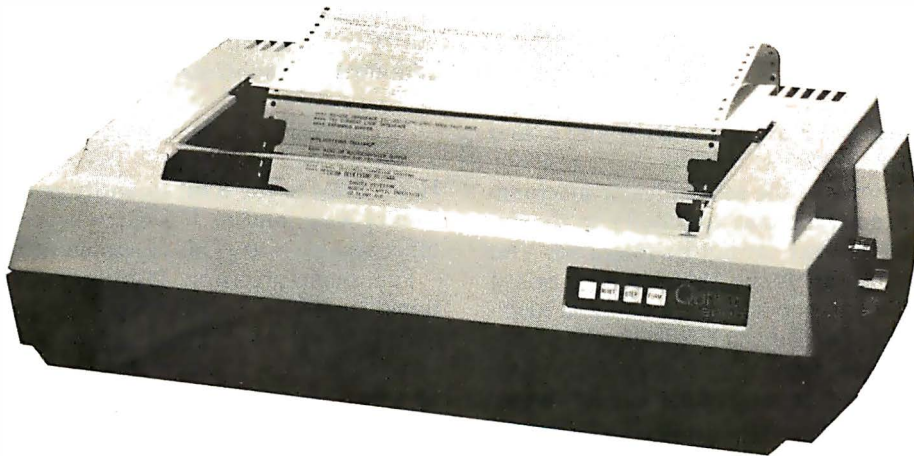
# MORE BANG

## Qantex Impact Printers 150 Characters Per Second 136 Columns Per Line

The microprocessor controlled Series 6000 is packed with standard features. True lower case descenders and underlining. Bidirectional logic seeking. Built-in test capability. Rugged 400 million character print head. Beautiful 96 character set in a 9 x 9 matrix. Parallel, or up to 19,200 baud serial interfaces supporting RS-232, X-ON, X-OFF or Current Loop. Full operator controls. Quietized, sleek enclosure to enhance your system. Delivery from stock.

### Qantex Division of North Atlantic Industries

60 Plant Avenue, Hauppauge, N.Y. 11787  
(516) 582-6060 TWX 510-227-9660  
(800) 645-5292



For more information call your local distributor:

<b>ARIZONA</b> Tempe Qualtech 602-967-4655	<b>CALIFORNIA</b> Inglewood Basic Systems 213-673-4300	<b>CALIFORNIA</b> San Diego Basic Systems 714-268-8000	<b>CALIFORNIA</b> Santa Clara Basic Systems 408-727-1800	<b>ILLINOIS</b> Addison Engineered Sales 312-832-8425	<b>INDIANA</b> So. Bend Audio Specialists 219-234-5001
<b>LOUISIANA</b> New Orleans Micro Computer Of New Orleans 504-885-5883	<b>MINNESOTA</b> Edina Integrated Peripherals 612-831-0349	<b>MINNESOTA</b> St. Paul Vikeland Sales 612-645-4647	<b>MISSOURI</b> Independence Computer Dataco 816-254-3600	<b>MISSOURI</b> St. Louis ESC Sales & Leasing 314-997-1515	<b>NEW MEXICO</b> Albuquerque Qualtech 505-255-6100
<b>AUSTRALIA</b> Sydney Mitsui Computer Systems 02-9299921	<b>BELGIUM</b> Brussels Computata Belgium 7205066	<b>CANADA</b> Toronto Computer Markets 416-445-1978	<b>FAR EAST</b> Hong Kong Equipment 5-453870	<b>FRANCE</b> Paris Gepsi 1-554-9742	<b>GERMANY</b> Munich Technitron 49(89)692-4141
					<b>THE NETHERLANDS</b> Computata Benelux B.V. 73-215700

Distributor inquiries welcome!

## Addition and Subtraction: The 1802 Versus the Z80

Stephen Merrin, 4470 NW Alpha Pl, Apt 6, Corvallis OR 97330

Binary arithmetic is inherently simple because it involves only 0s and 1s. But recently, while I was trying to understand the instruction sets of two very different microprocessors, the 1802 and the Z80, I became confused when examining addition and subtraction operations. The confusion arose primarily over the notion of "borrow" in subtraction.

When you perform multiple-byte additions and subtractions, instructions like ADD WITH CARRY and SUBTRACT WITH BORROW (CARRY) are needed. In the *1802 User Manual* the instruction SUBTRACT MEMORY WITH BORROW is defined as performing the following:

$$D - M(R(X)) - (\text{NOT } DF) \rightarrow DF, D$$

Here, 8-bit arithmetic is being performed. DF is the borrow (carry) bit and  $M(R(X))$  and D are 8-bit operands. On the other hand, in the Z80, you have the instruction SBC *s*, SUBTRACT WITH CARRY, which accomplishes:

$$A - A - s - CY$$

This operation involves the 8-bit operands A and *s*, and CY is the borrow (carry) bit.

If you are a programmer at the assembly- or machine-language level, you are aware that ambiguity in the description of the instruction set cannot be tolerated. You need to know such things as: Is the 1802 DF bit 0 or 1 if the result of subtracting two positive numbers is negative? Is the Z80 flag CY 0 or 1 if the result of subtracting two positive numbers is negative? (Oddly enough, even though CY and DF serve the same purpose in both microprocessors, the answer for the 1802 is opposite that of the Z80.)

My objective for this exercise was to explain to myself exactly what was happening at the bit level during these addition and subtraction operations. I also wanted to formulate a simple model of the operation. As it turned out, in the 1802, all addition and subtraction operations are very neatly and cleanly lumped into one category. In the Z80, however, the picture is not so simple. While the Z80 has a large and powerful instruction set which I prefer to that of the 1802, the 1802 has a certain elegant simplicity.

What I wanted to do was to first set up a model for binary addition and subtraction, without reference to any particular processor, then show how the 1802 and Z80 addition and subtraction operations could be inter-

preted in terms of my model. I wanted my model to reflect the inherent simplicity that I ascribed to binary arithmetic.

In addition to 8-bit arithmetic operations, the Z80 also allows for 16-bit and even 4-bit operations, the latter being used in BCD (binary-coded decimal) manipulations (the half-carry flag H is the analog of the other carry flag CY). In the 1802, except for incrementing and decrementing the 16-bit registers R(N), all arithmetic operations use 8-bit operands. In my model, I am concerned only with 8-bit operations and how they can be used to implement multiple-byte additions and subtractions.

A unified model for addition and subtraction is possible because a subtraction operation can actually be viewed as an addition operation. Addition and subtraction can be accomplished with the same hardware, provided there are circuits to do complementation.

Let X and Y be 8-bit quantities.  $\bar{Y}$  will denote the one's complement of Y ( $\bar{Y}$  is again an 8-bit quantity, obtained by replacing each 1 with a 0 and each 0 with a 1). Let  $c_i$  and  $c_o$  denote 1-bit values, called respectively "carry in" and "carry out." In my general model, all 8-bit additions and subtractions take the form:

$$X + Y + c_i - c_o, SUM$$

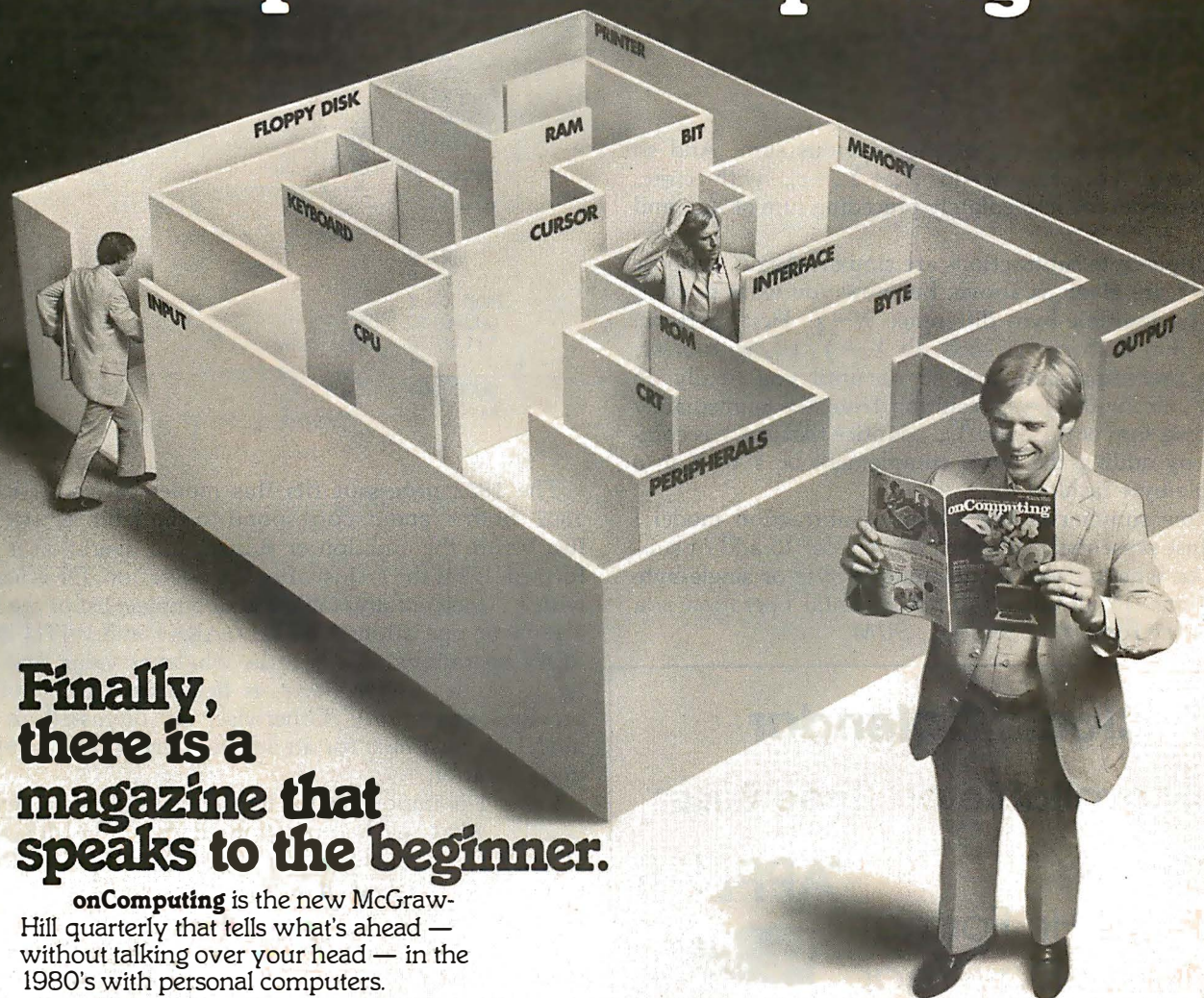
Here, SUM is the 8-bit quantity resulting from the addition of X, Y, and  $c_i$ . If a carry is generated, then  $c_o = 1$ ; otherwise  $c_o = 0$ . This is shown in figure 1.

For single-precision (1-byte) additions and subtractions,  $c_i = 0$  for addition and  $c_i = 1$  for subtraction. For multiple-byte operations,  $c_i$  will take on the value of  $c_o$  generated in the last performed operation. The results of an addition or subtraction will be in two's complement form. The 8-bit quantity  $\bar{Y} + 1$  (and throw away the carry, if there is one) is the two's complement of Y.

If you wish to add X and Y, you do  $X + Y + c_i$  with  $c_i = 0$ ; if you wish to compute the difference  $X - Y$ , you do  $X + \bar{Y} + c_i$  with  $c_i = 1$  (ie: add the two's complement of Y to X). Thus, as advertised, both the sum and difference of X and Y can be regarded as taking the form of an addition. The distinction is that, for subtraction,  $c_i$  has a different value and the one's complement  $\bar{Y}$  is used. Some examples are shown in figure 2.

The following is how multiple-byte sums are done. Suppose we have  $X = X_m, X_{m-1}, \dots, X_1$  (an *m*-byte sequence) and  $Y = Y_m, Y_{m-1}, \dots, Y_1$ , where each  $X_k$  and  $Y_k$  is 8 bits. Let's say that you want to compute the multiple-byte sum  $X + Y$ . You first perform  $X_1 + Y_1 + c_i$  with  $c_i = 0$ . Then do

# Let onComputing be your guide to personal computing.



**Finally,  
there is a  
magazine that  
speaks to the beginner.**

**onComputing** is the new McGraw-Hill quarterly that tells what's ahead — without talking over your head — in the 1980's with personal computers.

**onComputing** puts you on target with all the applications that go beyond your imagination.

- ☐ Personal computers in the home.
- ☐ Classrooms.
- ☐ They bring computer music.
- ☐ Electronic mail.
- ☐ Robots.
- ☐ They manage your personalized investment.
- ☐ The list goes on and on in **onComputing**.

If you're a beginner with personal computers, get the most understood magazine on computers, **onComputing**. And even if you're an experienced computer user, **onComputing** has the information you need in today's fast-growing personal computer market.

**onComputing**<sup>TM</sup>



**Get onto onComputing. Call 800-258-5485.**

**onComputing** Subscription Dept. P.O. Box 307, Martinsville, NJ 08836

7B31

DOMESTIC subscription rate:

☐ U.S. 1 yr. (4 issues) @ \$8.50 ☐ Canada & Mexico, 1 yr. (4 issues) @ \$10.00

FOREIGN (to expedite service, please remit in U.S. funds drawn on a U.S. bank)

☐ Europe (and all other countries, except above), 1 Yr. @ \$12.00 — surface delivery.

☐ Bill Visa ☐ Bill Master Charge ☐ Bill me (North America only)

Card Number

Expiration

Signature

Name (please print)

Street/Apartment Number

City

State/Province/Country Code

Please allow 6-8 weeks for processing.

©onComputing, Inc. 1981

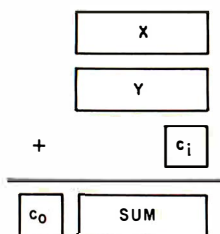


Figure 1: A pictorial model of the addition of  $X$ ,  $Y$ , and  $c_i$  to give  $SUM$  and the carry bit  $c_o$ .

$X_2 + Y_2 + c_i$  where  $c_i = c_o$  of the previous sum. And so forth until you finally do  $X_m + Y_m + c_i$ , with  $c_i = c_o$  resulting from the immediately preceding sum of  $X_{m-1}$  and  $Y_{m-1}$ .

Multiple-byte subtractions are similar. Again, suppose  $X$  and  $Y$  are given as above, but now you want to compute the multiple-byte difference  $X - Y$ . First, perform  $X_1 + Y_1 + c_i$  with  $c_i = 1$ . Next do  $X_2 + Y_2 + c_i$  with  $c_i = c_o$  of the preceding sum; and so on until you finally do  $X_m + Y_m + c_i$  with  $c_i = c_o$  resulting from the immediately preceding sum of  $X_{m-1}$  and  $Y_{m-1}$ . Notice that  $X - Y$  is computed by adding the two's complement of  $Y$  to  $X$  in a multiple-byte fashion.

Let me summarize the addition/subtraction model I have just presented. Whether you choose to add or subtract, or whether you want multiple-byte or single-byte operations, in all cases the fundamental operation is a sum of the form  $X + Y + c_i \rightarrow c_o, SUM$ .

$$\begin{array}{r} X = 5 \\ Y = 6 \\ \text{Find } X + Y \\ 00000101 \\ 00000110 \\ + \quad 0 \\ \hline 00001011 \\ c_o = 0 \end{array} \quad \begin{array}{l} X \\ Y \\ c_i \\ X + Y \end{array}$$

$$\begin{array}{r} X = 5 \\ Y = 6 \\ \text{Find } X - Y \\ 00000101 \\ 11111001 \\ + \quad 1 \\ \hline 11111111 \\ c_o = 0 \end{array} \quad \begin{array}{l} X \\ Y \\ c_i \\ X - Y \end{array}$$

$$\begin{array}{r} X = 6 \\ Y = 5 \\ \text{Find } X - Y \\ 00000110 \\ 11111010 \\ + \quad 1 \\ \hline 00000001 \\ c_o = 1 \end{array} \quad \begin{array}{l} X \\ Y \\ c_i \\ X - Y \end{array}$$

Figure 2: Some examples of a unified model for binary addition and subtraction.  $c_i$  and  $c_o$  are 1-bit values called "carry in" and "carry out." If a carry is generated by the addition of  $X$  and  $Y$ , then  $c_o = 1$ ; otherwise  $c_o = 0$ .

The 1802 processor fits this model perfectly. In the 1802, both  $c_i$  and  $c_o$  correspond to the 1-bit register DF. Just before the addition or subtraction operation is performed, DF is the  $c_i$ . Just after the operation, DF is loaded with  $c_o$ . (Incidentally, table 1 is a complete list of the 1802 arithmetic operations.) WITH CARRY and WITH BORROW operations take  $c_i$  to be whatever value that currently resides in DF (ie:  $c_i$  is determined by  $c_o$  of the previous operation). Otherwise, as discussed in my model,  $c_i$  must be 0 for an addition and 1 for a subtraction operation.

Table 1 is important for two reasons. First, it reveals exactly what each operation does. ( $D + M(R(X)) + DF \rightarrow DF, D$  is much clearer than  $D - M(R(X)) - (\text{NOT } DF) \rightarrow DF, D$ .) Second, it is obvious that, without exception, each addition and subtraction operation has the form  $X + Y + c_i \rightarrow c_o, SUM$ . This last fact is no accident, since (presumably) the same hardware is used for all operations.

In the Z80, the 1-bit carry flag CY serves the same function as the DF flag does in the 1802. In contrast with the 1802, where the DF bit corresponds exactly with the model's  $c_i$  and  $c_o$ , there is a distinction in the Z80 between an addition and a subtraction as far as the role of the CY is concerned. Consider this example that points out this distinction. Is the computation  $5 - 3$  the same as  $5 + (-3)$ ? That is, in the Z80, is there any difference in the outcome between the assembly-language sequences (LD A,05 SUB 03) and (LD A,05 ADD FD)? (FD is the two's complement representation of  $-3$ , written in hexadecimal.) While the end result is 02 in A for both computations, the final value of CY is not the same. When you do  $5 - 3$ ,  $CY = 0$ . When you do  $5 + (-3)$ ,  $CY = 1$ . If you do analogous operations in the 1802,  $DF = 1$  in both cases. How do you make sense out of all this?

Table 2 describes what occurs within the Z80 in terms of my model. Four classes of operations are shown in the table: add, add with carry, subtract, and subtract with carry.  $X$  and  $Y$  are arbitrary 8-bit operands within the

## Clock/Calendar

Now available on Three Buses

### Features

- 12/24 Hr. Format
- Month-Day-Year
- Day of Week
- Leap Year Bit
- 4 Interrupts
- +/- 30 Sec. Adjust
- Battery Backup
- Simple to Program

\*APPLE II



\*TRS-80



\$100



S-100 or Apple

A&T \$150  
Kit \$100  
Bare Bd. \$ 60

TRS-80

A&T Only \$150

**LAX COMPUTER PRODUCTS**

4728 Manhattan Beach Blvd.  
Lawndale, CA 90260  
(213) 542-4505

WE ACCEPT  
VISA, MC  
& AMER. EXP.

\* Apple is a Trademark of Apple Computer Co.

\* TRS80 is a Trademark of Tandy Corp.

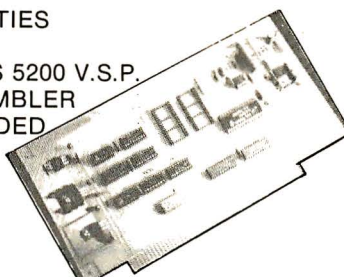
2716 (5V) \$9.95 4116 200NS \$3.75 2114L 300NS \$3.75

## NEW! IT TALKS

### "FAST TALKERS S-100"

LOW DATA RATE S100 SPEECH BOARD

- ★ UNLIMITED SPEECH POSSIBILITIES
- ★ S100 INTERFACE
- ★ USES TEXAS INSTRUMENT TMS 5200 V.S.P.
- ★ SOFTWARE VOICE DATA ASSEMBLER
- ★ 32 WORD VOCABULARY INCLUDED
- ★ AUDIO AMP W/SPEAKER
- ★ ASSEMBLED AND TESTED



NEW TECHNOLOGY SPEECH PROCESSOR  
ALLOWING UNLIMITED SPEECH POSSIBILITIES  
DELIVERY FROM STOCK

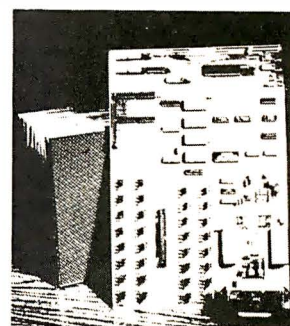
TMS-5200 VOICE SYNTHESIS PROCESSOR

Chip with Data Sheet \$69.00

**\$329.**

## "CONTROL TALKER II"

- ★ 110V 50/60 HZ
- ★ 32 INPUT LINES (TTL)
- ★ 32 10 AMP (50V) OUTPUT LINES
- ★ Z80 BASED SYSTEM
- ★ 8K PROM (SOCKET)
- ★ 1K RAM
- ★ VOICE OUTPUT
- ★ SINGLE BOARD
- ★ STEPPING MOTOR CONTROL (UP TO 8)



Control Talker II can be used to control stepping motors, relays, counters, etc., and support a variety of uses including robotics, telephone dialer, digital access, security, auto drilling, measuring, counting and virtually unlimited applications with added speech output to advise of status etc. Put one to work for you today!

**\$550.**

POLYESTER CAPACITORS + & - 10% TOLERANCE 50V				74LS TTL				% WT & 1/2 WT CARBON FILM 5% RESISTORS				CERAMIC DISC CAPACITORS 50V				LINEAR M = 8 PIN N = 14/16 PIN				4000 CMOS B SERIES ONLY			
Value	1+	25+	100+	Part#	Price	74LS150	30	74LS152	.70	10	100	1K	10K	100K	1M	Value	1+	25+	100+	Part#	Price	4000	Price
.001mf	13	11	08	74LS150	.30	74LS151	.30	74LS153	.79	12	120	1.2K	12K	120K	1.2M	4.7pf	07	06	04	LF355M	1.10	4001	35
.0012mf	13	11	08	74LS151	.30	74LS152	.30	74LS154	1.45	13	130	1.3K	13K	130K	1.3M	10pf	07	06	04	LF355M	1.10	4002	35
.0015mf	13	11	08	74LS152	.30	74LS153	.30	74LS155	.89	14	140	1.4K	14K	140K	1.4M	22pf	07	06	04	LF357M	1.10	4003	35
.0018mf	13	11	08	74LS153	.30	74LS154	.30	74LS156	.89	15	150	1.5K	15K	150K	1.5M	33pf	07	06	04	LM301AM	35	4004	1.05
.0022mf	13	11	08	74LS154	.30	74LS155	.30	74LS157	.89	16	160	1.6K	16K	160K	1.6M	39pf	07	06	04	LM307M	35	4005	1.05
.0027mf	13	11	08	74LS155	.30	74LS156	.30	74LS158	.89	17	170	1.7K	17K	170K	1.7M	47pf	07	06	04	LM308M	100	4006	1.15
.0033mf	13	11	08	74LS156	.30	74LS157	.30	74LS159	.89	18	180	1.8K	18K	180K	1.8M	56pf	07	06	04	LM309M	35	4007	35
.0039mf	13	11	08	74LS157	.30	74LS158	.30	74LS160	1.10	19	190	1.9K	19K	190K	1.9M	68pf	07	06	04	LM311M	85	4008	45
.0047mf	13	11	08	74LS158	.30	74LS159	.30	74LS161	.95	20	200	2K	20K	200K	2M	100pf	07	06	04	LM318M	1.95	4009	45
.0056mf	13	11	08	74LS159	.30	74LS160	.30	74LS162	.95	21	210	2.1K	21K	210K	2.1M	150pf	07	06	04	LM324M	90	4010	35
.0068mf	13	11	08	74LS160	.30	74LS161	.30	74LS163	.95	22	220	2.2K	22K	220K	2.2M	220pf	07	06	04	LM339M	99	4011	35
.0082mf	13	11	08	74LS161	.30	74LS162	.30	74LS164	1.05	23	230	2.3K	23K	230K	2.3M	330pf	07	06	04	LM337M	2.40	4012	35
.01mf	13	11	08	74LS162	.30	74LS163	.30	74LS165	1.05	24	240	2.4K	24K	240K	2.4M	470pf	07	06	04	LM380M	1.25	4013	50
.012mf	13	11	08	74LS163	.30	74LS164	.30	74LS166	1.89	25	250	2.5K	25K	250K	2.5M	001mf	07	06	04	LM381M	1.95	4014	85
.015mf	13	11	08	74LS164	.30	74LS165	.30	74LS167	1.19	26	260	2.6K	26K	260K	2.6M	0022mf	07	06	04	LM382M	1.25	4015	75
.018mf	14	12	09	74LS165	.30	74LS166	.30	74LS168	.89	27	270	2.7K	27K	270K	2.7M	0033mf	07	06	04	LM383M	1.95	4016	55
.022mf	14	12	09	74LS166	.30	74LS167	.30	74LS169	1.19	28	280	2.8K	28K	280K	2.8M	0047mf	07	06	04	LM384M	1.95	4017	1.05
.027mf	14	12	09	74LS167	.30	74LS168	.30	74LS170	1.85	29	290	2.9K	29K	290K	2.9M	01mf	07	06	04	LM385M	1.95	4018	95
.033mf	14	12	09	74LS168	.30	74LS169	.30	74LS171	.75	30	300	3K	30K	300K	3M	0022mf	07	06	04	LM386M	1.65	4019	55
.039mf	15	13	10	74LS169	.30	74LS170	.30	74LS172	.75	31	310	3.1K	31K	310K	3.1M	0033mf	07	06	04	LM387M	1.25	4020	1.10
.047mf	15	13	10	74LS170	.30	74LS171	.30	74LS173	.75	32	320	3.2K	32K	320K	3.2M	0047mf	07	06	04	LM388M	1.25	4021	1.10
.056mf	16	13	10	74LS171	.30	74LS172	.30	74LS174	.75	33	330	3.3K	33K	330K	3.3M	01mf	07	06	04	LM389M	1.25	4022	75
.068mf	17	14	11	74LS172	.30	74LS173	.30	74LS175	.75	34	340	3.4K	34K	340K	3.4M					LM709N	1.65	4023	75
.082mf	17	14	11	74LS173	.30	74LS174	.30	74LS176	.75	35	350	3.5K	35K	350K	3.5M					LM710N	75	4024	85
.1mf	18	15	12	74LS174	.30	74LS175	.30	74LS177	.75	36	360	3.6K	36K	360K	3.6M					LM711N	35	4025	35
.12mf	20	17	14	74LS175	.30	74LS176	.30	74LS178	.75	37	370	3.7K	37K	370K	3.7M					LM747N	35	4026	1.45
.15mf	22	18	15	74LS176	.30	74LS177	.30	74LS179	.75	38	380	3.8K	38K	380K	3.8M					LM1458M	55	4027	50
.18mf	24	20	16	74LS177	.30	74LS178	.30	74LS180	.75	39	390	3.9K	39K	390K	3.9M					LM1390PN	60	4028	75
.22mf	26	22	17	74LS178	.30	74LS179	.30	74LS181	.75	40	400	4K	40K	400K	4M					LM1436N	1.25	4029	1.15
.27mf	30	25	20	74LS179	.30	74LS180	.30	74LS182	.75	41	410	4.1K	41K	410K	4.1M							4030	50
.33mf	33	28	22	74LS180	.30	74LS181	.30	74LS183	.75	42	420	4.2K	42K	420K	4.2M							4031	2.55
.39mf	37	31	25	74LS181	.30	74LS182	.30	74LS184	.75	43	430	4.3K	43K	430K	4.3M							4032	99
.47mf	40	34	28	74LS182	.30	74LS183	.30	74LS185	.75	44	440	4.4K	44K	440K	4.4M							4033	99
				74LS183	.30	74LS184	.30	74LS186	.75	45	450	4.5K	45K	450K	4.5M							4034	99
				74LS184	.30	74LS185	.30	74LS187	.75	46	460	4.6K	46K	460K	4.6M							4035	99
				74LS185	.30	74LS186	.30	74LS188	.75	47	470	4.7K	47K	470K	4.7M							4040	1.15
				74LS186	.30	74LS187	.30	74LS189	.75	48	480	4.8K	48K	480K	4.8M							4041	1.15
				74LS187	.30	74LS188	.30	74LS190	.75	49	490	4.9K	49K	490K	4.9M							4042	1.05
				74LS188	.30	74LS189	.30	74LS191	.75	50	500	5K	50K	500K	5M							4043	95
				74LS189	.30	74LS190	.30	74LS192	.75	51	510	5.1K	51K	510K	5.1M							4044	95
				74LS190	.30	74LS191	.30	74LS193	.75	52	520	5.2K	52K	520K	5.2M							4045	1.15
				74LS191	.30	74LS192	.30	74LS194	.75	53	530	5.3K	53K	530K	5.3M							4046	1.35
				74LS192	.30	74LS193	.30	74LS195	.75	54	540	5.4K	54K	540K	5.4M							4047	1.35
				74LS193	.30	74LS194	.30	74LS196	.75	55	550	5.5K	55K	550K	5.5M							4048	99
				74LS194	.30	74LS195	.30	74LS197	.75	56	560	5.6K	56K	560K	5.6M							4049	50
				74LS195	.30	74LS196	.30	74LS198	.75	57	570	5.7K	57K	570K	5.7M							4050	50
				74LS196	.30	74LS197	.30	74LS199	.75	58	580	5.8K	58K	580K	5.8M							4051	1.10
				74LS197	.30	74LS198	.30	74LS200	.75	59	590	5.9K	59K	590K	5.9M							4052	1.10
				74LS198	.30	74LS199	.30	74LS201	.75	60	600	6K	60K	600K	6M							4053	85
				74LS199	.30	74LS200	.30	74LS202	.75	61	610	6.1K	61K	610K	6.1M							4054	39
				74LS200	.30	74LS201	.30	74LS203	.75	62	620	6.2K	62K	620K	6.2M							4055	39
				74LS201	.30	74LS202	.30	74LS204	.75	63	630	6.3K	63K	630K	6.3M							4056	39
				74LS202	.30	74LS203	.30	74LS205	.75	64	640	6.4K	64K	640K	6.4M							4057	39
				74LS203	.30	74LS204	.30	74LS206	.75	65	650	6.5K	65K	650K	6.5M							4058	295
				74LS204	.30	74LS205	.30	74LS207	.75	66	660	6.6K	66K	660K	6.6M							4059	89
				74LS205	.30	74LS206	.30	74LS208	.75	67	670	6.7K	67K	670K	6.7M							4060	1.39
				74LS206	.30	74LS207	.30	74LS209	.75	68	680	6.8K	68K	680K	6.8M							4061	39
				74LS207	.30	74LS208	.30	74LS210	.75	69	690	6.9K	69K	690K	6.9M							4062	35
				74LS208	.30	74LS209	.30	74LS211	.75	70	700	7K	70K	700K	7M							4063	35
				74LS209	.30	74LS210	.30	74LS212	.75	71	710	7.1K	71K	710K	7.1M							4064	35
				74LS210	.30	74LS211	.30	74LS213	.75	72	720	7.2K	72K	720K	7.2M							4065	35
				74LS211	.30	74LS212	.30	74LS214	.75	73	730	7.3K	73K	730K	7.3M							4066	39
				74LS212	.30	74LS213	.30	74LS215	.75	74	740	7.4K	74K	740K	7.4M							4067	35
				74LS213	.30	74LS214	.30	74LS216	.75	75	75												

Operation	Operands Used That Match the Formula:			
	Operation Code	X	+ Y	+ $c_i$ - $c_o$ , SUM
ADD	F4	$M(R(X))$	+ D	+ 0 → DF, D
ADD IMMEDIATE	FC	$M(R(P))$	+ D	+ 0 → DF, D
ADD WITH CARRY	74	$M(R(X))$	+ D	+ DF → DF, D
ADD WITH CARRY IMMEDIATE	7C	$M(R(P))$	+ D	+ DF → DF, D
SUBTRACT D	F5	$M(R(X))$	+ $\overline{D}$	+ 1 → DF, D
SUBTRACT D IMMEDIATE	FD	$M(R(P))$	+ $\overline{D}$	+ 1 → DF, D
SUBTRACT D WITH BORROW	75	$M(R(X))$	+ $\overline{D}$	+ DF → DF, D
SUBTRACT D WITH BORROW IMMEDIATE	7D	$M(R(P))$	+ $\overline{D}$	+ DF → DF, D
SUBTRACT MEMORY	F7	D + $\overline{M(R(X))}$		+ 1 → DF, D
SUBTRACT MEMORY IMMEDIATE	FF	D + $\overline{M(R(P))}$		+ 1 → DF, D
SUBTRACT MEMORY WITH BORROW	77	D + $\overline{M(R(X))}$		+ DF → DF, D
SUBTRACT MEMORY WITH BORROW IMMEDIATE	7F	D + $\overline{M(R(P))}$		+ DF → DF, D

Table 1: Arithmetic operations of the 1802 microprocessor.

Operation performed	X + Y	X + Y with carry	X - Y	X - Y with carry
Equivalent sequence of steps taken within the Z80 to perform the given operation	CY ← 0 $c_i$ ← CY SUM = X + Y + $c_i$ CY ← $c_o$	$c_i$ ← CY SUM = X + Y + $c_i$ CY ← $c_o$	CY ← 0 $c_i$ ← $\overline{CY}$ SUM = X + $\overline{Y}$ + $c_i$ CY ← $\overline{c_o}$	$c_i$ ← $\overline{CY}$ SUM = X + $\overline{Y}$ + $c_i$ CY ← $\overline{c_o}$

Table 2: Addition and subtraction operations in the Z80 microprocessor.

## No More Puns



From BD Software, available through Lifeboat Associates for a measly \$145. While this compiler is only a subset of the incredible Unix\* C, it is a subset designed to fit comfortably on CP/M systems and be maximally useful for *non*-number-crunching applications; i.e., there are no inherent floating point or long variable types. You do get: fast and reasonably short object code, quick compilation and linking, powerful hooks into CP/M, plus plenty of docs and sample programs.

Try it and . . .  
er, ahem . . . well,  
you know.

Unix is a trademark of Bell Laboratories.

CP/M is a trademark of Digital Research.

LIFEBOAT ASSOCIATES, 1651 3rd Ave., N.Y., N.Y. 10028  
Ph: (212) 860-0300. Telex: 640693.

Z80. Notice that the "with carry" operations (ADC, SBC) are distinguished from the others only in that CY is not initially zeroed. The peculiar feature of table 2 (in comparison with table 1) is that, when doing a subtraction, the CY bit is complemented beforehand to obtain  $c_i$ . Following the operation,  $c_o$  is complemented to yield the final value for CY. This explains why  $5-3$  and  $5+(-3)$  are not equivalent in the Z80 (as far as the end result of CY is concerned). When the operation performed is a subtraction, CY takes on the complement of  $c_o$ .

As an illustration of the importance of the above considerations, suppose that you want to compute  $X-Y$  (where X and Y are 8-bit positive values). Then you want to branch according to whether the result is negative or positive. In the 1802,  $DF=1$  means that the result was positive, and a branch is made based on the value of DF. Suppose in the Z80 you wish to branch according to CY (the branching could also be done according to the sign bit; however, there are cases when using CY is more convenient, such as a shift operation that follows a subtraction). The problem is not so straightforward now, because in the Z80, it is crucial to know whether or not  $X-Y$  was computed using a subtraction operation. If so, flag  $CY=0$  means the result was positive. ■

**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. We also ask that correspondents supply their telephone numbers, which will not be printed.

# COMPUTERS—TERMINALS—MODEMS!

## MODEMS AND COUPLERS

*Connect your Apple, TRS-80 or any other computer or terminal to the phone lines!*

Penril



**Penril  
300/1200**

Penril 300/1200—Bell 212A style ..... \$799  
Bell 212A style. 1200 baud and 300 baud. Manual originate, auto-answer. Full duplex. RS232. Direct connect to phone lines via RJ11C standard extension phone voice jack. 1 year warranty.



**U.S. Robotics  
USR-330A  
Bell 103/113 style  
USR-330D  
Bell 103/113 style**

USR-330D ..... \$339

Bell 103/113 style. 330 baud. Manual originate, auto-answer. Half/full duplex. RS232. 1 year warranty. Direct connect to phone lines via RJ11C standard extension phone voice jack.

USR-330A ..... \$399  
Same as USR-330D but includes auto-dial capability.



**U.S. Robotics  
The  
Phone Link  
Acoustic  
Modem**

Bell 103/113 style ..... \$179  
300 baud. Sleek, low profile. Originate and answer capability. Half/full duplex. Self-test. RS232. Light displays for On, Carrier, Test, Send Data, Receive Data. 15 oz.

### Digital Equipment Corporation



**DEC VT100**

DEC VT100 ... \$1668

Detachable keyboard. Separate numeric keypad with function keys. Business forms character set. Reverse video. Selectable double-size characters. Bidirectional smooth-scrolling. 80 cols or 132 cols. Split screen. Settable tabs. Line drawing graphic characters. Status line. Key-Click.

### CRT's

**Perkin-Elmer  
Corporation**



**Superowl 1251**

Perkin-Elmer Superowl 1251 ..... \$1564  
Intelligent, editing CRT. Detachable keyboard. 32 fully programmable function keys. Intelligent printer part. Business forms character set. Block mode. Protected fields. Blinking fields. Numeric fields. Reverse video. Half intensity. Polling. Down line loading of options. Remote control of all options by host computer. Settable tabs. Status line. Separate numeric keypad. Transparent mode.

### Perkin-Elmer Corporation



**Bantam 550B .... \$694**  
Compact. Silent. Upper/lower case. 80th col. wrap-around. Bell. Integrated numeric pad. Printer port. Transparent mode. Editing features. Tabbing.

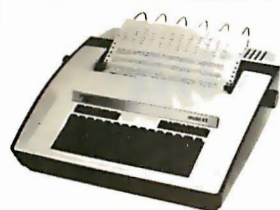
**Bantam 550E... \$755**  
Same as 550B plus separate numeric keypad and cursor direction keys.

**Bantam 550S ..... \$879**  
Same as 550E plus block mode. 8 function keys, and protected fields, reverse video fields, half intensity fields, blinking fields.

### 550 Options

20mA Current Loop Interface ..... \$70  
Non-Glare Screen ..... \$25  
2nd page of memory (550S only) .. \$100

## HARDCOPY TERMINALS



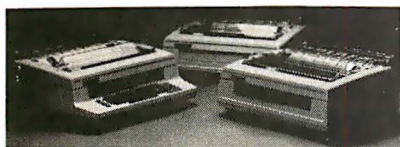
**Teletype  
Model 43**

**Teletype  
Corporation**

Teletype Model 43 KSR with RS232 and Connector Cable ..... \$999  
30 CPS. Dot matrix. 132 cols. True descenders on lower case. Excellent print quality for dot matrix printer. Pin feed.

### NEC Corporation

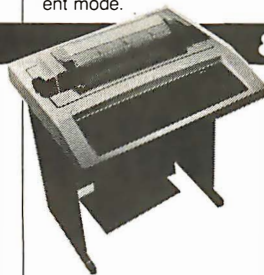
**NEC Spinwriter 5510 & 5520**



5520 KSR Spinwriter ..... \$3088  
55 CPS. Impact printer. Selectric print quality. Changeable print fonts. 110, 300 and 1200 baud data rate. Numeric keypad. Friction and tractor feed.

5510 Spinwriter ..... \$2754  
55 CPS. Impact printer. Selectric print quality. Changeable print fonts. 110, 300 and 1200 baud data rate. Friction and tractor feed.

## & PRINTERS



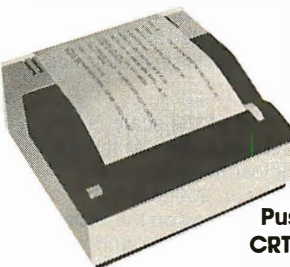
**DEC LA120**

**Digital Equipment  
Corporation**

DEC LA120 ... \$2388

180 CPS. Dot matrix. Upper/lower case. 1K buffer. Designed for 1200 baud communications. 30 character answerback message. Adjustable line spacing. Adjustable character sizes including double sized characters. Settable horizontal and vertical tabs. Top-of-form capability. RS232.

**Perkin-Elmer  
Corporation**



**Pussycat 650/655  
CRT Screen Printer**

650/655 Pussycat CRT Screen Printer. \$899  
100 CPS. Extremely compact and quiet. 110 to 9600 baud rate. 2K buffer. Ideal for producing rapid, reliable hardcopy of your CRT screen display. Can be added to any CRT with our interface option.



**DEC LA34DA ... \$939**

30 CPS. Dot matrix. Upper/lower case. 4 character sizes. Up to 217 cols per line. 6 lines per inch settings. Friction feed. Settable tabs. RS232.

**DEC LA34AA ..... \$1095**  
30 CPS. Dot matrix. Upper/lower case. 8 character sizes including double size characters. 6 lines per inch settings. Up to 217 cols per line. Friction feed. Settable horizontal and vertical tabs. Top-of-form capability.

### Options for LA34AA and LA34DA

Tractor Feed Mechanism ..... \$114  
Numeric Keypad w/ Function Keys.. \$69  
Pedestal ..... \$100  
Paper Out Sensor ..... \$25  
APL Capability with APL Keycaps .. \$499  
2K Buffer with Text Editor and 1200 Baud Communications Capability ..... \$499



Leasing rates and lease/purchase plan information is available on request.  
All equipment is shipped with a 10 day money back guarantee.  
We offer full service, on site maintenance plans on all equipment.  
All equipment in stock.

**U.S. ROBOTICS INC.**  
203 N. WABASH SUITE 1718 CHICAGO, ILL 60601

SALES  
GENERAL OFFICES  
SERVICE

(312) 346-5650  
(312) 346-5651  
(312) 733-0497

# Desk-Top Wonders

## Hunt the Wumpus with Your HP-41C

Hank Librach, 52 Bulkley Dr, Fairfield CT 06430

Are you envious of all the people on your block who have their own microcomputer systems with fancy displays, sound effects, and all sorts of goodies? You needn't feel inferior any more. With the Hewlett-Packard HP-41C programmable calculator, you can do all these things by considering the display to be a one-line video display with 12-character capability. It will prompt you, make different-frequency sounds, and scroll its alphanumeric display.

You have probably played the popular Hunt the Wumpus game (in BASIC) on a microcomputer system. Now, you can hunt him on your HP-41C. This version of Hunt the Wumpus has all the excitement of the big game, including the ability to throw gas cans, get snatched by bats, or fall into a pit. You'll also be warned when the Wumpus, a pit, or bats are near.

The program will easily fit into an unexpanded HP-41C. With added memory modules and a bit of ex-

perimentation, many refinements are possible.

### Playing the Game

After entering the program as shown in listing 1 (on page 232), set the following:

- SIZE 018 (eighteen registers are used)
- FIX 0
- Enter the register data as shown in table 1
- ASN WUMP XEQ (assigns program to XEQ key)
- Put HP-41C in USER mode
- Press XEQ

At this point, you will be prompted with "SHOOT?" Enter your choice, YES or NO (you will automatically be in the ALPHA mode), and press RUN. You will be asked which room you wish to enter. Continue until you win or lose. Happy hunting!■

## LSI-11 SYSTEMS FROM ANDROMEDA

### Any size you want.



No matter what your LSI-11 system needs are, Andromeda can satisfy them.

For example, the 11/M1 system shown on the right weighs only 14 pounds yet contains 102kb of mini disk storage

(expandable to 389kb), 64kb of RAM, space for up to 16kb of EPROM, 4 serial ports, and the LSI-11/2 CPU. All of this for less than \$4000. While the 11/M1 will run the RT-11 operating system, it is best suited for dedicated applications where its small size but large processing power are needed.

Near the other end of the scale is the 11/H23-DDF system shown at the left. The mobile enclosure includes the LSI-11/23 processor, 256kb main memory, 10mb of storage on the double density RK-05 cartridge disk and 1.2mb on the double density floppy disks. This system also has 4 serial ports and 7 empty dual width slots for additional interfaces. The \$22,500 price includes the video terminal shown, a 150 CPS matrix printer, and the RT-11 operating system.

These are just two examples of the many LSI-11 based systems available from Andromeda. And the standard systems are just starting points; we will provide any combination of pack-



age, processor, memory, interfaces, and peripherals to meet your requirements. In addition to general purpose systems, we also have turnkey packages for word processing, time-sharing, data acquisition, and graphics.

We also provide individual boards, software and accessories to support LSI-11 systems.

LSI-11, RT-11, and RK-05 are trademarks of the Digital Equipment Corp.

**ANDROMEDA**  
**SYSTEMS**   
**INC.**  
9000 Eton Ave.  
Canoga Park, Calif. 91304

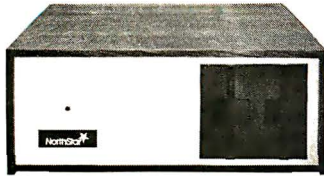
Phone: 213/709-7600

TWX: (910) 494-1248

Prices are domestic U.S.A. only.

# LOWEST PRICE - BEST QUALITY

## NORTH STAR



### North Star Horizon 2

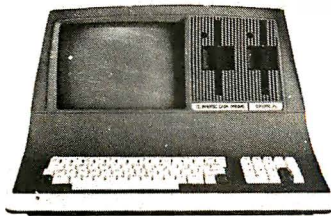
2-5 1/4 Disk Drives  
32K Double Den  
Factory assem. & tested  
Factory guaranteed  
List 3095

only **\$2274**

**POWERFUL NORTH STAR BASIC FREE  
SUPERB FOR BUSINESS & SCIENCE**

FACTORY ASSEMBLED & TESTED	LIST	ONLY
HORIZON-1-32K-DOUBLE DEN	\$2695	\$1980
HORIZON-2-32K-QUAD DENSITY	3595	2674
HORIZON-2-64K-QUAD + HARD DISK	9329	7149
HORIZON RAM ASSM 16K = \$389.		32K = \$579
HORIZON RAM KIT SALE! 16K = \$314		32K = \$469
HORIZON DISK DRIVE SALE DOUB DEN SAVE!		315
NORTH STAR HARD DISK 18 Mb	4999	\$3929
PASCAL-PLUS 14, 18 OR 36 DIGIT PRECISION		249

## SUPERBRAIN ZENITH



### SUPERBRAIN QD 64K

List \$3995 only \$2995



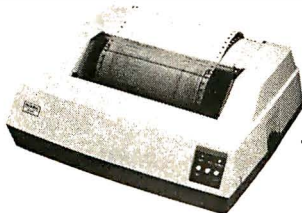
### Z-89 48K

List \$2895 only \$2299

**TERMINALS Z-19 \$725**

**INTERTUBE III only \$725**

**DIP-81 PRINTER only \$395**



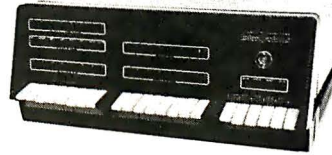
**MICROTEK \$675**

**NEC PRINTER \$2569**

**TRACTOR, THIMBLE, RIBBON**

## InterSystems

### ITHACA INTERSYSTEMS 2A



Z-80A CPU 4 MHz  
64K Dynamic RAM  
Front panel  
V I/O—with interrupts  
FDCII Disk Controller  
20 slot motherboard

List \$3595 You Pay Only **\$2795**

**PASCAL/Z + THE FASTEST PASCAL \$375**

**GET READY FOR ITHACA'S Z-8000**

**8086 16 BIT CPU & SUPPORT CARD SEATTLE \$575**

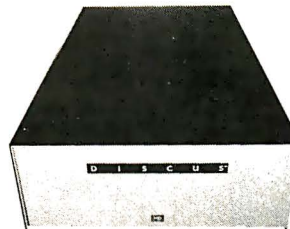
## MORROW 8" DISK

**DISCUS 2D + CP/M® 600K ONLY \$938**

**DISCUS 2 + 2 + CP/M® 1.2 MEGA B. \$1259**

**ADD DRIVES 2D = \$650 2 + 2 = \$975**

**2D-DUAL + CP/M® ONLY \$1555**



**MORROW HARD DISK  
26,000,000 BYTES!!**

**LIST \$4995 ONLY \$3995  
CP/M® IS INCLUDED!**

## SAVE ON MEMORY AND PROGRAMS

SYSTEMS MEMORY 64K A & T 4mHz	\$599	RCA-COSMAC VP-111 99 RCA-COSMAC VP-711	\$199
SYSTEMS MEMORY 64K BANK SELECT	\$789	COLOR! RAINBOW 385	\$289
CENTRAL DATA 64K RAM	\$599	SPECTRUM	\$289
ITHACA MEMORY 8/16-bit 64K	\$845	EZ-80 Machine Language Tutor	\$25
SEATTLE MEMORY 8/16 BIT 16K 4MHz	\$275	EZ-CODER Translates English to BASIC	\$71
SSM KITS Z-80 CPU	\$221	ECOSOFT FULL ACCOUNTING PKG	\$315
VIDEO BRD V83 4mHz	\$412	BOX OF DISKETTES	\$29
ANADEX PRINTER DP-9500-1	\$1349	SECRETARY WORD PROCESSOR	
CAT NOVAION MODEM	\$169	The Best! 99	
TARBELL DISK CONTROLLER DD	\$445	TEXTWRITER III Book Writing Program	\$112
ECONORAM 2A8K ASSM	\$179	GOFAST NORTH STAR BASIC Speeder	Upper 71
NSSE 1-22 & P01 TERRIFIC PROGRAMS	ONLY \$10. EACH	Which Computers are BEST? BROCHURE	FREE
NORTHWORD 294 MAILMAN 234		North Star Documentation refundable w/HRZ	\$20
INFOMAN	\$364		
TARBELL COMPUTER-PHONE			
AMERICAN SQUARE COMPUTERS BEATS ADV. PRICES			

square  
**American Computers**

919-889-4577

KIVETT DR. JAMESTOWN N.C. 27282

919-883-1105

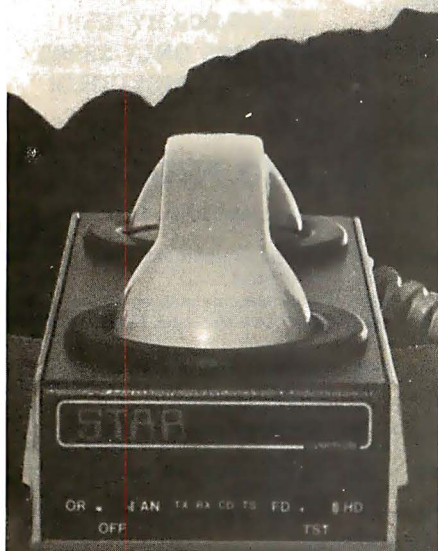
® CP/M is a registered trademark of Digital Research, Inc.

# The reachable star.

The STAR puts a quality 300 bps RS232 modem within reach of the small computer user...the same modem selected by IBM, GE, RCA, and ADP. The price? Under \$200!

We've designed this compact modem with exclusive triple-seal acoustic cups, crystal controlled oscillator, and built-in diagnostics and indicators. It's packaged inside an attractive injection molded case...and we stand behind the STAR with a two year warranty!

STAR models are available that interface directly with RS232 machines such as APPLE, ATARI, and NORTH STAR or IEEE 488 machines such as the PET, and that operate with either U.S. or European frequencies.



Available throughout the U.S., Canada, and Europe. For information and nearest dealer, call toll free (800) 227-2078, or (415) 447-2252 in California.

**Livermore**  
DATA SYSTEMS INC.

2050 Research Drive, Livermore, CA 94550

## Desk-Top Wonders

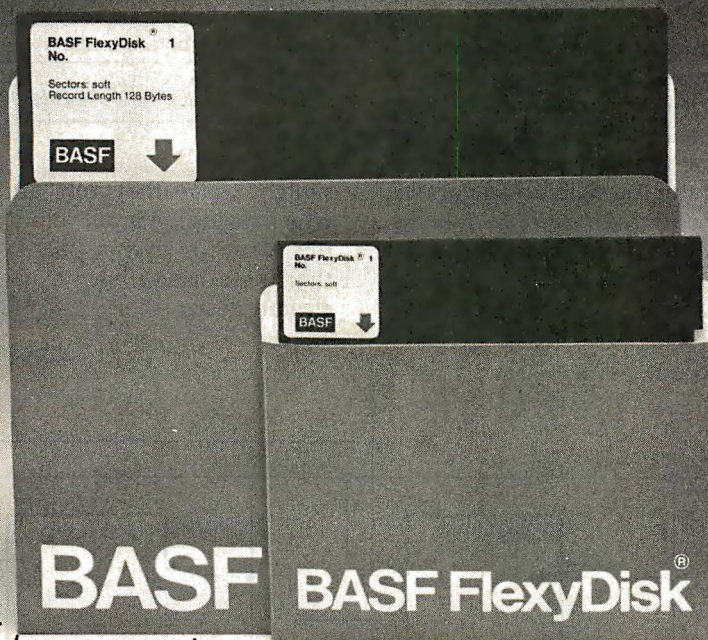
Register	Contents	Comments
R0	-	Your location, generated randomly
R1	2345	
R2	158 10	Room layouts, enter these values in ALPHA mode
R3	1467	
R4	1357	
R5	124 10	
R6	3789	
R7	3469	
R8	269 10	
R9	678 10	
R10	2589	Number of cans of gas, generated by program
R11	3	
R12	seed	Used for random number generation $0 < s < 1$
R13	-	Wumpus position
R14	-	Bat positions (all generated randomly)
R15	-	Pit position
R16	YES	Enter letters in ALPHA mode; used for string comparison
R17	NO	Enter letters in ALPHA mode; used for string comparison

**Table 1:** Register data used in the Hunt the Wumpus game for the HP-41C. A dash indicates data that varies from game to game. See the text for details on using the program.

**Listing 1:** Hunt the Wumpus for the HP-41C programmable calculator.

01 LBL "WUMP"	38 X<=Y?	75 "F CANS"	112 GTO 09
02 3	39 GTO 05	76 AVIEW	113 LBL 12
03 STO 11	40 "WUMPUS NEAR"	77 PSE	114 "FELL IN"
04 XEQ 01	41 AVIEW	78 "SHOOT?"	115 AVIEW
05 STO 13	42 LBL 05	79 ARCL 16	116 STOP
06 XEQ 01	43 RCL 14	80 "F"	117 LBL 13
07 STO 14	44 XEQ 06	81 ARCL 17	118 "TO ROOM:"
08 XEQ 01	45 X<=Y?	82 AVIEW	119 ARCL IND 00
09 STO 15	46 GTO 07	83 PSE	120 AVIEW
10 LBL 00	47 "BATS NEAR"	84 AON	121 PSE
11 XEQ 01	48 AVIEW	85 STOP	122 RTN
12 RCL 13	49 LBL 07	86 ASTO X	123 LBL 08
13 X=Y?	50 RCL 15	87 ROFF	124 1
14 GTO 00	51 XEQ 06	88 RCL 16	125 ST- 11
15 X<>Y	52 X<=Y?	89 X=Y?	126 XEQ 13
16 STO 00	53 GTO 14	90 GTO 08	127 STOP
17 LBL 09	54 "PIT NEAR"	91 XEQ 13	128 STO 00
18 XEQ 03	55 AVIEW	92 STOP	129 RCL 13
19 GTO 02	56 GTO 14	93 STO 00	130 -
20 GTO 14	57 LBL 06	94 LBL 04	131 X=0?
21 LBL 01	58 RCL 00	95 RCL 00	132 GTO 10
22 RCL 12	59 -	96 RCL 14	133 RCL 11
23 PI	60 ABS	97 -	134 X=0?
24 +	61 3	98 X=0?	135 GTO 15
25 21	62 RTN	99 GTO 11	136 "MISSED"
26 *	63 LBL 03	100 RCL 00	137 AVIEW
27 FRC	64 RCL 00	101 RCL 15	138 GTO 09
28 STO 12	65 "YOU ARE IN ROOM"	102 -	139 LBL 10
29 10	66 "F NO:"	103 X=0?	140 "GOT HIN"
30 *	67 ARCL X	104 GTO 12	141 AVIEW
31 INT	68 AVIEW	105 GTO 09	142 BEEP
32 1	69 PSE	106 LBL 11	143 STOP
33 +	70 PSE	107 XEQ 01	144 LBL 15
34 RTN	71 RTN	108 STO 00	145 "LOST"
35 LBL 02	72 LBL 14	109 "SNATCHED TO:"	146 AVIEW
36 RCL 13	73 "GOT"	110 ARCL 00	147 TONE 1
37 XEQ 06	74 ARCL 11	111 AVIEW	148 END

# Ten reasons why your floppy disk should be a BASF FlexyDisk®.



More than four decades of experience in magnetic media – BASF invented magnetic recording tape, the forerunner of today's wide range of magnetic media, back in 1934, and was the first independent manufacturer of IBM-compatible floppy disks.

Tough Tyvek sleeve – no paper dust, no static electricity.

Special self-cleaning jacket and liner help eliminate data errors and media wear and tear.

Packaging to suit your requirements – standard flip-top box, Kassette 10® storage case, or bulk pack.

Center hole diameter punched to more accurate standards than industry specifications, for top performance.

100% certification – every single disk is tested at thresholds 2-3 times higher than system requirements, to be 100% error-free.

Bi-axially oriented polyester substrate – for uniform and reliable performance year after year.

For the name of your nearest supplier, write BASF Systems, Crosby Drive, Bedford, MA 01730, or call 617-271-4030.

Cross-linked oxide coating – for low head wear and long trouble-free media life.

Total capability – one of two manufacturers in the world that makes both 8" and 5.25" models, has tape and disk experience, and manufactures floppy disk drives.

Double lubrication – lubricants both in the formula and on the disk surface, to minimize media wear due to head friction.



# BASF

Floppy Disks   Mag Cards   Cassettes   Computer Tapes   Disk Packs   Computer Peripherals

## Build a Simple Video Switch

Richard C Hallgren, Department of Biomechanics,  
College of Osteopathic Medicine, Michigan State University,  
East Lansing MI 48824

Although I know that there are many sophisticated ways of building a video switch, I am hard pressed to think of one that is easier to build, as inexpensive, or works as reliably as mine. In the process of building a CAI (computer-aided instruction) system, I needed a logic-controlled device to switch video to a video display at appropriate times. Because I had to transfer the video signal without excessive attenuation, I knew that the switch required a series impedance of less than 50 ohms at 10 MHz.

Motorola Semiconductor manufactures a quad bilateral switch (MC14016B) that is able to transfer frequencies up to 54 MHz, but the series resistance of each switch is in the neighborhood of 300 ohms. As I considered other alternatives, it occurred to me that if I took two of the devices and connected all eight of the switches in parallel, the series impedance would be approximately 37.5 ohms.

Figure 1 shows the schematic diagram of the video switch. Dropping the control line to ground opens the switch, and raising the control line to +5 V closes the switch.

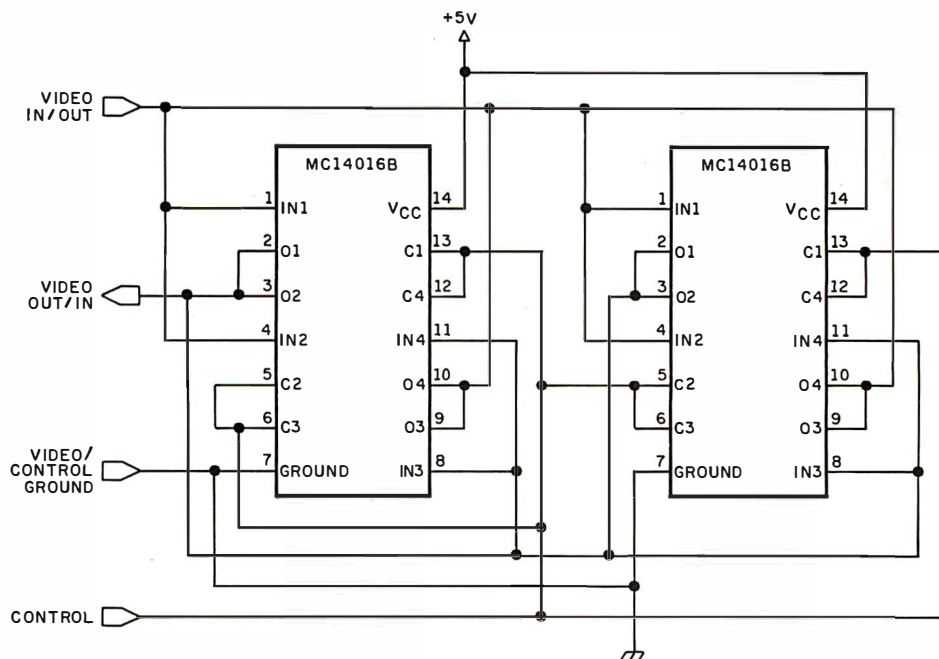


Figure 1: Schematic diagram of a simple video switch. The MC14016B integrated circuit is a Quad Analog Switch/Quad Multiplexer manufactured by Motorola Semiconductor.

### Quad Analog Switch/Quad Multiplexer

- High on/off output voltage ratio — 65 dB typical
- Quiescent current = 0.5 nA/package typical at 5 VDC
- Low crosstalk between switches — 80 dB typical at 1.0 MHz
- Diode protection on all inputs
- Supply voltage range = 3.0 VDC to 18 VDC
- Transmits frequencies up to 54 MHz at 5 VDC
- Linearized transfer characteristics
- Low noise — 12nV/ $\sqrt{\text{Cycle}}$ ,  $f > 1$  kHz typical
- Pin-for-pin replacement for CD4016, CD4066

### Maximum Ratings (voltage referenced to $V_{SS}$ )

Rating	Symbol	Value	Unit
DC supply voltage	$V_{DD}$	-0.5 to +18	VDC
Input voltage—all inputs	$V_{in}$	-0.5 to $V_{DD} + 0.5$	VDC
DC current drain per pin	1	10	mADC
Operating temperature range			
AL device	$T_A$	-55 to +125	°C
CU/CP device		-40 to +85	
Storage temperature range	$T_{stg}$	-65 to +150	°C

Table 1: Technical data for the MC14016B.

switch. Since the units are bilateral, it doesn't matter which line is the input or output. I have used the switch in this form for over a year, and it has performed so well that there hasn't been a need to replace it with a more elegant design. ■

DEALERS: By now you know that it takes . . . . .

# SOFTWARE TO SELL COMPUTERS

and International Micro Systems can provide you with the largest selection of quality business applications ever developed for the microcomputer industry.

If you are just looking for a G.L., A/P, and Payroll, you can find them in a dozen ads in this magazine. But there's a much bigger market for micros out there than that. Where can you find a fully interfaced Wholesale/Retail Distribution System? How about Manufacturing Inventory Control including Production Scheduling & Control. See that one anywhere else? Maybe your market is Medical/Dental and IMS has the full systems there too. You can't sell computers without software and IMS has the finest selection of software available for you. Each system has been developed by the IMS professional staff and we support what we sell.

But that's not all. International Micro Systems has the strongest dealer marketing plan in the industry. With our . . . . .

## \$245 Dealer Demo System.

we put all the software shown below in your office or store ready to demo to your prospects and we include the promotional material and our unique video sales presentation to help you move systems. Give us a call or drop us a card and let us show you what selling business systems should be all about.

### Financial Systems

- GL, A/P, A/R
- Payroll
- Cash Receipts/Disb.
- Job Costing
- Mailing List Mgmt.

### Medical/Dental

- Office Scheduler
- Patient Billing & A/R
- Insurance Forms

### Governmental/Educational

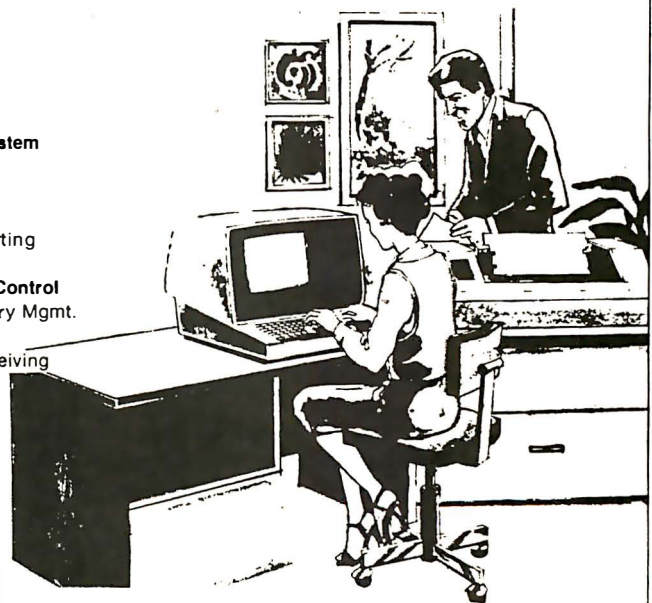
- Student Record Keeping and Scheduling
- Fund Accounting

### Wholesale Distribution System

- Purchasing & Receiving
- Inventory Control
- Invoicing & Receivables
- Salesman Comm. Reporting
- Backorder Management

### Manufacturing Inventory Control

- Finished Goods Inventory Mgmt.
- Parts Inventory Mgmt.
- Parts Purchasing & Receiving
- Bill of Material
- Production Scheduling



**I**NTERNATIONAL  
**M**ICRO  
**S**YSTEMS

For details on our demo special, contact us at:  
8425 Quivira Road, Lenexa, Kansas 66215  
Phone: (913) 888-8330

## Software Addressing Modes for the 8080

---

Dragan Bozinovic  
25 Wood St Apt 810  
Toronto, Ontario M4Y 2P9 Canada

---

If you have ever had to write a nontrivial program in Intel 8080 assembler, you probably missed the convenience of more sophisticated addressing modes such as indexed, indirect, and relative addressing. You may have also wished that you had an easy way to access data stored below the top of the stack.

Let's briefly review what Intel 8080 hardware offers in the area of addressing, along with suggestions for improvement:

1. *Direct addressing:* All 3-byte instructions are direct, with the absolute address stored in the last 2 bytes of the instruction. If you do not have a relocating assembler and loader, you must specify absolute starting addresses in your subroutines. This will force you to reassemble them whenever you have to change addresses. It would be convenient to have relative addressing instead, which would specify the displacement (positive or negative) of the referenced address relative to the address of the referencing instruction. Assemblers can easily calculate these displacements for you. All addresses in your subroutine will be independent of its starting location, allowing you to move the object code anywhere in memory. Relative addressing tends to confuse beginners, but they soon find that it is worth the effort to overcome the initial confusion.

2. *Implicit addressing:* Most instructions can reference the byte pointed to by the "data counter" (register pair HL), while a few accumulator-oriented instructions can use other registers as data counters. A nicer arrangement would be one in which any memory location could serve as a data counter, freeing the processor registers for more useful work. This is where indirect addressing comes in.

3. *Stack pointer addressing:* You can readily access the last 2 bytes stored in the stack, but if you think about retrieving bytes stored previously you may get a headache.

4. *Immediate data:* The instruction itself contains the data byte instead of an address.

What can software do to enhance the choice of addressing modes? If you're not overly concerned about execution speed, you may use software routines to create the illusion of having any addressing mode you desire. You will also need a few bytes of programmable (writable) memory.

How does it work? Just CALL the routine implementing the particular addressing mode, followed immediately by the instruction to be executed using that mode. That instruction will not be executed as is, but will provide the operation code and information necessary for EA (effective address) calculation. Instructions that are to be executed by hardware will be formed in programmable memory. After execution, control returns to the instruction following the pseudo-instruction unless it was a successful CALL or JMP. None of the registers are changed unless they are modified by the instruction to be executed.

Listing 1 contains detailed specifications of each routine and its source code. Concerning the programming conventions used, it may be noted that routines were developed using the Intel MAC80 assembler, which has only one location counter (\$). To define data storage close to the routines that use it, and still separate it physically into programmable memory, three predefined labels, PROG, DATA, and TEMP, are used to keep track of the addresses.

The basic idea behind the approach described here is that of covering hardware by a layer of software routines, creating an illusion of a machine that is easier to program. In fact, this is the concept behind the creation of a virtual machine. It can be expanded far beyond the basic addressing modes, particularly in the area of I/O (input/output) handling. This approach was developed to hide peripheral devices from the programmer, but the application to addressing modes is likely to be better understood by a wider circle of programmers. ■

Listing 1 and text box on pages 238 and 240.

# 16 BIT 8086 MICRO SYSTEM Tec-86 CP/M™-86

IEEE S-100 Bus — Available Now

Complete system up and operating

8086 System with Dual Floppy Disks

Available Now for only \$3990

CP/M-86™ only \$250

# CP/M-86 TEC-86 BREAK-THRU



Tec-86 / 8086 System

## \$3990

### Complete 8086 System for CP/M-86™

CP/M-86 Available Now - \$250 • IEEE 696 S-100 Compatible • 5 MHz 8086 CPU (Optional 4 or 8 MHz) • Vectored Interrupts • 24 Parallel I/O lines (three 8 bit ports) • Two RS-232 Ports • Baud rates from 50 to 19200 baud • Independent baud rate generator for each serial port • 32 Kilobytes of static RAM (Expandable) • ROM boot for CP/M-86™ • Dual 8-inch Shugart floppy disks with controller • Attractive, all metal desk top enclosure

CP/M-86™ registered trademark of Digital Research



Data Acquisition Systems and  
Video Digitization Systems Available  
23414 Greenlawn • Cleveland, OH 44122

**TECMAR, INC.**  
**(216) 382-7599**

## System Notes

**Listing 1:** Sophisticated addressing modes may be emulated on an Intel 8080 microprocessor with the use of these subroutines. They are passed values interpreted as pseudo-code, each setting up the proper absolute addresses, freeing the programmer from the bind of limited addressing. Similar routines could easily be developed for other processors.

Location	Object Code	Label	Operation	Operand				
A0DC			ORG	PROG	A108	ES	PUSH	H
A0DC					A109	EB	XCHG	
A0DC	E3	RELAT:	XTHL		A10A	5E	MOV	E,M
A0DD	F5		PUSH	PSW	A10B	23	INX	H
A0DE	D5		PUSH	D	A10C	56	MOV	D,M
A0DF	CD27A1		CALL	EMSUB	A10D	EB	XCHG	
A0E2	2B		DCX	H	A10E	E3	XTHL	
A0E3	2B		DCX	H	A10F	C319A1	JMP	EM1
A0E4	2B		DCX	H	000D		SET	\$(-INDRX
A0E5	C31DA1		JMP	EMEND	A112		SET	\$
000C		LENGTH	SET	\$(RELAT		PROG		
A0E8		PROG	SET	\$				
					A112		ORG	PROG
A0E8			ORG	PROG	A112		INDEX:	
A0E8	E3	SPNDX:	XTHL		A112	E3	XTHL	
A0E9	F5		PUSH	PSW	A113	F5	PUSH	PSW
A0EA	D5		PUSH	D	A114	D5	PUSH	D
A0EB	EB		XCHG		A115	D5	PUSH	D
A0EC	210600		LXI	H,6	A116	C319A1	JMP	EM1
A0EF	39		DAD	SP	0007		SET	\$(INDEX
A0F0	EB		XCHG		A119		SET	\$
A0F1	D5		PUSH	D	A119		SET	PROG
A0F2	C319A1		JMP	EM1	A119	CD27A1	CALL	EMSUB
000D		LENGTH	SET	\$(SPNDX	E1		POP	H
A0F5		PROG	SET	\$	A11D		EMEND:	
					A11D	19	DAD	D
A0F5		SPDEX:	ORG	PROG	A11E	22F167	SHLD	D
A0F5	E3		XTHL		A121	D1	POP	EMINS + 1
A0F6	F5		PUSH	PSW	A122	F1	POP	D
A0F7	D5		PUSH	D	A123	E1	POP	PSW
A0F8	E5		PUSH	H	A124	C3F0B7	POP	H
A0F9	210800		LXI	H,8			JMP	EMINS
A0FC	39		DAD	SP				
A0FD	E3		XTHL		A127		EMSUB:	
A0FE	CD39A1		CALL	EMS1B	A127	7E	MOV	A,M
A101	E1		POP	H	A128	32F0B7	STA	EMINS
A102	C31DA1		JMP	EMEND	A128	23	INX	H
0010		LENGTH	SET	\$(SPDEX	A12C	5E	MOV	E,M
A105		PROG	SET	\$	A12D	23	INX	H
					A12E	56	MOV	D,M
A105		INDRX:	ORG	PROG	A12F		EMSBR:	
A105	E3		XTHL		A12F	3E	DB	03EH
A106	F5		PUSH	PSW	A130	C3	DB	0C3H
A107	D5		PUSH	D	A131	32F387	STA	EMRTN
					A134	23	INX	H
					A135	22F4B7	SHLD	EMRTN + 1
					A138	C9	RET	
					A139		EMS1B:	
					A139	7E	MOV	A,M
					A13A	32F0B7	STA	EMINS
					A13D	C32FA1	JMP	EMSBR
					0027		SET	\$(EM1
					A140		SET	\$
					B7F0		ORG	TEMP
					B7F0		DS	3
					B7F3		DS	3
					B800		ORG	DATA
					B800		SET	\$
						DATA		

## the SORCIM Report

In the past three years, Sorcim's professionals have scored a string of software successes. These include:

- **PASCAL/M<sup>TM</sup>**, a complete implementation of the Wirth PASCAL language that supports the ISO standard.
- **TRANS 86<sup>TM</sup>**, a microprocessor code translator that converts existing 8080 or Z80 programs to run on Intel's 16 bit 8086/88 microprocessors.
- **The A.C.T.<sup>TM</sup>** series of cross assemblers that support virtually all popular CPUs.
- **Custom software** for specific businesses, as well as standard programs for OEM distribution.

In the months to come, Sorcim will introduce additional software tools that will continue our tradition of excellence. If you're not already familiar with our products and services, you should be; write today for a free brochure that shows how Sorcim's cost-effective software lets you unlock the full potential of today's - as well as tomorrow's - microcomputers.

Those of you who have already had a chance to experience the versatility and trouble-free operation of Sorcim products will be delighted to see what we'll be introducing in the future. Watch for our upcoming ads - there are more software success stories yet to come.

Sorcim is the source for microcomputer software tools.



1333 Lawrence Expressway, Suite 418  
Santa Clara, CA 95051  
(408) 248-5543

# ALL THESE FEATURES... IN THIS SMALL SPACE... AT THIS LOW PRICE!

## 4,695

Greater computer power . . . fewer separate components . . . larger capability . . . simpler to operate . . . modular maintenance . . .

These are the unique benefits of the Quasar Data QDP-100 Floppy Disk Computer . . . plus unsurpassed reliability...plus 12-month warranty on all PC boards.

Its highly reliable, industry-standard MFE drive is compact. Accepts both single AND double-sided disks.

Upgradeable from the Z-80™ microprocessor-based system to our Z8000™ microprocessor-based system by simply plugging in extra PC cards. Hard disk and multi-user systems available.

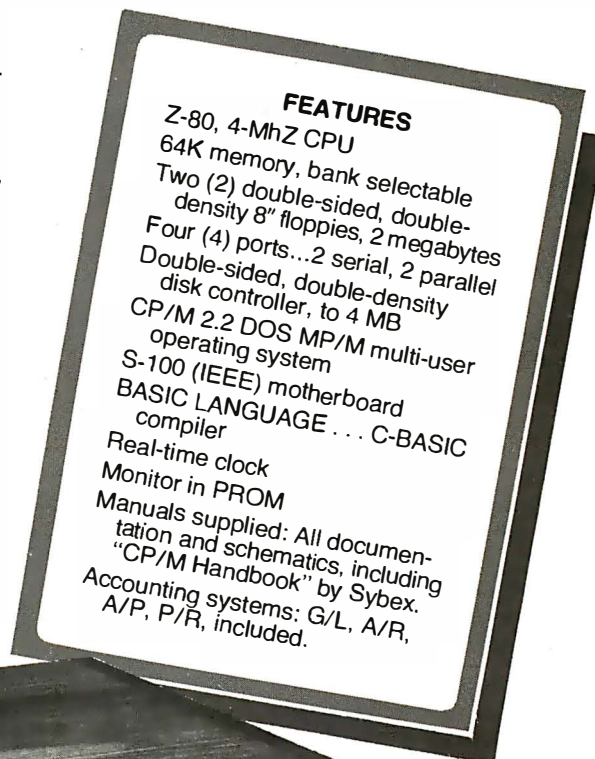
As your requirements grow, your QDP-100 can grow to fit them.

The Quasar Data QDP-100H is a larger version with 6-megabyte capacity; includes one double-sided floppy and one 5¼ microwinchster hard disk.

Both the Quasar Data QDP-100 and QDP-100H are fully compatible with all standard terminals.

Phone or write for descriptive bulletin and specifications. And ask for a demonstration. Dealer inquiries invited.

## QUASAR DATA'S QDP-100 COMPUTER SYSTEM.



18" wide  
16 7/8" deep  
11" high

Complete systems available

\*\*Z-80 and Z-28000  
are trademarks of Zilog Corporation

\*\*CP/M and MP/M  
are trademarks of Digital Research Corp.

## Quasar Data Products

10330 Brecksville Road, Brecksville (Cleveland), Ohio 44141  
Phone: 216/526-0838 / 526-0839  
Telex: 241596



## Interface Specifications

**Family:** EMUL

**Routines:** RELAT, INDEX, INDRX, SPNDX, SPDEX.

**Purpose:** This family of routines EMULates several addressing modes not implemented by Intel 8080 hardware.

**Description:** Routines consist of separate CALLable prefixes of code, common subroutine (EMSUB), and final processing routine (EMEND), grouped under the name EMUL (see listing 1). Prefixes of unnecessary routines may be removed. All routines share a common temporary data area defined in EMUL. In this work area two instructions are constructed and executed:

1. Instruction to be emulated
2. Return jump

CALLing interface basic description:

```
CALL  entry-point
      op    address-parameter
```

The instruction to be emulated is one of Intel 8080's 3-byte instructions: LDA, STA, LHLD, SHLD, LXI, JMP's and CALLs. Any other instruction is illegal and will produce incorrect results. Return is made after the emulated instruction (except for JMP and CALL). The instruction is not executed as coded, but serves as an argument to emulation routines. The value expected in the address field of the emulated instruction and the method of forming EA as well as eventual additional parameters are all described for each routine. Some of the routines are redundant and can be simulated by others from this family. Users will have to decide which to use depending on the concern for programming convenience, calling sequence storage requirements, and execution speed. If applicable, alternate ways of accomplishing each effect are given under the description of each routine.

**Side Effects:** The current stack is used three to four words deep and restored before return. None of the processor registers are changed (including PSW) unless modified by the emulated instruction.

### Routine: RELAT

**Purpose:** This routine is provided to facilitate writing of PIC (position-independent code). It emulates addressing relative to PC (program counter).

**Use:** If you are writing a module that must be capable of executing anywhere in memory you may reference a label in the same module as follows:

```
CALL  RELAT
      op    label-$ ; $ being the current location
                        counter value
```

The displacement label-\$ will be added to the content of PC to form the effective address and the instruction will be executed. The only precondition is to have RELAT code or JMP to it on the fixed absolute address known at assembly time.

### Routine: INDEX

**Purpose:** This routine emulates addressing relative to the content of the register pair DE. Effective address is formed as:

$$EA = (DE) + \text{displacement}$$

Displacement is taken from the address field of the emulated instruction and can be either positive or negative.

### Routine: INDRX

**Purpose:** This routine emulates addressing relative to content of the word pointed to by register pair DE. Effective address is formed as:

$$EA = ((DE)) + \text{displacement}$$

Calling sequence:

```
LXI    D,address
CALL    INDRX
```

is equivalent to:

```
LHLD    address
XCHG
CALL    INDEX
```

### Routine: SPNDX

**Purpose:** Sometimes you may wish to access not the top word of the current stack (using POP, XTHL, or PUSH), but a previously stored word or byte. This may be accomplished by calling this routine if the position of the desired word or byte relative to the top of the stack is known at assembly time. The word that is referenced by POP is accessed using an offset of zero (low byte zero, high byte one). The offset is found in the address field of the instruction to be emulated. It is not and cannot be checked against the current depth of the stack. The SP content is not changed.

### Routine: SPDEX

**Purpose:** This routine has the same purpose as SPNDX, but the offset is found in register pair DE instead of the address field of the following instruction. This permits the offset to be dynamically changed, even if the program is to be ROM (read-only memory) resident. The calling sequence of this routine is different from the general model. It is:

```
LXI    D,offset ; or equivalent
CALL    SPDEX
DB      op-code ; octal or hex
```

# MODEL II



26-4002  
64K 1 Drive  
\$3440.00

26-4160 1 Drive EXP. .... \$1035.00  
26-4161 2 Drive EXP. .... 1575.00  
26-4162 3 Drive EXP. .... 2115.00  
26-4501 Gen. Ledger. .... 180.00  
26-4502 Inventory. .... 180.00  
26-4503 Payroll. .... 360.00  
26-4554 Acct. Rec. .... 180.00  
26-4701 Fortran. .... 270.00  
26-1157A Daisy Wheel. .... 2290.00  
26-1158 Daisy Wheel II. .... 1799.00



## CENTRONICS

Fast 100 CPS Centronics  
730 Printer. .... 577.00  
Text Quality Centronics  
737 Printer. .... 737.00

Model II Cobol Compiler  
\$360.00  
Cobol Run Time Package  
\$36.00

# \$ DISCOUNT \$ TRS-80® DEALER A301

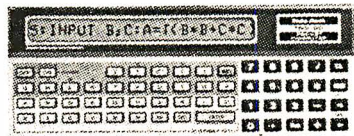
## COMPUTER SPECIALISTS

26-1155 Quick Printer II. .... \$187.00  
26-1145 RS-232 Board. .... 84.00  
26-1140 "O" K Interface. .... 249.00  
26-1141 "16" K Interface. .... 359.00  
26-1142 "32" K Interface. .... 469.00  
26-1160 Mini Disk - Drive O. .... 419.00  
26-1161 Mini Disk - Additional. .... 419.00  
26-1154 Lineprinter II. .... 699.00  
26-1165 Line Printer V. .... 1710.00  
26-1159 Lineprinter IV. .... 859.00  
26-1166 Line Printer VI. .... 1080.00  
26-1563 Scripsit - Disk. .... 79.00  
26-1566 Visicalc. .... 83.00  
26-1562 Profile. .... 72.00

ALL OTHER R.S. SOFTWARE  
FURNITURE, STANDS, CABLES  
AND ACCESSORIES AT  
DISCOUNT FROM  
CATALOG PRICE.

Novation Cat Modem. \$149.00  
CCA Data Management  
System. .... 72.00  
Adventure Games  
Games 1-9 each. .... 14.00

### Packet Computer



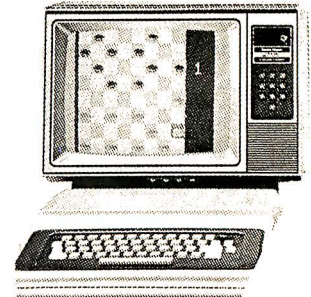
26-3501 1.9K P.C. .... \$225.00  
26-3503 Cassette I/F. .... 45.00  
14-812 Recorder. .... 72.00

# MODEL III



26-1061 4K I. .... \$630.00  
26-1062 16K III. .... 888.00  
26-1063 32K III  
2-Drives, RS232. .... 2225.00

## COLOR



26-3001 4K. .... \$360.00  
26-3002 16K. .... 540.00  
26-3010 Color Video. .... 360.00  
26-1206 Recorder. .... 54.00  
26-3008 Joysticks. .... 22.50



**Acorn**  
Software  
Products, Inc.

### GAMES:

Alien Invasion. .... \$9.00  
Stock Market. .... 9.00  
Star Trek. .... 9.00  
Block Em. .... 9.00  
Ting-Tong. .... 9.00

### UTILITIES:

System Savers. .... 14.00  
EDUCATION:  
Language Teacher. .... 18.00

**FREE: COMPUTER CATALOG  
UPON REQUEST**

# 1-800-841-0860 Toll Free Order Entry

# MICRO MANAGEMENT SYSTEMS, INC.

No Taxes on Out Of  
State Shipments

Immediate Shipment  
From Stock on Most Items

DOWNTOWN PLAZA SHOPPING CENTER  
115 C SECOND AVE. S.W.  
CAIRO, GEORGIA 31728  
(912) 377-7120 Ga. Phone No.

R.S. 90 Day Limited Warranty  
F-48 Form Provided

Largest Inventory  
In the S.E. U.S.A.

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

# BYTE LINES

## News and Speculation About Personal Computing

Conducted by Sol Libes

**Software Copyright Law Enacted:** Congress has passed the Computer Software Copyright Act of 1980. It protects the rights of individuals and companies who develop, sell, and lease computer programs. The law adds computer programs to the list of "writings" in which exclusive rights may be granted for "limited times," which generally is until 50 years after the author's death.

The law gives the author exclusive rights to copy the work and to transfer ownership rights, including sale and leasing arrangements. Piracy is punishable by fines, civil damages, or criminal penalties. Work does not have to be registered with the Copyright Office to be protected; it is protected once it is in "any tangible medium of expression."

Before the passage of this law, the copyright status of computer software was unclear.

**First 68000 System Introduced:** S-100-bus personal-computer users can now step up to the most powerful 16-bit micro-processor—the Motorola MC68000. Management Analysis & Control Inc, 3530 C Street NE, Auburn WA 98002, is the first manufacturer to announce a 68000-based personal-computer system. Its new processor card will sell for \$2095. (That's more than I paid for my entire S-100 cabinet and contents!) As yet, no software has been announced.

**Shugart Offers 5-Megabyte Hard-Disk System For Under \$2000:** If you're looking for a hard-disk system and

can do some minimal interfacing, you'll be interested in Shugart Associates' special deal, called the "Success Kit." The kit is really an evaluation offer for OEMs considering the design of a Shugart hard-disk drive into their computer systems; however, there are no restrictions on the offer, hence anyone can buy just one Success Kit. For \$1950 you can get an SA1002 8-inch, 5-megabyte Winchester-technology drive, an SA1400 intelligent controller, cables, and documentation. The controller provides backup on single- or double-sided floppy-disk drives. For more information, call (800) 824-7888; in California (800) 852-7777 (operator 12).

**FCC Grants Apple and Heath Extensions:** The FCC has granted Apple Computer Inc and Heath Company a 3-month extension on compliance with the January 1, 1981 deadline for RF (radio-frequency) radiation regulations. Each unit now carries a label warning that the equipment can interfere with radio and television reception and that the user is responsible for correcting it.

This is the second extension of the original July 1980 deadline given the companies by the FCC. Both contended that more time was needed to make the necessary product changes.

**AT&T Plans Home-Video Data Base:** AT&T has disclosed that it is about to begin a year-long test of an electronic telephone directory. The test will involve 700 color-video terminals in homes and businesses throughout Austin, Texas.

The terminals will be connected to telephone lines and used to access white- and Yellow-Pages listings. Users will also be able to store personal information.

A similar test involving eighty-three participants was conducted earlier in Albany, Texas; it involved black-and-white terminals. AT&T is conducting another test with the Knight-Ridder Newspaper group, in Coral Gables, Florida. That system includes news reports, home banking, and a home-shopping service.

If these tests are successful, it will be three to four years before the system is widely available.

**Japanese Sales Of US-Made Personal Computers Drop Sharply:** *Feedback From Fujitsu*, a Japanese computer-industry newsletter, reports that the sales of US-made personal computers in that country have dropped sharply. It says that until recently, Tandy/Radio Shack, Commodore, and Apple manufactured over 90% of the 6000 to 7000 personal computers sold monthly in Japan. However, their share of the market has fallen to 20% as Hitachi, NEC (Nippon Electric Company), and Sharp have moved into the manufacture and sale of personal computers.

Apple and Tandy have formed joint ventures with Japanese concerns in an attempt to combat these inroads on US sales. Commodore is reportedly studying a similar move.

**Japanese Establishing Foothold In US Personal Computing:** The Japanese presence is being felt in the American personal-comput-

er market. For example, all 142 Computerland stores will soon carry Japanese personal computers. Computerland is currently negotiating with Casio, NEC, Panasonic, and Hitachi. Several other distributors are flirting with Japanese personal computers. Apple, TI (Texas Instruments), and Atari appear to be the primary losers of valuable showroom space.

**Terminals To Replace Phone Directories:** The French government is preparing to launch a bold effort to give every telephone subscriber in France a mini-video terminal. Initially it will provide on-line telephone directories. The terminal will have a 7- to 8-inch diagonal screen with 24 lines of 40 characters each, solid-state keyboard, and a modem to send data at 75 bps (bits per second) and receive at 1200 bps. The PTT (Postal Telephone and Telegraph Authority) expects the terminal to cost \$75 to \$100. Over the next ten years, the PTT expects to procure more than 30 million terminals at a cost of \$3 billion, which it estimates is less than the cost of printed directories and directory-assistance operators.

**More Hobby Robotics Activities:** Add these developments to previously listed sources of robotics information.

The United States Robotics Society, Palo Alto, California, is resuming publication of its ROVOX newsletter. Membership is \$20 per year. The Computerworld Store, Van Nuys, California, has published the *Robotics Catalog*. Also, the International Institute of

# SOFTWARE DIGITAL MARKETING™ DIGITAL MARKETING™

March 1981

## MILESTONE™

"Critical path" network analysis program for scheduling manpower, dollars and time to maximize productivity.

An interactive project management program that runs under CP/M and can relate together different skills, hourly pay rates and projects to maximize efficiency. MILESTONE could be used to track paper flow, build a computer, check a salesman's performance, or build a bridge. MILESTONE can be used by executives, engineers, managers, and small businessmen to:

- Find the critical tasks which can't be delayed.
- Discover which tasks are not time critical.
- See how manpower and expenses vary versus time.
- Investigate tradeoffs between manpower, dollars and time.
- Communicate plans to others using a printed project schedule.
- Change details of the project and immediately see the results on the screen.

Requires 48K RAM and CP/M. Also available for Apple UCSD Pascal or UCSD Pascal Operating Systems.  
Formats: 8, NS, MP, CDOS, SB, TRS2, APPL  
SPECIAL INTRODUCTORY PRICE: \$295. until April 1, 1981  
Manual alone - \$30.

## DATEBOOK™ - \$295. Manual alone \$25.

- Replaces your office appointment calendar
- Searches for openings that fit time of day, day of week & day of year constraints
- Appointments made, modified or cancelled by a few key strokes
- Copies of day's appointments can be quickly printed
- Schedule appointments 4 months in advance - plus.
- Requires CP/M or UCSD Pascal and 48K RAM
- Requires CP/M, CDOS, SB, APPL, TRS2
- Formats: 8, NS, MP, CDOS, SB, APPL, TRS2

## TEXTWRITER II™ - \$125. Manual alone - \$25.

Requires CP/M, NorthStar DOS, or MDOS  
Formats: 8, NS, MP, TRS2

## REPORT WRITER™ - \$150. Manual alone - \$25.

Mini-word and arithmetic calculation processor designed to generate reports with ledger of figures and numeric calculations. Built-in calculator functions and calculator to paper errors. Saves data. Reports can be printed as often as desired. Changes in data can be easily entered and saved. "Cause and Effect" analysis easily computed using Recalculate function.  
Requires CP/M, Microsoft Basic and 48K RAM  
Formats: 8, NS, MP, SB, TRS2, CDOS

## MAGIC WAND™ - \$395. Manual alone - \$35.

Word Processing System

- Full screen text editing
- Full text formatting commands
- Merging with external data files
- Variables
- Conditional commands
- True proportional printing
- Specify disk format, terminal and printer.

## MAGIC MENU™

Turns Magic Wand into a turnkey system. Allows move from EDIT to PRINT, backup of files or disks, system status, etc. from menu without returning to CP/M 2.x  
Requires 56K RAM, CP/M and Magic Wand.  
Regular Price - \$95  
SPECIAL INTRODUCTORY PRICE: \$45. when purchased with Magic Wand.

Formats: 8, NS, MP, SB, TRS2, APPL

## PASCAL/M™. \$225. Manual alone - \$20.

CP/M compatible language for 8080/280 CPUs, supports full Jensen & Wirth plus 45 extensions to Standard Pascal including Random access files & 16 bit BCD real type.  
NOW INCLUDES symbolic debugger which features trapping on stores, examining and changing variables and tracing of program execution.

## SPECIAL OFFER: PASCAL/M DEMO DISK - \$20.

Includes demo disk and manual.

## PASCAL/M for 8086/88 - \$270.

Manual alone - \$20.  
All features of Pascal/M for the 8086 and 8088 processors running under the 8086/88 version of CP/M.

Requires CP/M & 54K RAM. Formats: 8, NS, CDOS, APPL, TRS2

## TRANS 86™ - \$125. Manual alone - \$20.

8086/88 Translator for existing 8080/280 programs. The new source code can be easily edited and assembled using ACT II to produce hex code which can be executed by 8086/88. Emphasizes the extensions and features available in the 8086/88.

Requires CP/M and 32K RAM  
Formats: 8, NS, CDOS, APPL

## ACT I™ - \$125. Manual alone - \$15.

CP/M compatible macro assembler for 280, 8080/85, 6502 & 6800.

One assembler that supports all major 8 bit micros. ACT features include full macro capabilities, comprehensive pseudo-ops, link-file structures, cross reference map, and algebraic expression processor. Requires 24K RAM & CP/M.

## ACT II - \$175. Manual alone - \$20.

CP/M 2.x compatible cross assembler for 8086/88

## ACT III - \$125. Manual alone - \$20.

CP/M 2.x compatible cross assembler for 6809.

## ACT I and ACT II together - \$225.

Formats: 8, NS, CDOS, MP/M, TRS2, APPL

## PEARL™

The application software generator Pearl asks questions that a programmer would have to answer to code the system. You answer the questions & Pearl uses built-in logic to construct both subroutines & mainline programs. The system then compiles & executes your program code.

- Level 1: For Personal Computing - \$130.
- Level 2: The Business Assistant - \$350.
- Level 3: Advanced Software Development - \$650.

Manuals alone - \$25. each  
Requires CP/M and CBASIC2. Formats: 8, NS, MP, SB, TRS2

## CBASIC2™ - \$120.

Industry standard intermediate code compiler with run-time interpreter. Features include chaining, integer & external precision arithmetic.

## ULTRASORT-II™ - \$175.

The sort/merge/select utility for CBASIC2 written in assembly language. Can be loaded by CBASIC during run-time; also can be used as a stand-alone utility.

## FABS™ - \$175. Manual alone - \$20.

Fast Access Btree Structure. Key sequential multi-path balanced tree structure. Faster than ISAM. Can be loaded by Cbasic2 during run-time; also can be used as stand-alone utility. Also supports Microsoft Basic Compiler or S-Basic.

Requires CP/M and CBASIC2, Microsoft Basic Compiler or S-Basic  
Formats: 8, NS, MP, SB, TRS2, CDOS

## COPYWRITER™ \$395. Manual alone - \$35.

A powerful CP/M Word Processing System which includes a fast screen editor and is exceptionally easy to learn and use. Copywriter supports both vertical and horizontal scrolling for 132 column printers. File size is limited only by disk size. The print formatting program allows control over output word processing files, and permits the insertion of variable data into form letters. Full proportional printing is also supported.

## COPYWRITER+ \$595. Manual alone - \$35.

All of the above plus an integrated mailing list system which can select any range of zip codes for printing; select which fields to fill into merge; select by title, position or department and zip codes.  
Copywriter Screen Editor alone - \$195.  
Copywriter version of Spellguard.

## COPYPROOF™ - \$295. Manual alone - \$35.

Copywriter version of Spellguard.

## DICTION I™ - \$95.

22,000 dictionary words not included in Copyproof or Spellguard. Compatible with any word processor using Spellguard.

## DICTION II - \$195.

40,000 more words not included in Diction I. Copyproof or Spellguard.  
Requires 54K RAM & CP/M. Formats: 8, NS

## SPELLGUARD™ - \$295. Manual alone - \$20.

20,000+ word dictionary containing commonly used words that find spelling & typographical errors in text files. Allows review of mis-matched words & speedy search routine.  
Requires CP/M, 48K RAM & Magic Wand, WordStar™ or Spellbinder™  
Formats: 8, NS, MP, SB, TRS2, CDOS

## S-BASIC™ - \$295. Manual alone \$25.

Produces chainable, relocatable native code.  
★ Fully defined user functions & procedures  
★ Local & global variables  
★ Single & double precision floating point  
★ Fixed point packed BCD  
★ Integer, string & character data types  
★ Packed binary disk storage  
Requires CP/M and 40K RAM. Formats: 8, NS, MP, SB, APPL

## SELECTOR IV™ - \$550. Manual alone - \$25.

A totally self-contained CP/M Data Base System providing complete data, procedural, query, and report definition functions. Allows records to be managed on a one-for-one basis, as well as in 'batch' mode where several files can communicate with each other in a variety of ways. Includes multiple 'key fields'. Requires 54K RAM, CP/M and CBASIC2  
Formats: 8, NS, MP, SB, APPL

## MICROSTAT™

Powerful statistical analysis package. Includes data management sub-system for editing, sorting, ranking, lagging, data file transfers PLUS eleven data transformations (e.g. linear, reciprocal, exponential, etc.)

- Frequency distributions
- Multiple regression
- Time series
- Crosstabs/Chi-Square
- Factorials, permutations, combinations
- Scatterplots
- ANOVA (one and two-way)
- Requires 48K RAM

## CP/M-CBASIC2 version - \$250.

## CP/M - Microsoft Basic 80 version - \$250.

## NorthStar Basic version - \$250.

Manual alone - \$25.  
Formats: 8, NS

FORMAT CODES: 8 (8" single density IBM soft-sectored) NS (NorthStar DD) MP (Micropolis Mod II/Vector MZ) SB (Superbrain 3.0) CDOS (8" Cromemco CDOS) (Apple II)

Report Writer trademark Carolina Business Computers  
Selector IV trademark Micro-Ap Pearl trademark  
of CPU Int'l Pascal/M, ACT & TRANS 86 trademarks Sorcim  
CBASIC2 trademark Compiler Systems Magic Wand trademark Small  
Business Applications Textwriter, Datebook & Milestone trademarks Organic Software  
Ultrasort-II & FABS trademarks Computer Control Systems Magic Menu trademark of Charles Merritt  
Spellguard trademark ISA CP/M & MP/M trademarks Digital Research TRS-80 trademark Tandy Superbrain trademark Interlec Data  
Systems UCSD Pascal trademark of Regents of University of California WordStar trademark Micro Pro Int'l Spellbinder trademark Lexisoft  
For shipping add \$5. in US; \$10. outside US per package California residents add appropriate state sales tax Terms: Prepaid check,  
M/C or VISA or in US COD (UPS) Dealer inquiries invited Prices quoted do not include dealer installation & training Prices effective until May 1, 1981

Robots in Pelahatchie, Mississippi, has resumed publication of its quarterly newsletter.

**Wristwatch-Sized Computer Proposed:** Ten years ago, who would have conceived of the table-top computer or, better yet, the pocket computer? Yet they are realities today. Current dreams envision something much smaller: the November 1980 *Computer* carried a detailed proposal by Stephen Kearney for a computer to be worn on your wrist. Kearney has overcome the I/O (input/output) problem with a clearly thought out display and keyboard. The LCD (liquid-crystal display) is 27 characters by 8 lines (for a total of 216 characters), with uppercase, lowercase, and special characters, in a space 1 7/8 by 3 inches. The unit has a 9-key keyboard capable of upper- and lowercase alphanumeric and special characters. The keyboard measures 3/4 inch by 2 inches.

**Which Computer Is The Fastest?:** Datamation recently conducted a survey to determine which computers are the fastest in production. The measurement used was KOPS (thousands of operations per second). This was felt to be a better measure than MIPS (millions of instructions per second). The top three were: Cray-1 (800,000 KOPS), CDC Cyber 205 (800,000 KOPS), and CDC 7600 (10,000 KOPS). The fastest IBM computer was the IBM 1088 (2X) with 1160 KOPS.

The KOPS rating is determined by measuring how long it takes the computer to execute a prescribed mix of programs; the measurement ignores I/O and operating-system considerations. As such, KOPS measures only processor speed and not system speed.

**Smart Wheelchair Shown:** The Rehabilita-

tion Engineering Center of the Veterans Administration Hospital, Palo Alto, California, has demonstrated a prototype microprocessor-controlled wheelchair for severely incapacitated persons. Using autofocus ultrasonic-ranging detectors aimed at the head, a person can direct the wheelchair's movements by moving his head. Sensors are included to detect objects in the chair's path and to gauge distance to walls so that the chair can track a wall at a fixed distance. Cruise control is provided so that the user can relax until a change in velocity is wanted. The developers expect this unit to add only \$100 to \$200 to the cost of a standard wheelchair.

**Flat-Panel Display Update:** There are over 2 million video terminals in use. It's expected that yearly shipments will top the million-unit level by the mid-1980s. However, they have some big disadvantages. They're bulky, they waste a lot of desk space, consume too much power, annoy users with reflected light, and are damaged easily.

More than a dozen companies are developing flat-panel displays. Some are already in production. Most successful are the plasma displays. LCD and ELD (electroluminescent displays) are also being developed.

The Japanese are working on flat-panel displays. Fujitsu, Hitachi, Matsushita, and Seiko Denki have all produced plasma and LCD prototypes. Hycom Corporation, a US subsidiary of Sharp, has developed an ELD for the US Army in portable battlefield terminals. Exxon Corporation, through its Kyles and Electrophoretic Information Display divisions, is also developing flat displays. Kyles is already producing an 8-line LCD panel, and it is rumored that this will soon be expanded.

There is no doubt that by

the end of the decade flat-panel displays will dominate the terminal- and television-display markets. They will offer low power consumption, high daylight visibility, and the shock resistance necessary to make the true portable computer and intelligent terminal a reality.

**Can A Computer Have Worms?** Several years ago rumor had it that an enterprising computer hacker had gained access to a DOD computer from a remote terminal. Once inside, he entered a program that re-wrote its data into all of the computer's memory, destroying the computer's software and data base. In other words, the program was like the shapeless monster from the classic science-fiction thriller, *The Blob*.

Now, from Xerox's Palo Alto (California) Research Center, comes the "Worm." The Worm is a series of programs that wiggles through a computer network at will, copying itself into inactive systems in the network. The Worm coordinates the operation of all the computer systems in the network. It delegates tasks to unused machines and coordinates the operation of machines in the network. Any complex computations are handled by harnessing multiple processors.

The Worm is still in the experimental stage. As such, it may be the precursor of much more powerful autonomous programs that, like the *Blob*, could take over and control entire networks.

**Computer Contest To Aid The Handicapped:**

The National Science Foundation, Johns Hopkins University, and Radio Shack have announced a nationwide competition for computer aids for the physically or mentally handicapped. (See "National Search to Aid the Handicapped Through Personal Computers," page 316.) The grand prize is

\$10,000, with runner-up prizes of equipment and money. There are several incentives to encourage participation, including separate entry categories for students, amateurs, and professionals. For more information, contact Personal Computers for the Handicapped, Johns Hopkins University, POB 670, Laurel MD 20810.

**Robot Destroys Itself:** An experimental robot at the University of Florida went out of control, destroying itself before a graduate student could press its cutoff button. The robot's arm was driven into its supporting body, ripping its shoulder off.

**Xerox Introduces First Ethernet System:** Xerox has been talking about Ethernet for two years, and I have reported on its progress many times. Finally, it has introduced the first system hardware. Called the Xerox System 8000, it allows users to create, file, print, and distribute documents and data to any and all users on the system. It allows many types of office equipment to be linked into an integrated local system via coaxial cable, and the system can be tied in to other external networks.

Without a doubt, many manufacturers will introduce hardware and software interfaces for the Ethernet system. IBM, Wang, Exxon, AT&T, and M/A-COM are working on their own local network systems.

**IBM Opens Retail Stores:** Philadelphia and Baltimore are the sites of IBM's two new storefront sales outlets. Several more are planned.

The stores carry typewriters, copiers, word processors, small-business computers, and supplies. IBM is following in the footsteps of

# TOMORROW'S answers for the H8® TODAY!

DG Electronic Developments provides the only enhancements to put the Heath® H8 ahead **TODAY** while maintaining its high standards, broad flexibility and high reliability.

## DG-80 (Z80® Based CPU)

The DG-80 offers the **BEST** foundation for the H8 to build on for the future. Compare the DG-80 to your current Heath® 8080 CPU and see the advantages of the DG-80's superior speed and flexibility. The Z80 gives twice the processing speed coupled with twice the instruction set making your H8 a truly professional microsystem. DG-80 aids the efficient writing of utility programs, user routines, sub-routines and use of assemblers.

**DG-80 \$249.** (Documentation only \$25.)

## DG-FP8/ADP4 (DG80 Front Panel Monitor)

The DG-FP8/ADP4 firmware/hardware package brings the world of standardization to your H8. The FP8/ADP4 allows the full use of currently available "STANDARD" CPM software, with 4 MHz operation. You can still use your HDOS and all its related software, by simply putting a disk in your drive. The DG firmware package gives you use of the full 64K of RAM available on the 64D or 64D5. The FP8/ADP4 firmware also offers many extras including hexadecimal OR split octal display; simplification of register and memory contents display; and the full use of all Z80 registers (more than twice the number of registers in the 8080). Plus, the unique front-panel single-step feature is maintained to aid in software troubleshooting.

**DG-FP8 \$69.95. DG-ADP4 \$19.95. Purchased together \$79.95.**

(Documentation only — source code not included \$15.)

## DG-64D (64K RAM Memory Board)

The DG-64D is **THE BEST** memory board available for the H8! Along with the DG-80 CPU, the 64D gives a full 64K of addressable memory. Its built-in flexibility ensures future compatibility. Multi-user configurations can be achieved accessing up to eight 64D's on line with the hardware/software bank select features. Memory contents are maintained and protected during extended wait states by asynchronous refresh.

**DG-64D priced from \$333 (8K) to \$529 (64K).** (Documentation only \$15.)

## DG-64D5 (5-Volt Power Supply 64K RAM)

The DG-64D5 memory board offers the **ultimate** in low power consumption for the H8 computer! The 64D5 is primarily designed for use with the Heath Color Graphics board. In addition to offering **ALL** of the features of the standard 64D, the 64D5 utilizes **single-supply** 5-volt-only dynamic RAMs and allows the use of extended wait states.

**Priced from \$333 (8K) to \$799 (64K).** (Documentation only \$15.)

**Chip Sets (8-4517 dynamic RAMS) \$150.**

## CP/M (Standard V2.2 Disk Operating System)

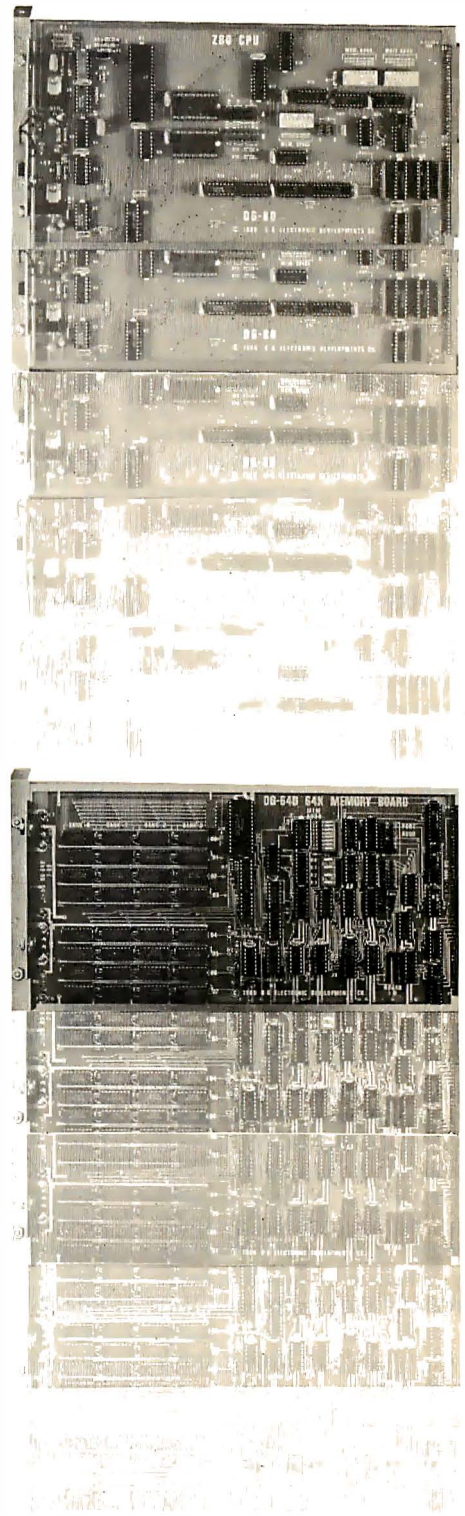
The final component for the "STANDARD" H8 system is Digital Research's CP/M® V2.2. Our full line of H8 enhancements in combination with CP/M gives the user unparalleled flexibility and puts thousands of CP/M software programs at your fingertips.

**CPM V2.2 \$130.** (Documentation only \$25.)

**All products supplied with complete documentation.**

**Please call or write for additional information.**

Heath® and H8® are registered trademarks of Heath Corporation, Benton Harbor, Michigan. CP/M® is the registered trademark of Digital Research of Pacific Grove, California. Z80® is the registered trademark of Zilog Corporation.



# DG ELECTRONIC DEVELOPMENTS CO.

**Ordering Information:** Products listed available from DG Electronic Developments Co., P.O. Box 1124, 1827 South Armstrong, Denison, Tx. 75020. Check, Money Order, VISA or MasterCard accepted. Phone orders (charge only) call (214) 465-7805. No COD's. Freight prepaid. Allow 3 weeks for personal checks to clear. Texas residents add 5%. Foreign orders add 30%. Prices subject to change without notice.

DEC, even though DEC closed two of its retail outlets and has put a halt to its retail expansion.

In a related development, Hewlett-Packard has entered into an agreement to sell its HP-1000L small-business computer through ABC Computers Inc's 350 retail outlets.

**P**rogrammer Fined For Copying Software: A Mobile County, Alabama, circuit court has fined a programmer \$50,000 for copying his former employer's software and using it in a competing business he started. A jury decided that a theft had occurred, even though nothing material was taken. The prosecution maintained that the former employee could not have recreated the identical programs in such a short period of time. The defense said he had done so. The programmer plans to appeal.

**P**ersonal Computing On Corporate Machines: Federal auditors discovered over 200 government employees at the Sandia Nuclear Weapons Research Center in Albuquerque, New Mexico, using the facility's Control Data Corporation systems for personal use. Sources report that 456 unauthorized files were located, including several hundred games such as *Star Trek* and *Adventure*, as well as poetry, jokes, personal letters, a beer-can collection catalog, and bowling-team rosters. One employee was caught helping local gamblers run a bookmaking operation.

**D**oes Computer Crime Pay? It certainly does... according to Paul Nolan, supervisory special agent in the FBI's White Collar Crime Section. He estimates that non-computer-aided embezzlement averages \$23,000 per occurrence, while computer-aided embezzle-

ment averages \$430,000. By the way, bank robbers average only \$3000.

**V**olume Production For 64 K-Bit Memories: Within two months, suppliers will start shipping the new 64 K-bit programmable memories to manufacturers and distributors. Prices will be in the \$25 to \$30 range; they'll drop under \$20 in July. Fifteen suppliers have announced devices, although some of the specification sheets are tentative.

It's not yet clear when personal-computer manufacturers will start using the 64 K-bit chips in place of 16 K-bit circuits. Many will stick with the 16 K-bit device until the 64 K units show a significant price drop.

Intel has let it be known that its 64 K-bit memories will use redundant bits for increased yield, the same technique used by IBM and Western Electric in their in-house circuits. Intel uses a "ROM-fuse" technique (an internal programmable read-only-memory) to decode addresses and replace one or more defective cells.

**A**da Status Report: It is estimated that the DOD (Department of Defense) uses over 500 general-purpose computer languages and that \$3 billion is spent each year for software development, whose control is a nightmare. That's what led the DOD to subsidize the Ada language project. The department wants Ada to be its only language.

In 1975, a DOD group undertook the task of evaluating twenty-three existing languages to find a standard language. None were found suitable. In mid-1978, the group invited specification recommendations from around the world and sponsored a competition among seventeen organizations. The Green language (later dubbed Ada),

developed by Cii Honeywell Bull (a French subsidiary of Honeywell), emerged the winner. Initial specifications were released in mid-1979 and refined and completed by mid-1980.

A fully functional Ada compiler for the entire language is expected to be available next year. Many private and educational institutions are currently developing Ada compilers, including Carnegie-Mellon University and the University of Karlsruhe, West Germany. Other schools studying various aspects of Ada include Stanford, Harvard, MIT, and the Universities of Texas, Massachusetts, Southern California, Pennsylvania, York (England), Tokyo, London, and the Technical University of Denmark.

The DOD has requested that the Ada compiler run on the DEC (Digital Equipment Corporation) VAX11/780 and produce code for the VAX, the DEC PDP-11, and the military AN/GYK-12.

A number of institutions already have "Little Ada" compilers running, and it's likely that we'll see a "Tiny Ada" implementation for 8080/Z80 systems by year's end.

**O**hio Scientific Sold: Ohio Scientific Inc (OSI), one of the early pioneers in personal-computing systems, has been purchased for an undisclosed sum by M/A-COM Inc of Burlington, Massachusetts. M/A-COM manufactures business communications equipment. OSI had sales of \$14.8 million for the 10-month period ending October 1980. Mike Cheiky, OSI founder, will remain as vice-president of development. In all likelihood OSI will move away from personal computing and into the small-business market.

**R**andom Rumors: Apple is rumored to be frantically working on a 16-bit computer system using the

Motorola 68000.... Sony and Canon are about to introduce computers using the Motorola 6809 8-bit micro-processor.... Radio Shack may introduce a disk system for the TRS-80 Color Computer system.... According to insiders, Texas Instruments will soon have a low-cost system and a Viewdata-type terminal. TI is concerned over Radio Shack's growing domination of the consumer communications market.... Experts predict that Radio Shack will have 40,000 people hooked up to data bases through their equipment by year end....

The Apple III appears to be designed to accept one of the new 5 1/4-inch Winchester hard disks in place of its 5 1/4-inch floppy-disk drives.... Informed sources say that Zilog is at last shipping fully functional Z8000s. Reportedly, the first four versions had some op codes that did not execute correctly.... Sony and Matsushita are expected to introduce portable microcomputer products that fit into your briefcase. They are intended for electronic mail and database access applications. (See "The Panasonic and Quasar Hand-Held Computers," by Gregg Williams and Rick Meyer January 1981 BYTE, page 34.) ...Expect a CP/M-like operating system for Atari's 800 personal computer.... Okidata will unveil a 35 cps overlapping dot-matrix printer for under \$1000 at the National Computer Convention in May....

**MAIL:** I receive a large number of letters each month as a result of this column. If you write to me and wish a response, please include a self-addressed, stamped envelope

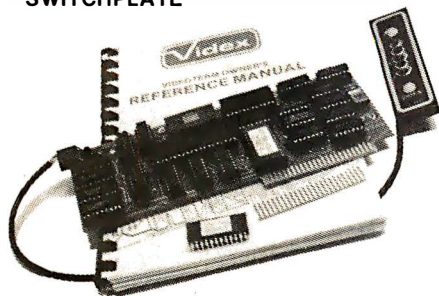
**Sol Libes**  
**POB 1192**  
**Mountainside NJ 07081**

# The Text Solution for APPLE II®

## Now APPLE II® Owners Can Solve Text Problems With VIDEOTERM 80 Column by 24 Line Video Display Utilizing 7 X 9 Dot Character Matrix

Perhaps the most annoying shortcoming of the Apple II® is its limitation of displaying only 40 columns by 24 lines of text, all in uppercase. At last, Apple II® owners have a reliable, trouble-free answer to their text display problem. VIDEOTERM generates a full 80 columns by 24 lines of text, in upper and lower case. Twice the number of characters as the standard Apple II® display. And by utilizing a 7 by 9 character matrix, lower case letters have true descenders. But this is only the start.

### VIDEOTERM, MANUAL, SWITCHPLATE



7X12 MATRIX  
18X80 OPTIONAL



7X9 MATRIX  
24X80 STANDARD

## VIDEOTERM

### BASICs

VIDEOTERM lists BASIC programs, both Integer and Applesoft, using the entire 80 columns. Without splitting keywords. Full editing capabilities are offered using the ESCape key sequences for cursor movement. With provision for stop/start text scrolling utilizing the standard Control-S entry. And simultaneous on-screen display of text being printed.

### Pascal

Installation of VIDEOTERM in slot 3 provides Pascal immediate control of the display since Pascal recognizes the board as a standard video display terminal and treats it as such. No changes are needed to Pascal's MISC.INFO or GOTOTOX files, although customization directions are provided. All cursor control characters are identical to standard Pascal defaults.

### Other Boards

The new Microsoft Softcard® is supported. So is the popular D. C. Hayes Micro-modem II®, utilizing customized PROM firmware available from VIDEX. The powerful EasyWriter® Professional Word Processing System and other word processors are now compatible with VIDEOTERM. Or use the Mountain Hardware ROMWriter® (or other PROM programmer) to generate your own custom character sets. Naturally, VIDEOTERM conforms to all Apple OEM guidelines, assurance that you will have no conflicts with current or future Apple II® expansion boards.

### Advanced Hardware Design

VIDEOTERM's on-board asynchronous crystal clock ensures flicker-free character display. Only the size of the Pascal Language card, VIDEOTERM utilizes CMOS and low power consumption ICs, ensuring cool, reliable operation. All ICs are fully socketed for easy maintenance. Add to that 2K of on-board RAM, 50 or 60 Hz operation, and provision of power and input connectors for a light pen. Problems are designed out, not in.

### Available Options

The entire display may be altered to inverse video, displaying black characters on a white field. PROMs containing alternate character sets and graphic symbols are available from Videx. A switchplate option allows you to use the same video monitor for either the VIDEOTERM or the standard Apple II® display, instantly changing displays by flipping a single toggle switch. The switchplate assembly inserts into one of the rear cut-outs in the Apple II® case so that the toggle switch is readily accessible. And the Videx KEYBOARD ENHANCER can be installed, allowing upper and lower case character entry directly from your Apple II® keyboard.

### Firmware

1K of on-board ROM firmware controls all operation of the VIDEOTERM. No machine language patches are needed for normal VIDEOTERM use.

### Firmware Version 2.0

Characters	7 x 9 matrix	Display	24 x 80 (full descenders)
Options	7 x 12 matrix option; Alternate user definable character set option; Inverse video option.		18 x 80 (7 x 12 matrix with full descenders)

Want to know more? Contact your local Apple dealer today for a demonstration. VIDEOTERM is available through your local dealer or direct from Videx in Corvallis, Oregon. Or send for the VIDEOTERM Owners Reference Manual and deduct the amount if you decide to purchase. Upgrade your Apple II® to full terminal capabilities for half the cost of a terminal. VIDEOTERM. At last.

PRICE:	• VIDEOTERM includes manual	... \$345
	• SWITCHPLATE	... \$ 19
	• MANUAL refund with purchase	... \$ 19
	• 7 x 12 CHARACTER SET	... \$ 39
	• MICROMODEM FIRMWARE	... \$ 25

Apple II® is a trademark of Apple Computer Inc.  
ROMWriter® is a trademark of Mountain Hardware Inc.  
Micromodem II® is a trademark of D. C. Hayes Associates Inc.  
Softcard® is a trademark of Microsoft  
EasyWriter® is a trademark of Information Unlimited Software Inc.

## APPLE II® OWNERS!

### Introducing the KEYBOARD & DISPLAY ENHANCER

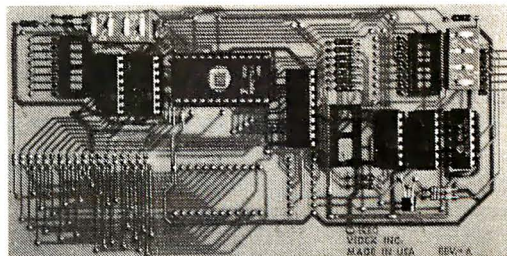
- PUT THE SHIFT AND SHIFT LOCK BACK WHERE IT BELONGS
- SEE REAL UPPER AND lower CASE ON THE SCREEN
- ACCESS ALL YOUR KEYBOARD ASCII CHARACTERS

Videx has the perfect companion for your word processor software: the **KEYBOARD AND DISPLAY ENHANCER**. Install the enhancer in your APPLE II and be typing in lower case just like a typewriter. If you want an upper case character, use the SHIFT key or the CTRL key for shift lock. Not only that, but you see upper and lower case on the screen as you type. Perfectly compatible with Apple Writer and other word processors like, for example, Super-Text.

If you want to program in BASIC, just put it back into the alpha lock mode; and you have the original keyboard back with a few im-

provements. Now you can enter those elusive 9 characters directly from the keyboard, or require the Control key to be pressed with the RESET to prevent accidental resets.

**KEYBOARD AND DISPLAY ENHANCER** is recommended for use with all revisions of the APPLE II. It includes 6 ICs, and EPROM and dip-switches mounted on a PC board, and a jumper cable. Easy installation, meaning no soldering or cutting traces. Alternate default modes are dip-switch selectable. You can even remap the keyboard, selecting an alternate character set, for custom applications.



PRICE	• KDE-700 (REV. 7 or greater)	... \$129.
	• KDE-000 (REV. 6 or less)	... \$129.

Apple II® is a trademark of Apple Computer, Inc.



**VIDEX**  
897 N.W. Grant Avenue  
Corvallis, Oregon 97330  
Phone (503) 758-0521

# SAVE!

## WITH DSC'S 10% CLUB

- YOU CAN BUY HARDWARE, SOFTWARE, AND SUPPLIES AT 10% ABOVE WHOLESALE
- JOIN NOW: \$15.00 ANNUAL MEMBERSHIP FEE INCLUDES \$10.00 CREDIT TOWARD FIRST PURCHASE AND CATALOG OF PRODUCTS
- TERMS — PREPAYMENT, CASH, CERTIFIED CHECK, M.O., M.C. AND VISA ADD 4%, FOB PHILA., PA.
- WARRANTIES — ALL EQUIPMENT CARRIES MANUFACTURER'S WARRANTY AND WILL BE SERVICED BY MANUFACTURER OR REPRESENTATIVE

### COMPUTERS

Intertec - SuperBrain 32K	2375.
SuperBrain 64K	2500.
SuperBrain QD 64K	2990.
Intertube III	724.
Atari - 400 Computer	475.
800 Computer	746.
815 Dual Disk Drive	1159.
Apple II + Apple II Plus - 16K	959.
32K	1049.
48K	1149.
Drives - Lobo for Apple- 5 1/4" with controller	442.50
VR Data - 40 tk 1 side	309.
80 tk 1 side	439.
40 tk 2 side	439.
80 tk 2 side	619.
8" CDC 9404B, Mod II comp.	749.
16K memory	28.95
Modems - D-Cat direct connect	150.
Lexicon acoustic	129.95
Radio Shack - Mod. I Expansion Interface	246.40
Model III 16K	869.
Model III 32K w/2 Drives	2199.
Color Computer 4K	345.
Color Computer 16K	520.

### PRINTERS

Centronics - 730-1 parallel	594.
730-3 serial	649.
737-1 parallel	715.
737-3 serial	799.
704-9 RS-232 serial	1599.
Anadex - 8000	794.
NEC - 5510 w/tractor	2490.
C. Itoh Starwriter 25 cps parallel	1279.

### SUPPLIES

Verbatim Diskettes - 5 1/4" MD-01 Data Life	26.90/10
550-01, DD	37.50/10
8" FD-34-9000-Data Life	32.40/10
Nashua Diskettes - 5 1/4" (high quality)	22.95/10
8" DD, FD-1D-WP	32.50/10
Dysan - 5 1/4" SS-SD	24.50/5

ALL BRANDS OF HARDWARE, SOFTWARE, PERIPHERALS, SUPPLIES AND BOOKS ARE AVAILABLE.

I WANT TO JOIN NOW.

NAME \_\_\_\_\_  
 STREET \_\_\_\_\_  
 CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_  
 CHARGE ☐ MASTER CHG. ☐ VISA  
 CARD NUMBER \_\_\_\_\_  
 EXPIRATION DATE \_\_\_\_\_

## DISK SUPPLY Co.

SUITE 439, 111 S. OLIVE ST. MEDIA, PA 19063  
 (215) 461-5437

## Software Received

### Apple II, PET, and TRS-80

**B-1 Nuclear Bomber**, historical strategy game for the Apple, PET, and TRS-80. Cassette, \$14.95. Avalon Hill Game Company, 4517 Harford Rd, Baltimore MD 21214.

**Planet Miners**, strategy game for the Apple, PET, and TRS-80 (three versions sold together). Cassette, \$14.95. Avalon Hill Game Company (see above).

### TRS-80

**Disk Editor/Assembler**, line editor and relocatable machine-language assembler for the TRS-80. Floppy disk, \$99.95. Radio Shack, 1 Tandy Ctr, Fort Worth TX 76102.

**FORTAN**, programming language and utilities for the TRS-80. Floppy disk, \$99.95. Radio Shack (see above).

**Lost Ship Adventure**, Adventure program for the TRS-80. Cassette, \$14.95. The Programmer's Guild, POB 66, Peterborough NH 03458.

**Profile**, general-purpose data base and report writer for the TRS-80. Floppy disk, \$79.95. Radio Shack (see above).

**Real Estate Volume II**, mortgage analysis program for the TRS-80. Cassette, \$29.95. Radio Shack (see above).

**Scriptit**, word-processing package for the TRS-80. Floppy disk, \$99.95. Radio Shack (see above).

**Standard & Poor's Stockpak and Portfolio Management System**, stock-analysis program for the TRS-80. Floppy disk, \$49.95. Radio Shack (see above).

**Star Trek 4.0**, action game for the TRS-80. Cassette, \$14.95. The Programmer's Guild (see above).

**Superdisk**, collection of utility programs for the TRS-80. Floppy disk, \$49.95. The Programmer's Guild (see above).

**VisiCalc**, numerical computation and forecasting tool for the TRS-80. Floppy disk, \$99.95. Radio Shack (see above).

### Texas Instruments 99/4

**Early Learning Fun**, educational activity for children for the TI 99/4. Floppy disk, \$30. Texas Instruments, 13500 N Central Expy, Dallas TX 75231.

**Personal Record Keeping**, computer-based filing system for the TI 99/4. Program cartridge, \$50. Texas Instruments (see above).

**Speech Editor**, speech synthesis aid for the TI 99/4. Program cartridge, \$45. Texas Instruments (see above).

### Other Computers

**Nevada COBOL**, version of the COBOL language for CP/M systems. Eight-inch floppy disk, \$99.95. Ellis Computing, 1480 17th Ave, San Francisco CA 94122.

This is a list of software packages that have been received by BYTE Publications during the past month. The list is correct to the best of our knowledge, but it is not meant to be a full description of the product or the forms in which the product is available. In particular, some packages may be sold for several machines or in both cassette and floppy-disk format; the product listed here is the version received by BYTE Publications.

This is an all-inclusive list that makes no comment on the quality or usefulness of the software listed. We regret that we cannot review every software package we receive. Instead, this list is meant to be a monthly acknowledgment of these packages and the companies that sent them. Companies sending software packages must include the suggested list price of the packages and (where appropriate) the alternate forms in which they are available.

# MULTI-USER OASIS HAS THE FEATURES PROS DEMAND. READ WHY.

**Computer experts (the pros) usually have big computer experience. That's why when they shop system software for Z80 micros, they look for the big system features they're used to. And that's why they like Multi-User OASIS. You will too.**

## DATA INTEGRITY: FILE & AUTOMATIC RECORD LOCKING

The biggest challenge for any multi-user system is co-ordinating requests from several users to change the same record at the same time.

Without proper co-ordination, the confusion and problems of inaccurate or even destroyed data can be staggering.

Our File and Automatic Record Locking features solve these problems.

For example: normally all users can view a particular record at the same time. But, if that record is being updated by one user, automatic record locking will deny all other users access to the record until the up-date is completed. So records are always accurate, up-to-date and integrity is assured.

Pros demand file & automatic record locking. OASIS has it.

## SYSTEM SECURITY: LOGON, PASSWORD & USER ACCOUNTING

Controlling who gets on your system and what they do once they're on it is the essence of system security.

## (THEN COMPARE.)

Without this control, unauthorized users could access your programs and data and do what they like. A frightening prospect isn't it?

And multi-users can multiply the problem.

But with the Logon, Password and Privilege Level features of Multi-User OASIS, a system manager can specify for each user which programs and files may be accessed—and for what purpose.

Security is further enhanced by User Accounting—a feature that lets you keep a history of which user has been logged on, when and for how long.

Pros insist on these security features. OASIS has them.

## EFFICIENCY: RE-ENTRANT BASIC

A multi-user system is often not even practical on computers limited to 64K memory.

OASIS Re-entrant BASIC makes it practical.

How?

Because all users use a single run-time BASIC module, to execute their compiled programs, less

memory is needed. Even if you have more than 64K, your pay-off is cost saving and more efficient use of all the memory you have available—because it services more users.

Sound like a pro feature? It is. And OASIS has it.

## AND LOTS MORE...

Multi-User OASIS supports as many as 16 terminals and can run in as little as 56K memory. Or, with bank switching, as much as 784K.

Multi-Tasking lets each user run more than one job at the same time.

And there's our BASIC—a compiler, interpreter and debugger all in one. An OASIS exclusive.

Still more: Editor; Hard & Floppy Disk Support; Keyed (ISAM), Direct & Sequential Files; Mail-Box; Scheduler; Spooler; all from OASIS.

Our documentation is recognized as some of the best, most extensive, in the industry. And, of course, there's plenty of application software.

Put it all together and it's easy to see why the real pros like OASIS. Join them. Send your order today.

### OASIS IS AVAILABLE FOR

SYSTEMS: Altos; CompuCorp; Cromemco; Delta Products; Digital Group; Digital Microsystems; Dynabyte; Godbout; IBC; Index; Intersystems; North Star; Onyx; SD Systems; TRS 80 Mod II; Vector Graphic; Vorimex.

CONTROLLERS: Bell Controls; Cameo; Corvus; Konan; Micromation; Micropolis; Tarbell; Teletex; Thinktoys; X Comp.

Write for complete, free Application Software Directory.

### PLEASE SEND ME:

Product	Price with Manual	Manual Only
<b>OPERATING SYSTEM</b> (Includes: EXEC Language; File Management; User Accounting; Device Drivers; Print Spooler; General Text Editor; etc.) SINGLE-USER MULTI-USER	\$150 350	\$17.50 17.50
<b>BASIC COMPILER/INTERPRETER/DEBUGGER</b>	100	15.00
<b>RE-ENTRANT BASIC COMPILER/INTERPRETER/DEBUGGER</b>	150	15.00
<b>DEVELOPMENT PACKAGE</b> (Macro Assembler; Linkage Editor; Debugger)	150	25.00
<b>TEXT EDITOR &amp; SCRIPT PROCESSOR</b>	150	15.00
<b>DIAGNOSTIC &amp; CONVERSION UTILITIES</b> (Memory Test; Assembly Language; Converters; File Recovery; Disk Test; File Copy from other OS; etc.)	100	15.00
<b>COMMUNICATIONS PACKAGE</b> (Terminal Emulator; File Send & Receive)	100	15.00
<b>PACKAGE PRICE</b> (All of Above) SINGLE-USER MULTI-USER	500 850	60.00 60.00
<b>FILE SORT</b>	100	15.00
<b>COBOL-ANSI '74</b>	750	35.00

Order OASIS from:

**Phase One Systems, Inc.**  
7700 Edgewater Drive, Suite 830  
Oakland, CA 94621

Telephone (415) 562-8085  
TWX 910-366-7139

NAME \_\_\_\_\_  
STREET (NO BOX #) \_\_\_\_\_  
CITY \_\_\_\_\_  
STATE \_\_\_\_\_ ZIP \_\_\_\_\_

AMOUNT \$ \_\_\_\_\_  
(Attach system description; add \$3 for shipping; California residents add sales tax)  
☐ Check enclosed ☐ VISA  
☐ UPS C.O.D. ☐ Mastercharge  
Card Number \_\_\_\_\_  
Expiration Date \_\_\_\_\_  
Signature \_\_\_\_\_



**MAKES MICROS RUN LIKE MINIS**

# 6809 SOFTWARE POWER TOOLS BY MICROWARE®

## OS-9™ MULTIPROGRAMMING OPERATING SYSTEM

**A** true multitasking, real time operating system for timesharing, software development, database, process control, and other general applications. This versatile OS runs on almost any 6809-based computer.

■ UNIX™-like file system with hierarchical directories, byte-addressable random-access files, and full file security. Versatile, easy-to-use input/output system is hardware independent and expandable.

■ Powerful "shell" command interpreter features: I/O redirection, multiple job stream processing, and more. Includes a complete set of utility commands.

■ OS-9 Level Two uses hardware memory management and can address over one megabyte of memory. Also includes pipes and filters for inter-process data transfers.

■ OS-9 Level One runs on systems without memory management hardware having up to 56K memory.

☐ OS-9 Level Two \$495\* ☐ Level One \$195

## BASIC09™ PROGRAMMING LANGUAGE SYSTEM

**E**xtended BASIC language compiler/interpreter with integrated text editor and debug package. Runs standard BASIC programs or minimally-modified PASCAL programs.

■ Permits multiple named program modules having local variables and identifiers. Modules are reentrant, position independent and ROMable.

■ Additional control statements for structured programming: IF ... THEN ... ELSE, FOR ... NEXT, REPEAT ... UNTIL, WHILE ... DO, LOOP ... ENDLOOP, EXITIF ... ENEXIT.

■ Allows user-defined data types and complex data structures. Five built-in data types: byte, integer, 9 digit floating-point, string and boolean.

■ Runs under OS-9™ Level One or Level Two. ☐ \$195\*

## OTHER OS-9™ FAMILY SOFTWARE

- Stylograph™ Screen-Oriented Word Processor
- Interactive Assembler    ■ Macro Text Editor
- Interactive Debugger

BASIC09 and OS-9 are trademarks of Microware® and Motorola. UNIX is a trademark of Bell Laboratories.\* Most software is available on ROM or diskette in versions for many popular 6809 computers. Contact Microware® for specific availability.



**MICROWARE®**

Microware Systems Corp., Dept. B2  
5835 Grand Avenue, Des Moines, Iowa 50304  
(515) 279-8844 • TWX 910-520-2535

## Could you pass this Red Cross swimming test?

### SWIM:

1. Breaststroke — 100 Yds.
2. Sidestroke — 100 Yds.
3. Crawl stroke — 100 Yds.
4. Back crawl — 50 Yds.
5. On back (legs only) — 50 Yds.
6. Turns (on front, back, side).
7. Surface dive — underwater swim — 20 Ft.
8. Disrobe — float with clothes — 5 mins.
9. Long shallow dive.
10. Running front dive.
11. 10-minute swim.

Anybody who's taken a Red Cross swim course knows how tough it can be. There's a good reason.

We believe drowning is a serious business.

Last year alone, we taught 2,589,203 Americans not to drown—in the seven different swim courses we offer all across the country. (Incidentally, most of the teaching—as with almost everything American Red Cross does—is done by dedicated volunteers.)

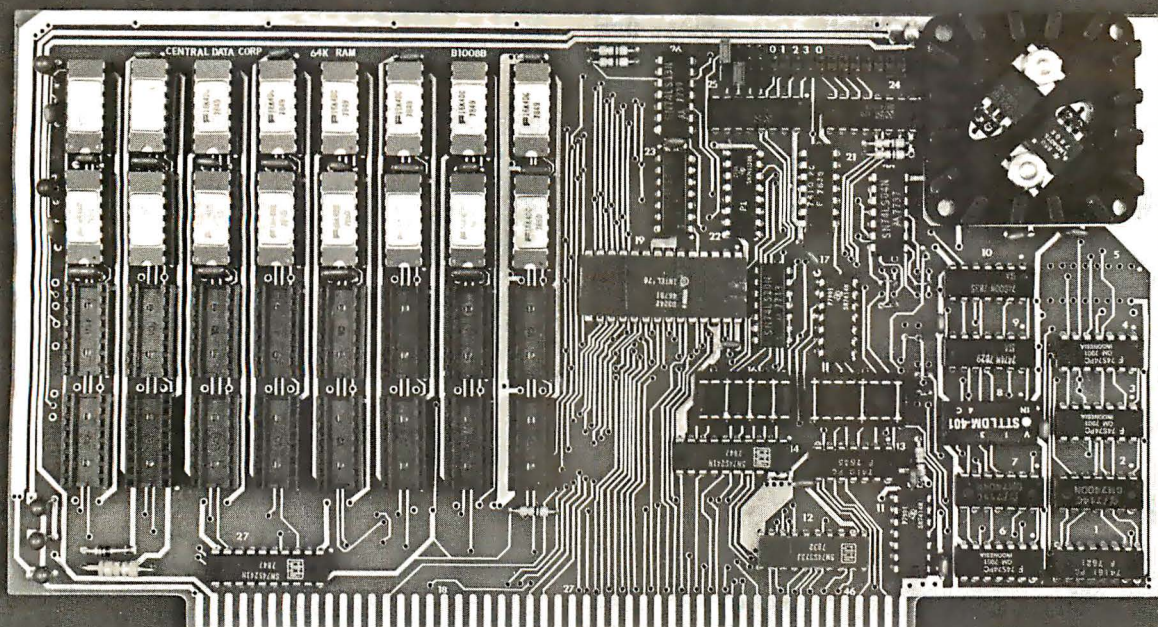
A good many of the youngsters not only are learning to keep *themselves* safe. Thousands upon thousands of them are learning to become lifesavers.

And the life they save—may be your own.



A Public Service of This Magazine & The Advertising Council





32K Board Pictured Above

# Why Not the Best?

## From The Dynamic RAM Company.

2MHz	4MHz
16K—\$249	\$259
32K—\$375	\$395
48K—\$500	\$530
64K—\$625	\$665

We have now been shipping our 2MHz dynamic RAM boards for over two years. Hundreds of 4MHz boards have been going out every month since early 1979. Our reliability is proven in the thousands of systems which contain our board. Many quality-minded systems houses across the country and overseas are using our boards for their equipment.

### Our prices still beat all.

Despite rising 16K memory chip prices (at least from reputable suppliers), Central Data continues to give you the best buy in memory today. Nobody offers a board with a capacity of 64K, assembled, tested, and guaranteed for a full year at the price we do.

**Deselect around PROMs.** Our boards have the important deselect feature which lets you overlap any fixed memory in your system with no interference.

**Our features make the board easily used and expanded.** You address our boards on 16K boundaries with mini-jumps (small shorting plugs that slide over wire-wrap pins) near the top of the board for easy access. If you want to expand your board after you have purchased it, all that you need to do is add memory. We can supply you with expansion packages (\$150-2MHz, \$160-4MHz) which include eight RAMs that you can depend on as well as two mini-jumps for addressing. And of course, our board **never** generates wait states.

**Low power consumption keeps your computer running cool and reliable.** The total power consumption of our 16K board is typically less than 4 watts (+8V @ 300ma, +16V @ 150ma and

—16V @ 20ma). Boards with additional memory typically increase power consumption only 1 watt per 16K!

**Standard S-100 Interface.** Our board is designed to interface with any standard S-100 CPU. All of the timing of the board is independent of the processor chip, and the board is set up for different processors by changing two plugs on the board.

**Call or write us today.** That will guarantee a fast response with more information on the board. Or make an order — you'll probably have the board in two weeks! **If you're interested, also ask for a catalog on our Z8000 16-bit processor board designed for the MULTIBUS.** All of these products are available to your local dealer, also.

Central Data Corporation, 713 Edgebrook Drive, PO Box 2530, Station A, Champaign, IL 61820. (217) 359-8010

**Central Data**

# TERMINALS FROM TRANSNET

PURCHASE PLAN • 12-24 MONTH FULL OWNERSHIP PLAN • 36 MONTH LEASE PLAN

	DESCRIPTION	PURCHASE PRICE	PER MONTH		
			12 MOS.	24 MOS.	36 MOS.
DEC	LA36 DECwriter II	\$1,695	\$162	\$90	\$61
	LA34 DECwriter IV	1,095	105	58	40
	LA34 DECwriter IV Forms Ctrl.	1,295	124	68	46
	LA120 DECwriter III KSR	2,295	220	122	83
	LA120 DECwriter III RO	2,295	220	122	83
	VT100 CRT DECscope	1,695	162	90	61
TEXAS INSTRUMENTS	VT132 CRT DECscope	2,295	220	122	83
	T1745 Portable Terminal	1,595	153	85	58
	T1765 Bubble Memory Terminal	2,595	249	138	93
	T1783 Portable KSR, 120 CPS	1,745	167	93	63
	T1785 Portable KSR, 120 CPS	2,395	230	128	86
	T1787 Portable KSR, 120 CPS	2,845	273	152	102
CENTRONICS	T1810 RO Printer	1,895	182	102	69
	T1820 KSR Printer	2,195	211	117	80
	730 Desk Top Printer	715	69	39	26
	737 W/P Desk Top Printer	895	86	48	32
	704 RS232-C Printer	1,795	172	96	65
	6081 High Speed Band Printer	5,495	527	293	198
DATAMEDIA	DT80/1 CRT Terminal	1,695	162	90	61
	DT80/1L 15" Screen CRT	2,295	220	122	83
	DT80/5 APL CRT	2,095	200	112	75
	DT80/5L APL 15" CRT	2,595	249	138	94
LEAR SIEGLER	ADM3A CRT Terminal	875	84	47	32
	ADM31CRT Terminal	1,450	139	78	53
	ADM42 CRT Terminal	2,195	211	117	79
HAZELTINE	1420 CRT Terminal	945	91	51	34
	1500 CRT Terminal	1,095	105	58	40
	1552 CRT Terminal	1,295	125	70	48
QUME	Letter Quality KSR, 55 CPS	3,395	326	181	123
	Letter Quality RO, 55 CPS	2,895	278	154	104
HEWLETT PACKARD	2621A CRT Terminal	1,495	144	80	54
	2621P CRT Terminal	2,650	255	142	96

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

OTHER POPULAR TERMINALS, COMPUTER PERIPHERALS AND COMPUTERS AVAILABLE.


**TRANSNET CORPORATION**

 1945 ROUTE 22 • UNION, N.J. 07083 • (201) 688-7800  
 TWX 710-985-5485

## Unlock the ENGINEERING POWER of the Microcomputer

### Engineering Software for TRS-80 Mods I, II & III

- Air Cond. Com. Cooling/Heating Load
- Residential Cooling/Heating Load
- Structural Space Frame Analysis
- Fire Sprinkler System Design

#### Lighting Design

- Air Duct Design

#### Accounting

- Surveying

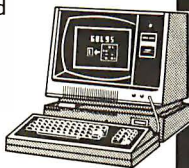
#### Solar F-Chart

- Econ. Analysis

#### Word Processing for Spec Writing

#### Hydraulic Pipe Design

#### Electrical Fault Current



#### Hardy Cross Water Analysis

#### Life Cycle Cost Analysis

Selected programs also available for other microcomputers.

PLEASE TELL ME MORE ABOUT YOUR ENGINEERING PROGRAMS.

Name \_\_\_\_\_

Company \_\_\_\_\_ Phone \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

I am interested in \_\_\_\_\_

**MC↑2**  
**PROGRAMS**
**McClintock Corp.**  
 P.O. Box 430980  
 Miami, FL 33143  
 (305) 666-1300

# Books Received

*Basic Computer Programs for Business, Volume I*, Charles D Sternberg.

Rochelle Park NJ: Hayden

Book Company Inc, 1980;

25 by 20 cm, 264 pages;

softcover, ISBN

0-8104-5162-X, \$9.95.

*Basic FORTRAN*, James S

Coan. Rochelle Park NJ:

Hayden Book Company Inc,

1980; 15.5 by 23 cm, 248

pages, softcover, ISBN

0-8104-5168-9, \$8.95.

*Communicating with*

*Microcomputers*, Ian H

Witten. London, England:

Academic Press Inc Ltd,

1980; 15.5 by 23 cm, 164

pages, hardcover, ISBN

0-12-760750-1, \$18; soft-

cover, ISBN 0-12-760752-8,

\$10.50.

*Computers and Program-*

*ming Guide for Scientists*

*and Engineers*, second edi-

tion, Donald D Spencer. In-

dianapolis IN: Howard W

Sams & Company Inc, 1980;

14 by 22 cm, 463 pages,

softcover, ISBN

0-672-21693-0, \$15.95.

*The Computer in the*

*School: Tutor, Tool, Tutee*,

Robert Taylor, editor. New

York: Teachers College

Press, 1980; 15.5 by 23.5

cm, 274 pages, softcover,

ISBN 0-8077-2611-7, \$14.95.

*Computer/Law Journal*,

*Volume II, Number 2*, Jay

Becker, editor. Los Angeles

CA: Center for Comput-

er/Law, 1980; 17.5 by 25.5

cm, 469 pages, softcover,

ISSN 0164-8756, \$16.

*Designs of VMOS Circuits*

*with Experiments*, Robert T

Stone and Howard M

Berlin. Indianapolis IN:

Howard W Sams & Com-

pany Inc, 1980; 14 by 22

cm, 174 pages, softcover,

ISBN 0-672-21686-8, \$10.95.

*A Guide to FCC Equip-*

*ment Authorizations*,

Willmar K Roberts. New

Smyrna Beach FL: Willmar

K Roberts, 4637 Van Kleeck

Dr, 1980; 21.5 by 27.5 cm,

142 pages, softcover, ISBN

none, \$24.50 in North

America, \$29.50 elsewhere.

*Introduction to Pascal, In-*

*cluding UCSD Pascal*,

Rodney Zaks. Berkeley CA:

Sybex, 1980; 18 by 23 cm,

421 pages, softcover, ISBN

0-89588-050-4, \$12.95.

*Introduction to TRS-80*

*Level II BASIC and Com-*

*puter Programming*, Michael

P Zabinski, PhD. Engle-

wood Cliffs NJ: Prentice-

Hall Inc, 1980; 22.5 by 29

cm, 186 pages, hardcover

ISBN 0-13-499970-3, \$14.95;

softcover, ISBN

0-13-499962-2, \$10.95.

*Micromatics*, Steven K

Roberts. Elmwood CT:

Scelbi Publications, 1980; 22

by 29 cm, 190 pages, hard-

cover, ISBN none, \$19.95.

*Modern Microprocessor*

*System Design*, Daniel R

McGlynn. Somerset NJ:

John Wiley & Sons, 1980;

22.5 by 29 cm, 295 pages,

hardcover, ISBN

0471-06492-0, \$21.95.

*The Nature of Computa-*

*tion: An Introduction to*

*Computer Science*, Ira Pohl

and Alan Shaw. Rockville

MD: Computer Science

Press Inc, 1981; 16 by 23.5

cm, 397 pages, hardcover,

ISBN 0-914894-12-9, \$16.95.

*Owning Your Home*

*Computer*, Robert L Perry.

New York: Everest House,

1980; 19 by 25.5 cm, 224

pages, softcover, ISBN

0-89696-093-5, \$10.95.

*Personal Computers*

*Handbook*, Walter H

Buchsbaum, Sc D. In-

dianapolis IN: Howard W

Sams & Company Inc, 1980;

14 by 22 cm, 286 pages,

softcover, ISBN

0-672-21724-4, \$11.95. ■

This is a list of books received at BYTE Publications during this past month. Although the list is not meant to be exhaustive, its purpose is to acquaint BYTE readers with recently published titles in computer science and related fields. We regret that we cannot review or comment on all the books we receive; instead, this list is meant to be a monthly acknowledgment of these books and the publishers who sent them.

# H & E COMPUTRONICS INC.

...**EVERYTHING FOR YOUR TRS-80™**...

TRS-80 is a trademark of the Radio Shack Division of Tandy Corporation

## 1980 INCOME TAX PAC

Completely Revised ★ Latest Tax Tables ★ Fully Tested ★ Complete Manual and Documentation

★ ★ The New Version Of The Income Tax Pacs Are Full Of Error Catching Codes ★ ★

★ ★ Making It Impossible To Make An Error ★ ★

— Follow The Simple Step By Step Procedure That Makes Tax Preparation Simple —

### ★ INCOME TAX PAC A

FOR LEVEL II 16K

- DOES FORM 1040 and 1040A
- SCHEDULE A ITEMIZED DEDUCTIONS
- SCHEDULE B INTEREST and DIVIDENDS
- OUTPUT TO VIDEO DISPLAY
- SCHEDULE C TAX COMPUTATION

### ★ INCOME TAX PAC B

FOR LEVEL II with or without Printer, Cassette or Disk. Has all features of Income Tax A PLUS,

- WORKS WITH LINE PRINTER
- FORMATS FORM 1040 and 1040A FOR TRACTOR FEED FORMS
- SCHEDULE C INCOME FROM A PERSONALLY OWNED BUSINESS
- FORM 2106 EMPLOYEE BUSINESS EXPENSE

- FORM 1040 (LONG FORM)
- FORM 1040A (SHORT FORM)
- FORM 2106 EMPLOYEE BUSINESS EXPENSE
- FORM 2440 DISABILITY INCOME EXCLUSION
- FORM 2441 CREDIT FOR CHILD AND DEPENDENT CARE EXPENSES
- FORMS 3903 MOVING EXPENSE ADJUSTMENT
- FORM 4797 SUPPLEMENTAL SCHEDULE OF GAINS AND LOSSES

### ★ ★ PROFESSIONAL ★ ★ INCOME TAX PAC C

- SCHEDULE A ITEMIZED DEDUCTIONS
- SCHEDULE B INTEREST AND DIVIDENDS
- SCHEDULE C PROFIT (OR LOSS) FROM BUSINESS OR PROFESSION
- SCHEDULE D CAPITAL GAINS AND LOSSES
- SCHEDULE E SUPPLEMENTAL INCOME SCHEDULE
- SCHEDULE G INCOME AVERAGING
- SCHEDULES R & RP-CREDIT FOR THE ELDERLY

**FOR MODEL I (32K) or MODEL II (64K)  
WITH 1 OR MORE  
DISK DRIVES**

- SCHEDULE SE-COMPUTATION OF SOCIAL SECURITY SELF-EMPLOYMENT TAX
- SCHEDULE TC TAX COMPUTATION
- OUTPUT TO VIDEO OR LINE PRINTER
- FORMATS FOR TRACTOR FEED OR INDIVIDUAL FORM FEED PRINTERS
- AUTOMATIC MEMORY STORAGE FOR INCOME TAX PREPARERS
- INSTANT LINE CHANGE
- BUILT IN ERROR CHECKING

**ALL SPECIFICATIONS SUBJECT TO CHANGE**

**COMPUTRONICS**  
MATHEMATICS, BUSINESS, MUSIC

50 N. PASCACK ROAD  
SPRING VALLEY, NEW YORK 10977

#### PLEASE SEND ME:

- ☐ INCOME TAX PAC A (\$19.95)
- ☐ INCOME TAX PAC B (\$49.95)
- ☐ PROFESSIONAL INCOME TAX PAC C (\$99.95)
- ☐ MODEL II PROFESSIONAL INCOME TAX PAC C (\$199.95)

**NEW TOLL-FREE  
ORDER LINE**

(OUTSIDE OF N.Y. STATE)

**(800) 431-2818**

#### ★ A COMPLETE LINE OF NELCO TAX FORMS ARE AVAILABLE

- INDIVIDUAL FEDERAL and STATE FORMS
- 2 OR MORE PART FORMS
- TRACTOR FEED FORMS
- PLASTIC OVERLAYS

- ★ All orders processed within 24-Hours
- ★ 30-Day money back guarantee on all Software
- ★ Add \$2.00 for shipping in UPS Areas
- ★ Add \$3.00 for C.O.D. or NON-UPS Areas
- ★ Add \$4.00 outside U.S.A., Canada & Mexico

CREDIT CARD NUMBER \_\_\_\_\_ EXP. DATE \_\_\_\_\_

SIGNATURE \_\_\_\_\_

NAME \_\_\_\_\_

STREET \_\_\_\_\_

CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_

Circle 165 on inquiry card.



**24** HOUR  
ORDER  
LINE

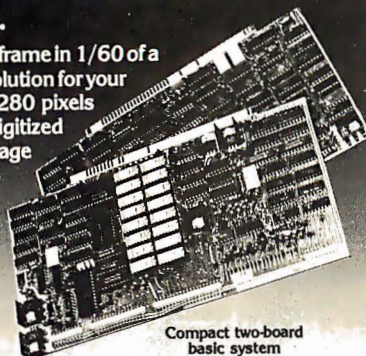
**(914) 425-1535**



# CAT-100 FULL COLOR GRAPHICS

The original 256-color imaging system with high resolution video FRAME GRABBER for the S-100 bus.

Capture and digitize a video frame in 1/60 of a second. Select the best resolution for your application, from 256 to 1280 pixels per TV line. Display your digitized or computer processed image with 256 gray levels or 256 colors on standard B&W, NTSC or RGB color TV monitors.



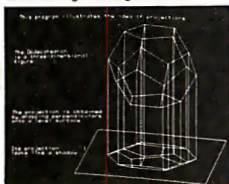
Compact two-board basic system

## Features:

- Highest possible quality 480x512x8 digital video image presently available on the market
- Input capability from TV camera or other sources
- Variety of synchronization choices
- 2 selectable video A/D conversion circuits
- Choice of 1, 2, 4, 8, 16 or 32 bits per pixel
- 32K-byte image memory on the basic system
- 32, 64, 128 & 256K byte system capacity
- Lightpen input
- Photographic trigger control input
- Software selectable system parameters
- Interfaces for TRS-80 and other processors
- Comprehensive line of accessories, monitors and support software



240x256 Digitized image, 16 levels



480x512 Computer-generated

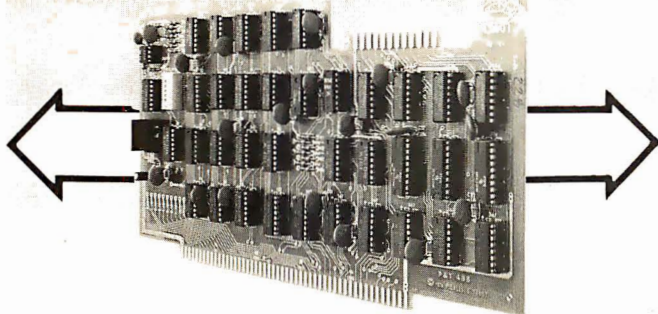
SEND FOR FREE CATALOG



DIGITAL GRAPHIC SYSTEMS

441 California Ave., Palo Alto, CA 94306 415/494-6088

## From S-100 to IEEE-488



**P&T-488 + S-100 computer = Intelligence for your Instrumentation System**

The P&T-488 permits an S-100 computer to operate as a talker, listener, or controller on the IEEE-488 instrumentation bus for less than half the cost of calculator-based systems. Software packages which give access to the 488 bus from high level languages such as BASIC are available for CP/M, North Star DOS /BASIC, and Cromemco CDOS. Or "roll your own" system with the custom system package of assembly language drivers.

P&T-488, assembled and tested, + any software package: \$450 (domestic USA)



**PICKLES & TROUT**

P.O. BOX 1206, GOLETA, CA 93017, (805) 967-9563

# Ask BYTE

Conducted by Steve Ciarcia

## Modem Modification

Dear Steve,

I read "A Build-It-Yourself Modem for Under \$50" (August 1980 BYTE, page 22) with great interest, as I do so many of your articles. Can the circuitry be modified easily to provide either originate or answer operation at the flick of a switch? From your article, it seems that the only difference between the originate and answer modes is the value of two capacitors in both the modulator and demodulator. If the values of these capacitors are switch-selected, then the modem could be either an originate- or an answer-only unit, as desired.

I have an uneasy feeling about several aspects of this scheme. Since you say that the capacitances are critical, will the switch capacitances cause trouble? Secondly, will the variable potentiometer settings be unique to each mode of operation, thus necessitating separate potentiometers for each switch setting?

It seems much more appealing to get expanded capability by buying a few additional components than by buying another complete set of components for both the modulator and demodulator.

Jonathan K Davis

*An originate/answer modem is more complicated*

to build than it might seem at first. While, in theory at least, the answer functions can be added to the design by changing a few capacitors and resistors, the logistics of doing this presents a problem. The wires necessary to add these components and connect them through switches act like an antenna. Due to the high impedances in the circuit, it would probably become "swamped" with noise and cease reliable operation.

The only effective way to connect these components is through CMOS (complementary metal-oxide semiconductor) switches such as the 4052 dual 1-of-4 analog multiplexer, which are mounted close to the modem board. Separate potentiometer settings for answer and originate modes are necessary as well. If done as a printed circuit, the result is a more complicated and expensive board.

I won't tell you that simply installing components with a switch will not work, but I hesitate to suggest it. Success depends on your construction abilities.

As for the kit mentioned in the article, many experimenters seem to be purchasing two kits at once (they are still available). Apparently they intend to change a few components on the second board to make it "answer."

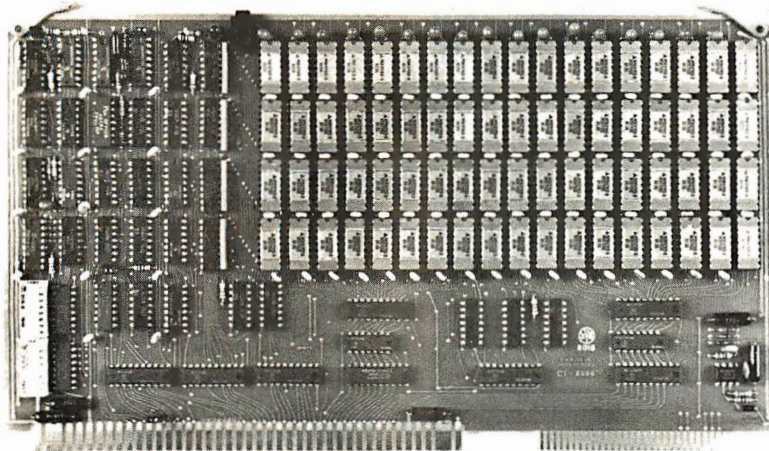
Also, instead of two speakers and two rubber

In "Ask BYTE," Steve Ciarcia answers questions on any area of microcomputing. The most representative questions received each month will be answered and published. Do you have a nagging problem? Send your inquiry to:

Ask BYTE  
c/o Steve Ciarcia  
POB 582  
Glastonbury CT 06033

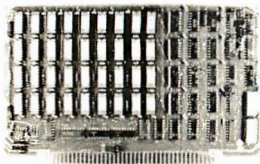
If you are a subscriber to The Source, send your questions by electronic mail or chat with Steve (TCE317) directly. Due to the high volume of inquiries, personal replies will be given as time permits. Please enclose a self-addressed, stamped envelope, and be sure to include "Ask BYTE" in the address.

# CHRISLIN YEARS AHEAD IN MEMORY DESIGN

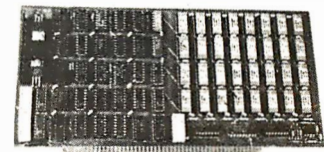


**WE'VE DONE IT AGAIN** — State of the Art Multibus® Memory Design. First to offer up to 512K on one board, and CHRISLIN again brings pricing sanity to the memory market. Why pay over \$2000 for our competitor's 64K x 8 memory board when we will give you the CI-8086 128K x 9 memory for just \$1500 or better yet, the CI-8086 512K x 9 memory module for \$4700.

Up to 512K bytes in a single option slot. Available in 64K, 96K, 128K, 256K, or 512K configurations. On board parity generator checker, for both 8 bit or 16 bit systems. Off shelf deliveries.



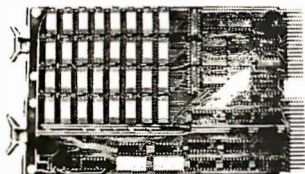
**CI-6800-2** — 16KB to 64KB. Plugs directly into Motorola's EXORciser I or II. Hidden refresh up to 1.5 Mhz. Cycle stealing at 2 Mhz. Addressable in 4K increments with respect to VXA or VUA. On board parity. **64K x 9 \$750.00.**



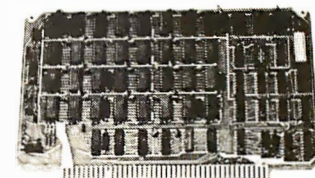
**CI-S100** — 16KB to 64KB. Transparent hidden refresh. No wait states at 4 Mhz. Compatible with Alpha Micro and all Major 8080, 8085 and Z80 Based S100 Systems. Expandable to 512K bytes thru Bank Selections. **64K x 8 \$750.00.**



**CI-8080** — 16KB to 64KB on a single board. Plugs directly into MDS 800 and SBC 80/10. Addressable in 4K increments up to 64K. **16KB \$390.00. 64KB \$750.00.**



**CI-1103** — 16KB to 256KB on a single dual height board. Plugs directly into LSI 11/2, H11 or LSI 11/23. Addressable in 2K word increments up to 256KB. **8K x 16 \$390.00. 32K x 16 \$750.00. 128K x 18 \$2880.00.**



**CI-6800** — 16KB to 64KB on a single board. On board hidden refresh. Plugs directly into EXORciser I and compatible with Rockwell's System 65. Addressable in 4K increments up to 64K. **16K x 8 \$390.00. 64K x 8 \$750.00.**

Tested and burned in. Full year warranty.

***DON'T ASK WHY WE CHARGE SO LITTLE, ASK WHY THEY CHARGE SO MUCH.***



## ***Chrislin Industries, Inc.***

Computer Products Division

31352 Via Colinas • Westlake Village, CA 91362 • 213-991-2254

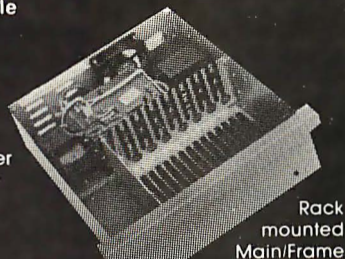
Multibus is a trademark of the Intel Corp.

LSI II is a trademark of Digital Equipment Corp.

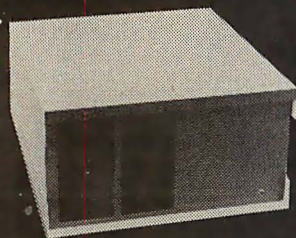
EXORciser is a trademark of Motorola

# Main/Frames from \$200

- 14 Basic Models Available
- Assembled & Tested
- Power Supply:  
8v@15A,  $\pm 16v@3A$
- 15 Slot Motherboard  
(connectors optional)
- Card cage & guides
- Fan, line cord, fuse, power  
& reset switches, EMI filter
- 8v@30A,  $\pm 16v@10A$   
option on some models



Rack  
mounted  
Main/Frame



8" Floppy Main/Frame  
(includes power for  
drives and main/frames)

Write or call for our  
brochure which includes our  
application note:

'Building Cheap Computers'

## INTEGRAND

8474 Ave. 296 • Visalia, CA 93277 • (209) 733-9288  
We accept BankAmericard/Visa and MasterCard

# STRETCH THE POWER

Of Your HP-85 or Commodore Pet/CBM With TNW's IEEE-488 Bus  
System Building Blocks...



TNW-2000

## TNW's RS-232 SERIAL INTERFACES

Connect your PET/CBM to any RS-232 Serial Printer, Plotter, CRT  
Terminal, Modem, or other device:

<b>TNW-1000</b>	ONE CHANNEL OUTPUT ONLY	<b>\$129</b>
<b>TNW-2000</b>	ONE CHANNEL INPUT AND OUTPUT	<b>\$229</b>
<b>TNW-232D</b>	TWO CHANNELS, INPUT & OUTPUT, 12 RS-232 CONTROL SIGNALS	<b>\$369</b>

## TURN YOUR PET INTO A TERMINAL

Access Timesharing Systems and Bulletin Boards with TNW's Pterm  
Software and full service telephone modem:

<b>TNW-103</b>	AUTO ANSWER/AUTO DIAL USE WITH DAA	<b>\$389</b>
----------------	---------------------------------------	--------------

Pterm also works with acoustical couplers and other modems interfaced  
to the PET with the TNW-2000 or TNW-232D. Electronic mail and TWX  
Terminal programs also available. All units are addressable IEEE-488  
devices, complete with power supply cabinet, full documentation and one  
year warranty.

## TNW CORPORATION

3351 Hancock St. • San Diego, CA. 92110 (714) 225-1040  
TWX910-335-1194  
Visa/Mastercharge Welcome • Dealer inquiries invited

## Ask BYTE

cushions in the coupler kit, MicroMint is shipping (at no extra cost) a ceramic microphone in place of one speaker. Even though I designed the prototype using an 8-ohm speaker as the "mike," the ceramic unit is far more reliable....Steve

## Communications

Dear Steve,

I am working on converting your biphase encoding/decoding circuits to use 8- instead of 4-bit words. (See "Hand-Held Remote Control for Your Computerized Home," July 1980 BYTE, page 22.) This approach looks promising, but I am not sure which communications medium I should use the circuits for. Radio is a possibility, but I really don't like the idea of having its interference. Infrared also looks good, but I am not sure about achieving long-range communications with it. To the best of my knowledge, the same holds true for ultrasonics. Can you suggest a particular system?

Also, in figure 3 of your article, there is a note next to the FSK OUTPUT saying that it can be connected to figure 5's input; however, figure 5 has two inputs labeled audio input modulation, plus and minus. Why?

Any of the systems you list will work. For the most part, ultrasonics and infrared communication are limited to use in one room. If the experience of model-airplane builders is worth anything, 49 MHz radio control may be your best bet. Interference presents less of a problem if you use the "smarts" available with a microprocessor. Perhaps you should require that, for any command to be acted upon, it must be received correctly with a synchronization word before and after the command.

There are many coding schemes that insure you

don't lose data. Rather than sending a single bit, you could send the same bit eight successive times. This makes for slow but reliable reception. Heathkit sells a variety of radio-control equipment that is adaptable to the task.

Finally, in figure 5, the plus (+) lead would be connected to the biphase output of figure 3 and the minus (-) lead would be connected to ground....Steve

## BSR X-10

Dear Steve,

I read with interest your article "Computerize a Home." (See the January 1980 BYTE, page 28.)

Can you suggest references or other aids for pursuing the option of directly synthesizing the command-console waveform and transmitting it directly onto the AC line? This approach may be useful in an application for which I'm developing a product.

Jim Konsevich

It so happens that the cover article of the September 1980 issue of Radio Electronics is about the BSR X-10. The article fully describes how to synthesize waveforms for direct injection into the AC line. It also has schematics of the command console and typical receivers. It should be just what you need.

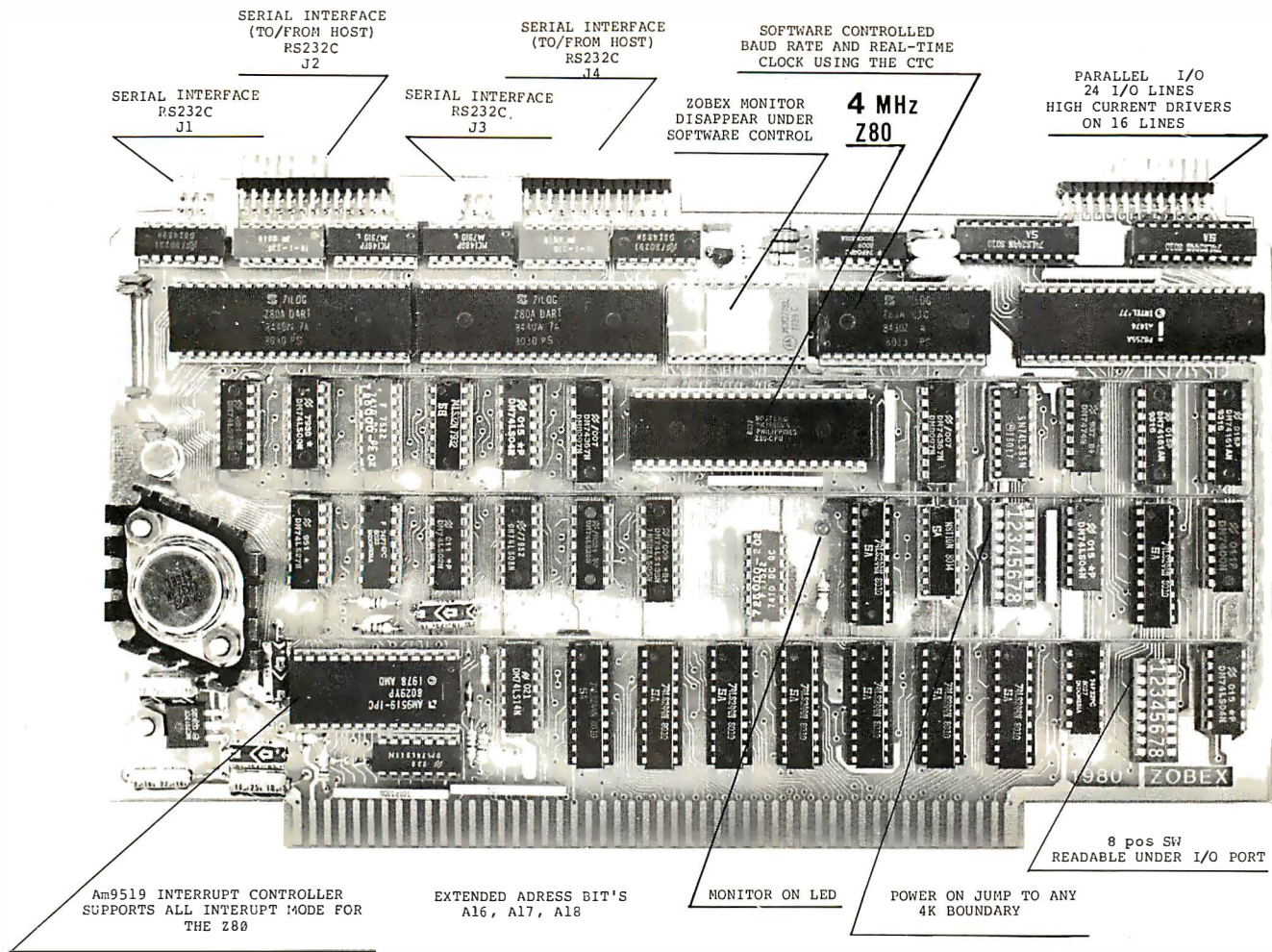
By the way, I wrote the article....Steve

## Reference Needed

Dear Steve,

In your article "Computer-Controlled Security for Your Home" (January 1979 BYTE, page 56) you indicate an MM5369 in figure 4. I cannot find any reference or cross-reference for this device. It looks like an interesting unit; where can I get one and who manufactures it?

James Bush



## ZOBEX CPU

**\$490**

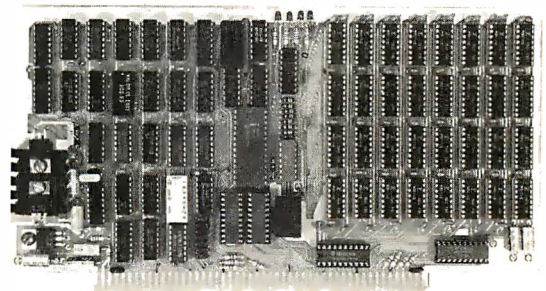
THE ZOBEX CPU IS A IEEE STANDARD S-100 MODULE THAT INCORPORATES PROCESSOR, 4 SERIAL AND 3 PARALLEL I/O, REAL-TIME CLOCK, AND PROM FEATURES, ALL ON ONE BOARD. IT IS ADAPTABLE TO WIDE VARIETY OF HOME AND OEM APPLICATIONS. THIS BOARD WILL RUN MODERN INTERRUPT DRIVEN OPERATING SYSTEMS SUCH AS \*\*MP/M, WITH NO EXTERNAL CIRCUITRY.

## 64K RAM BOARD

**\$795**

THE ZOBEX ZMS-100 64K RAM BOARD IS HIGH-SPEED BANK SELECTABLE DYNAMIC MEMORY FOR S-100 COMPUTERS.

- 4MHz OPERATION (no wait states)
- INVISIBLE REFRESHING
- FULL DMA OPERATION
- COMPATIBLE WITH \*CROMEMCO, etc.
- RUNS \*CROMIX AND \*\*MP/M WITH NO MODIFICATION



FLOPPY DISK CONTROLLER  
FOR IBM 3740 FORMAT

**\$245**

**ZOBEX®**

P.O. BOX 1847 SAN DIEGO, CA. 92112  
5333 MISSION CENTER RD. SAN DIEGO, CA. 92108  
(714) 296-9182

\*Cromemco, Cromix are trade marks of Cromemco Inc.  
\*\*MP/M is trade mark of Digital Research

**MR. RAINBOW SAYS...  
BLAST-OFF**

WITH OUR SPECIAL CATALOG FEATURE...



**ASTELLAR TREK**  
OUR HI-RES COLOR VERSION OF  
THE CLASSIC STARTREK GAME  
WITH 22 PAGES OF DOCUMENTATION  
NEEDS 48K APPLESOFT ROM  
DISK.... \$24.95

WRITE OR CALL TODAY  
FOR YOUR FREE  
CATALOG (OVER 100  
PAGES - INCLUDES  
PRODUCTS FROM  
EVERY MAJOR  
MANUFACTURER.)

FOR INNER STELLAR DELIVERY  
(BARRING KLINGONS) ADD \$2.00 US/  
\$10.00 FOREIGN FOR SHIPPING AND  
6% TAX IN CALIFORNIA

**apple computer inc.**  
OPEN TUES. - SUN.  
VISA / MASTERCARD WELCOME

**RAINBOW COMPUTING INC.**  
GARDEN PLAZA SHOPPING CENTER  
9719 RESEDA BOULEVARD DEPT. 3B  
NORTHridge, CALIFORNIA 91324  
PHONE: (213) 349-0300

## Ask BYTE

Radio Shack sells the MM5369 as part number 276-1769, for \$2.89. Radio Shack calls it an oscillator/divider. Be aware that the +12 V and ground-pin connections were listed incorrectly in the power-connection table. Pin 8 is the ground and pin 2 is +12 V....Steve

### Character Descension

Dear Steve,  
I own a Radio Shack TRS-80 Level II with 16 K bytes of memory, and I have installed an uppercase/lowercase kit.

If you have seen a system with this kit, you probably noticed that the lowercase letters p, q, and y do not descend below the line. Actually, they are the same size as the uppercase letters. This can be irritating. To cure this, the character generator must be changed, but I have yet to find a compatible device to replace the old one. It must have the same characters (graphics, etc) and of course, the new p, q, and y. Please tell me where I can get such a device and its approximate cost?

Mark T Cruse

*Apparently the device that you want is made by Motorola, but is proprietary to Radio Shack. The standard MCM6670 installed in TRS-80s is only available in quantities of 5000 or greater. There is the preprogrammed MCM6674 that is available, but it is a 5 by 7 matrix. Try ordering a new character generator directly from Radio Shack. I do not see any 5 by 9 dot-matrix 18-pin horizontal-scan character generators in the Motorola data manuals that would be applicable.*

*I asked a few non-Radio Shack TRS-80 dealers about this, and some expect to eventually carry it. All the new TRS-80s have a revised character generator installed, even though the descenders*

*cannot be used without the uppercase/lowercase option....Steve*

### Home Control

Dear Steve,

I work in software development for a videotext/electronic publishing concern. Hardware is not my area of expertise; however, I have done some minimal automation of my home, including a humidity-controlled bathroom fan. I anticipate using a computer-controlled BSR X-10, but mine will be different from yours. (See "Computerize a Home," January 1980 BYTE, page 28.) I plan to have my ultrasonic controller run through the computer to the X-10 unit. I hope to talk to the X-10 unit through an optoisolator that would replace the microphone in the unit.

The same technique can be applied to any remotely controllable consumer device. It avoids the potential conflicts between the various ultrasonic and infrared control methods used in televisions, turntables, cassette decks, and other products. In the future, a videodisk, a Telidon videotex terminal, and an electronic-music library will join the list of controlled devices. There will be an ultrasonic receiver in each room. To complement the computer control, each device will retain its local controls.

I am working on a computer-controllable preamplifier for my stereo, incorporating reed-switch relays and a voltage-controlled amplifier. Crown has a unit on the market, but it's a little too expensive. The preamplifier will lower its output by 20 dB whenever the telephone or the door is answered, etc.

I hope to stay with a single-board computer for the simple scheduling and control functions, but I have not yet calculated my memory requirements. I'm considering an SD Systems Z80 starter kit with an addi-

## THE PRACTICAL APPROACH TO MULTI-USER MULTI-TASKING APPLICATIONS



### OSM'S NEW EXPANDABLE MULTIPROCESSOR, MULTI-USER SYSTEM MODEL 6500

#### MODEL 6500 FEATURES:

- Up to 6 separate users per mainframe (10 in March, 1981). Each user has their own system consisting of Z80A CPU, 64K memory console and optional local printer I/O.
- S100 Bus and CP/M2.2 compatible. User and master processors do not communicate on the S100 Bus enabling users to operate at full speed.
- User processors are connected to the master processor through a high speed parallel bidirectional data channel.
- Multi-user System Executive. Unlike MP/M® there is no performance degradation as users are added.
- Users share common disk storage and master printer. The master processor handles disk (floppy and hard) access and printing, as well as automatic master printer spooling.
- Each user has a system reset button. If any of the users, whether local or remote (thru MODEM), should "crash", he may reset his CPU by depressing the console break key. Other users will not be affected providing complete autonomy. —Additional features include expandability to 100+ user terminals, interfaces to any ASCII CRT terminal, messages can be passed among users, and multi-level file security and file sharing interlock are provided.

CP/M and MP/M are registered trademarks of Digital Research.

**OSM COMPUTER CORPORATION**  
2364 WALSH AVENUE • SANTA CLARA, CA 95051  
(408) 496-6910 • TWX: 910 338 2099

# Why The People Who Know Use FMS-80

FMS-80, a data base management system, is the most powerful DBM program available to the microcomputer industry. Written in assembly language, it offers these features:

- Operates on CP/M\*, MP/M\* or CDOS\*\* systems.
- User Definable: Screen formatting with up to 255 screens per data file, report generator, and menus capable of calling other CP/M programs or FMS-80 programs.
- No restrictions to record size other than available RAM memory size.
- Instantaneous data record inquiry on indexed data records.
- Capable of selecting on any field or multiple fields with multiple selection criteria (fields do not have to be keyed).
- Mathematical manipulation of numeric data fields (add, subtract, multiply and divide).
- Capable of collecting information from multiple data files and generating a new data file or report.
- All menu driven.
- Capable of abstracting data from other programs written in other languages.
- Available now (off the shelf).

All these capabilities are available with the added plus of ease of programming.

See What Users of FMS-80 Have to Say:

Mike Ketcham, systems consultant and programmer for Management Information Systems: "FMS-80

allows me the flexibility of quickly creating programs for user applications. It is flexible, in that data can be entered in a form that the secretary recognizes and generates reports that the manager requires. Also, the user-definable menus allow me to actually generate a menu from which the user can select, creating a true turnkey system." Tom Niccoli, Partner, Computerland of Phoenix: "FMS-80 is flexible enough to acquire data from an application program that was previously written and allowed me to generate the reports that my customer needed. It closed the deal for me. Considering its capability, FMS-80 is one of the most cost-effective application programs available today."

If you're continuously asked to do applications programming, and you don't have the time to do it in Basic, consider FMS-80. For additional information on FMS-80, contact Systems Plus, 3975 East Bayshore, Palo Alto, CA 94303. Phone (415) 969-7047.



**Systems Plus**



Mike Ketcham, Management Information Systems, Belmont, CA

\*TM of Digital Research, Pacific Grove, CA  
\*\*TM of Cromemco, Sunnyvale, CA

## Ask BYTE

tional memory and I/O (input/output) board. Am I too optimistic?

I plan to loosely couple the control computer to a more general-purpose computer, for advanced scheduling and control functions (perhaps including voice recognition). The general-purpose machine will be used as a programming terminal for work I do at home; I currently use a TI Silent 700. Whatever I get, it must have good graphics, because I want to use it as a Telidon terminal until the real thing gets to market. Incidentally, why are high-speed modems so expensive?

Putting intelligence into home appliances can make them more useful, as you so aptly demonstrate in your column. Putting that same intelligence behind a hand-held controller would offer still more advantages. I've had a lot of fun considering the human engineering aspects of a single hand-held controller wielding so much power.

Ian Smith

*I appreciate your activities. I have been attempting a similar effort during*

*the past year and a half. The BUSY BOX was specifically designed because I was getting tired of expensive hard-wired AC control. I started out with a single-board computer, but it has evolved into a 26 K-byte mainframe with sixteen I/O ports and many of the interfaces presented in my articles during the past year. It's quite possible to use a single-board computer, but you may find, as I did, that a larger unit accommodating a combination of assembly-language and BASIC programming is necessary. BASIC makes report generation much easier.*

*I too have been thinking of hand-held master controllers. I have a few designs and will probably have more articles on this subject in the near future. If you get something working in the meantime, let me know.*

*High-speed modems must pack a lot of information into a limited bandwidth and recover this information, often in noisy environments. The high cost is a function of the increased circuit complexity necessary to accomplish this feat. I wish you luck in your venture.*  
...Steve ■

# 3 NEW MODEMS!

ORIG    ANS    OFF HOOK    SEND    REC    CARRIER

**MICRONET**  
MICROMATE ELECTRONICS, INC.

- |   |  |  |
|---|--|--|
| <p><b>1. A Smart One</b><br/>with auto everything built in!</p> <ul style="list-style-type: none"> <li>• Auto Dial</li> <li>• Auto Answer</li> <li>• Auto Mode (originate/answer)</li> <li>• "Direct Connect" for any computer with an RS232 Interface.</li> </ul> <p><b>\$299.00</b></p> | <p><b>2. An Acoustical Modem for the Apple.*</b><br/>Does not need an interface card!</p> <ul style="list-style-type: none"> <li>• Costs less to get on line than any similar modem.</li> <li>• 25 Keyboard commands.</li> <li>• Will also operate interactively with your programs!</li> </ul> <p><b>\$179.00</b></p> | <p><b>3. A "Direct Connect" for the Apple.*</b><br/>Does not need an interface card!</p> <ul style="list-style-type: none"> <li>• Auto Dial</li> <li>• Auto Answer</li> <li>• 25 Keyboard commands.</li> <li>• Will also operate interactively with your programs!</li> </ul> <p><b>\$289.00</b></p> |
|---|--|--|

**MICROMATE ELECTRONICS, INC.**

East Coast:  
2094 Front Street  
East Meadow, New York 11554  
(516) 794-1072

West Coast:  
1116A 8th Street  
Suite 110  
Manhattan Beach, California 90266

All "Direct Connect" modems are FCC certified.  
\*Registered trademark of Apple Computer, Inc.

# OVER 8 MBytes OF SOFTWARE AT \$8\* PER DISKETTE FULL

The exchange library of The CP/M® Users Group has nearly 50 volumes of software available. Everything from editors, assemblers, languages, games, tools and more—and almost everything in full source code.

Send \$6\*\* for full library catalog.

## THE CP/M USERS GROUP

1651 Third Avenue, New York, N.Y. 10028.

\*Domestic price. Inquire for overseas price.

\*\*The complete catalog of CPMUG is available for \$6 prepaid to the U.S., Canada and Mexico. \$11 prepaid to all other countries.

© CP/M is a registered trademark of Digital Research. The CP/M Users Group is not affiliated with Digital Research.

## And then there were none.

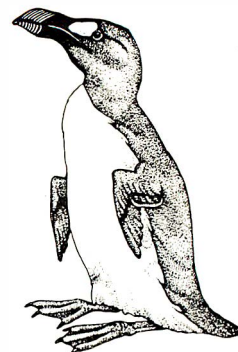
The list of already extinct animals grows . . . the great auk, the Texas gray wolf, the Badlands bighorn, the sea mink, the passenger pigeon . . .

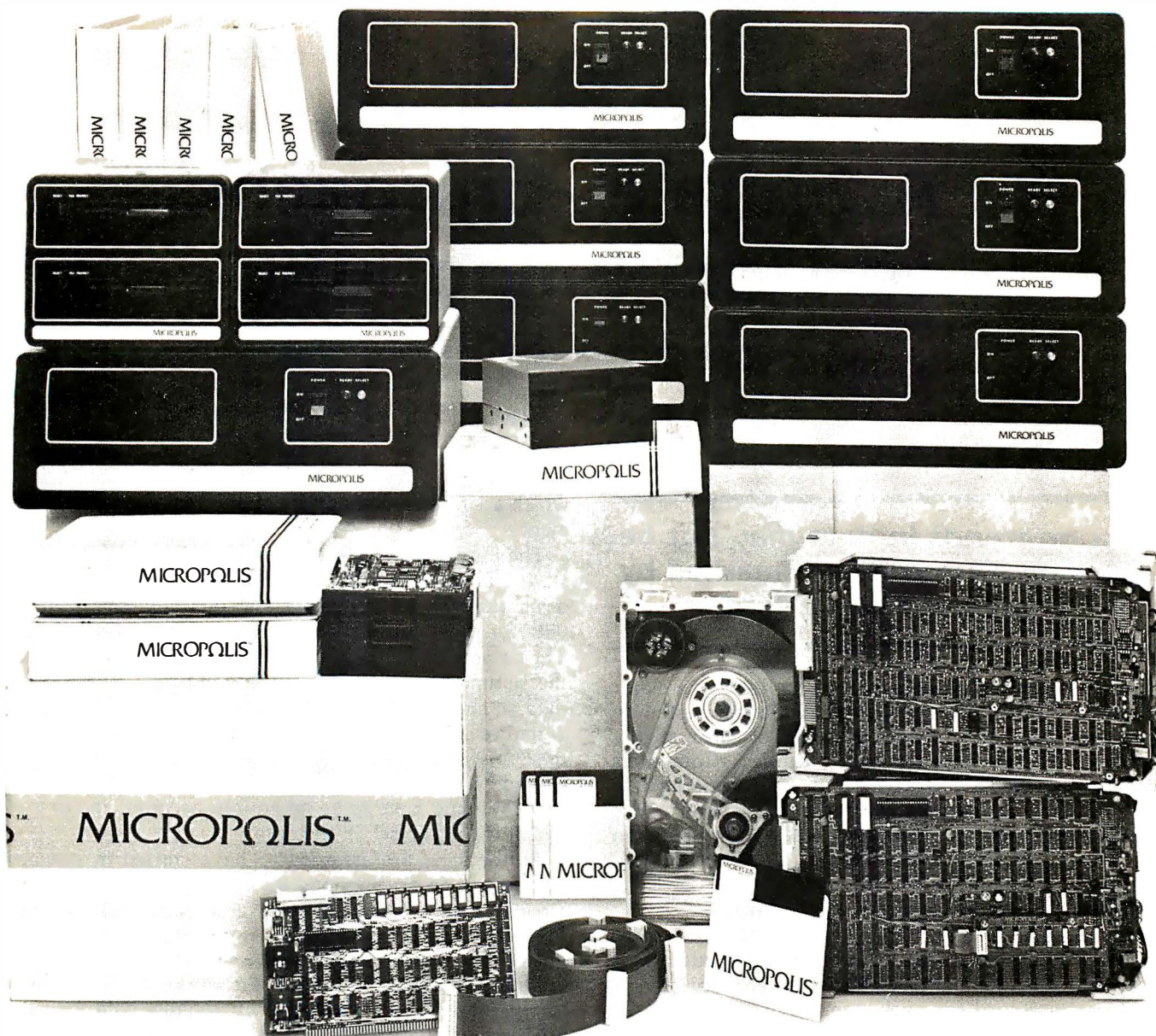
What happens if civilization continues to slowly choke out wildlife species by species?

Man cannot live on a planet unfit for animals.

Join an organization that's doing something about preserving our endangered species. Get involved. Write the National Wildlife Federation, Department 105, 1412 16th Street, NW, Washington, DC 20036.

It's not too late.





# THIS COULD BE THE START OF SOMETHING SMALL.

At Micropolis, we make a big deal over our small deals, too.

Because we believe there should be a place in the marketplace for the small systems integrator who doesn't order thousands of units at a time. And we do everything we can to take the big headaches out of building small systems for vertical markets.

When you ask us for help, we don't just slap a brochure in your hand, give you a plant tour, and show you out the back door. We actually work with you to get your system to market.

The single fact is, nobody can help systems integrators with

a broader range of high capacity, high performance, high reliability 5¼" floppy and 8" rigid disk products than we can. We offer storage modules, enclosures, power supplies, S-100 & SBC-80 controllers, cables and connectors, interfaces, single & multiuser 8080/Z-80 operating systems & disk BASIC software, documentation and tech training. And we offer as much or as little as you need, from complete sub-systems at the start to OEM drive and controller manufacturing licenses as you grow.

When you deal with Micropolis, you avoid a lot of the expense,

inconvenience and delay of trying to solve your own packaging, interfacing and system software development.

For more information about our system integrator program, call Jim Molenda at extension 330. He'll be glad to tell you all about it.

Because we're Micropolis.

And we've got big ideas for small system integrators.

## MICROPOLIS™

In the US: 21329 Nordhoff Street,  
Chatsworth, CA 91311 • 213/709-3300  
In Europe: Micropolis International  
(U.K.) 0734-860817 Telex 851847395

# A Simple Approach to Data Smoothing

Fred Ruckdeschel and Janice A Krinsky  
c/o BYTE  
POB 372  
Hancock NH 03449

## Existing trends in data may not be visible because they are masked by statistical fluctuations.

The storage and processing of data has become a major activity in modern society. Computers have created an increasing demand for data because of their highly organized storage and retrieval facilities. Computers have also provided a means for rapidly transforming data into a format that emphasizes particular aspects of the underlying information. *Data* and *information* as used in this context are not synonymous terms. The word *data* refers to sets of numbers. *Information* is the knowledge that may be derived from those numbers.

Data appears in many forms. For example, a person interested in stocks may have a history of daily quotations for a particular company. A businessman may have a weekly sales record for each item in his inventory. A hospital administrator may have a record of emergency admittances. A scientist may have a table of results from a series of experimental measurements. All these types of data, when plotted against time (or another *independent variable*), may contain information regarding trends. However, existing trends in the data may not be visible because they are masked by statistical fluctuations,

which are often a component of any real-world measurement.

The importance of somehow removing the "noise" (or statistical fluctuation) from the data may be seen by using a simple example. Consider the monthly sales-volume data for a new business or product as shown in table 1. The data clearly indicates that the sales generally peak in the summer, with a slump in late autumn. Plotting the data, as shown in figure 1, demonstrates the basic seasonal nature of the sales volume. If this data were to be used to supply information regarding the number of units that should be ready for sale for July of the next year, several factors would have to be taken into account, the first of which is the "noise" in the data.

As the sales are assumed to have started in January 1978, there is no previous history that can be used to directly measure the noise by a monthly comparison. Thus the noise must be extracted using the data given. If there is no reason to expect sales to be *statistically* much different during the next year, we can use the smoothed results for 1978 to predict 1979. If the raw data value of 6181 units were prepared for July 1979, there is a chance for that number to be too high, with a corresponding penalty to be paid (eg: bank interest) for maintaining the inventory. Thus, a more realistic estimate is required.

### Predicting Future Performance

One approach to obtaining sales estimates is to assume a functional form for the average sales-volume behavior and perform a regression. One mathematical form which might be tried is:

$$S(t) = A + B \times \sin \{ 2\pi(t+t_0)/12 \} \quad (1)$$

where  $t=1$  represents January,  $t=2$  represents February, and so on. A regression using  $S(t)$  could be performed that minimizes the sum of the squares of the differences between the true values and the ones eventually calculated using  $S(t)$ . The regressed coefficients would then be  $A$ ,  $B$ , and  $t_0$ , and the desired estimate for July 1979 is then  $S(7)$ .

There are two practical considerations that make this approach less than ideal for the average businessman. First, though the form of  $S(t)$  given above may be appropriate, it is simply a guess. Second, few businessmen have the knowledge, facilities, or inclination for doing

Month	1978 Sales Volume
January	3279
February	2421
March	4864
April	3629
May	3180
June	4744
July	6181
August	3653
September	3418
October	1722
November	1235
December	2408

**Table 1:** 1978 sales data for a hypothetical company. The figures indicate that the product being sold has an obvious seasonal appeal.

# DYNACOMP

Quality software for<sup>+</sup>:

ATARI  
PET  
APPLE II Plus

TRS-80 (Level II)\*  
NORTH STAR  
CP/M 8" Disk

## GAMES, SIMULATIONS, EDUCATION and MISCELLANEOUS

**BRIDGE 2.0 (Available for all computers)** Price: \$17.95 Cassette/\$21.95 Diskette  
An all-inclusive version of this most popular of card games. This program both BIDS and PLAYS either contract or duplicate bridge. Depending on the contract, your computer opponents will either play the offense OR defense. If you bid too high, the computer will double your contract! BRIDGE 2.0 provides challenging entertainment for advanced players and is an excellent learning tool for the bridge novice.

**HEARTS 1.5 (Available for all computers)** Price: \$14.95 Cassette/\$18.95 Diskette  
An exciting and entertaining computer version of this popular card game. Hearts is a trick-oriented game in which the purpose is not to take any hearts or the queen of spades. Play against two computer opponents who are armed with hard-to-beat playing strategies.

**STUD POKER (ATARI only)** Price: \$11.95 Cassette/\$15.95 Diskette  
This is the classic gambler's card game. The computer deals the cards one at a time and you (and the computer) bet on what you see. The computer does not cheat and usually bets the odds. However, it sometimes bluffs! Also included is a five card draw poker betting practice program. This package will run on a 16K ATARI. Color, graphics, sound.

**POKER PARTY (Available for all computers)** Price: \$17.95 Cassette/\$21.95 Diskette  
POKER PARTY is a draw poker simulation based on the book, POKER, by Oswald Jacoby. This is the most comprehensive version available for microcomputers. The party consists of yourself and six other computer players. Each of these players (you will get to know them) has a different personality in the form of a varying propensity to bluff or fold under pressure. Practice with POKER PARTY before going to that expensive game tonight! Apple Cassette and diskette versions require a 32 K (or larger) Apple II.

**VALDEZ (Available for all computers)** Price: \$14.95 Cassette/\$18.95 Diskette  
A simulation of super-tanker navigation in the Prince William Sound and Valdez Narrows. The program uses an extensive 256X256 element radar map and employs physical models of ship response and ship and iceberg traffic. Chart your own course through ship and iceberg traffic. Any standard terminal may be used for display.

**FLIGHT SIMULATOR (Available for all computers)** Price: \$17.95 Cassette/\$21.95 Diskette  
A realistic and extensive mathematical simulation of take-off, flight and landing. The program utilizes aerodynamic equations and the characteristics of a real airfoil. You can practice instrument approaches and navigation using radials and compass headings. The more advanced flyer can also perform loops, half-rolls and similar aerobically maneuvers.

**CRIBBAGE 2.0 (TRS-80 only)** Price: \$14.95 Cassette/\$18.95 Diskette  
This is a well-designed and nicely executed two-handed version of the classic card game, cribbage. It is an excellent program for the cribbage player in search of a worthy opponent as well as the beginner wishing to learn the game, in particular the scoring and jargon. The standard cribbage score board is continually shown at the top of the display (utilizing the TRS-80's graphics capabilities), with the cards shown underneath. The computer automatically scores and also announces the points using the traditional phrases.

**CHESS MASTER (North Star and TRS-80 only)** Price: \$19.95 Cassette/\$23.95 Diskette  
This complete and very powerful program provides five levels of play. It includes casting, en passant captures and the promotion of pawns. Additionally, the board may be preset before the start of play, permitting the examination of "book" plays. To maximize execution speed, the program is written in assembly language by SOFTWARE SPECIALISTS of California. Full graphics are employed in the TRS-80 version, and two widths of alphanumeric display are provided to accommodate North Star users.

**STARTREK 3.2 (Available for all computers)** Price: \$ 9.95 Cassette/\$13.95 Diskette  
This is the classic Star Trek simulation, but with several new features. For example, the Klingons now shoot at the Enterprise without warning while also attacking starbases in other quadrants. The Klingons also attack with both light and heavy cruisers and more when shot at! The situation is hectic when the Enterprise is besieged by three heavy cruisers and a starbase S.O.S. is received! The Klingons get even!

**SPACE TILT (Apple only)** Price: \$10.95 Cassette/\$14.95 Diskette  
Use the game paddles to tilt the plane of the TV screen to "roll" a ball into a hole in the screen. Sound simple? Not when the hole gets smaller and smaller! A built-in timer allows you to measure your skill against others in this habit-forming action game.

**GAMES PACK I (Available for all computers)** Price: \$9.95 Cassette/\$13.95 Diskette  
GAMES PACK I contains the classic computer games of BLACKJACK, LUNAR LANDER, CRAPS, HORSESHOE, SWITCH and more. These games have been combined into one large program for ease in loading. They are individually accessed by a convenient menu.

**GAMES PACK II (Available for all computers)** Price: \$9.95 Cassette/\$13.95 Diskette  
GAMES PACK II includes the games CRAZY EIGHTS, JOTTO, ACEY-DEUCEY, LIFE, WUMPUS and others. As with GAMES PACK I, all the games are loaded as one program and are called from a menu.  
Why pay \$7.95 or more per program when you can buy a DYNACOMP collection for just \$9.95?

**NOMINOES JIGSAW (TRS-80 only)** Price: \$16.95 Cassette/\$20.95 Diskette  
NOMINOES JIGSAW is an intriguing and sophisticated graphical puzzle. The jigsaw consists of a 9 by 9 board partially filled with randomly chosen shapes (nominos), of which there are 60 types. By knowing that the shapes must be legally connected, and by guessing the shape at each location, all the nominos may be eventually deduced. Scoring is based on the number of guesses required and the difficulty of the board set-up.

**MOVING MAZE (Apple only)** Price: \$10.95 Cassette/\$14.95 Diskette  
MOVING MAZE employs the games paddles to direct a duck from one side of a maze to the other. However, the maze is dynamically (and randomly) built and is continually being modified. The objective is to cross the maze without touching (or being hit by) a wall. Scoring is by an elapsed time indicator, and three levels of play are provided.

**BLACK HOLE (Apple only)** Price: \$14.95 Cassette/\$18.95 Diskette  
This is an exciting graphical simulation of the problems involved in closely observing a black hole with a space probe. The object is to enter and maintain, for a prescribed time, an orbit close to a small black hole. This is to be achieved without coming so near the anomaly that the tidal stress destroys the probe. Control of the craft is realistically simulated using sets for rotation and main thrusters for acceleration. This program employs Hi-Res graphics and is educational as well as challenging.

**TEACHER'S PET I (Available for all computers)** Price: \$ 9.95 Cassette/\$13.95 Diskette  
This is the first of DYNACOMP's educational packages. Primarily intended for pre-school to grade 3, TEACHER'S PET provides the young student with counting practice, letter-word recognition and three levels of math skill exercises.

**CRYSTALS (ATARI only)** Price: \$ 9.95 Cassette/\$13.95 Diskette  
A unique algorithm randomly produces fascinating graphics displays accompanied with tones which vary as the patterns are built. No two patterns are the same, and the combined effect of the sound and graphics are mesmerizing. CRYSTALS has been used in local stores to demonstrate the sound and color features of the Atari.

**CRANSTON MANOR ADVENTURE (North Star only)** Price: \$19.95  
At last! A comprehensive Adventure game for the North Star. CRANSTON MANOR ADVENTURE takes you into mysterious CRANSTON MANOR where you attempt to gather fabulous treasures. Lurking in the manor are wild animals and robots who will not give up the treasures without a fight. The number of rooms is greater and the associated descriptions are much more elaborate than the current popular series of Adventure programs, making this game the top in its class. Play can be stopped at any time and the status stored on diskette. Requires 32K.

**NORTH STAR SOFTWARE EXCHANGE (NSSE) LIBRARY** Price: \$9.95 Diskette  
DYNACOMP now distributes the 20+ volume NSSE library. Most of these diskettes offer an outstanding value for the purchase price. Write for details regarding the contents of this library and quantity (four or more) purchases.

## Availability

DYNACOMP software is supplied with complete documentation containing clear explanations and examples. Unless otherwise specified, all programs will run within 16K program memory space (ATARI requires 24K). Except where noted, programs are available on ATARI, PET, TRS-80 (Level II) and Apple (AppleII) cassette and diskette as well as North Star single density (double density compatible) diskette. Additionally, most programs can be obtained on standard (IBM format) 8" CP/M floppy disks for systems running IBMASIC.

\* ATARI, PET, APPLE II, TRS-80, NORTH STAR, CP/M and IBM are registered trade names and/or trademarks.

## BUSINESS and UTILITIES

**MAIL LIST II (Apple and North Star diskettes only)** Price: \$21.95  
This many-featured program now includes full alphabetic and zip code sorting as well as file merging. Entries can be retrieved by user-defined code, client name or Zip Code. The printout format allows the use of standard size address labels. Each diskette can store more than 1100 entries (single density North Star or Apple DOS 3.2; over 2200 with double density North Star or Apple DOS 3.3).

**FORM LETTER SYSTEM (FLS) (Apple and North Star diskette only)** Price: \$17.95  
FLS may be employed to generate individually addressed form letters. The user creates the address file and separately composes the letter. FLS will then print form letters using each address. FLS is completely compatible with MAIL LIST II, which may be used to manage your address files.  
FLS and MAIL LIST II are available as a combined package for \$37.95.

**TEXT EDITOR I (Letter Writer)** Price: \$14.95 Cassette/\$18.95 Diskette  
An easy to use, line-oriented text editor which provides variable line widths and simple paragraph indexing. This text editor is ideally suited for composing letters and is quite capable of handling much larger jobs. Available for all computers.

**PERSONAL FINANCE SYSTEM (ATARI only)** Price: \$34.95 Diskette  
PFS is a single disk menu oriented system composed of 10 programs designed to organize and simplify your personal finances. Features include a 300 transaction capacity; fast access; 26 optional user codes; data retrieval by month, code or payer; optional printing of reports; checkbook balancing; bar graph plotting and more. Also provides on the diskette is ATARI DOS 2.

**FINDIT (North Star only)** Price: \$19.95  
This is a three-in-one program which maintains information accessible by keywords of three types: Personal (eg: last name), Commercial (eg: plumbers) and Reference (eg: magazine articles, record albums, etc.). In addition to keyword searches, there are birthday, anniversary and appointment searches for the personal records and appointment searches for the commercial records. Reference records are accessed by a single keyword or by cross-referencing two or three keywords.

**DFILE (North Star only)** Price: \$19.95  
This handy program allows North Star users to maintain a specialized data base of all files and programs in the stack of disks which invariably accumulates. DFILE is easy to set up and use. It will organize your disks to provide efficient locating of the desired file or program.

**COMPARE (North Star only)** Price: \$12.95  
COMPARE is a single disk utility software package which compares two BASIC programs and displays the file sizes of the programs in bytes, the lengths in terms of the number of statement lines, and the line numbers at which various listed differences occur. COMPARE permits the user to examine versions of his software to verify which are the more current, and to clearly identify the changes made during development.

**COMPRESS (North Star only)** Price: \$12.95  
COMPRESS is a single-disk utility program which removes all unnecessary spaces and (optionally) REMARK statements from North Star BASIC programs. The source file is processed one line at a time, thus permitting very large programs to be compressed using only a small amount of computer memory. File compressions of 20-50% are commonly achieved.

**GRAFIX (TRS-80 only)** Price: \$12.95 Cassette/\$16.95 Diskette  
This unique program allows you to easily create graphics directly from the keyboard. You "draw" your figure using the program's extensive cursor controls. Once the figure is made, it is automatically appended to your BASIC program as a string variable. Draw a "happy face", call it H\$ and then print it from your program using PRINT H\$! This is a very easy way to create and save graphics.

**TIDY (TRS-80 only)** Price: \$10.95 Cassette/\$14.95 Diskette  
TIDY is an assembly language program which allows you to renumber the lines in your BASIC programs. TIDY also removes unnecessary spaces and REMARK statements. The result is a compacted BASIC program which uses much less memory space and executes significantly faster. Once loaded, TIDY remains in memory; you may load any number of BASIC programs without having to reload TIDY!

## STATISTICS and ENGINEERING

**DATA SMOOTHER (Not available for ATARI)** Price: \$14.95 Cassette/\$18.95 Diskette  
This special data smoothing program may be used to rapidly derive useful information from noisy business and engineering data which are equally spaced. The software features choice in degree and range of fit, as well as smoothed first and second derivative calculation. Also included is automatic plotting of the input data and smoothed results.

**FOURIER ANALYZER (Available for all computers)** Price: \$14.95 Cassette/\$18.95 Diskette  
Use this program to examine the frequency spectra of limited duration signals. The program features automatic scaling and plotting of the input data and results. Practical applications include the analysis of complicated patterns in such fields as electronics, communications and business.

**TFA (Transfer Function Analyzer)** Price: \$19.95 Cassette/\$23.95 Diskette  
This is a special software package which may be used to evaluate the transfer functions of systems such as hi-fi amplifiers and filters by examining their response to pulsed inputs. TFA is a major modification of FOURIER ANALYZER and contains an engineering-oriented desktop versus log-frequency plot as well as data editing features. Whereas FOURIER ANALYZER is designed for educational and scientific use, TFA is an engineering tool. Available for all computers.

**HARMONIC ANALYZER (Available for all computers)** Price: \$24.95 Cassette/\$28.95 Diskette  
HARMONIC ANALYZER was designed for the spectrum analysis of repetitive waveforms. Features include data file generation, editing and storage/retrieval as well as data and spectrum plotting. One particularly unique facility is that the input data need not be equally spaced or in order. The original data is sorted and a cubic spline interpolation is used to create the data file required by the FFT algorithm.  
FOURIER ANALYZER, TFA and HARMONIC ANALYZER may be purchased together for a combined price of \$44.95 (three cassettes) and \$56.95 (three diskettes).

**REGRESSION I (Available for all computers)** Price: \$19.95 Cassette/\$23.95 Diskette  
REGRESSION I is a unique and exceptionally versatile one-dimensional least squares "polynomial" curve fitting program. Features include very high accuracy; an automatic degree determination option; an extensive internal library of fitting functions; data editing; automatic data and curve plotting; a statistical analysis (eg: standard deviation, correlation coefficient, etc.) a great deal more. In addition, new fits may be tried without reentering the data. REGRESSION I is certainly the cornerstone program in any data analysis software library.

**REGRESSION II (PARAFIT) (Available for all computers)** Price: \$19.95 Cassette/\$23.95 Diskette  
PARAFIT is designed to handle those cases in which the parameters are embedded (possibly nonlinearly) in the fitting function. The user simply inserts the functional form, including the parameters (A1), (A2), etc.) as one or more BASIC statement lines. Data and results may be manipulated and plotted as with REGRESSION I. Use REGRESSION I for polynomial fitting, and PARAFIT for those complicated functions.

**MULTILINEAR REGRESSION (MLR) (Available for all computers)** Price: \$19.95 Cassette  
MLR is a professional software package for analyzing data sets containing two or more linearly independent variables. In performing the basic regression calculation, this program also provides easy to use data entry, storage, retrieval and editing functions. In addition, the user may interrogate the solution by supplying values for the independent variables. The number of variables and data size is limited only by the available memory.  
REGRESSION I, II and MULTILINEAR REGRESSION may be purchased together for \$49.95 (three cassettes) or \$61.95 (three diskettes).

**BASIC SCIENTIFIC SUBROUTINES, Volume I (Not available for ATARI)**  
DYNACOMP is the exclusive distributor for the software key to the text *BASIC Scientific Subroutines, Volume I* by F. Ruckdeschel (see the BYTE/McGraw-Hill advertisement in BYTE magazine, January 1981). These subroutines have been assembled according to chapter. Included with each collection is a menu program which selects and demonstrates each subroutine.

Collection #1: Chapters 2 and 3: Data and function plotting, complex variables  
Collection #2: Chapter 4: Matrix and vector operations  
Collection #3: Chapters 5 and 6: Random number generators, series approximations  
Price per collection: \$14.95 Cassette/\$18.95 Diskette  
All three collections are available for \$39.95 (three cassettes) and \$49.95 (three diskettes).  
Because the text is a vital part of the documentation, *BASIC Scientific Subroutines, Volume I* is available from DYNACOMP for \$19.95 plus 75¢ postage and handling.

**ROOTS (Available for all computers)** Price: \$9.95 Cassette/\$13.95 Diskette  
In a nutshell, ROOTS simultaneously determines all the zeroes of a polynomial having real coefficients. There is no limit on the degree of the polynomial, and because the procedure is iterative, the accuracy is generally very good. No initial guesses are required as input, and the calculated roots are substituted back into the polynomial and the residuals displayed.

## Ordering Information

All orders are processed and shipped postpaid within 48 hours. Please enclose payment with order along with computer information. If paying by VISA or Master Card, include all numbers on card. For orders outside North America add 10% for shipping and handling.

Add \$2.50 to diskette price for 8" floppy disk (IBM format soft sector, CP/M, Microsoft BASIC)  
\*TRS-80 diskettes are not supplied with DOS or BASIC.

**Deduct 10% when ordering 3 or more programs.**

Ask for DYNACOMP programs at your local software dealer. Write for detailed descriptions of these and other programs from DYNACOMP.

**DYNACOMP, Inc.**

6 Rippington Road  
Pittsford, New York 14534  
24 hour mail order phone: (716) 586-7579  
Office phone (9AM-5PM EST): (716) 442-8960

New York State residents please add 7% NYS sales tax.



**Listing 1:** Listing of program for data smoothing. This program was written in North Star BASIC, version 6, release 4. To make the software portable to other machines, only a subset of the language was used. In most cases, only the statement delimiters, backslashes, need to be changed to colons, and certain commas changed to semicolons (in print statements) to get this program to operate in other BASICs (in particular, Microsoft BASIC).

```

1 REM
2 REM
3 REM DATA SMOOTHING PROGRAM
4 REM
5 REM BY F.R. RUCKDESCHEL
6 REM
7 REM
8 REM
9 REM
10 DIM B(5,3),C(8,91),D(70),E(8)
11 REM DIMENSION OF D,Y AND Y1 MAY HAVE TO
12 REM INCREASED FOR LARGE SETS.
13 DIM U(8),V(8,12),W(12),Y(70),Y1(70)
14 PRINT
15 PRINT
16 PRINT "DATA SMOOTHER FOR EQUALLY"
17 PRINT "SPACED DATA SETS"
18 PRINT
19 PRINT
20 PRINT "INPUT THE NUMBER OF"
21 PRINT "DATA POINTS IN SET: ",
22 INPUT N4
23 PRINT
24 PRINT "HOW MANY POINTS ARE"
25 PRINT "TO BE AVERAGED OVER: ",
26 INPUT N3
27 PRINT
28 PRINT "WHAT IS THE DESIRED LEVEL"
29 PRINT "OF FIT (1,2,3,4,5): ",
30 INPUT N1
31 PRINT
32 PRINT "WHAT IS THE DESIRED"
33 PRINT "DERIVATIVE (0,1,2,3): ",
34 INPUT N2
35 REM CHECK FOR ERRORS
36 REM DETERMINE TABLE
37 GOSUB 169
38 REM CHECK ERROR CODES
39 GOSUB 193
40 PRINT
41 PRINT
42 IF E=0 THEN GOTO 50
43 PRINT "*** ERROR IN INPUT ***"
44 PRINT "    ERROR CODE",E
45 PRINT
46 PRINT "RESTART"
47 PRINT
48 GOTO 20
49 REM IF THIS POINT PASSED, OK
50 PRINT
51 PRINT "INPUT DATA AS PROMPTED:"
52 PRINT
53 FOR K=1 TO N4
54 PRINT K,TAB(6),
55 INPUT Y(K)
56 NEXT K
57 REM PLOT ABS VALUE OF DATA
58 PRINT
59 PRINT
60 FOR K=1 TO N4
61 D(K)=ABS(Y(K))
62 NEXT K
63 REM GO TO PLOTTING SUBROUTINE
64 GOSUB 472
65 REM GOTO SUPERVISOR SUBROUTINE
66 PRINT "CALCULATING....."
67 PRINT
68 GOSUB 118
69 REM RESULTS READY FOR DISPLAY
70 PRINT
71 PRINT
72 PRINT "THE SMOOTHED DATA IS: "
73 PRINT
74 FOR K=1 TO N4
75 PRINT K,TAB(6),Y1(K)

```

Listing 1 continued on page 266

such a regression. Thus, a more reasonable method might be to simply "eyeball" a curve through the data (as done by the dashed lines in figure 1). Using the dashed curve, the businessman would plan on having about 4800 units ready in July, instead of 6181.

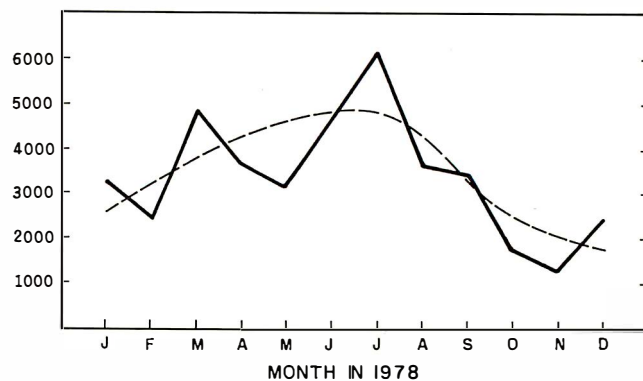
The eyeballing method shown above has two clear deficiencies. The first obvious shortcoming is the assumption that the data of the next year, 1979, is a continuation of the data of the present year, 1978. This assumption is violated because the slopes of the curve at the January and December end points are not the same. However, this could be corrected graphically by a second freehand curve that would make sure that the tangent lines at January and December are parallel.

The second and more important deficiency is that there is uncertainty whether the smoothed value obtained for July 1979 is statistically correct, coupled with a lack of knowledge as to what the *expected* error might be. For example, a "better" analysis might show that the estimate is 4900 units with a standard deviation of 700 units. Thus, if 4900 units were on hand, there would be a 50% chance that all the orders could be filled. If 5600 (4900 plus one standard deviation) were available, the probability would become roughly 83%. With this type of information (that is, conclusions about data), the businessman can better plan his inventory.

In the following sections, a very simple technique is presented for data smoothing. This technique is based on the use of tables that are applied to adjust the value of a given data point according to the *weighted sum* of the values of surrounding data points. The smoothing criterion used is that of *least squares*, although it is applied in a manner not commonly taught in numerical analysis courses. As we will see, the method is amenable to pencil and paper calculations, but it is much more readily accomplished with a computer. A program to accomplish this, given in listing 1, is written in a nearly universal dialect of BASIC.

An important point is that the utility of the procedure is based on the assumption that the "noise" apparent in figure 1 is truly a random fluctuation *independent* of the signal (or month). In principle, it is possible for the month-to-month sales volume to be totally deterministic

Text continued on page 276



**Figure 1:** Chart of sample data used in this article. The data plotted in this chart, drawn in a solid line, represents the sales of a hypothetical company for the months January through December 1978. The broken line is a human-drawn estimate of the ideal numbers that the given data roughly represents.

Are important letters and reports  
leaving your office with spelling errors?

# SpELLGUARD<sup>TM</sup> can proofread 10,000 words in one minute.\*

SPELLGUARD is a revolutionary new computer program that finds spelling mistakes and typographical errors in documents prepared with CP/M<sup>1</sup> or CDOS<sup>2</sup> compatible word processors and text editors.

In less than one minute, SPELLGUARD proofreads 20 pages of text (10,000 words) and identifies all misspelled or mis-typed words based on its 20,000-word dictionary. After proofreading, SPELLGUARD first provides an alphabetized list of the words identified as potential errors. The operator judges each word as correct or incorrect. Correct words may be added to the dictionary. SPELLGUARD *automatically* marks incorrect words in the text with a special character. The operator can then use the word processor to easily find and correct them in the document.

## SPELLGUARD is Easy to Use

- proofreading capabilities are mastered in a few minutes.
- comprehensive user's manual contains step-by-step examples of all SPELLGUARD features.

## SPELLGUARD is Powerful

- text files to 85 pages (CP/M 1.4), and 2,800 pages (CP/M 2.0). includes a 20,000-word, expandable dictionary.
- contains powerful commands to construct customized dictionaries for special areas, e.g., medicine, real estate, law, insurance, engineering.

## SPELLGUARD is Reliable

- thoroughly tested in actual use with free one-year maintenance service.
- 30-day money-back limited warranty.
- includes computer program for software updates and maintenance.

**Minimum System Requirements:** 8080/85, Z80 CPU with 32K memory: CP/M<sup>1</sup> 1.4 (dictionaries to 256K bytes), CP/M<sup>1</sup> 2.0 or later (dictionaries to 4 MB), or CDOS; word processor or text editor compatible with SPELLGUARD (currently several excellent new CP/M word processors, and WordStar<sup>3</sup>, WordMaster<sup>2</sup>, Magic Wand<sup>3</sup>, Electric Pencil<sup>4</sup>, and ED).

**Trademarks:** <sup>1</sup>Digital Research (registered). <sup>2</sup>MicroPro Int'l Corp., <sup>3</sup>Small Business Applications, <sup>4</sup>Michael Shroyer Software, <sup>5</sup>Cromemco.

\*Time estimates based on 4Mhz 8085 with 48K memory, CP/M 2.1 double density 8" floppy drive, 10,000-word text file.

The price of SPELLGUARD includes rapid turnaround and delivery by UPS or airmail. Sales will be made only if the purchasers' word processor is compatible with SPELLGUARD. Software license agreement is required.

- ☐ Send me a free, detailed description and latest diskette format availability.
- ☐ Send me SPELLGUARD at \$295.00. (Manual and diskette(s). Formats: 8" CP/M single density Shugart compatible, and 5¼" Northstar double.)
- ☐ Send me \_\_\_\_\_ copies of the SPELLGUARD manual at \$20.00 each. (Airmail, credited toward purchase.)
- ☐ Send COD (add \$10.00 handling). California residents add 6% tax. Add \$10.00 for foreign shipment.

Check enclosed for \$ \_\_\_\_\_.  
(Certified check, COD, and money order shipped immediately.)

NAME \_\_\_\_\_

ORGANIZATION \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_

STATE \_\_\_\_\_

PHONE \_\_\_\_\_

WORD PROCESSOR \_\_\_\_\_

COMPUTER SYSTEM \_\_\_\_\_

DISK SIZE \_\_\_\_\_

DISK FORMAT \_\_\_\_\_

Checks payable to ISA  
Box 2797, Menlo Park, CA 94025.

(Dealer inquiries invited.)



**INNOVATIVE SOFTWARE APPLICATIONS**

Box 2797, Menlo Park, California 94025 415-326-0805

STATE-OF-THE-ART  
SOFTWARE



No. P7 Zenith Data Systems Z89F Microcomputer with Z47 8" Dual Disk Drive

ZENITH DATA SYSTEMS	LIST	OUR PRICE
Z89-FA Microcomputer System .....	\$2,895	\$2,495
48KB, 5.25" Disk, HDOS		
Z89-GA Microcomputer System .....	\$2,595	\$2,259
48KB, HDOS (No Disk)		
Z19 CRT Terminal .....	SPECIAL \$ 950	\$ 795
Z87 Dual 5.25" Disk Unit (200 KB) .....	\$1,195	\$1,095
Z47-BA Dual 8" Disk Unit (2MB) .....	NEW \$3,695	\$3,295
CP/M® V.2.2 for Z89 .....	\$ 150	\$ 140
HDOS Operating System (with BASIC) .....	\$ 150	\$ 140
Microsoft BASIC V5.1 for CP/M .....	\$ 175	\$ 160
Microsoft BASIC V5.1 for HDOS .....	\$ 150	\$ 140
Microsoft FORTRAN .....	\$ 195	\$ 180
Microsoft COBOL .....	\$ 395	\$ 350
Word Processing for Z89 .....	\$ 395	\$ 375

**To Order:** Send Check or Money Order to: PK Systems, Inc., 113 North Center, Bloomington, IL 61701. Allow two weeks for personal checks to clear. For COD Orders, add 5% for handling and service charge. Rush orders, add \$50.00.

**Shipping:** Freight collect, FOB Bloomington. We ship UPS, air freight, or motor freight.

PK Systems is an Authorized Zenith Data Systems Dealer and Zenith Service Center.



CP/M is a trademark of Digital Research

# MULTIPATH TREE KEY FILE SYSTEM RUNS ON UCSD\* PASCAL

Locate 1 Key Element in 32,000 +  
in Under 3 Disk Accesses

Library procedures Allow You To:  
INSERT DELETE FIND NEXT RANGE

Optional Procedures For:  
CREATE PRINT TREE

One single density 8 inch disk (others available)  
contains 24 variations—  
use the one best suited to your application.

Also available using this key system are high performance  
business, engineering, system and personal software  
packages. Write for more information and catalog.

Diskette plus Documentation \$90.00  
Please specify type of system and version operating system.

KeeSoft, Suite 1351, 10 Milk St. Boston, MA 02108

\*TM Univ. Of Calif.

Listing 1 continued:

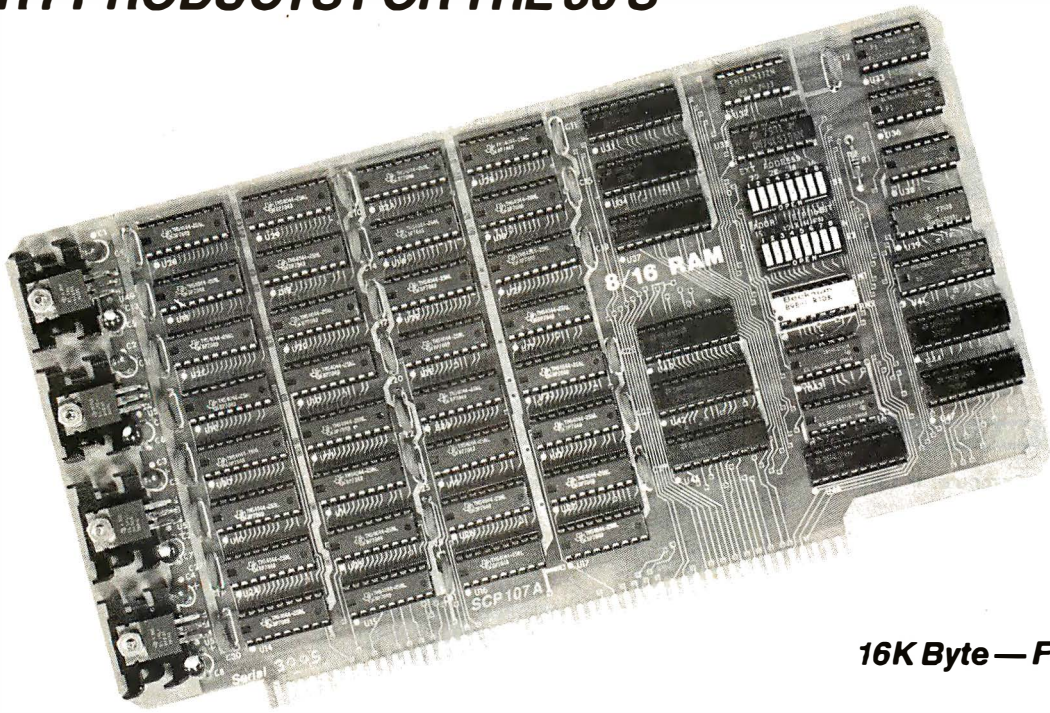
```

76 NEXT K
77 PRINT
78 GOSUB 535
79 PRINT "THE STANDARD DEVIATION"
80 PRINT "BETWEEN THE SMOOTHED AND"
81 PRINT "UNSMOOTHED DATA SETS IS",
82 PRINT D
83 PRINT
84 GOSUB 535
85 REM PLOT ABSOLUTE VALUE OF RESULTS
86 FOR K=1 TO N4
87 D(K)=ABS(Y1(K))
88 NEXT K
89 REM GO TO PLOTTING SUBROUTINE
90 PRINT
91 PRINT
92 GOSUB 472
93 PRINT
94 PRINT
95 PRINT
96 END
97 REM *****
98 REM DATA SMOOTHER SUPER-
99 REM VISOR SUBROUTINE
100 REM IT IS ASSUMED THAT
101 REM B,C,D,U,V,W,Y AND Y1
102 REM HAVE ALREADY BEEN
103 REM DIMENSIONED.
104 REM B(5,3)
105 REM C(8,91)
106 REM D(N4+2*N3+2)
107 REM U(8)
108 REM V(8,12)
109 REM W(12)
110 REM Y(N4)
111 REM Y1(N4)
112 REM IT IS ALSO ASSUMED THAT
113 REM THE INPUT DATA IS
114 REM AVAILABLE-
115 REM N1,N2,N3,N4
116 REM Y(K)
117 REM THE PROGRAM USES I AND J
118 I=N1
119 J=N2
120 REM THE OUTPUT IS Y1(K)
121 REM FIRST INITIALIZE Y1(K)
122 FOR K=1 TO N4
123 Y1(K)=0
124 NEXT K
125 REM DETERMINE THE TABLE
126 GOSUB 169
127 REM DETERMINE IF ERROR
128 GOSUB 197
129 REM ERROR ON E>0
130 IF E>0 THEN RETURN
131 REM OBTAIN COEFFICIENTS
132 REM U(I),V(I,J)
133 REM C(I,K)
134 GOSUB 225
135 REM SAVE THE SYMMETRY AND
136 REM NORMALIZING FACTORS
137 U=U(B(I,J))
138 A=(N3-1)/2
139 V=V(B(I,J),13-A)
140 REM GET WEIGHTS, W(K)
141 GOSUB 375
142 REM CREATE AUGMENTED
143 REM DATA VECTOR, D(K)
144 GOSUB 419
145 REM SMOOTH THE DATA VECTOR D(K)
146 REM THE DATA POSITION POINTER
147 REM IS M
148 FOR M=A+1 TO N4+A+1
149 GOSUB 439
150 Y1(M)=D
151 NEXT M
152 REM SHIFT Y1(M) DOWN
153 GOSUB 452
154 REM RESULT IS Y1(M)
155 REM GET STANDARD DEVIATION
156 GOSUB 459
157 REM RESULT IS D
158 PRINT

```

Listing 1 continued on page 268

## MEMORY PRODUCTS FOR THE 80'S



**16K Byte — Fully Static**

# 8/16 RAM

## Designed with the Future in Mind...

- Able to use the full 24-bit address bus of the IEEE S-100 Standard for a 16-megabyte address range.
- Fully static design eliminates system timing problems. Promotes reliable operation with a wider range of CPU cards and DMA devices.
- Easy to integrate into your system. Addressable on 4K boundaries. PHANTOM, extended addressing, 16-bit operation may be switched off if desired.
- Can act as either an 8-bit or 16-bit wide memory. Dynamic bus switching per the IEEE Standard.
- Fast 200 nanosecond memory chips help you keep up with the ever-rising clock speeds of newer CPUs.
- The 8/16 is the only memory board made which is designed to run at full speed with our 16-bit 8Mhz. 8086 CPU card. And, it has plenty of speed to spare.

### From Seattle Computer, the Static Memory Experts

Why static memory? First, compatibility. Most S-100 products do not meet the IEEE Standard. Because of their critical timing requirements, dynamic memory boards must often be configured for a particular CPU — a situation that could make future upgrading difficult. Static memories are inherently more versatile.

Second, speed. The access times of static and

dynamic memories are not comparable numbers. Static memories get a substantial head start while dynamic memories wait for a "clock." The IEEE S-100 Standard **guarantees** this head start is **at least** 70 nanoseconds. The result: most of today's dynamic memory boards will not run at full speed with tomorrow's (or even today's) faster CPUs. The 8/16 will.

The 8/16 memory card is fully assembled, tested, guaranteed one full year. Suggested retail price: 1-4, \$395; 5-9, \$345. Manual only — \$3. Overseas purchasers add \$15 per board for air shipment.



**Seattle Computer Products, Inc.**

1114 Industry Drive, Seattle, WA. 98188  
(206) 575-1830

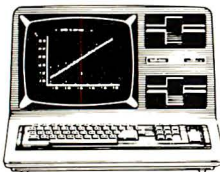
# meet a REAL PLUS




Color Computer 4K \$310

Model II 64K  
\$3375

Pocket Computer \$199

Model III 16K  
\$859

These are just a few of our many fine offers — computers, peripherals, modems, printers, disc drives and an unusual selection of package values. Call TOLL FREE today and check us out for price and warranty.

 Pure Radio Shack equipment warranted at any Radio Shack store or dealer. Factory warranties on Apple and Atari equipment. Other equipment carries manufacturer's warranty or Computer Plus 180 day extended warranty. Combined warranties carry Computer Plus 180 day warranty or original manufacturer's warranty.

DEALER INQUIRIES ARE INVITED

Prices subject to change without notice.

TRS-80 is a registered trademark of Tandy Corp.

call TOLL FREE  
**1-800-343-8124**

# computer plus

Write for your  
free catalog...

Dept. E  
245A Great Road  
Littleton, MA 01460

(617) 486-3193

## Listing 1 continued:

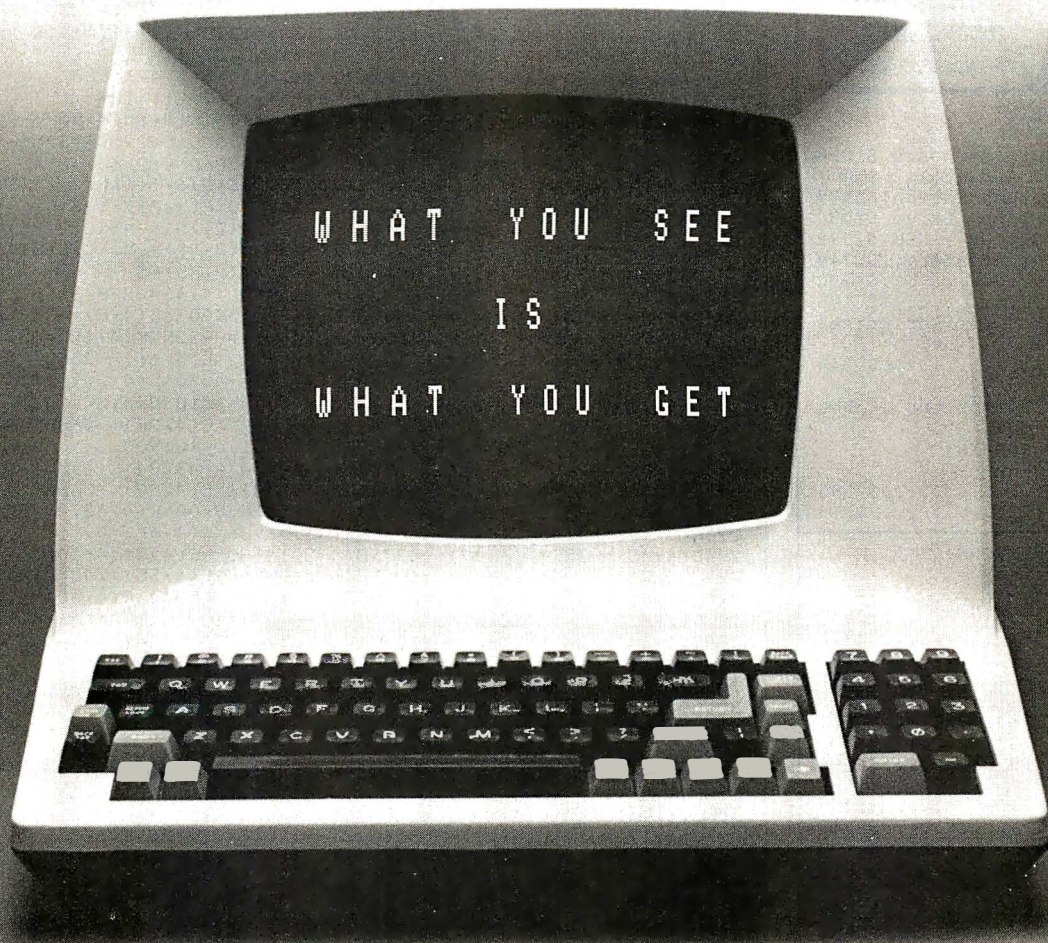
```

159 REM *****
160 REM TABLE DECODE SUBROUTINE
161 REM THERE ARE 8 TABLES OF
162 REM COEFFICIENTS TO BE CHOSEN
163 REM ACCORDING TO THE DEGREE OF
164 REM FIT, I, AND THE DERIVATIVE
165 REM LEVEL, J. THE DECODING
166 REM ARRAY IS B(I,J).
167 REM NEW TABLES 12 AND 13
168 REM ARE MOVED TO 5 AND 3
169 B(1,0)=5\B(1,1)=3\B(1,2)=0\B(1,3)=0\B(2,0)=1\B(2,1)=3
170 B(2,2)=6\B(2,3)=0\B(3,0)=1\B(3,1)=4\B(3,2)=6\B(3,3)=8
171 B(4,0)=2\B(4,1)=4\B(4,2)=7\B(4,3)=8\B(5,0)=2\B(5,1)=0
172 B(5,2)=7\B(5,3)=0
173 E(1)=5\E(2)=7\E(3)=3\E(4)=5\E(5)=3\E(6)=5\E(7)=5\E(8)=5
174 RETURN
175 REM *****
176 REM ERROR CODING SUB.
177 REM E=0 - NO ERROR
178 REM E=1 - TOO FEW POINTS
179 REM E=2 - TOO MANY POINTS
180 REM E=3 - DERIVATIVE > FIT
181 REM     LEVEL
182 REM E=4 - FIT TOO HIGH
183 REM E=5 - DERIVATIVE TOO
184 REM     HIGH
185 REM E=6 - TABLE NOT AVAIL.
186 REM E=7 - NOT ENOUGH DATA
187 REM E=8 - ILLEGAL VALUE
188 REM N1=LEVEL OF FIT
189 REM N2=ORDER OF DERIVATIVE
190 REM N3=NO. OF DATA POINTS
191 REM     TO BE AVERAGED
192 REM N4=TOTAL DATA SET SIZE
193 E=0
194 IF B(N1,N2)=0 THEN E=6
195 IF N1<0 THEN E=8
196 IF N2>3 THEN E=5
197 IF N3<3 THEN E=1
198 IF N3>25 THEN E=2
199 IF N3<E(B(N1,N2)) THEN E=1
200 IF N2>N1 THEN E=3
201 IF N2<0 THEN E=8
202 IF INT (N3/2)=N3/2 THEN E=8
203 IF N3>N4 THEN E=7
204 IF N1>5 THEN E=4
205 RETURN
206 REM *****
207 REM COEFFICIENT STORAGE SUB.
208 REM THE WEIGHTS ARE STORED IN
209 REM THE ARRAY C(I,K). THE IN-
210 REM DEX, I, REPRESENTS THE
211 REM TABLE NUMBER (1 TO 8).
212 REM THE INDEX, K, REPRESENTS
213 REM THE ELEMENT IN TABLE I.
214 REM THERE ARE UP TO 91 SUCH
215 REM ELEMENTS.
216 REM ALSO STORED ARE THE NORM-
217 REM ALIZING FACTORS, V(I,K),
218 REM WHERE K RANGES FROM 1 TO
219 REM 13. IN ADDITION, THE 8
220 REM SYMMETRY VALUES, U(I),
221 REM ARE ALSO INCLUDED.
222 REM NOTE THAT TABLES 12 (NOW 5)
223 REM AND 13 (NOW 3) ARE CALCULATED
224 REM ELSEWHERE.
225 U(1)=1\U(2)=1\U(3)=-1\U(4)=-1\U(5)=1\U(6)=1\U(7)=1\U(8)=-1
226 V(1,1)=5175\U(1,2)=805\U(1,3)=3059\U(1,4)=2261
227 V(1,5)=323\U(1,6)=1105\U(1,7)=143\U(1,8)=429\U(1,9)=231
228 V(1,10)=21\U(1,11)=35\U(2,1)=30015\U(2,2)=6555
229 V(2,3)=260015\U(2,4)=7429\U(2,5)=4199\U(2,6)=46189
230 V(2,7)=2431\U(2,8)=429\U(2,9)=429\U(2,10)=231
231 V(4,1)=1776060\U(4,2)=197340\U(4,3)=3634092\U(4,4)=255816
232 V(4,5)=23256\U(4,6)=334152\U(4,7)=24024\U(4,8)=5148
233 V(4,9)=1188\U(4,10)=252\U(4,11)=12
234 V(6,1)=26910\U(6,2)=17710\U(6,3)=33649\U(6,4)=6783
235 V(6,5)=3876\U(6,6)=6188\U(6,7)=1001\U(6,8)=429\U(6,9)=462
236 V(6,10)=42\U(6,11)=7\U(7,1)=4292145\U(7,2)=2812095
237 V(7,3)=245157\U(7,4)=490314\U(7,5)=478686\U(7,6)=277134
238 V(7,7)=160446\U(7,8)=16731\U(7,9)=4719\U(7,10)=99\U(7,11)=3
239 V(8,1)=296010\U(8,2)=32890\U(8,3)=86526\U(8,4)=42636
240 V(8,5)=3876\U(8,6)=7956\U(8,7)=572\U(8,8)=858\U(8,9)=198
241 V(8,10)=6\U(8,11)=2
242 FOR K=1 TO 12\U(5,K)=27-2*K\U(3,13-K)=K*(K+1)*(2*K+1)/3\NEXT K

```

Listing 1 continued on page 270

# Can your word processor pass this screen test?



WordStar™ software does\*! And does it better than any other word processing system. Not only do you get all the sophisticated features you'd expect from the high-priced WP system, with WordStar you have a true screen image of what your printout will look like **before you print it!**

With WordStar, you'll erase, insert, delete and move entire blocks of copy. Page breaks are

displayed and automatically revised on the screen. You can specify enhancements like underlining and boldfacing, and much more.

And WordStar's so much easier to learn because of its unique and extensive self-help menus. Every typist in your office can be an instant screen star. Call (415) 457-8990 and ask for a copy of our WordStar demon-

stration booklet. Remember, when you're the star, we're the star.

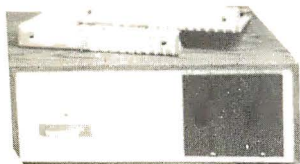
**MicroPro**™  
INTERNATIONAL CORPORATION  
**The Star Maker**

MicroPro International Corporation  
1299 4th Street, San Rafael, CA 94901  
(415) 457-8990 TELEX 340388  
Sold through authorized dealers and distributors only. OEM inquiries invited.

\*Runs on most Z80/8080/8085 microcomputers with CP/M (TM of Digital Research); 48K, and terminal with addressable cursor.

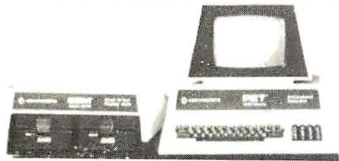
# MBC Systems, Inc.

(203) 342-2747



## NORTH STAR HORIZON:

HRZ-2-32K-D-Factory ASMS\$2275  
 HRZ-2-32K-Q-Factory ASMS\$2675  
 64K DD or Q Also Available  
 HDS-18-F.....\$4449  
 Northword DQ.....\$ 359  
 INFO-Manager.....\$ 365  
 Mail Manager.....\$ 269  
 General Ledger.....\$ 775  
 ACC. REC. OR ACC. PAY..\$ 445  
 Word Star.....\$ 350  
 Medical-Dental SYS.....\$2500



## COMMODORE (PET):

2001-32K-BorN Keyboard \$1090  
 16K Also in Stock...\$859!!!  
 8032 (80 Column Screen)\$1599  
 2040 Dual Floppy Drive \$1090  
 8050 Dual Floppy (1MEG)\$1599  
 2022 Tractor Printer...\$ 749  
 Word PRO IV.....\$ 290  
 VISICALC.....\$ 195  
 APPLE II PLUS Call For Price!  
 ATARI 800.....\$ 849  
 TI 99/4 Console&Monitor.. \$990  
 INTERTEC SUPERBRAIN:  
 32K RAM.....\$2595  
 64K RAM.....\$2695

## PRINTERS

=====

### Letter Quality:

NEC 5510 or 5530.....\$2550  
 NEC 5520 KSR.....\$2950  
 DIABLO 630.....\$2390  
 C.I.TOH.....\$1690

### Dot Matrix:

CENTRONICS 730.....\$ 599  
 " " 737-1.....\$ 799  
 " " 799.....\$ 999  
 EPSON MX-80.....\$ 599  
 PAPER TIGER 460G.....\$1250  
 BASE II MST.....\$ 649

## DISPLAY TERMINALS

=====

HAZELTINE 1420.....\$ 949  
 " " 1500.....\$ 999  
 INTERTUBE III.....\$ 775  
 TELEVIDEO 920C.....\$ 849

Since 1977 complete sales and service. Most items in stock, prices are subject to change. Visa and Master Charge welcome. Most items shipped by UPS.

## MBC Systems, Inc.

Multi Business Computer Systems, Inc.  
 28 MARLBOROUGH STREET  
 PORTLAND, CONN. 06480

(203) 342-2747 TWX 710-428-6345  
 M-F 9-6 SAT.9:30-3:00

## Listing 1 continued:

243FORK=1T012V(7,K)=12\*V(7,K)\NEXTK  
 244C(1,1)=467\N(1,2)=462\N(1,3)=447\N(1,4)=422\N(1,5)=387  
 245C(1,6)=342\N(1,7)=287\N(1,8)=222\N(1,9)=147\N(1,10)=62  
 246C(1,11)=-33\N(1,12)=-138\N(1,13)=-253\N(1,14)=79\N(1,15)=78  
 247C(1,16)=75\N(1,17)=70\N(1,18)=63\N(1,19)=54\N(1,20)=43  
 248C(1,21)=30\N(1,22)=15\N(1,23)=-2\N(1,24)=-21\N(1,25)=-42  
 249C(1,26)=329\N(1,27)=324\N(1,28)=309\N(1,29)=284\N(1,30)=249  
 250C(1,31)=204\N(1,32)=149\N(1,33)=84\N(1,34)=9\N(1,35)=-76  
 251C(1,36)=-171\N(1,37)=269\N(1,38)=264\N(1,39)=249  
 252C(1,40)=224\N(1,41)=189\N(1,42)=144\N(1,43)=89\N(1,44)=24  
 253C(1,45)=-51\N(1,46)=-136\N(1,47)=43\N(1,48)=42\N(1,49)=39  
 254C(1,50)=34\N(1,51)=27\N(1,52)=18\N(1,53)=7\N(1,54)=-6  
 255C(1,55)=-21\N(1,56)=167\N(1,57)=162\N(1,58)=147\N(1,59)=122  
 256C(1,60)=87\N(1,61)=42\N(1,62)=-13\N(1,63)=-78\N(1,64)=25  
 257C(1,65)=24\N(1,66)=21\N(1,67)=16\N(1,68)=9\N(1,69)=0  
 258C(1,70)=-11\N(1,71)=89\N(1,72)=84\N(1,73)=69\N(1,74)=44  
 259C(1,75)=9\N(1,76)=-36\N(1,77)=59\N(1,78)=54\N(1,79)=39  
 260C(1,80)=14\N(1,81)=-21\N(1,82)=7\N(1,83)=6\N(1,84)=3  
 261C(1,85)=-2\N(1,86)=17\N(1,87)=12\N(1,88)=-3\N(2,1)=4253  
 262C(2,2)=4125\N(2,3)=3750\N(2,4)=3155\N(2,5)=2385\N(2,6)=1503  
 263C(2,7)=590\N(2,8)=-255\N(2,9)=-915\N(2,10)=-1255  
 264C(2,11)=-1122\N(2,12)=-345\N(2,13)=1265\N(2,14)=1011  
 265C(2,15)=975\N(2,16)=870\N(2,17)=705\N(2,18)=495\N(2,19)=261  
 266C(2,20)=30\N(2,21)=-165\N(2,22)=-285\N(2,23)=-285  
 267C(2,24)=-114\N(2,25)=285\N(2,26)=44003\N(2,27)=42120  
 268C(2,28)=36660\N(2,29)=28190\N(2,30)=17655\N(2,31)=6378  
 269C(2,32)=-3940\N(2,33)=-11220\N(2,34)=-13005\N(2,35)=-6460  
 270C(2,36)=11628\N(2,37)=1393\N(2,38)=1320\N(2,39)=1110  
 271C(2,40)=790\N(2,41)=405\N(2,42)=18\N(2,43)=-290  
 272C(2,44)=-420\N(2,45)=-255\N(2,46)=340\N(2,47)=883  
 273C(2,48)=825\N(2,49)=660\N(2,50)=415\N(2,51)=135  
 274C(2,52)=-117\N(2,53)=-260\N(2,54)=-195\N(2,55)=195  
 275C(2,56)=11063\N(2,57)=10125\N(2,58)=7500\N(2,59)=3755  
 276C(2,60)=-165\N(2,61)=-2937\N(2,62)=-2860\N(2,63)=2145  
 277C(2,64)=677\N(2,65)=600\N(2,66)=390\N(2,67)=110  
 278C(2,68)=-135\N(2,69)=-198\N(2,70)=110\N(2,71)=143  
 279C(2,72)=120\N(2,73)=60\N(2,74)=-10\N(2,75)=-45\N(2,76)=18  
 280C(2,77)=179\N(2,78)=135\N(2,79)=30\N(2,80)=-55\N(2,81)=15  
 281C(2,82)=131\N(2,83)=75\N(2,84)=-30\N(2,85)=5  
 282C(4,1)=0\N(4,2)=-8558\N(4,3)=-16649\N(4,4)=-23806  
 283C(4,5)=-29562\N(4,6)=-33450\N(4,7)=-35003\N(4,8)=-33754  
 284C(4,9)=-29236\N(4,10)=-20982\N(4,11)=-8525\N(4,12)=8602  
 285C(4,13)=30866\N(4,14)=0\N(4,15)=-1222\N(4,16)=-2365  
 286C(4,17)=-3350\N(4,18)=-4098\N(4,19)=-4530\N(4,20)=-4567  
 287C(4,21)=-4130\N(4,22)=-3140\N(4,23)=-1518\N(4,24)=815  
 288C(4,25)=3938\N(4,26)=0\N(4,27)=-29592\N(4,28)=-56881  
 289C(4,29)=-79564\N(4,30)=-95338\N(4,31)=-101900  
 290C(4,32)=-96947\N(4,33)=-78176\N(4,34)=-43284\N(4,35)=10032  
 291C(4,36)=84075\N(4,37)=0\N(4,38)=-2816\N(4,39)=-5363  
 292C(4,40)=-7372\N(4,41)=-8574\N(4,42)=-8700\N(4,43)=-7481  
 293C(4,44)=-4648\N(4,45)=68\N(4,46)=6936\N(4,47)=0  
 294C(4,48)=-358\N(4,49)=-673\N(4,50)=-902\N(4,51)=-1002  
 295C(4,52)=-930\N(4,53)=-643\N(4,54)=-98\N(4,55)=748\N(4,56)=0  
 296C(4,57)=-7506\N(4,58)=-13843\N(4,59)=-17842\N(4,60)=-18334  
 297C(4,61)=-14150\N(4,62)=-4121\N(4,63)=12922\N(4,64)=0  
 298C(4,65)=-832\N(4,66)=-1489\N(4,67)=-1796\N(4,68)=-1578  
 299C(4,69)=-660\N(4,70)=1133\N(4,71)=0\N(4,72)=-296  
 300C(4,73)=-503\N(4,74)=-532\N(4,75)=-294\N(4,76)=300  
 301C(4,77)=0\N(4,78)=-126\N(4,79)=-193\N(4,80)=-142\N(4,81)=86  
 302C(4,82)=0\N(4,83)=-58\N(4,84)=-67\N(4,85)=22\N(4,86)=0  
 303C(4,87)=-8\N(4,88)=1\N(6,1)=-52\N(6,2)=-51\N(6,3)=-48  
 304C(6,4)=-43\N(6,5)=-36\N(6,6)=-27\N(6,7)=-16\N(6,8)=-3  
 305C(6,9)=12\N(6,10)=29\N(6,11)=48\N(6,12)=69\N(6,13)=92  
 306C(6,14)=-44\N(6,15)=-43\N(6,16)=-40\N(6,17)=-35\N(6,18)=-28  
 307C(6,19)=-19\N(6,20)=-8\N(6,21)=5\N(6,22)=20\N(6,23)=37  
 308C(6,24)=56\N(6,25)=77\N(6,26)=-110\N(6,27)=-107\N(6,28)=-98  
 309C(6,29)=-83\N(6,30)=-62\N(6,31)=-35\N(6,32)=-2\N(6,33)=37  
 310C(6,34)=82\N(6,35)=133\N(6,36)=190\N(6,37)=-30\N(6,38)=-29  
 311C(6,39)=-26\N(6,40)=-21\N(6,41)=-14\N(6,42)=-5\N(6,43)=6  
 312C(6,44)=-19\N(6,45)=34\N(6,46)=51\N(6,47)=-24\N(6,48)=-23  
 313C(6,49)=-20\N(6,50)=-15\N(6,51)=-8\N(6,52)=1\N(6,53)=12  
 314C(6,54)=25\N(6,55)=40\N(6,56)=-56\N(6,57)=-53\N(6,58)=-44  
 315C(6,59)=-29\N(6,60)=-8\N(6,61)=19\N(6,62)=52\N(6,63)=91  
 316C(6,64)=-14\N(6,65)=-13\N(6,66)=-10\N(6,67)=-5\N(6,68)=2  
 317C(6,69)=11\N(6,70)=22\N(6,71)=-10\N(6,72)=-9\N(6,73)=-6  
 318C(6,74)=-1\N(6,75)=6\N(6,76)=15\N(6,77)=-20\N(6,78)=-17  
 319C(6,79)=-8\N(6,80)=7\N(6,81)=28\N(6,82)=-4\N(6,83)=-3  
 320C(6,84)=0\N(6,85)=5\N(6,86)=-2\N(6,87)=-1\N(6,88)=2  
 321C(7,1)=-441870\N(7,2)=-418011\N(7,3)=-348429\N(7,4)=-239109  
 322C(7,5)=-100026\N(7,6)=54855\N(7,7)=207599\N(7,8)=336201  
 323C(7,9)=414786\N(7,10)=413409\N(7,11)=298155\N(7,12)=31119  
 324C(7,13)=-429594\N(7,14)=-373230\N(7,15)=-349401  
 325C(7,16)=-280275\N(7,17)=-172935\N(7,18)=-39186  
 326C(7,19)=104445\N(7,20)=236709\N(7,21)=331635\N(7,22)=358530

Listing 1 continued on page 272



# Great software doesn't have to be hard to find. Just look for the Hayden name.

**SARGON II** (Spracklens) The Champ of champs "...an excellent program which will provide a true challenge for many players... Save your money and buy SARGON II... '80 Software Critique. 03403, TRS 80 Level II; 03404, Apple II; 03410, OSI C/P; 03440, OSI C4P; 03401, PET; each tape \$29.95. 03408, TRS 80 Level II Disk; 03409, Apple II Disk; 03414, OSI C/P Disk; 03444, OSI C4P Disk; 03484, C8P Disk; each \$34.95

**BLACKJACK MASTER:** A Simulator/Tutor/ Game (Wazaney) A serious game that performs complex simulations and evaluations of playing and betting strategies. 05303, TRS 80 Level II tape, \$24.95; 05308, TRS 80 Disk Version, \$29.95

**REVERSAL** (Spracklen) Winner of the software division of the First International Man Machine OTHELLO™ Tournament, this version of the 200-year old game Reversi. Features 27 levels of play and high-resolution color graphics. 07004, APPLE II tape, \$29.95; 07009, APPLE II Disk, \$34.95

**APPLESOFT UTILITY PROGRAMS** (Gilder) Increase your BASIC programming speed and flexibility. Contains 9 useful subroutines: 1. REM Writer 2. PRINT Writer 3. POKE Writer 4. Hexadecimal/Decimal Converter 5. Line Counter 6. Renumber 7. Append 8. Byte Counter 9. Slow List/Stop List 03504, Apple II tape, \$29.95

**ENERGY MISER** (SuperSoft Associates) A complete heating/cooling analysis program for your home or office that will calculate heat loss or gain due to poor insulation, leaky doors and windows, and more. 05601, PET; 05603, TRS 80 Level II; 05604, Apple II; each tape \$24.95; 05609, Apple II Disk Version; 05613, Heathkit/Zenith Disk Version; \$29.95

**6502 DISASSEMBLER** (Stamm) Produce assembly language source files with labeled subroutines and references from programs already in memory. It is compatible with Hayden's ASSEMBLY LANGUAGE DEVELOPMENT SYSTEM. 08609, APPLE II Disk, \$34.95

**PSEUDODISK** (Neuschatz) This money-saving program simulates a disk memory system for Integer BASIC programs. It allows multiple programs in memory at the same time which can be run from a catalog. 04804, APPLE II tape, \$24.95

**LINE & VARIABLE CROSS REFERENCE GENERATOR** (Johnson) Provides a cross-reference of line numbers and variable names. 07301, PET tape, \$16.95

**DISK CATALOGER** (LeBar) Automatically maintains a cross-reference listing of all your programs, their location by disk number, their function and use. Catalogs, lists and sorts programs. 05203, TRS 80 Level II tape, \$16.95; 05208, TRS 80 Level II Disk, \$21.95

**APPLE™ ASSEMBLY LANGUAGE DEVELOPMENT SYSTEM: An Assembler/Editor/Formatter** (Lutus) Write and modify your machine language programs quickly and easily. 04609, Apple II Disk Version, \$39.95

**SUPER APPLE™ BASIC** (Lutus) A structured BASIC that compiles into an optimized Applesoft or Integer BASIC program. 05409, Apple II Disk, \$39.95

**MAILING LIST** (Tru-Data Software) Lists addresses, prints labels, allows for alterations and deletions, and has the capacity to make duplicate data file disks. Can only be used with version 1.5. 05713, Heath Disk, \$49.95

**FINPLAN: A Financial Planning Program for Small Business** (Montgomery) Allows you to enter data from a balance sheet into the program, to make assumptions about future growth of business, and to have the computer project results for up to a five-year period based on those assumptions. And if you change any data, the program revises all resulting data automatically. The disk version can only be used with TRSDOS Version 2.3. 05103, TRS 80 Level II tape, \$69.95; 05108, TRS 80 Level II Disk Version, \$74.95

**DATA MANAGER: A Data Base Management System and Mailing List** (Lutus) Store information on a floppy disk, and retrieve it quickly and easily by specific names, or by category. 04909, Apple II Disk Version, \$49.95

**MCAP: A Microcomputer Circuit Analysis Program** (Savon) Performs a linear voltage, impedance, or transfer impedance analysis of an electronic circuit. 04501, PET; 04503, TRS 80 Level II; 04504, Apple II; each tape \$24.95; 04513, Heathkit/Zenith Disk, \$29.95

**MICROCOMPUTER AIDED DESIGN OF ACTIVE FILTERS** (Gilder) Eight programs that simplify the design of active filters and will calculate the component values needed for various handpass, low-pass, and notch-type filters. 01401, PET; 01403, TRS 80 Level II; 01404, Apple II; 01407, Heath; each tape \$16.95; 01413, Heathkit/Zenith Disk Version, \$21.95

**DISK CERTIFIER AND COPIER** (Jacc Inc.) A handy utility program that certifies the acceptability of blank diskettes and rejects those with flaws. It also includes a fast machine language disk copying program that will work on single and dual drive systems. 07809, APPLE II Disk, \$19.95

**SONGS IN THE KEY OF APPLE** (Lopatin) Allows you to see and hear your favorite tunes, pre-programmed tunes or music you create (up to 200 notes, including rests, per musical piece). 03304, Apple II tape, \$10.95

**HOW TO BUILD A COMPUTER-CONTROLLED ROBOT** (Loofbourrow) Contains 5 control programs that consist of: Joystick Control Program; Self-Direction Program; Impact Sensor Control Routine; and more. 00100, KIM-1 tape, \$14.95. Should be used with text HOW TO BUILD A COMPUTER-CONTROLLED ROBOT, 5681 8. \$9.75

Apple is a trademark of Apple Computer Company, Inc. and is not affiliated with Hayden Book Company, Inc.

**Call Toll Free,**  
**24 hours a day,**  
(1-800-821-3777, ext. 302)\* **TO CHARGE**  
**YOUR ORDER** to Master Card or Visa.  
Minimum order is \$10.00; customer pays  
postage and handling.  
From Missouri call (1-800-892-7655, ext. 302)

## ORDERING INFORMATION

Send me the software checked below. A check or money order is enclosed. I understand that Hayden pays shipping and handling costs and that I can return any disk or tape within 10 days if it is defective or I am dissatisfied with it for any reason. Residents of NJ and CA must add sales tax. Offer good in US only.

<input type="checkbox"/> 00100	<input type="checkbox"/> 02404	<input type="checkbox"/> 03401	<input type="checkbox"/> 03414	<input type="checkbox"/> 04503	<input type="checkbox"/> 05105	<input type="checkbox"/> 05603	<input type="checkbox"/> 07809
<input type="checkbox"/> 01401	<input type="checkbox"/> 02501	<input type="checkbox"/> 03403	<input type="checkbox"/> 03440	<input type="checkbox"/> 04504	<input type="checkbox"/> 05108	<input type="checkbox"/> 05604	<input type="checkbox"/> 08609
<input type="checkbox"/> 01403	<input type="checkbox"/> 02503	<input type="checkbox"/> 03404	<input type="checkbox"/> 03444	<input type="checkbox"/> 04513	<input type="checkbox"/> 05203	<input type="checkbox"/> 05609	<input type="checkbox"/> 5681 8
<input type="checkbox"/> 01404	<input type="checkbox"/> 02601	<input type="checkbox"/> 03408	<input type="checkbox"/> 03484	<input type="checkbox"/> 04609	<input type="checkbox"/> 05208	<input type="checkbox"/> 05613	
<input type="checkbox"/> 01407	<input type="checkbox"/> 02701	<input type="checkbox"/> 03409	<input type="checkbox"/> 03504	<input type="checkbox"/> 04804	<input type="checkbox"/> 05308	<input type="checkbox"/> 07009	
<input type="checkbox"/> 01413	<input type="checkbox"/> 03304	<input type="checkbox"/> 03410	<input type="checkbox"/> 04501	<input type="checkbox"/> 04909	<input type="checkbox"/> 05409	<input type="checkbox"/> 07301	

Name

Address

City/State/Zip

Name of individual ordering must be filled in.

B 3/81

**Hayden**  
**Book Company, Inc.**  
50 Essex Street, Rochelle Park, NJ 07662

**Hayden**  
**Book Company, Inc.**  
50 Essex Street, Rochelle Park, NJ 07662

# MTI stocks 'em all for faster delivery.

No hidden charges. Prices include delivery.  
Ask about our "QED" discounts.  
VISA and MasterCard orders accepted.

## VIDEO TERMINALS

VT100 DECscope.....	\$ 1695
VT132 DECscope.....	2295
ADM-3A (dumb terminal) .....	*
ADM-3A+ (dumb terminal) .....	*
ADM-31 (2 page buffer) .....	*
ADM-42 (8 page buffer avail.) .....	*
1410 (Hazeltime dumb terminal) .....	825
1420 (dumb terminal) .....	895
1421 (Consul 580 & ADM-3A comp.).....	895
1500 (dumb terminal) .....	1045
1510 (buffered) .....	1145
1520 (buffered printer port) .....	1395
1552 (VT-52 compatible) .....	1350

## 300 BAUD TELEPRINTERS

LA34-DA DECwriter IV .....	1045
LA34-AA DECwriter IV .....	1295
Teletype 4310 .....	1085
Teletype 4320 .....	1225
Diablo 630 RO .....	2295
Diablo 1640 RO .....	3085
Diablo 1640 KSR .....	3285
Diablo 1650 RO .....	3185
Diablo 1650 KSR .....	3385
TI 743 (portable) .....	1190
TI 745 (portable/built-in coupler) .....	1585
TI 763 (portable/bubble memory) .....	2690
TI 765 (port/bubble mem/b-i coupler) .....	2895

## 600 BAUD TELEPRINTERS

TI 825 RO impact .....	1565
TI 825 KSR impact .....	1645
TI 825 RO Pkg. ....	1750
TI 825 KSR Pkg. ....	1895

## 1200 BAUD TELEPRINTERS

LA120-AA DECwriter III (forms pkg.) ..	2410
LA180 DECprinter I .....	2195
TI 783 (portable) .....	1745
TI 785 (port/built-in coupler) .....	2395
TI 787 (port/internal modem) .....	2845
TI 810 RO impact .....	1800
TI 810 RO Pkg. ....	2047
TI 820 KSR impact .....	1895
TI 820 KSR Pkg. ....	1995
TI 820 RO .....	1895
TI 820 RO Pkg. ....	2047

## 2400 BAUD

Dataproducts M200 (2400 baud) .....	2595
<b>DATAPRODUCTS LINE PRINTERS</b>	
B300 (300LPM band) .....	5535
B600 (600LPM band) .....	6861
2230 (300LPM drum) .....	7723
2260 (600LPM drum) .....	9614
2290 (900LPM drum) .....	12655

## ACOUSTIC COUPLERS

A/J A242-A (300 baud orig.) .....	242
A/J A247 (300 baud orig.) .....	315
A/J AD342 (300 baud orig./ans.) .....	395
A/J 1234 (Vadic compatible) .....	895
A/J 1245 (300/1200 Bell comp.) .....	695

## MODEMS

GDC 103A3 (300 baud Bell) .....	395
GDC 202S/T (1200 baud Bell) .....	565
GDC 212-A (300/1200 baud Bell) .....	850
A/J 1256 (Vadic compatible) .....	825

## CASSETTE STORAGE SYSTEMS

Techtran 816 (store/forward) .....	1050
Techtran 817 (store/for/speed up) .....	1295
Techtran 818 (editing) .....	1795
Techtran 822 (dual) .....	2295
MFE 5000 (editing) .....	1495

## FLOPPY DISK SYSTEMS

Techtran 950 (store/forward) .....	1395
Techtran 951 (editing) .....	1995

\*Please call for quote.



Applications Specialists & Distributors  
Great Neck, New York/Cleveland, Ohio.

N.Y.: 516/482-3500 & 212/895-7177  
800/645-8016. Ohio: 216/464-6688

## Listing 1 continued:

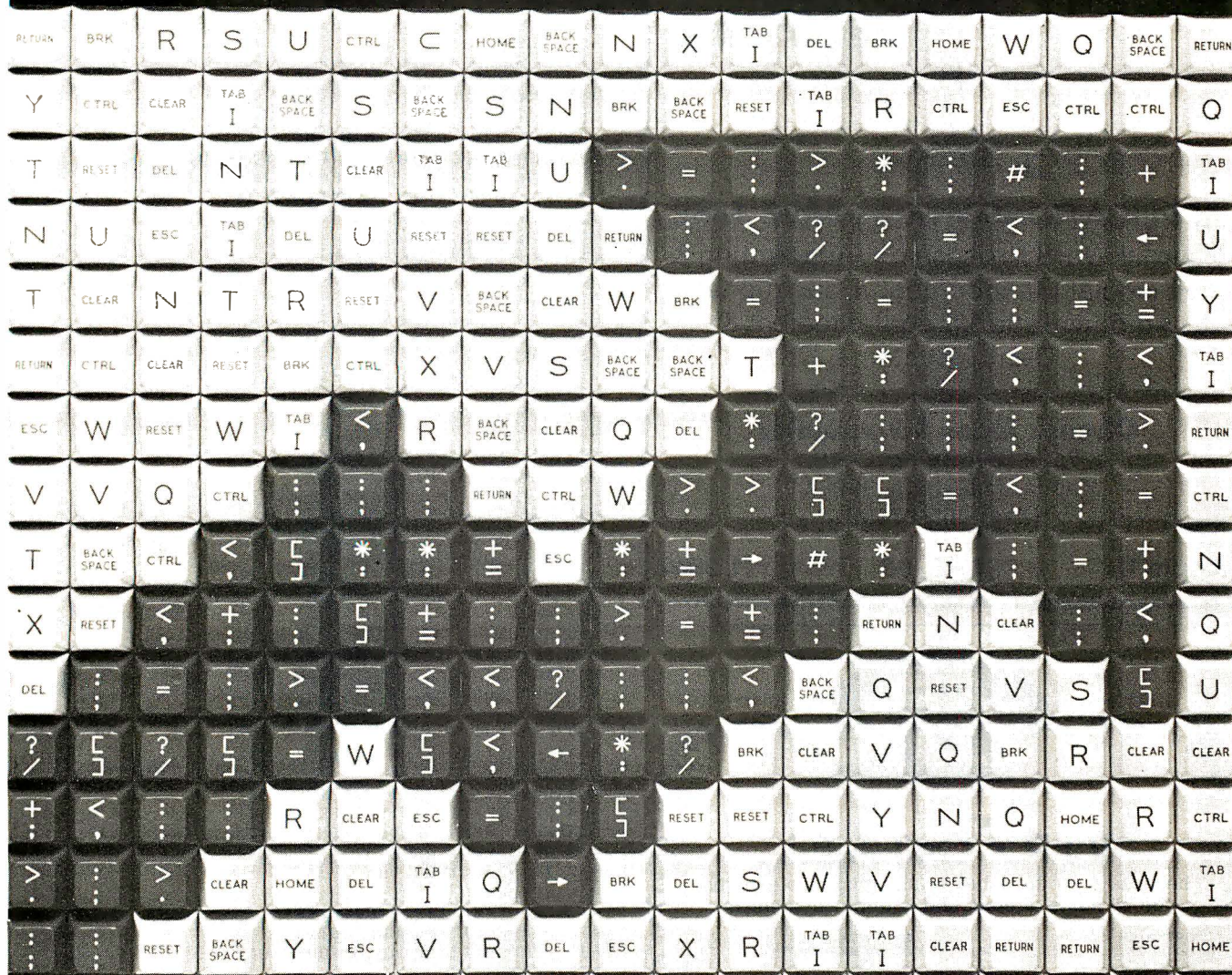
```

327C(7,23)=281979\C(7,24)=61845\C(7,25)=-346731\C(7,26)=-42966
328C(7,27)=-39672\C(7,28)=-30183\C(7,29)=-15678\C(7,30)=1878
329C(7,31)=19734\C(7,32)=34353\C(7,33)=41412\C(7,34)=35802
330C(7,35)=11628\C(7,36)=-37791\C(7,37)=-116820
331C(7,38)=-105864\C(7,39)=-74601\C(7,40)=-27846\C(7,41)=26376
332C(7,42)=76830\C(7,43)=109071\C(7,44)=105444\C(7,45)=45084
333C(7,46)=-96084\C(7,47)=-160740\C(7,48)=-141873
334C(7,49)=-88749\C(7,50)=-11799\C(7,51)=71592\C(7,52)=137085
335C(7,53)=153387\C(7,54)=82251\C(7,55)=-121524
336C(7,56)=-137340\C(7,57)=-116577\C(7,58)=-59253
337C(7,59)=19737\C(7,60)=95568\C(7,61)=133485\C(7,62)=88803
338C(7,63)=-93093\C(7,64)=-124740\C(7,65)=-99528
339C(7,66)=-32043\C(7,67)=53262\C(7,68)=115632\C(7,69)=98010
340C(7,70)=-72963\C(7,71)=-22230\C(7,72)=-15912\C(7,73)=117
341C(7,74)=17082\C(7,75)=20358\C(7,76)=-10530\C(7,77)=-12210
342C(7,78)=-6963\C(7,79)=4983\C(7,80)=12243\C(7,81)=-4158
343C(7,82)=-630\C(7,83)=-171\C(7,84)=603\C(7,85)=-117
344C(7,86)=-90\C(7,87)=48\C(7,88)=-3\C(8,1)=0\C(8,2)=77
345C(8,3)=149\C(8,4)=211\C(8,5)=258\C(8,6)=285\C(8,7)=287
346C(8,8)=259\C(8,9)=196\C(8,10)=93\C(8,11)=-55\C(8,12)=-253
347C(8,13)=-506\C(8,14)=0\C(8,15)=13\C(8,16)=25\C(8,17)=35
348C(8,18)=42\C(8,19)=45\C(8,20)=43\C(8,21)=35\C(8,22)=20
349C(8,23)=-3\C(8,24)=-35\C(8,25)=-77\C(8,26)=0\C(8,27)=54
350C(8,28)=103\C(8,29)=142\C(8,30)=166\C(8,31)=170\C(8,32)=149
351C(8,33)=98\C(8,34)=12\C(8,35)=-114\C(8,36)=-285\C(8,37)=0
352C(8,38)=44\C(8,39)=83\C(8,40)=112\C(8,41)=126\C(8,42)=120
353C(8,43)=89\C(8,44)=28\C(8,45)=-68\C(8,46)=-204\C(8,47)=0
354C(8,48)=7\C(8,49)=13\C(8,50)=17\C(8,51)=18\C(8,52)=15
355C(8,53)=7\C(8,54)=-7\C(8,55)=-28\C(8,56)=0\C(8,57)=27
356C(8,58)=49\C(8,59)=61\C(8,60)=58\C(8,61)=35\C(8,62)=-13
357C(8,63)=-91\C(8,64)=0\C(8,65)=4\C(8,66)=7\C(8,67)=8
358C(8,68)=6\C(8,69)=0\C(8,70)=-11\C(8,71)=0\C(8,72)=14
359C(8,73)=23\C(8,74)=22\C(8,75)=6\C(8,76)=-30\C(8,77)=0
360C(8,78)=9\C(8,79)=13\C(8,80)=7\C(8,81)=-14\C(8,82)=0
361C(8,83)=1\C(8,84)=1\C(8,85)=-1\C(8,86)=0\C(8,87)=2
362C(8,88)=-1
363 RETURN
364 REM *****
365 REM WEIGHTS SUBROUTINE
366 REM N3=NO. OF DATA POINTS
367 REM TO BE AVERAGED OVER
368 REM B(I,J)=THE TABLE NUMBER
369 REM THE TABLE IS STRUNG
370 REM OUT STARTING WITH THE
371 REM 25 POINT SET WHICH, AS
372 REM IT IS IS SYMMETRICAL,
373 REM IS REDUCED TO 13 ELE-
374 REM MENTS.
375 IF B(I,J)=5 THEN GOSUB 397
376 IF B(I,J)=3 THEN GOSUB 407
377 IF B(I,J)=5 THEN RETURN
378 IF B(I,J)=3 THEN RETURN
379 L=12
380 K=1
381 FOR K1=0 TO L
382 W(K1)=C(B(I,J),K)
383 K=K+1
384 NEXT K1
385 REM TABLE IS READ IN
386 REM SEQUENCE UNTIL THE
387 REM RIGHT SET IS FOUND.
388 IF A=L THEN RETURN
389 L=L-1
390 GOTO 381
391 REM *****
392 REM TABLE 12 (5) SUBROUTINE
393 REM THIS TABLE IS FOR THE
394 REM LINEAR LEAST SQUARES
395 REM SMOOTHING AND IS
396 REM ONLY A MOVING AVERAGE.
397 FOR K=0 TO 12
398 W(K)=1
399 NEXT K
400 RETURN
401 REM *****
402 REM TABLE 13 (3) SUBROUTINE
403 REM THIS TABLE IS FOR
404 REM LINEAR LEAST SQUARES
405 REM FIRST DERIVATIVE
406 REM SMOOTHING.
407 FOR K=0 TO 12
408 W(K)=-K
409 NEXT K
410 RETURN
411 REM *****
412 REM DATA VECTOR SUB.

```

Listing 1 continued on page 274

# KEYS TO PRODUCTIVITY



If you plan, make, use, or buy computer systems or services, you can't afford to miss the upcoming **National Computer Conference**, McCormick Place, Chicago, May 4-7.

The theme of this year's conference is "Keys to Productivity", how to use computers and computer services to help increase output and control costs.

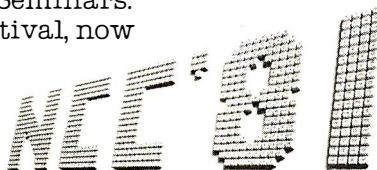
Come see the latest in new equipment and money-saving techniques at over 300 exhibits. Take your pick of over 100 technical sessions and 21 Professional Development Seminars. Enjoy the Personal Computing Festival, now a part of the main conference.

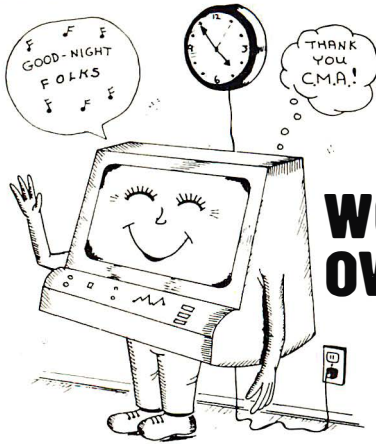
Save time. Save money. Pre-register now for the most dynamic NCC ever. You can:

- Avoid long registration lines
- Save \$15 on the full 4-day program
- Secure preferential housing and discount travel.

For Conference Information, call or write **National Computer Conference c/o AFIPS, P.O. Box 9658, 1815 N. Lynn Street, Arlington, VA 22209, (703) 558-3610.**

For discount air fares, airline reservations, hotel and show information, or to pre-register, call toll-free (800) 556-6882.





## WORKING OVERTIME

### APPLICATIONS WHICH SAVE TIME

Payroll, Word Processing, Accounting & Financial Management, Educational Administration, Legal, Medical & Dental Systems

Check your Local Dealer or Contact:

**Charles Mann & Associates**  
7594 San Remo Trail  
Yucca Valley, Ca. 92284  
(714) 365-9718

Apple II

TRS-80

TI 99/4



## V.I.P.'s Call A.E.I.

because A.E.I. tests before shipping; has expertise on all items offered; and is price competitive.

<b>NORTHSTAR</b>	
HRZ 1D 32K.....	\$1985
HRZ 2D 32K.....	2270
HRZ 2Q 32K.....	2650
HRZ 2Q 64K.....	3100
HARD DISK SYSTEM.....	3935
<b>DYNA BYTE</b>	
NEW SYSTEMS...LOW!..... CALL	
<b>TERMINALS</b>	
TELEVIDEO 912.....	\$665
TELEVIDEO 920.....	715
SOROQ IQ 120.....	695
HAZELTINE 1500.....	850
<b>PRINTERS</b>	
NEC 5510.....	\$2540
NEC 5520.....	2900
NEC 5530.....	2520
ALL NECS. INC. TRACT. RIBBON & THIMBLE	
TI-820.....	1640
TI-810.....	1495
ANADIX DP 9500- OR 01.....	1345

<b>EPSON MX 80 BEST..... CALL</b>	
<b>EPSON MX 70 BEST..... CALL</b>	
<b>ANACOM..... 1150</b>	
<b>MORROW</b>	
DISCUS 2+2 1 DRIVE.....	\$1250
DISCUS 2D 1 DRIVE.....	935
DISCUS M26 HARD DISK.....	3925
<b>SYSTEMS GROUP</b>	
DM 6400 64K 250ns.....	\$595
DMB 6400 64K 250ns.....	745
2ND GENERATION—	
LATEST RELEASES..... CALL	
<b>INDUSTRIAL MICRO SYSTEMS</b>	
XLNT PRICES!..... CALL	
SSM—LOWEST PRICES!..... CALL	
<b>SOFTWARE—DISKS</b>	
WORDSTAR.....	\$325
GRAHAM DORIAN—LOW!..... CALL	
STRUCTURED SYSTEMS—	
LOW!..... CALL	
5" DISKS.....	26
8" DISKS.....	30



These Fine Products and More

We Will Try To Beat Any Advertised Price  
**Automated Equipment Inc.**  
18430 Ward Street, Fountain Valley, Calif. 92708  
TOLL FREE ORDERING

(714) 963-1414 (800) 854-7635

### Listing 1 continued:

```

413 REM THE INPUT DATA, Y(K),
414 REM ARE CONVERTED TO A
415 REM DATA VECTOR WHICH IS
416 REM AUGMENTED BY ZEROES ON
417 REM BOTH THE LEFT AND
418 REM RIGHT.
419 FOR K=0 TO A
420 D(K)=0
421 D(K+N4+A+1)=0
422 NEXT K
423 FOR K=1 TO N4
424 D(K+A)=Y(K)
425 NEXT K
426 RETURN
427 REM *****
428 REM CONVOLUTION SUBROUTINE
429 REM THIS ROUTINE SMOOTHS THE
430 REM DATA POINT M USING THE
431 REM SURROUNDING N3 DATA POINTS.
432 REM THE WEIGHTING FUNCTION IS
433 REM W(I), AND THE DATA D(K).
434 REM THE SYMMETRY IN WEIGHTING
435 REM IS GIVEN IN U.
436 REM THE RESULT IS D.
437 REM THE RESULT IS NORMALIZED
438 REM USING V.
439 D=0
440 D=D+W(O)*D(M)
441 FOR K=1 TO A
442 D=D+W(K)*(U*D(M+K)+D(M-K))
443 NEXT K
444 D=D/V
445 RETURN
446 REM *****
447 REM DATA SHIFT SUB.
448 REM THE SHIFTED AND
449 REM SMOOTHED DATA SET
450 REM IS D(K). THE DESIRED
451 REM SMOOTHED SET IS Y1(K).
452 FOR K=1 TO N4
453 Y1(K)=Y1(K+A)
454 NEXT K
455 RETURN
456 REM *****
457 REM STANDARD DEVIATION
458 REM SUBROUTINE
459 D=0
460 FOR K=1 TO N4
461 D=D+(Y(K)-Y1(K))*(Y(K)-Y1(K))
462 NEXT K
463 D=SQR(D/(N4-I-.999999))
464 REM IF Y1(K) IS A DERIVATIVE
465 REM THEN CALCULATION IS NOT
466 REM APPLICABLE.
467 IF N2>0 THEN D=0
468 RETURN
469 REM *****
470 REM PLOTTING SUBROUTINE
471 REM SHIFT DATA TO NON-NEGATIVE
472 PRINT
473 PRINT "INPUT DESIRED PLOT WIDTH: ",
474 INPUT L
475 REM FIND MAX. DATA VALUE
476 C=0
477 FOR K=1 TO N4
478 IF C<D(K) THEN C=D(K)
479 NEXT K
480 REM DETERMINE PRINTING SCALE VALUE
481 A=L/C
482 PRINT
483 PRINT
484 PRINT"***** DATA PLOT (SCALED) *****"
485 PRINT
486 PRINT
487 PRINT "MAXIMUM VALUE= ",C
488 PRINT
489 PRINT
490 REM GO TO AXIS PRINT SUBROUTINE
491 GOSUB 519
492 FOR K=1 TO N4
493 REM INSERT LINE FEED FOR AUTO SPACING
494 FOR P=1 TO (INT(0.6*L/N4))
495 PRINT":",TAB(L),":":
496 NEXT P
497 REM LOCATE DATUM POSITION
498 E2=A*D(K)

```

Listing 1 continued on page 276

**CP/M® ↔ IBM  
CP/M ↔ DEC  
Compatibility with  
REFORMATTER™**

Exchange data files with most IBM and DEC equipment through **REFORMATTER** disk utilities. With **REFORMATTER**, you can read and write IBM 3740 and DEC RT-11 formatted diskettes on your CP/M system. Programs feature bi-directional data transfer and full directory manipulation. ASCII/EBCDIC conversion provided with CP/M ↔ IBM.

Each program \$195.00 from stock. Specify CP/M ↔ IBM or CP/M ↔ DEC when ordering.

Program Data Sheets and Application Guide available from MicroTech Exports, Inc., 467 Hamilton Ave., Suite 2, Palo Alto, CA 94301 ☐ Tel: 415/324-9114 ☐ TWX: 910-370-7457 MUH-ALTOS ☐ Dealer & OEM discounts available.



CP/M® is a registered trademark of Digital Research.

Circle 257 on inquiry card.

## S-100 VOICE

The ARTICULATOR board allows you to record, store, and play-back any vocabulary on your S-100 computer. Input speech is digitized by the ARTICULATOR and sent to the computer via an on-board port for storage at 1K to 2K bytes/sec. This data is then sent back from the computer to the ARTICULATOR for very high quality playback. On-board VOX switching minimizes memory storage requirements.

**PRICE — \$350 A&T  
AVAILABLE NOW**

Quintrex, Inc.  
9185 Bond  
PO Box 14126  
Shawnee Mission, Ks. 66215  
(913)888-3353

Circle 258 on inquiry card.

## COMPUTER COMPONENTS SLUDER

### Q.T. COMPONENTS FROM SLUDER

Assembled & Tested	List	Sale
QT 386 34 MHz Serial/Parallel 280A	280	228
QT280A Rev 1.2 4 MHz Serial	210	175
Ram 16 16K 4MHz Static Ram	210	175
Ram 5 50K 4MHz Static Ram Bank Select	270	230
Expandable 64K Dynamic Ram NorthStar, Crom	625	525
Address	675	565
Science + Motherboards	90	45
12 Slot	90	75
18 Slot	140	120
Mainframe with power supply	350	285
Mainframe with psis & Dual 5 1/4 Disk Cabinet	400	325
Mainframe with psis & Dual 8 Disk Cabinet	370	300
For Mainframe + 4 Motherboard & 400 bit Parallel	320	260
Clock/Calendar + with 2 mo. battery for 5100	150	120
Apple Computer and Radio Shack TMS 80	150	120
DDC + 8 Single 8 Disk Drive Cabinet with psis	280	240
DDC + 88 Dual 8 Disk Drive Cabinet with psis	601	295
Shugart 8 SABA/R White Supplies Last	295	250
MPi 5 1/4 B51 Disk Drive	42	37
QT Computer Systems Computers	4400	3900
SYS + SSB Single Sided Dual Density	4995	4350
above System in 2 Cabinets & 18 slot mother	2495	2120
SYS + Double Sided Dual Density	2795	2375
QT Mini-system single sided 5 1/4 density		
Mini-system double sided 5 1/4 density		

Complete Accounting package FREE with purchase of QT System from SLUDER. Includes General Ledger, General Journal, Accounts Receivable/Accounts Payable, Payroll Inventory, Fixed Assets and Mailing List. Requires OS/2 for use in QT Systems.

4116 200ns 1ram from Motorola 16K 8 pieces 32

Make Cashiers checks, certified checks, or postal money orders payable to SLUDER PO Box 951, Westminster, CA 92683 Call 714/895-1746 9 to 5 Pacific Time M-F. Postage minimum \$2.00. \$500 on floppies & Mainframes. \$1500 on Systems. California Residents add 6% Sales Tax. Prices subject to change.

PO BOX 951

WESTMINSTER CA 92683

714 895 1746

Circle 259 on inquiry card.

## INVENTORY CONTROL SYSTEM WITH PARTS EXPLOSION FOR FINISHED GOODS AND ASSEMBLIES

Parts requirements forecasting & Pull Sheets  
Economic Order Quantities

1500 Items per single density 8" disk side

AVAILABLE FOR CROMEMCO. CP/M®.

AND OASIS OPERATING SYSTEMS

Hardware requirements: 64K RAM,  
132 Column printer. Manual and 8" floppy  
disk ..... \$250.  
Multi-level explosion version ..... \$499.

Accounts Receivable, Accounts Payable,  
Order Entry, General Ledger, Payroll and  
Mailing List programs also available.

**FEITH SOFTWARE, INC.**  
CEDARBROOK HILLS A-1103  
WYNCOTE, PA. 19095  
(215) 887-9780

Circle 260 on inquiry card.

## QUARTZ CRYSTALS

3218 8	5.2428 8	9.9336 8	20.000 8	36.2886 8	42.8518 8	46.8128 8
5390 8	5.6108 8	9.98408 8	20.4988 8	36.3636 8	42.8768 8	47.3768 8
1000 A	5.7143 8	9.98650 8	22.1184 8	37.9828 8	42.9258 8	47.8338 8
1.8432 A	5.855 8	10.000 8	22.6258 8	38.3768 8	42.9828 8	48.000 8
1.8437 8	5.982 8	10.2458 8	26.3558 8	38.4448 8	43.0008 8	48.3008 8
2.000 A	6.000 8	10.4968 8	26.5008 8	38.6258 8	43.0378 8	48.6668 8
2.0871 A	6.144 8	10.7758 8	26.6708 8	38.9258 8	43.0748 8	48.7008 8
2.4576 A	6.15038 8	10.8258 8	27.000 8	39.3128 8	43.1858 8	48.8768 8
2.500 A	6.2918 8	10.8368 8	27.0008 8	39.5008 8	43.2398 8	49.1008 8
2.6657 8	6.400 8	11.1368 8	27.6508 8	39.6668 8	43.3338 8	49.7338 8
2.9950 8	6.5536 8	11.155 8	28.4008 8	39.7538 8	43.3708 8	49.8128 8
3.000 A	6.72538 8	11.2186 8	28.6276 8	39.8768 8	43.4078 8	50.2508 8
3.067 8	6.75848 8	11.2868 8	28.7538 8	39.9828 8	43.4378 8	51.0558 8
3.200 8	6.9003 8	11.4718 8	29.8758 8	40.4448 8	43.4448 8	51.3028 8
3.2768 A	7.0053 8	11.6568 8	29.9378 8	40.5928 8	43.5558 8	51.7778 8
3.500 8	7.0336 8	11.6818 8	30.0648 8	40.8128 8	43.6298 8	51.8508 8
3.579 8	7.0916 8	12.440 8	30.3608 8	40.8336 8	43.6668 8	52.8128 8
4.000 8	7.1836 8	14.3182 8	30.6258 8	40.8758 8	43.7778 8	56.7508 8
4.1943 8	7.2586 8	14.4368 8	30.8768 8	40.8868 8	43.8028 8	56.8008 8
4.3478 8	8.000 8	15.006 8	31.4378 8	40.9258 8	43.8148 8	58.7508 8
4.4803 8	8.0556 8	15.4408 8	31.7538 8	41.0008 8	43.8398 8	56.7508 8
4.6103 8	8.1416 8	15.5068 8	31.9008 8	41.1668 8	43.8888 8	70.4008 8
4.6503 8	8.1818 8	16.000 8	32.000 8	41.3768 8	43.9258 8	75.0008 8
4.8303 8	8.3308 8	16.3498 8	33.2008 8	41.9378 8	44.0008 8	90.8338 8
4.9157 8	8.4998 8	17.2248 8	33.658 8	42.0008 8	44.0378 8	99.9668 8
5.000 8	8.5766 8	17.2422 8	34.5558 8	42.5836 8	44.3768 8	100.6668 8
5.0698 8	8.6056 8	18.000 8	34.7538 8	42.6258 8	44.7778 8	101.4668 8
5.1203 8	8.9606 8	18.4320 8	34.9776 8	42.7008 8	45.1256 8	103.0668 8
5.1650 8	8.9906 8	19.4860 8	35.9258 8	42.7538 8	45.3008 8	103.4668 8
5.1856 8	9.47208 8	19.7508 8	36.000 8	42.8148 8	46.7008 8	104.9918 8
ALL A — \$2.99		ALL B — \$1.99				100 MORE REDUCT 5%

ADD \$1.00 SHIPPING

CAL. RES. ADD 6% SALES TAX  
FREE OSCILLATOR SCHEMATICS  
WITH ANY ORDER

**QUALITY COMPUTER PARTS**  
P.O. BOX 743 / CHATSWORTH, CA 91311

Circle 261 on inquiry card.

## !! REAL TIME !!

The TIME MACHINE from ALPHA OMEGA COMPUTER SYSTEMS isn't just another digital clock chip surrounded by interface circuitry. It's an intelligent microcomputer based peripheral device.

The TIME MACHINE communicates with your computer via a serial I/O port at user selectable data rate between 300 and 2400 baud. RS-232, RS-422, or current loop communication may be used.

Battery protection against power loss is included. The TIME MACHINE automatically computes day of the week and leap year. Buffered output pulses at one second, one minute, and one hour intervals are provided.

Dimensions are 2.5 x 4.75 x 7.5 inches. Batteries, power supply, and communication cable are included.

Price is only \$450 single lot and quantity discounts are available. Dealer inquiries invited. Off the shelf delivery.

**ALPHA OMEGA COMPUTER SYSTEMS, INC.**  
P.O. Box 727 / Corvallis, Oregon 97330  
Industrial Computer and Control Systems  
(503) 754-1911



Circle 263 on inquiry card.

## OSI COMPUTER REPAIR

**FAST PROFESSIONAL SERVICE  
ON ALL OHIO SCIENTIFIC  
COMPUTERS AND PERIPHERALS.**

**PACE AGE TECHNOLOGY IS  
A FULLY EQUIPPED OSI FACILITY.  
MOST REPAIRS IN 48 HRS. OR LESS.**

SHOP LABOR \$25.00/HR. SERVICE CALLS \$35.00/HR.  
HAVE PLANE AND CAN FLY TO YOU

**Call Michael Pace  
(404) 266-8582  
PACE AGE TECHNOLOGY  
3271 ROSWELL ROAD  
ATLANTA, GA. 30305**

Circle 264 on inquiry card.

## 12" BLACK & WHITE LOW COST VIDEO TERMINAL

**\$165.00 LIST**

Add \$6 for shipping and handling  
Texas residents add 5% sales tax.



90 day  
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 1IN  
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 265 on inquiry card.

Listing 1 continued:

```

499 REM FORMATTED PRINT
500 IF E2>=1 THEN GOTO 503
501 PRINT"*,
502 GOTO 506
503 PRINT":",
504 PRINT TAB(E2),"*,
505 IF INT(E2)=L THEN GOTO 507
506 PRINT TAB(L),":",
507 PRINT
508 NEXT K
509 REM GO TO AXIS PRINT SUBROUTINE
510 GOSUB 519
511 PRINT
512 GOSUB 535
513 PRINT
514 PRINT
515 REM RETURN TO DATA SOURCE PROGRAM
516 RETURN
517 REM *****
518 REM AXIS PLOT
519 FOR K=1 TO L/5
520 PRINT"I----",
521 NEXT K
522 PRINT"I",
523 E4=(K-1)*5+1
524 IF E4=L+1 THEN PRINT
525 IF E4=L+1 THEN GOTO 532
526 E4=E4+1
527 IF E4>=L+1 THEN GOTO 530
528 PRINT"--",
529 GOTO 526
530 PRINT":
531 REM RETURN TO MAIN PLOTTING PROGRAM
532 RETURN
533 REM *****
534 REM PAUSE
535 PRINT "CONTINUE",
536 INPUT R4$
537 PRINT
538 RETURN
READY

```

Text continued from page 264:

(eg: a government contract) so that, depending on the situation, the next year's sales might be either exactly the same or drastically different. Thus data smoothing must be performed using some common sense concerning how to evaluate the results.

### The Moving Average

This section presents the basic table-oriented algorithm; the following section provides the mathematical derivation of the table values for the linear least-squares case. Although the mathematics may appear complicated, especially for the parabolic, cubic, and higher fits, you will find the actual application of the results very simple.

The algorithm is conceptually identical to that of the *moving average*. In the calculation of the three-point moving average, the data point for the month of interest (using our example from table 1) is replaced by the average value of that data point and its two surrounding neighbors:

$$S(t) = \frac{Y(t-1) + Y(t) + Y(t+1)}{3} \quad (2)$$

In this notation,  $S(t)$  is the smoothed value at position  $t$  and  $Y(t)$  is the actual datum for position  $t$ . If a five-point moving average were used, the corresponding equation would be:

$$S(t) = \frac{Y(t-2) + Y(t-1) + Y(t) + Y(t+1) + Y(t+2)}{5} \quad (3)$$

## THUNDERCLOCK PLUS™

### PUT TIME AND REMOTE CONTROL IN YOUR APPLE II

The THUNDERCLOCK PLUS is two peripheral systems on one card for your APPLE II OR II PLUS. An accurate, reliable, real-time clock/calendar and an interface for the popular BSR X-10 Home Control System.

The THUNDERCLOCK clock/calendar makes accurate time and date available to your programs: month, date, day-of-week, hour, minute, and second, in any of four software selectable formats. On-board batteries keep your THUNDERCLOCK running when your APPLE II is turned off - for up to four years before battery replacement. On-card 1K firmware makes reading or setting the time easy from APPLESOFT or INTEGER BASIC, PASCAL, or assembly language programs. And it provides software selectable interrupts at any of three rates: 64, 256, or 2048 interrupts/second.

### THE PLUS

Add THUNDERWARE'S X-10 ULTRASONIC INTERFACE OPTION to your THUNDERCLOCK and your programs can send all 22 BSR X-10 commands so you can remotely control lights and appliances. A full 128 dim/bright levels. And a powerful disk software package! The THUNDERWARE SCHEDULER software lets you create schedules to control lights, appliances, security systems, or almost any other electrical device. The software includes: SCUTIL- the SCHEDULER utility that lets you make or change a schedule, and SCHED- executes your schedules in real-time using the THUNDERCLOCK. SCHED runs in the 'background' so you can run other programs in the 'foreground'.

The THUNDERCLOCK PLUS is a SYSTEM for your APPLE II. Supported by intelligent, easy to use firmware, a powerful software package, and good documentation!

Available through your dealer.

Suggested retail prices:

THUNDERCLOCK PLUS.....\$139  
Clock/calendar card with batteries and user's manual

X-10 INTERFACE OPTION.....\$49  
BSR X-10 Ultrasonic interface, disk with SCHEDULER SOFTWARE & demos, and user's manual

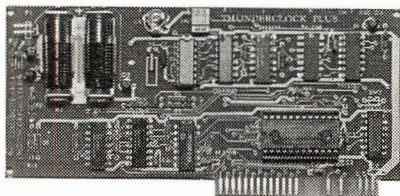
PASCAL SOFTWARE.....\$29  
Disk with PASCAL interface for clock and X-10 interface, and user's guide

MANUALS ONLY, each.....\$5  
California residents add 6% sales tax

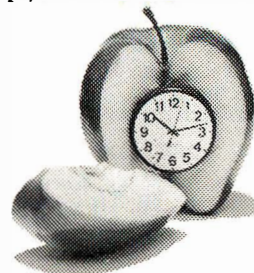
If your dealer doesn't carry the THUNDERCLOCK PLUS:  
ORDER TOLL FREE (VISA/MC) CALL:  
800-227-6204 EXT 307 (Outside California)  
800-632-2131 EXT 307 (California Only)

OR WRITE TO:

THUNDERWARE INCORPORATED  
P.O. Box 13322, Oakland, CA 94661



BSR X-10 is a trademark of BSR (USA) LTD.  
APPLE II is a trademark of APPLE COMPUTER, INC



## Fine Software Tools in C



### The Toolbox

- list** prints that missing source listing
- xref** cross reference C programs
- sort** alphabetize by all or part of text line
- col** arrange text in columns on page
- print** paginates text for hard copy
- and more**

All programs are in portable Whitesmith C. **xref** and **list** are compatible with the compiler's error listing. Title lines on **list** and **print** output includes the date on RT-11 systems. Source code on 8" floppy and manual available immediately for \$45 (tax and shipping included). Specify **RT-11** or **CP/M** format.

**The Toolsmith**  
Dept. **BYTE**  
P. O. Box 22511  
San Francisco, CA 94122

RT-11 is a trademark of Digital Equipment Corp.  
CP/M is a trademark of Digital Research.

Circle 266 on inquiry card.

## MEMORY

2716's \$10  
5V EPROM

2114 \$5  
STATIC RAM

6514 \$14  
CMOS RAMS

**ALL PRIME QUALITY CHIPS**

### ORDERING INFORMATION

- ORDERS UNDER \$25 INCLUDE \$2 HANDLING
- ALL PREPAID ORDERS SHIPPED UPS PPD
- VISA, MC & C.O.D.'S CHARGED SHIPPING
- MOST ORDERS SHIPPED NEXT DAY

SEND FOR COMPLETE LISTINGS

**ATLANTIS**  
**COMPUTERIZED SERVICES**  
34-13 30th Ave  
Astoria, NY 11103  
(212) 728-6700

Circle 268 on inquiry card.

## MEDICAL BILLING

for  
**APPLE II**

- 7000 ACCOUNTS
  - 2000 TRANSACTIONS
- \$995

**PROSOFT**

3604 Foothill, LaCrescenta, CA  
(213) 248-2884

Circle 270 on inquiry card.

## HARDWARE SPECIALS

PRINTERS	
CENTRONICS 730-1	\$ 575
CENTRONICS 737-1	\$ 720
DIABLO 630	\$2075
TERMINALS	
TELEVIDEO 920C	\$ 835
TELEVIDEO 912C	\$ 775

### NORTH STAR HORIZON MICROPROCESSORS

Fully Tested Liberal Return Policy

NS HORIZON II	
QUAD DENSITY, 32K	\$2938
DOUBLE DENSITY, 32K	\$2524
UPGRADE TO 64K	\$ 520
CP/M FOR NORTHSTAR	\$ 150

### GREAT DEALS ON SOFTWARE

MICROPRO

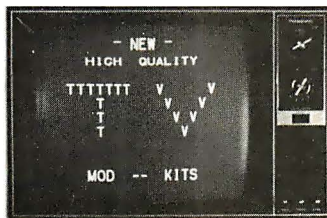
WORDSTAR™	\$ 325
MAILMERGE™	\$ 100
DATASTAR™	\$ 230
SUPERSORT I™	\$ 165
SUPERSORT II™	\$ 130

SMALL BUSINESS APPLICATIONS, INC.  
MAGIC WAND™ \$ 275

20% OFF CP/M WITH NS HORIZON II  
10% OFF ALL OTHER SOFTWARE WITH  
NS HORIZON II

**DWP Inc.** (703) 241-2910  
123 Rowell Court, Falls Church, Virginia 22046  
CP/M is a registered trademark of Digital Research Corp.

## CONVERT ANY TV TO A HIGH QUALITY MONITOR



- Hot Chassis or Transformer sets\*
- 64-80 characters per line
- By-passes tuner & I.F.
- Normal viewing unaffected
- Safe—Easy kit installation
- ACVM Hi-resolution \$34.95 ppd.
- \* Referenced to neutral

**V. A. M. P. INC.**  
Box 29315, Los Angeles, CA 90029  
Calif. Residents add 6% Sales Tax

Circle 269 on inquiry card.

## Save up to 50%

using our buying power. We buy over three million dollars of computer equipment wholesale per year for clients who range in size from the largest manufacturers to the home hobbyist. Our fee is one fourth of what we save you off the manufacturer's suggested list price, so it is to our advantage to save you money.

**THE PURCHASING AGENT**  
1635 School Street, Suite 101  
Moraga, CA 94556  
(415) 376-9020



Circle 267 on inquiry card.

## ?? APPLE\*-ITIS ??

**Hardware or Software Problems?**  
Save time and money by having your own diagnostic disk. Determine immediately if you have a hardware problem.

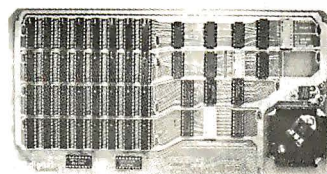
XPS's **APPLE\*-CILLIN** can help you cure your problems fast and easily.

Order **APPLE\*-CILLIN** for  
\$29.95\*\*

**XPS inc.**

323 York Road  
Carlisle, PA 17013

\*trademark of Apple Computer Inc.  
\*\*PA Residents add 6% sales tax  
Requires 48K and one Disk II\*



### 16K STATIC MEMORY

"UNISELECT"

200 ns Memory Chips, A & T,  
Guaranteed \$235.00

Fully Static - 2114L2. NO OMA restrictions  
S-100 Bus - Meets IEEE-S100 Standard SW address, bank select in 16K block, phantom, socketed gold contacts.  
Bank Select - by SW settable port & bit, compatible with CROMECO, NORTH STAR, ALPHA MICRO, etc.  
Guarantee - One full year. Check, MC, Visa or C.O.D. (\$4 fee).  
Stock to 72 hour delivery. Illinois residents add 5 1/4% tax.  
Other - S-100 Boards available

**S. C. DIGITAL**  
P.O. Box 906, Aurora, IL 60507  
Phone: (312) 897-7749

Circle 271 on inquiry card.

## 8088

### \$100 BOARD

**16 BIT PROCESSING**  
**ACOM'S P188**

KIT \$275

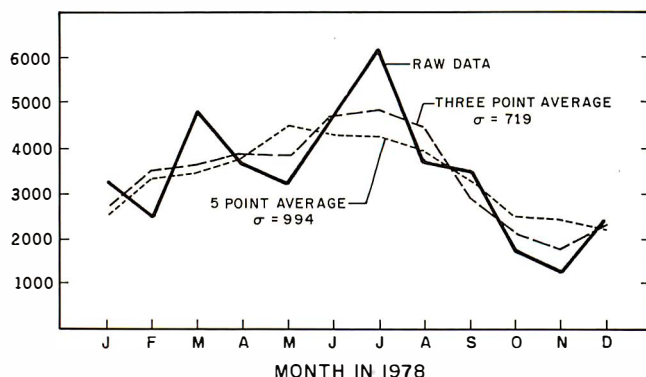
**ASSEM. & TESTED \$345**

**ACOM Electronics**  
4151 Middlefield  
Palo Alto, CA 94303  
(415) 494-7499

Circle 272 on inquiry card.

Month	1978 Sales Volume	Three-Point Smoothing	Five-Point Smoothing
(November)	(1235)		
(December)	(2408)		
January	3279	2703	2842
February	2421	3521	3321
March	4864	3638	3475
April	3629	3891	3768
May	3180	3851	4520
June	4744	4702	4277
July	6181	4859	4235
August	3653	4417	3944
September	3418	2931	3242
October	1722	2125	2487
November	1235	1788	2412
December	2408	2307	2213
(January)	(3279)		
(February)	(2421)		
Standard Deviation:		719	994

**Table 2:** 1978 sales with three-point and five-point moving-average data smoothing. Note that extrapolated figures must be given for November and December 1977 and January and February 1979 in order for the smoothed versions to be calculated.



**Figure 2:** Computation of a smoothed set of data using the moving-average method. The chart shows the raw data (solid line), the smoothed version using a three-point average (the dashed line) and the smoothed version using a five-point average (the dotted line). The Greek letter  $\sigma$  indicates the standard deviations for the respective graphs.

Note that the number of points included in the average is odd. This is required to keep the smoothed points from being shifted in *phase*. Contrast this with the average of the two data points for June and July—the smoothed value would have to be plotted halfway between the two months.

The results of applying the three-point and five-point moving averages to the data shown in table 1 are given in table 2, and the results are plotted in figure 2. The assumption that the pattern will repeat is used to supply the extra data points required at either end of the data set.

This particular example demonstrates several general features of moving-average data smoothing. First, from figure 2, it is apparent that the moving average tends to smooth out extreme fluctuations in the data. Using a five-point average instead of a three-point one has a greater effect on limiting the range of variation. However, using a five-point average does not guarantee that a locally smoother curve will result, although the tendency will exist.

Note, for example, the region near May. The five-point average equally weights the values from the two-month periods on either side, which, in this case, contain two peaks (one in March and one in July). Thus, where there is a local *minimum* in the raw data, the five-point average gives a local *maximum*. This obvious weakness in the smoothing is due to the implied assumption that the five data points over which the averaging is performed should all be equally *weighted*; the July value is included with the May value with equal importance, even though the smoothed result is being calculated for May. As we will see later, nonuniform weighting may be used, partially avoiding this problem.

The second feature to note is that the three-point and five-point moving averages naturally give different results. For the smoothed July value, the three-point method gives an average of 4859, with a standard deviation of 719, while the five-point method gives an average of 4235, with a standard deviation of 994.

Which result is correct? The answer is probably neither. However, one result is likely to be more representative of the truth than the other. If reason exists for believing that correlation between monthly results extends only as far as one month on either side of a given month, then the three-month average is likely to be better. (That is, if the sales for the June and August time periods are expected to be the same as those for July, with the only difference being the "noise," then it is reasonable to average these three months, or *maybe more*. This is the case for, say, a five-month average. However, if the May and September sales are expected to represent a seasonal response different from the response that caused the July sales, then the average should be limited to a span of only three points. Such might be the case if the data in table 1 represented the sales of a seasonal item such as lawn mowers.

The conclusion is that the number of points used in the moving average (3, 5, 7, 9,...) should be dictated by some knowledge of the time frame associated with the underlying customer sales motivation (or, for physicists, the *physics*; for engineers, the *forcing function*). The span parameter in the moving-average and the weighted-averaging techniques to be discussed in the next section should generally be chosen based on some idea of the general trends that are the basis of the observed data. With this in mind, the moving-average calculation can then be used to refine the estimate in an intelligent manner. Only in this way can real *information* be derived from the data.

### Least-Squares Data Smoothing

The simple moving-average calculation presented in the previous section is a special case of the general concept of weighted averages, which can be stated mathematically as follows:

$$S(t) = \frac{\sum_{i=-n}^{i=n} w(i)Y(t+i)}{\sum_{i=-n}^{i=n} w(i)} \quad (4)$$

$$= \frac{w(-n)Y(t-n) + \dots + w(0)Y(t) + \dots + w(n)Y(t+n)}{\sum_{i=-n}^{i=n} w(i)}$$

For the moving-average case we have  $w(i)=1$  for all  $i$ .

## IEEE-488 To TRS-80\* INTERFACE



Everything needed to add powerful GPIB-488 controller capability to TRS-80,

**Model 1, Level 2 or DOS**

Mod. 488-80B \$225.00 + shipping, insurance & tax

SPECIFY DISK OR TAPE

For Model 3 Operation, Contact Factory

## SCIENTIFIC ENGINEERING LABORATORIES

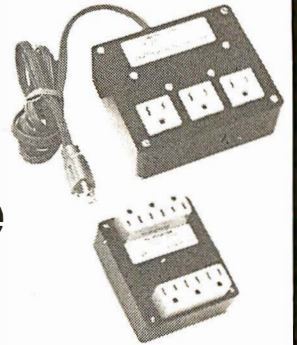
11 NEIL DRIVE • OLD BETHPAGE, NEW YORK 11804

TELEPHONE (516) 694-3205

\*Trade Mark of Tandy Corp. There is no affiliation between Scientific Engineering Laboratories and Tandy Corporation or Radio Shack

DISK DRIVE WOES?  
PRINTER INTERACTION?  
MEMORY LOSS?  
ERRATIC OPERATION?

## Don't Blame The Software!



Power Line Spikes, Surges & Hash could be the culprit!

Floppies, printers, memory & processor often interact! Our unique ISOLATORS eliminate equipment interaction AND curb damaging Power Line Spikes, Surges and Hash.

- ISOLATOR (ISO-1) 3 filter isolated 3-prong sockets; Integral Surge/Spike Suppression; 1875 W Maximum load, 1 KW load any socket ..... \$62.95
- ISOLATOR (ISO-2) 2 filter isolated 3-prong socket banks; (6 sockets total); Integral Spike/Surge Suppression; 1875 W Max load, 1 KW either bank ..... \$62.95
- SUPER ISOLATOR (ISO-3), similar to ISO-1 except double filtering & Suppression ..... \$94.95
- ISOLATOR (ISO-4), similar to ISO-1 except unit has 6 individually filtered sockets ..... \$106.95
- ISOLATOR (ISO-5), similar to ISO-2 except unit has 3 socket banks, 9 sockets total ..... \$87.95
- CIRCUIT BREAKER, any model (add-CB) ..... Add \$ 8.00
- CKT BRKR/SWITCH/PILOT (-CBS) ..... Add \$16.00

Master Charge, Visa, American Express  
Order Toll Free 1-800-225-4876  
(except AK, HI, MA, PR & Canada)

**ESP Electronic Specialists, Inc.**

171 South Main Street, Natick, Mass. 01760  
Technical & Non-800: 1-617-655-1532

A REFURBISHED ASCII TERMINAL OFFERED FOR THE FIRST TIME  
TO SMALL BUSINESS AND PERSONAL COMPUTER USERS.

# The AJ 630. For just \$495\* you can have a quiet thermal printer terminal.

Now, for less than the price of a good electric typewriter, you can have your own personal ASCII printer terminal.

And the AJ 630 gives you a lot of features for interactive timesharing, data entry/retrieval, and communications.

- A wide carriage—up to 140 characters per line
- Built-in lamp for paper illumination



- Upper and lower case characters
- 128-character ASCII code set
- RS-232C interface
- Selectable 110, 150, or 300 bps operation
- Desktop portability
- 30-day warranty on parts and labor

Perhaps best of all, the AJ 630 is *quiet*. You can use it anywhere without disturbing anyone—in the office or at home. And we'll make it easy for you to pay—with cash, certified check, Master Charge, or Visa.

Call toll-free for more information and details on our 10-day money back guarantee.\*\*

**800/538-9721**

California residents call 408/263-8520, Extension 263.

\*Plus \$50 terminal checkout charge and one 15" four hundred foot roll of paper.

\*\*Excluding checkout charge of \$50.

Available only in the continental United States.

**ANDERSON  
JACOBSON**

Number of Averaging Points

Index $i$	25	23	21	19	17	15	13	11	9	7	5	3
12	1											
11	1	1										
10	1	1	1									
9	1	1	1	1								
8	1	1	1	1	1							
7	1	1	1	1	1	1						
6	1	1	1	1	1	1	1					
5	1	1	1	1	1	1	1	1				
4	1	1	1	1	1	1	1	1	1			
3	1	1	1	1	1	1	1	1	1	1		
2	1	1	1	1	1	1	1	1	1	1	1	
1	1	1	1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	1	1	1
-1	1	1	1	1	1	1	1	1	1	1	1	1
-2	1	1	1	1	1	1	1	1	1	1	1	1
-3	1	1	1	1	1	1	1	1	1	1	1	1
-4	1	1	1	1	1	1	1	1	1	1	1	1
-5	1	1	1	1	1	1	1	1	1	1	1	1
-6	1	1	1	1	1	1	1	1	1	1	1	1
-7	1	1	1	1	1	1	1	1	1	1	1	1
-8	1	1	1	1	1	1	1	1	1	1	1	1
-9	1	1	1	1	1	1	1	1	1	1	1	1
-10	1	1	1	1	1	1	1	1	1	1	1	1
-11	1	1	1	1	1	1	1	1	1	1	1	1
-12	1	1	1	1	1	1	1	1	1	1	1	1

Normalizing factor,

$N$  25 23 21 19 17 15 13 11 9 7 5 3

Table 3: Weighting coefficient table for the moving-average method of data smoothing. This is a trivial case, but it clearly introduces the table concept.

At this point, you should become familiar with the idea of tables of *weighting coefficients*, which are the  $w(i)$  terms in equation 4. Such a tabulation for moving averages is shown in table 3. Although this table is trivial, it demonstrates the concept of integer weighting coefficients as presented in an article by Savitzky and Golay. (See references.) In that article (and here as well), the weighting coefficients,  $w(i)$ , are integers, and the normalization  $N$  is performed after the multiplication/addition sequence:

$$S(t) = \frac{1}{N} \sum_{i=-n}^{i=n} w(i)Y(t+i) \quad (5)$$

For a given number of averaging points, the coefficients are easily found in the table, the summation performed, and the result then normalized (by dividing by, for the moving-average case,  $N=2n+1$ , the sum of all the  $w(i)$ s from  $w(-n)$  to  $w(n)$ ).

For the moving average, it is very obvious how the entries in table 3 were obtained. As an illustrative example, we will now derive the table entries for a linear (as opposed to parabolic, cubic, etc) least-squares smoothing.

Consider a set of data where there are  $2n+1$  elements having coordinates  $(X_i, Y_i)$ . Generally, the method of linear least-squares fitting leads to a "best fit" line having the equation:

$$Y(X) = mX + b \quad (6)$$

The "best fit" criterion is to find values for  $m$  and  $b$  such that the sum of squares,  $SS$ , is a minimum:

$$SS = \sum_{i=-n}^{i=n} (Y(X_i) - Y_i)^2 \quad (7)$$

The case we are considering is a little special in the sense that we are examining least-squares fitting with only an odd number of data points. The index range is not the usual  $i=1$  to some positive value, but rather  $i=-n$  to  $i=n$ .

The analytical solution to the desired parameters,  $m$  and  $b$ , may be found in any standard statistics text. For example, reference 2 presents the results in a particularly convenient form modified here:

$$m = \frac{\sum_{i=-n}^{i=n} (X_i - \bar{X})(Y_i - \bar{Y})}{\sum_{i=-n}^{i=n} (X_i - \bar{X})^2} \quad (8)$$

$$b = \bar{Y} - m\bar{X} \quad (9)$$

In this notation,  $\bar{X}$  and  $\bar{Y}$  are simply the averages of  $X_i$  and  $Y_i$ :

$$\bar{X} = \frac{\sum_{i=-n}^{i=n} X_i}{2n+1} \quad (10)$$

$$\bar{Y} = \frac{\sum_{i=-n}^{i=n} Y_i}{2n+1} \quad (11)$$

The weighting coefficients we are looking for are implicitly contained in the above equations. This may be seen as follows.

We are interested in replacing the data point  $Y_0$  with a "better" one as determined by the least-squares smoothing. This smoothed value is simply:

$$Y = mX_0 + b = mX_0 + \bar{Y} - m\bar{X} \quad (12)$$

AOS On  
A NOVA® 4/X?

Wild Hare's

MTSS Provides NOVA® Users  
With Multi-User Capabilities

DG users now have a choice when upgrading to a multi-user environment. Previously, the only way to support a true multi-user environment was to upgrade to AOS, but not anymore.

MTSS provides all of the standard RDOS features for up to 16 users simultaneously and each user is totally independent. Users may edit, compile and execute programs written in FORTRAN IV, FORTRAN V, ALGOL, BASIC, MACS, etc.

This means no software rewriting is necessary. No new operating system need be installed.

More importantly, MTSS supports all NOVA's as well as ECLIPSE's so no expensive hardware upgrade is required.

Now Data General Users  
Have A Choice!

**WILD HARE**  
COMPUTER SYSTEMS, INC.

P.O. Box 3581, Boulder, Colorado 80307  
(303) 422-1182

**MARYMAC INDUSTRIES, INC.**

To Place An Order  
From Outside Texas  
1-800-231-3680



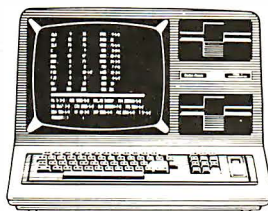
Questions & Answers  
& Orders  
Texas 1-713-392-0747

Store #G-189

AUTHORIZED SALES CENTER

**BRAND NEW IN CARTONS DELIVERED.** Marymac Industries owns & operates Radio Shack® dealership in Katy, Texas. Warranties will be honored by all company owned Radio Shack® stores, & participating franchisees and dealer authorized sales centers. Save State Sales Tax. Texas Residents Add Only 5% Sales Tax. Open Mon.-Sat. 10-7. We pay freight and insurance. No extra charge for Master Charge & Visa. Call us for reference in or near your city. Ref: Farmers State Bank, Brookshire, Texas. Write or visit us at, 21969 Katy Fwy, Katy (Houston), Texas 77450.

## WE OFFER ON REQUEST

Federal Express ☒Houston Intercontinental Airport Delivery ☒U.P.S. BLUE ☒References from people who have bought computers from us probably in your city ☒

In stock TRS-80 Model II and III

No Tax on Out of Texas Shipments!

**Save**  
**10% 15%**

OR MORE

Model III



In Stock

## WE ALWAYS OFFER

☒ NO extra charge for Master Charge or Visa☒ We always pay the freight and insurance☒ Toll free order number☒ Our capability to go to the giant Tandy Computer warehouse 5 hours away, in Ft. Worth, Texas, to keep you in stock.

ED McMANUS



JOE McMANUS



### AT LAST!

Mass production prices for high quality software. Buy direct and save 50%. Also available for CPM and HDOS.

**DATA BASE MANAGER** Mod I & III \$69, \$149 (48K). Mod-II \$199  
Maintain a data base and produce reports, all without user programming. Define file parameters and report formats on-line. Key random access, fast multi-key sort, field arithmetics, audit log, label. No time-consuming overlays. 500 happy users in one year. Mod-II and 48K versions have over 50 enhancements, including 40 fields maximum. "IDM-M2 is great!" - 80-US.

**A/R** Mod-I \$69 Mod-II \$149 Mod-III \$69  
Handles invoices, statements, aging, sales analysis, credit checking, forms input, and order entry. Unlike other accounts receivable programs, ours can be used by doctors, store managers, etc.

**WORD PROCESSOR** \$49  
Centers, justifies, indents, and numbers pages. Mod-I version features upper/lower case without hardware modification! File merge option available.

**MAILING LIST** Mod I & III \$59, \$79 (48K). Mod-II \$99  
The best! Compare and be selective. Includes forms input, 5-digit selection code, zip code extension, sort on any field, and multiple labels. Who else offers a report writer and merges with word processor?

**INVENTORY** Mod I & III \$89, \$109 (48K) Mod-II \$149  
Fast key random access. Reports include order info, performance summary, EOQ and user-specified reports. Many people have converted to our system! "Next to impossible to damage the file."

**GL. A/R. A/P. PAYROLL** Mod-II \$129 each  
Integrated accounting package. 100+ page manual. As opposed to Osborne's slow binary search and 64 column screen, we use fast ISAM and 80 columns. Dual disk and TRSDOS required.

**L216** \$59  
A cassette package of 10 business programs for Level II 16 K systems. Includes word processor and data base manager. Poker game \$19.

Most programs are on-line, interactive, random-access, bug-free, documented, and delivered on disks. Mod-I programs require 32K TRSDOS. We're #1 in business software—don't let our low price fool you! Ask for our free 20-page catalog if you're still not convinced. Compiled versions are available.

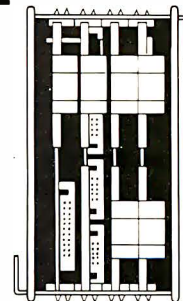


**MICRO ARCHITECT, INC.**  
96 Dothan St., Arlington, MA 02174

## DEC LSI-11 Components

Dependable service  
at discount prices

Domestic  
and Export



**Mini  
Computer Suppliers, Inc.**

25 Chatham Rd., Summit, N.J. 07901  
Since 1973

(201) 277-6150 Telex 13-6476

©Mini Computer Suppliers, Inc.  
1979

Number of Averaging Points													
Index <i>i</i>	25	23	21	19	17	15	13	11	9	7	5	3	
12	12												
11	11	11											
10	10	10	10										
9	9	9	9	9									
8	8	8	8	8	8								
7	7	7	7	7	7	7							
6	6	6	6	6	6	6	6						
5	5	5	5	5	5	5	5	5					
4	4	4	4	4	4	4	4	4	4				
3	3	3	3	3	3	3	3	3	3	3			
2	2	2	2	2	2	2	2	2	2	2	2		
1	1	1	1	1	1	1	1	1	1	1	1	1	
W	0	0	0	0	0	0	0	0	0	0	0	0	0
E	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
I	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
G	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
H	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4
T	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
S	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6
-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7
-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9
-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10
-11	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11
-12	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12
Normalizing factor, <i>N</i>													
<i>N</i>	1300	1012	770	570	408	280	182	110	60	28	10	2	

**Table 4:** Weighting-coefficient table for linear, least-squares, first-derivative data smoothing. The symmetry around  $i=0$  allows this table to be cut in half when used in a computer program.

Since the data points are equally spaced, it does no harm to redefine the  $X_i$  values. In particular, choose  $X_i=i$ . In that case,  $X_0=0$  and  $\bar{X}=0$ , giving the smoothed value:

$$\bar{Y} = \bar{Y} = \sum_{i=-n}^{i=n} Y_i / 2n+1 = \frac{1}{2n+1} \sum_{i=-n}^{i=n} Y_i \quad (13)$$

That is, the smoothed value obtained by the linear least-squares criterion is just the moving average! Thus table 3 gives the weighting coefficients for linear, least-squares data smoothing.

The analysis can be taken yet one more step. If we want the first derivative at  $X_0=0$  of the function fitted to the  $2n+1$  points centered at  $X_0$ , we have simply:

$$\left. \frac{dY}{dX} \right|_{X=X_0} = m \quad (14)$$

Recalling that  $\bar{X}=0$  and noting that  $\sum X_i \bar{Y}$  is proportional to  $\bar{X} \bar{Y}$ , we get:

$$\left. \frac{dY}{dX} \right|_{X=X_0} = \frac{\sum_{i=-n}^{i=n} X_i Y_i}{\sum_{i=-n}^{i=n} X_i^2} \quad (15)$$

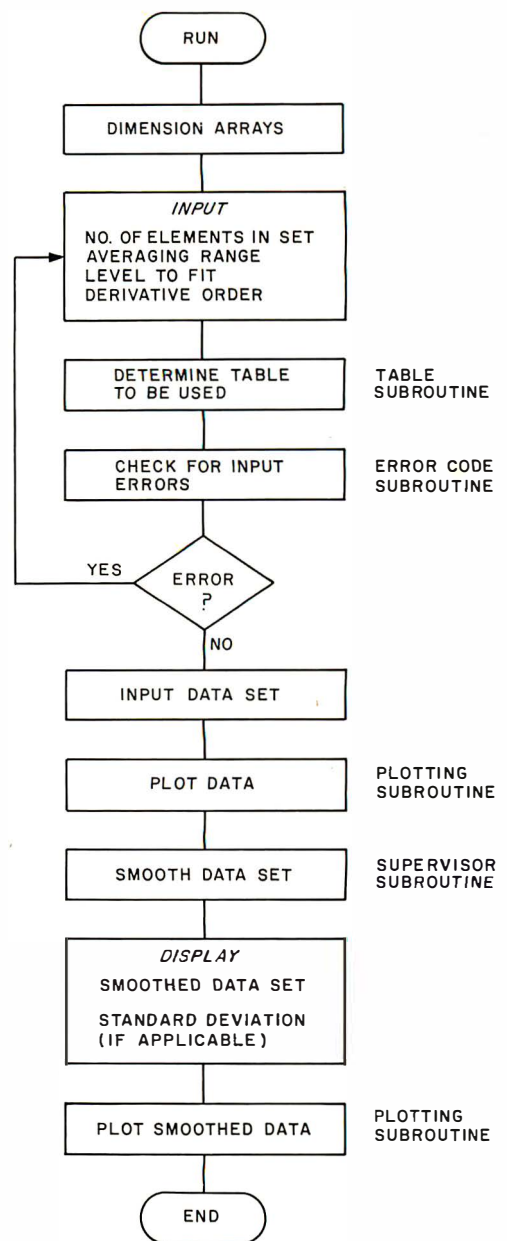
Thus, the nonnormalized integer weighting coefficients for linear, least-squares, first-derivative data smoothing are:

$$W(i)=i \quad (-n \leq i \leq n) \quad (16)$$

$$\text{with } N = \sum_{i=-n}^{i=n} i^2 = \frac{n(n+1)(2n+1)}{3} \quad (17)$$

The last two equations were used to generate table 4.

Two important characteristic features are apparent from table 4. The first is that the normalizing factor,  $N$ , is



**Figure 3:** Flowchart for the least-squares data-smoothing program given in listing 1. See figure 4 for the supervisor subroutine flowchart.

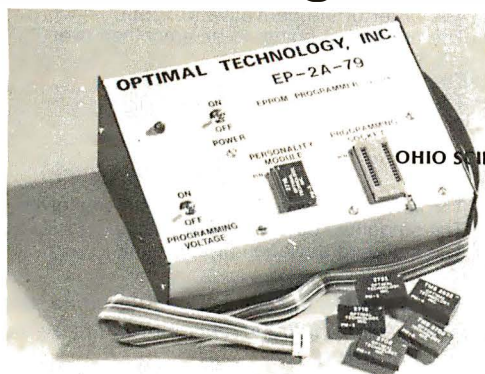
not simply a sum of the weighting factors in the corresponding column. That is true only for the moving average. Second, the table is symmetrical about the  $i=0$  row. The weighting tables are exactly symmetrical or inversely symmetrical, thus making nearly half the entries redundant. This property may be used to save program space.

### Implementing the Algorithm

The algorithm represented by equation (5) may easily be implemented as a computer program that applies the appropriate table depending on the prompted inputs. The flowchart for such a program is shown in figure 3.

The program is laid out in modular (ie: subroutine) form. As shown in figure 3, the basic program flow is to input the smoothing parameters, check for errors in those parameters, and then input the data. The input data is

## Model EP-2A-79 EPROM Programmer



TRS-80  
PET  
APPLE  
AIM-65  
KIM-1  
SYM-1  
OHIO SCIENTIFIC  
SWTPC

Software available for F-8, 6800, 8085, 8080, Z-80, 6502, 1802, 2650, 6809 based systems.

EPROM type is selected by a personality module which plugs into the front of the programmer. Power requirements are 115 VAC 50/60 Hz. at 15 watts. It is supplied with a 36-inch ribbon cable for connecting to microcomputer. Requires 1½ I/O ports. Priced at \$169.00 with one set of software. (Additional software on disk and cassette for various systems.) Personality modules are shown below.

Part No.	Programs	Price
PM-0	TMS 2708	\$17.00
PM-1	2704, 2708	17.00
PM-2	2732	33.00
PM-3	TMS 2716	17.00
PM-4	TMS 2532	33.00
PM-5	TMS 2516, 2716, 2758	17.00
PM-8	MCM68764	35.00

**Optimal Technology, Inc.**  
Blue Wood 127, Earlsville, Virginia 22936  
Phone (804) 973-5482

**apple computer**  
Sales and Service



**Apple III System**  
128 K Apple III Computer  
VisiCalc III  
Business Basic Software

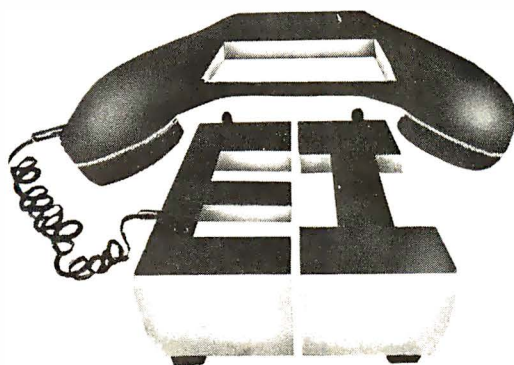
only \$4740<sup>00</sup>

- Full line of Apple Products
  - Personalized Service
  - Classes & Seminars
- See our "Apple I" on display.



**FARNSWORTH  
COMPUTER CENTER**

1891 N. Farnsworth Ave.  
(Immediately S. of EW Tollway)  
Aurora, IL (312) 851-3888  
WEEKDAYS 10-8; SAT. 10-5



## VIP's Call A.E.I.

VIP's customarily need top quality and service within stringent budgetary limits. Naturally, they call A.E.I.

For software, firmware, or hardware; For custom systems assistance, connectors, interface boards and service; For peripherals, including printers, CRT's, disc drives, or modems; For as little as one part such as a cable or connector, or as much as an entire national computer complex for a multi-branch company.

**Item:** A.E.I. tests virtually every\* item sold, before shipping.

**Item:** A.E.I. initializes every piece of software, and makes a copy. If you have a problem, A.E.I. can check to locate the problem by using the in-house duplicate, saving you time.

**Item:** A.E.I. has in-house expertise on every item offered.

**Item:** A.E.I. prices are competitive with the lowest, no-service, no in-house expertise dealer.

**40% OF ALL A.E.I. SALES ARE TO PUBLIC AND SEMI-PUBLIC INSTITUTIONS.**

A partial list\*\* of A.E.I. customers who purchased during the last quarter of 1980 includes: University of Nebraska, University of Virginia, U.S. Dept. of Interior, University of Kentucky, University of California, Massachusetts Institute of Technology, U.S. Air Force, Naval Air Development Center, Brown University, University of Oregon, University of Utah, Ohio State University, University of Southern California, California State Dept. of Water Resources, University of Michigan, and Princeton University.

In the private sector, an equal number of major national organizations purchased during the same period.

**You can call A.E.I. too!**

\*With our normal fast shipping, we have time to test; expedited shipment may preclude testing.

\*\*A.E.I. does not wish to imply that any of these fine organizations endorse A.E.I., merely that A.E.I. is proud to have them as customers.

**Automated Equipment, Inc.**

18430 Ward Street, Fountain Valley, California 92708 (714) 963-1414 (Outside of California (800) 854-7635)

then plotted, and control is subsequently passed to a generalized supervisor (or executive) program that performs the desired smoothing by calling in several other subroutines. (See figure 4.) The smoothed results are returned to the main program and are printed out along with the standard deviation between the original and smoothed data. In the case of derivative smoothing, which will be discussed later, the concept of standard deviation is not applicable, and 0 is printed. After the numerical display, the smoothed results are plotted.

The plotting routine properly deals with only non-negative data. This restriction helps keep the program short and simple. If negative values are encountered, only the absolute values are plotted. This generally does not cause much confusion because the values themselves are also printed. The plot is only a convenience item.

The supervisor subroutine is interesting because it can be called by some other data-gathering program instead of the one outlined in figure 3. It requires the variables given in table 5a as input and returns the values given in table 5b.

Before entering the supervisor, the arrays must have already been dimensioned. The reason for this requirement is that in many BASIC interpreters an array cannot be dimensioned more than once. Since the supervisor subroutine may be called more than once, it therefore cannot contain DIM (dimension) statements.

The complete program is shown in listing 1. As can be seen from the listing, the subroutines indicated in figures 3 and 4 are clearly identified by liberal use of REM (remark) statements.

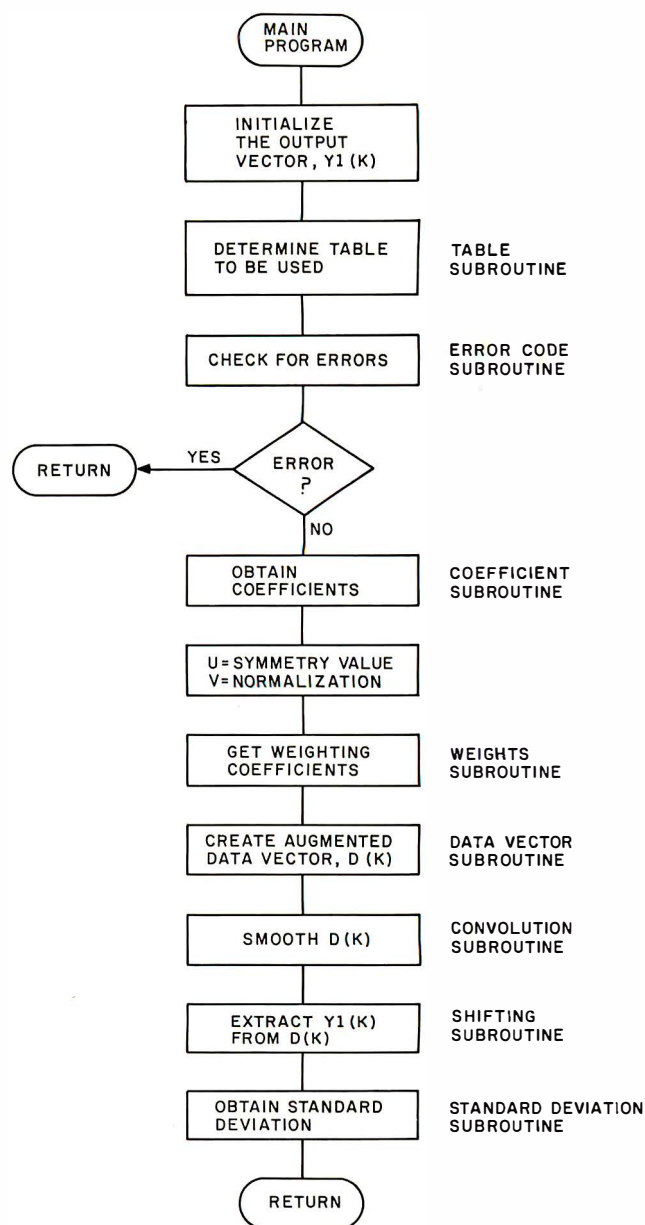
(5a)

N1: The level of fit (0,1,2,3,4,5).  
N2: The order of the derivative (0,1,2,3).  
N3: The number of points to be smoothed over (3,5,7,9,...25).  
N4: The number of data points.  
Y(K): The data array.

(5b)

E: The error code if an improper input was given.  
Y1(K): The smoothed data (or derivative).  
D: The standard deviation (if applicable).

**Table 5: Variables used in the supervisor subroutine that appears in the flowchart in figure 4. This subroutine is given in lines 98 thru 158 of listing 1.**



**Figure 4: Flowchart for the supervisor subroutine. The supervisor calls several other subroutines in order to perform the task of data smoothing. Note that the calling program, shown in figure 3, can be entirely replaced by a program that obtains the appropriate inputs and then calls this subroutine.**

# Electronic Programmers

We're more than the world's #1 toymaker. We're also a place where creative and ambitious people can express their ideas and see tangible results. If you thrive in a fast-paced environment and seek the stimulation of an innovative company, consider this opening:

Your job will involve concept development and design of sophisticated electronic toys using state-of-the-art technology. 1-2 years experience in micro-computer systems, good familiarity with 6502, 6800, Z80 or

8080 required. Knowledge of ASSEMBLY and BASIC language, input/output routines and real-time programming also required.

At Mattel, we offer a stimulating, creative environment, excellent benefits, top salaries and the chance to work with people whose business is fun. Interested?

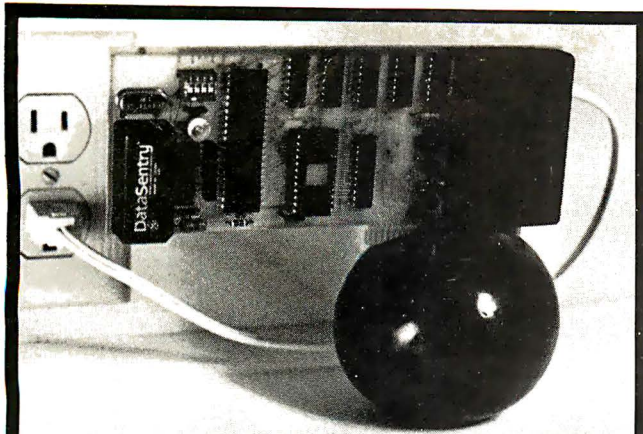
Send your resume with salary history to: Sandy Wales, Dept. G.

**MATTEL**  
5150 Rosecrans Ave.  
Hawthorne, CA 90250

An Equal Opportunity Employer M/F



**The kind of jobs  
most people  
just dream about.**



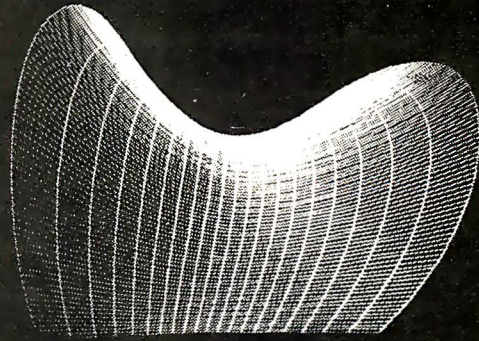
## REMOTE MONITORING AND CONTROL FOR THE APPLE II COMPUTER

### Real time clock/calendar included

Connects directly to and communicates thru the AC power line. **OUTPUT** Operates up to 256 BSR System X-10 remote control modules. Also operates intelligent control modules and alarm and voice output modules, soon to be available from ICS. **INPUT** Use the BSR Command Console to send commands to your computer. Monitor the status of security and temperature remote input modules, and the status of ICS output modules. **CLOCK** The clock provides sec, min, hour, date, day of week, mo, year, plus 4 selectable interrupt rates for background operation of control programs. On board battery backup. **SOFTWARE** On board software is provided to handle the remote I/O, set and read clock, run background control schedules, and simulate the BSR Command Console. Easy access from BASIC. **TRADEMARKS**-APPLE II: Apple Computer, Inc., System X-10: BSR Ltd. SEE YOUR DEALER OR ORDER FROM ICS FOR \$185 (+\$5 ship./hand.)

**INTELLIGENT CONTROL SYSTEMS, INC.**  
PO BOX 14571 MINNEAPOLIS, MN 55414 (612) 699-4342

## S-100 GRAPHICS



Unretouched photograph

- 512 x 640 matrix available in black and white, gray tones, or color
- Bit mapped design for high speed performance
- Easily expandable from basic black and white by adding memory planes.
- Variety of software: graphical BASIC, Tektronix emulator, printer drivers, character editor
- Compatible monitors and printers available.



**CAMBRIDGE DEVELOPMENT  
LABORATORY**

36 Pleasant Street, Watertown, MA 02172  
(617) 926-0869

# THE FIRST TRS-80<sup>®</sup> COMPATIBLE COMPUTER WITH HIGH DENSITY COLOR GRAPHICS!



**LNW80**

PC BOARD **\$89.95**

Ask about our : Keyboard  
cabinet  
Leads:  
VIDEO 100-80

**LNW  
RESEARCH**

LNW RESEARCH 3183-E AIRWAY AVE COSTA MESA CA 92626 714-552-8946

\* Apple II is a TM of Apple Computer, Inc.  
© 1981 LNW Research, Inc.

LNW RESEARCH introduces the LNW80, a high performance color computer, compatible with the TRS-80<sup>™</sup> Model I. The fully integrated LNW80 is a sophisticated and versatile microcomputer with the following powerful features.

#### COMPATIBILITY

Hardware and software compatible to the Radio Shack TRS-80<sup>™</sup> Model I computer, provides the widest software base of any microcomputer. cassette interface; expansion bus

#### DISPLAY

quality upper and lower case display.

Two modes of color graphics, high resolution graphics, 384 x 192 in eight colors - higher density than the Apple II\*. Low density color graphics of 128 x 192 are also available in eight colors.

High resolution - black and white graphics - of 384 x 192 mixed with text and TRS-80<sup>™</sup> standard graphics.

Reverse video, composite video RF output.

#### PERFORMANCE

The LNW80 utilizes the fast Z-80A microprocessor which executes at a speed of 4 MHz - over twice the speed of the TRS-80<sup>™</sup> Model I.

**NEW**

EXTERNAL DATA SEPARATOR  
ASSEMBLED  
AND FULLY TESTED  
\$14.95

**SYSTEM  
EXPANSION**

AT  
**\$69.95** [PC BOARD &  
USER MANUAL]

- SERIAL RS232C/20 mA I/O
- FLOPPY CONTROLLER
- 32K BYTES MEMORY
- PARALLEL PRINTER PORT
- DUAL CASSETTE PORT
- REAL-TIME CLOCK
- SCREEN PRINTER BUS
- ONBOARD POWER SUPPLY
- SOFTWARE COMPATIBLE
- SOLDER MASK, SILK SCREEN

#### ORDERING INFORMATION

Add \$3 for postage and handling.  
CA residents add 6% sales tax



**IPEX** PRESENTS THE  
**Tireless Twosome**



**YOUR TYPEWRITER • OUR INTERFACE**  
 Get perfect print quality at a budget price.

Your typewriter. Our interface. Together they let your tireless computer do your typing for you. And, of course, with perfect typewriter print quality. Better print quality even than you can get from much more expensive daisy-wheel printers. Use your IBM SELECTRIC® I, II, or III, including correcting models. Produce perfect letters, reports, statements, contracts..., any output from your computer.

Our interface is compatible with nearly all computers, small or large, and with most popular word processing software. You can install the interface yourself or we will install it for you.

So put the TIRELESS TWOSOME to work in your office. Get print quality prettier than a whole field of daisies, and for a lot less money too.

• We export to all countries • Call or write for our complete information package, today.

The word "SELECTRIC" is a registered trademark of the IBM Corporation.

**IPEX** INTERNATIONAL INC.  
 16140 Valerio Street  
 Van Nuys, CA 91406 USA  
 Tel: 213/781-0020 Telex/Twx: 910 495 1767

A	M
B(I,J)	N1
C(I,J)	N2
D	N3
D(I)	N4
E	O
E(I)	P
E2	R4\$
E4	U
I	U(I)
J	V
K	V(I,J)
K1	W(I)
L	Y(I)
	Y1(I)

**Table 6:** A table of variables used in the subroutines of listing 1. This table is used to prevent duplication of variable names when generating a new main program that uses the subroutines of listing 1.

Derivative					
		0	1	2	3
Level of Fit	1	Yes	Yes	No	No
	2	Yes	Yes	Yes	No
	3	Yes	Yes	Yes	Yes
	4	Yes	Yes	Yes	Yes
	5	Yes	No	Yes	No

**Table 7:** Table of permitted data-smoothing operations with the program shown in listing 1. The derivative/level-of-fit combinations omitted were done to keep the program at a reasonable length.

**TWICE THE BYTE!**



**8" DISK CONTROLLER  
 NOW—DOUBLE SIDED OPTION!**

- DOUBLES APPLE II STORAGE
- APPLE DOS COMPATIBLE
- SHUGART 800 OR 850 COMPATIBLE
- IBM 3740 DATA ENTRY CAPABILITY
- CP/M, UCSD PASCAL CAPABILITY

Available at your local APPLE Dealer: \$400.

**SVA** **SORRENTO VALLEY ASSOCIATES**  
 11722 SORRENTO VALLEY RD.  
 SAN DIEGO, CA 92121

The smoothing parameters are stored as explicit arrays. It would have been more efficient to store this information in BASIC data statements. However, the supervisor (and the routines it calls) is meant to be a subroutine, and it is not good programming to use data statements in subroutines that may be called often. For example, if the main program and the subroutine both have data stored that way, how does the subroutine read the appropriate data and restore the data pointer to its proper location after repeated calls? The way the program shown in listing 1 is written, the main program (statements 1 thru 96) can be replaced by a user program without any change in the subroutines. If you want to replace the main program, keep in mind that the subroutines have variables that should not also be employed in the calling program without some caution. The subroutine variables list is shown in table 6.

### Using the Program

As presented, the program may be used to smooth data over the range of fits and derivatives shown in table 7. As an example of how the program operates, we will now apply it to the sales-volume example discussed earlier.

Listing 2 shows a sample run in which a parabolic (ie: second level) fit was applied using a five-point average. Note that sixteen data points are necessary to do this, since we require an additional two points on either side of the point of interest. (These points can be deleted later.) The user inputs are underlined. If a "fatal" error in the parameter input sequence had been made, the error

*Text continued on page 290*

**computer  
case  
company**

**comp  
case**



### CASES NOW AVAILABLE

- AP101 Apple and Single Disk Drive ..... \$109
- AP102 Apple and Double Disk Drive ..... 119
- AP103 Apple, 9 inch Monitor and Double Drive ..... 129
- RS201 TRS-80, Expansion Unit and Double Drive ..... 109
- RS202 TRS-80 Monitor and Accessories ..... 84
- P401 Paper Tiger Printer ..... 99
- P402 Line Printer II-Centronics 730 ..... 89
- CC90 Matching Attache Case ..... 75

### CASES SOON AVAILABLE

- RS204 Model III Radio Shack
- RS205 Radio Shack Color Computer
- AP104 Apple/// with Disk Drives and Silentyte
- AP105 12 inch Monitor and Accessories

**computer case company**

5650 INDIAN MOUND CT. COLUMBUS, OHIO 43213 (614) 868-9464



# S-100 Modem

An Atlanta bulletin board system uses a Hayes S-100 modem around the clock. Since March 1979, it has logged over 21,500 calls and been down a mere 10 minutes. For performance like this, depend on the Hayes Micromodem 100.™ Features include automatic dialing/answering, 45 to 300 baud operation, a built-in serial interface and direct connection to any modular phone jack.

The Micromodem 100—and Micromodem II™ for Apple II\* computers—are now available nationwide. Call or write for the name of your nearest dealer.



**Hayes Microcomputer Products Inc.**

5835 Peachtree Corners East, Norcross, GA 30092 (404) 449-8791

Micromodem 100 & Micromodem II are trademarks of Hayes Microcomputer Products Inc. \*TM Apple Computer Inc.

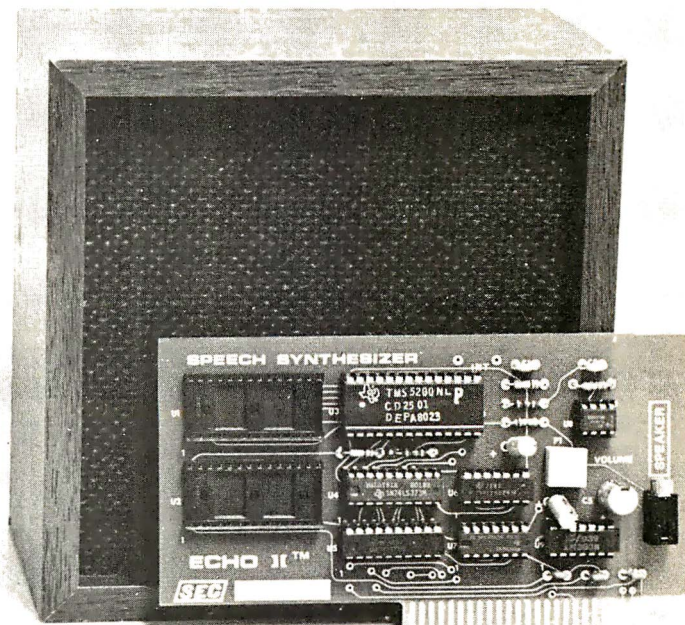
## ECHO SERIES™ SPEECH SYNTHESIZERS COMPUTERS ARE SPEAKING OUT!

Now you can add intelligible speech to your computer without using vast amounts of memory! The ECHO ]™ speech synthesizer for the Apple\* is the first of a series of synthesizers based on the same technology that made the Speak & Spell\*\* a success.

The initial operating system allows the creation of your own vocabulary with phonemes (word sounds) while using very little RAM memory (approx. 800 bytes + 20 bytes/word). Enhanced operating systems and vocabulary ROMs will be offered as they become available.

The ECHO ]™ comes complete with speaker, instruction manual, and a disk containing a speech editor, sample programs, and a sample vocabulary. Suggested list price is \$225.

See your dealer or contact:



**SEC** STREET ELECTRONICS  
CORPORATION

\* Trademark of Apple Computer

3152 E. La Palma Ave., Suite C  
Anaheim, CA 92806 (714) 632-9950

\*\* Trademark of Texas Instruments

Circle 208 on inquiry card.

**Listing 2:** Sample run of data smoothing program, using data from table 1. In this listing, user input is underlined.

RUN

DATA SMOOTHER FOR EQUALLY  
SPACED DATA SETS

INPUT THE NUMBER OF  
DATA POINTS IN SET: ?16

HOW MANY POINTS ARE  
TO BE AVERAGED OVER: ?5

WHAT IS THE DESIRED LEVEL  
OF FIT (1,2,3,4,5): ?2

WHAT IS THE DESIRED  
DERIVATIVE (0,1,2,3): ?0

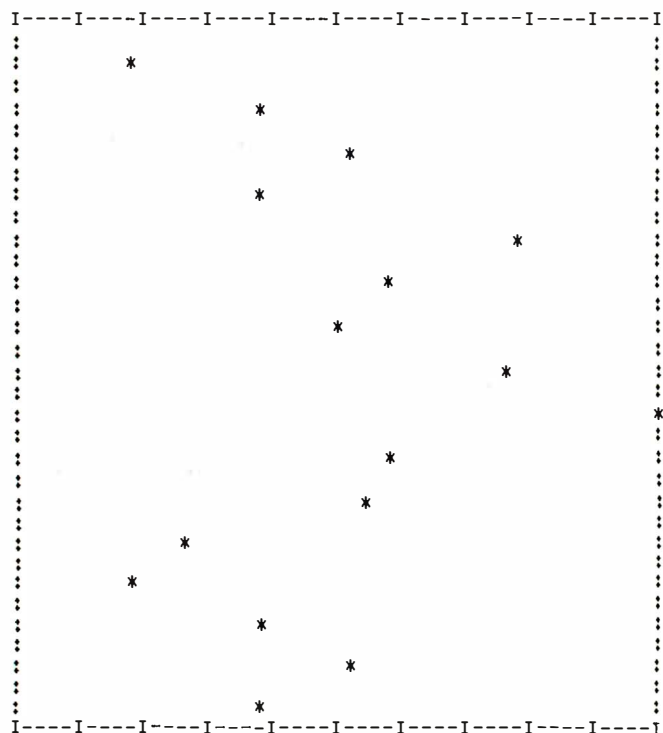
INPUT DATA AS PROMPTED:

```
1  ?1235
2  ?2408
3  ?3279
4  ?2421
5  ?4864
6  ?3629
7  ?3180
8  ?4744
9  ?6181
10 ?3653
11 ?3418
12 ?1722
13 ?1235
14 ?2408
15 ?3279
16 ?2421
```

INPUT DESIRED PLOT WIDTH: ?50

\*\*\*\*\* DATA PLOT (SCALED) \*\*\*\*\*

MAXIMUM VALUE= 6181



CONTINUE?Y

CALCULATING.....

THE SMOOTHED DATA IS:

```
1  1144.4
2  2509.7429
3  2725.5429
4  3450.3429
5  3883.1714
6  3906.4571
7  3468.6
8  4889.5429
9  5315.6286
10 4511.1714
11 2867.3714
12 1912.2
13 1441.8286
14 2362.1429
15 3142.4571
16 2093.7429
```

CONTINUE?Y

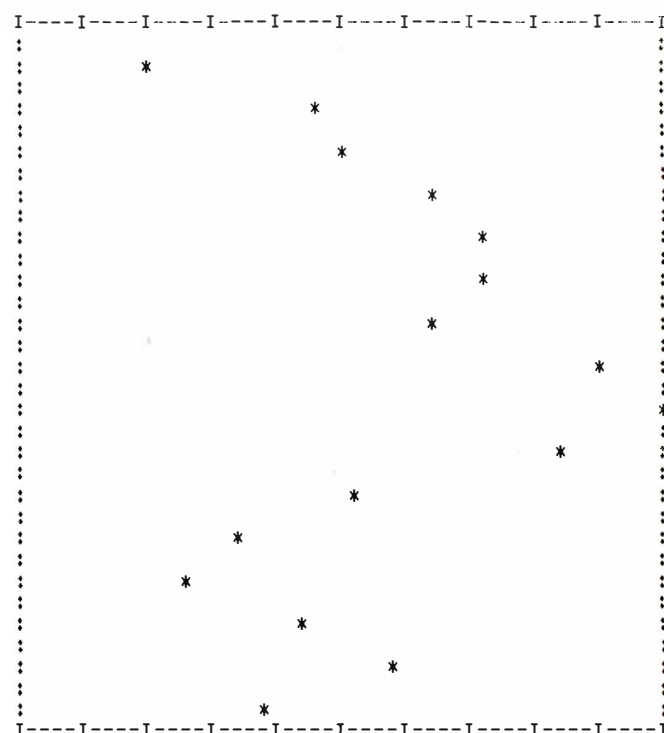
THE STANDARD DEVIATION  
BETWEEN THE SMOOTHED AND  
UNSMOOTHED DATA SETS IS 589.8642

CONTINUE?Y

INPUT DESIRED PLOT WIDTH: ?50

\*\*\*\*\* DATA PLOT (SCALED) \*\*\*\*\*

MAXIMUM VALUE= 5315.6286



CONTINUE?

# Stocking genuine DEC computer spares

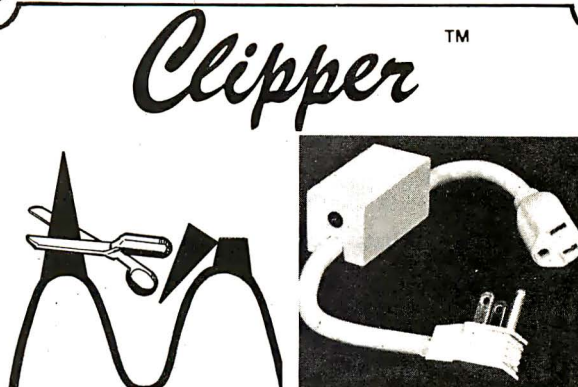
Spare Parts for:  
DEC PDP Computer Family  
DEC Line Printers  
DEC Video Screens  
LSI-11  
Others

Call Radgo. We handle genuine DEC parts manufactured by DIGITAL EQUIPMENT CORPORATION. We sell at factory prices with FACTORY WARRANTY. Radgo is stocked and staffed to help you with your requirements for most general purpose K & M series and many COMPUTER SPARE MODULES and COMPONENTS. We also stock a large assortment of COMPUTER SUPPLIES.

## Radgo Sales Co.

To order or for free catalog call:  
1-800-543-1986. Ohio customers phone  
1-513-752-6880.

3988 McMANN RD., CINCINNATI, OH 45245



## LINE VOLTAGE TRANSIENT CLIPPING

Features Parallel Operation 5000 Hits/Second

### PROTECTS:

- Computers
- Micro-Computer Systems
- Word Processors
- Cash Registers
- Power Supplies

### PROTECTS AGAINST:

- High Energy Voltage Transients
- On-Off Switching
- Lightning Induced Transients
- Inrush of On/Off Power

**DYMARC**  
INDUSTRIES, INC.

(formerly P D F)

7133 Rutherford Rd. Baltimore, Md. 21207  
(301) 298-3130 800-638-9098



## HARD DISK MULTIPLEXOR WITH 10 MEG HARD DISK FOR THE TRS-80\* Mod II

### NOW YOU CAN HAVE THAT LARGE COMMON DATA BASE!!

- Allows up to 4 Mod II's to connect to a single controller — up to 4 hard disk drives per controller. Users may access the same file simultaneously (first-come first-served).
- Uses Cameo controller and standard 10-megabyte cartridge (hard) disk drives along with RACET Hard/Soft Disk System (HSD) software.
- Access times 3 to 8 times faster than floppy. Mixed floppy/hard disk operation supported.
- Compatible with your existing TRSDOS programs! All BASIC statements are identical.
- A single file may be as large as one disk. Alternate mode allows 24-million byte record range. Directory expandable to handle thousands of files.
- Includes special utilities — backup and copies, HPURGE for multiple deletions, HDOS directory catalog system, and Hard Disk Superzap. FORMAT utility includes options for specifying sectors/track, platters/drive, logical disk size, etc.

**HARD DISK DRIVE & CONTROLLER \$5995 RACET HSD Software \$400**  
Call for multiuser pricing. Dealers call for OEM pricing.

**INFINITE BASIC (Mod I & III Tape or Disk) Mod I \$50.00, Mod III \$60.00**  
Extends Level II BASIC with complete MATRIX functions and 50 more string functions. Includes RACET machine language sorts! Sort 1000 elements in 9 seconds!! Select only functions you want to optimize memory usage.

**INFINITE BUSINESS (Requires Infinite BASIC) Mod I & III \$30.00**  
Complete printer pagination controls — auto headers, footers, page numbers. Packed decimal arithmetic — 127 digit accuracy +, -, \*, /. Binary search of sorted and unsorted arrays. Hash codes.

**BASIC CROSS REFERENCE UTILITY (Mod II 64K) \$50.00**  
SEEK and FIND functions for Variables, Line Numbers, Strings, Keywords. 'All' options available for line numbers and variables. Load from BASIC — Call with 'CTRL'R' Outout to screen or printer!

**DSM Mod I \$75.00, Mod II \$150.00, Mod III \$90.00**  
Disk Sort/Merge for RANDOM files. All machine language stand-alone package for sorting speed. Establish sort specification in simple BASIC command File. Execute from DOS. Only operator action to sort is to change diskettes when requested! Handles multiple diskette files! Super fast sort times — improved disk I/O times make this the fastest Disk Sort/Merge available on your TRS.

(Mod I Min 32K 2-drive system. Mod II 64K 1-drive. Mod III 32K 1-drive)

### ★ ★ NEW ★ ★ DISCAT (32K 1-drive Min)

This comprehensive Diskette Cataloging/Indexing utility allows the user to keep track of thousands of programs in a categorized library. Machine language program works with all TRSDOS and NEWDOS versions. Files include program names and extensions, program length, diskette numbers, front and back, and diskette free space.

### ★ ★ NEW ★ ★

**KFS-80 (1-drive 32K Min — Mod II 64K) Mod I, III \$100.00; Mod II \$175.00**  
The keyed file system provides keyed and sequential access to multiple files. Provides the programmer with a powerful disk handling facility for development of data base applications. Binary tree index system provides rapid access to file records.

### ★ ★ NEW ★ ★

**MAILLIST (1-drive 32K Min — Mod II 64K) Mod I, III \$75.00; Mod II \$150.00**  
This ISAM-based maillist minimizes disk access times. Four keys — no separate sorting. Supports 9-digit zip code and 3-digit state code. Up to 30 attributes. Mask and query selection. Record access times under 4 seconds!!

### ★ ★ NEW ★ ★ LPSPPOOL (32K 1-drive Min)

**Mod I \$75.00**  
LPSPPOOL — Add multi-tasking to permit concurrent printing while running your application program. The spooler and despooler obtain print jobs from queues maintained by the system as print files are generated. LPSPPOOL supports both parallel and serial printers.

### UTILITY PACKAGE (Mod II 64K)

**\$150.00**  
Important enhancements to the Mod II. The file recovery capabilities alone will pay for the package in even one application! Fully documented in 124 page manual! XHIT, XGAT, XCOPY and SUPERZAP are used to reconstruct or recover data from bad diskettes! XCOPY provides multi-file copies, 'Wild-card' mask select, absolute sector mode and other features. SUPERZAP allows examine/change any sector on diskette include track-0, and absolute disk backup/copy with I/O recovery. DCS builds consolidated directories from multiple diskettes into a single display or listing sorted by disk name or file name plus more. Change Disk ID with DISKID. XCREATE preallocates files and sets 'LOF' to end to speed disk accesses. DEBUGII adds single step, trace, subroutine calling, program looping, dynamic disassembly and more!!

### DEVELOPMENT PACKAGE (Mod II 64K)

**\$125.00**  
Includes RACET machine language SUPERZAP, Apparatus Disassembler, and Model II interface to the Microsoft 'Editor Assembler Plus' software package including uploading services and patches for Disk I/O.

CHECK, VISA, M/C, C.O.D., PURCHASE ORDER

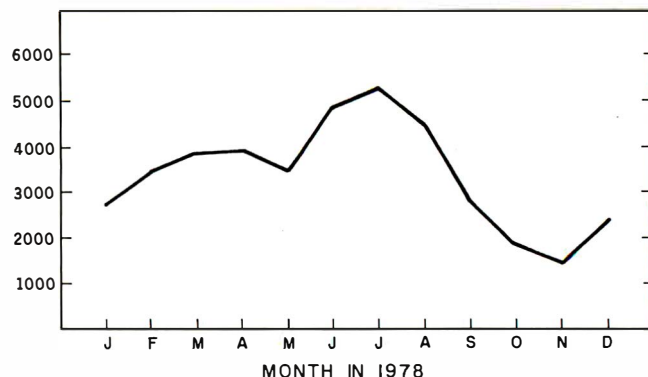
TELEPHONE ORDERS ACCEPTED (714) 637-5016

\* TRS-80 IS A REGISTERED TRADEMARK OF TANDY CORPORATION

**RACET COMPUTES**  
1330 N. Gissel, Suite 'M'  
Orange, CA 92665

Error Code	Explanation
0	No Error.
1	Number of data points to be averaged over is too small.
2	Number of data points to be averaged over is too large.
3	The order of the derivative is greater than the level of the fit, which gives a trivial (0) result.
4	The level of fit attempted is too high.
5	The order of the derivative attempted is too high.
6	The particular table required is not available in the program.
7	There is not enough data to do the smoothing requested.
8	An illegal or otherwise out-of-range parameter was given.

**Table 8:** Table of error codes returned by a call to the supervisor subroutine.



**Figure 5:** Chart of smoothed sample data using five-point parabolic smoothing. This chart is identical to the one plotted in listing 2.

Text continued from page 286:

would have been indicated according to the code in table 8.

As shown in listing 2, the program prompts for all the inputs. The user can then specify the plotting width for the terminal being used. Note that only absolute values are plotted. The program then performs the smoothing and calculates the standard deviation (when applicable).

Finally, the routine plots the smoothed data.

The smoothed data for the sales-volume example has been replotted as shown in figure 5. Observe that the first two and last two of the sixteen input values have been discarded. If a seven-point average had been used, three points on either side of the desired results would have been dropped. Comparing figure 5 with figure 2, we see that the five-point parabolic smoothing looks much more "reasonable" than the three-point and five-point linear smoothing. The peak in July is apparent, as well as the dips in May and November. Recalling that the nominal purpose of the example was to better predict the July sales volume, we find the value to be 5316 units, with a standard deviation of 590. We expect that the standard deviation will be lower for the parabolic fit than for the corresponding linear fit, and it is.

Discarding points at the ends of the smoothed data set is necessary. The smoothing at each position uses data on either side. At the extremes of the data set there is missing information. The program supplies values (eg: 0) for this missing data. In general, if the number of data points averaged over is  $N3$ , then the number of data points that should be discarded at either end of the data list is  $(N3-1)/2$ .

### Square-Wave Example

We will now look at the results of smoothing a very discontinuous function, the square wave. The purpose is to show the comparative effects of the various levels of fit on "smoothing" an abrupt transition.

## ELIMINATE INTERACTING FLOPPIES, PRINTERS

and processors with these AC power centers that have spike suppressors and filtered AC sockets.

8 sockets, 3 pairs individually filtered, spike suppression

MFJ-1107  
**\$69<sup>95</sup>**



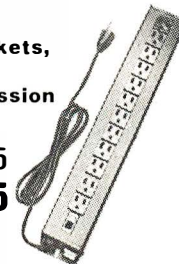
12 sockets, one filter for all, spike suppression

MFJ-1106  
**\$49<sup>95</sup>**



12 sockets, spike suppression

MFJ-1105  
**\$39<sup>95</sup>**



New MFJ multi-outlet AC power centers let you eliminate interaction of floppies, printers, memory, etc. caused by power line coupling, and eliminate power line spikes that can cause memory loss, errors, and erratic operation.

**MFJ-1107**, varistors (from each line to ground and line to line) suppress spikes.

**8 sockets (4 pairs)**, all 3-prong. RFI pi-filters on each line for each of 3 pairs of sockets isolate equipment from each other and power line. Fourth pair is unswitched/unisolated.

**Lighted power switch**. Pop-Out fuse. 3-wire 6 foot cord, 15A/125VAC. 1875 watts total.

**Rugged heavy-gauge aluminum case**. Black. Easy mounting slots. 18"L x 2-3/4"W x 1-7/8"H.

**MFJ-1106**, similar to 1107 but 12 sockets (2 unswitched), one filter for all, has spike protection, lighted switch, fuse.

section, lighted switch, fuse.

**MFJ-1105**, same as 1106, less RFI filter.

Order from MFJ and try it — no obligation. If not delighted, return it within 30 days for refund (less shipping). One year unconditional guarantee.

Order today. Call toll free 800-647-1800. Charge VISA, MC or mail check, money order for amount as indicated above plus \$4.00 shipping each.

Eliminate spikes and interaction, order now.

**CALL TOLL FREE ... 800-647-1800**

Call 601-323-5869 for technical information, order/repair status. Also call 601-323-5869 outside continental USA and in Mississippi.

**MFJ ENTERPRISES, INCORPORATED**

Box 494, Mississippi State, MS 39762

# NEVADA COBOL

## For CP/M

Powerful subset of ANSI-74

Why wait?  
All the elegant simplicity  
of COBOL is now affordable!

**\$99<sup>95</sup>**  
DISKETTE  
&  
MANUAL

**REQUIRES** only 16K RAM.  
Available on 8" CP/M  
standard single density or  
5¼" diskettes for North  
Star, TRS-80 Mod I and  
Superbrain. Other formats  
tool Manual alone \$24.95.

These powerful, easy to use  
**COBOL APPLICATION PACKAGES**  
are also available:

1. **BUDGET PLAN REPORT GENERATOR**  
Fantastic time saver and planning  
aid for beginning or established  
businesses.
2. **PERSONAL FINANCIAL REPORTING**  
Eye-opening insights of personal  
spending.
3. **LABELS** for mailing lists.
4. **PRECOCOL** (a preprocessor).

**ALL 4 in one BOOK!**  
73 pages with complete COBOL  
source code listings and super  
documentation.

**\$24<sup>95</sup>**

WE WELCOME C.O.D.'s



**(415) 751-1522**

**Ellis Computing**  
600-41st Avenue  
San Francisco, CA 94121  
U.S.A.

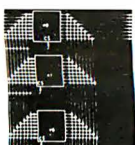
In CA add sales tax. CP/M trade mark of Digital Research. TRS-80 trade mark of Tandy Corp.

North Star® Disk System users:

# Run BASIC in timeshare mode for just \$150!

**NORTHSHARE®** Release 5 lets you connect up to  
8 terminals to your system! Each terminal shares  
the same copy of BASIC, but has its own program  
and data areas. More than one user can run BASIC  
simultaneously, but independently of other users.  
No additional memory needed! Present NORTH-  
SHARE users can upgrade for \$75. NORTHSHARE  
Release 5 is at your North Star dealer, or write us  
for a \$15 documentation package.

© North Star Computers, Inc. © Alpha-Omega Enterprises



**SILVERMAN  
ASSOCIATES**  
4010 Opal St., Oakland, CA 94609

TOLL FREE OUTSIDE CAL. 1(800)421-0347, 1(800)423-5886

Order from  
the No 1 Dealer  
in the Country!  
**TOLL FREE**  
1(800) 421-0347

**C-commodore**

Call for latest price on:



CBM 8000  
Business computer  
CBM 2001  
Business computer  
CBM 2001  
PET  
CBM 2022  
Printer  
CBM 2023  
Printer  
CBM2040  
Dual Drive  
Floppy Disk  
CBM 8050  
Dual Drive  
Floppy Disk

CBM Modem  
(300 Baud)  
CBM Voice  
Synthesizer



Here is THE computer from NEC.  
Centronics and RS232 interfaces are  
standard. Up to 64 K (RAM). SEND FOR  
PRICE AND INFO., OR CALL TOLL FREE!

## monitors

9" Black and white. Only \$185.

Also available in Sanyo

12" Black and white.

15" Black and white.

## TRS-80\*

All TRS-80 Compatible Hardware  
and Software. Call us and tell us what  
you need! TRS-80 is a trademark of Tandy Corp.

print wheels and thimbles

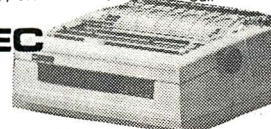
Huge selection for Qume, Diablo,  
NEC. Plastic or metal.  
Call 1-800-421-0347.

## apple cards

Hi-Speed Serial Interface  
Communications Interface  
Parallel Printer Interface  
Centronics Printer Interface  
Hobby/Prototype  
Integer Basic Firmware  
Applesoft Firmware

Call  
Call  
Call  
Call  
Call  
Call  
Call

## NEC



Letter quality high speed printer, bi-  
directional, high resolution plot-  
ting, graphics.

RO with Tractor Feed **\$2865.**

KSR with Tractor Feed **\$2995.**

**Paper Tiger (1P440) \$949.**

With Graphics

**Anadex DP9500 \$1449**

**DP8000 \$849.**

**Epson MX 80 \$645.**



**DATA SYSTEMS**  
Smart Video Terminal

**\$795**



The HP-85 is a powerful  
BASIC language computer  
complete with keyboard,  
CRT display, printer, and  
tape drive—all in one com-  
pact unit. Call

**16K RAM**  
Set of 8 **\$39.95**

VISA

MasterCard

Prices subject to change without  
notice. Please allow ample time for  
checks to clear. Please add 2% for  
shipping and handling. California  
residents please add 6% sales tax.  
Sorry, no COD.

Copyright 1980 MICRO Business World

## \* apple II

## inventory control system

The first truly professional system  
that can tackle up to 8,100 items,  
transaction register/audit trail, in-  
ventory status report, re-order  
report, keeps track of purchase  
orders automatically, will handle  
multiple departments or divisions,  
fast data retrieval. Minimum hard-  
ware requirements: Apple II Plus  
with 48K, one disk drive and 80  
column printer. Available also for  
the new DOS 3.3.

## dysan diskettes



8" (Box of 10)  
3740/1 sgl side/sgl density **\$4.50 ea.**  
3740/1D sgl side/dbl den **\$6.95 ea.**  
5" (Box of 5)  
104/1 soft sector, **\$4.50 ea.**  
107/1 10 sectors,  
105/1 16 sectors



Micromodem 100 Call  
Micromodem II Only \$325

In California Call (213) 996-2252



**MICRO  
BUSINESS WORLD™**  
15818 Hawthorne Blvd.,  
Lawndale, CA 90260

Immediate response to your orders

U.S. and International Dealer  
inquiries invited.

## Using a computer, the mechanics of data smoothing can be made fairly simple.

To electrical engineers, the multipoint averaging technique presented in this discussion is the equivalent of *nonrecursive digital filtering*. The way in which the calculation is applied is identical to *convolution*. According to one of the important theorems of Fourier transform theory, performing a discrete convolution on a "signal" (the data) is the same as frequency filtering. The shape of the frequency filter is simply the discrete Fourier transform of the weighting function.

Thus, every table of weighting coefficients can be converted to a corresponding set of filter coefficients. Usually, in electrical engineering one chooses the frequency filter response and *then* finds the convolution (ie: weighting) coefficients. In our case, we chose our coefficients according to a least-squares curve-fitting criterion first. However, the idea of frequency filtering is still valid.

The square wave is built of many spatial-frequency components. Filtering out some of the high-frequency components results in a less-than-abrupt square-wave transition. Figure 6a on page 294 shows the square-wave input data that was provided as an example to the program. The square wave is 1 unit high and 18 units wide. For clarity, lines have been drawn between the points plotted by the computer.

Figure 6b shows the effect of applying a linear (first level fit, zeroth-order derivative) smoothing using nine averaging points. The effect is simple. Applying a parabolic fit leads to a more curious form. (See figure 6c.) The dashed parts of the "curve" indicate negative values. The overshoot effect is called *ringing*.

Going one step further and applying a quartic (fourth-order polynomial) smoothing, we get figure 6d. Note that the ringing has increased, but the standard deviation between the square wave and the quartic smooth version has decreased relative to the parabolic or linear case. There is more ringing but a better fit. The overshoot effect is related to the *Gibbs phenomenon*, which is a nonuniform convergence problem in Fourier transform theory.

The square wave may also be used to demonstrate derivative smoothing. (See figures 7a and 7b on page 298.) It might be argued that these curves are not very smooth: however, remember that the unsmoothed derivative is an infinite spike!

Figure 7a calls attention to an important point regarding derivatives. From figure 6b, we might have expected the linear smoothing of the first derivative to be just a step from 0 to 1/9 and back to 0 again, since the linearly smoothed function has a constant slope ramp on one side. However, the result shown in figure 7a resembles a parabola. The reason for the difference is that the derivative is not derived from the smoothed data. Rather, at each data point the derivative of the curve fitted over the nine-point interval surrounding that position is used. This is *not* the same as the slope between neighboring smoothed data points, a very important conceptual difference.

As you might expect, the situation for the second and third derivatives is even more complicated. Examination of those forms is left to you.

### Conclusion

As indicated earlier, the mechanics of data smoothing can be made fairly simple given a computer that can execute the program provided. Running the program is easy. Choosing the appropriate fitting parameters and applying the results is much more difficult. The two main choices for fitting are the averaging range and the level of fit. The averaging range should be chosen based on an idea of the *true* correlation between the data points. If changes over a range of  $N/3$  are *not* expected, then an averaging range of that size is warranted.

Choosing the level of fit is more difficult. In the sales-volume example, the parabolic fit appeared better than the corresponding linear fit. However, that is a subjective judgment based largely on the feeling that the peak and two major dips observed in the data should appear in the smoothed curve. There is still no replacement for common sense! ■

### REFERENCES

1. Savitzky A, and M J E Golay. "Smoothing and Differentiation of Data by Simplified Least Squares Procedures." *Analytical Chemistry*, Volume 36, Number 8, July 1964.
2. Wesolowsky, G O. *Multiple Regression and Analysis of Variance*. New York: Wiley Interscience, 1976.
3. Weast, R C and S M Selby. *Handbook of Tables for Mathematics, Third Edition*. Cleveland OH: Chemical Rubber Company, 1967.

# SYNCHRO-SOUND



**SOROC Technology**

1Q 120 \$699.  
1Q 140 \$999.



**ADDS**

Regent 25 \$795.



**TELEVIDEO**

912 \$825.  
920 \$895.  
950 \$1195.



**TELETYPE**

43 \$995.

**We carry a full line of: ADDS, LEAR-SIEGLER, HAZELTINE, QUME, TELETYPE, DEC, FLORIDA DATA SYSTEMS, TEXAS INSTRUMENTS**



**SYNCHRO-SOUND**

The Computer People

193-25 Jamaica Avenue  
Jamaica, N.Y. 11423

ENTERPRISES, INC.

PHONE ORDERS, CALL:

New York — 212/468-7067

Toll Free

800-221-2320

## Save on Calculators

Model	Retail	Your Cost
New HP-41CV 2.2K bytes, 4 mem. modules built-in, slanted keyboard	\$325.00	\$239.95
System One, HP41CV & Card Reader	495.00	394.95
System Two, HP41CV-Card Reader & Printer	840.00	669.95
Card reader for 41C/41CV	215.00	169.95
Printer for 41C/41CV	385.00	289.95
HP 41C new price	250.00	189.95
Quad Ram to upgrade the HP41C to 2.2K bytes leaving 3 ports...Plugs into the 41C	95.00	84.95
Optical Wand for 41C/41CV	125.00	109.95
Memory Modules for 41C/41CV	39.50	27.95
HP-34C Scientific	150.00	119.95
HP-38C Bus/R.E.	150.00	119.95
HP-33C Scientific	90.00	78.95
HP-32E Adv. Scientific	55.00	49.95
HP-37E Bus Calc.	75.00	63.95
HP-67 Programmable Sci.	375.00	299.95
HP-97 Prog. Printer Sci.	750.00	579.95
HP-85 Computer	3250.00	2495.00
New HP-83 Computer, similar to HP-85 without printer & cassette	2250.00	1795.00

**hp HEWLETT PACKARD**

Olympic Sales is an HP franchised dealer.

Call us for the best deal.

"C" stands for continuous memory.

One year guarantee by HP on all calcs, 90 days on computers. All units complete.



## Texas Instruments

Ask about special rebate on some TI calculators and free software on TI-59.

TI-99/4 Computer Console	\$469.95	Speak and Read	74.95
TI-59	199.95	Speak and Math	67.95
TI-58C	89.95	Language Tutor (Speaks)	129.95
TI-57	49.95	Language Teacher	72.95
PC 100C	159.95	Invest Analyst	48.95
TI-5230 printer (was \$495.)	189.95	Bus Analyst II	43.95
TI-55	35.95	TI Programmer	48.95
TI-50	35.95	TI-5040 Printer	74.95
Speak and Spell	58.95	Ask about the new line of TI plain paper printers at new low costs.	



## SPECIALS Computers at unbeatable prices

APPLE II and APPLE III

Huge inventory of Apple II computers. 16K-32K-48K. Disk drives, monitors, 80 column card. Dow Jones & Quote Reporter.

Pascal-Fortran-DOS 3.3, etc. You name it...we've got it at super low prices.

Immediate delivery on Apple III computers 96K and 128K systems. Call us!

SCM Typewriters • 320 models Seiko watches • Royal • Victor • Canon • Sharp • Casio and more.

Prices f.o.b. L.A. Minimum freight & handling charge—\$4.95. In CA, add 6% sales tax. Goods subject to availability. We'll beat any advertised price if competitor has goods on hand.

Call Mon-Sat 7AM-6PM.  
Outside CA, toll free 800-421-8045  
Inside CA, toll free 800-252-2153

**OLYMPIC SALES COMPANY, INC.**

216 South Oxford Ave. • P.O. Box 74545 • Los Angeles, CA 90004 • (213) 381-3911  
Order Desk (213) 739-1130 • Customer Service (213) 739-1100 • Telex 67-3477

## MAIL ORDER DISCOUNTS

**apple computer**  
Sales and Service

**APPLE II PLUS 48K**

**\$1,175**



**APPLE III CALL FOR PRICES**

### ACCESSORIES

DISK II DRIVE & CONTROLLER (DOS 3.3)	525	MICROSOFT Z-80 SOFTCARD SYSTEM	290
DISK II DRIVE ONLY	445	VIDEX 80 COLUMN BOARD	
INTEGER BASIC FIRMWARE CARD	149	W/GRAPHICS AND SWITCH	350
APPLESOFT II FIRMWARE CARD	149	HAYES MICROMODEM II	325
M&R SUP-R-MOD RF MODULATOR	30	SILENTYPE PRINTER W/INT. CARD	535
CENTRONICS PRINTER INTERFACE CARD	179	LANGUAGE SYSTEM W/PASCAL	395
HIGH-SPEED SERIAL INTERFACE CARD	139	GRAPHICS TABLET	649
SSM AIO SERIAL/PARALLEL I/O CARD	169	LEDEX 12" B&W MONITOR & CABLE	149

### SOFTWARE

APPLE DOS TOOLKIT	65	THE CONTROLLER BUSINESS SYSTEM	515
APPLEPLOT GRAPH & PLOT SYSTEM	60	APPLE FORTRAN	59
VISICALC	115	APPLEWRITER TEXT EDITOR	59
DESKTOP PLAN	79	BASF 5 1/4" DISKETTE (10)	30
CCA DATA MANAGEMENT	85	VINYL DISKETTE HOLDER PAGE (10)	8

### CALL FOR PRICES AND SELECTIONS OF PRINTERS AND MONITORS

TO ORDER: Please phone using VISA, Master Card and American Express. Or send cashier's check, money order or personal check (allow 10 business days to clear). VISA and MC credit card service add 2%. AE credit card service add 5%. Shipping, handling and insurance in U.S. add 3% (minimum \$3). California residents add 6% sales tax. Foreign orders add 10% for shipping. Equipment is subject to price change and availability. All equipment carries factory warranty.

**computer age, inc.**

Authorized Apple Dealer & Service Center

4688 CONVOY ST., SUITE 105, SAN DIEGO, CA 92111 (714) 565-4062

**Combine accurate flight characteristics with the best in animation graphics and you'll have SubLOGIC's**

# A2-FS1 Flight Simulator

for the Apple II *on cassette or disk!*

SubLOGIC's A2-FS1 is the smooth, realistic simulator that gives you a real-time, 3-D, out-of-the-cockpit view of flight.

Thanks to fast animation and accurate representation of flight, the non-pilot can now learn basic flight control, including take-offs and landings! And experienced pilots will recognize how thoroughly they can explore the aircraft's characteristics.

Once you've acquired flight proficiency, you can engage in the exciting British Ace 3-D Aerial Battle Game included in the package. Destroy the enemy's fuel depot while evading enemy fighters.

Computer and aviation experts call the A2-FS1 a marvel of modern technology. You'll simply call it *fantastic!*

### Special Features:

- 3 frame-per-second flicker free animation
- Keyboard or joystick input

**\$25<sup>00</sup>**

on cassette, usable on all systems (16K memory required)

**\$33<sup>50</sup>**

on disk, usable on DOS 3.2, DOS 3.3, or Language System (32K memory required)

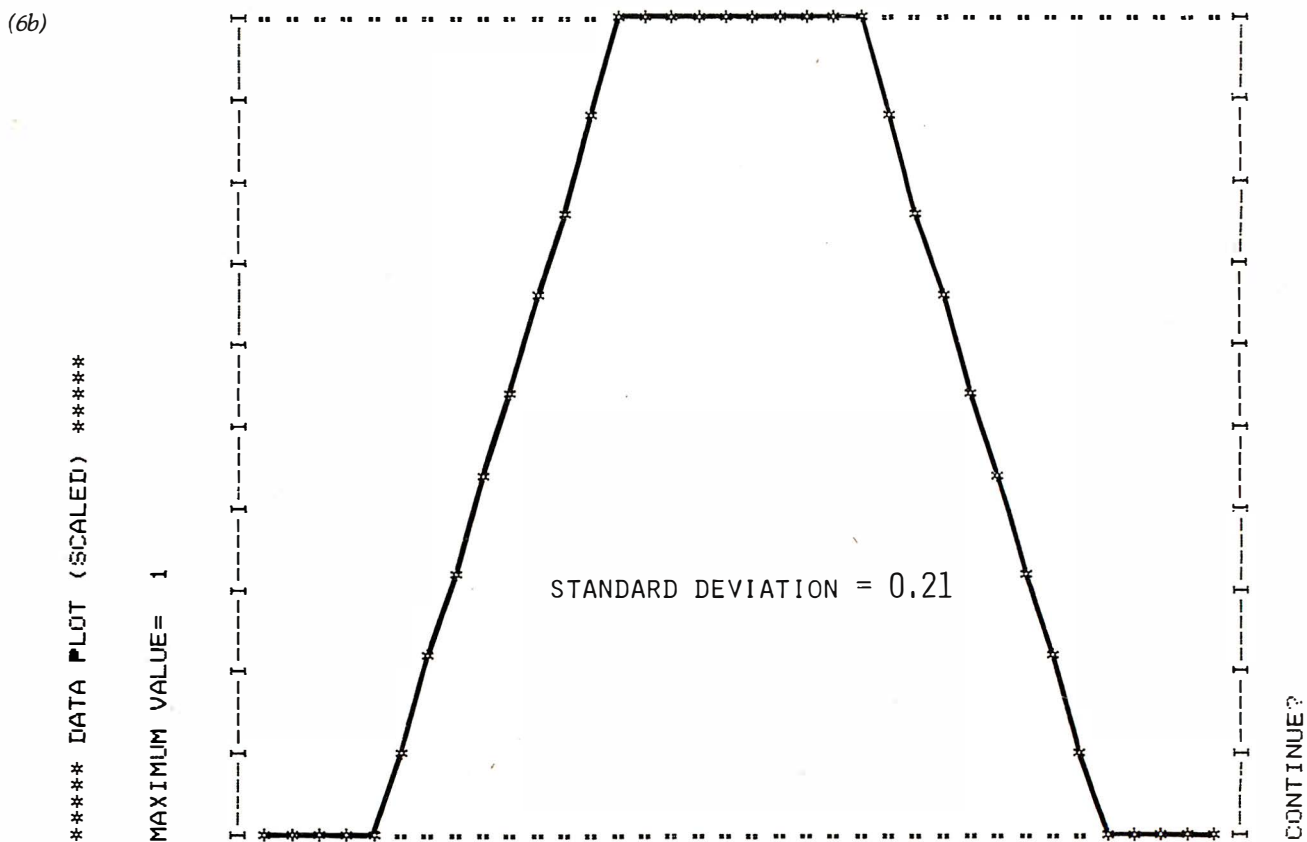
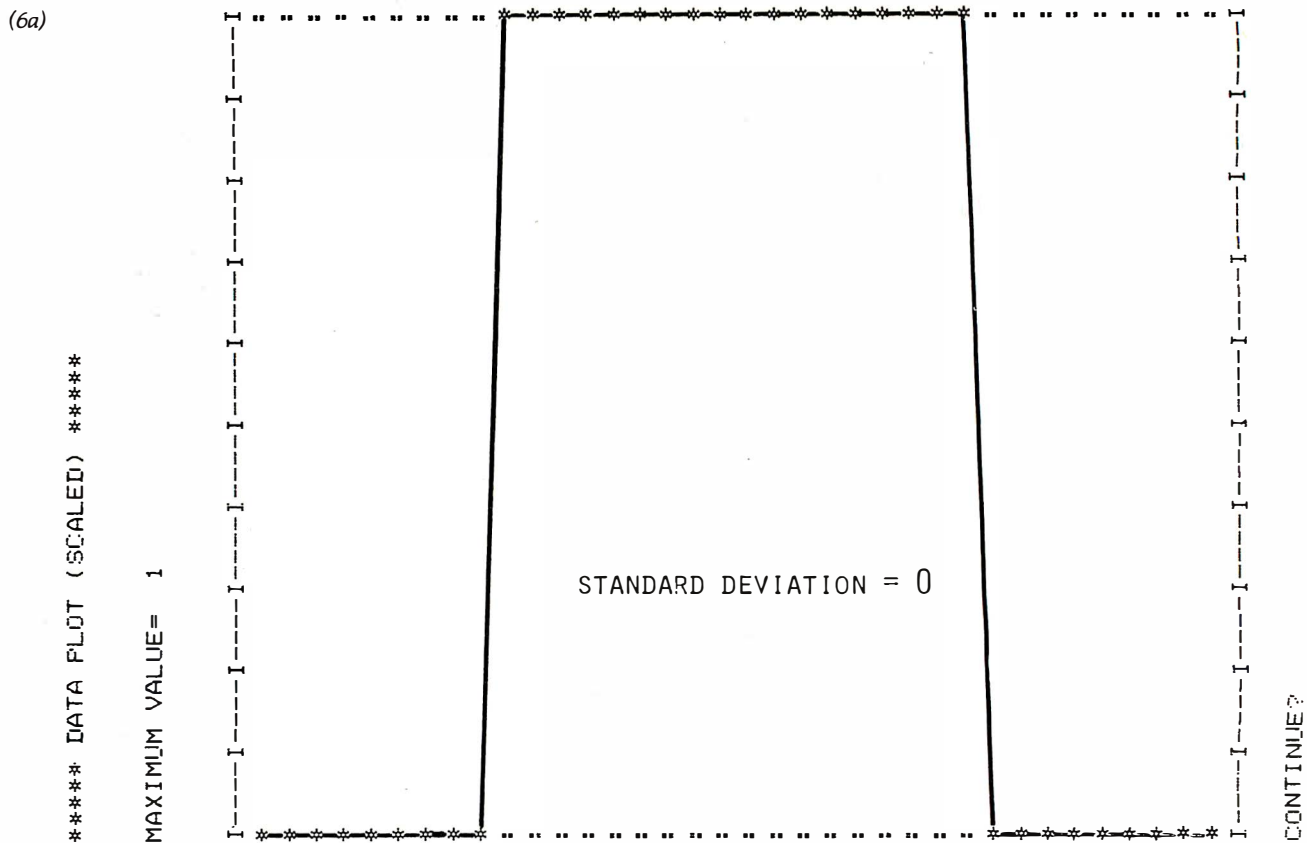
See your dealer or order direct. For direct order, include \$1.25 and specify UPS or first class mail. Illinois residents add 5% sales tax. Visa and Mastercard accepted.

Present cassette users may send back their cassette (but not the manual), along with \$10 (first class shipping included), and receive the disk version.



**subLOGIC**

Communications Corp.  
Box V, Savoy, IL 61874  
(217) 359-8482  
Telex: 206995



**Figure 6:** Smoothing a square wave. The test square wave in figure 6a was smoothed in figures 6b thru 6d using a nine-point average. Figure 6b shows a linear smoothing. Figure 6c shows the results of a parabolic smoothing with a cubic smoothing giving the same results. Figure 6d shows the results of a quartic and quintic smoothing. In all figures, dashed lines denote negative values plotted here as positive. These figures and those of figure 7 were generated using the program given in listing 1.

Why buy used or obsolete boards, when you can purchase new IEEE standard current designs at

## Spectacular Savings!

ALL GODBOUT  
ELECTRONICS  
FACTORY ASSEMBLED  
& TESTED BOARDS

**20%** OFF LIST

We carry the largest variety of S-100 products in the world. For a special cash price please call.

For our 1981 Catalog, please write

Subject to available quantities. Shipping and insurance extra. VISA and Master Charge accepted at no additional charge for orders over \$500.00.

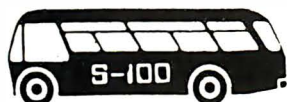
**S-100, inc.**

7 White Place

Clark, N.J. 07066

201-382-1318

Hours: Mon.-Fri. 10 a.m. to 6 p.m.



## THE FORTH SOURCE

Specializing in printed material for the FORTH language. Send for listing of current material.

Installation Manual	\$10.00
8080 Listing	\$10.00
6502 Listing	\$10.00
6800 Listing	\$10.00
6809 Listing	\$10.00
PDP-11 Listing	\$10.00
more	

Using FORTH, Manual	\$25.00
PDP-11 User's Guide	\$20.00
Kitt Peak Primer	\$25.00
more	

Dealer Inquiries Invited.

Write for complete listing of FORTH material.

**MOUNTAIN VIEW PRESS**

**PO Box 4656**

**Mt. View, CA 94040**

# Anti-Static Dust Covers

Protect your computer and accessories.

- Anti-static vinyl helps prevent static from damaging sensitive components and causing faulty operation.
- Double-fold stitching will not rip out and is unmatched for strength and long life.
- Heavy gauge textured vinyl blends with any decor and folds easily for convenient storage.
- Over 1000 custom designs guaranteed to fit precisely.
- 100% satisfaction guarantee means we stand behind our product.

Yes, there are differences in Dust Covers. Differences which can be vitally important to the proper functioning of your system.

At Cover Craft we've manufactured the highest quality Dust Covers for the electronics industry for more than six years. We've been selected by major equipment manufacturers to make covers for their products. Our covers are in use in every state and in more than 50 countries. We know what it takes!



THE BEST  
DUST COVERS  
AT ANY PRICE

MOST PRICED  
\$7.95 to \$11.95  
PLUS POSTAGE AND  
HANDLING  
VISA-MasterCharge

So visit your dealer or contact Cover Craft for our latest catalog and list of over 200 dealers.



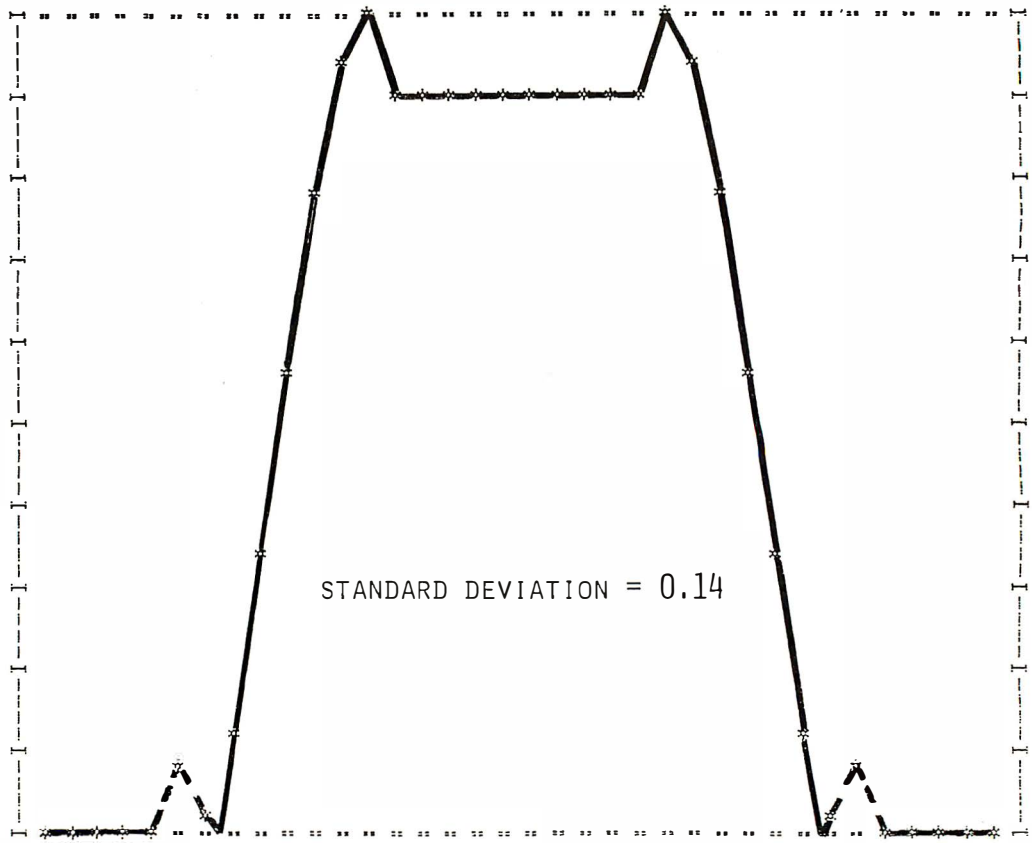
**COVER CRAFT**

P.O. BOX 555 • AMHERST, NH 03031 • (603) 889-6811

(6c)

\*\*\*\*\* DATA PLOT (SCALED) \*\*\*\*\*

MAXIMUM VALUE= 1.0909091

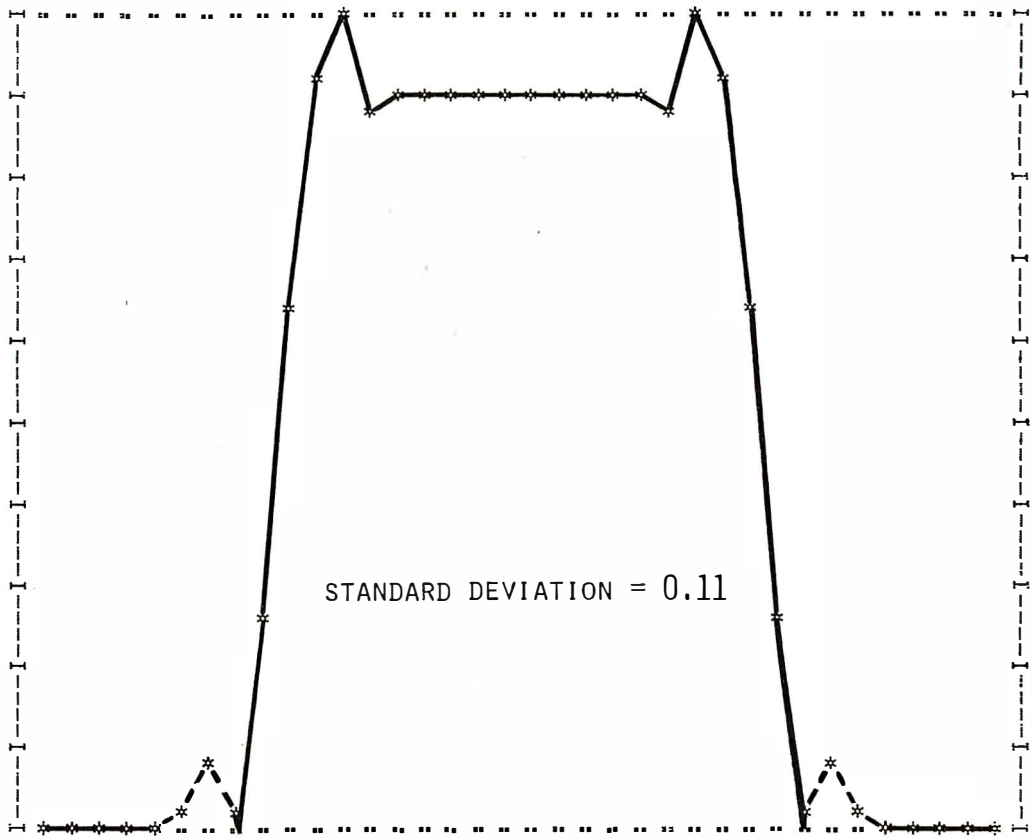


CONTINUE?

(6d)

\*\*\*\*\* DATA PLOT (SCALED) \*\*\*\*\*

MAXIMUM VALUE= 1.0932401



CONTINUE?

# DISCOUNT PRICES

## APPLE II COMPUTERS

16K APPLE II	1089.00
32K APPLE II	1134.00
48K APPLE II	1179.00
DISK W CONTROLLER	545.00
DISK ONLY	450.00
APPLESOFT CARD	159.00
INTEGER CARD	159.00
PASCAL SYSTEM	425.00
SILENTYPE PRINTER	525.00

### RAM MEMORY

FOR TRS-80, APPLE II  
16K SET 4116's 45.00



## NORTH STAR COMPUTERS



HRZ-1D-32K-ASM	2125.00
HRZ-2D-32K-ASM	2475.00
HRZ-1Q-32K-ASM	2375.00
HRZ-2Q-32K-ASM	2990.00

### VERBATIM DISKETTES

BOX OF 10 5 1/4"	29.50
BOX OF 10 8"	39.50

## FREDERICK COMPUTER PRODUCTS

MUNICIPAL AIRPORT  
FREDERICK, MD. 21701  
(301) 694-8884

\*\*\*\*\* ATTENTION \*\*\*\*\*  
\* CENTRONICS 737 \*  
\* LINE PRINTER IV \*  
\*\*\*\*\* OWNERS \*\*\*\*\*

Cognitive Systems is proud to announce Justex 3.1 -- a sophisticated printer driver designed exclusively for the Centronics model 737 dot matrix printer. Justex 3.1 is a highly optimized Z-80 machine language program occupying only 2k of memory. When combined with existing word processors, it allows full utilization of the 737's many features. These are some of the many features available with this program:

- 1) 1, 1/2, or 2 spaces between lines like a typewriter
- 2) Optional right and left justification
- 3) Adjustable spacing between words
- 4) Use of the 737's N x 9 serif character set
- 5) Sophisticated underline feature
- 6) Easy to use subscripting and superscripting
- 7) Normal and elongated text on the same page
- 8) Special columnar mode, which allows adjustment of spacing between columns without changing the text
- 9) Optional line numbering for legal work
- 9) Full control over print wheel allows two column 'newsletter-style' text to be easily printed

Justex 3.1 is currently available in ready to run form for TRS-80 Mod. I Disk systems using Scripsit for \$24.95 with the instruction manual selling for \$9.95. Users with other Z-80/8080 based computers can purchase the commented source code for \$19.95. CP/M users or TRS-80 owners using other word processors are asked to write for more information. This ad was printed using Justex. Readers are invited to circle the reader service # or write directly for more samples.

send check or money order to ...  
COGNITIVE SYSTEMS  
350 Mira Loma Lane  
Escondido, CA 92025  
(Dealer inquiries also welcome.)



\* TRS-80 & Scripsit TM Tandy Corp. -- CP/M TM Digital Research  
All orders + \$2.50 postage/handling - CA residents add 6%

# Tips For Your Chips

Get the maximum use and enjoyment from your micro with these popular paperbacks

## DATA FILE PROGRAMMING IN BASIC

LeRoy Finkel & Jerald R. Brown

With your own microcomputer, minimal knowledge of BASIC, and this easy-to-use guide, you can learn how to use data files to keep track of billings, customer inventory, and expenses, maintain mailing lists, process numerical and statistical information, and much more. Sample programs and lots of practical advice assist you every step of the way. The guide uses the most popular variants of BASIC, TRS-80 BASIC and Microsoft BASIC-80. An extensive appendix covers BASIC for the Northstar computer.

0 471 08333-X March 1981  
approx. 320 pp. \$9.95 (tent.)

Look for these and other STGs at your favorite bookstore or computer shop. For more information, and a complete listing of current and forthcoming STGs, write to Pam Byers, Dept. 7497.

Files, fun, and fancy functions plus practical applications

## MORE TRS-80 BASIC™

Don Inman, Ramon Zamora & Bob Albrecht

This exciting new interactive guide to programming in TRS-80 Level II BASIC teaches scores of practical applications—both recreational and educational. You'll get a clear demonstration of different methods to display graphics; files handling techniques applied to both cassette and disk files; plus animation, games, and fun.

0 471 08010-1 April 1981  
approx. 300 pp. \$8.95 (tent.)

Get maximum power from your micro by using assembly language

## INTRODUCTION TO 8080/8085 ASSEMBLY LANGUAGE PROGRAMMING

Judi Fernandez & Ruth Ashley

Use your microcomputer to write fast, sophisticated, complex programs with the help of this guide, the only self-instructional book of its kind. You'll learn what machine language is, how to perform routine operations, input/output, conditional commands, machine language logic, stack routines, and more. Sample programs illustrate every technique and concept.

0 471 08009-8 April 1981  
approx. 300 pp. \$8.95

**Wiley Self-Teaching Guides also teach BASIC, COBOL, FORTRAN, Job Control Language, Flowcharting, and other computer skills.**

How to perform complex, sophisticated operations with your micro

## 8080/Z80 ASSEMBLY LANGUAGE Techniques For Improved Programming

Alan R. Miller

Now advanced and intermediate programmers can get the most response their micro is capable of generating with the help of this complete guide to programming the 8080 and Z80 microprocessors. Learn assembly language swiftly and easily by developing a powerful system monitor in a step-by-step, top-down approach. Ten indispensable appendices contain all the necessary material to write 8080 or Z80 assembly language programs.

0 471 08124-8 Jan. 1981  
approx. 224 pp. \$9.95

Implement all functions provided by CP/M with this working tool

## USING CP/M®

Judi N. Fernandez & Ruth Ashley

A complete, detailed introduction to the use of the Control Program/Microcomputers software package for maximum capability and efficiency with any hardware.

"A marvelous addition to the CP/M literature... I only wish that I had had the book when I was starting out!"

—Alan R. Miller, *New Mexico Tech & Software Editor, Interface Age*  
0 471 08011-X 1980 243 pp. \$8.95



JOHN WILEY & SONS, Inc.

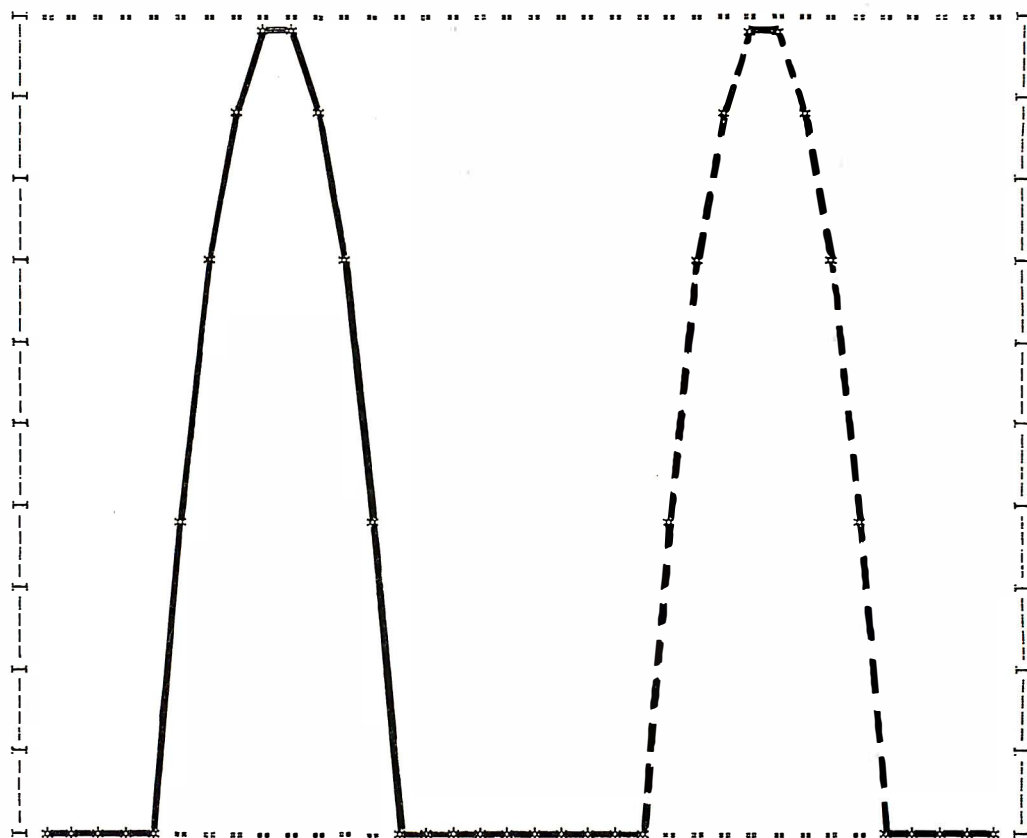
605 Third Avenue  
New York, NY 10158  
In Canada: 22 Worcester Road,  
Rexdale, Ontario

Prices subject to change without notice.

(7a)

\*\*\*\*\* DATA PLOT (SCALED) \*\*\*\*\*

MAXIMUM VALUE= .16666667

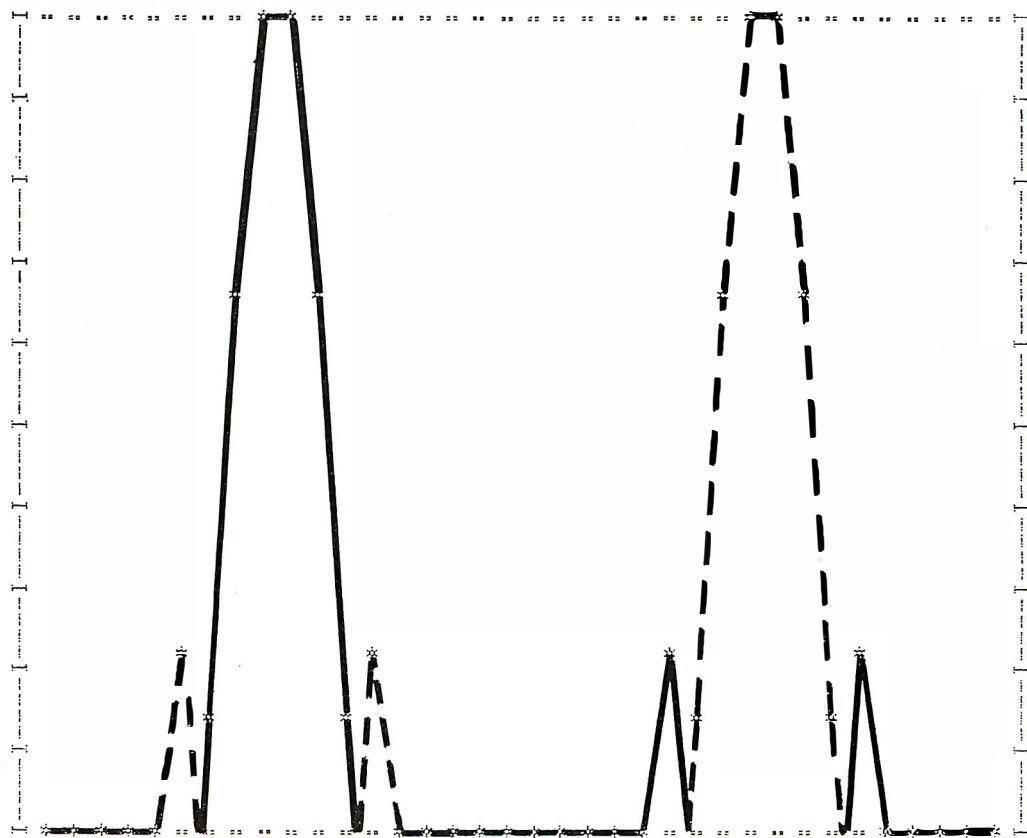


CONTINUE?

(7b)

\*\*\*\*\* DATA PLOT (SCALED) \*\*\*\*\*

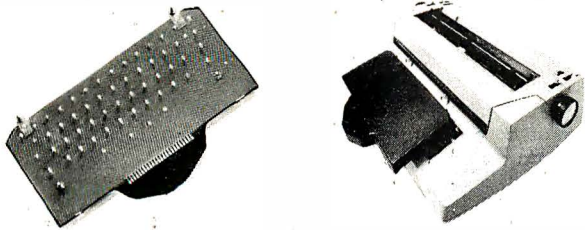
MAXIMUM VALUE= .31565657



CONTINUE?

Figure 7: Least-squares smoothed (nine-point) first derivatives of the square wave shown in figure 6a. Figure 7a shows the result for a linear and a parabolic first-derivative smoothing. (Both are the same.) Figure 7b shows the result for a cubic and quartic first-derivative smoothing.

## At last --- the **DYNATYPER** TYPEWRITER INTERFACE!™



**Turn your electric typewriter into a low cost, high quality hard copy printer. 1 year warranty**

**DYNATYPER** - Rochester Data's patented\* Computer/Typewriter Interface is the industry standard for typewriter output.

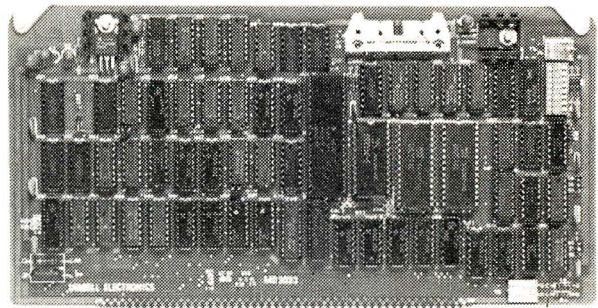
- 2 minutes to initially install and 5 seconds to remove or replace.
- You do not have to modify your typewriter. All factory warranties and maintenance agreements on your typewriter will be honored.
- Compatible with all power carriage return typewriters having standard U.S. keyboard. The Dynatyper works with Selectrics (model 1) and most non-Selectrics (model 2). Please specify. Typewriter conversion between models takes 2 minutes and the kit (17 plungers) is available for a nominal fee.
- The Dynatyper is compatible with all major word processing software. (Scripsit, Pencil, Applewriter, Easywriter, Magic Window, Visi-calc CCADBM, Supertext, Write On)
- Interfaces available for TRS-80, APPLE, PET/CBM, OSI, Northstar, HP-85, H-89. Weighs only 3 lbs. Extremely portable.
- Delivery: Stock to two weeks. Price \$499 for complete system. F.O.B. Rochester, Domestic. VISA and Master Card accepted. Call Ken Yanicky at 716-244-7804

\*Pat. Pending

**ROCHESTER DATA**

TM is a registered trademark of Rochester Data incorporated  
3000 Winton Road South, Rochester, N.Y. 14623

## NEW TARBELL S-100 CPU/IO BOARD



- Z-80\*\* will run at 2 or 4 Mhz
- 2 RS-232 Serial I/O ports
- Powerful Memory Management
- Programmable Timer
- Full masked priority interrupts
- Has everything needed for MP/M\*\*
- 6 month full warranty

Z-80 is a trademark of Zilog Inc.

MP/M is a trademark of Digital Research

*Tarbell*  
Electronics

950 Dovlen Place, Suite B  
Carson, CA 90746  
Phone (213) 538-4251

## From *Ballet on Broadway* to *Billiards in Dallas...*

... people are finding unique ways to use the Powerful SciTronics REMOTE CONTROLLER



*Whether it's the intricate lighting for a Broadway Ballet or the simple remote lighting of pool tables in a Dallas billiards hall, people are finding out SciTronics Remote Controller can meet their needs.*

### Here's Why:

- ☒ Controls 256 BSR remote switches—not just 16
- ☒ Hardware driven—requires minimum software
- ☒ No ultrasonic link—prevents erratic operation
- ☒ No BSR command module necessary

S-100 CONTROLLER BOARD	<b>\$159.</b>
S-100 REAL TIME CLOCK BOARD	<b>\$159.</b>
ENCASED CONTROLLER (TRS-80, Apple II etc.)	<b>\$184.</b>
ENCASED CONTROLLER & REAL TIME CLOCK (TRS-80, Apple II etc)	<b>\$269.</b>
APPLE II CLOCK BOARD	<b>\$129.</b>

### Real Time Clock gives Remote Controller an added dimension!

Real Time Clocks are now available to make your remote controller even more powerful. The RTC feature allows for energy consumption scheduling, event scheduling and much more. Your imagination is your only limitation when it comes to the ways which this RC/RTC combination can be used.

### Real Time Clocks feature:

- ☒ Lithium battery back-up
- ☒ Crystal controlled accuracy (.002%)
- ☒ Clock generates interrupts (seconds, minutes, hours) for foreground/background operation
- ☒ Complete software in BASIC to Set and Read clock

Send check

or money

order to:

### SciTronics Inc.

523 S. Clewell St., P.O. Box 5344  
Bethlehem, PA 18015  
(215) 868-7220

Please list system with which you plan to use peripheral. Master Charge and Visa accepted. PA residents add sales tax. COD's accepted.

# The New Literacy:

## Programming Languages as Languages

---

*"To be a good programmer today is as much a privilege as it was to be a literate man in the sixteenth century."*

*Andrei Ershov, USSR Academy of Sciences, Novosibirsk University*

---

Many people would declare that Ershov is making an incongruous comparison: he compares the ability to read, a universally desirable trait, with the ability to program a computer, which fewer people deem to be a desirable trait. Stranger still, he compares reading, which is linked with the appreciation of literature and with the artistic use of language, to programming. Programming is the recording of arcane codes that make a computer perform some data manipulation. Such coding seems unconnected with art and language, yet he implies that it is. Consonant with this view, program-coding systems are called languages, but most people would find it difficult to specify any way in which a computer programming system merits the label *language*.

Some people are, in fact, hostile to the very idea that programming and programming languages have anything at all to do with creativity and language. Sometimes these people are confused between the computer and its human programmer, attributing programming to the computer rather than to human beings.

Programming languages *are* in fact languages in a meaningful sense of that word: they exhibit some of the complexity of form and function that natural languages do. Computer programming languages are much more than mere coding systems.

It is important that programming languages be recognized by lay people as languages. The ability to pro-

---

Jon Handel  
3 Gilmore Ct  
Scarsdale NY 10583

---

gram computers, or at least to understand programming and computers in a general way, is important today, just as literacy was important in the sixteenth century. Those who lack the new literacy—computer literacy—will find increasing difficulty in participating effectively in political, professional, and business life. If you don't know what a computer can do, how can you decide whether we should sell them to the Soviets—or whether you should buy one to help around the house?

What a computer can do is greatly determined by its software—that is, by the programs it executes. The software is expressed in some programming language, and this is the subject to which we now turn.

To explore the nature of programming languages and examine the characteristics of natural language exhibited by programming languages, the term *language* must first be defined. A reasonable definition is that language consists of a set of symbols, sounds, and/or gestures, and a set of rules according to which these elements may be systematically combined to communicate an indefinite number and variety of thoughts and ideas. Usually, these symbols are combined into subunits called words,

and these words are then combined into sentences.

Notice that the communication effected by a language need not be between people; it may also involve machines. A computer programming language is a language which is most often used for communication with computing machinery. The instrument of communication is a computer program, which is a detailed, step-by-step set of directions for the computer to follow. The purpose of a particular program can be practically anything from printing mathematical tables to controlling oil refineries.

Three computer programs in common languages will be examined. Following this is an examination of the communicative function of programming languages and the grammar of programming languages. The examples presented will show that programming languages are much more than mere coding systems. They exhibit structural patterns and concepts that are both complex and in some ways parallel to patterns and concepts of natural languages.

(The several computer languages discussed in this article represent only a small fraction of the existing languages. Jean Sammet of IBM compiled a list of 167 major languages, noting the existence of numerous dialects of some of these (*Communications of the ACM*, December 1976, page 655). In an earlier roster (*Communications of the ACM*, July 1972, page 601), Sammet presented a chronological chart of languages ar-

ranged by application area (eg: scientific computation, business data processing, experimental, etc). There are dotted, dashed, single, and double lines on the chart representing evolutionary changes from one language to another, as well as circles, squares, triangles, and three different type styles. The whole effect is that of a collapsed and tangled spiderweb. This complexity reflects the diversity of programming languages in use today.)

My sample programs deal with a specific problem. Imagine a computer user who wishes to calculate the reciprocals of some numbers. The user is sitting at a computer terminal and will use it to type in the numbers to the computer and receive the printout of the reciprocals. The programs illustrated will allow her or him to input a number X and have the computer print out the reciprocal of the number X, which is 1 divided by X. If the number X is 0, instead of printing the result of its computation, the program will print the message "Reciprocal of 0 does not exist."

### BASIC Program

Listing 1 shows the reciprocal program coded in the BASIC language. When this program is typed into the computer as shown, and the command RUN is typed, the computer begins executing the program in the order of increasing line numbers. Line 10 instructs the machine to print the message in quotation marks exactly as it is written. The message reminds the user of what he will be expected to do. Line 20 causes the machine to print a question mark at the terminal and wait for the user to type in a number. Since the statement identifies the input as X, whatever number the user types will be placed in the variable X. The program can then use the number by referring to X.

In line 30, the program tests to see if X is equal to 0. If so, the computer does not execute the next statement in numerical order (line 40), but transfers control to line 70, as directed by the IF-THEN statement, and continues from there. Line 70 causes the printout of the message indicating that the reciprocal of 0 does not exist. Line 80, which is executed next, tells the computer that the program is over. The computer stops executing the program, and the user

may restart it and enter a new number, or run a different program altogether.

If X does not equal 0, then the program continues from line 30 on to line 40. Line 40 performs a computation of the reciprocal of X. This value is placed in the variable Y. Subsequent references to Y will use this computed value.

Continuing with the sequence, line 50 prints the numerical value of Y. If the number typed in were 2, then Y

---

**It should be realized that even though programming languages are used for communication in many ways, they do not serve the same communicative functions as natural languages. Programming languages are used for communicating technical procedures in a precise fashion.**

---

would be printed as 0.5. Finally, line 60 causes the computer to stop executing the program. This line has essentially the same effect as the END statement in line 80.

### ALGOL Program

Listing 2 shows the reciprocal program written in ALGOL 60. ALGOL 60 was created and formally defined in a report of an international committee which appeared in 1960. ALGOL 60 is important because its syntax was described using a formal notation. (See "An Introduction to BNF" by W D Maurer, BYTE, January 1979, page 116.) A different version of the language, ALGOL 68, appeared eight years later.

When execution begins, the first line of the program in listing 2 serves two distinct functions. The word BEGIN indicates the beginning of a program, and the phrase REAL X,Y declares that variables named X and Y will be used in the program. These two variables are to represent real numbers (ie: numbers that can have a

decimal point and a decimal fraction part, for example, 0.5, 6.2, or 4).

On the next two lines, the PRINT and INPUT directives work in a similar manner to those in the BASIC program, although the syntax is slightly different.

The IF-THEN-ELSE structure on the succeeding lines is different from the IF-THEN encountered in BASIC. The intent is the same, but the structure is more complex. In the ALGOL program, if X is equal to 0, the clause following THEN is executed [PRINT ("RECIPROCAL OF 0 DOES NOT EXIST")]; otherwise, the compound statement following ELSE is executed. This compound statement is composed of the two statements Y:=1/X, which assigns the value of the reciprocal of X to Y, and PRINT(Y), which prints out the value of Y. These two statements are bracketed by the pair of words BEGIN and END. This bracketing allows the two statements to be treated syntactically as a single statement group. If X does not equal 0, it is this compound statement that is executed.

Finally, we encounter the second END statement, which is paired with the BEGIN at the beginning of the program. This indicates the end of the program; execution of the program terminates.

Notice that, in contrast to the BASIC program, the physical layout of the ALGOL program displays its logical structure. The indentation shows the functional grouping of individual statements. This indentation, and the associated BEGIN-END delimiters, are used to clarify the structure of ALGOL programs. [Editor's note: Indentation is also used to clarify structure in other languages, such as Pascal. . . . RSS]

Despite the differences between ALGOL and BASIC, one common characteristic of the two languages is that they are both similar to English and conventional algebra in the notation and verbs (eg: PRINT and INPUT) that they use. This similarity is not a characteristic of the language used for the third version of the reciprocal program, which makes extensive use of Greek letters and special symbols.

### APL Program

The language of the third

# Z8000

**MICRO PRICE for MINI POWER**  
**MICRO-MINI™ matches Series I by IBM**  
**DELIVERING CURRENT ORDERS**

You cannot buy a more powerful micro:

- **Power:** 1 to 32 independent users
- **Memory:** directly addresses to 16 Meg!
- **Mapping:** efficient memory management
- **Disk:** 2M to more than 250M
- **Speed:** throughput 10 times Z80
- **Files:** simultaneous access
- **Communication:** inter-user via terminals
- **Security:** all files password protected
- **Options:** expandable in the field
- **Bus:** Intel Multibus™ compatible
- **Languages:** Pascal, BASIC, COBOL, FORTRAN

**SYSTEM I .....\$3509**

Z8001 CPU board with on-board ROM monitor  
 32K dynamic RAM

I/O board: 8 serial ports

Back plane: 15-slots, Multibus™ compatible

Case: switching power, fans, cage, fixtures

**SYSTEM II .....\$6659**

Z8001 CPU with memory management circuitry  
 64K dynamic RAM

I/O board: 8 serial ports

FDC board: for 4 floppies, sgl/dbl density

ZMOS: multi-user/-tasking operating system

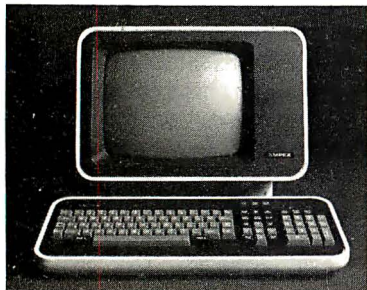
Back plane: 15-slots, Multibus™ compatible

Case: switching power, fans, cage, fixtures

Disks: dual floppies (ss: sgl/dbl density)

CRT: Dialogue 80™ interactive/edit terminal

**Call for further system specifications.**



**AMPEX Dialogue 80™**

Dialogue 80™ fully-featured video terminal:

- Full ASCII with numeric and edit keypads
- Elegant case with detachable keyboard
- Display 24 lines with 25th status line
- 20 user programmable function keys
- 2 pages display memory (4 optional)
- 11 graphics and 21 control codes
- 10 modes including block, protect, program
- Transparent mode displays control codes

**Dialogue 80™ .....\$1045**

**Dialogue 80™ with phone coupler.....1194**

Applications: word processing, data entry, interactive programming, data base inquiry/response/update, transaction processing, whether on-site or remote. For our system or for yours, this interactive terminal is the perfect match.

Prices: Prepaid or Purchase Order Net 10.

Prices subject to change without notice.

Warranty: 120 day minimum on all systems.

Interfacing cables free with all systems.

10% down fixes price, guarantees priority.

MasterCard and VISA cards accepted.



(312) 684-3183

**COMPUTEX**  
 MICROCOMPUTER SYSTEMS

5710 Drexel, Chicago, IL 60637

**Listing 1: Reciprocal-determining program written in the BASIC language.**

```

10 PRINT "INPUT NUMBER FOR RECIPROCAL";
20 INPUT X
30 IF X=0 THEN GOTO 70
40 LET Y=1/X
50 PRINT Y
60 STOP
70 PRINT "RECIPROCAL OF 0 DOES NOT EXIST."
80 END
  
```

**Listing 2: Reciprocal program written in ALGOL.**

```

BEGIN REAL X,Y;
PRINT ("INPUT NUMBER FOR RECIPROCAL");
INPUT (X);
IF X=0 THEN
  PRINT ("RECIPROCAL OF 0 DOES NOT EXIST.")
ELSE
  BEGIN
    Y:=1/X;
    PRINT (Y)
  END
END
  
```

**Listing 3: Reciprocal program written as an APL function.**

```

▽ RECIPROCAL
(1) ' INPUT NUMBER FOR RECIPROCAL'
(2) → (0=X←□)/5
(3) □ ←Y←÷X
(4) → 0
(5) ' RECIPROCAL OF 0 DOES NOT EXIST.'
▽
  
```

reciprocal program is APL (A Programming Language), which was created by Dr Kenneth Iverson. The keys to its power are conciseness of notation and ability to deal with tables of data (arrays) as easily as with a single number. This conciseness can, however, make even a simple program difficult to read for the uninitiated.

Listing 3 shows our reciprocal routine written in APL. The first line, which is unnumbered, denotes the beginning of an APL function to be named RECIPROCAL. (Programs are called *functions* in APL. Once a function is entered into the computer, it is executed by typing its name, RECIPROCAL.) Execution proceeds starting with line 1.

Line 1 simply causes the computer to print the text that is within the single quotation marks.

Line 2 illustrates some of the complexity of the APL language. This line

does two separate things. The characters X←□ cause input from the computer terminal to be placed in the variable X for subsequent use. These three characters do the same thing as the seven characters INPUT X (counting the space) do in BASIC.

Continuing on line 2, once X has been assigned the numeric value input from the terminal, the expression 0=X compares the value, now in X, against 0. If X is equal to 0, the expression produces the logical value 1; if X is not equal to 0, the expression produces the logical value 0.

This logical result of either 0 or 1 is still within the parentheses of line 2. The combination of this value (0 or 1) and the /5 to the right of the parentheses produces either a null vector or the value 5.

The arrow → at the left of line 2 is followed by the expression in parentheses, whose value is either the null vector or 5. The arrow is known as

the *branch arrow*; to branch is to change the order of execution of program statements. The branch arrow does this as the GOTO statement does in BASIC. If the value following the arrow is 5, indicating that X is equal to 0, the arrow causes a branch to line 5. If the value is the null vector, indicating that X is not equal to 0, no branch at all is taken and execution proceeds to line 3 of the function.

In summary, line 2 performs the functions of the following two lines from the BASIC version of the program:

```
20 INPUT X
30 IF X=0 THEN GOTO 70
```

Line 3, which should be read from *right to left*, calculates the reciprocal of X (written in APL as  $\div X$ ), places this value in the variable Y, and then prints Y. This line functions as do the lines:

```
40 LET Y=1/X
50 PRINT Y
```

in the BASIC program.

Line 4 seems to direct a branch to line 0. Actually,  $\rightarrow 0$  is an idiom that means branch out of the function entirely—in other words, stop the program.

Finally, line 5, which is only executed if X was found equal to 0 in line 2, directs the computer to print the text in quotation marks. After line 5 is executed, the computer encounters the  $\nabla$  symbol, which denotes the end of the program.

### Uses of Programming Languages

Programming languages, like all languages, are used for communication in a variety of ways. Two broad classifications are communication between people and machines, and communication between people and people.

The way in which people use programming languages to communicate their desires to computers is self-evident. If the user desires computation of reciprocals, a program is written for this computation in a language understood by the particular computer at the programmer's disposal. It should then be entered into the machine. The aspect of communication is the same for more difficult tasks.

Programming languages are also

used for communication between people. For example, since many programming projects involve more than one person, those involved must communicate. Naturally, much of this communication requires transmission of segments of the program being worked on.

Another example of this type of communication is the publication in professional journals of algorithms expressed by programs. One of the most popular languages for such communication is ALGOL 60. The ALGOL 60 report, by defining a publication language differing slightly from the hardware representation, explicitly recognizes the two facets of programming language communication.

It should be realized that even though programming languages are used for communication in many ways, they do not serve the same communicative function as natural languages. Programming languages are used for communicating technical procedures in a precise fashion. Natural languages are not very well adapted to this type of communication. Indeed, natural languages, when used for communication of detailed instructions, are often augmented with charts, diagrams, pictures, and mathematical expressions.

### Grammar and Syntax

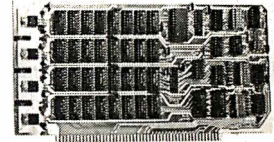
The *noun* of a programming language is the *variable*, which is conceptually an object or storage cell capable of holding information. The primal variable, seen in the reciprocal programs, can hold only one number. There are two distinct directions in which this concept of variable may be extended: by allowing different *types* of data to be stored in the variable, or by allowing different *amounts* of data to be stored.

In most languages, if different types of data are to be stored in different variables, the variables themselves must possess the attribute of *data type*. This attribute is an identification that a particular variable can be used to store a particular type of data. Consider some of the data types offered by ALGOL 68 as shown in table 1. For example, to declare in an ALGOL 68 program that I and "class size" (a single variable; lower-case and spaces are okay) are to be variables capable of storing an integer; COST, to be capable of storing

Now-Break Through The 64K  
Micro-Memory Limit!

## SWEET SIXTEEN

Bank Selectable 16K Static RAM



SAVE \$50.00  
LIMITED TIME OFFER

Don't buy any more antique RAMs (RAM without bank select) — now there's Netronic's new SWEET SIXTEEN board featuring a universal software bank select system. SWEET SIXTEEN is capable of addressing 2,048 different banks. With SWEET SIXTEEN boards you can add memory beyond the 64K limit, or expand to a multi-terminal system.

### LOOK AT THESE FEATURES:

- 300 NS, low power 2114's.
- Software Bank Selector — Universal decoder works with Cromenco, Alpha Micro, Netronics, most other systems, or your design. Onboard dip switches: Bank Select Enable; Reset Enable; Reset Disable; Port Address; Port Data.
- All Inputs And Outputs meet the proposed IEEE standards for the S-100 bus.
- 4.0 MHz Operation.
- Schmitt Trigger Buffer on all signals for maximum noise immunity.
- Addressable On 16k Boundaries, 0-64k, dip switch selectable.
- Phantom Option, dip switch selectable.
- PWR/MWRITE Option, dip switch selectable.
- LED Indicator to display status.
- Glass Epoxy PC Board with gold-plated contacts and double-sided solder mask.
- Fully Socketed.
- Four Separate Regulators for maximum stability.
- 10-Day Money-Back Policy For Wired & Tested Unit: Try a fully wired board — then either keep it, return it for kit, or simply return it in working condition.

Continental U.S.A. Credit Card Buyers  
Outside Connecticut

CALL TOLL FREE:

800-243-7428

From Connecticut Or For Assistance:  
(203) 354-9375

Please send the items checked below:

- ☐ SWEET SIXTEEN kit: No. S-16 ... (reg. price \$249.95) now \$199.95\*
- ☐ SWEET SIXTEEN, fully assembled, tested, burned in: No. S-16W ... (reg. price \$289.95) now \$239.95\*

\*Plus \$2 postage & insurance. Connecticut residents add sales tax.

Total Enclosed: \$ \_\_\_\_\_

☐ Personal Check ☐ Money Order/Cashier's Check

☐ VISA ☐ Master Charge (Bank No. \_\_\_\_\_)

Acct. No. \_\_\_\_\_ Exp. Date \_\_\_\_\_

Signature \_\_\_\_\_

Print \_\_\_\_\_

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

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

**NETRONICS**

RESEARCH & DEVELOPMENT, LTD.  
333 Litchfield Rd., New Milford, CT 06776

a real number, and NAME, to be capable of storing a character string (such as "John Smith"); the programmer would use the following statements:

```
INT I, class size;
REAL COST;
STRING NAME;
```

The structure of these declarations is:

predicate-adjective subject

with an omitted linking verb. This structure is similar to the English structure:

subject is predicate-adjective

Data types are attributes of variables and are specified in the same way as an attribute of a noun in English. (The parallel is even stronger in Russian, since that language usually omits the linking verb in the present tense.) The names of the data types (INT, REAL, CHAR, STRING, and others) are adjectives in the grammar of ALGOL 68.

In addition to the four data types outlined above, ALGOL 68 offers a number of other data types, each of

which is an extension of the concept of data type in a distinct direction. One class of data type that is of a particular interest is *reference-to modes*. (Mode means data type.)

Such modes can be viewed simply as the recognition of the difference between nouns and pronouns. A noun, in English, is a symbol for some person, place, or thing. A pronoun is a reference to a particular noun, termed the *referent* of the pronoun. With this distinction in mind, consider the following sequence of ALGOL 68 statements:

```
BEGIN
INT I,J;
I:=2;
J:=I+3;
END
```

This seems simple enough, but consider carefully the statement  $J := I + 3$ . What is being added here? The 3, certainly, is being used as it stands, but the I really is not. The I refers to a number (2 in this case) and it is actually this number that figures in the addition,  $2 + 3$ . The constants 2 and 3 in this program are the nouns and the variables I and J are pronouns.

The declaration INT I,J is a shorthand: it does not signify that I and J are themselves of type INT, but that they are to *refer to* objects (ie: numbers) of type INT. The variables themselves are of mode (type) REF INT, meaning *reference to integer*. REF REAL, REF CHAR, REF STRING, etc are all possible. These different types of reference-to modes are analogous to pronouns of different genders and cases in human languages.

The distinction between variables and the values to which they point may strike you as pointless. Indeed, some languages—BASIC, APL—ignore the distinction. Others—ALGOL 68, Pascal—don't. Like genders and cases in Russian, *pointer* variables (a more common term than *reference-to*) can be a pain to learn, but once learned, a subtle and useful tool.

The concept of variable type or mode is only one way in which the concept of variable may be extended. Another extension is to remove the restriction that a variable hold only one item. Such variables must have some internal organization or structure to allow access to subsets of the stored data. One type of structured variable is the array.

In an array, all data items are of the same type (eg: all integers) and are arranged in a regular rectangular pattern. A one-dimensional array is called a vector or list; an example is:

95 78 99

This three-element vector could represent the final examination grades of three students; the first scored a 95, the second a 78, and the third a 99. Though all elements of the vector are integers, the programmer can just as easily work with a vector of real numbers, of characters, or of any particular type. To create this vector of integers for use in an ALGOL 68 program, use the following statements:

```
[1:3] INT GRADES;
GRADES:=(95,78,99);
```

The first statement declares GRADES to be a vector of integers, the elements of which are numbered from 1 to 3. The second statement assigns to GRADES the three grades 95, 78, and 99. It is clear that a vector is called a one-dimensional array

(212) 986-7690

## MAIL ORDER ONLY

Micro Computer    Your One Stop For... Quality and Huge Savings

# DISCOUNT

Company

**QUALITY • DELIVERY • SERVICE**

60 E. 42nd St. Suite 411 New York, NY 10017

EPSON MX-80  
EPSON MX-70

PAPER TIGER  
445 & 460

CALL FOR PRICE

 <b>CENTRONICS</b> CALL FOR PRICES	 <b>APF</b> IM1 - \$495 IM2 - \$988	 <b>COMMODORE</b> 8K - \$729 16K - \$888 32K - \$1088 2022 - \$695 2040 - \$1088 8050 - \$1435 8032 - \$1495	 <b>SUPERBRAIN*</b> *32K - \$2445 64K - \$2645 64KQD - \$3395 *32K add-in memory only \$10 with purchase
<b>ATARI</b> 800—\$795 	 <b>XYMEC</b> HQ 1000 - \$2395	 <b>NEC SPINWRITER</b> 5510 - \$2795 5520 - \$2990	 <b>*XEROX</b> 1740 RO - \$2619 1740 KSR - \$2995 1750 RO - \$2795 1750 KSR - \$2995 1730 - \$2195

**MAIL ORDER ONLY**

Send Certified Check (Personal or Company Checks require 2 weeks to clear.) We pay all shipping and insurance charges except items marked with asterisk. VISA, MasterCard add 5% N.Y.S. Residents add appropriate sales tax.

\*(DENOTES ITEMS SHIPPED F.O.B. NYC)

**PHONE (212) 986-7690**

because it is an array of numbers that extends in one direction only (mathematically, along one dimension).

An example of a two-dimensional array, or matrix, is:

```
96 95 98 95
67 83 72 78
97 95 99 99
```

Each row could correspond to the test grades of a particular student; thus, student number 1 scored a 96 on the first test, a 95 on the second, a 98 on the third, and a 95 on the final exam. A matrix is called a two-dimensional array because it extends along two directions, horizontal and vertical.

Higher-dimensional arrays are also possible, though clumsy to represent on the printed page. It is even possible in ALGOL 68 to have arrays of arrays, arrays of arrays of arrays, and so forth.

The concept of array is analogous to that of plurals in natural languages. At one stroke, a sentence such as *Cheshire cats always grin* makes a statement about all members of the set of Cheshire cats. Similarly, the expression  $Y := \text{GRADES} - 5$  subtracts 5 from all elements of GRADES at once, setting Y equal to (90,73,94).

There is also a parallel between array subscripting and prepositional phrases. Consider again the vector GRADES. To access the first element of GRADES by itself, the subscripts to the elements in GRADES must be assigned. In ALGOL 68, this is written GRADES [1].

GRADES [1] is the single number 95; it may be printed or used in calculations just like a single variable. The construction [1] may be viewed as a prepositional phrase, the brackets being the preposition, and the 1, its object. The preposition [ ] shows the relationship between the two nouns GRADES and 1. Interestingly, the way GRADES [1] is read aloud reflects this structure: "GRADES sub [meaning subscripted by] one."

Just as a noun cannot communicate much without verbs, a variable is useless without the verbs of programming languages, *operators* and *functions*. Operators are the symbols used in mathematics and programming languages to represent arithmetic and other operations. Thus, +, -, and \* (multiplication) are all operators. In conventional notation, operators are

placed between their operands ( $X + Y$ ) if there are two, or in front of them ( $-X$ ) if there is one.

Functions, on the other hand, precede and enclose their operands. For example, the function SQRT(X) in FORTRAN computes the square root of X. A function can have more than one operand. An example of this is the function MAX(X1, X2, X3, . . .), which selects the largest of its indefinitely many operands. The distinction between functions and operators is fundamentally one of notation; operators will be used in the examples presented here.

Operators change their actions depending on the data types of their operands. For instance, there are differences in the accuracy of addition of real operands and of integer operands, while addition of string operands is actually concatenation (eg: "John" + "Smith" yields "John Smith"). In general, ALGOL 68 actually allows total redefinition of operators based on the data types of their operands.

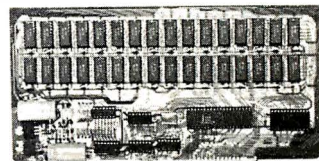
Operators can also change their actions depending on the structure of their operands. To use an operator with arrays and inhomogeneous structures, ALGOL 68 requires prior definition of the operator's actions, which allows a great deal of flexibility. In contrast to ALGOL 68, the APL language provides definitions such as "the addition of two arrays is the addition of their corresponding elements"; the programmer cannot redefine operators in APL. The PL/I language has a different solution; to add correspondingly named elements in two inhomogeneously structured variables, A and B, one uses:

$C = A + B, \text{BY NAME};$

The keyword BY NAME functions as an adverb, modifying the + operator.

APL, in addition to functions (such as + and -, which most languages call operators) which act as simple verbs, also has operators, which act as *auxiliary* verbs. These operators (again, note the special meaning in APL) modify the results of regular functions in a systematic way. For example, + is the familiar addition function. Applied to two vectors, it yields the sum of corresponding elements (eg: 3 4 5 + 6 8 9 produces 9 12 14). The reduction operator, /, is an auxiliary verb. Juxtaposed, as +/, these

**The days of complicated, unreliable, dynamic RAM are gone:**



## INTRODUCING JAWS

the ultrabyte memory board

**\$199.95** (complete kit with 16K memory)

Netronics consistently offers innovative products at unbeatable prices. And here we go again — with JAWS, the ultrabyte 64K S100 memory board.

### ONE CHIP DOES IT ALL

JAWS solves the problems of dynamic RAM with a state-of-the-art chip from Intel that does it all. Intel's single chip 64K dynamic RAM controller eliminates high-current logic parts . . . delay lines . . . massive heat sinks . . . unreliable trick circuits.

### REMARKABLE FEATURES OF JAWS

Look what JAWS offers you: Hidden refresh . . . fast performance . . . low power consumption . . . latched data outputs . . . 200 NS 4116 RAMs . . . on-board crystal . . . 8K bank selectable . . . fully socketed . . . solder mask on both sides of board . . . designed for 8080, 8085, and Z80 bus signals . . . works in Explorer, Sol, Horizon, as well as all other well-designed S100 computers.

**GIVE YOUR COMPUTER A BIG BYTE OF MEMORY  
POWER WITH JAWS — SAVE UP TO \$900  
INTRODUCTORY LIMITED-OFFER SPECIAL PRICES!**

UNDECIDED? TRY A WIRED 16K JAWS IN YOUR COMPUTER ON OUR 10-DAY MONEY-BACK OFFER (SPECIFY YOUR COMPUTER).

CONTINENTAL U.S.A. CREDIT CARD BUYERS: OUTSIDE CONNECTICUT CALL

**CALL TOLL FREE 800-243-7428**

From Connecticut Or For Assistance, (203) 354-9375 Dept. B3

**NETRONICS RESEARCH & DEVELOPMENT LTD.**

333 Litchfield Road, New Milford, CT 06776

Please send the items checked below:

- ☐ JAWS 16K RAM kit, No. 6416, \$199.95.\*
- ☐ JAWS 16K RAM fully assembled, tested, burned in, No. 6416W, \$229.95.\*
- ☐ JAWS 32K RAM kit, No. 6432, (reg. price \$329.95), SPECIAL PRICE \$299.95.\*
- ☐ JAWS 32K RAM fully assembled, tested, burned in, No. 6432W, (reg. price \$369.95), SPECIAL PRICE \$339.95.\*
- ☐ JAWS 48K RAM kit, No. 6448, (reg. price \$459.95), SPECIAL PRICE \$399.95.\*
- ☐ JAWS 48K fully assembled, tested, burned in, No. 6448W, (reg. price \$509.95), SPECIAL PRICE \$449.95.\*
- ☐ JAWS 64K RAM kit, No. 6464, (reg. price \$589.95), SPECIAL PRICE \$499.95.\*
- ☐ JAWS 64K RAM fully assembled, tested, burned in, No. 6464W, (reg. price \$649.95), SPECIAL PRICE \$559.95.\*
- ☐ Expansion kit, JAWS 16K RAM module, to expand any of the above in 16K blocks up to 64K, No. 16EXP, \$129.95.\*

\*All prices plus \$2 postage and handling. Connecticut residents add sales tax.

Total enclosed: \$

☐ Personal Check ☐ Money order or Cashiers Check

☐ VISA ☐ MASTER CHARGE (Bank No. . . . )

Acct. No. Exp. Date

Signature

Print Name

Address

City

State Zip

☐ Send me more information

two form a new function, "plus-reduction," that operates on a single vector and produces the sum of its elements (eg: +/3 4 5 yields 12). The +/ function *reduces* its operand to a single number by addition.

These complex verbs, nouns, adjectives, adverbs, pronouns, and prepositions all fit into equally complex syntactic structures. As with English, there is a range of syntactic complexity; some languages, such as BASIC, have a very simple set of syntactic patterns. Other languages encompass some very complex and powerful syntactic structures.

Probably the simplest syntactic form is that of many BASIC statements, which may be characterized as:

imperative-verb object

Examples of this form are PRINT X, INPUT Y, and GOTO 200. The object may also be a verbal phrase, as in PRINT X+Y, in which the verb in the verbal is the + operator.

A few forms of greater complexity are found in BASIC. One of these is the IF-THEN statement, an example of which is:

INT	integer
REAL	rational number [it may have a fractional component]
CHAR	character [a single character only]
STRING	string of characters [text string]

Table 1: Data types which may be assigned to variables in the ALGOL 68 language.

IF X=3 THEN PRINT  
"X IS EQUAL TO 3."

This is a more complex form than the first for two reasons. First, it uses a conjunction-conjunctive adjective pair, IF and THEN; second, the phrase following THEN can be any BASIC statement. This makes the IF-THEN statement, in the terminology of English grammar, a complex sentence.

Syntactic patterns much more complex than these are found in ALGOL 60 and 68. An example from ALGOL 60 is the statement:

X:=2+(IF Y=1 THEN 3  
ELSE 6)

This statement assigns to X the value 5 (2+3) if Y is equal to 1, and the value 8 (2+6) if Y is not equal to 1. An IF-THEN-ELSE clause may be

used wherever a noun (ie: numerical or character value) is required by the syntax of ALGOL 60. This freedom is restrictive compared to the rules of ALGOL 68; there, not only IF-THEN-ELSE statements can be used as clauses in place of nouns, but *any* valid statement can be so used.

Statements and phrases may be combined in ways such as:

k:=(INT i; read(i); i+1)

This statement declares the variable i to be of type INT, accepts a value for i as input from some device (possibly a computer terminal), calculates the value of i+1, and finally assigns this value to the variable k. One of the most impressive aspects of ALGOL 68 is that the labyrinthine syntax of the entire language is rigorously defined using a formal notation.

## Omikron's Mapper + NEWDOS/80 8" Drives for the TRS-80

**NEWDOS/80** is Apparat's latest upgrade to NEWDOS. Features include variable length records, chaining, and drivers specifically configured for Omikron's MAPPER II. \$150.

**MAPPER II** adapts the TRS-80 to run both 5" and 8" drives. With NEWDOS/80, storage is increased to 300K per 8" drive. \$99 plus \$50 per cable connector.

**MAPPER I** adapts the TRS-80 to run the vast library of CP/M software as well as the TRS-80 software. All Lifeboat Software may be ordered for the MAPPER I. All MAPPER I CP/M software is compatible with the CP/M for the Model II. With MAPPER II and 8" drives, the Model I becomes disk compatible with the Model II.

Standard features include lower case support, serial and parallel printer drivers, and an addressable cursor. MAPPER I is supplied with complete utilities including a memory test, a disk test, a copy program, and a proprietary program for converting TRS-DOS files to CP/M files. \$199.

**WORD PROCESSING**—MAPPER I supports professional word processors like the Magic Wand and Word Star (see reviews in June 80 Kilobaud). Omikron's implementation includes a blinking cursor, auto repeat, shift lock, debouncing, and an input buffer that eliminates missed characters. Magic Wand super discount price \$299.

**FIELD PROVEN DESIGNS**—After one year of MAPPER production, Omikron has established an impeccable reputation for reliability, integrity, and user support. Omikron's customers include the US Government, major corporations, universities, medical doctors, and professionals in all fields.

**SYSTEMS**—Omikron sells complete systems featuring Model II compatible Shugart disk drives. Call for prices and delivery.

**FOREIGN ORDERS** must include full payment in US funds plus \$25 for air shipping and handling.

See review in July 80 BYTE By Jerry Pournelle.



As has been implicit in the above discussion, the meaning of a statement (English or programming language) is often determined by the meaning of the individual words (such as *grin* or *PRINT*) and the syntactic operations which combine them. This is made light of by Lewis Carroll in his poem "Jabberwocky," which begins:

*'Twas brillig, and the slithy toves  
Did gyre and gimble in the wabe:  
All mimsy were the borogoves,  
And the mome raths outrabe.*

This verse is amusing because we understand the syntax, while the words, though suggestive, are meaningless.

In the realm of more standard language, there are constructions whose meaning is not simply a composition of individual word meanings. Such expressions are called idioms. A sentence like *The FBI kept tabs on Bill's unicorn* has nothing to do with actually sticking plastic tabs on a unicorn. And thinking about *The cat got his tongue* in such literal terms would lead to an anxiety attack.

In programming languages, too, there are idioms. In APL, there are the constructions  $\rightarrow$ ,  $\rightarrow 0$ , and  $\rightarrow$  (null vector), all of which are idioms for special types of program branching. In ALGOL 68, there are operators such as  $+=$ : (plus and becomes).  $A+=:1$  is equivalent to  $A=:A+1$ , and instructs the computer to take the value of A, add 1 to it, and store the result back into A. These are truly idioms, as their meanings cannot be derived directly from the meanings of their individual elements.

Good examples of expletives may be found in both ALGOL 68 and FORTRAN. In ALGOL 68, the SKIP statement is an expletive; it does nothing and is explicitly undefined. A similar example in FORTRAN is the CONTINUE statement, the execution of which also has no effect. In practice, CONTINUE is used in only one particular context, while SKIP is used in many different contexts.

While idioms, expletives, and syntax in general reveal the similarity between programming languages and natural languages on the level of the word and the sentence, there are also similarities on the level of the paragraph and the document. The paragraph in ALGOL 60 is the *block*,

which is a sequence of statements beginning with BEGIN and variable declarations (REAL, INTEGER, etc), and ending with END. This is similar to a paragraph of English in several ways. It has a clearly marked beginning and end. It is required to state at the beginning the objects (variables) it will be working with, just as a good paragraph should declare its subject at the beginning. Finally, a good block deals with only one phase of the problem being solved by the program, just as a paragraph should deal with only one aspect of the idea being discussed.

The analogy between programming languages and natural languages at the level of whole documents is seen by comparing computer programs with books. Both usually have titles; some programming languages—APL and Pascal—actually require them. Many books have a dust-jacket blurb or preface to make the book easier to read and use. Good computer programs have comments written into the code for the same purpose.

You may be surprised to find paragraphs, idioms, expletives, and so forth in programming languages, if you have thought of them only as characteristics of natural language. Throughout this discussion, however, we have seen how closely programming languages parallel natural languages. Therefore, the existence of idioms and similar attributes in programming languages is a nearly predictable situation.

### Importance of Similarity

Granting that programming languages are languages in the same sense as English or Mandarin, the question that follows is: does this make any difference to working programmers? Yes, it makes a great deal of difference, for it leads to the concept of programming style, with associated benefits.

The concept of programming style follows naturally. Just as English is a tool for which there are different uses and styles, so too are programming languages tools for which there are different uses and styles. Further, just as in English there are some writing styles that are superbly clear and efficient, while others are not, there are some programming styles that are more desirable than others. *Aesthetic* considerations indicate that a

desirable style is a clear and concise one. But why should this interest the working programmer, who is just interested in doing a job, not in creating a work of art?

Too many programs are written today without consideration for later revisions that may be necessary. It is as though these programs will never be read or changed. The inevitable result of such a programming practice is programs that *do* need to be patched, altered, and debugged to make them work, and programs that are so incomprehensible that they can be changed to meet future requirements only with great difficulty. Worse, the result may be a program that works 99 times out of 100. On that hundredth time, the program may fail and produce incorrect results that are accepted as true. Or perhaps it will be obvious, as bank accounts are jumbled, an oil refinery burns, or a spacecraft explodes upon launch, that something is indeed amiss with the computer programs in use.

Working programs, programs that can be confidently (and even mathematically) labeled correct, are serious business in a society in which computers are performing more and more functions of ever greater importance. For this and other reasons related to the costs of debugging a poorly written program, structured programming (which advocates a clear and systematic approach to programming) has become popular.

Many programmers still do not write programs that work correctly the first time. There is still much to be done before good programming is nearly universal. However, better programming languages are being developed, more programmers are developing a clear and functional programming style, and more programs work the first time. ■

### References

1. Ershov, A P. "Aesthetics and the Human Factor in Programming." *Communications of the ACM*, July 1972, pages 501 thru 505.
2. Kernighan, B W and P J Plauger. *The Elements of Programming Style*. New York: McGraw-Hill, 1974.
3. Ledgard, H F. *Programming Proverbs*. Rochelle Park NJ: Hayden Book Co, 1975.
4. Naur, P (editor). "Revised Report on the Algorithmic Language ALGOL 60." *Communications of the ACM*, January 1963, pages 1 thru 17.

# Event Queue

## March 1981

### March

**Fairchild Education Center Courses**, South San Jose CA. Bit-slice techniques, the 3870 microprocessor, and programming in Pascal are the courses offered by Fairchild during March. For details, contact Dr Dennis Lunder, Fairchild Education Center, M/S 43-4022, 133

Bernal Rd, South San Jose CA 95119, (408) 224-7095.

### March-April

**Courses from George Washington University**, Washington DC. George Washington University has schedules and descriptions of many courses in computers and communications. For your copy, contact the Director, Continuing Engineering Education,

George Washington University, Washington DC 20052, (800) 424-9773; in Washington DC (202) 676-6106.

### March-September

**Seminars from WPI**, Worcester Polytechnic Institute, Worcester MA. A series of 2-day seminars covering data communications, microprocessors, and other topics of interest to

data-processing professionals is offered by WPI. For a detailed brochure, write to the Office of Continuing Education, Worcester Polytechnic Institute, Worcester MA 01609, (617) 753-1411, attn: Ms Ginny Bazarian.

### March-November

**Advanced Data Processing Workshops**, Deltak Inc, various cities throughout the US and Canada. These 5-day workshops are aimed at data-processing training managers responsible for the management and administration of data-processing training and involved in planning, monitoring, evaluating, and reporting to upper management on the status of the training. For a schedule of dates and locations, contact Deltak Inc, 1220 Kensington Rd, Oak Brook IL 60521, (312) 920-0700.

### March 8-11

**TI-MIX 1981**, Marriott Hotel, New Orleans LA. This is a conference for Texas Instruments equipment users. Thirty-six sessions consisting of individual presentations, panel discussions, and workshops are planned. Two exhibit rooms featuring the latest computer equipment from Texas Instruments will be open. Contact TI-MIX, M/S 2200, POB 2909, Austin TX 78769, (512) 250-7151.

### March 11-13

**Business- and Personal-Computer Sales and Exposition and New York Business Show**, Madison Square Garden, New York NY. For details, contact Produx 2000 Inc, POB 2000, Bala-Cynwyd PA 19004, (215) 457-2300.

### March 14

**The Fourth Annual PACS Computer Games Festival**, LaSalle College Ballroom, Philadelphia PA. This event is sponsored by PACS

**\* \* \* WRITE OR CALL FOR FREE CATALOGUE \* \* \***

JOHN D. OWENS ASSOCIATES, INC. JOHN D. OWENS ASSOCIATES, INC. JOHN D. OWENS ASSOCIATES, INC. JOHN D. OWENS ASSOCIATES, INC. JOHN D. OWENS ASSOCIATES, INC.

JOHN D. OWENS ASSOCIATES, INC. JOHN D. OWENS ASSOCIATES, INC. JOHN D. OWENS ASSOCIATES, INC. JOHN D. OWENS ASSOCIATES, INC. JOHN D. OWENS ASSOCIATES, INC.

<b>CALIFORNIA COMPUTER SYSTEMS HIGH IN QUALITY. LOW IN PRICE</b> Z80 CPU, 4 Mhz, with one serial port; 12 slot S-100 mainframe, disk controller, 64K Dynamic Ram, CP/M 2.2 <sup>®</sup> ..... \$1,645. Interface to 2 Shugart 8 inch drives w/ power supply & cabinet ..... \$1,250. A complete S-100 system for under \$3,000. THE BEST BUY ON THE MARKET.	
<b>IMS 5000 and 8000 Systems</b> The new rising stars! Beautifully designed and constructed with the Industrial Micro System reputation for fine quality. These systems feature a Z80 CPU, S-100 bus; double density drives (either single or double sided) CP/M <sup>®</sup> . 5000 series uses mini floppies, 8000 uses maxi floppies. Hard disk and MP/M now available. Model 5-00125 with two double density drives, 32K Static RAM ..... \$2,765. Model 8-00125 as above but with 8" drives ..... \$4,185.	
<b>PER SCI—THE KING AND QUEEN OF DRIVES!</b> Model 299B: Dual headed drives, total 3.2 MB unformatted ..... \$2,300. Model 277: Dual 8 inch drives, voice coil positioned, IBM compatible, 1600 K BYTES per drive, unformatted ..... \$1,210. Slimline cabinet and power for either 277 or 299 ..... \$ 300.	
<b>DRIVES Dual 800R Shugarts</b> power supply, cabinet and fan, A & T ..... \$1,250. Qume data track 8, double sided, power supply, fan cabinet, A & T ..... \$1,650. MPI B51 ... \$265. Shugart ... \$525. B52 ... \$365. B92 ..... \$500.	<b>IMS MEMORY 16 K static</b> ..... \$285. 32 K static ..... \$585. 64 K Dynamic with parity ..... \$950.
<b>HAZELTINE 1500</b> ..... \$925. 1510 ..... \$1,030.	<b>TEI MAINFRAMES, S—100</b> 12 slot, table top ..... \$500. 22 slot, table top ..... \$670. Rack mounts, add ..... \$ 50. 50 Hz, 220 volts, add ..... \$ 50.
<b>AMPEX DIALOGUE 80 CRT</b> ..... \$950. Removable keyboard, 2 page memory, (4 optional), block transmit.	<b>TARBELL</b> Double density controller ..... \$420. Cables ..... \$ 40. Complete TARBELL Product Line Available.
<b>CENTRONICS 737</b> ..... \$780. Same as TRS-80 Model IV Apple serial/parallel interface ... \$195. EPSON MX80B ..... \$550.	<b>3M SCOTCH<sup>®</sup> Diskettes</b> Buy the best. 8" or 5" (Model 740 or 744) One box of ten diskettes ..... \$29. Five boxes, each ..... \$26.50
<b>TELEVIDEO SMART CRTs</b> 912 ..... \$780. 920 ..... \$850.	

**WE EXPORT:** Overseas Callers: TWX 710 588 2844  
 Phone 212 448-6298 or Cable: OWENSASSOC

SEE OUR AD FOR 8" FLOPPY NORTH STAR SUBSYSTEM ON PAGE 28

**JOHN D. OWENS**  
**Associates, Inc.**  
 12 Schubert Street  
 Staten Island, New York 10305  
 212 448-6283 212 448-2913 212 448-6298

(Philadelphia Area Computer Society) and the LaSalle College Physics Department. Presentations on computer-aided learning will be featured. Contact Stephen A Longo, Physics Department, LaSalle College, Philadelphia PA 19141, (215) 951-1255.

March 17-20

**The Fourteenth Annual Simulation Symposium**, Tampa FL. Papers describing digital discrete simulation and other techniques will be read. This symposium is a forum for the exchange of ideas and techniques in computer simulation. Contact Annual Simulation Symposium, POB 22621, Tampa FL 33622.

March 20

**Digital Computer Association Annual Meeting**, Pacifica Hotel, 6161 Centinela Blvd, Culver City CA. Cocktails, dinner, and the annual meeting are the features of this gathering. For more information, contact Mary Rich, 731 Bayonne St, El Segundo CA 90245.

March 23-25

**Office Automation Conference**, Albert Thomas Convention Center, Houston TX. This conference presents seminars on the concepts and the methods behind the latest office technologies and an exhibition of office equipment. Contact Office Automation Conference, POB 9659, Arlington VA 22209, (703) 558-3617.

March 24-27

**Printemps Informatique**, Palais des Congres, Paris, France. This is an electronic data-processing exhibition for computer OEMs (original equipment manufacturers). Additional information is available from Kallman Associates, 30 Journal Sq, Jersey City NJ 07306, (201) 653-3304.

March 24-26

**The Southwest Semiconductor Exposition**, Phoenix

Civic Plaza Convention Center, Phoenix AZ. More than 140 equipment and materials makers will exhibit semiconductor, hybrid, and printed-circuit board production, processing, and test equipment. Contact Cartledge & Associates Inc, 491 Macara Ave, Suite 1014, Sunnyvale CA 94086, (408) 245-6870.

March 31-April 2

**Cincinnati Business Show**, Cincinnati Convention-

Exposition Center, Cincinnati OH. Office equipment and services, including automated systems, communications, computers, telephone systems, word processing, data processing, printing equipment, and other office supplies, will be featured. A program of business seminars is also scheduled. Contact Ray G Nemo, 5679 Creek Rd, Cincinnati OH 45242, (513) 531-5959.

## April 1981

April 1-2

**Communications in the Twenty-First Century**, Philip Morris Operations Center, Richmond VA. This conference focuses on technological advances and their economic, political, social, and psychological implications. Elie Abel, Professor of Communications at Stanford University and Lord Briggs, provost of Worcester Col-

* * * TELETYPE MODEL 43 INVENTORY SALE * * *	
<b>TELETYPE</b> <b>Model 4320 AAA</b> ..... \$ 885. 220V. model with transformer installed inside cabinet ..... \$ 985. <b>Model 43ASR</b> , 8 level, 1" tape . \$2,595. Limited supply of Model 45 available.	<b>GRAPHICS SOFTWARE</b> On line, real time, for the M9900 to drive the Microangelo. For use in design of PC board masks, IC masks and other applications.
<b>TELEBUFFER 43 ASR</b> ..... \$945. Circuit card designed for internal installation in the Model 43 Teletype. Changes the 43 into a buffered send/receive device, enabling it to function as a Telex without paper tape. Provides from 4K to 16K bytes of internal memory for storage of message. Contents of memory may be edited and manipulated in preparation for transmission. Options include forms control and answer back.	<b>CORVUS HARD DRIVES</b> We are the S-100 CORVUS dealer in the New York area. Demonstrations by appointment. <b>MODEL 11, Hard Disk System</b> . \$4,820. <b>Mirror Backup System</b> ..... \$ 715. <b>Host Multiplexer</b> ..... \$ 675.
<b>IBM 3101 CRT Model 10</b> ..... \$1,195. <b>Model 20</b> ..... \$1,395. Selectric-like, detached keyboard. 9x16 dot matrix. Maintenance contract from IBM only \$70 per year	<b>MULTI-BUS</b> Z-8000 CPU and supporting boards. From Central Data Corp. Complete systems starting at ..... \$6,500.
<b>ITHACA INTERSYSTEMS</b> Full S-100 IEEE Compatibility! Full 24 address bits. DMA disk controller. SYSTEM 2A includes 20 slot mainframe with front panel, 64K Dynamic RAM. Z80 CPU. 4 MHZ, extended addressing capability. 4 parallel, 2 serial I/O floppy controller. Our discounted price \$3,415.	<b>UPGRADE DEC LA 35/36</b> .... \$750. Increases baud rate to 1200. Microprocessor controlled. Many options available. Enthusiastic user response. Long-term reliability. From DataSouth.
<b>MARINCHIP SYSTEMS M9900</b> Elegant 16 bit CPU. S-100 compatible, multi user, multi processor operating system. BASIC, FORTH, META, PASCAL, Word processor, text editor. CPU kit and software package . \$ 550. Assembled ..... \$ 700. Complete system, 64KB, two drives ..... \$5,400.	<b>COMPUTER TO COMPUTER COMMUNICATIONS</b> Enables communications from a micro to a terminal or to another micro, mini or maxi computer. Modes of operation: TERMINAL (your system acts like an intelligent terminal), FILE-TO-FILE, LOCAL (Disk commands), Full/Half Duplex on 8" or 5" disks. COM to COM mode does full CRC 16 error check and retransmits block on error. Object Code \$75. Source Code \$250.
<b>MICROANGELO</b> ..... \$2,280. High resolution graphics system. 15", 22MHZ, green phosphor screen, 72 key keyboard; includes complete cabling and software. From SCION. S-100 Graphics card ..... \$ 960.	<b>THE MAX BOX</b> 8" Dual Drive Cabinet complete with power supply and fan. Will hold Qumes, Shugarts or Siemens. Excellent design and engineering ..... \$400.
<b>CAT from NOVATION</b> Originate/Answer back ..... \$175. <b>CAT-D</b> ..... \$185. Connects directly to telephone line with a plug-in jack. Eliminates need for acoustic coupler.	

WE OFFER A FULL RANGE OF EXPERT CONSULTING SERVICES COVERING ALL AREAS OF COMPUTER APPLICATIONS AND SYSTEMS

**JOHN D. OWENS**  
**Associates, Inc.**  
**SEE OUR AD ON FACING PAGE**

## DISK DRIVES

8"

**Shugart 801R** ..... \$395.00  
Sgl/Sided Dbl/Den

**Qume Datatrak 8" dbl sided, dbl density**  
QME-8DS (851R) compatible ... **\$625.00**  
Pkg of two ..... **\$1150.00**

5 1/4"

**MPI-B51 MPI B-51** ..... **\$250.00**  
Sgl Sided Sgl/Dbl Den  
Exact Replacement for SA-400

**MPI-B52 MPI B-52** ..... **\$350.00**  
Dbl Sided, Dbl Den

**MPI-B91 MPI B-91** ..... **\$375.00**  
Sgl Sided, Dbl Den, 77 tracks

**Shugart SA400 SHU-SA400** ..... **\$250.00**  
Sgl Sided, Dbl/Den

## QT DISK PACKAGES

**DDC-88-1** Dbl Den Controller, A&T, two 8" dbl den drives (801R) CP/M®  
2.2 cabinet, power supply & cables ..... **SPECIAL \$1395.00**

**DDC-88-2** Two 801R disk drives with cabinet, power supply, fan &  
cables ..... **\$1100.00**

**DDC-88-22** Two DT-8 Qume drives with cabinet, power supply, fan  
& cables ..... **\$1500.00**

**DDC-88-3** Cabinet with power supply, fan & cables ..... **\$250.00**

**DDC-88-4** Cabinet only ..... **\$75.00**



**COMPUTER  
SYSTEMS  
INC.**

15620 South Inglewood Ave.  
Lawndale, California 90260  
(213) 970-0952

**WE ACCEPT M/C, VISA, AM EXP  
PLACE ORDERS TOLL FREE  
1-800-421-5150**

**(CONTINENTAL U.S. ONLY)  
(EXCEPT CALIFORNIA)**

CP/M is a trademark of Digital Research

## FINDING SOLUTIONS AND BEING COMPETITIVE IS OUR BUSINESS.

Having problems and looking for a  
computer to help solve them?

Are you finding computer dealers  
come in one of two ways? Either  
Full system support with Full price  
or Take it or Leave it with Low  
price. At Omega we don't believe  
that you should have to make a  
choice. Yes, we're in business to sell  
products but also, to solve your  
problems. Our prices will be the  
lowest possible. Our support and  
product quality will be second to none. Check out our Mail Order prices in this  
ad (our retail prices will be higher). See if you don't agree with our first claim.  
For our second claim, call us with your data processing needs and problems.  
Better yet, come in and see us. Finding solutions and being competitive is our  
business. We never forget either of them.



**apple computer**  
Authorized Dealer

APPLE III ..... **CALL**  
APPLE II "PLUS" 48K ..... \$ 1169.95  
HEWLETT PACKARD 85 or 83 ..... **CALL**

### APPLE II ACCESSORIES:

Disk II with controller ..... \$ 535.00  
Disk II 2nd drive ..... 455.00  
Graphics Tablet ..... 665.00  
Language System with PASCAL ..... 395.00  
Silentype Printer W/Int ..... 526.00  
Integer Firmware Card ..... 152.00  
Microsoft Z-80 Softcard ..... 259.00  
Videx videoterm 80 col Card ..... 279.00  
Sanyo 12" Green Monitor ..... 269.00

Mail Order Terms of Sales: Price based on prepaid orders. NO COD's. Visa or Master Charge orders add 3% to purchase price. Allow 14 working days for personal and company checks to clear. Order under \$100.00 add \$3.00 for shipping and handling. All orders (unless specified in ad) within Continental U.S. shipped U.P.S. no charge. APO or out of Continental U.S. write or call for shipping charges. All prices subject to change and all offers subject to withdrawal without notice. CA residents add 6% sales tax.

**Supplies:**  
Scotch Diskettes - Best of Quality!  
price per box of (10)  
744-0, 10, 32 ..... \$ 27.00  
740-0 SS/SD 0 Sector ..... 31.00  
741-0 SS/DD 0 Sector ..... 37.00  
743-0 DS/DD No Format ..... 44.00

**New Products:**  
Videx L/C Adapter ..... 110.00  
Microsoft 16K RAM Card ..... 169.00  
D.C. Hayes Micromodem II ..... 315.00  
Novation DCAT Modem ..... 195.00  
EPSON MX-80 ..... **CALL**

## OMEGA MICRO COMPUTERS

The Problem Solving Company

3447 Torrance Boulevard • Torrance, California 90503 • (213) 370-9456

lege, Oxford, England, are keynote speakers. For information, contact the Manager of Media Relations, Philip Morris Inc, 100 Park Ave, New York NY 10017.

April 1-3

**Assuring Quality in Electronic Data Processing Applications**, McCormick Inn Hotel, Chicago IL. The objective of this conference is to explain the methods, tools, and techniques that are valuable in improving the quality of computerized applications. Tutorials cover the areas of quality assurance; managing structured design; and designing, implementing, and enforcing application standards. Contact DPMA Quality Assurance Conference, 12611 Davan Dr, Silver Spring MD 20904, (301) 622-0066.

April 3-5

**The Sixth West Coast Computer Faire**, Civic Auditorium, San Francisco CA. The Faire, a major personal-computing event, has continually attracted larger and larger numbers of exhibitors and attendees. A full program of talks plus a large display of hardware and software are featured. For more information, contact Computer Faire, 333 Swett Rd, Woodside CA 94062, (415) 851-7075.

April 6-10

**Tutorial Week—East**, Orlando Marriott Inn, Orlando FL. Tutorials on VLSI (very large-scale integration) and microprocessors and graphics, software-engineering methodology and testing, and distributed computing and networks will be presented. For IEEE members, the cost is \$400; for nonmembers, the cost is \$475. Contact Tutorial Week—East, POB 639, Silver Spring MD 20901, (301) 439-7007.

April 7-8

**Top Secrets '81**, Pointe Resort, Phoenix AZ. Honeywell's annual computer security and privacy conference. Many author-

ities in the field of data security will discuss the business and legal impact of the latest incidents in computer crime and abuse. The conference fee is \$500. Contact the Security Symposium Registrar, Honeywell Information Systems, M/S T-99-4, POB 6000, Phoenix AZ 85005, (800) 528-5343.

April 7-9

**Computerized Office Equipment Expo**, O'Hare Exposition Center, Rosemont IL. More than 200 exhibitors will feature their office equipment at this show. Executives and administrators from wholesale, retail, commercial, financial, and industrial establishments are invited, along with the general public. Contact Industrial & Scientific Conference Management Inc, 222 W Adams St, Chicago IL 60606, (312) 263-4866.

April 7-9

**Electro/81**, New York Coliseum and Sheraton Centre Hotel, New York NY. Electro/81 will feature computers and computer-related equipment, plus seminars on components, devices, and materials; computer communications; memories; office automation; speech; and more. Contact Electronic Conventions Inc, 999 N Sepulveda Blvd, Suite 410, El Segundo CA 90245, (800) 421-6816; in California (213) 772-2965.

April 13-16

**The Fifteenth International Symposium on Minicomputers and Microcomputers**, MIMI '81, Sheraton Hotel, Mexico City, Mexico. The scope of this symposium covers hardware, software, distributed processor architecture, computer networks, telecommunications, real-time applications, education, and more. Contact Ing. Jorge Gil, Academic Secretary, MIMI Symposium, IIMAS-UNAM, Apartado Postal 20-726, Mexico 20 D F, Mexico.

April 26-30

**Saudibusiness '81**, Riyadh, Saudi Arabia. This show has

## System Log

3:10 P.M. - *System Down!*

4:45 P.M. - *Problem diagnosed using DIAGNOSTICS II.*

*Board replaced and system back on line.*

# DIAGNOSTICS II

**Diagnostics II is SuperSoft's expanded Diagnostic package.**

Diagnostic II builds upon the highly acclaimed Diagnostics I. It will test each of the five areas of your system:

Memory      Terminal      Printer      CPU      Disk

## Every test is expanded.

Every test is "submit"-able. A "submit" file is included in the package which "chains" together the programs in Diagnostics II, achieving an effective acceptance test. All output can be directed to a log file for unattended operation, for example over night testing. Terminal test is now generalized for most crt terminals. A quick-test has been added for quick verification of the working of the system.

The memory test is the best one we have encountered. It has new features, including:

- default to the size of the CP/M Transient Program Area (TPA)
- printout of a graphic memory map
- bank selection option
- burn in test
- memory speed test

Diagnostics-II still includes the only CPU test for 8080/8085/Z80.

A Spinwriter/Diablo/Qume test has been added, which tests for the positioning and control features of the Spinwriter/Diablo/Qume as well as its ASCII printing features. (Serial Interface only)

**And, as with all SuperSoft products, a complete online HELP system and user manual is included.**

Price: \$100.00 (manual only): \$15.00

Requires: 32K CP/M

CP/M Formats: 8" soft sector, 5" Northstar, 5" Micropolis  
Mod II, Vector MZ, Superbrain DD/QD



**All Orders and General Information:**

**SUPERSOFT ASSOCIATES**

P.O. BOX 1628

CHAMPAIGN, IL 61820

(217) 359-2112

Technical Hot Line: (217) 359-2691

(answered only when technician is available)

CP/M REGISTERED TRADEMARK DIGITAL RESEARCH

*SuperSoft*

**First in Software Technology**

**FREE**  
with software purchase—  
choice of:  
1. One year subscription to **InfoWorld**  
2. CP/M Summary (\$4.95 value)

Ad#11

# DISCOUNT SOFTWARE

✓ **new items/new prices.**

**FANTASTIC PRICE PROTECTION POLICY**

We'll match any advertised price on any item that we carry. And if you find a lower price on what you bought within 30 days of buying it, just show us the ad and we'll refund the difference.

It's that simple.

Combine our price protection with the availability of full professional support and our automatic update service and you have the Ultimate Software Plan.

It's a convenient, uncomplicated, logical way to get your software.

DISK WITH  
MANUAL  
ONLY

## CP/M\*

**OSBORNE** †  
General Ledger# ..... \$ 59/\$20  
Acct Rec/Acct Pay# ..... \$ 59/\$20  
Payroll w/Cost# ..... \$ 59/\$20  
Buy 2 get 1 free ..... \$ 118/\$57  
All 3 & CBASIC-2 ..... \$ 199/\$71

## DIGITAL RESEARCH

CP/M 2.2 Northstar ..... \$ 149/\$25  
✓ CP/M 2.2 Micropolis ..... \$ 169/\$25  
✓ CP/M 2.2 Durango  
F-85 ..... \$ 169/\$25  
CP/M 2.2 Cromemco ..... \$ 189/\$25  
CP/M (other versions) ..... Call  
PL/I-80 ..... \$ 459/\$35  
Mac ..... \$ 85/\$15  
Sid ..... \$ 65/\$15  
Z-Sid ..... \$ 95/\$15  
Tex ..... \$ 70/\$15  
DeSpool ..... \$ 50/\$10

## MICROSOFT

Basic-80 ..... \$ 294/\$30  
Basic Compiler ..... \$ 334/\$30  
Fortran-80 ..... \$ 384/\$30  
Cobol-80 ..... \$ 574/\$30  
Macro-80 ..... \$ 144/\$20  
Edit-80 ..... \$ 84/\$20  
MuSimp/MuMath ..... \$ 224/\$25  
MultiSp-80 ..... \$ 174/\$20

## MICRO DATA BASE SYSTEMS

HDBS ..... \$ 250/\$40  
✓ MDBS ..... \$ 795/\$40  
Other ..... Call

## S.O.F.T.W.A.R.E.

MicroFax\*† ..... \$ 749/\$50  
Federal individual ..... \$ 249/\$25  
Federal corporate ..... \$ 249/\$25  
State individual ..... \$ 249/\$25

## TCS‡

✓ General Ledger ..... \$ 79/\$25  
✓ Acct Receivable ..... \$ 79/\$25  
✓ Acct Payable ..... \$ 79/\$25  
✓ Payroll ..... \$ 79/\$25  
✓ All 4 ..... \$ 269/\$99

## SUPERSOFT

Forth (8080 or Z80) ..... \$ 129/\$25  
Diagnostic I ..... \$ 49/\$20  
Other disk software ..... less 10%

## SOFTWARE WORKS

Adapt ..... \$ 69/ na  
Ratfor ..... \$ 86/ na

## COMPUTER PATHWAYS

Pearl (level 1)# ..... \$ 99/\$25  
✓ Pearl (level 2)# ..... \$ 299/\$40  
✓ Pearl (level 3)# ..... \$ 549/\$65

## COMPLETE BUSINESS SYSTEMS‡

✓ Creator ..... \$ 269/\$25  
✓ Reporter ..... \$ 169/\$20  
✓ Both ..... \$ 399/\$45

## MICROPRO

✓ WordStar ..... \$ 324/\$60  
Mail/Merge ..... \$ 114/\$25

CP/M users: specify disk systems and formats. Most formats available.

## THIS MONTH'S SPECIAL: T.I.M. DBMS JUST \$299.

Terrific for inventory, mailings, financial, you-name-it! Menu-driven, auto-sort, 32000 records per file, any number of files, and dynamite documentation!

✓ WordStar/Mail-Merge ..... \$ 434/\$85  
✓ DataStar ..... \$ 279/\$60  
✓ Word-Master ..... \$ 119/\$40  
✓ SuperSort I ..... \$ 199/\$40  
✓ SuperSort II ..... \$ 169/\$40  
✓ SuperSort III ..... \$ 119/\$40

## PEACHTREE\*†‡

General Ledger ..... \$ 399/\$40  
Acct Receivable ..... \$ 399/\$40  
Acct Payable ..... \$ 399/\$40  
Payroll ..... \$ 399/\$40  
Inventory ..... \$ 799/\$40  
Property Mgt ..... \$ 799/\$40  
C.P.A. Client Write-up ..... \$ 799/\$40  
Mailing Address ..... \$ 349/\$40

## STRUCTURED SYSTEMS

GL or AR or AP# ..... \$ 747/\$25  
Payroll# ..... \$ 747/\$25  
Inventory Control# ..... \$ 447/\$40  
Analyst# ..... \$ 197/\$20  
Letterright# ..... \$ 167/\$20  
NAD# ..... \$ 87/\$20  
QSORT ..... \$ 87/\$20

## GRAHAM-DORIAN†

General Ledger# ..... \$ 693/\$40  
Acct Receivable# ..... \$ 693/\$40  
Acct Payable# ..... \$ 693/\$40  
Job Costing# ..... \$ 693/\$40  
Payroll# ..... \$ 493/\$40  
Inventory# ..... \$ 493/\$40  
Cash Register# ..... \$ 493/\$40  
Apartment Mgt# ..... \$ 493/\$40

## MICRO-AP

Selector III-C2# ..... \$ 269/\$20  
Selector IV# ..... \$ 469/\$35  
✓ S-Basic ..... \$ 269/\$25

## WHITESMITHS

"C" Compiler★ ..... \$ 600/\$30  
Pascal (incl "C")★ ..... \$ 750/\$45

## EIDOS SYSTEMS

Kiss ..... \$ 299/\$25  
K-Basic ..... \$ 529/\$50

## ORGANIC SOFTWARE

TextWriter III ..... \$ 111/\$20  
DataBook ..... \$ 269/\$25

## SoHo Group

✓ MatchMaker ..... \$ 97/\$20  
✓ Worksheet ..... \$ 177/\$20

## "OTHER GOODIES"

Tiny "C" ..... \$ 89/\$50  
✓ Tiny "C" Compiler ..... \$ 229/\$50  
✓ CBASIC-2 ..... \$ 89/\$15  
Pascal/Z ..... \$ 369/\$30

Pascal/UCSD ..... \$ 299/\$30  
Pascal/MT+ ..... \$ 224/\$30  
Pascal/M ..... \$ 149/\$20  
Nevada Cobol ..... \$ 129/\$25  
✓ Raid ..... \$ 229/\$25  
✓ MAGSAM III ..... \$ 129/\$25  
✓ MAGSAM IV ..... \$ 259/\$25  
✓ BSTAM ..... \$ 129/\$10  
FMS-80 ..... \$ 649/\$45  
dBASE II DBMS ..... \$ 629/\$50  
Condor DBMS ..... \$ 599/\$30  
Vulcan DBMS ..... \$ 469/\$30  
T.I.M. DBMS† ..... \$ 329/\$35  
CBS ..... \$ 369/\$45  
Whatsit? ..... \$ 149/\$25  
✓ Ultra-Sort II ..... \$ 159/\$25  
✓ MicroStat ..... \$ 224/\$15  
String/80 ..... \$ 84/\$20  
✓ Vedit ..... \$ 99/\$15  
Postmaster ..... \$ 149/\$20  
WordSearch ..... \$ 179/\$25  
SpellGuard ..... \$ 269/\$25  
Spell Binder ..... \$ 349/\$45  
✓ VTS/80 ..... \$ 489/\$65  
✓ Magic Wand ..... \$ 299/\$45  
Electric Pencil II ..... less 15%  
CPAids ..... less 12%

## APPLE II\*

## MICROSOFT

Softcard (CP/M) ..... \$ 292  
Cobol ..... \$ 574

## PERSONAL SOFTWARE

Visicalc\* ..... \$ 122  
CCA Data Mgr ..... \$ 84  
Desktop/Plan ..... \$ 84  
✓ Zork ..... \$ 34

## PEACHTREE\*†‡

General Ledger ..... \$ 224/\$40  
Acct Receivable ..... \$ 224/\$40  
Acct Payable ..... \$ 224/\$40  
Payroll ..... \$ 224/\$40  
Inventory ..... \$ 224/\$40

## MUSE

Super-Text II ..... \$ 127  
Other disk software ..... less 10%

## STC (Software Tech.)

✓ Prof. Time & Billing ..... \$ 279  
Other ..... less 15%

## "OTHER GOODIES"

✓ Data Factory ..... \$ 129  
✓ Whatsit? ..... \$ 129  
✓ Creator ..... \$ 229  
✓ LedgerPlus (GL A/R & A/P) ..... \$ 549

## TRS-80\* MODEL II

CP/M 2.2 (P&T) ..... \$ 159/\$35  
Electric Pencil II ..... less 15%

## NORTHSTAR

✓ NorthWord ..... \$ 299  
✓ Mail Manager ..... \$ 239  
✓ Info Manager ..... \$ 369  
✓ General Ledger ..... \$ 749  
✓ Acct Receivable ..... \$ 449  
✓ Acct Payable ..... \$ 449

been designed for the fast-growing Saudi Arabian business community. Pavilions by the United States, the United Kingdom, West Germany, France, Italy, and approximately fifteen other countries will be featured. For more information, contact Donald Ryan, Project Manager, Rm 3200, US Department of Commerce, Washington DC 20230, (202) 377-4652.

## May 1981

May 2

**National Computer Problem-Solving Contest for Junior and Senior High School Students**, throughout the US. Small teams of junior and senior high school students will compete for two hours on computer systems to solve five programming problems. Winners will be judged on whether their programs run properly using the test data supplied in the problem, are easy to read, logical, imaginative, and creative.

To receive a copy of the 1981 contest problems, local school directors should contact the University of Wisconsin—Parkside by April 4. Directors must agree to keep the problems confidential until the day of the contest. After that, any organization can use the problems to conduct their own contest.

Local contest winners can enter the national and international contest. A national and worldwide ranking will be determined by a team of judges from the University of Wisconsin—Parkside. All interested schools or organizations can share the 1981 contest problems.

For additional information, write Dr Donald T Piele, Associate Professor of Mathematics, University of Wisconsin—Parkside, Kenosha WI 53141.

May 4-7

**National Computer Conference**, McCormick Pl, Chicago IL. Approximately 90,000 people are expected

\*—Special Bonus with order †—Requires microsoft BASIC ‡—Supplied in source code #—Requires CBASIC-2 ®—Mfgs. Trademark

ORDERS ONLY—CALL TOLL FREE VISA • MASTERCHARGE

1-800-854-2003 ext. 823 • Calif. 1-800-522-1500 ext. 823

Overseas—add \$10 plus additional postage • Add \$2.50 postage and handling per each item • California residents add 6% sales tax • Allow 2 weeks on checks, C.O.D. ok • Prices subject to change without notice All items subject to availability •

**THE DISCOUNT SOFTWARE GROUP**

1610 Argyle Ave., Bldg. 102 • Los Angeles, CA 90028 • (213) 666-7677

to attend the National Computer Conference (NCC) this year. The use of robots and artificial intelligence will be among the program sessions at the Personal-Computing Festival during the NCC.

For the first time, personal-computing exhibits will join the rest of the conference in the main exhibit area. Over thirty technical sessions will be held. All major companies will be represented. Contact the American Federation of Information Processing Societies Inc, POB 9658, 1815 N Lynn St, Arlington VA 22209, (703) 558-3617.

May 11-13

**The Thirty-First Electronic Components Conference,** Colony Square Hotel, Atlanta GA. Papers on semiconductor-processing technology, optoelectronic devices, manufacturing technology, hybrid microcircuits, discrete components, interconnections, reliability, and connectors will be read. Contact T G Grau, Bell Laboratories, Whippany Rd, Rm 3B-312, Whippany NJ 07981; or Electronics Industries Association, 2001 Eye St NW, Washington DC 20006.

May 14-16

**The Tenth ASIS Mid-Year Meeting,** Fort Lewis College, Durango CO. The American Society for Information Science's (ASIS) theme for this meeting is "Using Information." Among the topics to be addressed are user studies, decision making, organizational change, government, education, management, access to information, and designing information systems for use. For information, contact ASIS, 1010 16th St NW, Washington DC 20036, (202) 659-3644.

May 17-20

**Expo '81,** Loew's Anatole Hotel, Dallas TX. Expo '81 is a combination of exhibits and technical sessions. The exhibits cover everything from graphics systems to industrial computer-control systems. The technical ses-

## CPU's & SUPPORT CHIPS

8080A	- 5.95	2114L3	- 3.95
8085A	- 12.95	4116-3	- 3.75
AMD 2901	- 13.95	4116-2	- 3.75
8205	- 3.95	21L02-3	- .99
8212	- 2.75	2102-4	- .90
8216	- 2.90	2102-3	- .90
8226	- 2.75	2107B-5280	- 1.75
8228	- 4.50	MM5270	- 1.45
8251	- 6.95	MM5270	- 1.45
8259	- 6.95	MM5270	- 1.45
8257 (AM9517)	- 8.95	MM5270	- 1.45
280A SD	- 17.95	MM5270	- 1.45
8275	- 16.95	MM5270	- 1.45
FD1791	- 34.95	MM5270	- 1.45

## UART's

AY5 1013	- 3.75	8251	- 6.95
TR1602U1	- 3.95	82512	- 4.95
AY3-8500	- 1.95	82512	- 4.95
TP1482B	- 3.25	82513	- 3.95

## INTERFACE & DRIVERS

1488	- 1.25	82513	- 3.95
1489	- 1.25	82513	- 3.95
8130	- 2.50	82513	- 3.95
8131	- 2.50	82513	- 3.95
8830	- 2.50	82513	- 3.95
8833	- 2.50	82513	- 3.95
8834	- 2.00	82513	- 3.95
8837	- 2.00	82513	- 3.95
8838	- 2.00	82513	- 3.95
81380	- 2.00	82513	- 3.95

## SHIFT REGISTERS

MM1402	- 1.75	82513	- 3.95
MM1403	- 1.75	82513	- 3.95
MM1404	- 1.75	82513	- 3.95
MM1503	- 2.50	82513	- 3.95
MM1506	- 2.50	82513	- 3.95
MM1508	- 2.50	82513	- 3.95
MM1509	- 2.50	82513	- 3.95
MM1510	- 2.50	82513	- 3.95

## PRINTED CIRCUIT BOARD

4" x 6" DOUBLE SIDED	- 5.95
4" x 6" SINGLE SIDED	- 5.95
4" x 6" SINGLE SIDED	- 5.95
4" x 6" SINGLE SIDED	- 5.95

## CRYSTALS

2.000 MHz	- 3.45 ea.	4.000 MHz	- 3.45 ea.
3.000 MHz	- 3.45 ea.	5.000 MHz	- 3.45 ea.
4.000 MHz	- 3.45 ea.	6.000 MHz	- 3.45 ea.
5.000 MHz	- 3.45 ea.	7.000 MHz	- 3.45 ea.
6.000 MHz	- 3.45 ea.	8.000 MHz	- 3.45 ea.

## CRYSTALS

2.000 MHz	- 3.45 ea.	4.000 MHz	- 3.45 ea.
3.000 MHz	- 3.45 ea.	5.000 MHz	- 3.45 ea.
4.000 MHz	- 3.45 ea.	6.000 MHz	- 3.45 ea.
5.000 MHz	- 3.45 ea.	7.000 MHz	- 3.45 ea.
6.000 MHz	- 3.45 ea.	8.000 MHz	- 3.45 ea.

## CRYSTALS

2.000 MHz	- 3.45 ea.	4.000 MHz	- 3.45 ea.
3.000 MHz	- 3.45 ea.	5.000 MHz	- 3.45 ea.
4.000 MHz	- 3.45 ea.	6.000 MHz	- 3.45 ea.
5.000 MHz	- 3.45 ea.	7.000 MHz	- 3.45 ea.
6.000 MHz	- 3.45 ea.	8.000 MHz	- 3.45 ea.

## CRYSTALS

2.000 MHz	- 3.45 ea.	4.000 MHz	- 3.45 ea.
3.000 MHz	- 3.45 ea.	5.000 MHz	- 3.45 ea.
4.000 MHz	- 3.45 ea.	6.000 MHz	- 3.45 ea.
5.000 MHz	- 3.45 ea.	7.000 MHz	- 3.45 ea.
6.000 MHz	- 3.45 ea.	8.000 MHz	- 3.45 ea.

## CRYSTALS

2.000 MHz	- 3.45 ea.	4.000 MHz	- 3.45 ea.
3.000 MHz	- 3.45 ea.	5.000 MHz	- 3.45 ea.
4.000 MHz	- 3.45 ea.	6.000 MHz	- 3.45 ea.
5.000 MHz	- 3.45 ea.	7.000 MHz	- 3.45 ea.
6.000 MHz	- 3.45 ea.	8.000 MHz	- 3.45 ea.

## CRYSTALS

2.000 MHz	- 3.45 ea.	4.000 MHz	- 3.45 ea.
3.000 MHz	- 3.45 ea.	5.000 MHz	- 3.45 ea.
4.000 MHz	- 3.45 ea.	6.000 MHz	- 3.45 ea.
5.000 MHz	- 3.45 ea.	7.000 MHz	- 3.45 ea.
6.000 MHz	- 3.45 ea.	8.000 MHz	- 3.45 ea.

## CRYSTALS

2.000 MHz	- 3.45 ea.	4.000 MHz	- 3.45 ea.
3.000 MHz	- 3.45 ea.	5.000 MHz	- 3.45 ea.
4.000 MHz	- 3.45 ea.	6.000 MHz	- 3.45 ea.
5.000 MHz	- 3.45 ea.	7.000 MHz	- 3.45 ea.
6.000 MHz	- 3.45 ea.	8.000 MHz	- 3.45 ea.

## CRYSTALS

2.000 MHz	- 3.45 ea.	4.000 MHz	- 3.45 ea.
3.000 MHz	- 3.45 ea.	5.000 MHz	- 3.45 ea.
4.000 MHz	- 3.45 ea.	6.000 MHz	- 3.45 ea.
5.000 MHz	- 3.45 ea.	7.000 MHz	- 3.45 ea.
6.000 MHz	- 3.45 ea.	8.000 MHz	- 3.45 ea.

## CRYSTALS

2.000 MHz	- 3.45 ea.	4.000 MHz	- 3.45 ea.
3.000 MHz	- 3.45 ea.	5.000 MHz	- 3.45 ea.
4.000 MHz	- 3.45 ea.	6.000 MHz	- 3.45 ea.
5.000 MHz	- 3.45 ea.	7.000 MHz	- 3.45 ea.
6.000 MHz	- 3.45 ea.	8.000 MHz	- 3.45 ea.

## CRYSTALS

2.000 MHz	- 3.45 ea.	4.000 MHz	- 3.45 ea.
3.000 MHz	- 3.45 ea.	5.000 MHz	- 3.45 ea.
4.000 MHz	- 3.45 ea.	6.000 MHz	- 3.45 ea.
5.000 MHz	- 3.45 ea.	7.000 MHz	- 3.45 ea.
6.000 MHz	- 3.45 ea.	8.000 MHz	- 3.45 ea.

## CRYSTALS

2.000 MHz	- 3.45 ea.	4.000 MHz	- 3.45 ea.
3.000 MHz	- 3.45 ea.	5.000 MHz	- 3.45 ea.
4.000 MHz	- 3.45 ea.	6.000 MHz	- 3.45 ea.
5.000 MHz	- 3.45 ea.	7.000 MHz	- 3.45 ea.
6.000 MHz	- 3.45 ea.	8.000 MHz	- 3.45 ea.

## CRYSTALS

2.000 MHz	- 3.45 ea.	4.000 MHz	- 3.45 ea.
3.000 MHz	- 3.45 ea.	5.000 MHz	- 3.45 ea.
4.000 MHz	- 3.45 ea.	6.000 MHz	- 3.45 ea.
5.000 MHz	- 3.45 ea.	7.000 MHz	- 3.45 ea.
6.000 MHz	- 3.45 ea.	8.000 MHz	- 3.45 ea.

## CRYSTALS

2.000 MHz	- 3.45 ea.	4.000 MHz	- 3.45 ea.
3.000 MHz	- 3.45 ea.	5.000 MHz	- 3.45 ea.
4.000 MHz	- 3.45 ea.	6.000 MHz	- 3.45 ea.
5.000 MHz	- 3.45 ea.	7.000 MHz	- 3.45 ea.
6.000 MHz	- 3.45 ea.	8.000 MHz	- 3.45 ea.

## CRYSTALS

2.000 MHz	- 3.45 ea.	4.000 MHz	- 3.45 ea.
3.000 MHz	- 3.45 ea.	5.000 MHz	- 3.45 ea.
4.000 MHz	- 3.45 ea.	6.000 MHz	- 3.45 ea.
5.000 MHz	- 3.45 ea.	7.000 MHz	- 3.45 ea.
6.000 MHz	- 3.45 ea.	8.000 MHz	- 3.45 ea.

## CRYSTALS

2.000 MHz	- 3.45 ea.	4.000 MHz	- 3.45 ea.
3.000 MHz	- 3.45 ea.	5.000 MHz	- 3.45 ea.
4.000 MHz	- 3.45 ea.	6.000 MHz	- 3.45 ea.
5.000 MHz	- 3.45 ea.	7.000 MHz	- 3.45 ea.
6.000 MHz	- 3.45 ea.	8.000 MHz	- 3.45 ea.

## CRYSTALS

2.000 MHz	- 3.45 ea.	4.000 MHz	- 3.45 ea.
3.000 MHz	- 3.45 ea.	5.000 MHz	- 3.45 ea.
4.000 MHz	- 3.45 ea.	6.000 MHz	- 3.45 ea.
5.000 MHz	- 3.45 ea.	7.000 MHz	- 3.45 ea.
6.000 MHz	- 3.45 ea.	8.000 MHz	- 3.45 ea.

## RAM's

4001	- 25	4027	- 45	4081	- 25	74C74	- 50
4002	- 25	4028	- 60	4082	- 25	74C76	- 70
4006	- 25	4029	- 95	4083	- 75	74C78	- 130
4007	- 27	4030	- 35	4088	- 175	74C78	- 140
4008	- 80	4034	- 225	4501	- 95	74C86	- 50
4009	- 45	4035	- 12	4510	- 75	74C90	- 40
4010	- 45	4040	- 90	4511	- 75	74C93	- 95
4011	- 25	4042	- 65	4514	- 195	74C95	- 175
4012	- 45	4043	- 100	4515	- 135	74C95	- 175
4013	- 37	4044	- 75	4516	- 100	74C160	- 120
4014	- 10	4046	- 60	4518	- 120	74C161	- 115
4015	- 65	4049	- 45	4520	- 70	74C163	- 115
4016	- 37	4050	- 85	4523	- 27	74C165	- 125
4017	- 70	4051	- 80	74C50	- 27	74C173	- 130
4018	- 60	4052	- 110	74C52	- 27	74C174	- 130
4019	- 45	4053	- 110	74C54	- 27	74C175	- 130
4020	- 70	4066	- 70	74C58	- 30	74C182	- 130
4021	- 80	4067	- 70	74C59	- 27	74C201	- 50
4022	- 100	4071	- 35	74C14	- 120	74C26	- 695
4023	- 25	4072	- 25	74C20	- 27		
4024	- 55	4074	- 80	74C25	- 35		
4025	- 25	4077	- 35	74C73	- 75		

## ROM's

2708	- 6.95	2716	- 12.95
2716	- 12.95	2716	- 12.95
2716	- 12.95	2716	- 12.95
2716	- 12.95	2716	- 12.95
2716	- 12.95	2716	- 12.95
2716	- 12.95	2716	- 12.95
2716	- 12.95	2716	- 12.95
2716	- 12.95	2716	- 12.95
2716	- 12.95	2716	- 12.95
2716	- 12.95	2716	- 12.95

## SHIFT REGISTERS

MM1402	- 1.75	8251	- 6.95
MM1403	- 1.75	82512	- 4.95
MM1404	- 1.75	82512	- 4.95
MM1503	- 2.50	82513	- 3.95
MM1506	- 2.50	82513	- 3.95
MM1508	- 2.50	82513	- 3.95
MM1509	- 2.50	82513	- 3.95
MM1510	- 2.50	82513	- 3.95

## PRINTED CIRCUIT BOARD

4" x 6" DOUBLE SIDED	- 5.95
4" x 6" SINGLE SIDED	- 5.95
4" x 6" SINGLE SIDED	- 5.95
4" x 6" SINGLE SIDED	- 5.95

## CRYSTALS

2.000 MHz	- 3.45 ea.	4.000 MHz	- 3.45 ea.
3.000 MHz	- 3.45 ea.	5.000 MHz	- 3.45 ea.
4.000 MHz	- 3.45 ea.	6.000 MHz	- 3.45 ea.
5.000 MHz	- 3.45 ea.	7.000 MHz	- 3.45 ea.
6.000 MHz	- 3.45 ea.	8.000 MHz	- 3.45 ea.

## CRYSTALS

2.000 MHz	- 3.45 ea.	4.000 MHz	- 3.45 ea.
3.000 MHz	- 3.45 ea.	5.000 MHz	- 3.45 ea.
4.000 MHz	- 3.45 ea.	6.000 MHz	- 3.45 ea.
5.000 MHz	- 3.45 ea.	7.000 MHz	- 3.45 ea.
6.000 MHz	- 3.45 ea.	8.000 MHz	- 3.45 ea.

## CRYSTALS

2.000 MHz	- 3.45 ea.	4.000 MHz	- 3.45 ea.
3.000 MHz	- 3.45 ea.	5.000 MHz	- 3.45 ea.
4.000 MHz	- 3.45 ea.	6.000 MHz	- 3.45 ea.
5.000 MHz	- 3.45 ea.	7.000 MHz	- 3.45 ea.
6.000 MHz	- 3.45 ea.	8.000 MHz	- 3.45 ea.

## CRYSTALS

.40	74S151	1.25	ALCO MINATURET MTA 106 SPDT. MTA 206DPDT MTA 206B-DPDT
.40	74S157	1.25	
.60	74S158	1.25	
1.90	74S174	1.40	

CALL TOLL FREE

**800-538-5000**CALL US FOR VOLUME QUOTES. ALL MERCHANDISE 100% GUARANTEED.  
WE WILL BEAT ANY COMPETITORS PRICES. GIVE US A CALL AND WE'LL PROVE IT.**NEC UPD416C-2  
4116-200NS**8/29.95 100/3.45<sub>EA</sub>**2716-SINGLE SUPPLY**10.95<sub>EA</sub> 8/9.95<sub>EA</sub>2708 6.25<sub>EA</sub> 8/5.95<sub>EA</sub>**2114L-3 4K STATIC  
LOW POWER 300 NS**8/29.95 100/3.49<sub>EA</sub>21L02 Low Power 450NS 1.29<sub>EA</sub>2102 450NS .99<sub>EA</sub>**LS SERIES****LOOK AT THIS LS PRICING!**

74LS00	.32	74LS73	.44	74LS156	.95	74LS251	1.32
74LS01	.28	74LS74	.48	74LS157	.79	74LS253	.89
74LS02	.38	74LS75	.58	74LS158	.82	74LS257	.89
74LS03	.32	74LS76	.50	74LS160	.94	74LS258	.89
74LS04	.35	74LS78	.59	74LS161	.99	74LS259	2.89
74LS05	.28	74LS83	.90	74LS162	.99	74LS260	.68
74LS08	.38	74LS85	1.23	74LS163	.99	74LS266	.68
74LS09	.38	74LS86	.45	74LS164	.99	74LS273	1.69
74LS10	.32	74LS90	.70	74LS165	.99	74LS275	3.39
74LS11	.29	74LS92	.82	74LS166	2.40	74LS279	.59
74LS12	.29	74LS93	.71	74LS168	1.79	74LS283	1.03
74LS13	.38	74LS95	1.11	74LS169	1.79	74LS290	1.25
74LS14	.99	74LS96	.86	74LS170	1.89	74LS293	1.89
74LS15	.35	74LS107	.43	74LS173	.82	74LS295	1.09
74LS20	.26	74LS109	.49	74LS174	1.19	74LS298	1.24
74LS21	.30	74LS112	.48	74LS175	1.09	74LS352	1.59
74LS22	.34	74LS113	.48	74LS181	2.19	74LS353	1.59
74LS26	.40	74LS114	.55	74LS190	1.15	74LS363	1.39
74LS27	.35	74LS122	.55	74LS191	1.31	74LS365	.99
74LS28	.39	74LS123	.99	74LS192	.88	74LS366	.99
74LS30	.35	74LS125	.99	74LS193	.98	74LS367	.99
74LS32	.39	74LS126	.88	74LS194	1.80	74LS368	.99
74LS33	.54	74LS132	.69	74LS195	1.39	74LS373	1.85
74LS37	.78	74LS136	.58	74LS196	.82	74LS374	1.81
74LS38	.39	74LS138	.79	74LS197	.82	74LS377	1.48
74LS40	.25	74LS139	.79	74LS221	1.28	74LS385	1.90
74LS42	.79	74LS145	1.19	74LS240	1.89	74LS386	.65
74LS47	.78	74LS148	1.39	74LS241	1.89	74LS390	1.90
74LS48	.78	74LS151	.79	74LS242	1.89	74LS393	1.90
74LS51	.35	74LS153	.79	74LS243	1.89	74LS395	1.69
74LS54	.35	74LS154	2.39	74LS244	1.79	74LS670	2.20
74LS55	.32	74LS155	1.19	74LS245	2.89		

**8080 SUPPORT**

8212	2.75
8214	5.25
8216	2.75
8224	2.95
8226	3.49
8228	4.95
8238	5.50
8251	6.95
8253	12.95
8255	6.50
8257	16.95
8259	14.95
8275	49.95
8279	15.95

**CPU's**

Z-80	9.95
Z-80A	12.95
8080A	3.95
8085A	12.95
2650	12.95

**.43"LED DISPLAY  
BEAUTIFUL RED  
7 SEGMENT DISPLAY  
HP 5082-7760  
.79 100/65<sub>EA</sub>**

**MISC**

Ay5-1013	4.99
8T97	1.69
1488	1.39
1489	1.39
8202	34.95
3242	16.95

**EPROMS**

MM5203AQ	1us	256 x 8	13.95
MM5204AQ	750ns	512 x 8	14.95
1702A	1us	256 x 8	4.95
2708	450ns	1K x 8	5.95
2716	450ns	2K x 8	10.95
2732	450ns	4K x 8	29.95

**PROMS**

74S188	(82S23)	OC	32 x 8	4.75
74S287	(82S129)	TS	256 x 4	4.75
74S288	(82S123)	TS	32 x 8	4.75
74S387	(82S126)	OC	256 x 4	5.75
74S471		TS	256 x 8	18.75
74S472	(82S147)	TS	512 x 8	18.75
74S474	(82S141)	TS	512 x 8	19.95
74S570	(82S130)	OC	512 x 4	7.80
74S571	(82S131)	TS	512 x 4	7.80

**DIP SWITCHES**

4 Position	.99	7 Position	1.09
5 Position	1.02	8 Position	1.14
6 Position	1.06		

**VOLTAGE REG'S**

7805T	.89	7905T	.99
7812T	.89	7912T	.99
7815T	.99	7915T	1.19
7824T	.99	7924T	1.19
7805K	1.39	7905K	1.49
7812K	1.39	7912K	1.49
7810L	.69	7910L	.79
7812L	.69	7912L	.79
7815L	.69	7915L	.79

**IC SOCKETS**

8 PIN	10/1.29
14 PIN	10/1.49
16 PIN	10/1.69
18 PIN	10/1.99
20 PIN	10/2.89
22 PIN	10/2.99
24 PIN	10/2.99
28 PIN	10/3.99
40 PIN	10/4.99

**LINEAR**

LM301V	.34	LM567V	1.29
LM309K	1.49	LM723	.49
LM311V	.64	LM741V	.29
LM317T	2.29	LM747	.79
LM323K	4.95	LM1310	1.90
LM324	.59	LM1414	1.59
LM339	.99	LM1458	.69
LM377	2.29	LM1488	1.39
LM380	1.29	LM1489	1.39
LM555V	.39	LM1800	1.99
LM556	.69	LM1889	2.49
LM565	.99	LM3900	.59
LM566V	1.49	75451V	.39

**JDR MICRODEVICES, INC.**

1101 South Winchester Blvd.  
San Jose, California 95128  
408-247-4852  
800-538-5000

TERMS: Include \$2 for shipping. \$10 minimum order. Send SASE for complete catalog. Bay Area Res. add 6 1/2% sales tax. Calif. Res. add 6% sales tax. We reserve the right to limit quantities and substitute manufacturer. Prices subject to change without notice.

**VISA®**

sions range from tool design, design engineering, and robotics to numerical control. For more information, contact the Numerical Control Society, 519 Zenith Dr, Glenview IL 60025, (312) 297-5010.

May 26-29

**The Second Annual Korea International Office Management Exhibition and Conference**, Korea Exhibition Center, Seoul, Korea. American, British, Japanese, and Korean exhibitors will attend this conference. Exhibits include computers, facsimile systems, copiers, duplicators, micrographics, and other office equipment and products. Write to Clapp & Poliak, International, 7315 Wisconsin Ave, Washington DC 20014, (301) 657-3090. ■

**BYTE's Bits****Missing References In Circuit Cellar**

Three references were inadvertently omitted from Steve Ciarcia's Circuit Cellar article "Electromagnetic Interference" (January 1981 BYTE, page 48). The following books provide additional reading material for those interested in the topic:

1. Ott, Henry W. *Noise Reduction Techniques in Electronic Systems*. New York: John Wiley & Sons, 1976.
2. Jones, R W. *Electric Control Systems*. New York: John Wiley & Sons, 1953.
3. Shadowitz, Albert. *Electromagnetic Field*. New York: McGraw-Hill Book Company, 1974.

*Noise Reduction Techniques in Electronic Systems* was reviewed by J N Demas in the September 1980 BYTE, page 311. ■

# Clubs and Newsletters

## Atari Club Newsletter

Each month the *Atari Computer Enthusiasts News* contains news, hints, and assistance for Atari owners and users. Most of the information is supplied by club members, but articles from all interested Atari users are welcomed. Contact the *Atari Computer Enthusiasts*, 3662 Vine Maple Dr, Eugene OR 97405.

## TSUNAMI

*The Sorcerer Users Newsletter Around Michigan* (TSUNAMI) is a free, bi-monthly newsletter for Exidy Sorcerer owners. The editorial focus is on advanced applications in a variety of languages. Recent issues have featured a 7-generation per second Life program and a Paper Tiger screen-printer program. Contact Joseph R Power, 124 Cedar St #5, East Lansing MI 48823, (517) 337-1049.

## MENTAT

*MENTAT* is a brand-new publication probing professional and recreational uses of computers, plus fantasy and role-playing designs, games, and simulations. *MENTAT* is an Amateur Press Association member. If you are interested in contributing, send a self-addressed, stamped envelope to Bill Seligman, 667 Rugby Rd, Brooklyn NY 11230.

## CPT Users Group Formed

An independent group for CPT word-processing system users has been formed. A quarterly newsletter covering word- and data-processing techniques and applications is published. The newsletter features a pro-

gramming and problem clearinghouse, application notes, program reviews, a directory of software and support packages, and general-interest items. The group is not affiliated with the CPT Corporation. Contact Larry Matthews, c/o APB Inc, 919 Lindy Ct, Dayton OH 45415, (513) 890-9593.

## Boston Computer Update

The *Boston Computer Update* is a bimonthly publication from the Boston Computer Society. It is free when you join the society; membership fees are \$15 per year. Articles, news reports, and story ideas are welcomed. Members can place

free classified ads for non-commercial items. For further details, contact the society at 3 Center Plz, Boston MA 02108, (617) 227-9178. ■

## YOU THINK YOU'VE SEEN WORD PROCESSING SOFTWARE?

The **MAGIC WAND**<sup>TM</sup> Word Processing System offers you the best features of any system in the micro market

Version 1.1 is now available

### FEATURES INCLUDE:

- Full-screen text editor
  - Simple, control key operation
- Edit programs as well as text
  - Assemble, compile or run programs without modification
- Files larger than memory
  - Files up to 256K
- Library files
  - Merge part or all of one file with another
- Spool printing
  - Print a file while editing another
- Easy page formatting
  - Simple commands set margins, page length, etc.
- Override commands at run-time
  - Give any command from the keyboard as well as in file
- Variable pitch control
  - Change pitch in mid-line, even mid-word
- Up to 128 user-defined variables
  - String, numeric or dollar format
- Form letter generation from external data files
  - Compatible with both sequential and fixed-record files
- Conditional commands
  - Any command may be conditional
- Print to disk and/or printer
  - Save all or part of output on disk
- Switch from specialty printer to CP/M list device
  - Print the same file on either specialty or standard printer

### EASE OF OPERATION

With all its power, the MAGIC WAND is remarkably easy to use. This is no accident. The command structure is designed to be flexible and logical so that you can perform basic functions with a minimum of commands.

We have included in the manual a step-by-step instructional program, for the person who has never used a word-processor before. The trainee uses sample files from the system disk and compares his work to simulated screens and printouts.

In addition to the lessons, the manual has a complete documentation of the command structure, special notes for programmers, an introduction to CP/M for non-programmers and a glossary. The manual is typeset, rather than typewritten, for greater legibility.

We have written the manual in non-technical English, because we want you to read it. We don't overload you with a bunch of jargon that could confuse even a PhD in Computer Sciences.

We send out newsletters so that users of the MAGIC WAND can learn special applications of the print commands. For example, we might show you how to create a mailing list or set up an index for a file.

In short, we've done everything we can to make things easy for you. Because the best software in the world is just a bunch of code if you can't use it.

For more information, call or write:

**small business applications, inc.**

3220 Louisiana • Suite 205 • Houston, Texas 77006 • 713-528-5158

CP/M is a registered trademark of Digital Research Corp.



**Photo 1:** Personal computers can give the handicapped access to everyday activities. Here, a Johns Hopkins engineer demonstrates typing on a computer-aid electronic keyboard activated by a chin controller. The Johns Hopkins National Search for Applications of Personal Computing to Aid the Handicapped hopes to uncover similar applications.

## National Search to Aid the Handicapped Through Personal Computers

Johns Hopkins University has announced a national search for ideas and inventions using personal computers and related technology to assist the handicapped. The National Science Foundation and the Radio Shack Division of the Tandy Corporation are cosponsoring the search.

The competition seeks ideas, devices, methods, and computer programs to help handicapped people overcome learning disabilities, employment difficulties, and barriers that prevent adapting to home and community settings. Categories that can be addressed include computer-based aids for the blind, deaf, and mentally retarded; for individuals with learning disabilities, neurological or neuromuscular conditions; and the orthopedically handicapped. One hundred awards will be made, including a \$10,000 grand prize, and other prizes consisting of computer equipment and cash. Proceedings describing the winning entries will be published at the end of the contest. All participants will retain commercial rights to their entries.

Entries are being sought from computer specialists, high school and college students, and from all interested people. Orientation meetings are being scheduled at rehabilitation centers throughout the US to bring together potential inventors, handicapped individuals, and professionals in the habilitation/rehabilitation fields.

Contestants must prepare and submit their entries by June 30, 1981. To obtain additional information and a contest application, BYTE urges you to write to Personal Computing to Aid the Handicapped, Johns Hopkins University, POB 670, Laurel MD 20810, (301) 953-7100. ■

## All Printer Interface Cables \$35.00

(Call for all cable needs)

### RS232 CABLES

Male to Male 9' long	\$24.00
Male to Male 18' long	\$29.00
Male to Female 9' long	\$29.00
Male to Female 18' long	\$34.00
Female to Female 9' long	\$34.00
Female to Female 18' long	\$39.00
Male to Open 9' long	\$18.00
Male to Open 18' long	\$23.00
Female to Open 9' long	\$24.00
Female to Open 18' long	\$29.00
26 Pin Card-edge Connector to DB25S 18' long	\$19.00
26 Socket Type Connector to DB25S 4' long	\$19.00
Power Cable Kit for Disk Drives comes with AC & DC plug and wire	\$10.00

### DISK DRIVE SIGNAL CABLES

Single 5¼" Drive Cable	\$24.00
Dual 5¼" Drive Cable	\$29.00
Quad 5¼" Drive Cable	\$34.00
Single 8" Drive Cable	\$24.00
Dual 8" Drive Cable	\$32.00
Quad 8" Drive Cable	\$40.00
Please state type connector: card-edge or socket.	

4116 (200 ns) —	8/\$30.00
2708 —	\$6.00
2716 (5V) —	\$9.00
2732 —	\$25.00
2114L3 —	8/\$28.00

Call for prices on all types of connectors

**LAX** COMPUTER PRODUCTS  
4728 Manhattan Beach Blvd.  
Lawndale, CA 90260  
(213) 542-4505

**WE ACCEPT VISA,  
MASTER CHARGE AND  
AMERICAN EXPRESS**

# Computer Music: A Design Tutorial

The computational power necessary to synthesize high-quality, polyphonic computer music in real time exceeds the resources of the currently available microprocessors. Despite this discouraging observation, I decided early in the fall of 1978 to design a microprocessor-based music synthesizer. My goal was to discover just how successful I would be with a minimum system constructed from readily available parts. My self-imposed design constraints included an avoidance of special-purpose hardwired logic and an intention to stick with a byte-oriented architecture.

I hesitate to call the results of my efforts a music synthesizer. A more honest description might be a program-controlled, digital tone generator. Specifically, the design generates a predetermined sequence of sinusoidal waveforms in the manner of a player piano. A binary musical score or *command program* specifies the pitch and duration of each note. Each instruction in the command program selects between approximately 30,000 possible pitches from 0.1 Hz to 3 kHz, and selects between 255 possible dura-

---

Thomas P Orlofsky  
8 Victoria Dr  
Eatontown NJ 07724

---

tions from 10 ms to 2.55 seconds. This relatively fine time and frequency resolution permits quite sophisticated melodic articulations such as the slur, glissando, and vibrato. While the design provides memory for 341 notes or rests, this limitation is by no means essential.

I will begin by discussing the frequency-synthesis method before diving into a more detailed description of the implementation in both hardware and software. Along the way, you will become familiar with the engineering trade-offs inherent in the design of a digital sound system. At the conclusion, some possible improvements and points of departure for your own experiments will be discussed.

## Frequency-Synthesis Method

Frequency synthesis is the process of generating an output frequency bearing a mathematical relationship to some reference frequency. Digital synthesis differs from analog synthesis in that the waveform is constructed from a mathematical process rather than from modification of the energy storage of a physical system. Since the digital method is mathe-

matical, the quality of the output signal is theoretically unlimited. In practice, however, the transformation from samples to smoothly changing voltages introduces noise that is independent of the precision of the mathematical calculation.

Figure 1 illustrates the method of digital-frequency synthesis used in the design. A complete sine wave is divided into 256 segments. The average amplitude of each segment is measured with 8-bit precision. These measurements, or *samples*, are stored in consecutive memory locations. Each sample specifies the amplitude of the waveform at a particular phase angle. Consequently, the address of a sample is equivalent to its phase. One way to vary the frequency of the constructed waveform is by varying the rate at which the samples are selected. However, a more practical procedure maintains a constant sampling rate and varies the phase increment between the samples. A larger phase increment has the effect of skipping some of the samples during a pass through the memory.

Observe that the phase of the current sample being selected is formed from the sum of the phase increment and the phase of the previous sample. Only the nine most significant bits of the phase register actually contribute to the address of the current sample. The addition of the phase and phase increment is performed modulo  $2^{16}$ , and the overflow is equivalent to a

## About the Author

Tom Orlofsky is an employee of Bell Telephone Laboratories Inc. He works in systems engineering. His hobbies, in addition to application of home computers to music, include tennis, hiking, and skiing.

## UCSD p-System\* for the INTERTEC SUPERBRAIN™

With UCSD Pascal\* and FORTRAN

UCSD p-System includes: operating system, editor, filer, library, Z80 assembler, and documentation.

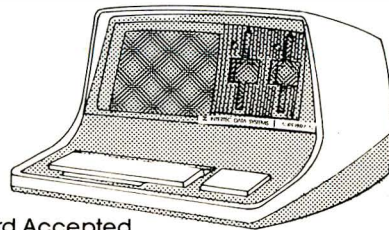
with Pascal	\$ 400
with FORTRAN	450
with Pascal and FORTRAN	600

## NOESIS COMPUTING COMPANY

615 Third Street, San Francisco, CA 94107  
Telephone: (415) 495-7440

VISA/Master Card Accepted

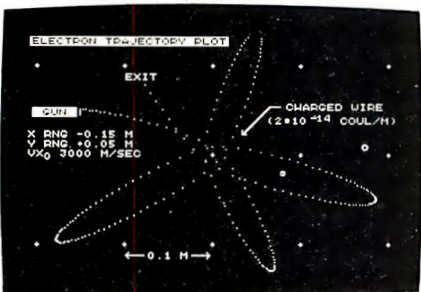
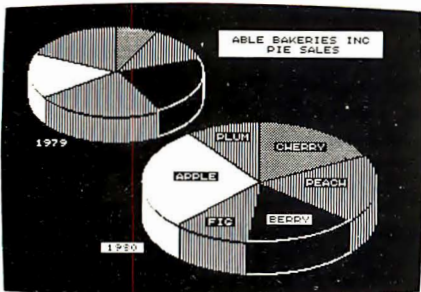
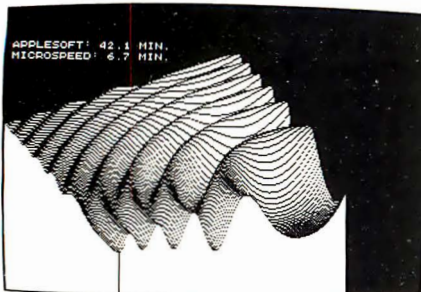
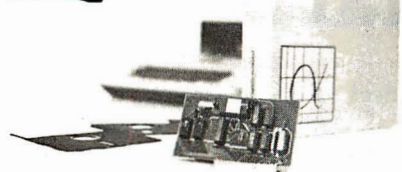
\*UCSD p-System and UCSD Pascal are trademarks of the Regents of the University of California  
™Trademark of Intertec Data Systems





FOR THE APPLE :

# ASPEED



THE **MICROSPEED** LANGUAGE SYSTEM

- SIX TO SIXTY TIMES **FASTER** THAN APPLESOFT (BENCHMARKED FASTER THAN THE PDP-11/03)
- MORE POWERED THAN BASIC, PASCAL OR FORTRAN
- FAST, EXTENDED HIGH-RESOLUTION GRAPHICS
- EXCEPTIONALLY COMPACT, **COMPILED** CODE
- PROGRAMMING EFFORT DRASTICALLY REDUCED
- E-LEVEL** LANGUAGE - BASED ON FORTH (UNLIMITED HIGH-LEVEL MACROS)
- AUXILIARY PROCESSOR CARD - USES AMD 9511
- REQUIRES 48K APPLE II OR II+, SINGLE DISK

Please send: ☐ Complete System \$495.00  
☐ User's Manual only \$35.00  
☐ Detailed information

Name \_\_\_\_\_  
 Address \_\_\_\_\_  
 City \_\_\_\_\_  
 State \_\_\_\_\_ Zip \_\_\_\_\_

**applied analytics incorporated**

5406 Roblee Dr., Upper Marlboro, MD 20870

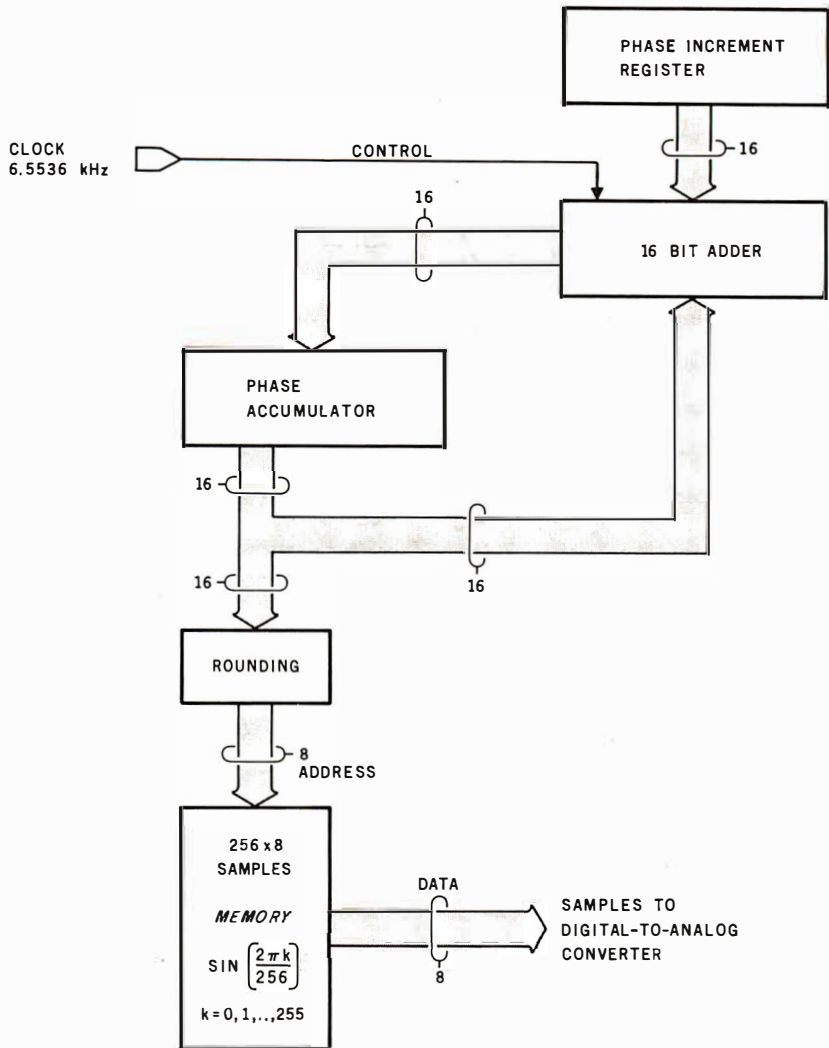


Figure 1: Conceptual block diagram of the frequency-synthesis method. This scheme will produce one of 32,768 unique frequencies.

phase shift of  $-2\pi$ .

As an illustrative exercise, assume a phase increment of 256, and that the addition is performed at a rate of 6.5536 kHz. Under these circumstances, the resultant set of addresses will select every sample once per cycle and produce a constructed waveform of frequency equal to  $(6.5536 \text{ kHz} / 256)$  or 25.6 Hz. Now assume a phase increment of 257. In each cycle through the memory, one sample is skipped. However, one particular sample is skipped only once in 257 cycles. This shows that the second phase increment increases the frequency of the constructed waveform in such a way that the second waveform will complete 257 cycles in the time that the first completed 256 cycles. The new frequency is  $(6.5536 \text{ kHz} \times 257) / (256 \times 256)$  or 25.7 Hz. This particular choice of sampling rate and register size provides a con-

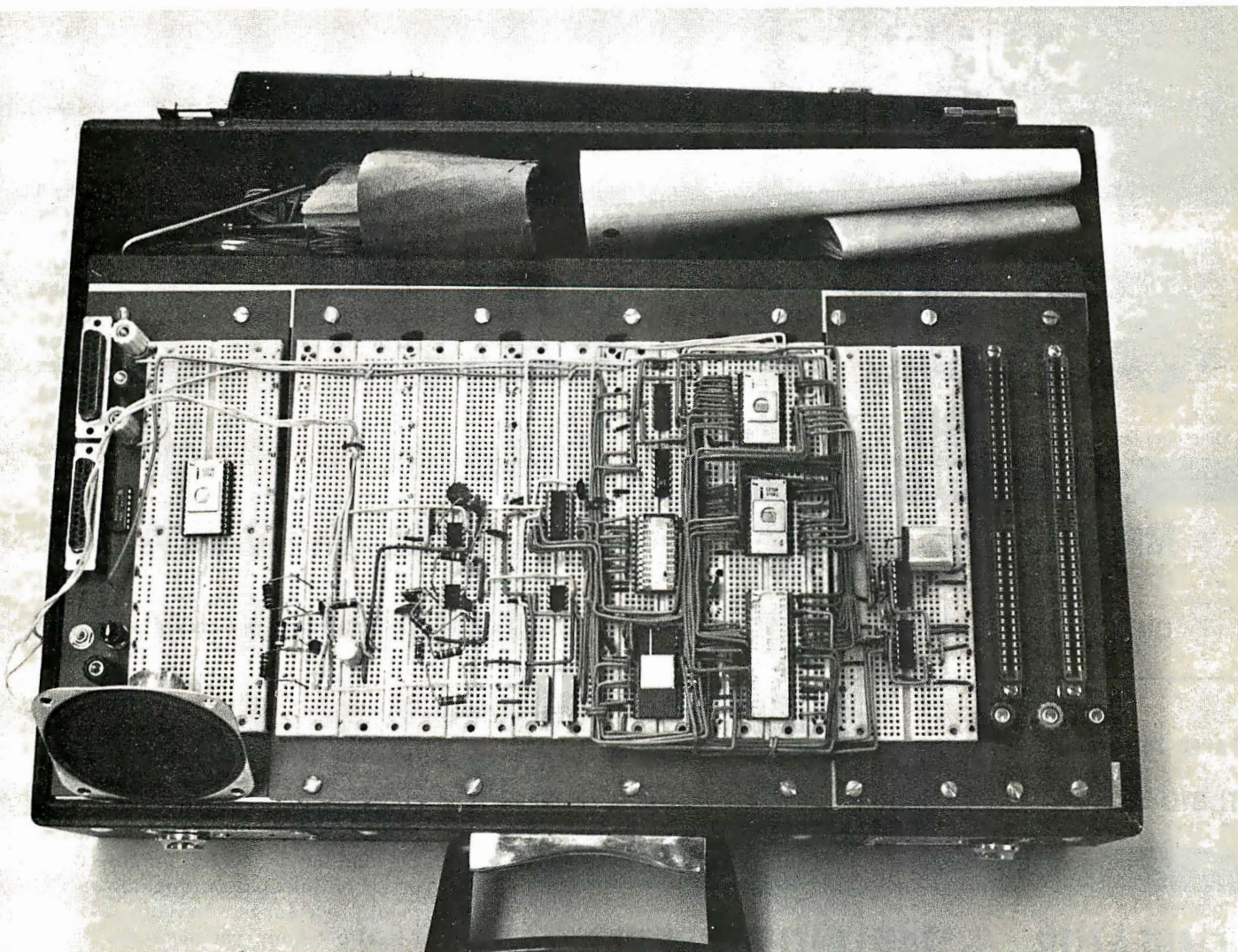
venient frequency resolution of 0.1 Hz.

It is crucial to observe that the sampling rate is fixed and that the amplitude envelope of the selected samples determines the frequency of the constructed waveform. In other words, the average period of the constructed waveform is not constrained to be an integer multiple of the sampling period. This result of sampling theory follows from the elegant properties of sine waves in the frequency domain. Sampling theory also shows that perfect construction of the sine wave is theoretically possible with as few as two samples per cycle.

### Critical Design Considerations

At this point, we judge that the sampling rate is by far the most critical design parameter. Increasing

*Text continued on page 320*



**Photo 1:** The author's microprocessor computer music system implemented in a breadboard prototype suitcase. A 2½-inch speaker (lower left) provides audio output for demonstrations. Best results were obtained by patching into the power amplifier of a high-fidelity receiver.

## S-100 USERS: GIVE YOUR COMPUTER THE GIFT OF SIGHT!

The DS-80 Digisector® is a random access video digitizer. It works in conjunction with a TV camera (either interlaced or non-interlaced video) and any S-100 computer conforming to the IEEE standards. Use it for:

- Precision Security Systems
- Moving Target Indicators
- Computer Portraiture
- Fast To Slow Scan Conversion
- Robotics
- Reading UPC Codes, schematics, paper tape, musical scores



● IMAGE PROCESSED BY DS-80 ●

### CHECK THESE FEATURES:

- ☐ **High resolution** — a 256 x 256 picture element scan
- ☐ **Precision** — 64 levels of grey scale
- ☐ **Speed** — Conversion time of 14 microseconds per pixel
- ☐ **Versatility** — scanning sequences user programmable
- ☐ **Economy** — a professional tool priced for the hobbyist; comes fully assembled, tested and burned in, with fully commented portrait printing software.

**Price: \$349.95** MasterCharge and Visa

THE **MICRO**  
**WORKS**

P.O. BOX 1110, DEL MAR, CA 92014 714-942-2400

Buy From Computer Marketing Corporation, The

Best  
Prices  
Anywhere!

# SUPERBRAIN<sup>TM</sup> SPECIALISTS

TO ORDER CALL (206)453-9777



Intertec  
10mb Hard Disc....\$3890

## SUPERBRAIN<sup>TM</sup>

**32K** List \$2995. Dual discs and two R5232 parts. Complete with CPM. **\$2495**

**64K** Single-sided, double density. Retail \$3345. **\$2595**

**QD** Double-sided, double density, 720k bytes storage. 64k RAM. Retail \$3995. **\$3245**

## LOOK AT OUR PRINTERS & PRICES!

### MPI 88G

1K buffer, dual tractor/pressure feed, forms control, graphics, 2 k buffer available. Retail \$749.

**ONLY \$600**

### EPSON MX-80

Parallel, multi-column, 80 cps, disposable print head. Retail \$645.

RS 232 **\$625** PARALLEL **\$555**

### C. ITOH

Daisy wheel starwriter, 25 cps, one year warranty. Retail \$2195.

CMC Price **\$1795**

We won't be undersold by any advertised price. List \$2795

**45 cps \$2025**

### DOT MATRIX

All printers with RS-232

#### PAPER TIGER 440

w/graphics & 2k Buffer . . . **\$985**

TI 810 Reg. \$1895 . . . **\$1650**

TI 810 w/full ASCII Reg.\$2155 . **\$1950**

### DAISY WHEEL or THIMBLE

XYMEC Reg. \$2875 . . . **\$2530**

QUME 5/45RO Reg. \$3073 . . . **\$2695**

KSR Reg. \$3537 . . . **\$3145**

With tractor Reg. \$3787 . . . **\$3350**

ANADIX DP 9500 or 9501 . . . **\$1399**

## TERMINALS

Intertec

### EMULATOR

List \$895 **\$745**

Intertec

### INTERTUBE III

List \$895 **\$745**

## WORD PROCESSING

Magic Wand Reg. \$400 . . . **\$325**

VTS-80 Reg. \$549 . . . **\$469**

WORD STAR Reg. \$495 . . . **\$400**

WORD STAR/MAIL MERGE . . . **\$515**

LINK 80 COMMUNICATIONS . . . **\$89**

CAT Novation Modem . . . **\$169**

## LANGUAGES

C Basic . . . . . Your Cost **\$125**

M Basic . . . . . **\$325**

Fortran . . . . . **\$450**

Cobol . . . . . **\$650**

Pascal (UCSD) Reg.\$400 . . . **\$325**

EPROM Reg. \$125 . . . . . **\$120**

Cuts access time in half. Allows serial number of machine on chio and all software.

## SOFTWARE

### Osborne - TCS - Graham-Dorian - CMC

	CBasic	MBasic	Reg.	Cost
Account Receivable	X	X	\$750	\$350
Accounts Payable	X	X	\$750	\$350
General Ledger	X	X	\$750	\$350
Payroll	X	X	\$750	\$350
Inventory	X	X	\$750	\$350
Restaurant Payroll	X		\$750	\$350
Job Costing	X		\$750	\$350
Client Billing	X		\$750	\$350

### PEACHTREE SOFTWARE

	List	Cost
General Ledger	\$995	\$595
Accounts Receivable	\$995	\$595
Accounts Payable	\$995	\$595
Inventory	\$995	\$595
Property Management	\$1595	\$995

## DEALER INQUIRIES INVITED

TO ORDER CALL (206) 453-9777



**Computer Marketing Corp.**

11058 Main Street, Bellevue, WA 98004

TELEX 152556



(Washington Residents Add  
5% Sales Tax)

Text continued from page 318:

the sampling rate increases the audio bandwidth, but the sampling rate is limited by the rate at which the microprocessor system can deliver samples to the output port.

The method of waveform construction adds considerations to the issue of the sampling rate beyond those already mentioned. A digital-to-analog (D/A) converter transforms the samples into discrete voltage levels producing a sine wave with a staircase appearance. A low-pass filter smooths over the discontinuities by removing the so-called sampling harmonics. Unfortunately, a practical filter passes some of the sampling harmonics due to finite attenuation of frequency components in the rejection band. Therefore, the design must sacrifice some of the theoretical bandwidth of the synthesizer to achieve tones that are relatively free of audible distortion. The magnitude of the sacrifice is, of course, a function of your sensitivity to harmonic distortion. If you are to judge harmonic distortion by the advertised specifications of high-fidelity audio equipment, it is quite undesirable.

My choice of sampling at a rate of 6.5536 kHz represents a compromise. On one hand, the 150 microseconds or so of calculation time allows the microprocessor to execute a non-trivial program, yet the audio bandwidth encompasses the range of the fundamental frequency of most musical instruments. However, on the other hand, much of the bandwidth contains audible harmonic distortion.

Another important design consideration concerns the necessary precision and quantity of the stored samples. The difference between the stored value of a sample and the actual value of the sine function evaluated at the same phase introduces an error into the constructed waveform. This disturbance is known as *quantization noise*. The quantization noise associated with 256 8-bit samples has an average power that is about one percent of the average power of the sine wave. Therefore, in this particular design, the noise due to quantization is quite inaudible in comparison with the sampling harmonics that sneak through the filter.

Finally, the design must exhibit sufficient resolution between frequencies. You may have noticed in the il-

lustrative example that the length of the phase accumulator determined the smallest possible frequency increment. Resolution of 0.1 Hz provides the potential of arbitrary tuning. Two tones 0.1 Hz apart in frequency played simultaneously beat together once every 10 seconds. Such mistuning is imperceptible under normal conditions. Another aspect is the granularity of pitch changes during a glissando. While 0.1 Hz might be sufficient for the casual listener, the granularity is audible under close scrutiny. Unfortunately, increased resolution for fixed-register length is purchased with decreased audio bandwidth, and the bandwidth cannot be spared.

### Hardware

Now that the problems facing the designer are in perspective, the hardware design will be described so that you may digest the schematic diagram. Figure 2 provides an overview of the system implementation; figure 3 is the schematic diagram. The hardware is functionally divided between the microprocessor system and the analog signal conditioning. In addition to the Z80 processor, the microprocessor system includes 2 K bytes of erasable programmable read-only memory (EPROM) and two input/output (I/O) devices. An 8212 8-bit I/O port, hardwired into a simple output latch, serves as an interface to the D/A converter. A Z80 counter-timer circuit provides interval timing. The system includes no general-purpose programmable memory. The processor and counter-timer circuit serve as depositories for all dynamic information. A simple crystal oscillator generates the system clock signal, and a momentary push button allows the system to be reset. Sufficient device-select logic insures that two devices cannot be simultaneously enabled, regardless of the state of the machine. Finally, the system requires well-regulated external power supplies of +5, +12, and -12 V.

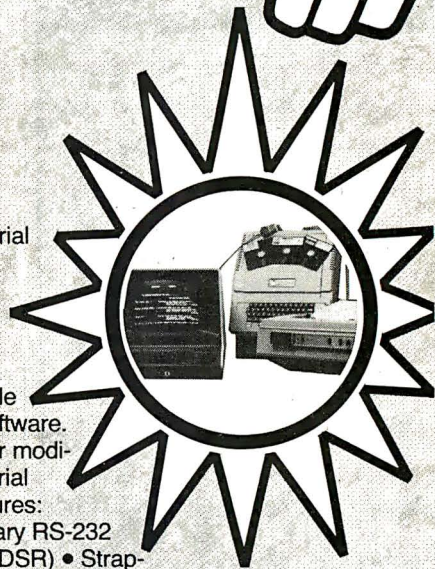
Although the 6 kHz sampling rate is quite demanding from the computational point of view, the rate is quite modest with respect to state-of-the-art conversion speeds. An inexpensive D/A converter such as the MC1408 proves to be quite sufficient. The active low-pass filter is a second-order Butterworth-type with a cutoff

## GIFTS FROM PROMETHEUS NEW for APPLE II<sup>(1)</sup> Advanced products at Down-to-Earth PRICES.

### DUAL SERIAL CARD-1.

All functions of two independent serial cards on one board — plus more. Provides Apple II<sup>(1)</sup> users with two simultaneous asynchronous serial channels. DSC-1 appears as two separate logical serial cards to the Apple II<sup>(1)</sup>. Fully software compatible with all Apple II's<sup>(1)</sup> and Microsoft software. 2716 EPROM used for easy driver modification. In addition, the second serial channel supports these extra features:

- Strapable DCE/DTE. • Secondary RS-232 handshake functions (DCP, DTR, DSR) • Strapable logical slot location and hardware looks like it's another slot.



Order: PP-DSC-1 @ \$189.00 each.

**MEMORY EXPANSION MODULE-1.** Expand your Apple II<sup>(1)</sup> to a full 64K RAM system with highest quality 16K dynamic RAMS. Fully buffered to provide reliable operation — even with fully loaded Apples. Total compatibility with Microsoft Softcard<sup>(2)</sup>/CP/M<sup>(3)</sup> and all Apple software. Supplied complete with installation instructions and test program.

Order: PP-MEM-1 @ \$149.50 each.

**PASCAL MT+ MEM-1.** A modular native Z-80 code Pascal compiler. ISO standard. Includes a MEM-1 (detailed above). Have a full Pascal compiler at half the Apple price. Requires a Microsoft Softcard<sup>(2)</sup> and two disk drives. Note that the Pascal MT+ alone is normally \$250.00.

Order: PP-PMT-1 @ \$299.00 each.

**16K RAM ADD-ON KITS.** For TRS-80 and Apple II<sup>(1)</sup>. Eight (8) full-specification industry standard 16K RAMS. These are not seconds.

Order: PP-RAK-16 @ \$29.00 each.

All Prometheus boards are completely tested and burned-in prior to shipment. One year warranty covers parts and labor. **MONEY BACK GUARANTEE:** Order now without risk. Boards may be returned, in good condition, after up to 10-days of trial for a full and prompt cash refund.



California: add 6% tax; BART Counties, 6½%. Orders under \$150, add \$3.00 postage for handling charge. Freight allowed on orders over \$150. *Dealer inquiries invited. Quantity discounts available.*



# PROMETHEUS

## PROMETHEUS PRODUCTS INCORPORATED

4509 Thompson Ct. • Fremont, CA 94538 • (415) 791-0266

Registered Trade Marks: (1) Apple Computers, Inc. (2) Microsoft Consumer Products (3) Digital Research, Inc.

# WHAT'S BETTER THAN AN ISAM

## And Will Turn

MICROSOFT'S  
BASIC  
COBOL  
FORTRAN

DIGITAL'S  
PL/I-80

CBASIC  
PASCAL/MT+  
S-BASIC

CROMEMCO 16K BASIC

into first class application  
languages?

## MICRO B+™

The first and most complete  
implementation of **B-TREE**  
index structures for micro-  
computers. **B-TREES** eliminate  
index file reorganization.

## Search

An index of over

**10,000 Key  
Values In Less  
Than One  
Second**

On A Floppy Disk System  
for only

**\$260.00!**

System Houses:

**MICRO B+™**

Available in Language C

**FAIR COM** 2606 Johnson Drive  
Columbia, MO 65201  
(314) 445-3304  
© 1980 Fair Com

Shipping \$4 USA / \$8 Foreign  
We accept VISA and MASTERCARD

PL/I-80 is a trademark of Digital Research  
CBASIC is a trademark of Compiler Systems, Inc.  
S-BASIC is a trademark of Topaz Programming  
PASCAL/MT+ is a trademark of MT MicroSystems

at approximately 3 kHz. If you are interested in maximum tone purity, use a higher-order filter design. The filter output appropriately buffered and attenuated can be patched into the power amplifier section of a typical home audio system. As usual, precautions should be taken to insure signal compatibility. You might want to use a blocking capacitor to trap the DC voltage present in the output during rests.

## Software

Now with the hardware out of the

way, I can get down to the heart of system design, the software. The software is functionally divided between the *system program* and the *command program*. You can view the system program as a special-purpose operating system that not only performs the frequency synthesis, but also interprets the command program. The command program is essentially a musical score in a form understandable by the system program. Since the command program resides in its own memory device,

*Text continued on page 324*

Number	Type	+ 5 V	GND	- 12 V	+ 12 V
IC1	Z80-CPU	11	29		
IC2	Z80-CTC	24	5		
IC3	2708	24	12		19
IC4	2708	24	12		19
IC5	8212	24	12		
IC6	74LS32	14	7		
IC7	74LS74	14	7		
IC8	74LS04	14	7		
IC9	74LS04	14	7		
IC10	MC1408	13	2	3	7
IC11	741			4	7
IC12	741			4	7
IC13	741			4	7

Power Wiring Table for Figure 3

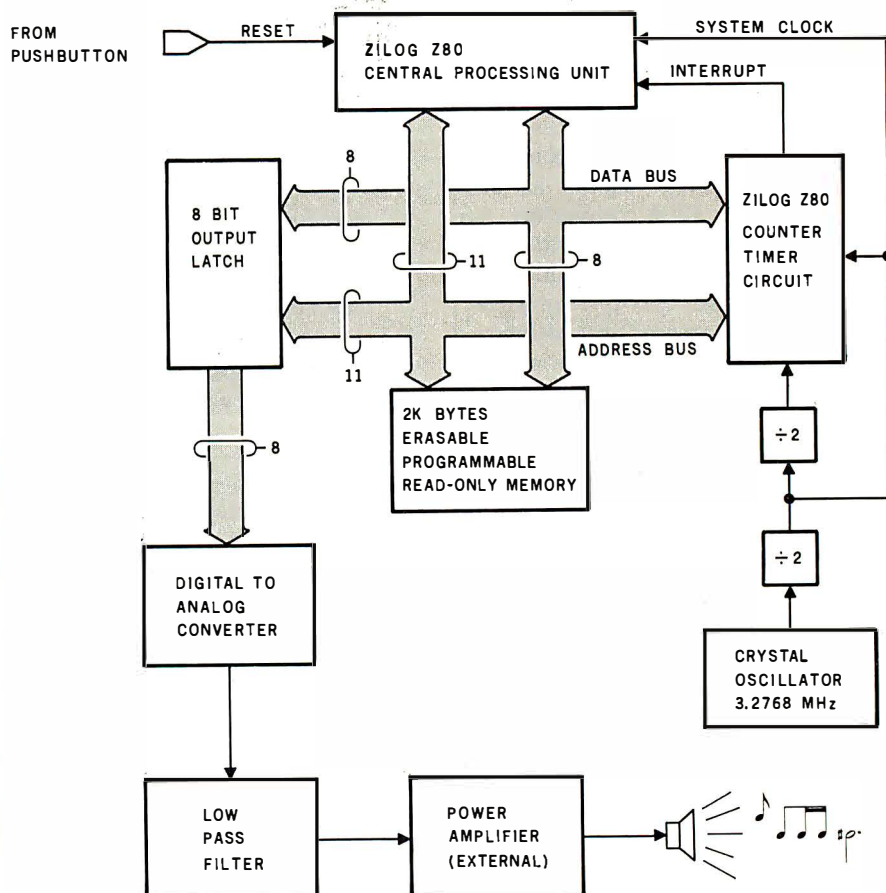
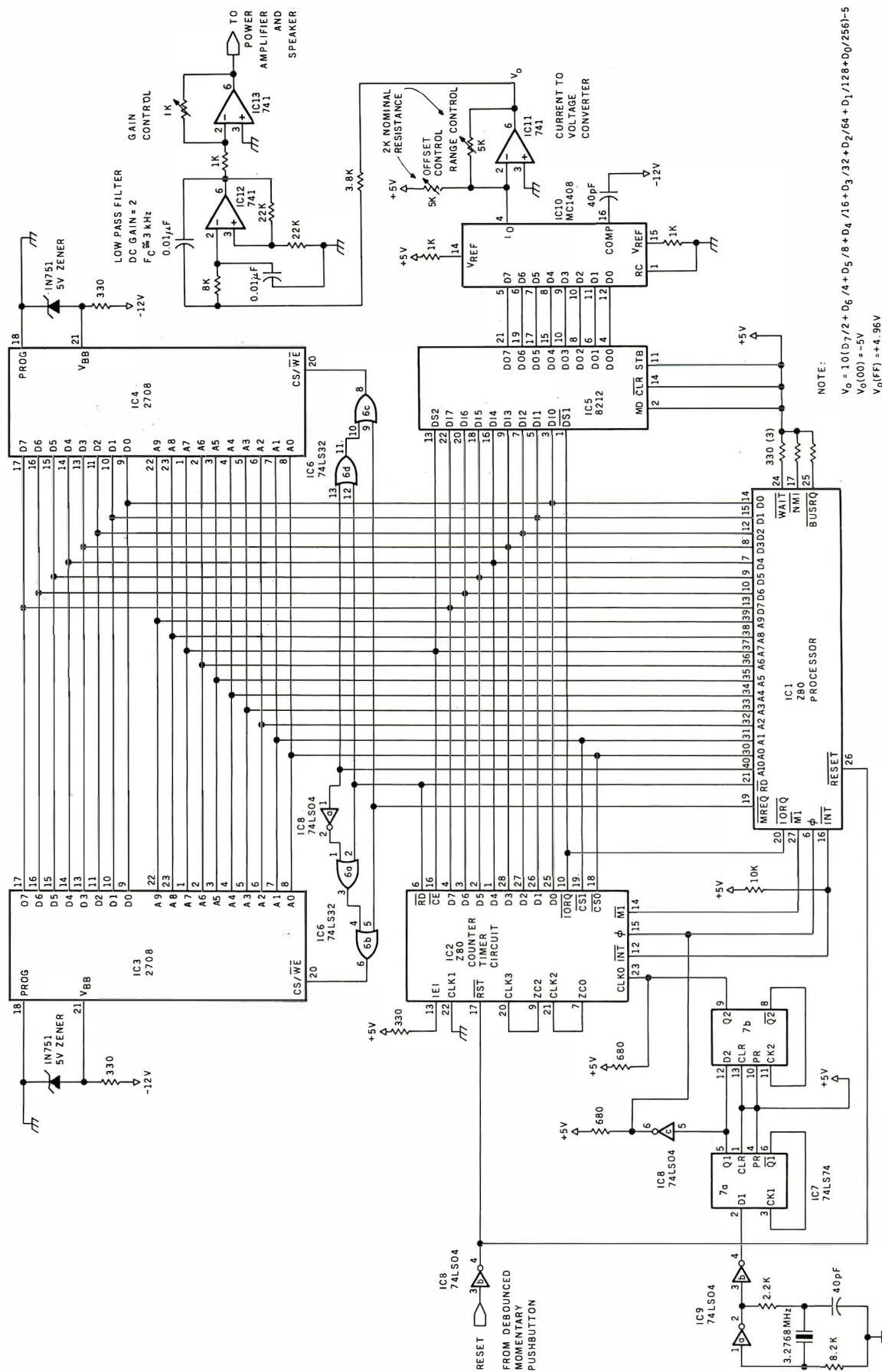


Figure 2: Functional overview of the hardware organization and signal flow.

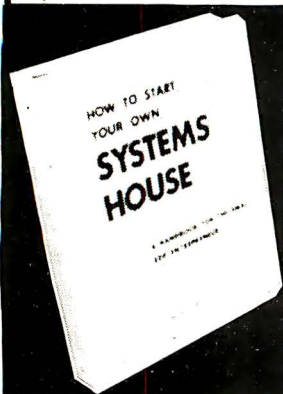


**Figure 3:** Schematic diagram for the microprocessor-controlled music system. The design is self-contained except for power and the final audio-output stage. Efficient use of registers within the primary microprocessor eliminates the need for general-purpose memory.

# ENTREPRENEURS NEEDED

**MORE THAN EVER IN THE MICRO-COMPUTER INDUSTRY.**

The shortage of knowledgeable dealers/distributors is the #1 problem of microcomputer manufacturers. Over 300 new systems houses will go into business this year, but the number falls short of the 1200 needed. It is estimated that the nationwide shortage of consultants will be over 3000 by 1981. The HOW TO manuals by Essex Publishing are your best guide to start participating in the continued microcomputer boom.



**\$36. No. 10**

Service Problem • Protecting Your Product • Should You Start Now? • How to Write a Good Business Plan • Raising Capital

## HOW TO START YOUR OWN SYSTEMS HOUSE

6th edition, March 1980

Written by the founder of a successful systems house, this fact-filled 220-page manual covers virtually all aspects of starting and operating a small systems company. It is abundant with useful, real-life samples: contracts, proposals, agreements and a complete business plan are included in full, and may be used immediately by the reader.

Proven, field-tested solutions to the many problems facing the small systems house are presented.

From the contents:

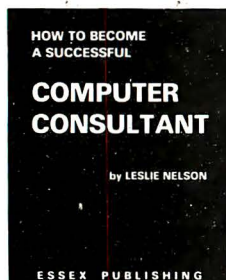
• New Generation of Systems Houses • The SBC Marketplace • Marketing Strategies • Vertical Markets & IAPs • Competitive Position/Plans of Major Vendors • Market Segment Selection & Evaluation • Selection of Equipment & Manufacturer • Make or Buy Decision • Becoming a Distributor • Getting Your Advertising Dollar's Worth • Your Salesmen: Where to Find Them • Product Pricing • The Selling Cycle • Handling the 12 Most Frequent Objections Raised by Prospects • Financing for the Customer • Leasing • Questions You Will Have to Answer Before the Prospect Buys • Producing the System • Installation, Acceptance, Collection • Documentation • Solutions to the

## HOW TO BECOME A SUCCESSFUL COMPUTER CONSULTANT

by Leslie Nelson, 2nd revised edition, Jan 1981

Independent consultants are becoming a vitally important factor in the microcomputer field, filling the gap between the computer vendors and commercial/industrial users. The rewards of the consultant can be high: freedom, more satisfying work and doubled or tripled income. **HOW TO BECOME A SUCCESSFUL COMPUTER CONSULTANT** provides comprehensive background information and step-by-step directions for those interested to explore this lucrative field:

• Established consulting markets • How to get started • Itemized start-up costs • Are you qualified? • Beginning on a part-time basis • The Marketing Kit • Should you advertise? • Five marketing tips • Getting free publicity • How much to charge • When do you need a contract? • Sample proposals • Which jobs should be declined • Future markets • The way to real big money • Avoiding the legal pitfalls • How consultants' associations can help you • The National Register of Computer Consultants • How others did it: real-life sample cases • and much more.



**\$28. No. 16**

money • Avoiding the legal pitfalls • How consultants' associations can help you • The National Register of Computer Consultants • How others did it: real-life sample cases • and much more.

## FREE-LANCE SOFTWARE MARKETING

by B.J. KORITES

KERN PUBLICATIONS

**\$30. No. 32**

training users and providing maintenance and support. It also contains sample software contracts that have been used in actual software transactions. Also included are tips on how to negotiate with a large corporation, ways of avoiding personal liability, techniques for obtaining free computer time and hints on how to run a free-lance software business while holding a full-time job.

## FREE-LANCE SOFTWARE MARKETING 3rd edition, June 1980

Writing and selling computer programs as an independent is a business where • you can get started quickly, with little capital investment • you can do it full time or part time • the potential profits are almost limitless. Since the demand for computer software of all kinds is growing at an explosive rate, the conditions for the small entrepreneur are outstanding.

This manual will show you how to sell your own computer programs using these proven techniques: • direct to industries • through consulting firms • through manufacturers of computer hardware • in book form • mail order • through computer stores. It will show you how to profitably sell and license all types of software ranging from sophisticated analytical programs selling for thousands of dollars, down to simple accounting routines and games for personal computers.

The book will guide you step by step through the process of marketing, advertising, negotiating a contract, installing software, training users and providing maintenance and support. It also contains sample software contracts that have been used in actual software transactions. Also included are tips on how to negotiate with a large corporation, ways of avoiding personal liability, techniques for obtaining free computer time and hints on how to run a free-lance software business while holding a full-time job.

## ESSEX PUBLISHING CO. Dept. 2

285 Bloomfield Avenue • Caldwell, N.J. 07006

Order books by number. Send check, money order (U.S.\$), VISA or Master Charge #. Publisher pays 4th class shipping. For UPS shipping (USA only) add \$1.00 per book. For Air Mail shipping add \$2.50 per book in North America, \$5.00 in Europe and South America, \$8.00 elsewhere. N.J. residents add 5% sales tax. ☐ No. 10 ☐ No. 16 ☐ No. 32 ☐ Check enclosed ☐ Credit card ☐ 4th class ☐ UPS ☐ Air

Name

Address

City  State  Zip

Card #  Exp.

For faster shipment on credit card orders call (201) 783-6940 between 9 and 5 Eastern time.

Hexadecimal Address	Contents	Device
0000	System Program	IC4
03FF	Command Program	IC3
0400		
07FF		
08FF		
FFFF		Nonexistent

**Table 1: Memory map for the software of listings 1 and 2.**

Text continued from page 322:

you can play a new song by simply substituting one memory chip for another.

Figure 4 provides the algorithmic flow of the system program. Upon reset, the system program initializes registers within the Z80 processor and counter-timer circuit, reads the first command, calculates the first sample, and halts. The remainder of the program, contained entirely within one interrupt-service routine, executes once per sampling period in response to interrupt requests from the counter-timer circuit. As the samples are generated, the counter-timer circuit clicks them off in a down counter. The processor polls the down counter during every sampling period and branches to the new-tone procedure when the counter reaches zero. The new-tone procedure fetches the next command and updates the registers accordingly. When the new-tone procedure reaches an end of file, it performs an unconditional branch to the beginning of the command program.

Three bytes make up a command. The system program loads the first byte, the note duration, into the down counter within the counter-timer circuit. Bytes 2 and 3 contain the pitch information or phase increment. Observe that a phase increment with a value of zero results in a stream of constant samples, a DC signal or rest.

Hexadecimal Address	Device
00	Counter-Timer
.	Circuit (CTC)
03	
04	
.	Nonexistent
7F	
80	8212 Latch
81	
.	Nonexistent
FF	

Table 2: I/O port map of the hardware of figure 3.

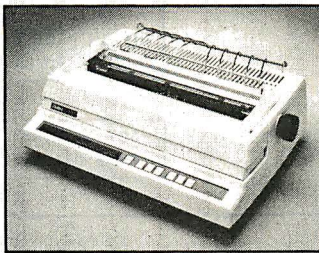
In general, the system program completes the sample calculation with time to spare. However, during the command fetch, the processor delays acknowledgment of the next sample interrupt for a fraction of the sampling period. Basically, the processor steals some extra time for housekeeping. Fortunately, the postponement of one sample among thousands is inaudible. If you are familiar with the Z80, then you should have minimal difficulty in deciphering the details of the system program provided in listing 1.

The command program example shown in listing 2 performs the measure of music pictured in figure 5. A macroassembler facilitates generation of the command program. User-defined symbols for notes of the equally tempered scale (see text box) and common note durations eliminate the need to edit numbers. A note macroinstruction, which defines the data structure, reduces each command to a single line of code. The programmer can generate the command program quite efficiently by defining nested macroinstructions that specify repeated rhythms or articulations. Nevertheless, the process is quite tedious.

You may wonder why it is necessary to use sixteen bits to distinguish between twenty-four or so pitch symbols. The answer is that it is not strictly necessary, but immense tonal flexibility can be gained. First of all, you can specify the sliding-note effects mentioned earlier. Second, you are not locked into the equally

Text continued on page 331

# Data Terminals Fast ...from MICROMAIL



## DIABLO

630

The Diablo Model 630 is a reliable, high quality, full-character serial printer for anyone who is seeking superior print quality at a low cost. This is the first Diablo printer to offer complete interchangeability between metal and plastic print wheels. And the sophisticated and discerning user does not sacrifice print quality to obtain this versatility. Every aspect of the Diablo 630 design has been focused on maintaining outstanding print quality. Terminals also have self-test, extensive internal diagnostics and automatic bidirectional printing.

**\$1,999.00**

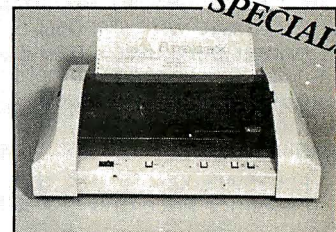
With A Adjustable Forms Tractor add **\$200.00**

## ANADEx

## DP-9500/9501

The Anadex Models DP-9500 and DP-9501 Alphanumeric Line Printers are designed for all printer applications, including those requiring high density graphics. Standard features include three standard interfaces (RS 232C, Centronics Parallel, and Current Loop), software selectable print sizes including compressed and expanded print, heavy-duty nine-wire printhead (permits true underlining and descending lower case letters), and fast bi-directional printing. The model 9501 offers slightly higher graphics resolution and a slightly slower print speed than the model 9500.

**\$1,299.00**



## PRINTERS

## C.R.T.'s

## TELEPRINTERS

### ANADEx

**DP9000 \$1199**  
**DP-9001 \$1199**

Just like the 9500/9501, but 5 inches narrower. Uses paper up to 9.5 inches wide.

### T.I.

**810/2 \$1599**

(includes upper/lower case option)

**810/2 VFC/CP \$1724**

(includes u/i case, forms control & compressed print)

### DIABLO

**1640RO \$2525**

Uses plastic daisywheels, prints up to 45 c.p.s.

**1650 RO \$2675**

Uses metal daisywheels, prints up to 40 c.p.s.

### Tele Video

**912C \$ 725**

**920C \$ 795**

**950 \$ 995**

NEW! Features a detachable keyboard & programmable function keys.

### SOROC

**IQ120 \$ 689**

**IQ140 \$1099**

**IQ135 \$ 849**

NEW! Microprocessor controlled, programmable function keys.

### C. ITOH

**CIT100 \$1625**

### DEC

**VT-100 \$1650**

### DEC

**LA 34 \$ 969**

Dot-matrix, 30 c.p.i. Adjustable character sizes & line spacing.

**LA 34 AA \$1099**

Includes programmable forms length control.

### TELETYPE

**43 \$ 999**

Very reliable 30 c.p.s. teleprinter. Ideal for use with 300-baud acoustic couplers or modems.

### DIABLO

**1640 KSR \$2830**

Uses plastic daisywheels, prints up to 45 c.p.s.

**1650 KSR \$2940**

Uses metal daisywheels, prints up to 40 c.p.s.



**To Order:** Send check to MICROMAIL, P.O. Box 3297, Santa Ana, CA 92703. Personal or company checks require two weeks to clear. Visa/MasterCard accepted. C.O.D. requires a 15% deposit. **Handling:** Add 3% to orders less than \$750. 2% to orders \$751 - \$2,000. 1% to orders over \$2,000. **NOTE:** Handling charges are waived on orders pre-paid in advance by check. **Shipping:** We ship FREIGHT COLLECT via UPS or Motor Freight! Air and Express delivery is available.

# CLOSE OUT!

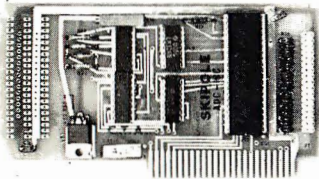


## GTC-101 Terminals

We're overstocked on these powerful, reliable standard data terminals. The GT-101 is Z-80 based with standard printer port, user-settable clock, 8 user-programmable function keys and much more! Order Today! Limited Quantities.

Reg. \$999.00  
Clearance Price Only **\$795**

# NEW



## CTA ADC-16C 16 Channel Variable A-D Board!

Can be used for Position/Pressure/Photo-electric/and Temperature Measurements, and as a computerized Volt/Ohm meter. Board is shipped with operating manual, software, and a test conductor. For use with Apple II/III.

Introductory Price **179<sup>95</sup>**

**NOTE:** Soon To Be Available - CTA's new 16K Memory Board!

**CTA** COMPUTER TECHNOLOGY ASSOCIATES

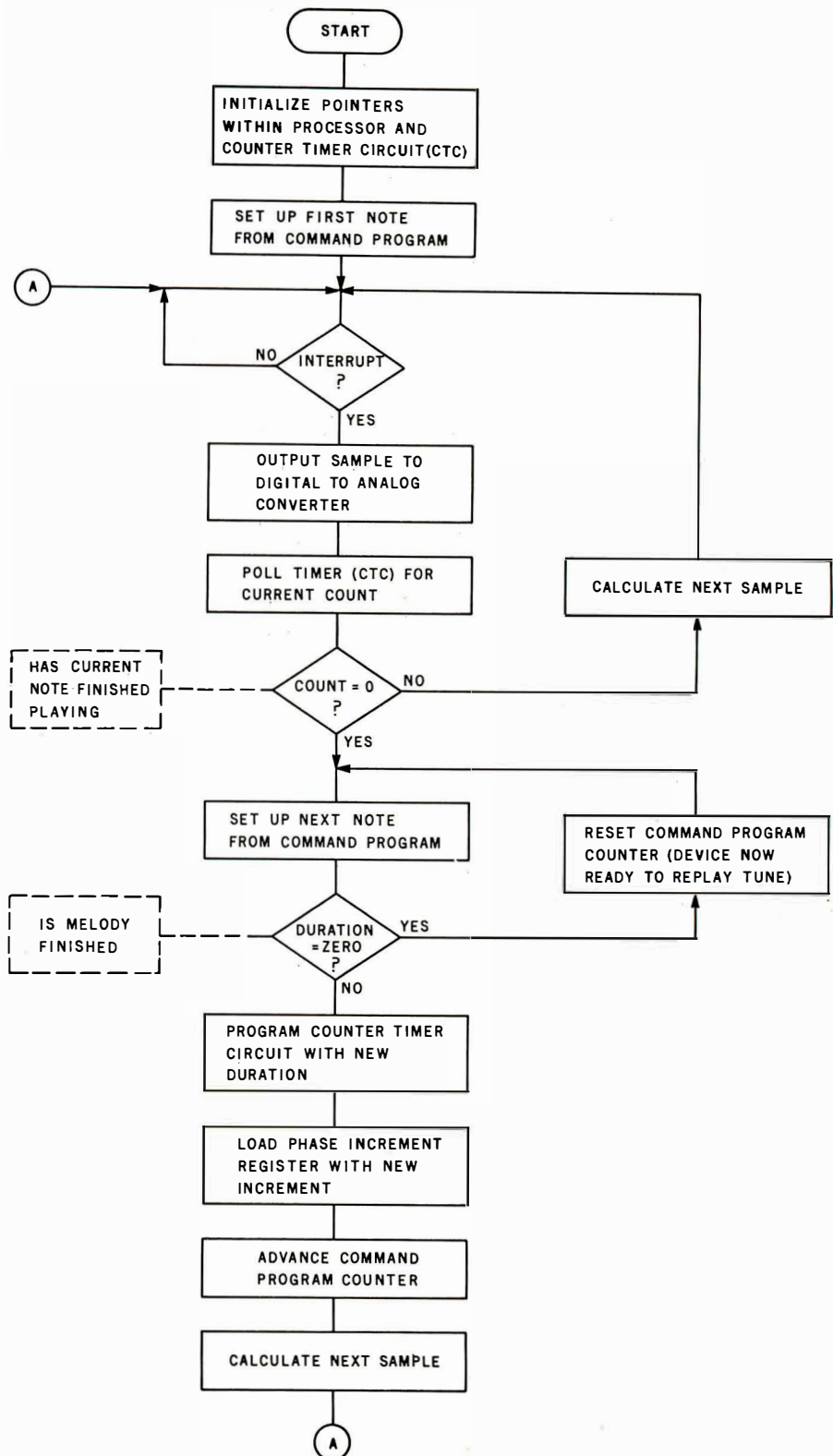
5812 Cromo Drive, Suite 102  
El Paso, Texas 79912  
(915) 581-3500

Visa/MasterCard/Diner's Club Accepted.

**TO ORDER:** Send check, money order or credit card number and exp. date to Computer Technology Associates, 5812 Cromo Drive, Suite 102, El Paso, Texas 79912. Personal or company checks require two weeks to clear. Credit card users can call with card information.

**SHIPPING:** We ship terminals PREPAID by motor freight. Air and express delivery are available on all products.

There is no handling charge.



**Figure 4:** Flowchart of the system program. The system program, executed in real time, performs the frequency synthesis and interprets the binary musical score contained in the command program.

**Listing 1:** The system program written in Z80 assembly language. See comment lines for details.

```

0002 ;*****
0003 ;
0004 ;      TONE SYNTHESIZER          WRITTEN BY
0005 ;      SYSTEM PROGRAM          TOM ORLOFSKY
0006 ;                               12-8-78
0007 ;
0008 ;      THIS PROGRAM IS WRITTEN FOR A Z80 MICRPRO-
0009 ;CESSOR SYSTEM CONSISTING OF A Z80-CPU, Z80-CTC,
0010 ;2K PROM, 8212 USED AS AN OUTPUT LATCH, 8 BIT DAC,
0011 ;AND ANALOG SIGNAL CONDITIONING. THIS PROGRAM WHICH
0012 ;RESIDES IN THE FIRST 1K OF MEMORY GENERATES
0013 ;SINUSOIDAL SAMPLES AT APPROX. 6 KHZ. THE PITCH
0014 ;AND DURATION OF EACH SINUSIOD OR TONE IS SELECTED BY
0015 ;THE COMMAND PROGRAM WHICH RESIDES IN THE SECOND 1K
0016 ;OF MEMORY. THE SYSTEM PROGRAM EXECUTES THE INSTRUCTIONS
0017 ;PROVIDED BY THE COMMAND PROGRAM SEQUENTIALLY.
0018 ;      INTERRUPTS FROM CHANNEL 0 OF THE CTC DRIVE
0019 ;THE SYSTEM PROGRAM. CHANNELS 2 & 3 OF THE CTC
0020 ;ARE USED TO TIME TONE DURATION. THE SYSTEM PROGRAM
0021 ;POLLS CH3 FOR A TIME OUT CONDITION.
0022 ;
0023 ;REGISTER USE:
0024 ;      HL:      CONTAINS THE PHASE
0025 ;      BC:      CONTAINS THE PHASE INCREMENT
0026 ;      DE:      CONTAINS THE SAMPLE ADDRESS
0027 ;      IX:      COMMAND PROGRAM COUNTER
0028 ;      AF:      CONTAINS THE CONTROL CODE FOR CTC CH3
0029 ;      A:        CONTAINS THE NEXT SAMPLE WHEN THE CPU
0030 ;                IS HALTED
0031 ;CTC CHANNEL USE:
0032 ;      CH0:      DETERMINES THE SAMPLING PERIOD
0033 ;                (250 T CYCLES)
0034 ;      CH2:      DIVIDE BY TEMPO SCALING FACTOR
0035 ;      CH3:      TIMES NOTE DURATION (CLOCKED BY CH2)
0036 ;
0037 ;
0038 ;      LIST      NOGEN      ;SUPPRESS PRINTING OF
0039 ;                MACRO-EXPANSIONS
0040 ;
0041 ;*****
0042 ;
0043 ;      SYMBOL DEFINITION
0044 ;
0045 ;*****
0046 CH3      EQU      03H      ;ADDRESS OF CTC CH3
0047 CH2      EQU      02H      ;ADDRESS OF CTC CH2
0048 CH0      EQU      00H      ;ADDRESS OF CTC CH0
0049 BASE     EQU      0H       ;DISPLACEMENT FOR IX REG ADD
0050 DAC       EQU      80H      ;ADDRESS OF DAC BUFFERED
0051 ;                BY 8212
0052 ;*****
0053 ;
0054 ;      MACRO DEFINITION
0055 ;
0056 ;      THE MACRO FACILITATES EDITING THE SAMPLES
0057 ;
0058 ;*****
0059 DATA:    MACRO      #A, #B, #C, #D, #E, #F, #G, #H
0060           DB          #A
0061           DB          #B
0062           DB          #C
0063           DB          #D
0064           DB          #E
0065           DB          #F
0066           DB          #G
0067           DB          #H
0068           MEND
0069 ;*****
0070 ;
0071 ;      INITIALIZATION PROCEDURE
0072 ;
0073 ;
0074 ;*****
0075           ORG          0H
0076 INIT:     LD          HL, 0H      ;INIT PHASE REGISTER
0077           LD          IX, 400H    ;INIT COMMAND PROGRAM COUNTER
0078           LD          A, 1H      ;INIT INTERRUPT REGISTER
0079           LD          I, A
0080           LD          A, 0H      ;LOAD CTC INTERRUPT VECTOR
0081           OUT          CHO, A
0082           IM2          ;INTERRUPT MODE 2
0083           LD          SP, 0200H  ;INIT SP TO FAKE STAK
0084           LD          A, 57H     ;INIT CTC CHANNEL 3

```

Listing 1 continued on page 328

# NO FRILLS! NO GIMMICKS! JUST GREAT **DISCOUNTS** MAIL ORDER ONLY

## ATARI 800

Personal Computer  
System ..... **\$79900**

## NORTHSTAR

Horizon II 32K ..... **234900**  
Horizon II Quad ..... **279900**  
Horizon II 64K ..... **299900**  
Horizon Quad 64K ..... **339900**

## TELEVIDEO

912 ..... **74900**  
920 ..... **79900**

## HAZELTINE

1420 ..... **79500**  
1500 ..... **84900**  
1510 ..... **104900**  
1520 ..... **122900**

## OKIDATA

Microline 80 ..... **55900**

## SOROC Technology

IQ 120 ..... **69900**  
IQ 140 ..... **99900**

## CROMEMCO

System 3 ..... **569500**  
Z2H ..... **799500**

## TELETYPE

43 ..... **94900**  
Acoustic Coupler ..... **17900**

## DECwriter IV

LA34 ..... **97900**

## TEXAS INSTRUMENT

810 Multi Copy  
Impact Printer ..... **149900**

**We'll meet or beat any advertised prices!**

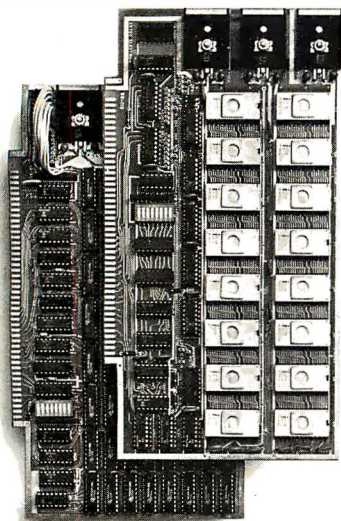
Most items in stock for immediate delivery.  
Factory sealed cartons. Full manufacturer's guarantee.

## DATA DISCOUNT CENTER

135-53 Northern Blvd., Flushing, N.Y. 11354  
Visa • Master Charge • N.Y.S. residents add Sales Tax  
Shipping F.O.B. N.Y.

Phone Orders Call 212-465-6609

# Have some great memories.



## 16K PROM boards.

- PROM card has 2708-type memory
- Quality board construction ■ 0-4 wait states
- Address any 4K group to any 4K boundary
- Control up to 8 banks of memory ■ Fully assembled and tested ■ PRICE—\$300

(California residents add 6% sales tax)

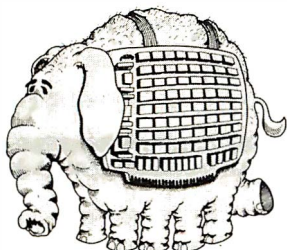
## Expandable 5 MHz RAM boards.

- 8—32K expandable RAM board uses TI 4044 memory runs at 5MHz ■ Fast 250 ns access time ■ Bank select ■ Address any 4K block to any 4K boundary ■ Quality board construction

PRICE—8K—\$175; 16K—\$315; 24K—\$475; 32K—\$620; 8K add-on kits—\$135

(California residents add 6% sales tax)

Call or write Artec for details



**ARTEC ELECTRONICS, INC.**

605 Old County Rd., San Carlos, CA 94070  
Telephone (415) 592-2740

Listing 1 continued:

```

0016 08          0094      EX    AF,AF' ;SAVE CONTROL WORD
0017 DD7E00      0095      LD    A,(IX+BASE);FETCH FIRST DURATION
001A 08          0096      EX    AF,AF' ;GET CONTROL WORD
001B D303        0097      OUT   CH3,A ;OUTPUT CONTROL WORD
001D 08          0098      EX    AF,AF' ;SAVE CONTROL WORD
001E D303        0099      OUT   CH3,A ;OUTPUT TIME CONSTANT
0020 3E57        0100      LD    A,57H ;INIT CTC CH2 SAME
                                EXCEPT FOR TIME CONSTANT
0022 D302        0101      ;
0024 3E40        0102      OUT   CH2,A ;OUTPUT CONTROL WORD
0026 D302        0103      LD    A,64D ;TEMPO SCALING FACTOR
0028 DD23        0104      OUT   CH2,A ;OUTPUT TIME CONSTANT
002A DD4E00      0105      INC    IX ;INCREMENT COMMAND PC
002D DD23        0106      LD    C,(IX+BASE);INIT PHASE INC REG
002F DD4600      0107      INC    IX ;INCREMENT COMMAND PC
0032 DD23        0108      LD    B,(IX+BASE);MOST SIGNIFICANT BYTE
0034 110002      0109      INC    IX ;INCREMENT COMMAND PC
0037 3ED7        0110      LD    DE,200H ;INIT SAMPLE ADDRESS REG
0039 D300        0111      LD    A,0D7H ;INIT CTC CHO SAME AS CH3
003B 3E7D        0112      OUT   CHO,A ;EXCEPT ENABLE INTERRUPTS
003D D300        0113      LD    A,125D ;AND DIFFERENT TIME CONSTANT
003F 1A          0114      OUT   CHO,A ;OUTPUT TIME CONSTANT
0040 FB          0115      LD    A,(DE) ;LOAD A WITH FIRST SAMPLE
0041 76          0116      EI ;ENABLE INTERRUPTS
                                ;WAIT HERE FOR ALL INTERRUPTS
                                *****
0119 ;*****
0120 ;
0121 ;
0122 ;
0123 ;
                                INTERRUPT SERVICE ROUTINE
                                *****
0042          0124      ORG     100H
0100 0201      0125      DW     INTRPT ;ADDRESS FOR INDIRECT JUMP
                                TO INTERRUPT SERVICE ROUTINE
                                THE INTERRUPT VECTOR PROVIDED BY THE CTC POINTS HERE
0102 D380      0126      ;
0104 09        0127      ;
                                INTRPT: OUT   DAC,A ;OUTPUT SAMPLE TO DAC
                                0128      ADD    HL,BC ;INCREMENT PHASE REG
                                0129      ;
                                0130      ;
                                0131      ;
                                0132      ;
                                0133      ;
                                0134      ;
                                0135      LD    E,H
                                0136      BIT   7,L ;IF 1 THEN ROUND UP
                                0137      JP    Z,NEXT ;IF 0 THEN ROUND DOWN
                                0138      INC    E ;ROUND UP
                                0139 NEXT: IN    A,CH3 ;POLL CTC CHANNEL 3
                                0140      SUB   A,1H ;TEST FOR VALUE 1
                                0141      JP    Z,NEW ;1 MEANS CHANGE TO NEXT TONE
                                0142      LD    A,(DE) ;CONTINUE PRESENT TONE
                                0143      ;
                                0144      EI ;ENABLE INTERRUPTS
                                0145      RETI ;RETURN FROM INTERRUPT
                                *****NEXT TONE PROCEDURE*****
0117 DD7E00      0146      NEW: LD    A,(IX+BASE);FETCH NEW DURATION
011A C600        0147      ADD    A,0H ;TEST FOR VALUE 0
                                0148      ;
                                0149      ;
                                0150      ;
                                0151 TEST: JP    NZ,ANOTHER
                                0152      LD    IX,400H ;COMMAND PROGRAM STARTS 400H
                                0153      JP    NEW
                                0154 ANOTHER: EX  AF,AF' ;LOAD CTC CH3 WITH NEW DURATION
                                0155      OUT   CH3,A ;OUTPUT CONTROL WORD
                                0156      EX    AF,AF' ;SAVE CONTROL WORD
                                0157      OUT   CH3,A ;OUTPUT NEW TIME CONSTANT
                                0158      INC    IX ;INCREMENT COMMAND PC
                                0159      ;
                                0160      LD    C,(IX+BASE);FETCH LOWER BYTE
                                0161      INC    IX ;INCREMENT COMMAND PC
                                0162      LD    B,(IX+BASE);FETCH UPPER BYTE
                                0163      INC    IX ;INCREMENT COMMAND PC
                                0164      LD    A,(DE) ;LOAD A WITH NEXT SAMPLE
                                0165      ;
                                0166      ;
                                0167      ;
                                0168      EI ;ENABLE INTERRUPTS
                                0169      RETI ;RETURN FROM INTERRUPT
                                *****
0139 FB          0170      ;
013A ED4D        0171      ;
                                0172      ;
                                0173      ;
                                0174      ;
                                0175      ;
                                0176      ;
                                0177      ;
                                0178      ;
                                DEFINE FAKE STAK
                                SINCE THERE IS NO WRITABLE MEMORY THE CPU
                                WILL NOT BE ABLE TO STORE THE RETURN ADDRESS
                                OF THE INTERRUPTED INSTRUCTION. IT MUST BE
                                PROVIDED IN READ ONLY MEMORY.

```

## Listing 1 continued:

```

0179 ;*****
0180      ORG      1FEH
0181      DW      HOLD      ;ADDRESS OF THE HALT
0182 ;                      INSTRUCTION
0184 ;*****
0185 ;
0186 ;          SINUSOIDAL SAMPLES
0187 ;          256 8 BIT SAMPLES OVER 360 DEGREES
0188 ;          PRINTING OF THE OBJECT CODE IS SUPPRESSED
0189 ;          NUMBERS ARE LISTED IN DECIMAL.
0190 ;
0191 ;*****
0200      DATA     128D,131D,134D,137D,141D,144D,147D,150D
0208      DATA     153D,156D,159D,162D,165D,168D,171D,174D
0210      DATA     177D,180D,183D,186D,188D,191D,194D,196D
0218      DATA     199D,202D,204D,207D,209D,212D,214D,216D
0220      DATA     219D,221D,223D,225D,227D,229D,231D,233D
0228      DATA     234D,236D,238D,239D,241D,242D,244D,245D
0230      DATA     246D,247D,249D,250D,250D,251D,252D,253D
0238      DATA     254D,254D,255D,255D,255D,255D,255D,255D
0240      DATA     255D,255D,255D,255D,255D,255D,255D,254D
0248      DATA     254D,253D,252D,251D,250D,250D,249D,247D
0250      DATA     246D,245D,244D,242D,241D,239D,238D,236D
0258      DATA     234D,233D,231D,229D,227D,225D,223D,221D
0260      DATA     219D,216D,214D,212D,209D,207D,204D,202D
0268      DATA     199D,196D,194D,191D,188D,186D,183D,180D
0270      DATA     177D,174D,171D,168D,165D,162D,159D,156D
0278      DATA     153D,150D,147D,144D,141D,137D,134D,131D
0280      DATA     128D,125D,122D,119D,115D,112D,109D,106D
0288      DATA     103D,100D,097D,094D,091D,088D,085D,082D
0290      DATA     079D,076D,073D,070D,068D,065D,062D,060D
0298      DATA     057D,054D,052D,049D,047D,044D,042D,040D
02A0      DATA     037D,035D,033D,031D,029D,027D,025D,023D
02A8      DATA     022D,020D,018D,017D,015D,014D,012D,011D
02B0      DATA     010D,009D,007D,006D,006D,005D,004D,003D
02B8      DATA     002D,002D,001D,001D,001D,000D,000D,000D
02C0      DATA     000D,000D,000D,000D,001D,001D,001D,002D
02C8      DATA     002D,003D,004D,005D,006D,006D,007D,009D
02D0      DATA     010D,011D,012D,014D,015D,017D,018D,020D
02D8      DATA     022D,023D,025D,027D,029D,031D,033D,035D
02E0      DATA     037D,040D,042D,044D,047D,049D,052D,054D
02E8      DATA     057D,060D,062D,065D,068D,070D,073D,076D
02F0      DATA     079D,082D,085D,088D,091D,094D,097D,100D
02F8      DATA     103D,106D,109D,112D,115D,119D,122D,125D

```

Errors 0

## Listing 2: A command program example making use of a macroassembler. The score of this music is given in figure 5.

```

0002 ;*****
0003 ;
0004 ;      TONE SYNTHESIZER      WRITTEN BY
0005 ;      COMMAND PROGRAM      TOM ORLOFSKY
0006 ;      EXAMPLE              12-8-78
0007 ;
0008 ;      THE COMMAND PROGRAM IS A REPRESENTATION OF
0009 ;      A MUSICAL SCORE IN OBJECT CODE EXECUTABLE BY THE
0010 ;      SYSTEM PROGRAM. THE FIRST BYTE IS THE NOTE DURA-
0011 ;      TION AND CAN HAVE VALUE 2H,3H, . . . ,FFH. THE
0012 ;      SYSTEM PROGRAM INTERPRETS A ZERO NOTE DURATION AS
0013 ;      AN UNCONDITIONAL REPEAT. THE FOLLOWING TWO BYTES
0014 ;      CONTAIN THE PITCH INFORMATION AND CAN HAVE VALUE
0015 ;      1H,2H, . . . ,800H. VALUES >800H CAUSE ALIASING
0016 ;      AND VALUE ZERO CAUSES A DC OUTPUT OR APPARENT
0017 ;      REST.
0018 ;
0019 ;      SYMBOLS FOR TWO OCTAVES OF THE EQUALLY
0020 ;      TEMPERED SCALE AND COMMON NOTE DURATIONS SIMPLIFY
0021 ;      THE TRANSLATION PROCESS. THE NOTE DURATIONS ARE
0022 ;      SET AT A TEMPO OF APPROXIMATELY 96 QUARTER NOTES
0023 ;      PER MINUTE. OTHER NOTE DURATIONS CAN BE CONSTRUCTED
0024 ;      WITH EXPRESSIONS. OTHER TEMPOS REQUIRE
0025 ;      MODIFICATION OF THE TEMPO SCALING FACTOR IN THE
0026 ;      SYSTEM PROGRAM.
0027 ;*****
0028 ;*****
0029 ;
0030 ;      SYMBOL DEFINITION
0031 ;
0032 ;*****
0033 ;      DEFINE NOTE DURATIONS
0034 ;      128TH NOTE
0035 ;      64TH NOTE
0036 ;      32ND NOTE
0037 ;      16TH NOTE
0038 ;      8TH NOTE
0039 ;      QUARTER NOTE

```

Listing 2 continued on page 330

**STRICTLY**  
 **apple**  
 AUTHORIZED DEALER



APPLE II PLUS: YOU SAVE

16K \$888 34%

48K \$999 34%

64K \$1149 34%

Above 1980 model available while supplies last.

Savings above reflect new Apple Feb. 1 list prices. 48K and 64K units with our RAM. 64K unit includes Microsoft 16K RAM board.

**IMPORTANT NOTE:** We will repair all Apple equipment regardless of where you purchased it.

**APPLE II Plus,**

16K 1981 model	\$1049	22%
48K 1981 model	\$1099	29%
64K 1981 model	\$1249	28%
Disk II & Controller	\$ 499	23%
Disk II	\$ 429	14%
Monitor, Sanyo 9"	\$ 169	30%
Monitor, Sanyo 12"	\$ 249	23%
Cable for monitor	\$ 9	40%
RF Modulator, M&R	\$ 25	38%
Silentype printer	\$ 459	23%
Qume Sprint 5 45RO	\$2599	30%
Serial Interface Card	\$ 129	35%
Apple Writer program	\$ 59	21%
Smarterm, 80 column	\$ 329	15%
Language/Pascal Sys.	\$ 379	24%
Apple Pilot	\$ 119	21%

**Microsoft,**

Z80 Softcard	\$ 250	28%
16K RAM Card	\$ 149	25%
Paper Tiger printer	\$ 666	17%
Tiger to Apple cable	\$ 19	46%
DC Hayes Micromodem	\$ 299	23%
16K Expansion RAM	\$ 39	74%
10 Memorex 5" disks	\$ 25	45%

Above prices for mail orders only. Mail Order Dept. is located in Jacksonville, OR. Our store showroom is at 126 NE F St., Grants Pass, OR. Store prices will differ. CALL ORDER DESK:

**(800) 547-1289**

TECHNICAL &amp; OREGON:

(503) 899-7297

**ORDERING INFORMATION:** Minimum order \$100. Mail or phone orders (800 547-1289 orders only.) Money Orders or Cashier Checks Welcomed. Visa and MC orders add 3%. Personal checks accepted (allow 10 days to clear). Include your telephone number. Include shipping costs of 3% (10% for foreign). Sorry, at these prices no COD's. Prices subject to change without notice. Order desk hours are 10 to 5 PST, 10 to 3 Saturdays. Warehouse at 126 NE F Street, Grants Pass, OR. Retail store prices may differ from mail order prices.

**THE MICRO COMPUTER STORE****MAIL ORDER DEPT.**

**Mail to: P O BOX 1380  
 Jacksonville, OR 97530**

## Save up to 50%

using our buying power. We buy over three million dollars of computer equipment wholesale per year for clients who range in size from the largest manufacturers to the home hobbyist. Our fee is one fourth of what we save you off the manufacturer's suggested list price, so it is to our advantage to save you money.

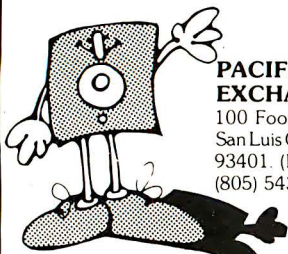
**THE PURCHASING AGENT**  
1635 School Street, Suite 101  
Moraga, CA 94556  
(415) 376-9020



Circle 246 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 247 on inquiry card.

## TWX-LINK

TWX-LINK is a complete software package which interfaces your Cromemco or MP/M based multi-user computer to a Western Union TWX line.

Using an FCC approved direct connect modem, TWX-LINK allows your computer to act as a TWX terminal for both incoming and outgoing messages.

TWX-LINK constantly monitors your TWX line. Incoming messages are automatically received, acknowledged, and written to disk storage.

TWX, TELEX, MAILGRAMS, AND TELEGRAMS can all be created, edited, and sent from your computer by using TWX-LINK.

Call, write, or TWX for more info:  
**CAWTHON SCIENTIFIC GROUP**  
24224 Michigan Avenue  
Dearborn, Michigan 48124  
PH: (313) 565-4000  
TWX: 810-221-1265

Circle 248 on inquiry card.

### Listing 2 continued:

```

(0080)      0040 .2      EQU      128D      ;HALF NOTE
(0100)      0041 .1      EQU      256D      ;WHOLE NOTE
(0000)      0042 REST    EQU      0D
              0043 ;
(0898)      0044 A01     EQU      2200D
(091B)      0045 AS01    EQU      2331D
(091B)      0046 BF01    EQU      AS01
(09A5)      0047 B01     EQU      2469D
(0A38)      0048 C01     EQU      2616D
(0AD4)      0049 CS01    EQU      2772D
(0AD4)      0050 DF01    EQU      CS01
(0B79)      0051 D01     EQU      2937D
(0C27)      0052 DS01    EQU      3111D
(0C27)      0053 EF01    EQU      DS01
(0CE0)      0054 E01     EQU      3296D
(0DA4)      0055 F01     EQU      3492D
(0E74)      0056 FS01    EQU      3700D
(0E74)      0057 GF01    EQU      FS01
(0F50)      0058 G01     EQU      3920D
(1038)      0059 GS01    EQU      4152D
(1038)      0060 AF01    EQU      GS01
(1130)      0061 A0      EQU      4400D
(1236)      0062 AS0     EQU      4662D
(1236)      0063 BF0     EQU      AS0
(134B)      0064 B0      EQU      4939D
(1471)      0065 C0      EQU      5233D
(15A8)      0066 CS0     EQU      5544D
(15A8)      0067 DF0     EQU      CS0
(16F1)      0068 D0      EQU      5873D
(184F)      0069 DS0     EQU      6223D
(184F)      0070 EF0     EQU      DS0
(19C1)      0071 E0      EQU      6593D
(1B49)      0072 F0      EQU      6985D
(1CE8)      0073 FS0     EQU      7400D
(1CE8)      0074 GF0     EQU      FS0
(1EA0)      0075 G0      EQU      7840D
(2072)      0076 GS0     EQU      8306D
(2072)      0077 AF0     EQU      GS0
              0079 ;
0080 ;*****
0081 ;
0082 ;
0083 ;
0084 ;
0085 ;
0086 ;
0087 ;
0088 ;*****
0089 N:      MACRO      #TIME, #PITCH
0090          DB          #TIME
0091          DW          #PITCH
0092          MEND
0094 ;*****
0095 ;
0096 ;
0097 ;
0098 ;
0099 ;
0100 ;*****
0101          ORG          0H
0102 M1      N          .4, C0
0103+        DB          .4
0104+        DW          C0
0105          N          .64, REST
0106+        DB          .64
0107+        DW          REST
0108          N          .4-.64, C0
0109+        DB          .4-.64
0110+        DW          C0
0111          N          .64, REST
0112+        DB          .64
0113+        DW          REST
0114          N          .4-.64, C0
0115+        DB          .4-.64
0116+        DW          C0
0117          N          .8, B0
0118+        DB          .8
0119+        DW          B0
0120          N          .8, A0
0121+        DB          .8
0122+        DW          A0
0123          N          .8, G01
0124+        DB          .8
0125+        DW          G01
0126          N          .8, F01
0127+        DB          .8
0128+        DW          F01
0129          N          .4, G01
0130+        DB          .4
0131+        DW          G01
0132          N          .8, REST
0133+        DB          .8
0134+        DW          REST

```

Listing 2 continued on page 331

tempered scale, but can experiment with other scale temperings. It is necessary to choose between the benefits of such flexibility and the value of considerable data compression possible in a table-lookup approach.

Once you gain confidence in the methods of music synthesis, you may wish to add features or otherwise improve the system. For instance, you may decide to generate a second melodic line, or voice, using the system. Careful analysis of the instruction-execution cycles in the system described in this article show that sufficient computing time is available to generate a second voice.

The second voice may be synthesized along with the first, using the remaining registers in the control microprocessor and counter-timer microprocessor. As the last step in the synthesis, the separate samples should be summed and then scaled by a factor of 0.5.

Control of dynamics (amplitude) of the music is made possible by the addition of a programmable reference voltage for the signal converter. Four bits (a nybble) may be added to each note specification to select between sixteen possible dynamic levels.

If you are satisfied with the single voice, you may decide to improve the command interpreter instead. A good place to start is to add commands such as change tempo, branch conditionally, and halt.

If you are willing to try distributed processing, you can develop a command interpreter of practically unlimited capability. One microprocessor can be dedicated to the task of note synthesis, while another processor can handle the interpretation of commands and note specifications.

In a system that uses distributed processing, the command processor, unencumbered with calculations of samples, has time to execute complex routines during the intervals between processing of commands. A parallel



**Figure 5:** One measure that has been translated into the command program example provided in listing 2.

0021		0135	N	.8,CO
0021	20	0136+	DB	.8
0022	7114	0137+	DW	CO
0024		0138	N	.8,BO
0024	20	0139+	DB	.8
0025	4B13	0140+	DW	BO
0027		0141	N	.8,CO
0027	20	0142+	DB	.8
0028	7114	0143+	DW	CO
002A	00	0144	DB	OH
002B	(0000)	0145	END	

## Errors

C

system architecture could enable more exact control over individual waveform samples. For example, a parallel processor could modulate the

signal on a sample-by-sample basis, creating attack and decay envelopes or frequency-modulated timbres.

As new and more powerful micro-

# The Microhouse March

*"Some high notes  
on low prices!"*

LIST MICROHOUSE

Software &amp; Manual/Manual Only

## COMPILED & INTERPRETERS

- ☐ **BASIC 80** by Microsoft. Version 5.2 and 4.51 included. \$350.00  
\$299/\$30
- ☐ **BASIC COMPILER** by Microsoft. Language compatible with MBASIC. Includes MACRO 80 assembler . . . . . \$395.00 **\$330/\$30**
- ☐ **Whitesmith's "C" COMPILER.** Conforms to full UNIX® version 7 C language. . . . . \$630.00 **CALL/\$30**
- ☐ **STACKWORKS FORTH.** For Z80 or 8080 CPU (specify.) Supplied in source. Assembler included. . . . . \$175.00 **\$125/\$30**
- ☐ **FORTRAN 80** by Microsoft \$500.00  
\$390/\$30
- ☐ **MACRO 80** by Microsoft. Assembler for 8080 and Z80 \$200.00 **\$140/\$20**
- ☐ **PASCAL/M** compiler by SORCIM. Full Wirth implementation. Produces P-code. . . . . \$175.00 **\$139/\$20**
- ☐ **PASCAU/Z** compiler by ITHACA INTERSYSTEMS. Produces Z80 native assembly code. \$395.00 **\$359/\$30**
- ☐ **UCSD PASCAL.** \$350.00 **\$299/\$50**
- ☐ **"Tiny" PASCAL** Designed to run in as little as 36K RAM. Supplied in source. . . . . \$85.00 **\$58/\$15**
- ☐ **muSIMP/muMATH** by Microsoft. muSIMP is a fast, efficient interpreter for sophisticated mathematical functions of up to 611 digits. muMATH is a package of programs written in muSIMP. Requires 40K . . . \$250.00  
**\$225/\$25**
- ☐ **WORDSTAR** The premier word processing software from MicroPro . . . . . \$495.00 **\$322/\$40**
- ☐ **MAILMERGE** option for wordstar 2.X . . . . . \$150.00 **\$110/\$25**

LIST MICROHOUSE

Software &amp; Manual/Manual Only

- ☐ **WORDMASTER** by MicroPro  
..... \$150.00 **\$119/\$25**
- ☐ **SUPERSORT I** by MicroPro. Can be used as a stand-alone program or can be linked to programs with a Microsoft format. .... \$250.00  
**\$189/\$25**
- ☐ **SUPERSORT II** A stand-alone-only version of above. .... \$200.00  
**\$165/\$25**
- ☐ **DATASTAR** by MicroPro. . \$350.00  
**\$269/\$35**
- ☐ **TEXTWRITER III** by Organic Software. .... \$125.00 **\$110/\$20**
- ☐ **LETTERRIGHT** by Structured Systems ..... \$200.00 **\$135/\$20**
- ☐ **TCS/Atlanta INTERACTIVE ACCOUNTING SYSTEM** for small businesses. Each package can be used alone or can post automatically to the General Ledger. Requires Microsoft BASIC, 48K RAM, 132-column printer, 24x80 CRT, and CP/M®.
- COMPARE AT UP TO \$530/pkg.  
**NEW LOW PRICE!**
- GENERAL LEDGER** \$75/\$25  
**ACCOUNTS RECEIVABLE**  
..... **\$75/\$25**  
**ACCOUNTS PAYABLE**  
..... **\$75/\$25**  
**PAYROLL** ..... **\$75/\$25**  
**ALL FOUR** ..... **\$259/\$90**  
**SAMPLE PRINTOUT BOOK**  
**of ALL FOUR** ..... **\$15**
- ☐ **BIG DISCOUNTS ON DYNABYTE, CROMEMCO, NORTHSTAR AND IMS SYSTEMS.** Call or write for prices!

**CALL OR WRITE FOR  
FREE CATALOG**

*"We will attempt to meet or beat any advertised price!"*

511 North New Street  
Bethlehem, PA 18018  
(215) 868-8219

# Microhouse

PRICES AND SPECIFICATIONS SUBJECT TO  
CHANGE WITHOUT NOTICE

**MASTERCARD OR VISA WELCOME**

APPLE is a registered trademark of Apple Computers  
 UNIX is a registered trademark of Bell Labs

UNIX is a registered trademark of Bell Labs  
TRS-80 is a registered trademark of Tandy Corp  
CP/M is a registered trademark of Digital Research

# WORK WITHIN YOUR OWN PARAMETERS

## THE CONFIGURABLE BUSINESS SYSTEM™

is a parameter-driven information manager that makes the business of applying computers easier and more efficient. A pre-defined framework gives you the tools to design and implement your own well-documented system, including:

- sophisticated data entry
- concise data-based management system
- user customized job streams and menus
- personalized report generation

User training and support is minimized by a comprehensive operating manual. CBS Disks can fit any 8080 or Z80 computer with CP/M.\*

Disks and manual, \$395: Manual only, \$40.

Your DMA representative can tell you about DMA.DOS, our CP/M compatible operating system, and ASCOM, an Asynchronous Communication Control Program.

## DMA • WE SPEAK YOUR LANGUAGE

### DYNAMIC MICROPROCESSOR ASSOCIATES

545 Fifth Avenue  
New York, New York 10017  
Telephone: (212) 687-7115

MasterCharge and VISA accepted.  
We ship prepaid and COD orders.  
Shipping and handling charges extra.

CP/M\* is a Trademark of Digital Research Corp.

processors become available, those of us that synthesize music as a hobby will use them in our circuit designs. And since systems built for hobby use do not have to be compatible with any previous equipment, we are free to use the best ideas currently available. ■

*Use of equally tempered tuning makes it possible to play music in any diatonic scale on a keyboard instrument without having to change the tuning of the instrument. By international convention, the note A4 (second space on the treble clef) is defined to have the frequency of 440.0 Hz. Since raising a pitch by one octave is the same as doubling the frequency, we can calculate the frequency of A in any octave quite easily by multiplying and dividing by the appropriate power of 2.*

*In equally tempered tuning, the octave is divided into twelve notes; each pair of adjacent notes is separated by an interval called a semitone. The ratio of frequencies between the adjacent notes is equal to the twelfth root of 2, or*

$$f_{k+1} / f_k = 2^{1/12}$$

*Using these relationships, it is easy to calculate the frequency of any arbitrary note.*

### References

1. Hillburn, J L and D E Johnson, *Manual of Active Filter Design*, McGraw-Hill Book Company, New York, 1973, pages 5 thru 52.
2. Osborne, A, J Kane, R Rector, and S Jacobson, *Z80 Programming for Logic Design*, Osborne/McGraw-Hill, Berkeley CA, 1978.
3. Snell, J, "Design of a Digital Oscillator Which Will Generate Up to 256 Low Distortion Sine Waves in Real Time," *Computer Music Journal*, April 1977, pages 4 thru 24.
4. Tierney, J, C M Rader, and B Gold, "A Digital Frequency Synthesizer," *IEEE Transactions Audio and Electroacoustics*, March 1971, pages 43 thru 57.
5. *Z80-CPU Technical Manual*, Zilog Inc, Cupertino CA, 1977.
6. *Z80 Counter Timer Circuit Technical Manual*, Zilog Inc, Cupertino CA, 1977.

# Programming Quickies

## Constellation I: An Astronomy Program

Howard Berenbon, 2681 Peterboro, West Bloomfield MI 48033

Here is an educational program for those interested in astronomy. It displays ten of the most well-known constellations and gives a multiple-choice test to see if you've been paying attention.

Constellation I (see listing 1) is written in BASIC and will run on many computers, including the Radio Shack TRS-80 Model I Levels I and II and Sw.TPC 6800. It requires roughly 4 K bytes of memory.

### Operation

After running the program, you can review the constellations by entering a 1. You can enter a 0 to take the test. If you choose to review the constellations (highly suggested before taking the test), enter another number from 1 thru 10. For each number entry, a constellation will be displayed using asterisks as stars, along with its name (see listing 2). The constellations may be reviewed in or out of sequence and for any length of time.

When you review the tenth constellation, you again have a choice of taking or not taking the test. Enter a 0 if you are ready. Otherwise, you can continue reviewing.

The test consists of ten multiple-choice questions. A constellation is displayed with four possible answers. Enter the number (1 thru 4) of the name that corresponds to the constellation. The program will advance to the

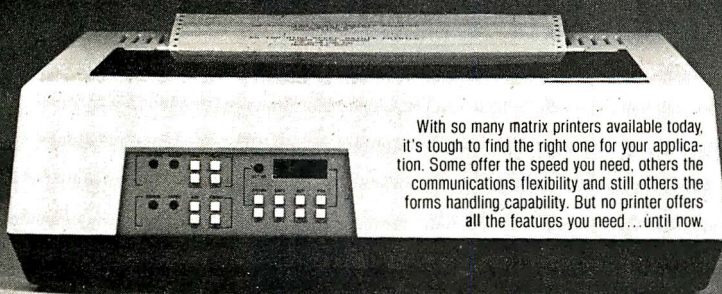
*Text continued on page 335*

**Listing 1:** *Constellation I, a program for learning ten constellations. This program requires only 4 K bytes of memory and will run without modification in many BASIC systems.*

```
5 PRINT "CONSTELLATION I"
10 PRINT "COPYRIGHT (C) 1979 BY HOWARD BERENBON"
20 PRINT
30 PRINT "THIS PROGRAM DISPLAYS 10 CONSTELLATIONS AND"
35 PRINT "GIVES A MULTIPLE CHOICE TEST,"
40 PRINT
45 FOR I=1 TO 10
50 A(I)=0
55 NEXT I
100 INPUT "1-REVIEW, 0-TEST"; A
110 IFA=0 THEN 3000
118 PRINT
120 PRINT "ENTER #1-10"
125 INPUT B
130 ON B GO TO 2400,2430,2460,2500,2530,2560,2600,2630,2660,2700
200 PRINT "CASSIOPEIA"
220 PRINT TAB(12); "*"
230 PRINT TAB(26); "*"
240 PRINT " "
250 PRINT TAB(33); "*"
260 RETURN
300 PRINT "LEO"
320 PRINT TAB(30); "*"
330 PRINT " "
340 PRINT TAB(23); "*"
350 PRINT " "
360 PRINT " "
370 RETURN
400 PRINT "URSA MAJOR"
415 PRINT TAB(32); "*"
420 PRINT " "
430 PRINT " "
440 PRINT " "
450 RETURN
500 PRINT "CEPHEUS"
520 PRINT TAB(21); "*"
530 PRINT " "
540 PRINT " "
550 PRINT " "
560 PRINT TAB(23); "*"
576 PRINT " "
580 PRINT " "
590 PRINT " "
600 PRINT TAB(24); "*"
610 RETURN
```

*Listing 1 continued on page 334*

### datasouth announces... THE TOTAL PRINTER PACKAGE!



With so many matrix printers available today, it's tough to find the right one for your application. Some offer the speed you need, others the communications flexibility and still others the forms handling capability. But no printer offers all the features you need...until now.

**datasouth**  
computer corporation

The DS 180 provides a total package of performance features for any application where quality impact printing is required. Not a "hobby-grade" printer, the DS 180 is a real work-horse designed to handle your most demanding printer requirements.

**High Speed Printing**—Bidirectional printing at 180 cps offers throughput of over 200 lpm on average text. A 9-wire printhead generates a 9x7 font with true lower case descenders and underlining.

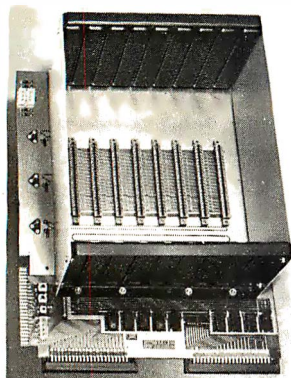
**Non-volatile Format Retention**—A unique keypad featuring a non-volatile memory makes programming the DS 180 quick and easy. Top of form, tabs, perforation skipover, communications parameters and many other features may be entered and stored from the keypad. The DS 180 even remembers the line where you stopped printing—eliminating the need to reset the top of form at power-on.

**Communications Versatility**—Interfaces include RS232, current loop and 8-bit parallel. Baud rates from 110-9600 may be selected. A 1K buffer and X-on, X-off handshaking ensure optimum throughput.

**Forms Handling Flexibility**—Forms ranging from 3"-15" may be fed from the front or bottom, and an adjustable printhead provides crisp and clear copy on forms with as many as 6-parts.

For more information on how the DS 180's low-cost total printer package can fill your application, contact us at Datasouth. The DS 180 is available for 30-day delivery from our sales/service distributors throughout the U.S.

4740 Dwight Evans Road • Charlotte, North Carolina 28210 • 704/523-8500



**PRICE: \$139.00**

We also carry the **SYM-1**  
Microcomputer with manuals **\$229.00**

## VAK-1 MOTHERBOARD

- Designed specifically for use with the AIM-65, SYM-1, and KIM-1 microcomputers
- Standard KIM-4\* Bus
- Fully buffered Address and Data Bus
- Provides 8 expansion board slots
- Complete with rigid card-cage
- All IC's are socketed
- Provides separate jacks for one audio-cassette, TTY, and Power
- Completely assembled (except for card-cage)

We manufacture a complete line of high quality expansion boards. Use reader service card to be added to our mailing list, or U.S. residents send \$1.00 (International send \$3.00 U.S.) for airmail delivery of our complete catalog.

*\*Product of MOS Technology*



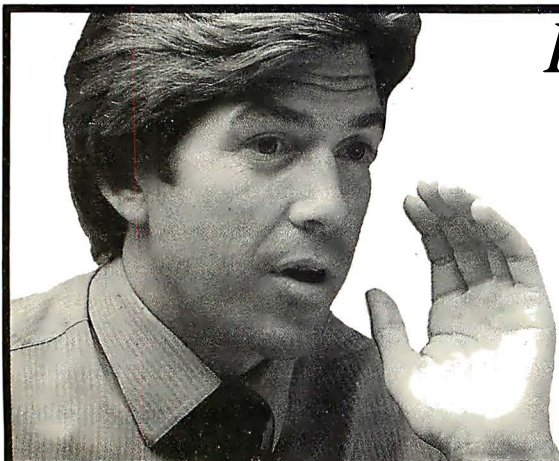
2951 W. Fairmount Avenue • Phoenix, AZ 85017 • (602) 265-7564  
Please note new address

*Listing 1 continued:*

```

700 PRINT "GEMINI"
720 PRINT "      x      x"
730 PRINT
740 PRINT
750 PRINT TAB(14); "x"
760 PRINT "      x      x"
770 PRINT
780 PRINT "      x      x"
790 PRINT "      x      x"
795 RETURN
800 PRINT "CORONA BOREALIS"
820 PRINT "      x      x"
830 PRINT "      x      x"
840 PRINT "      x      x"
850 PRINT "      x      x"
860 RETURN
900 PRINT "SAGITTARIUS"
920 PRINT "      x      x"
930 PRINT "      x      x"
940 PRINT TAB(12); "x"
950 PRINT
960 PRINT "      x      x"
970 PRINT "      x      x"
980 PRINT "      x      x"
990 RETURN
1000 PRINT "LYRA"
1020 PRINT "      x      x"
1030 PRINT "      x      x"
1040 PRINT "      x      x"
1060 PRINT "      x      x"
1070 PRINT "      x      x"
1080 PRINT "      x      x"
1090 RETURN
1200 PRINT "AURIGA"
1220 PRINT "      x      x"
1230 PRINT "      x      x"
1240 PRINT "      x      x"
1250 PRINT "      x      x"
1260 PRINT "      x      x"
1270 PRINT "      x      x"
1280 RETURN
1400 PRINT "CYGNUS"
1420 PRINT "      x      x"
1430 PRINT "      x      x"
1440 PRINT "      x      x"
1450 PRINT "      x      x"
1470 PRINT TAB(29); "x"
1480 PRINT TAB(32); "x"
1490 PRINT TAB(35); "x"
1500 RETURN
2400 GOSUB 200
2410 GOT0118
2430 GOSUB 300
2440 GOT0118
2460 GOSUB 400
2470 GOT0118
2500 GOSUB 500
2510 GOT0118
2530 GOSUB 700
2540 GOT0118
2560 GOSUB 800
2570 GOT0118
2600 GOSUB 900
2610 GOT0118
2630 GOSUB 1000
2640 GOT0118
2660 GOSUB 1200
2670 GOT0118
2700 GOSUB 1400
2710 GOT0100
3000 P=0
3010 PRINT "MULTIPLE CHOICE TEST"
3020 PRINT "ENTER CORRECT ANSWER (#1-4)"
3030 PRINT
3040 PRINT "1)"
3050 GOSUB 320
3060 PRINT "(1) LEO"
3070 PRINT "(2) BOOTES"
3080 PRINT "(3) LYRA"
3090 PRINT "(4) LYNX"
3100 GOSUB 5050
3110 IFC=1GOSUB 5000:A(1)=10
3130 PRINT "2)"
3150 GOSUB 520
3170 PRINT "(1) PROCYON"
3180 PRINT "(2) AURIGA"
3190 PRINT "(3) CEPHEUS"
3200 PRINT "(4) ORION"
3210 GOSUB 5050
3220 IFC=3GOSUB 5000:A(2)=10
3230 PRINT "3)"
3240 GOSUB 1220
3260 PRINT "(1) LEO"
3270 PRINT "(2) AURIGA"
3280 PRINT "(3) GEMINI"
3290 PRINT "(4) HYDRA"
3300 GOSUB 5050
3310 IFC=2GOSUB 5000:A(3)=10
3320 PRINT "4)"
3340 GOSUB 720

```



## Have you Heard?

PBS has the UCSD Pascal™ system for:

**SofTech certified  
system for \$450**  
(documentation included).

**Run-Time-Only  
system for \$350.**

- Cromemco
- Dynabyte
- Onyx
- Vector Graphic

Quantity discounts  
available.

Contact:



PROFESSIONAL  
BUSINESS  
SOFTWARE

(415) 546-1596 119 Fremont St., San Francisco, CA 94105





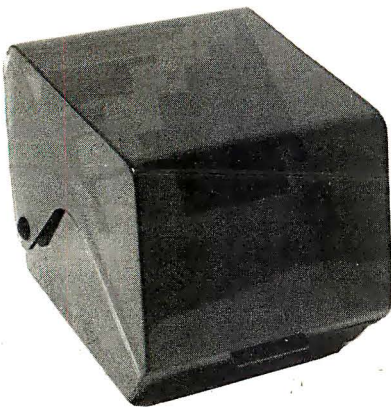
# META TECHNOLOGIES

## FOR YOUR DISK SYSTEM



### FILE BOX

DISKETTE STORAGE SYSTEM



**\$24<sup>95</sup>** for 5 1/4" disks  
for 8" disks . . . \$29.95

MTC brings you the ULTIMATE diskette storage system, at an affordable price. Storing 50 to 60 diskettes, this durable, smoke-colored acrylic unit provides easy access through the use of index dividers and adjustable tabs. Unique lid design provides dust-free protection and doubles as a carrying handle.

#### PLASTIC LIBRARY CASES (not shown)

An economical form of storage for 10 to 15 diskettes, and is suitable for your bookshelf! Case opens into a vertical holder for easy access.

5 1/4-inch diskette case . . . . . \$3.25  
8-inch diskette case . . . . . \$3.50

### TRS-80™ PRODUCTS

James Favour

**MICROSOFT BASIC DECODED**

& OTHER MYSTERIES

for the TRS-80



NEWDOS/80 by Apparat . . . . . \$149.95  
NEWDOS+ with ALL UTILITIES  
35-track . . . . . \$69.95  
40-track . . . . . \$79.95  
TRS-80™ DISK  
AND OTHER MYSTERIES . . . . . \$19.95  
MICROSOFT™ BASIC DECODED & OTHER  
MYSTERIES for the TRS-80™ . . . . . \$29.95

### 'RINGS' & THINGS

Help prevent data loss and media damage due to improper diskette centering and rotation with the FLOPPY SAVER™ reinforcing hub ring kit. 7-mil mylar rings install in seconds. Kit is complete with centering tool, pressure ring, 25 adhesive backed hub rings and instructions.

HUB RING KIT for 5 1/4" diskettes . . \$9.95  
REFILLS (50 Hub Rings) . . . . . \$4.95

Protect your expensive disk drives and your valuable diskettes with our diskette drive head cleaning kit. The kit, consisting of a pair of special "diskettes", cleaning solution and instructions, can be used for 52 cleanings. Removes contamination from recording surfaces in seconds without harming drives.

CLEANING KIT for 5 1/4" drives . . . \$24.95

Single Sided, Single Density, Soft-Sector'd  
5 1/4-inch, (for TRS-80™) Mini-floppy

### DISKETTES

**\$21<sup>95</sup>** box of 10

These are factory fresh, absolutely first quality (no seconds!) mini-floppies. They are complete with envelopes, labels and write-protect tabs in a shrink-wrapped box.

#### PLAIN JANE™ DISKETTES

The Beautiful Floppy  
with the Magnetic Personality™

Thousands of people have switched to this low-cost alternative. These quality diskettes are packaged in a plain white box . . . no fancy printing, fancy names or fancy labels, not even our own (labels cost money). Trust us.

PLAIN JANE™ Diskettes . . . . . \$21.95  
10 boxes of 10 . . . . . (each box) \$21.50

VERBATIM'S PREMIUM DISKETTES AT  
AFFORDABLE PRICES

#### DATALIFE™

Seven data-shielding improvements mean greater durability and longer data life. These individually certified diskettes feature thicker oxide coating, longer-lasting lubricant, improved liner, superior polishing and more! Meets or exceeds IBM, Shugart, ANSI, ECMA and ISO standards. Buy the best . . . buy DATALIFE™.

VERBATIM DATALIFE™ DISKETTES

5 1/4-inch (box of 10)  
MD525-01 . . . . . \$26.95  
10 boxes of 10 . . . . . (each box) \$25.95  
8-inch FLOPPIES  
Single-Density, FD34-1000 . . \$29.95  
Double-Density, FD34-8000 . . \$39.95

**CALL FOR INFORMATION ON  
OTHER TRS-80™ PRODUCTS**

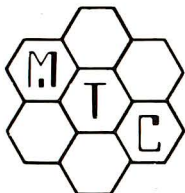
Products damaged in transit will be exchanged.  
Prices, Specifications, and Offerings subject to change without notice.

**MOST ORDERS  
SHIPPED  
WITHIN ONE  
BUSINESS DAY**

PRICES IN EFFECT  
March 1, 1981 THRU  
March 31, 1981

**WE ACCEPT**  
• VISA  
• MASTER CHARGE  
• CHECKS  
• MONEY ORDERS  
• C.O.D.

• Add \$2.50 for standard UPS shipping & handling  
• \$2.00 EXTRA for C.O.D.  
• Ohio residents add 5 1/2% sales tax.



**FOR PRODUCT INFO**  
**1-800-321-3640**

**CALL  
TOLL  
FREE**

**TO PLACE ORDER**  
**1-800-321-3552**

IN OHIO call (216)289-7500 (COLLECT)

**META TECHNOLOGIES CORPORATION**

26111 Brush Avenue, Euclid, Ohio 44132

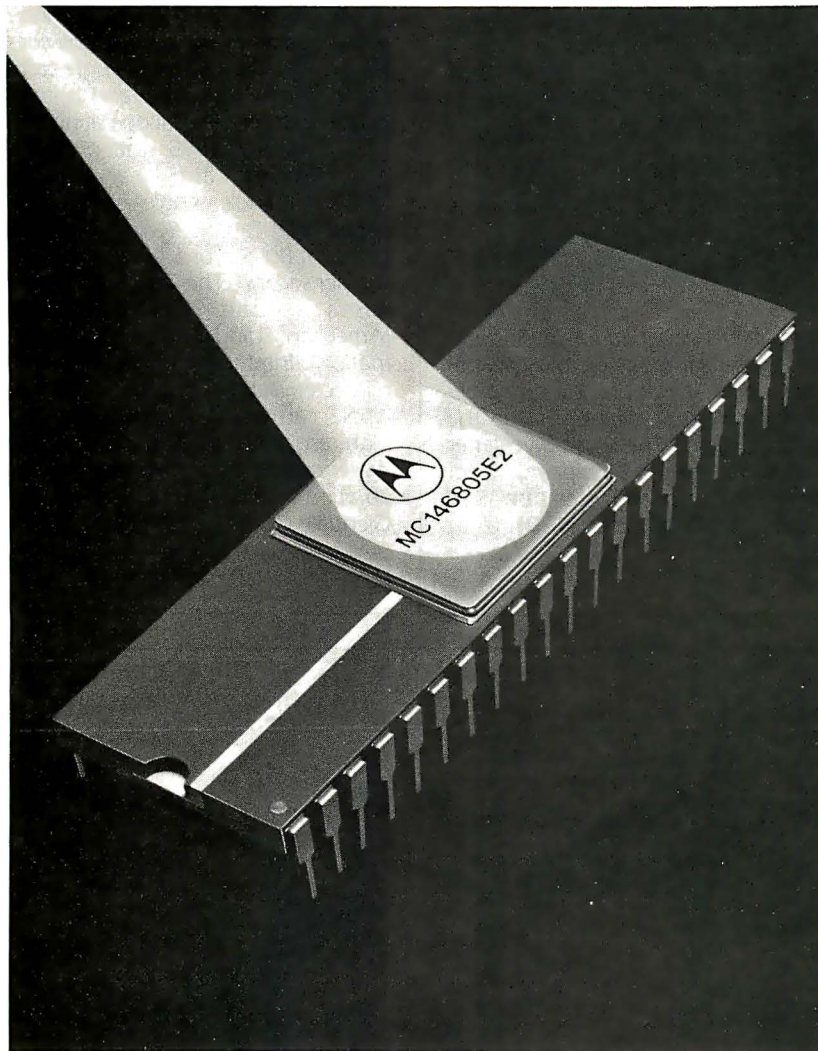


810115  
TRS-80 is a TM of Tandy Corp.  
PLAIN JANE is a TM of MTC.  
©1981 by Metatechnologies Corporation, Inc.

# What's New?

## SYSTEMS

### CMOS Processor from Motorola



The MC146805E2 is an 8-bit CMOS microprocessor with a set of 61 instructions similar to the MC6800's. There's a set of bit-manipulation instructions to allow any bit in programmable memory or any I/O (input/output) line to be set or cleared with a single instruction. The device requires only 20 mW at 1 MHz and less than 1 mW in the standby mode. The supply-voltage range is 3 to 6 V DC. The unit includes an 8-bit timer with a software-programmable 7-bit prescaler, 112 bytes of programmable memory, and a clock generator. The multiplexed bus has an 8 K-byte addressing range. A 2 K-byte CMOS ROM is available. The processor is priced at \$45 in unit quantities. Contact Motorola Semiconductor Products Inc., 3501 Ed Bluestein Blvd, Austin TX 78721.

Circle 400 on inquiry card

### DTC's Microcomputer

The DTC Micro 210 contains 64 K bytes of programmable memory, a 2 K phantom ROM (read-only memory), an 8085A-2 microprocessor, and four RS-232C asynchronous interface ports. The unit employs two BASF 5-inch floppy-disk drives having 300 K bytes of storage. The operating systems available with the Micro 210 are compatible with DTC's other microcomputers. Single- and multi-user systems are available. Applications software can be written under CP/M, DTC's Multi-User Business BASIC, or DTC's version of Microsoft BASIC. The price for the Micro 210 is \$3295 from DTC, 590 Division St, Campbell CA 95008, (408) 378-1112.

Circle 402 on inquiry card

### 8088-Based Board for the S-100

The CP88 is a 5 MHz 8088-based microprocessor board designed for the S-100-bus system. It features 1-megabyte address space, 64 K I/O addresses, an instruction set with full 16-bit mathematics and extensive string-handling capabilities, a 3 K-byte EPROM, provision for 1 K bytes of programmable memory, memory addressing in the top 4 K bytes of address space, and the ability to disable memory space. The memory-access time is 450 ns. The CP88 has switch-selectable 5 to 8 MHz clock rates and spare sockets for breadboarding. The CP88 is available as a bare board

only. It comes with documentation for \$59.95 from Microfuture, POB 5951, San Jose CA 95150, (408) 249-0560.

Circle 401 on inquiry card

### Where Do New Products Items Come From?

The information printed in the new products pages of BYTE is obtained from "new product" or "press release" copy sent by the promoters of new products. If in our judgment the information might be of interest to the personal computing experimenters and homebrewers who read BYTE, we print it in some form. We openly solicit releases and photos from manufacturers and suppliers to this marketplace. The information is printed more or less as a first-in first-out queue, subject to occasional priority modifications. While we would not knowingly print untrue or inaccurate data, or data from unreliable companies, our capacity to evaluate the products and companies appearing in the "What's New?" feature is necessarily limited. We therefore cannot be responsible for product quality or company performance.

# What's New?

## PERIPHERALS

### Music Filter



The Music Sweetener is a low-pass filter designed to enhance Software Affair's Orchestra-80 and other commercial and homebrew D/A (digital-to-analog) converter music synthesizers that do not already have a filter. The unit attenuates the unwanted high-frequency sampling noise better than a stereo system's treble tone

control. It is designed for use in four-part music synthesis on most microcomputers. The device is inserted between the music peripheral and the audio amplifier. The Music Sweetener is \$39.95, plus \$2 shipping, from Newtech Computer Systems Inc, 230 Clinton St, Brooklyn NY 11201, (212) 625-6220.

Circle 403 on inquiry card

### Apple II Printer

IMP2-Apple is an impact printer designed for the Apple II. It provides lowercase characters, single-command printer functions, and is compatible with the Pascal operating system. Priced at \$895, the printer is equipped with friction and tractor feed to handle single sheets, roll paper, and fanfold forms. The unit can print 80, 96, or 132 columns at 1 line per second. The 7 by 7 dot matrix has a standard 96-character ASCII (American Standard Code for Information Interchange) set; special character sets are optional. IMP2-Apple can handle user-defined and high-resolution graphics under software control. Contact Axiom Corporation, 5932 San Fernando Rd, Glendale CA 91202, (213) 245-9244.

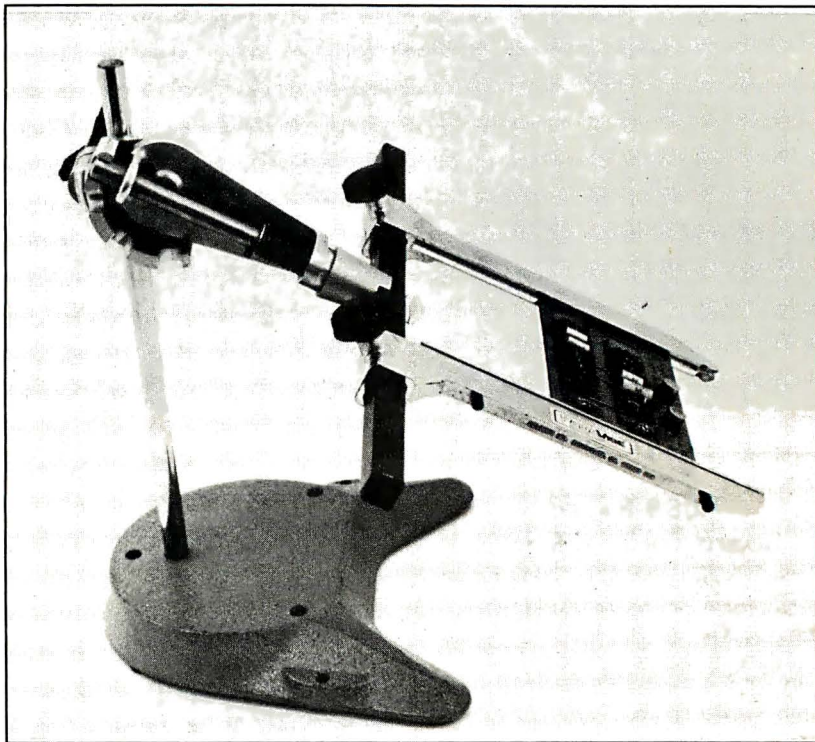
Circle 404 on inquiry card

### Vision for Your Microcomputer

Microtex Corporation has developed an image-processing subsystem that allows microprocessors to be used in the gray-scale data acquisition from Reticon line-scan and matrix cameras. The Microtex 6400 device acquires 8-bit (256 gray level) data at 1 or 2.5 MHz, and provides all power, control, and clock signals to the Reticon camera. A board designed for the Digital Equipment Corporation LSI-11 family of microprocessors, the 6400-A has a general-purpose interface for use with many other 16-bit microprocessors. An optional video processor will allow the user to see real-time data from the 256 by 256 matrix camera at approximately 30 frames per second.

The basic 6400 system includes the camera-control logic, an external synchronization input that initiates the scan, an 8-bit A/D (analog-to-digital) converter, 64 K bytes of programmable memory, and the Q-bus interface, which contains all the registers for software control of the subsystem. The 6400-A costs \$4595 for the 1 MHz version and \$4895 for the 2.5 MHz version. For more information, contact Microtex Corporation 80 Trowbridge St, Cambridge MA 02138, (617) 491-2874.

Circle 405 on inquiry card



### Circuit-Board Holder

The Model 333 circuit-board holder from PanaVise Products Inc features an 8-position rotating adjustment, indexing at 45° increments, and 6 lock positions in the vertical plane, allowing a 10-inch height adjustment. With cross-bars available up to 30

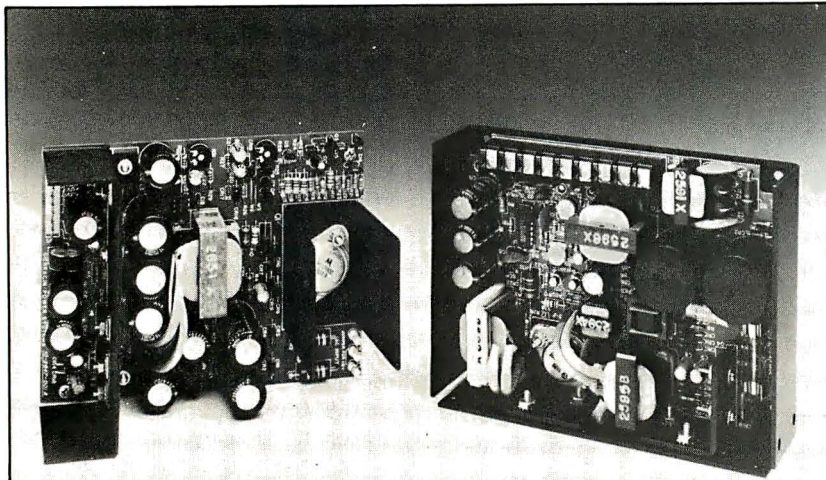
inches in length, the holder can support circuit boards up to 28 inches wide. Extra arms can be added. It is built onto a pre-drilled cast-iron base for stability and easy mounting. Contact PanaVise Products Inc, 2850 E 29th St, Long Beach CA 90806, (213) 595-7621.

Circle 406 on inquiry card

# What's New?

## PERIPHERALS

### 40 and 60 W Switching DC Power Supplies



Sierracin/Power Systems has developed a series of 40 and 60 W open-frame switching DC power supplies. The 5A and 5B series, 40 and 60 W respectively, come in single- and multiple-output versions. The single-output models 5A5 and 5B5 deliver 5 V at 7 A and 12 A at full load. Prices for these models are \$45 and \$75 respectively. The 40 W multiple-output 5AXMP delivers 5 V at

4 A,  $\pm 12$  V at 0.5 A, -5 V at 0.5 A, and +15 V at 1.0 A for \$59. The 60 W multiple-output 5BXMP delivers 5 V at 7 A, +12 V at 1.5 A, -12 V at 0.5 A, and -5 V at 0.25 A for \$89. For complete details, contact Sierracin/Power Systems, 20500 Plummer St, Chatsworth CA 91311, (800) 423-5569; in California (213) 998-9873.

Circle 412 on inquiry card

### DIP-85 Printer

The DIP-85 impact printer features a 7 by 7 or 14 by 7 dot matrix, 6 character sizes, 100 cps (characters per second) bidirectional print speed, tractor or friction paper feed, and a ribbon cartridge. It has variable line density and continuous form-length controls. The printer has a high-resolution graphic capability and can provide plotting, video-display graphics, illustrations, and special-effects symbols. The unit has data rates up to 9600 bps, parallel and serial RS-232C ports, and a 1 K-byte buffer. With a 96-character ASCII (American Standard Code for Information Interchange) set, the DIP-85 is capable of uppercase and lowercase printing at 80, 96, or 132 characters per line on standard-sized paper. Paper feed is at the rate of 10 lines per second. Operator control includes power, select/deselect, line feed, top of form, self-test, and variable vertical-tab setting. The DIP-85 is priced at \$625 in quantities of 100. For more information, contact DIP Inc, 745 Atlantic Ave, Boston MA 02111, (617) 482-4214.

Circle 413 on inquiry card

we have **PRINTERS !!**  
**\$499.00 Dip 81**  
 (Friction Feed)

- 7x7 DOT MATRIX
- UPPER/LOWER CASE
- BI-DIRECTIONAL PRINTING
- FAN COOLED    ▪ 100c.p.s.

Other models available with tractor feed, & other options. Write for complete details.

NEW!

### PROM PROGRAMMER

- IEEE 696/S-100 CARD PROGRAMS 1K, 2K, 4K, & 8K PARTS
- 8 SOCKETS ACCEPT PROGRAMMED EPROMS or RAMS ...& MUCH MORE
- SWITCH SETTABLE: EXTENDED ADDRESS EXTENDED DEVICE SELECT

NEW!

### S-100 KLUGE CARD

- ADDRESS BUFFERING • DATA BUS BUFFERING
- CONTROL LOGIC • DEVICE SELECT ETC.

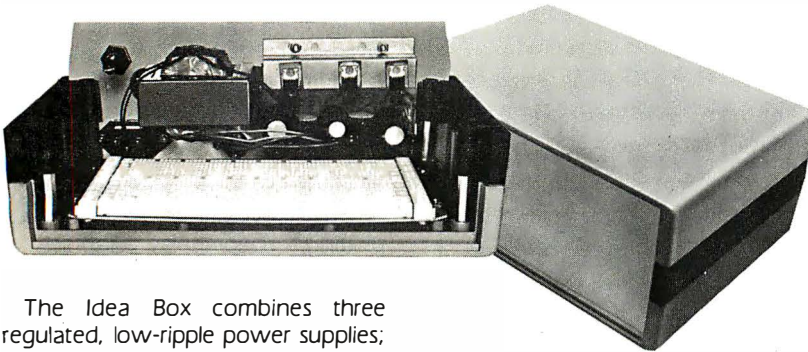
**ads**

Ackerman Digital Systems, Inc. (312)530-8992  
 110 N. York Rd., Suite 208, Elmhurst, Ill. 60126

# What's New?

## PERIPHERALS

### Idea Box for Experimenters



The Idea Box combines three regulated, low-ripple power supplies; a choice of a solderless breadboard, a pre-etched, pre-drilled printed-circuit board, or a blank foil board. This combination allows easy construction of a prototype or a built-once-only device. The Idea Box is priced from \$149.95. The circuit cards and printed-circuit

layout pads are available individually from \$4.95 to \$44.95. Contact Global Specialties Corporation, 70 Fulton Ter, New Haven CT 06509, (203) 624-3103.

Circle 407 on inquiry card

### Interface the Apple II to Centronics-Type Printers

The Model 7728 Centronics Printer Interface makes the Apple II compatible with printers using Centronics-type parallel interfaces, such as the Okidata Microline 80, the Microtek MT-80P, the MPI 88T, and Centronics printers. A 256-byte ROM (read-only memory) provides driver firmware and controls character output to the printer. The 7728 supports the interrupt daisy chain with arbitration logic, including jumper-selectable IRQ gen-

eration, and it provides direct-memory-access daisy-chain pass-through. The printer interface includes an 8-bit data output bus, four status inputs, data strobe and acknowledge handshake signals, and a printer-reset signal. The 7728 comes assembled and tested, with documentation, for \$119.95. Cables for different printers are available from the manufacturer. Contact California Computer Systems, 250 Caribbean Dr, Sunnyvale CA 94086, (408) 734-5811.

Circle 408 on inquiry card

### Five-Inch Hard-Disk Drive

Tandon Magnetics Corporation has a family of hard-disk drives that can store 3.19 to 11.5 megabytes. The TM 600 family of 5-inch Winchester-type hard-disk drives contains one-, two-, and three-platter models. These drives feature a track-to-track access time of 3 ms and an average access time of 168 ms. Recording density is 7690 bits per inch and rotating speed is 3600 rpm (revolutions per minute). Tandon offers two interfaces, the S and the T versions. The S version is compatible with higher-capacity drives, and the T version is compatible with Tandon's TM 100 floppy-disk drives. The T version allows the TM 600 series to run in a

daisy chain with the TM 100-4 floppy-disk drive. This permits 11.5 megabytes of fixed-disk storage in a daisy chain with 3 megabytes of floppy-disk storage.

The three-platter TM 603E offers a capacity of 11.5 unformatted megabytes with 230 cylinders. The TM 602E is a two-platter unit offering 7.66 megabytes of storage with 230 cylinders. The two-platter TM 602 model stores 6.38 megabytes, and the TM 603 delivers 9.57 megabytes with three platters. Up to four TM 600s can be daisy-chained on a single bus. The TM 600 family is priced in the \$1400 to \$1600 range. Contact Tandon Magnetics Corporation, 9333 Oso Ave, Chatsworth CA 91311, (213) 993-6644.

Circle 409 on inquiry card

### 80 by 24 Video Display for the Apple II

The Full-View 80 is an 80-column by 24-line uppercase and lowercase plug-in video-display card for the Apple II. Under keyboard or program control, Full-View 80 permits user selection of 80- or 40-column graphics on the same monitor. Four character generators are offered. One is a 7 by 9 dot-character font. Two are user-programmable EPROM (erasable programmable read-only memory) types that contain line-drawing graphics; one has 127 characters and the other 255 characters. The fourth is a 5 by 7 dot matrix to permit 80-column display on low-performance monitors. The Full-View 80 works with Apple Pascal, Microsoft's SoftCard, the Hayes Microcomputer Products Micromodem, the Apple Communications Card, and all Apple peripherals. A 2 K-byte ROM provides keyboard editing, cursor control, tabbing, and scrolling. Seven other keyboard-function keys are provided. The firmware incorporates Pascal and BASIC protocols. A real-time non-maskable interrupt clock can be software-enabled to permit timing of programs in background mode. A read-screen capability, a blank-screen function, and a light-pen connector with firmware support are provided. When the keyboard is shift-locked, the cursor blinks. The price is \$395 from Bit 3 Computer Corporation, 1890 Huron St, St Paul MN 55113, (612) 926-6997.

Circle 410 on inquiry card

### 240 lpm Thermal Printer/Plotter

Printer Systems Corporation's TH 240 is an 80-column thermal printer that prints 240 lpm (lines per minute). This speed permits copying a 24-line video display in less than 6 seconds. The 240 has an optional plotting mode that produces 70 by 560 dots per inch resolution. The TH 240 is priced at \$1395 for the alphanumeric version and \$1595 for the alphanumeric-plus-plotting version. For details, contact Printer Systems Corporation, 1 W Deer Park Rd, Suite 104, Gaithersburg MD 20760, (301) 840-1070.

Circle 411 on inquiry card

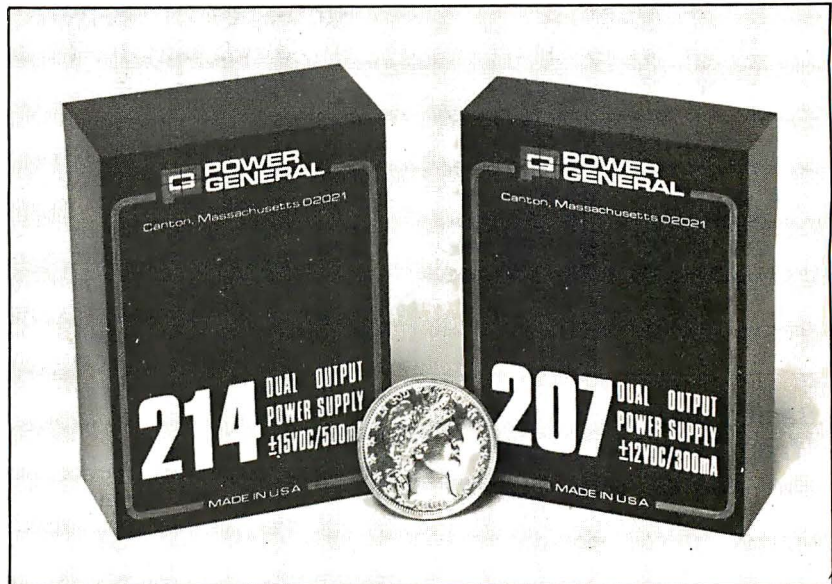
# What's New?

## MISCELLANEOUS

### Dual-Output DC Power Supplies

The 200 series dual-output DC power supplies from Power General include thirteen models with outputs of  $\pm 5$  VDC,  $\pm 12$  VDC, or  $\pm 15$  VDC with output currents from  $\pm 50$  mA to  $\pm 500$  mA. Other specifications include: input voltage range 105 to 125 VAC; input frequency 50 to 440 Hz; output-voltage accuracy  $\pm 1\%$ ; line regulation  $\pm 0.05\%$ ; load regulation  $\pm 0.1\%$ ; ripple and noise 1 mV RMS; transient recovery time 50  $\mu$ s; breakdown voltage 1500 VAC; and an operating temperature range of  $-25^{\circ}\text{C}$  to  $+71^{\circ}\text{C}$ . Prices range from \$49 to \$109. Contact Power General, 152 Will Dr, Canton MA 02021, (617) 828-6216.

Circle 417 on inquiry card



### Let This Program Write Your Programs

PEARL Level 3 is an automatic systems generator. PEARL allows you to respond to on-screen menus and prompts to define a desired program. PEARL uses this input to generate error-free source code in BASIC and to produce desired applications software. It can also create complex multiple-file applications programs. The program lets you describe performance requirements, then turn the linear programming over to PEARL. PEARL 3 enables you to create programs for menu selection, file update and edit, reports, editing control data,

file reorganization, and general report writing. It can define and cross-index elements between multiple files within a single system, define reports using data from multiple files, extend the standard program menu, define the interrelationships between data elements in different files, post journal files to a master file, provide extended report generation, and support multiple index keys for a file. PEARL 3 is priced at \$650, PEARL 2 for \$350, and PEARL 1 for \$130. PEARL 1 and 2 are for beginning and intermediate programmers. Contact CPU, POB 12892, Salem OR 97309, (503) 370-8653.

Circle 418 on inquiry card

### Mostek Announces a 64 K-Byte Dynamic Programmable Memory

The MK4164 is a series of 64 K-byte programmable memories featuring polysilicon lines instead of diffused bit lines for a 50% signal increase to the sense amplifier. By relocating the bit lines to a different level, the distance between adjacent capacitors is reduced to 3 microns. This space savings permits an increase of the storage-capacitor size to 75% of the total cell area. To increase the density from 16 to 64 K bits, the device uses

512 sense amplifiers. The MK4164s feature an internal refresh counter. Another refresh feature permits the output to be held valid indefinitely by holding  $\overline{\text{CAS}}$  (column address strobe) active low. The series features single +5 V supply operation, maximum power of 300 mW (20 mW standby), and 150 ns access time. The MK4164-15 has a 325 ns cycle time. The price for the MK4164-20 in 100-piece lots is \$59.99. For complete details on the MK4164s, contact Mostek Corporation, 1215 W Crosby Rd, Carrollton TX 75006, (214) 323-6000.

Circle 419 on inquiry card

### Built-In Foreign Languages

The ML-32 multi-language system offers users the ability to select sets of 32 different languages, resident in the system, and display these languages simultaneously on the screen or have them printed. The system offers multi-language communications in a word-processing package. Black-and-white graphics are included with color graphics provided in the CML-32. The ML-32 can interface with any host computer system. The screen displays 34 lines of 80 characters on a high-resolution monitor. There are 80 programmable function keys on the keyboard. The system can also utilize floppy-disk drives, cassette tape players, and hard-disk drives. RS-232C, IEEE, and IBM 3270 input/output ports are provided. The languages in the system include English, Greek, Arabic, Hebrew, Russian, Japanese, Chinese, German, French, Italian, Welsh, Dutch, Norwegian, Swedish, Turkish, Spanish, Latin, Icelandic, Hungarian, Albanian, Bulgarian, and Portuguese. The price for the ML-32 is \$17,500, and the CML-32 is priced at \$26,000. For more information, contact Michael Root at Computer Systems Consultants Inc, 225 Main St, Chelmsford MA 01863, (617) 251-8561.

Circle 420 on inquiry card

# What's New?

## MISCELLANEOUS

### Hayden Books Brochure

Hayden Book Company Inc.'s new brochure lists books on computer science, electricity and electronics, engineering, mathematics, and other special interests. It is available free upon request from the Hayden Book Company Inc., 50 Essex St., Rochelle Park NJ 07662, (800) 827-3777, ext 302.

Circle 421 on inquiry card

### Basic Electricity Course from Heathkit/Zenith

The EE-3100 Basic Electricity Course, from Heathkit/Zenith Educational Systems, is designed for the self-starter. If you wish to expand your knowledge of basic electronics, this course will serve as your introduction to Ohm's Law, power, series and parallel circuits, electromagnetism, types of current, motors, generators, and meters. The course is written in a programmed-instruction format, and includes two audio cassettes. It costs \$29.95. Contact Heathkit/Zenith Educational Systems, Department 350-540, Benton Harbor MI 49022, (616) 982-3210.

Circle 422 on inquiry card

### Graphics Coprocessor Integrated Circuits

EFCIS, a subsidiary of Thomson-CSF, has introduced two graphics devices. The EF 9365 (512 by 512 pixels) and the EF 9366 (512 by 256 pixels) graphics processors can directly execute high-level-language descriptors by means of vector-descriptor files. The on-chip vector generator allows a writing speed of more than 500 meters per second on a 51 cm (21-inch) screen. The devices generate all the timing signals required for interfacing with video displays. The circuits contain a 96-character ASCII (American Standard Code for Information Interchange) generator. They also have light-pen registers and controls, three types of interrupt requests, and TTL-LS I/O ports. For additional details, contact EFCIS at 23, rue de Courcelles, B.P.96.08, 75362, Paris, Cedex 08, France.

Circle 423 on inquiry card

### High-Speed 16 K-Byte ROM Challenges Bipolar PROMs

Synertek has announced the SY3316 MOS (metal-oxide semiconductor) 2048 by 8 high-speed ROM (read-only memory) that can replace bipolar PROMs (programmable read-only memories) in many applications. The device features a maximum access time of 80 ns. It is fully compatible with 16 K-byte PROMs. The SY3316 is compatible with TTL (transistor-transistor logic) on all inputs and outputs and operates on a single +5 V power supply. It includes three-state outputs. The device uses static circuitry and operates asynchronously. The three circuit-selects are mask programmable so that high, low, or undecided active states are possible. Eight ROMs can be connected without needing external decoding. In quantities of 250, the device is priced at \$56. For more information, contact Synertek, 3001 Stender Way, Santa Clara CA 95051, (408) 988-5623. Circle 424 on inquiry card

### Intel's EEPROM

Intel Corporation has introduced an electrically erasable programmable read-only memory (EEPROM). The 2816 is a 16 K-bit nonvolatile memory that is byte-erasable with an access time of 250 ns. Users can erase, read, and write on the device without removing it from the computer. The 2816 erases and writes by causing electrons to tunnel across a thin layer of silicon dioxide. At 125°C, the 2816 will retain data for at least 20 years. The circuit is fully static and it needs no refreshing. Erasing and writing requires the application of a 21 V pulse for 10 ms. Any of the 2 K bytes of the 2816 can be erased and rewritten in 20 ms. Separate chip-enable and output-enable pins permit 2-line control of the unit, which eliminates contention between addresses and data on multiplexed bus lines. It is pin-for-pin compatible with the 2716 ultraviolet EPROM and plug-compatible with 2732 and 2764 EPROMs. The 2816 costs \$120 in 100-piece lots. Contact Intel Corporation, 3065 Bowers Ave, Santa Clara CA 95051, (408) 987-6742.

Circle 425 on inquiry card

### Color Computer from Commodore

VIC 20 (video interface computer) is a color computer priced under \$300. It connects to any television set or monitor and provides 5 K bytes of memory. VIC 20 features color, sound, programmable function keys, memory expansion to 32 K bytes, PET BASIC, expansion ports, a 22-character by 23-line screen display, high-resolution graphics, graphics character set, joystick, paddles, light pen, and plug-in memory and program cartridges. VIC system peripherals include a cassette-tape drive, a floppy-disk drive, and a printer. The computer uses the 6502 microprocessor and the VIC (video interface chip), which incorporates programmable memory, ROM (read-only memory), and video-control circuitry on the same integrated circuit. Contact Commodore Business Machines Inc., 950 Rittenhouse Rd, Norristown PA 19403, (215) 666-7950.

Circle 426 on inquiry card

### Check Spelling with Spellguard

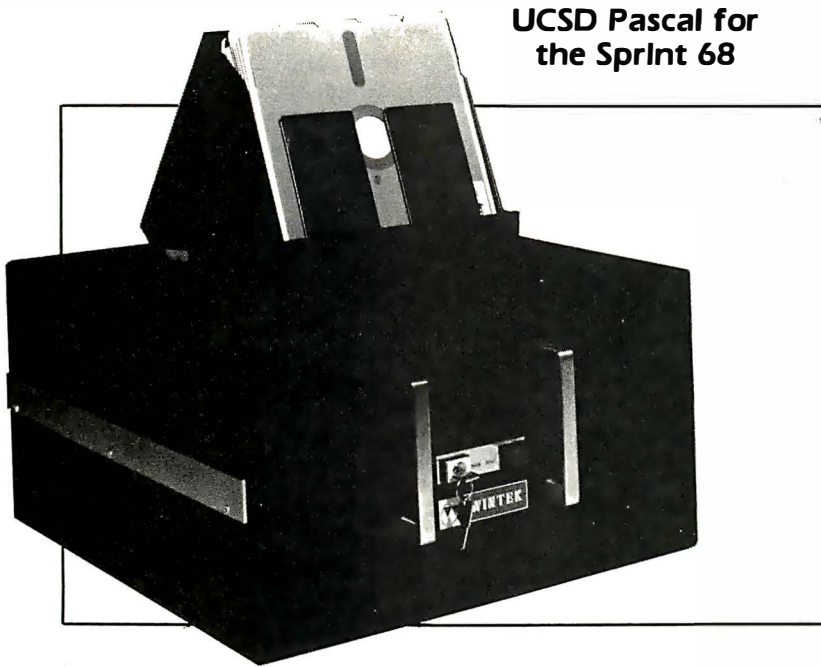
Spellguard is a program to check spelling in documents prepared with word processors and text editors. A 10,000-word document (20 pages) can be checked for spelling and typographical errors in under one minute. Spelling is checked using a dictionary supplied with the Spellguard package. The dictionary contains the 20,000 most-commonly used words in English and can be expanded. The dictionary size is limited only by disk-file size. One feature of Spellguard is the ability to create multiple dictionaries. Spellguard also contains a self-diagnostic feature for protection. Spellguard works with most CP/M-based word processors, including WordStar, Magic Wand, Electric Pencil, and Spellbinder. The program requires an 8080-, 8085A-, or Z80-based system, at least 32 K bytes of programmable memory, one 8-inch floppy-disk drive, and CP/M 1.4 or a later version. Spellguard has a suggested retail price of \$295; a manual is available for \$15. Contact Innovative Software Applications, 915 Timothy Ln, Menlo Park CA 94025, (415) 326-0805.

Circle 427 on inquiry card

# What's New?

## SOFTWARE

### UCSD Pascal for the Sprint 68



Wintek has the UCSD Pascal compiler available for its Sprint 68 microcomputer. The package includes an interactive operating system, Pascal compiler, screen-oriented editor, macroassembler, linker, p-code

interpreter, and a library of utilities. The price for the package is \$675 from Wintek Corporation, 1801 South St, Lafayette IN 47905, (317) 742-8428.

Circle 429 on inquiry card

### Duel-N-Droids

Duel-N-Droids is a sound and graphics game program for the TRS-80 Model I Level II. It features two sword-wielding androids that clash with each other in both practice and tournament duels. Each player controls his androids with four letter keys, causing it to maintain defense, back off, or attack. Each win moves the rank of the player's android up one level on the game scale. In practice duels, the player manually controls one android while the computer controls the other. In tournament duels, the machine controls both androids, using the skills instilled by the player during practice sessions. The program is priced at \$14.95 for cassette versions and \$20.95 on floppy disks. Contact Acorn Software Products Inc, 634 North Carolina Ave SE, Washington DC 20003, (202) 544-4259.

Circle 430 on inquiry card

### Alpha Micro FIG-FORTH

Version 3.2 of  $\mu$ A/FORTH is available for Alpha Micro systems. This version is aligned with the 1978 standard of the FORTH International Standards Team. It allows complete access to Alpha Micro's AMOS operating system. It implements full-length names up to 31 characters, checks code at compile-time with error reporting, and contains string-handling routines and a string-search editor. A FORTH assembler is included. FORTH words (commands) may be created from previously defined words, and even the original words supplied with the system can be redefined. It comes on an AMS format floppy disk and includes all source code, an editor, an assembler, and a string package. It costs \$130 from Professional Management Services, 724 Arastradero Rd, Suite 109, Palo Alto CA 94306, (408) 252-2218.

Circle 431 on inquiry card

### Apple II Curve Fitter

Curve Fitter allows you to select an appropriate mathematical curve to fit your experimental results. Methods include scaling and transformations, averaging, smoothing, interpolation, least-squares fitting, and interpolation of unknown values from the fitted curve. Using an optional A/D (analog-to-digital) converter, data can be entered directly from instruments. Curve Fitter is compatible with VisiChart. Curve Fitter runs on a 48 K-byte Apple II with Applesoft in ROM (read-only memory). It is available on floppy disk with a 29-page manual for \$35. The manual is available separately for \$5. Contact Paul K Warne, Interactive Microware Inc, POB 771, State College PA 16801, (814) 238-8294.

Circle 428 on inquiry card

### UniFLEX Operating System

UniFLEX is a multitasking, multi-user operating system. Several users can run different programs simultaneously, and one user can run several programs at a time. Users must log in with a password before being permitted to use the system. UniFLEX supports a hierarchical file system allowing file sizes up to 1 gigabyte (ie: 1 billion bytes) and disk capacities of over 8 gigabytes. All system I/O is device-independent. Any combination of interrupt-driven devices can be attached to the system. Intertask communication is supported, and task swapping can occur. The basic UniFLEX system includes the operating system, approximately 50 system utilities, a text editor, macroassembler, and system-configuration programs. System maintenance is also available. Software that runs under this system includes a C compiler, Pascal, word processors, a debug package, and BASIC. UniFLEX is available for 6809 and 68000 systems. The price is \$450 for the 6809 version. Contact Technical Systems Consultants Inc, POB 2570, 1208 Kent Ave, West Lafayette IN 47906, (317) 463-2502.

Circle 432 on inquiry card

# What's New?

## SOFTWARE

### **FORTRAN and COBOL for the Apple II with the SoftCard**

The Apple II can now have FORTRAN and COBOL thanks to Microsoft Consumer Products. Both languages run under the CP/M operating system and are designed to be used with Microsoft's SoftCard. FORTRAN-80 can compile several hundred statements per minute in a single pass. The FORTRAN compiler creates true Z80 machine code and supports double-precision, integer X4 and integer X1 data types. The FORTRAN-80 package includes the

compiler, a linking loader, and a user's manual. It also requires 48 K bytes of memory and a floppy-disk drive. The suggested price is \$195.

COBOL-80 includes sequential, line-sequential, relative, and indexed-sequential data files. Program chaining with parameter passing allows systems control from within COBOL applications. The program supports String, Unstring, Compute, Search, Perform, and Varying/Until verbs; abbreviated and compound conditions; ASCII (American Standard Code for Information Interchange), packed and binary data formats; run-time assignment of file names; full Copy

facility; and packed-decimal data format. The COBOL-80 package includes the compiler, linking loader, macroassembler, library manager, cross-reference assembler, and documentation. It runs on the Apple II with SoftCard, 48 K bytes of programmable memory, and two disk drives. The suggested price is \$750. For complete details, contact Microsoft Consumer Products, 400 108th Ave NE, Suite 200, Bellevue WA 98004, (206) 454-1315.

Circle 433 on inquiry card

### **Remote Batch Terminal Emulator**

The Remote Batch Terminal Emulator, RBTE, allows Z80 systems to emulate an IBM 3780, 2780, 2770, 3741, or 2968 remote batch terminal. It provides the ability to transfer data files to and from mainframe computers or other remote batch terminals. Data rates up to 19.2 kbps (thousand bits per second) can be set. IBM bisynchronous protocol, hardware diagnostics, dynamic terminal configuration, on-line communication trace, attended and unattended operation, and user-customization are featured. The RBTE runs under CP/M, OASIS, and other special operating

systems for Z80 microcomputers. It is designed for TRS-80, Cromemco, North Star, Onyx, Gnat, Vector Graphic, Ithaca Intersystems, and other Z80 microcomputer systems. Versions are available for 8086, Z8000, and 68000 microprocessor-based systems. Software to emulate X.25 protocol is also available. The price for the RBTE is \$500 for a single-use license. The operator manual and the programmer manual are available for \$25 and \$15, respectively. For complete details, contact Winterhalter and Associates Inc, 3825 Zeeb Rd, Dexter MI 48130, (313) 665-5582.

Circle 434 on inquiry card

### **This Program Moves Files Through VisiCalc**

VU #3 is a utility program for Personal Software's calculating and bookkeeping program VisiCalc. VU #3 allows the user to enter data into VisiCalc from any program by inserting data into an array defined by VU #3. The program can transfer data generated from VisiCalc into any of the user's programs through another array as defined in the instructions. VU #3 runs on the Apple II. It is available from Progressive Software, POB 273, Plymouth Meeting PA 19462.

Circle 435 on inquiry card

### **Wordbank for the TRS-80 Model II**

The Wordbank is a word-processing program for writing letters, reports, manuals, or other documents on a one-time or repetitive basis. Up to 7500 document lines are available; lines may be added, changed, or deleted; page control is user-assigned or automatic; and automatic line numbering and pagination are included. Wordbank requires a TRS-80 Model II with 64 K bytes of programmable memory, one floppy-disk drive, and a printer. Wordbank is available from Taranto and Associates Inc, POB 6073, 121 B Paul Dr, San Rafael CA 94903, (415) 472-2670, for \$149.95.

Circle 436 on inquiry card

### **Pascal Data Base Written In UCSD Pascal**

The Pascal Database can be used for mailing lists, accounting, inventory, job estimates, sales analysis, and property management. The data base can update, search, and traverse data-base files; sort on multiple fields; and maintain records in several sorted orders. There is user-programmable screen formatting and automatic indexing of information at data entry. Users can define file, record, and field names. Reports can also generated. The Pascal Database for the Apple II costs \$400, and it is available from Arizona Computer Systems Inc, POB 125, Jerome AZ 86331, (602) 634-7301.

Circle 437 on inquiry card

### **General Ledger System for Prodigy Computers**

Prodigy Systems has a small-business accounting package with a general-ledger program for its computers. Features include a user-defined chart of accounts, current balances, audit trail, and the ability to produce comparative statements. The system allows users to format their own reports. The reports include account charts, general ledger, trial balance, income statements, balance sheets, and transaction proof listings. The general-ledger system includes accounts receivable, accounts payable, and payroll packages. Contact Prodigy Systems Inc, 497 Lincoln Hwy, Iselin NJ 08830, (201) 283-2000.

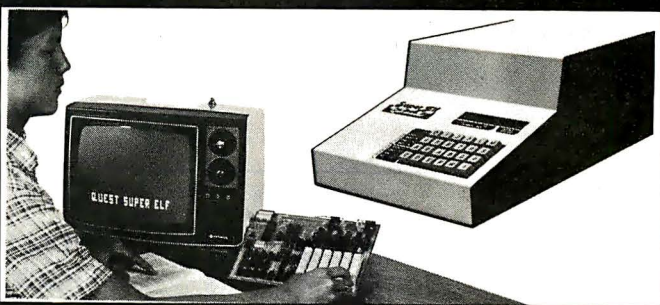
Circle 438 on inquiry card

P.O. Box 4430X  
Santa Clara, CA 95054  
Will calls: 2322 Walsh Ave.  
**ELECTRONICS** (408) 988-1640 TWX 910-338-2139

Sameday shipment. First line parts only. Factory tested. Guaranteed money back. Quality IC's and other components at factory prices.

### INTEGRATED CIRCUITS

7400TTL	LM320K-5	1.35	CD4026	2.50	2114L 450ns	4.00	CONNECTORS	
7400N	LM320K-12	1.35	CD4027	2.50	4116 200ns	4.50	30 pin edge	2.50
7400N	LM320K-15	1.35	CD4028	2.50	8416 200ns	4.50	44 pin edge	2.75
7400N	LM320T-5	95	CD4029	1.35	MM5262	4.00	86 pin edge	4.00
7400N	LM320T-12	95	CD4030	1.35	MM5262	4.00	100 pin edge	4.50
7400N	LM320T-15	95	CD4031	1.35	MM5320	9.95	100 pin edge	5.50
7400N	LM320K-5	95	CD4040	1.35	MM5320	5.94	100 pin edge	5.25
7400N	LM320K-12	95	CD4041	1.35	PD1110-3	4.00	IC SOCKETS	
7400N	LM320K-15	95	CD4042	1.35	PD1110-4	5.00	Solder Tin Low Profile	
7400N	LM320K-5	95	CD4043	1.35	PD1110-5	5.00	Pin 1 UP	1.00
7400N	LM320K-12	95	CD4044	1.35	PD1110-6	5.00	Green, Yellow TO18	15
7400N	LM320K-15	95	CD4045	1.35	PD1110-7	5.00	Jumbo Red	20
7400N	LM320K-5	95	CD4046	1.35	PD1110-8	5.00	Green, Orange, Yellow Jumbo	25
7400N	LM320K-12	95	CD4047	1.35	PD1110-9	5.00	Clipping LED Mounting Clips	8.5/12.5
7400N	LM320K-15	95	CD4048	1.35	PD1110-10	5.00	(specify red, amber, green, yellow, clear)	
7400N	LM320K-5	95	CD4049	1.35	PD1110-11	5.00	Enclosure Plastic	16.95
7400N	LM320K-12	95	CD4050	1.35	PD1110-12	5.00	Metal Enclosure	29.95
7400N	LM320K-15	95	CD4051	1.35	PD1110-13	5.00		
7400N	LM320K-5	95	CD4052	1.35	PD1110-14	5.00		
7400N	LM320K-12	95	CD4053	1.35	PD1110-15	5.00		
7400N	LM320K-15	95	CD4054	1.35	PD1110-16	5.00		
7400N	LM320K-5	95	CD4055	1.35	PD1110-17	5.00		
7400N	LM320K-12	95	CD4056	1.35	PD1110-18	5.00		
7400N	LM320K-15	95	CD4057	1.35	PD1110-19	5.00		
7400N	LM320K-5	95	CD4058	1.35	PD1110-20	5.00		
7400N	LM320K-12	95	CD4059	1.35	PD1110-21	5.00		
7400N	LM320K-15	95	CD4060	1.35	PD1110-22	5.00		
7400N	LM320K-5	95	CD4061	1.35	PD1110-23	5.00		
7400N	LM320K-12	95	CD4062	1.35	PD1110-24	5.00		
7400N	LM320K-15	95	CD4063	1.35	PD1110-25	5.00		
7400N	LM320K-5	95	CD4064	1.35	PD1110-26	5.00		
7400N	LM320K-12	95	CD4065	1.35	PD1110-27	5.00		
7400N	LM320K-15	95	CD4066	1.35	PD1110-28	5.00		
7400N	LM320K-5	95	CD4067	1.35	PD1110-29	5.00		
7400N	LM320K-12	95	CD4068	1.35	PD1110-30	5.00		
7400N	LM320K-15	95	CD4069	1.35	PD1110-31	5.00		
7400N	LM320K-5	95	CD4070	1.35	PD1110-32	5.00		
7400N	LM320K-12	95	CD4071	1.35	PD1110-33	5.00		
7400N	LM320K-15	95	CD4072	1.35	PD1110-34	5.00		
7400N	LM320K-5	95	CD4073	1.35	PD1110-35	5.00		
7400N	LM320K-12	95	CD4074	1.35	PD1110-36	5.00		
7400N	LM320K-15	95	CD4075	1.35	PD1110-37	5.00		
7400N	LM320K-5	95	CD4076	1.35	PD1110-38	5.00		
7400N	LM320K-12	95	CD4077	1.35	PD1110-39	5.00		
7400N	LM320K-15	95	CD4078	1.35	PD1110-40	5.00		
7400N	LM320K-5	95	CD4079	1.35	PD1110-41	5.00		
7400N	LM320K-12	95	CD4080	1.35	PD1110-42	5.00		
7400N	LM320K-15	95	CD4081	1.35	PD1110-43	5.00		
7400N	LM320K-5	95	CD4082	1.35	PD1110-44	5.00		
7400N	LM320K-12	95	CD4083	1.35	PD1110-45	5.00		
7400N	LM320K-15	95	CD4084	1.35	PD1110-46	5.00		
7400N	LM320K-5	95	CD4085	1.35	PD1110-47	5.00		
7400N	LM320K-12	95	CD4086	1.35	PD1110-48	5.00		
7400N	LM320K-15	95	CD4087	1.35	PD1110-49	5.00		
7400N	LM320K-5	95	CD4088	1.35	PD1110-50	5.00		
7400N	LM320K-12	95	CD4089	1.35	PD1110-51	5.00		
7400N	LM320K-15	95	CD4090	1.35	PD1110-52	5.00		
7400N	LM320K-5	95	CD4091	1.35	PD1110-53	5.00		
7400N	LM320K-12	95	CD4092	1.35	PD1110-54	5.00		
7400N	LM320K-15	95	CD4093	1.35	PD1110-55	5.00		
7400N	LM320K-5	95	CD4094	1.35	PD1110-56	5.00		
7400N	LM320K-12	95	CD4095	1.35	PD1110-57	5.00		
7400N	LM320K-15	95	CD4096	1.35	PD1110-58	5.00		
7400N	LM320K-5	95	CD4097	1.35	PD1110-59	5.00		
7400N	LM320K-12	95	CD4098	1.35	PD1110-60	5.00		
7400N	LM320K-15	95	CD4099	1.35	PD1110-61	5.00		
7400N	LM320K-5	95	CD4100	1.35	PD1110-62	5.00		
7400N	LM320K-12	95	CD4101	1.35	PD1110-63	5.00		
7400N	LM320K-15	95	CD4102	1.35	PD1110-64	5.00		
7400N	LM320K-5	95	CD4103	1.35	PD1110-65	5.00		
7400N	LM320K-12	95	CD4104	1.35	PD1110-66	5.00		
7400N	LM320K-15	95	CD4105	1.35	PD1110-67	5.00		
7400N	LM320K-5	95	CD4106	1.35	PD1110-68	5.00		
7400N	LM320K-12	95	CD4107	1.35	PD1110-69	5.00		
7400N	LM320K-15	95	CD4108	1.35	PD1110-70	5.00		
7400N	LM320K-5	95	CD4109	1.35	PD1110-71	5.00		
7400N	LM320K-12	95	CD4110	1.35	PD1110-72	5.00		
7400N	LM320K-15	95	CD4111	1.35	PD1110-73	5.00		
7400N	LM320K-5	95	CD4112	1.35	PD1110-74	5.00		
7400N	LM320K-12	95	CD4113	1.35	PD1110-75	5.00		
7400N	LM320K-15	95	CD4114	1.35	PD1110-76	5.00		
7400N	LM320K-5	95	CD4115	1.35	PD1110-77	5.00		
7400N	LM320K-12	95	CD4116	1.35	PD1110-78	5.00		
7400N	LM320K-15	95	CD4117	1.35	PD1110-79	5.00		
7400N	LM320K-5	95	CD4118	1.35	PD1110-80	5.00		
7400N	LM320K-12	95	CD4119	1.35	PD1110-81	5.00		
7400N	LM320K-15	95	CD4120	1.35	PD1110-82	5.00		
7400N	LM320K-5	95	CD4121	1.35	PD1110-83	5.00		
7400N	LM320K-12	95	CD4122	1.35	PD1110-84	5.00		
7400N	LM320K-15	95	CD4123	1.35	PD1110-85	5.00		
7400N	LM320K-5	95	CD4124	1.35	PD1110-86	5.00		
7400N	LM320K-12	95	CD4125	1.35	PD1110-87	5.00		
7400N	LM320K-15	95	CD4126	1.35	PD1110-88	5.00		
7400N	LM320K-5	95	CD4127	1.35	PD1110-89	5.00		
7400N	LM320K-12	95	CD4128	1.35	PD1110-90	5.00		
7400N	LM320K-15	95	CD4129	1.35	PD1110-91	5.00		
7400N	LM320K-5	95	CD4130	1.35	PD1110-92	5.00		
7400N	LM320K-12	95	CD4131	1.35	PD1110-93	5.00		
7400N	LM320K-15	95	CD4132	1.35	PD1110-94	5.00		
7400N	LM320K-5	95	CD4133	1.35	PD1110-95	5.00		
7400N	LM320K-12	95	CD4134	1.35	PD1110-96	5.00		
7400N	LM320K-15	95	CD4135	1.35	PD1110-97	5.00		
7400N	LM320K-5	95	CD4136	1.35	PD1110-98	5.00		
7400N	LM320K-12	95	CD4137	1.35	PD1110-99	5.00		
7400N	LM320K-15	95	CD4138	1.35	PD1110-100	5.00		



## RCA Cosmac 1802 Super Elf Computer \$106.95

Compare features before you decide to buy any other computer. There is no other computer on the market today that has all the desirable benefits of the Super Elf for so little money. The Super Elf is a small single board computer that does many big things. It is an excellent computer for training and for learning programming with its machine language and yet it is easily expanded with additional memory, Full Basic, ASCII Keyboards, video character generation, etc.

Before you buy another small computer, see if it includes the following features: ROM monitor; State and Mode displays; Single step; Optional address displays; Power Supply; Audio Amplifier and Speaker; Fully socketed for all IC's; Real cost of in warranty repairs; Full documentation.

plus load, reset, run, wait, input, memory protect, monitor select and single step. Large, on board displays provide output and optional high and low address. There is a 44 pin standard connector slot for PC cards and a 50 pin connector slot for the Quest Super Expansion Board. Power supply and sockets for all IC's are included in the price plus a detailed 127 pg. instruction manual which now includes over 40 pgs. of software info. including a series of lessons to help get you started and a music program and graphics target game. Many schools and universities are using the Super Elf as a course of study. OEM's use it for training and R&D.

The Super Elf includes a ROM monitor for program loading, editing and execution with SINGLE STEP for program debugging which is not included in others at the same price. With SINGLE STEP you can see the microprocessor chip operating with the unique CPU address and data bus displays before, during and after executing instructions. Also, CPU mode and instruction cycle are decoded and displayed on 8 LED indicators.

Remember, other computers only offer Super Elf features at additional cost or not at all. Compare before you buy. Super Elf Kit \$106.95, High address option \$8.95, Low address option \$9.95. Custom Cabinet with drilled and labelled plexiglass front panel \$24.95. All metal expansion Cabinet, painted and silk screened, with room for 5 S-100 boards and power supply \$57.00. NICAD Battery Memory Saver Kit \$6.95. All kits and options also completely assembled and tested.

An RCA 1861 video graphics chip allows you to connect to your own TV with an inexpensive video modulator to do graphics and games. There is a speaker system included for writing your own music or using many music programs already written. The speaker amplifier may also be used to drive relays for control purposes.

Questdata, a software publication for 1802 computer users is available by subscription for \$12.00 per 12 issues. Single issues \$1.50. Issues 1-12 bound \$16.50.

A 24 key HEX keyboard includes 16 HEX keys

Tiny Basic Cassette \$10.00, on ROM \$38.00, original Elf kit board \$14.95. 1802 software; Moew's Video Graphics \$3.50. Games and Music \$3.00, Chip 8 Interpreter \$5.50.

## Super Expansion Board with Cassette Interface \$89.95

This is truly an astounding value! This board has been designed to allow you to decide how you want it optioned. The Super Expansion Board comes with 4K of low power RAM fully addressable anywhere in 64K with built-in memory protect and a cassette interface. Provisions have been made for all other options on the same board and it fits neatly into the hardware cabinet alongside the Super Elf. The board includes slots for up to 6K of EPROM (2708, 2758, 2716 or TI 2716) and is fully socketed. EPROM can be used for the monitor and Tiny Basic or other purposes. A 1K Super ROM Monitor \$19.95 is available as an on board option in 2708 EPROM which has been preprogrammed with a program loader/editor and error checking multi file cassette read/write software, (relocatable cassette file) another exclusive from Quest. It includes register save and readout, block move capability and video graphics driver with blinking cursor. Break

points can be used with the register save feature to isolate program bugs quickly, then follow with single step. If you have the Super Expansion Board and Super Monitor the monitor is up and running at the push of a button. Other on board options include Parallel Input and Output Ports with full handshake. They allow easy connection of an ASCII keyboard to the input port. RS 232 and 20 ma Current Loop for teletype or other device are on board and if you need more memory there are two S-100 slots for static RAM or video boards. Also a 1K Super Monitor version 2 with video driver for full capability display with Tiny Basic and a video interface board. Parallel I/O Ports \$9.95, RS 232 \$4.50, TTY 20 ma I/F \$1.95, S-100 \$4.50. A 50 pin connector set with ribbon cable is available at \$15.25 for easy connection between the Super Elf and the Super Expansion Board. Power Supply Kit for the complete system (see Multi-volt Power Supply).

## Quest Super Basic V5.0

A new enhanced version of Super Basic now available. Quest was the first company worldwide to ship a full size Basic for 1802 Systems. A complete function Super Basic by Ron Kenner including floating point capability with scientific notation (number range  $\pm 1.7E^{38}$ ), 32 bit integer  $\pm 2$  billion; multi dim arrays, string arrays; string manipulation; cas-

settle I/O; save and load, basic, data and machine language programs; and over 75 statements, functions and operations. New improved faster version including re-number and essentially unlimited variables. Also, an exclusive user expandable command library. Serial and Parallel I/O included. Super Basic on Cassette \$55.00.

## Gremlin Color Video Kit \$69.95

32 x 16 alpha/numerics and graphics; up to 8 colors with 6847 chip; 1K RAM at E000. Plugs into Super Elf 44 pin bus. No high res. graphics. On board RF Modulator Kit \$4.95

## Elf II Adapter Kit \$24.95

Plugs into Elf II providing Super Elf 44 and 50 pin plus S-100 bus expansion. (With Super Expansion). High and low address displays, state and mode LED's optional \$18.00.

## 1802 16K Dynamic RAM Kit \$149.00

Expandable to 32K. Hidden refresh w/clocks up to 4 MHz w/no wait states. Add. 16K RAM \$63.00

## Super Color S-100 Video Kit \$129.95

Expandable to 256 x 192 high resolution color graphics. 6847 with all display modes computer controlled. Memory mapped. 1K RAM expandable to 6K. S-100 bus 1802, 8080, 8085, 280 etc. Dealers: Send for excellent pricing/margin program.

Tiny Basic Extended on Cassette \$15.00 (added commands include String, Array, Cassette I/O etc.) S-100 4-Slot Expansion \$ 9.95 Super Monitor V1.1 Source Listing \$15.00

Editor Assembler \$25.00 (Requires minimum of 4K for E/A plus user source)

1802 Tiny Basic Source listing \$19.00 Super Monitor V2.0/2.1 Source Listing \$20.00

## PROM Eraser

assembled. 25 PROM capacity \$37.50 (with timer) \$69.50. 6 PROM capacity OSHA/UL version \$69.50 (with timer \$94.50).

## 280 Microcomputer

16 bit I/O, 2 MHz clock, 2K RAM, ROM Breadboard space. Excellent for control. Bare Board \$28.50. Full Kit \$99.00. Monitor \$20.00. Power Supply Kit \$35.00. Tiny Basic \$30.00

# What's New?

## PUBLICATIONS

### BYTE Books Brings You Two Books from Steve Ciarcia

Ciarcia's *Circuit Cellar, Volume II*, is a collection of articles from BYTE. The book tells you about microcomputers and how you can use them in various environments. Construction projects show you how to build a computer-controlled home-security system, computerize home appliances, make an inexpensive joystick, send digital information over a light beam, and explore the Intel 8086 microprocessor system-design kit. Each project is presented in such a way that even beginners should have little trouble making and enjoying these useful devices. *Ciarcia's Circuit Cellar, Volume II*, costs \$11.95.

**Build Your Own Z80 Computer** is for the engineer, computer technician, student, and anyone interested in building his or her own computer. The computer is based on the Zilog Z80 microprocessor. Each computer subsystem (ie: I/O, serial interface, keyboard, memory, etc) is fully explained and supported by proven design and testing information. The board contains a 2 K-byte operating system, serial and parallel ports, hexadecimal display, and audio-cassette mass storage, with expansion to include a video terminal. You can modify this system to meet your individual needs. All required components are readily available and have been selected to allow simple system checkout. This book costs \$15.95. Both books by Steve Ciarcia are published by BYTE Books, 70 Main St, Peterborough NH 03458, (800) 258-5420; in New Hampshire (603) 924-9281.

Circle 439 on inquiry card

### Microcomputer and Minicomputer Supplies

Daily Business Products Inc's 68-page catalog features supplies and accessories for all microcomputers, minicomputers, and word-processing systems. For a free copy, contact Daily Business Products Inc, 464 New York Ave, Huntington NY 11743, (800) 645-5332; in New York (212) 594-8065.

Circle 440 on inquiry card

### 1981 Radlo Shack Catalog

Radio Shack's 1981 catalog is available free at Radio Shack stores and dealers. The catalog features computer and stereo equipment, toys and electronic games, plus parts and accessories for home entertainment, or hobbyists and experimenters. The TRS-80 Pocket Computer, the Color Computer, the Model III system, six new stereo receivers, five cassette tape decks, twelve new telephone products, home-alarm systems, and thirteen new electronic calculators are among the items in the catalog.

Circle 441 on inquiry card

### Datapro Directory of Small Computers

This guide is designed to help data-processing professionals and managers locate, compare, and evaluate small-computer systems, software, peripherals, services, and the companies that manufacture and distribute them. This directory service is updated monthly. More than 200 microcomputer systems are reported on, with each report giving a summary of current models, memory size, base price, primary uses, popular options, principal applications, and more. The reports have details on hardware specifications, such as the processor used, memory, display, keyboard, direct-access storage, printers, data communications, and I/O electronics. Software information covers languages, operating systems, database-management systems, and applications programs. An applications index, a section on advice and guidelines on purchasing, a listing of over 16,000 companies, and sections on computer concepts, user ratings, and user groups are included. The subscription rate is \$330. Each subscription to the **Datapro Directory of Small Computers** includes two volumes, 12 monthly supplements, 12 monthly newsletters, and use of a telephone-inquiry service. Contact Datapro Research Corporation, 1805 Underwood Blvd, Delran NJ 08075, (609) 764-0100.

Circle 442 on inquiry card

### Time-Sharing and Remote-Computing Services Report

Details on 117 remote-computing services, including results of a user survey, are available in this report from Datapro Research Corporation. **All About Time-Sharing and Remote Computing Services** gives you the name of the service, areas currently served, type of computer, number of simultaneous users, conversational and batch terminals supported, programming languages, principal applications, and pricing information. A listing of vendors is included. The report provides a discussion of user benefits and disadvantages, a guide for evaluation and selection of remote-computing services, and an index of application programs and user programming aids. The report is available for \$15 per copy from Datapro Research Corporation, 1805 Underwood Blvd, Delran NJ 08075, (609) 764-0100.

Circle 443 on inquiry card

### Packaging and Breadboarding Materials Brochure

A brochure from Vector Electronic Company Inc describes 109 electronic packaging and breadboarding products available at electronic and personal-computer component stores. Highlighted are microcomputer interface boards, Vector products, motherboards, cases, tools, wiring terminals, and kits. A price list is included. Contact Vector Electronic Company Inc, 12460 Gladstone Ave, Sylmar CA 91342, (213) 365-9661.

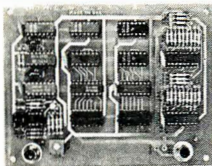
Circle 444 on inquiry card

### SDK-85 Experiments

**The 8085 Microprocessor—Fundamentals and Applications: 76 Control Experiments with the Intel SDK-85**, by Dr Howard Boyet is available from MTI, 14 E 8th St, New York NY 10003, (212) 473-4947. Other books from MTI describe hands-on experiments with the 8080, 8085, and 8048 microprocessors.

Circle 445 on inquiry card

## A-D & D-A CONVERTER

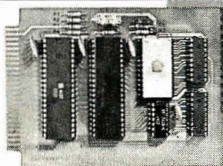


JBE A-D & D-A Converter can be used with any system having parallel ports

- Interfaces with JBE Parallel I/O Card
- D-A conversion time — 5  $\mu$ s
- A-D conversion time — 20  $\mu$ s
- Uses JBE 5V power supply
- Parallel inputs & outputs include 8 data bits, strobe lines & latches
- Analog inputs & outputs are medium impedance 0 to 5 volt range.

79-287 ASSM. \$79.95  
Bare Board \$29.95 Kit \$59.95

## 6502 MICROCOMPUTER



This control computer has:

- 1024 bytes RAM (two 2114s)
- 2048 bytes EPROM (2716)
- Uses one 6522 VIA (comp. doc. incl.)
- Interfaces with JBE Solid State Switches & A-D & D-A Converter
- Uses JBE 5V power supply
- 2716 EPROM available separately (2716 can be programmed with an Apple II & JBE EPROM Programmer & Parallel Interface)
- 50 pin connector included in kit & assm.

80-153 ASSM. \$110.95  
Bare Board \$24.95 Kit \$ 89.95

## SOLID STATE SWITCH

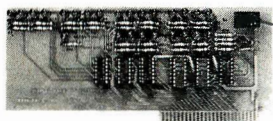


Your computer can control power to your printer, lights, stereo & any 120VAC appliances up to 720 watts (6 amps at 120VAC). Input 3 to 15VDC

- 2-14MA TTL compatible
- Isolation — 1500V
- Non zero crossing
- Comes in 1 or 4 channel version
- Includes doc. for interfacing with Dimmer Control.

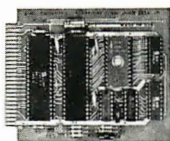
79-282-1 ASSM. \$13.95  
Bare Board \$6.95 Kit \$10.95  
79-282-4 ASSM. \$49.95  
Bare Board \$24.95 Kit \$39.95

## APPLE II DISPLAY BOARD



80-144 ASSM. \$49.95  
Bare Board \$25.95 Kit \$42.95

## Z80 MICROCOMPUTER

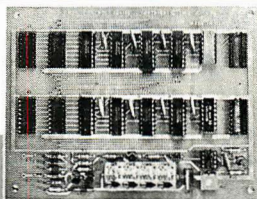


JBE is announcing a single board dedicated computer designed for control functions. It features:

- A Z80 Microprocessor software compatible with the Z80, 8080 & 8085 Microprocessors
- Uses a Z80 PIO chip for I/O which has 2 independent 8 bit bidirectional peripheral interface ports with handshake & data transfer control
- Uses one 2716 EPROM (2K) & two 2114 RAM memories (1K)
- Single 5V power supply at 300MA req.
- Clock frequency is 2MHz, RC controlled
- Board comes with complete doc.
- 50 pin connector is included
- 2716 EPROM available separately.

80-280 ASSM. \$129.95  
Bare Board \$29.95 Kit \$119.95

## DIMMER CONTROL



JBE Dimmer Control features:

- 4 channels
- 256 brightness levels
- On-board power supply
- Four 8 bit parallel input ports
- Interfaces with JBE Solid State Switch & Apple II Parallel Interface.

80-146 ASSM. \$89.95  
Bare Board \$25.95 Kit \$79.95

## POWER SUPPLIES

- Use wall transformers for safety
- Protected against short circuit and thermal breakdown.

### 5 VOLT POWER SUPPLY

Rated at 5V 500MA • Operates JBE A-D & D-A Converter, Z80 & 6502 Microcomputers, 8085 & 8088 Microcomputers.

80-160 ASSM. \$20.95  
Bare Board \$8.95 Kit \$16.95

### ± 12 VOLT POWER SUPPLY

Rated at ± 12V 120MA • Can be used as a single 24V power supply • Ideally suited to OP-AMP experiments.

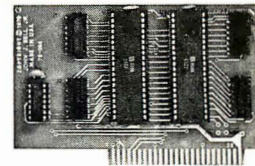
80-161 ASSM. \$22.95  
Bare Board \$8.95 Kit \$18.95

## ICS

6502	\$9.95
6522	\$9.95
Z80	\$9.95
Z80 PIO	\$9.95
2716 5V	\$19.95

- Has run-stop, single step switch
- Has 16 address LEDs, 8 data LEDs & 1 RDY LED
- All lines are buffered.

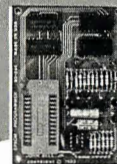
## 6522 APPLE II INTERFACE



- Interfaces printers, synthesizers, keyboards, JBE A-D & D-A Converter & Solid State Switches
- Has handshaking logic, two 6522 VIAs & a 74LS74 for timing. Inputs & outputs are TTL compatible.

79-295 ASSM. \$69.95  
Bare Board \$22.95 Kit \$59.95

## 2716 EPROM PROGRAMMER



JBE 2716 EPROM Programmer was designed to program 5V 2716 EPROMS • It can also read 2716s. It interfaces to the Apple II using JBE Parallel I/O Card & four ribbon cable connectors

- An LED indicates when power is being applied to the EPROM
- A textool zero insertion force socket is used for the EPROM
- Comes with complete doc. for writing and reading in the Apple II or Apple II+ • Cables available separately.

80-244 ASSM. \$49.95  
Bare Board \$24.95 Kit \$39.95

## BARE BOARDS

### APPLE II EXTENDER BOARD

3½" x 2½". Price includes 50 pin Apple Connector.

80-143 \$12.95

### 8085 3 CHIP SYSTEM

State-of-the-art system using an 8085, 8156 & either an 8355 or 8755 • Instruction set 100% upward compatible with 8080A.

Bare Board \$24.95

### 8088 5 CHIP SYSTEM

An 8086 family microcomputer system using an 8088 CPU, 8284, 8155, 8755A & an 8185.

Bare Board \$29.95

### CRT CONTROLLER

This intelligent CRT Controller is based on an 8085A Microprocessor & an 8275 Integrated CRT Controller. It features:

- 25 lines, 80 characters/line
- 5x7 dot matrix
- Upper case only
- Two 2716s
- Serial Interface RS232 & TTL
- Baud rates of 110, 150, 300, 600, 1200, 2400, 4800 & 9600
- Keyboard scanning system
- Req's. unencoded keyboard
- Uses +5V & ± 12V power supplies.

Bare Board \$39.95

50 pin connector	\$5.95
STD. Dip Jumpers	
16 Pin, 2 ft.	\$4.25



# JOHN BELL ENGINEERING

ALL PRODUCTS ARE AVAILABLE FROM: JOHN BELL ENGINEERING • P.O. BOX 338  
DEPT 8 • REDWOOD CITY, CA 94064 • ADD 6% SALES TAX IN CALIFORNIA • ADD 5% SHIPPING & HANDLING  
(415) 367-1137

## 7400 74LS00

SN7400N	19	SN74123N	59	74LS00N	35	74LS164N	119
SN7401N	22	SN74125N	59	74LS01N	28	74LS165N	89
SN7402N	22	SN74126N	59	74LS02N	28	74LS166N	248
SN7403N	22	SN74128N	59	74LS03N	28	74LS168N	189
SN7404N	22	SN74132N	59	74LS04N	39	74LS169N	189
SN7405N	23	SN74135N	59	74LS05N	28	74LS170N	199
SN7406N	23	SN74139N	95	74LS06N	39	74LS172N	199
SN7407N	21	SN74142N	59	74LS07N	39	74LS174N	99
SN7408N	26	SN74142N	295	74LS08N	28	74LS175N	99
SN7409N	23	SN74143N	95	74LS09N	39	74LS181N	220
SN7410N	22	SN74144N	295	74LS10N	39	74LS181N	115
SN7411N	29	SN74145N	62	74LS11N	39	74LS181N	115
SN7412N	29	SN74147N	195	74LS12N	47	74LS191N	115
SN7413N	39	SN74148N	120	74LS13N	125	74LS192N	99
SN7414N	59	SN74150N	99	74LS14N	39	74LS193N	99
SN7415N	29	SN74151N	67	74LS15N	26	74LS194N	115
SN7416N	29	SN74152N	67	74LS16N	36	74LS195N	95
SN7417N	29	SN74152N	67	74LS17N	38	74LS196N	95
SN7420N	22	SN74153N	67	74LS18N	39	74LS197N	95
SN7421N	35	SN74154N	119	74LS19N	39	74LS201N	149
SN7422N	29	SN74155N	82	74LS20N	39	74LS240N	195
SN7423N	29	SN74156N	89	74LS21N	36	74LS241N	195
SN7424N	29	SN74157N	89	74LS22N	38	74LS242N	195
SN7425N	29	SN74158N	95	74LS23N	79	74LS243N	195
SN7426N	29	SN74159N	95	74LS24N	79	74LS244N	195
SN7427N	45	SN74161N	95	74LS25N	26	74LS245N	195
SN7430N	23	SN74162N	89	74LS26N	79	74LS247N	110
SN7432N	23	SN74163N	87	74LS27N	79	74LS248N	110
SN7437N	29	SN74164N	97	74LS28N	79	74LS249N	169
SN7438N	29	SN74165N	97	74LS29N	79	74LS251N	171
SN7439N	29	SN74166N	120	74LS30N	35	74LS253N	98
SN7440N	24	SN74167N	195	74LS31N	35	74LS257N	98
SN7441N	79	SN74170N	169	74LS32N	45	74LS258N	98
SN7442N	57	SN74172N	595	74LS33N	59	74LS259N	295
SN7443N	79	SN74173N	67	74LS34N	69	74LS260N	69
SN7444N	79	SN74174N	89	74LS35N	45	74LS261N	249
SN7445N	79	SN74175N	89	74LS36N	65	74LS266N	59
SN7446N	79	SN74176N	85	74LS37N	99	74LS273N	175
SN7447N	59	SN74177N	85	74LS38N	119	74LS275N	440
SN7448N	79	SN74178N	180	74LS39N	45	74LS279N	59
SN7449N	23	SN74180N	75	74LS40N	75	74LS283N	110
SN7451N	23	SN74181N	175	74LS41N	75	74LS290N	129
SN7453N	23	SN74182N	75	74LS42N	75	74LS293N	195
SN7454N	23	SN74184N	195	74LS43N	88	74LS295N	119
SN7455N	23	SN74185N	195	74LS44N	98	74LS298N	129
SN7456N	23	SN74186N	95	74LS45N	98	74LS301N	171
SN7470N	39	SN74188N	390	74LS46N	45	74LS347N	195
SN7472N	34	SN74190N	115	74LS47N	49	74LS348N	195
SN7473N	38	SN74191N	115	74LS48N	49	74LS352N	165
SN7474N	36	SN74192N	85	74LS49N	55	74LS353N	165
SN7475N	36	SN74193N	85	74LS50N	55	74LS354N	149
SN7476N	36	SN74194N	85	74LS51N	119	74LS355N	99
SN7479N	450	SN74195N	85	74LS52N	135	74LS366N	99
SN7480N	59	SN74196N	85	74LS53N	89	74LS367N	73
SN7481N	110	SN74197N	85	74LS54N	125	74LS368N	73
SN7482N	110	SN74198N	139	74LS55N	79	74LS373N	275
SN7483N	55	SN74199N	39	74LS56N	149	74LS374N	275
SN7485N	65	SN74201N	139	74LS57N	89	74LS375N	69
SN7486N	39	SN74202N	105	74LS58N	89	74LS377N	195
SN7489N	175	SN74203N	105	74LS59N	149	74LS385N	195
SN7490N	110	SN74204N	215	74LS60N	79	74LS390N	195
SN7491N	65	SN74205N	390	74LS61N	249	74LS395N	170
SN7492N	52	SN74206N	125	74LS62N	119	74LS399N	295
SN7493N	49	SN74207N	125	74LS63N	99	74LS424N	295
SN7494N	72	SN74208N	125	74LS64N	99	74LS425N	295
SN7495N	65	SN74209N	125	74LS65N	75	74LS426N	295
SN7496N	310	SN74210N	68	74LS66N	98	74LS427N	295
SN7497N	310	SN74211N	68	74LS67N	98	74LS428N	295
SN74100N	99	SN74212N	68	74LS68N	98	74LS429N	295
SN74101N	32	SN74213N	68	74LS69N	115	74LS430N	295
SN74102N	53	SN74214N	68	74LS70N	115	74LS431N	295
SN74103N	99	SN74215N	68	74LS71N	115	74LS432N	295
SN74104N	99	SN74216N	68	74LS72N	115	74LS433N	295
SN74105N	99	SN74217N	68	74LS73N	115	74LS434N	295
SN74106N	99	SN74218N	68	74LS74N	115	74LS435N	295
SN74107N	99	SN74219N	68	74LS75N	115	74LS436N	295
SN74108N	99	SN74220N	68	74LS76N	115	74LS437N	295
SN74109N	99	SN74221N	68	74LS77N	115	74LS438N	295
SN74110N	99	SN74222N	68	74LS78N	115	74LS439N	295
SN74111N	99	SN74223N	68	74LS79N	115	74LS440N	295
SN74112N	99	SN74224N	68	74LS80N	115	74LS441N	295
SN74113N	99	SN74225N	68	74LS81N	115	74LS442N	295
SN74114N	99	SN74226N	68	74LS82N	115	74LS443N	295
SN74115N	99	SN74227N	68	74LS83N	115	74LS444N	295
SN74116N	99	SN74228N	68	74LS84N	115	74LS445N	295
SN74117N	99	SN74229N	68	74LS85N	115	74LS446N	295
SN74118N	99	SN74230N	68	74LS86N	115	74LS447N	295
SN74119N	99	SN74231N	68	74LS87N	115	74LS448N	295
SN74120N	99	SN74232N	68	74LS88N	115	74LS449N	295
SN74121N	99	SN74233N	68	74LS89N	115	74LS450N	295
SN74122N	99	SN74234N	68	74LS90N	115	74LS451N	295
SN74123N	99	SN74235N	68	74LS91N	115	74LS452N	295
SN74124N	99	SN74236N	68	74LS92N	115	74LS453N	295
SN74125N	99	SN74237N	68	74LS93N	115	74LS454N	295
SN74126N	99	SN74238N	68	74LS94N	115	74LS455N	295
SN74127N	99	SN74239N	68	74LS95N	115	74LS456N	295
SN74128N	99	SN74240N	68	74LS96N	115	74LS457N	295
SN74129N	99	SN74241N	68	74LS97N	115	74LS458N	295
SN74130N	99	SN74242N	68	74LS98N	115	74LS459N	295
SN74131N	99	SN74243N	68	74LS99N	115	74LS460N	295
SN74132N	99	SN74244N	68	74LS100N	115	74LS461N	295
SN74133N	99	SN74245N	68	74LS101N	115	74LS462N	295
SN74134N	99	SN74246N	68	74LS102N	115	74LS463N	295
SN74135N	99	SN74247N	68	74LS103N	115	74LS464N	295
SN74136N	99	SN74248N	68	74LS104N	115	74LS465N	295
SN74137N	99	SN74249N	68	74LS105N	115	74LS466N	295
SN74138N	99	SN74250N	68	74LS106N	115	74LS467N	295
SN74139N	99	SN74251N	68	74LS107N	115	74LS468N	295
SN74140N	99	SN74252N	68	74LS108N	115	74LS469N	295
SN74141N	99	SN74253N	68	74LS109N	115	74LS470N	295
SN74142N	99	SN74254N	68	74LS110N	115	74LS471N	295
SN74143N	99	SN74255N	68	74LS111N	115	74LS472N	295
SN74144N	99	SN74256N	68	74LS112N	115	74LS473N	295
SN74145N	99	SN74257N	68	74LS113N	115	74LS474N	295
SN74146N	99	SN74258N	68	74LS114N	115	74LS475N	295
SN74147N	99	SN74259N	68	74LS115N	115	74LS476N	295
SN74148N	99	SN74260N	68	74LS116N	115	74LS477N	295
SN74149N	99	SN74261N	68	74LS117N	115	74LS478N	295
SN74150N	99	SN74262N	68	74LS118N	115	74LS479N	295
SN74151N	99	SN74263N	68	74LS119N	115	74LS480N	295
SN74152N	99	SN74264N	68	74LS120N	115	74LS481N	295
SN74153N	99	SN74265N	68	74LS121N	115	74LS482N	295
SN74154N	99	SN74266N	68	74LS122N	115	74LS483N	295
SN74155N	99	SN74267N	68	74LS123N	115	74LS484N	295
SN74156N	99	SN74268N	68	74LS124N	115	74LS485N	295
SN74157N	99	SN74269N	68	74LS125N	115	74LS486N	295
SN74158N	99	SN74270N	68	74LS126N	115	74LS487N	295
SN74159N	99	SN74271N	68	74LS127N	115	74LS488N	295
SN74160N	99	SN74272N	68	74LS128N	115	74LS489N	295
SN74161N	99	SN74273N	68	74LS129N	115	74LS490N	295
SN74162N	99	SN74274N	68	74LS130N	115	74LS491N	295
SN74163N	99	SN74275N	68	74LS131N	115	74LS492N	295
SN74164N	99	SN74276N	68	74LS132N	115	74LS493N	295
SN74165N	99	SN74277N	68	74LS133N	115	74LS494N	295
SN74166N	99	SN74278N	68	74LS134N	115	74LS495N	295
SN74167N	99	SN74279N	68	74LS135N	115	74LS496N	295
SN74168N	99	SN74280N	68	74LS136N	115	74LS497N	295
SN74169N	99	SN74281N	68	74LS137N	115	74LS498N	295
SN74170N	99	SN74282N	68	74LS138N	115	74LS499N	295
SN74171N	99	SN74283N	68	74LS139N	115	74LS500N	295
SN74172N	99	SN74284N	68	74LS140N	115	74LS501N	295
SN74173N	99	SN74285N	68	74LS141N	115	74LS502N	295
SN74174N	99	SN74286N	68	74LS142N	115	74LS503N	295
SN74175N	99	SN74287N	68	74LS143N	115	74LS504N	295
SN74176N	99	SN74288N	68	74LS144N	115	74LS505N	295
SN74177N	99	SN74289N	68	74LS145N	115	74LS506N	295
SN74178N	99	SN74290N	68	74LS146N	115	74LS507N	295
SN74179N	99	SN74291N	68	74LS147N	115	74LS508N	295
SN74180N	99	SN74292N	68	74LS148N	115	74LS509N	295
SN74181N	99	SN74293N	68	74LS149N	115	74LS510N	295
SN74182N	99	SN74294N	68	74LS150N	115	74LS511N	

# ADVANCED COMPUTER PRODUCTS

FIRST TO OFFER PRIME PRODUCTS TO THE HOBBYIST AT FAIR PRICES!

1. Proven Quality Factory tested products only.

2. Guaranteed Satisfaction

3. Over \$1,000,000.00 Inventory

1981 CATALOG AVAILABLE SOON.

Send \$2.00 for your copy of the most complete catalog of computer products. A must for the serious computer user.

## STATIC RAM BOARDS

● **S-100 32K** (uses 2114) *less than 1 1/2¢ per bit!*  
**ASSEMBLED Kit**  
 450ns. 389.00 450ns. 339.00  
 250ns. 409.00 250ns. 359.00  
 Bare Board 39.95  
 Bare Board w/all parts less mem. 99.95

## MODEL 2065 64K DYNAMIC RAM MODULE \$600.00

Designed to IEEE Protocol S-100 bus standards.  
 Supports 1Mbit/16Kbit RAM modules.  
 Operates with either an 8080 or 8085 S-100 system.  
 Provides processor/keyboard interface with both.  
 Bank select system allows system memory expansion and compatibility with all common systems.  
 Bank select 200 address lines.  
 Bank select 200 address lines.

**FLOPPY DISK CONTROLLER \$400. 280 CPU BOARD \$300.**

## TRS80 ADD-ON THE VISTA V-80 Disk Drive System

More for Less. Speed. Capacity. Price.  
 The Vista V-80 mini disk system is 8 times faster than the TRS-80. 23% more storage capacity, and costs less.  
 Features:  
 • Vistas offers 102K bytes to Radio Shack's 89K. That's 13K more bytes per drive for Vista.  
 • The V80 operates at 12ms versus 40ms for TRS-80. Our drive can operate at 5ms, but only 50% of TRS-80 will be operational at 5ms. Therefore, Vista has purposely set the access time at 12ms.  
 • Totally compatible with all available disk operating systems.  
 • Upgraded system increased storage and speed.

**\$289.00**

## VISTA DUAL V-80 includes cable \$670.00

Item	Storage Capacity	Drive	Shipping	Price
V80 E-20	400	2 Drive	251cs	1199.80
V80 E-22	800	2 Drive	251cs	1549.00
V80 E-30	680	3 Drive	251cs	1549.00
V80 E-32	12 MC	Double Disk	321cs	1999.00

## ATTENTION VIDEO HOBBYISTS!!!

● **BOX BUILDERS**  
 ● **USE AS REMOTE TUNER/TIMER**  
 ● **FULL COMPATIBLES AVAILABLE**  
 ● **FOR ONLY \$5.90! - FREE W/PURCHASE**  
 A Recent Special Purchase Allows Us To Present The Following  
**NEW, UNUSUAL COMPONENTS**  
 From The RCA VCR-201 Videocassette Recorder  
 1. VHS/NTSC Tuner, Subcarrier, and Video Amps... **\$59.95**  
 2. For Modulator with Audio & Video inputs... **\$39.95**  
 3. Detail Clock Module, 24 Pin... **\$19.95**  
 4. 300 Line 1075 Ohm Matching... **\$2.49**  
 5. Complete Set of All the Above... **\$123.34**  
 Metal Enclosure \$29.95 **Call For Volume Discounts**

## LOW COST FLOPPY DISK SUBSYSTEM

Siemens FDD 120-6 (2) VISTA Floppy Controller (S-100, Case, Power Supply & Cable, GPIB Disk Operating System Assembled & Tested Walnut Wood Sides... **\$1499.00**  
 ● **CHECK OUR FLOPPY DISK PRICING ON THIS PAGE**  
 ● **SAVE \$300.00 (\$1799.00 VALUE)**

## WATANABE MILOPT

Max pen speed 50 mm/sec, resolution 10 mm typically 10 mm ball-n character generator sizes and 4 degrees of rotation absolute draw relative draw, absolute drawing with simple commands.  
**\$1195.00**

## IMS STATIC RAM BOARDS

	250 ns.	450 ns.
8K Static	\$209.00	\$189.00
16K Static	\$449.00	\$399.00
32K Static	\$729.00	\$629.00

## SALE! SD SYSTEMS BOARDS TAKE 10% OFF!

Model	Description	Price
SBC 100	Single Board Computer (2MHz)	\$285.00
SBC 200	Single Board Computer (4MHz)	\$299.00
SBC 300	Single Board Computer (8MHz)	\$319.00
SBC 400	Single Board Computer (16MHz)	\$349.00
SBC 500	Single Board Computer (32MHz)	\$399.00
SBC 600	Single Board Computer (64MHz)	\$449.00
SBC 700	Single Board Computer (128MHz)	\$499.00
SBC 800	Single Board Computer (256MHz)	\$549.00
SBC 900	Single Board Computer (512MHz)	\$599.00
SBC 1000	Single Board Computer (1024MHz)	\$649.00
SBC 1100	Single Board Computer (2048MHz)	\$699.00
SBC 1200	Single Board Computer (4096MHz)	\$749.00
SBC 1300	Single Board Computer (8192MHz)	\$799.00
SBC 1400	Single Board Computer (16384MHz)	\$849.00
SBC 1500	Single Board Computer (32768MHz)	\$899.00
SBC 1600	Single Board Computer (65536MHz)	\$949.00
SBC 1700	Single Board Computer (131072MHz)	\$999.00
SBC 1800	Single Board Computer (262144MHz)	\$1049.00
SBC 1900	Single Board Computer (524288MHz)	\$1099.00
SBC 2000	Single Board Computer (1048576MHz)	\$1149.00
SBC 2100	Single Board Computer (2097152MHz)	\$1199.00
SBC 2200	Single Board Computer (4194304MHz)	\$1249.00
SBC 2300	Single Board Computer (8388608MHz)	\$1299.00
SBC 2400	Single Board Computer (16777216MHz)	\$1349.00
SBC 2500	Single Board Computer (33554432MHz)	\$1399.00
SBC 2600	Single Board Computer (67108864MHz)	\$1449.00
SBC 2700	Single Board Computer (134217728MHz)	\$1499.00
SBC 2800	Single Board Computer (268435456MHz)	\$1549.00
SBC 2900	Single Board Computer (536870912MHz)	\$1599.00
SBC 3000	Single Board Computer (1073741824MHz)	\$1649.00
SBC 3100	Single Board Computer (2147483648MHz)	\$1699.00
SBC 3200	Single Board Computer (4294967296MHz)	\$1749.00
SBC 3300	Single Board Computer (8589934592MHz)	\$1799.00
SBC 3400	Single Board Computer (17179869184MHz)	\$1849.00
SBC 3500	Single Board Computer (34359738368MHz)	\$1899.00
SBC 3600	Single Board Computer (68719476736MHz)	\$1949.00
SBC 3700	Single Board Computer (137438953472MHz)	\$1999.00
SBC 3800	Single Board Computer (274877906944MHz)	\$2049.00
SBC 3900	Single Board Computer (549755813888MHz)	\$2099.00
SBC 4000	Single Board Computer (1099511627776MHz)	\$2149.00
SBC 4100	Single Board Computer (2199023255552MHz)	\$2199.00
SBC 4200	Single Board Computer (4398046511104MHz)	\$2249.00
SBC 4300	Single Board Computer (8796093022208MHz)	\$2299.00
SBC 4400	Single Board Computer (17592186044416MHz)	\$2349.00
SBC 4500	Single Board Computer (35184372088832MHz)	\$2399.00
SBC 4600	Single Board Computer (70368744177664MHz)	\$2449.00
SBC 4700	Single Board Computer (140737488355328MHz)	\$2499.00
SBC 4800	Single Board Computer (281474976710656MHz)	\$2549.00
SBC 4900	Single Board Computer (562949953421312MHz)	\$2599.00
SBC 5000	Single Board Computer (1125899906842624MHz)	\$2649.00
SBC 5100	Single Board Computer (2251799813685248MHz)	\$2699.00
SBC 5200	Single Board Computer (4503599627370496MHz)	\$2749.00
SBC 5300	Single Board Computer (9007199254740992MHz)	\$2799.00
SBC 5400	Single Board Computer (18014398509481984MHz)	\$2849.00
SBC 5500	Single Board Computer (36028797018963968MHz)	\$2899.00
SBC 5600	Single Board Computer (72057594037927936MHz)	\$2949.00
SBC 5700	Single Board Computer (144115188075855872MHz)	\$2999.00
SBC 5800	Single Board Computer (288230376151711744MHz)	\$3049.00
SBC 5900	Single Board Computer (576460752303423488MHz)	\$3099.00
SBC 6000	Single Board Computer (1152921504606846976MHz)	\$3149.00
SBC 6100	Single Board Computer (2305843009213693952MHz)	\$3199.00
SBC 6200	Single Board Computer (4611686018427387904MHz)	\$3249.00
SBC 6300	Single Board Computer (9223372036854775808MHz)	\$3299.00
SBC 6400	Single Board Computer (18446744073709551616MHz)	\$3349.00
SBC 6500	Single Board Computer (36893488147419103232MHz)	\$3399.00
SBC 6600	Single Board Computer (73786976294838206464MHz)	\$3449.00
SBC 6700	Single Board Computer (147573952589676412928MHz)	\$3499.00
SBC 6800	Single Board Computer (295147905179352825856MHz)	\$3549.00
SBC 6900	Single Board Computer (590295810358705651712MHz)	\$3599.00
SBC 7000	Single Board Computer (1180591620717411303424MHz)	\$3649.00
SBC 7100	Single Board Computer (2361183241434822606848MHz)	\$3699.00
SBC 7200	Single Board Computer (4722366482869645213696MHz)	\$3749.00
SBC 7300	Single Board Computer (9444732965739290427392MHz)	\$3799.00
SBC 7400	Single Board Computer (18889465931478580854784MHz)	\$3849.00
SBC 7500	Single Board Computer (37778931862957161709568MHz)	\$3899.00
SBC 7600	Single Board Computer (75557863725914323419136MHz)	\$3949.00
SBC 7700	Single Board Computer (151115727451828646838272MHz)	\$3999.00
SBC 7800	Single Board Computer (302231454903657293676544MHz)	\$4049.00
SBC 7900	Single Board Computer (604462909807314587353088MHz)	\$4099.00
SBC 8000	Single Board Computer (1208925819614629174706176MHz)	\$4149.00
SBC 8100	Single Board Computer (2417851639229258349412352MHz)	\$4199.00
SBC 8200	Single Board Computer (4835703278458516698824704MHz)	\$4249.00
SBC 8300	Single Board Computer (9671406556917033397649408MHz)	\$4299.00
SBC 8400	Single Board Computer (19342813113834066795298816MHz)	\$4349.00
SBC 8500	Single Board Computer (38685626227668133590597632MHz)	\$4399.00
SBC 8600	Single Board Computer (77371252455336267181195264MHz)	\$4449.00
SBC 8700	Single Board Computer (15474250491067253436239552MHz)	\$4499.00
SBC 8800	Single Board Computer (30948500982134506872479104MHz)	\$4549.00
SBC 8900	Single Board Computer (61897001964269013744898208MHz)	\$4599.00
SBC 9000	Single Board Computer (123794003928538027489796416MHz)	\$4649.00
SBC 9100	Single Board Computer (247588007857076054979592832MHz)	\$4699.00
SBC 9200	Single Board Computer (495176015714152109959185664MHz)	\$4749.00
SBC 9300	Single Board Computer (990352031428304219918371328MHz)	\$4799.00
SBC 9400	Single Board Computer (1980704062856608439836742656MHz)	\$4849.00
SBC 9500	Single Board Computer (3961408125713216879673485312MHz)	\$4899.00
SBC 9600	Single Board Computer (7922816251426433759346970624MHz)	\$4949.00
SBC 9700	Single Board Computer (15845632502852867518693941248MHz)	\$4999.00
SBC 9800	Single Board Computer (31691265005705735037387882752MHz)	\$5049.00
SBC 9900	Single Board Computer (63382530011411470074775765504MHz)	\$5099.00
SBC 10000	Single Board Computer (126765060022822940149551551008MHz)	\$5149.00

## 6800 MICROMODULE™ PRICE LIST

Model No.	Description	Price
9600A	Single Board Microcomputer	\$495.00
9600B	Advanced Single Board Comp. (8080)	\$595.00
9601	16 Slot Mother Board	\$175.00
9602	Card Cage	\$75.00
9603	8 Slot Mother Board	\$100.00
9604	Power Supply	\$75.00
9605	DC Input Power Supply	\$35.00
9606	Utility Proto. Board	\$95.00
9607	Arith. Proc/Memory Module	\$495.00
9608	Buffered Utility Proto Board	\$49.00
9609	32K Static RAM Module	\$100.00
9610	EPROM Programming Head	\$250.00
9611	16 Channel Parallel I/O Module	\$95.00
9612	Serial-Parallel I/O Module	\$325.00
9613	32K Static RAM Module	\$100.00
9614	32K Static RAM Module	\$100.00
9615	32K Static RAM Module	\$100.00
9616	32K Static RAM Module	\$100.00
9617	32K Static RAM Module	\$100.00
9618	32K Static RAM Module	\$100.00
9619	32K Static RAM Module	\$100.00
9620	32K Static RAM Module	\$100.00
9621	32K Static RAM Module	\$100.00
9622	32K Static RAM Module	\$100.00
9623	32K Static RAM Module	\$100.00
9624	32K Static RAM Module	\$100.00
9625	32K Static RAM Module	\$100.00
9626	32K Static RAM Module	\$100.00
9627	32K Static RAM Module	\$100.00
9628	32K Static RAM Module	\$100.00
9629	32K Static RAM Module	\$100.00
9630	32K Static RAM Module	\$100.00
9631	32K Static RAM Module	\$100.00
9632	32K Static RAM Module	\$100.00
9633	32K Static RAM Module	\$100.00
9634	32K Static RAM Module	\$100.00
9635	32K Static RAM Module	\$100.00
9636	32K Static RAM Module	\$100.00
9637	32K Static RAM Module	\$100.00
9638	32K Static RAM Module	\$100.00
9639	32K Static RAM Module	\$100.00
9640	32K Static RAM Module	\$100.00
9641	32K Static RAM Module	\$100.00
9642	32K Static RAM Module	\$100.00
9643	32K Static RAM Module	\$100.00
9644	32K Static RAM Module	\$100.00
9645	32K Static RAM Module	\$100.00
9646	32K Static RAM Module	\$100.00
9647	32K Static RAM Module	\$100.00
9648	32K Static RAM Module	\$100.00
9649	32K Static RAM Module	\$100.00
9650	32K Static RAM Module	\$100.00
9651	32K Static RAM Module	\$100.00
9652	32K Static RAM Module	\$100.00
9653	32K Static RAM Module	\$100.00
9654	32K Static RAM Module	\$100.00
9655	32K Static RAM Module	\$100.00
9656	32K Static RAM Module	\$100.00
9657	32K Static RAM Module	\$100.00
9658	32K Static RAM Module	\$100.00
9659	32K Static RAM Module	\$100.00
9660	32K Static RAM Module	\$100.00
9661	32K Static RAM Module	\$100.00
9662	32K Static RAM Module	\$100.00
9663	32K Static RAM Module	\$100.00
9664	32K Static RAM Module	\$100.00
9665	32K Static RAM Module	\$100.00
9666	32K Static RAM Module	\$100.00
9667	32K Static RAM Module	\$100.00
9668	32K Static RAM Module	\$100.00
9669	32K Static RAM Module	\$100.00
9670	32K Static RAM Module	\$100.00
9671	32K Static RAM Module	\$100.00
9672	32K Static RAM Module	\$100.00
9673	32K Static RAM Module	\$100.00
9674	32K Static RAM Module	\$100.00
9675	32K Static RAM Module	\$100.00
9676	32K Static RAM Module	\$100.00
9677	32K Static RAM Module	\$100.00
9678	32K Static RAM Module	\$100.00
9679	32K Static RAM Module	\$100.00
9680	32K Static RAM Module	\$100.00
9681	32K Static RAM Module	\$100.00
9682	32K Static RAM Module	\$100.00
9683	32K Static RAM Module	\$100.00
9684	32K Static RAM Module	\$100.00
9685	32K Static RAM Module	\$100.00
9686	32K Static RAM Module	\$100.00
9687	32K Static RAM Module	\$100.00
9688	32K Static RAM Module	\$100.00
9689	32K Static RAM Module	\$100.00
9690	32K Static RAM Module	\$100.00
9691	32K Static RAM Module	\$100.00
9692	32K Static RAM Module	\$100.00
9693	32K Static RAM Module	\$100.00
9694	32K Static RAM Module	\$100.00
9695	32K Static RAM Module	\$100.00
9696	32K Static RAM Module	\$100.00
9697	32K Static RAM Module	\$100.00
9698	32K Static RAM Module	\$100.00
9699	32K Static RAM Module	\$100.00
9700	32K Static RAM Module	\$100.00

UNPOPULATED BOARDS (Also Available)

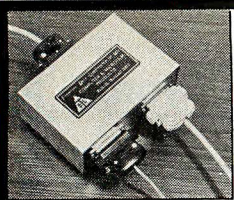
## APPLE/EXIDY/EXPANDO TRS 80 16K-UPGRADE KIT

**\$49.95 TRS-80/APPLE \$49.95**  
 MEMORY EXPANSION KITS.  
 4116's, 16K (200/250 ns.)  
 8 pcs for \$49.95  
 w/instructions & jumpers  
 Call For Volume Pricing

★ Special: TRS80 Schematic... \$ 4.95  
 ★ Expansion Interface Schematic... \$ 4.95  
 ★ Expansion Interface Connector... 7.95

## EXPANDORAM II MEMORY KITS

★ Bank Selectable ★ Uses 4116 200 ns.  
 ★ Write Protect LOW ★ Power 8VDC, ±16VDC  
 ★ Phantom JUMPERS ★ Up to 4 MHz  
 Expando 64 Kit (4116) Assembled & Tested Add \$50.  
 16K \$249.00 48K \$435.00  
 32K \$289.00 64K \$509.00



# TERMINAL DATA CORPORATION

## MODEL 1200 RS-232 BI-DIRECTIONAL DATA SPLITTER available in kit form

Model 1200K gives the terminal or micro-processor user a second interface for a printer, plotter, cassette or tape drive. It operates at any speed & isolates the two output devices from each other, while providing 2 RS-232 interfaces from the terminal or microprocessor.

The kit consists of 3 RS-232 connectors, printed circuit board, all necessary components, enclosure, mounting hardware & assembly instructions ..... \$69.00

write or call

TERMINAL DATA CORP.  
11878 Conkley Cir.  
Rockville, MD 20852  
(301) 881-7655

Circle 276 on Inquiry card.

## ATARI OWNERS

### SCREEN PRINT INTERFACE

Obtain hardcopy of any screen image (graphics and / or text) on either a TRENDCOM 200 or IDS 440 Paper Tiger printer. Simply attach the supplied parallel printer cable and load the software from cassette (may be transferred to Disk). Obtain a "picture" of the screen on your printer under direct (CTRL7) or program (XIO) control. Works in all graphics / text modes as well as LPRINT and LIST "P."

Only \$139

Parallel Printer Interface for the  
ATARI 400 / 800

Connects to controller jacks 3&4 works with BASIC / DOS / ASSEMBLER Three printer connectors available:

ATARI 400 / 800  
TRENDCOM 100 / 200 A4P-1 A8P-1  
CENTRONICS 730 / 737 A4P-2 A8P-2  
CENTRONICS 36 PIN\* A4P-3 A8P-3

CA sales add 6% tax  
MC / VISA accepted.

\$69.95

\* Fits all other parallel Centronics plus Anadex, Base 2, Epson, Comprint and Microtek. Order by part number, ATARI is a recognized trademark of ATARI, Inc.

MACROTRONICS, inc. ®

1125 N. Golden State Blvd. / Suite G  
Turlock, CA 95380 (A) (209) 667-2888 / 634-8888

Circle 277 on Inquiry card.

FOR TRS-80

### CUSTOM SOUND

A programmable SOUND GENERATOR for your computer. Three voices, each capable of tones from subaudible to ultrasonic; each voice has its own noise mixer and individual volume control, each keyed by the computer or by an internal envelope generator. All inputs are latched, enabling the computer to control the device while performing other tasks. The device is capable of producing three simultaneous tone music of any note structure (not just octaves) as well as complex sound effects (sirens, etc). All this at a fraction of the cost of comparable units. With the double cable, two units can be "ganged" together to produce six voices for your computer.

SOUND GENERATOR KIT: (needs only cable, SVDC & speaker) --- \$49  
two for \$80

CABLE: ribbon cable with PC edge connectors, plugs into expansion port of CPU --- \$20  
or E3/INT. double connector --- \$25

SVDC REGULATED POWER SUPPLY: fully assembled, 1.2 amp, OVP. --- \$23

kit comes complete with sample software & instructions.

COMING SOON! SPEECH SYNTHESIZER  
computer controlled phoneme generator  
capable of most any human speech  
INQUIRIES WELCOME

Custom  
Peripherals

include \$2  
for shipping  
Check or Money Order  
+ 6% for R.I. res

Box 8759 Warwick, Rhode Island 02888

allow 4-6 weeks for delivery

\* registered trademark of Tandy Corp.

Circle 278 on inquiry card.

## DISK DRIVES REMEX

Compatible with IBM and Shugart.  
Double sided, Double Density

..... 1600 K Bytes.  
RFD 4000 ..... \$595

Double Sided, Double Density

RFD 2000 ..... \$395

For fast delivery, send certified checks, money orders or call to arrange direct bank wire transfers. Personal or company checks require two weeks to clear. California Res. add 6% sales tax. Minimum shipping charge \$10.00. No C.O.D.

Electronic Equipment Unlimited  
3845 Birch Street

Newport Beach, CA 92660

PH: (714) 540-5231

Pricing and availability subject to change without notice.

Circle 279 on inquiry card.

## SURPLUS ELECTRONICS

ASCII



ASCII

TRS-80\* COMPATIBLE, IBM  
SELECTRIC®-BASED I/O TERMINAL  
with ASCII conversion installed: \$645.00

Many Other Items Available: Tape Drives; Cable; Cassette Drives; Wire; Power Supplies (5 volt 35 amp, others); Displays; Cabinets; Transformers; Heat Sinks; Printers; Components.

Send for Free Catalog

WORLDWIDE ELECTRONICS, INC.

130 Northeastern Blvd.

Nashua, N.H. 03062

Phone orders accepted using VISA or MC

Toll Free 1-800-258-1036

in NH 603-889-7661

\*TRS-80 is a trademark of the Radio Shack Division of Tandy Corporation.

Circle 280 on inquiry card.

## J and S Computers

2247 Shetland Road

Livermore, Ca. 94550

### CENTRONIC PRINTER SALE

730-1 ..... \$617.00

730-3 SERIAL ..... \$654.00

737-1 ..... \$760.00

737-3 SERIAL ..... \$795.00

### SCOTCH DISKETTES

740-0 8 INCH BOX OF 10 ..... \$32.00

743-0 DOUBLE DENSITY /

DOUBLE SIDED BOX OF 10 ..... \$58.00

California residents add 6% sales tax

Write for free catalogue

Circle 281 on inquiry card.

## SPECIAL OFFER! LIMITED TIME! OWNERS OF TRS-80™ LEVEL II, 16K

### DERBY II

Outstanding game of racing designed by a scientist and statistician. Six mutual probability algorithms precisely coded (not just RND). Every race a cliffhanger. Bet to win place, or show; perfectos; trifectas! Photo finishes! Inquiries! Play different odds every race! Can be beaten with a lot of skill. 1 to 5 players, plus a tout who bets every race using exactly the same handicapping information you have (he will even place a bet for you-for a fee of course). Excellent spot graphics for realistic motion.

### CAN YOU BEAT THE TOUT

ORDER NOW for one of the most remarkable games you'll ever play.

Only \$15.00 (check or m.o.) for qual. cassette.  
Add \$.50 postage, handling. FL res. add 4% tax.

C&A ASSOCIATES, Inc.

P.O. Box 2362

Sofellite Beach, FL 32937

## (✓) Check Your Options!

### Sensors Available:

- ☐ Temperature ..... \$ 64.95
- ☐ Relative Humidity .... \$ 82.95
- ☐ Pressure ..... \$ 85.95
- ☐ Magnetic Field ..... \$108.95
- ☐ Flow Sensor ..... \$ 99.95
- ☐ Light Level ..... \$ 49.95
- ☐ Liquid Level ..... \$ 78.95
- ☐ Live Object ..... \$ 64.95

### These Functions And

More Available Off

The Shelf ...

systems

(602) 299-9831

P.O. Box 35879

Tucson, Arizona 85740

Circle 283 on inquiry card.

## 16-BIT MC68000 CROSS-ASSEMBLER

written in FORTRAN IV

has now been added to our line of stock FORTRAN cross-assemblers for the popular 8 bit microprocessors (6809, 6805, 6800, 8080/5, MC6802, CD6802). All of these cross assembler programs can be run on most any large or small computer system that supports standard FORTRAN IV. Packages include new, expanded user's manual, printed source listing, and IDMs exclusive Software Support Service.

SOURCE MEDIA	8-BIT ASSEMBLERS	16-BIT ASSEMBLERS
CARD DECK PACKAGE (1026 or 029 punch)	\$125.00	\$250.00
MAGNETIC TAPE PACKAGE (ASCII or EBCDIC, 1600 or 800 bpi, blocked)	\$125.00	\$250.00
MANUAL & LISTING ONLY	\$50.00	\$100.00

All prices include shipping in the continental USA. 10% discount on prepaid orders.

\*Also available: M6800 to M6809 Source code translator.

\*\*COMING SOON - Cross assemblers in FORTRAN for the other 16 bit microprocessors: 8086, Z8000, TMS9900. Send for our free information on assemblers, simulators, and others software products.

IDM

Intelligent Devices of Mn.

P.O. Box 14538 Minneapolis, Mn. 55414

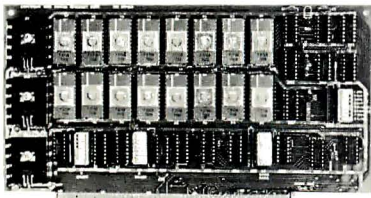
(612) 427-0787 7AM-12 Noon

Circle 284 on inquiry card.

# DIGITAL RESEARCH COMPUTERS

(214) 271-3538

## 32K S-100 EPROM CARD NEW!



**\$74.95**  
KIT

USES 2716's

Blank PC Board - \$34

ASSEMBLED & TESTED  
ADD \$30

SPECIAL: 2716 EPROM's (450 NS) Are \$11.95 EA. With Above Kit.

### KIT FEATURES:

1. Uses +5V only 2716 (2Kx8) EPROM's.
2. Allows up to 32K of software on line!
3. IEEE S-100 Compatible.
4. Addressable as two independent 16K blocks.
5. Cromemco extended or Northstar bank select.
6. On board wait state circuitry if needed.
7. Any or all EPROM locations can be disabled.
8. Double sided PC board, solder-masked, silk-screened.
9. Gold plated contact fingers.
10. Unselected EPROM's automatically powered down for low power.
11. Fully buffered and bypassed.
12. Easy and quick to assemble.

## 32K SS-50 RAM

**\$379<sup>00</sup>** KIT

For 2 MHZ  
Add \$10

Blank PC Board  
\$50

For SWTPC  
6800 - 6809 Buss

Support IC's  
and Caps  
\$19.95

Complete Socket Set  
\$21.00

Fully Assembled,  
Tested, Burned In  
Add \$30

**NEW!**

At Last! An affordable 32K Static RAM with full 6809 Capability.

### FEATURES:

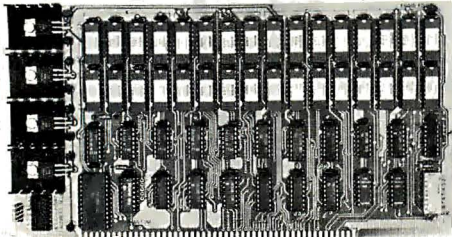
1. Uses proven low power 2114 Static RAMs.
2. Supports SS50C - EXTENDED ADDRESSING.
3. All parts and sockets included.
4. Dip Switch address select as a 32K block.
5. Extended addressing can be disabled.
6. Works with all existing 6800 SS50 systems.
7. Fully bypassed. PC Board is double sided, plated thru, with silk screen.

## 16K STATIC RAM KIT-S 100 BUSS

PRICE CUT!

**\$199<sup>95</sup>** KIT

FOR 4MHZ  
ADD \$10



### 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 1.5 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 \$35

**OUR #1 SELLING  
RAM BOARD!**

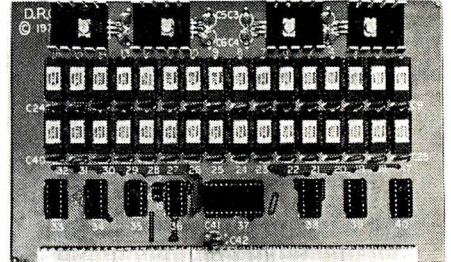
## 16K STATIC RAM SS-50 BUSS

PRICE CUT!

**\$195** KIT

FULLY STATIC!

FOR 2MHZ  
ADD \$10



FOR SWTPC  
6800 BUSS!

ASSEMBLED AND  
TESTED - \$35

### KIT FEATURES:

1. Addressable on 16K Boundaries
2. Uses 2114 Static Ram
3. Fully Bypassed
4. Double sided PC Board. Solder mask and silk screened layout.
5. All Parts and Sockets included
6. Low Power: Under 1.5 Amps Typical

BLANK PC BOARD-\$35

COMPLETE SOCKET SET-\$12

SUPPORT IC'S AND CAPS-\$19.95

## NEW! S-100 SOUND COMPUTER BOARD NEW!

At last, an S-100 Board that unleashes the full power of two unbelievable General Instruments AY3-8910 NMOS computer sound IC's. Allows you under total computer control to generate an infinite number of special sound effects for games or any other program. Sounds can be called in BASIC, ASSEMBLY LANGUAGE, etc.

### KIT FEATURES:

- \* TWO GI SOUND COMPUTER IC'S.
  - \* FOUR PARALLEL I/O PORTS ON BOARD.
  - \* USES ON BOARD AUDIO AMPS OR YOUR STEREO.
  - \* ON BOARD PROTO TYPING AREA.
  - \* ALL SOCKETS, PARTS AND HARDWARE ARE INCLUDED.
  - \* PC BOARD IS SOLDERMASKED, SILK SCREENED, WITH GOLD CONTACTS.
  - \* EASY, QUICK, AND FUN TO BUILD. WITH FULL INSTRUCTIONS.
  - \* USES PROGRAMMED I/O FOR MAXIMUM SYSTEM FLEXIBILITY.
- Both Basic and Assembly Language Programming examples are included.

### SOFTWARE:

SCL™ is now available! Our Sound Command Language makes writing Sound Effects programs a SNAP! SCL™ also includes routines for Register-Examine-Modify, Memory-Examine-Modify, and Play-Memory. SCL™ is available on CP/M compatible diskette or 2708 or 2716. Diskette - \$24.95 2708 - \$19.95 2716 - \$29.95. Diskette includes the source. EPROMS are ORG at E000H.

### COMPLETE KIT!

**\$84<sup>95</sup>**

(WITH DATA MANUAL)

BLANK PC  
BOARD W/DATA  
\$31

## 4K DYNAMIC RAM BLOWOUT!

SAME AS INTEL 2107B!

4K RAMS AT AN UNBELIEVABLE 50¢ EACH!!!

Prime, new, National Semi., 1979 date coded, full spec. parts. N.S. #MM5280-5N. Same as INTEL 2107B-4, T.I. TMS4060, NEC uPD411, etc. We bought a HUGE QTY. from a West Coast Distributor at truly DISTRESS PRICES! One of the most popular and reliable RAM's ever made. These parts have been used by almost all Major Computer Main Frame Mfg. the world over! Arranged as 4K x 1, 270 NS Access Time, 22 Pin Dip. These units DO NOT use multiplexed addressing, thus making REFRESH and other timing very simple. See INTEL MEMORY DESIGN HANDBOOK for full application notes. The NAT. SEMI. MEMORY DATA BOOK is available at most Radio Shack Stores. Prime units in original factory tubes!

(With Pin  
Out Data)

#5280-5N 4096 BITS x 1 270 NS ACCESS

8 FOR \$4.95 32 FOR \$16

FACTORY CASE (450 PCS) — \$180

Sockets Special: 22 Pin Low Profile (With Purchase of 5280's) 8 FOR \$1.

## COMPUTER PARTS SPECIALS

74LS175 - .99	8035 Intel Single Chip CPU 6.95
74LS240 - 1.19	Signetics 2901 4 Bit Slice - 6.95
74LS241 - 1.19	AMD 2903 4 Bit Super Slice - 12.50
74LS244 - 1.19	AMD 29705 Dual Port RAM - 8.95
74LS373 - 1.29	Intel 2716-1 (350 NS) - 12.95

## NEW! G.I. COMPUTER SOUND CHIP

AY3-8910 As featured in July, 1979 BYTE! A fantastically powerful Sound & Music Generator. Perfect for use with any 8 Bit Microprocessor. Contains: 3 Tone Channels. Noise Generator, 3 Channels of Amplitude Control. 16 bit Envelope Period Control, 2-8 Bit Parallel I/O. 3 D to A Converters, plus much more! All in one 40 Pin DIP. Super easy interface to the S-100 or other busses. **\$11.95 PRICE CUT!**

SPECIAL OFFER: **\$14.95** each Add \$3 for 60 page Data Manual.

**Digital Research Computers**  
(OF TEXAS)

P.O. BOX 401565 • GARLAND, TEXAS 75040 • (214) 271-3538

TERMS: Add \$1.50 postage. We pay balance. Orders under \$15 add 75¢ handling. No C.O.D. We accept Visa and MasterCard. Tex. Res. add 5% Tax. Foreign orders (except Canada) add 20% P & H. Orders over \$50, add 85¢ for insurance.

ALL SALES ARE MADE SUBJECT TO THE TERMS OF OUR 90 DAY LIMITED WARRANTY. A COPY OF THIS WARRANTY IS AVAILABLE FREE, ON REQUEST.

## Know The Reasons Why The FORCE-80 is your "Best Buy."

### FORCE-80

- Power dropout protection
- Suppresses transient voltages
- Suppresses RFI
- Disc protection
- Factory warranty
- Satisfaction guaranteed
- Direct from factory

## FORCE-80

Only \$121.50 plus \$5.00 shipping & handling

Check, Mastercharge, Visa accepted

(5% discount for cash)

No C.O.D.'s please



P&S Electronics, Inc.

P.O. Box 23014 Dept. B  
Nashville, TN 37202

Allow 6-8 weeks for delivery.  
Add 14 days for personal checks.

## STATISTICAL SOFTWARE

The Winchendon Group announces its powerful statistical system which includes a data-base system, all BASIC transformations, simple statistics, stepwise regression, correlation, crosstabs, factor analysis and more.

Now available for the Apple II + \*, 48k with DOS 3.2.1\*. \$150, for the complete version.

Write for further information.

*The Winchendon Group*

P.O. Box 10114

Alexandria, Va. 22310

\*Apple II+ and DOS 3.2.1 are trademarks of the Apple Computer Company

## !!!PROGRAMMERS!!!



TURN YOUR WILDEST IMAGININGS INTO CASH \$\$\$ WE'RE LOOKING FOR NEW CONCEPTS IN COMPUTER VIDEO GAMES AND WE'RE WILLING TO PAY PROGRAMMERS TOP PRICES FOR ORIGINAL IDEAS. SUBMIT A WORKING PROTOTYPE TO:

MR. DOMINIC SANZO  
GAME-A-TRON CORP.  
931 WEST MAIN ST.  
NEW BRITAIN, CT. 06051

CALL 1-203-223-2760  
FOR FURTHER INFORMATION



## GAME IDEAS WANTED

Circle 285 on Inquiry card.

Circle 286 on inquiry card.

## PRINTERS

**NEW BASE, MODEL 850**

LIST \$799 **OUR PRICE \$735**

**BASE, MODEL 800B**

LIST \$699 **OUR PRICE \$585**

**NEW BASE, /APPLE GRAPHICS  
INTERFACE**

LIST \$160 **OUR PRICE \$140**

**OKIDATA p LINE 80**

LIST \$800 **OUR PRICE \$550**

\*PLEASE ADD 3% FOR S&H TO ORDER\*

SEND FOR INFORMATION ON OUR OTHER PRODUCT LINES

**TECHNICAL INNOVATIONS**

**P.O. BOX 803 DEPT B2**

**HILLSBORO, OR 97123**

**503-648-6423**

## SOFTWARE DESIGN ENGINEER

BSEE/BSCS. minimum 3 years programming experience. Real-time systems programming and software development for electronic switches is a plus. Experience with PASCAL or C or Assembly language required. Call collect or send resume to Kenneth W. Cooper, Harris Corporation, RF Communications Division, 1680 University Avenue, Rochester, NY 14610, (716) 244-5830, EXT 3356.

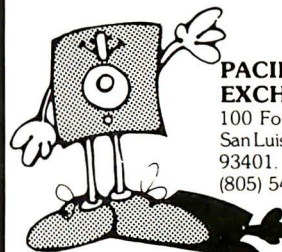


**HARRIS**  
COMMUNICATION AND  
INFORMATION PROCESSING

An Equal Opportunity Employer M/F

## 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 287 on Inquiry card.

Circle 288 on inquiry card.

Circle 289 on Inquiry card.

## Save up to 50%

using our buying power. We buy over three million dollars of computer equipment wholesale per year for clients who range in size from the largest manufacturers to the home hobbyist. Our fee is one fourth of what we save you off the manufacturer's suggested list price, so it is to our advantage to save you money.

THE PURCHASING AGENT  
1635 School Street, Suite 101  
Moraga, CA 94556  
(415) 376-9020



Circle 290 on Inquiry card.

## OHIO SCIENTIFIC COMPUTERS

C1P SERIES II — \$479.00

**OUR PRICE — \$399.00**

other OSI discounts available

CALL NOW TOLL FREE  
**1-800-558-0870**

**COMPUTERS  
PLUS, INC.**

2749 S. 108th St.  
MILWAUKEE, WI 53227  
[414] 321-1770  
IN WISCONSIN

Circle 291 on Inquiry card.

## EXOTIC BASIC PROGRAM

**BATTLE FOR  
GAMMA OMICRON  
OUTPOST #1**

(a game in the tradition of great star battles in space)  
\$2 postage and handling for listing

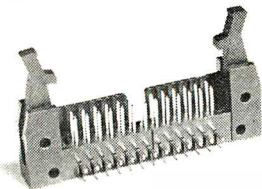
\*\*\*\*\*  
\* **EXTRA BONUS LISTING:** \*  
\* **LAS VEGAS BINGO PIN-BALL** \*  
\* **(card simulation)** \*  
\*\*\*\*\*  
bonus offer expires March 31, 1981

**THE COMPUTER SOCIETY**  
P.O. BOX 1056  
WASHINGTON PARK, IL. 62204

Circle 292 on inquiry card.

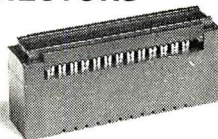
## INSULATION DISPLACEMENT SOCKETS

## RIGHT ANGLE HEADERS



Pins	PC Mounting	Wire Wrap
10	IDH10SR .80	IDH10WR 1.75
20	IDH20SR 1.25	IDH20WR 2.75
26	IDH26SR 1.85	IDH26WR 3.60
34	IDS34SR 2.15	IDH34WR 4.15
40	IDH40SR 2.50	IDH40WR 4.90
50	IDH50SR 3.15	IDH50WR 6.15
EJECTOR EARS .25 EACH		

## CARD EDGE CONNECTORS



Pins	Part No.	
10	IDE10	3.25
20	IDE20	3.50
26	IDE26	4.05
34	IDE34	4.85
40	IDE40	5.65
50	IDE50	5.90

## RIBBON CABLE



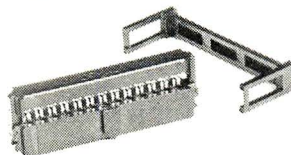
	Conductors: Solid Color		Color Coded	
	10 ft.	100 ft.	10 ft.	100 ft.
10	2.90	17.00	4.00	30.00
14	3.40	23.80	5.00	42.00
16	3.70	27.20	5.60	48.00
20	4.40	34.00	7.00	60.00
24	5.00	40.80	8.00	72.00
26	5.40	44.20	8.60	78.00
34	6.80	57.80	11.00	102.00
40	7.80	68.00	13.00	120.00
50	9.50	85.00	16.00	150.00

## 25 PIN "D" CONNECTORS



Style	Part #	
<b>SOLDER STYLE</b>		
Male	DB25P	.2.25
Female	DB25S	3.00
Hood	DB25C	1.10
<b>INSULATION DISPLACEMENT</b>		
Male	IDC25P	4.95
Female	IDC25S	5.25
Hood	IDC25C	1.35

## SOCKETS



Pins	Part No.		Stain Relief
10	IDS10	1.25	.25
20	IDS20	2.02	.25
26	IDS26	2.65	.25
34	IDS34	3.50	.25
40	IDS40	4.05	.25
50	IDS50	5.06	.25

## CABLE PLUGS



Pins	Part No.	
14	IDP14	1.25
16	IDP16	1.40
24	IDP24	2.25
40	IDP40	3.65

## WIRE WRAP WIRE

Length	100/Bag	500/Bag	1K/Bag	Length	100/Bag	500/Bag	1K/Bag
2.5"	\$1.25	\$3.58	\$ 6.19	6.5"	\$1.92	\$6.44	\$11.81
3.0"	1.30	3.86	6.78	7.0"	1.99	6.76	12.44
3.5"	1.37	4.15	7.37	7.5"	2.08	7.07	13.09
4.0"	1.42	4.44	7.94	8.0"	2.14	7.38	13.73
4.5"	1.48	4.74	8.54	8.5"	2.18	7.69	14.36
5.0"	1.54	5.04	9.13	9.0"	2.24	8.11	15.01
5.5"	1.58	5.38	9.72	9.5"	2.30	8.32	15.65
6.0"	1.65	5.66	10.31	10.0"	2.39	8.71	16.28

Kynar precut wire. All lengths are overall, including 1" strip on each end. Colors and lengths cannot be mixed for quantity pricing. Choose from colors Red, Blue, Black, Yellow, White, Green, Orange, and Violet.

## WIRE KITS

Kit No. 1 \$9.95				Kit No. 3 \$32.95			
250	3"	100	4 1/2"	500	2 1/2"	500	4 1/2"
250	3 1/2"	100	5"	500	3"	500	5"
100	4"	100	6"	500	3 1/2"	500	5 1/2"
				500	4"	500	6"
Kit No. 2 \$24.95				Kit No. 4 \$59.95			
250	2 1/2"	250	5"	1000	2 1/2"	1000	4 1/2"
500	3"	100	5 1/2"	1000	3"	1000	5"
500	3 1/2"	250	6"	1000	3 1/2"	1000	5"
500	4"	100	6 1/2"	1000	4"	1000	6"
250	4 1/2"	100	7"				

## ORDERING INFORMATION:

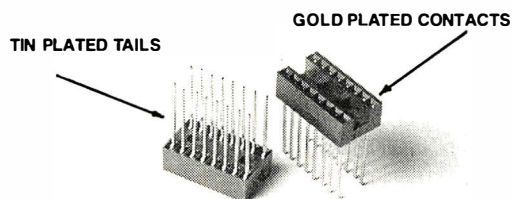
- Orders under \$25 include \$2 handling
- All prepaid orders shipped UPS Ppd.
- Visa, MC & COD's charged shipping.
- All prices good through cover date.
- Most orders shipped same day.
- Byte must be mentioned to get sale price.

Write or call for 1981 catalog

- IC Sockets
- Vector Board & Pins
- Bishop Drafting Aids
- OK Tools
- RN IDC Crimp Connectors

### "NEW" WIRE WRAP SOCKETS

FEATURING A SELECTIVE PLATING METHOD THAT WILL SAVE YOU MONEY BY HAVING GOLD ONLY WHERE IT COUNTS.



3 Level closed entry.

**RN Side Wipe contact design gives twice the contact area for high reliability.**

Size	Quantity/Tube	Price ea.*	Price/Tube
8	52	.41	21.32
14	30	.47	14.10
16	26	.51	13.26
18	23	.70	16.10
20	21	.87	18.27
22	19	.94	17.86
24	17	.96	16.32
28	15	1.25	18.75
40	10	1.70	17.00

\*FOR REFERENCE. MUST BE ORDERED IN TUBE QUANTITIES.

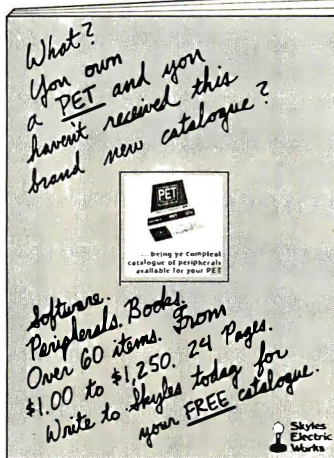
**TOLL FREE ORDERING NUMBER 1-(800)-423-7144**

## Eleusis and The TI-59

Your TI-59 can now act as God (well, dealer) in the New Eleusis (the card game introduced in the October 1977 *Scientific American*). The Eleusis-Dealer program randomly chooses a rule then accepts or rejects the cards played.

To obtain magnetic cards for the program, along with documentation, Eleusis instructions, and the latest newsletter, send \$6 to

**Robert Abbott**  
Box 1175, General P.O.  
New York, NY 10116



## Skyles Electric Works

231 E South Whisman Road  
Mountain View, CA 94041

Circle 295 on Inquiry card.

## "Attention Computer Owners"

If you own a mini or micro... you could be on your way to fantastic riches. Put your computer to a new use by monitoring real estate investments. Set up your own office in your home...never work for the other guy again. It is the most ingenious program ever devised. Make six digits annually.

First time offered. Complete package—\$36.00. We pay postage & handling. Send check or M.O. to:

**C.B.A.S.**  
P.O. Box 163  
Ontario, OH 44862

Circle 296 on Inquiry card.

## LETTER QUALITY DAISY WHEEL PRINTER \$2,195.00

\* Based on latest version of electronic typewriter by Olivetti, Ltd.

\* Use offline as typewriter

\* RS232C Interface Standard

\* Over 200 words per minute

\* 10, 12 & 15 C.P.I.

\* International Type Fonts

\* Available Immediately

Money order or C.O.D. to:

**Vertical Data Systems, Inc**  
1215 Meyerside Dr., Unit 2A  
Mississauga, Ontario, Canada  
L5T 1H3  
(416) 671-1752

Circle 297 on Inquiry card.

## ATARI®

### COMPLETE LINE OF ATARI COMPUTER PRODUCTS 20-25% OFF

Atari 800 with 16K.....\$810 Atari 810 Disk Drive.....\$460  
Atari 400 with 8K.....\$399 Atari 410 Cassette Player...\$69  
Visicalc.....\$170 Kurta Graphics Tablet.....\$560  
Ramercam 32K Modules (upgrade 400 or 800).....\$256

### ALL ATARI SOFTWARE 20% OFF BIT BUCKET SOFTWARE FOR ATARI:

Utilities Disk with Disassembler, Basic Renumberer, Character Generator, Cruncher Utility (requires 24K).....\$45

Games: Mastercode, Mr. Simon, City Bomber (each).....\$12.95

Hex, Cryptogram, Flying Saucers (each).....\$14.95

Any 3 of above \$30.00. (specify disk or cassette)

ALSO: Commodore Pet at Similar Savings

PLUS: Centronics, NEC, Zenith, Intertec, and More!



**The Bit Bucket**  
Hardware, Software, Consulting  
168 North Beacon Street  
P.O. Box 365  
Newton Highlands, MA 02161  
Phone: (617) 783-3144

Circle 298 on Inquiry card.

## COMPUTER EQUIPMENT & SOFTWARE BARGAINS



### EVERY MONTH

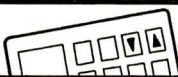
BUY, SELL OR TRADE ALL TYPES OF COMPUTER EQUIPMENT AND SOFTWARE (pre-owned and new) among 20,000 readers nationwide in BIG (11x14") pages. Classified ads are only 10¢ per word and are indexed for easy and fast location. Subscription: \$10 a year / 12 issues. Money back guarantee. Sample copy, \$1.50.

### COMPUTER SHOPPER

P.O. Box F-14  
Titusville, FL 32780  
(305) 269-3211

MasterCard or VISA subscription orders only,  
call TOLL FREE 1-800-528-6050 Ex. 184.

Circle 299 on Inquiry card.



**NEW**

## POCKET COMPUTER NEWSLETTER

P.O. BOX 232, Seymour, CT 06483

### FOR POCKET COMPUTER USERS!

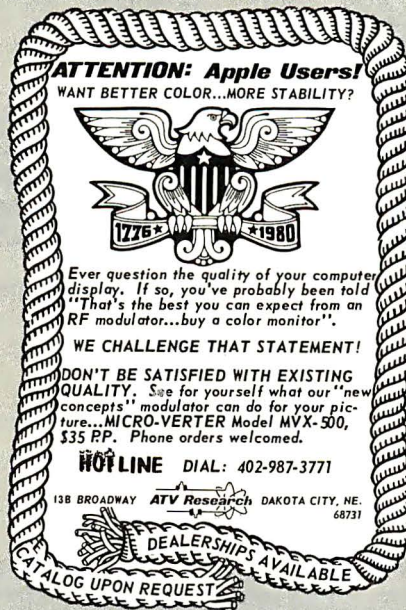
News and Product Reviews  
Programming Tips  
Operating Timesavers  
Tutorials  
Customizing Your Unit  
Short Cuts  
Practical Programs  
Technical Details  
Inside Information  
Application Forums

—and—  
more!

- ☐ YES! Sign me up as a charter subscriber. Enclosed is my \$20.00 for 10 issues. (\$24 to Canada. \$30 elsewhere.)
- ☐ Not sure. Enclosed is \$2 for a sample issue.

Name \_\_\_\_\_  
Addr \_\_\_\_\_  
City/St \_\_\_\_\_ Zip \_\_\_\_\_

Circle 300 on Inquiry card.



You may be in danger of spending almost \$200 for a so-called FORTH\* system that is not interactive!

Timin FORTH has a memory resident editor and a virtual memory subsystem, as well as all the features of true FORTH.

Our heavily advertised competitor does not!

Place your order today—then go FORTH and conquer!

\*For CP/M (Digital Research Corp.)

**MITCHELL E. TIMIN**  
**ENGINEERING COMPANY**  
9575 GENESEE AVENUE • SUITE E2  
SAN DIEGO, CALIFORNIA 92121  
714-455-9008

Circle 301 on Inquiry card.

# MICROPROCESSOR SUPPORT I.C.'S

## WE GUARANTEE FACTORY PRIME PARTS

We are going to become the largest supplier of prime microprocessor support I.C.'S. We guarantee that our I.C.'S are purchased from manufacturer authorized distributors. This is the only way to deliver prime parts at the lowest possible prices. Our commitment is to offer the best price and the fastest delivery to our customer. We give many thanks to our valued customers who have helped us grow.

### NEC 16Kx1 DYNAMIC RAM 200 N.S.

These are prime 4116's from one of the best MOS RAM manufacturers in the world.

**4116** **200ns**  
**8 for \$25.00** **32 for 96.00**  
 Only prepaid orders on this special.

### NEC 1Kx4 STATIC RAM 250 N.S.

These are prime low power static ram's NEC for the finest in MOS MEMORY.

**2114L** **250ns**  
**8 for \$25.00** **32 for \$96.00**  
 Only prepaid orders on this special.

8080A	CPU	4.95	2708	EPROM 1Kx8	4.95
8085A	CPU	8.95	2716	EPROM 2Kx8	8.95
8086	CPU	99.95	2732	EPROM 4Kx8	21.00
8088	CPU	44.95	4118	STATIC 1Kx8	15.00
Z-80	CPU	10.50	4164	200ns 64Kx1 Call	
Z-80A	CPU	12.95	Z80B	CPU	21.00

Z80-P10	7.75	8289	49.95	4050	.69	4531	.99	74C925	6.95	74LS107	.45	74LS244	1.95
Z80A-P10	9.75	4000	.35	4051	1.10	4532	1.25	74LS00	.35	74LS109	.45	74LS245	4.95
Z80-CTC	7.75	4001	.35	4052	1.10	4539	.99	74LS01	.28	74LS112	.49	74LS247	1.10
Z80ACTC	9.75	4002	.35	4053	1.10	4543	1.99	74LS02	.28	74LS122	.55	74LS248	1.10
Z80-DMA	22.25	4006	1.39	4055	3.95	4553	3.50	74LS03	.28	74LS123	1.19	74LS249	1.69
Z80A-DMA	27.75	4007	.29	4056	2.95	4555	.75	74LS04	.39	74LS125	1.35	74LS251	1.79
Z80-S10/0	24.95	4008	1.39	4059	9.95	4556	.75	74LS05	.28	74LS126	.89	74LS253	.98
Z80A-S10/0	29.95	4009	.49	4060	1.39	4581	1.99	74LS08	.39	74LS132	.79	74LS257	.98
Z80-S10/1	24.95	4010	.49	4066	.75	4582	1.01	74LS09	.39	74LS136	.59	74LS258	.98
Z80A-S10/1	29.95	4011	.35	4068	.75	4584	.55	74LS10	.28	74LS138	.89	74LS259	2.95
Z80-S10/2	24.95	4012	.29	4069	.35	4585	.99	74LS11	.39	74LS139	.89	74LS260	.69
Z80A-S10/2	29.95	4013	.49	4070	.49	4702	9.95	74LS12	.39	74LS145	1.25	74LS261	2.49
3205	3.45	4014	1.39	4071	.35	74C00	.39	74LS13	.47	74LS148	1.49	74LS266	.59
3242	10.00	4015	1.15	4072	.35	74C02	.39	74LS14	1.25	74LS151	.79	74LS273	1.75
8155	11.25	4016	.59	4073	.35	74C04	.39	74LS15	.39	74LS153	.79	74LS275	4.40
8185	29.95	4017	1.19	4075	.35	74C08	.49	74LS20	.26	74LS155	1.19	74LS279	.59
8185-2	39.95	4018	.99	4076	1.29	74C10	.49	74LS21	.38	74LS156	.99	74LS283	1.10
8202	45.00	4019	.49	4078	.35	74C14	1.65	74LS22	.38	74LS157	.99	74LS290	1.29
8205	3.45	4020	1.19	4081	.35	74C20	.39	74LS26	.39	74LS158	.75	74LS293	1.95
8212	2.00	4021	1.19	4082	.35	74C30	.39	74LS27	.39	74LS160	.98	74LS295	1.10
8214	3.95	4022	1.15	4085	1.95	74C32	.99	74LS28	.39	74LS161	1.15	74LS298	1.29
8216	1.85	4023	.38	4086	.79	74C42	1.85	74LS30	.26	74LS162	.98	74LS324	1.75
8224	2.65	4024	.79	4093	.99	74C48	2.39	74LS32	.39	74LS163	.98	74LS347	1.95
8226	1.85	4025	.38	4099	2.25	74C73	.85	74LS37	.79	74LS164	1.19	74LS348	1.95
8228	5.00	4026	2.50	4104	1.99	74C74	.85	74LS38	.39	74LS165	.89	74LS352	1.65
8238	5.45	4027	.65	4501	.39	74C85	2.49	74LS42	.79	74LS166	2.49	74LS353	1.65
8243	4.65	4028	.85	4502	1.65	74C89	4.95	74LS47	.79	74LS170	1.99	74LS363	1.49
8251A	5.55	4029	1.29	4503	.69	74C90	1.85	74LS48	.79	74LS173	.89	74LS365	.99
8253	9.85	4030	.45	4505	8.95	74C93	1.85	74LS51	.26	74LS174	.99	74LS366	.99
8255A	5.40	4031	3.25	4506	.75	74C95	1.85	74LS54	.35	74LS175	.99	74LS367	.73
8255A-5	5.40	4032	2.15	4507	.95	74C107	1.19	74LS55	.35	74LS181	2.20	74LS368	.73
8257	9.25	4033	2.15	4508	3.95	74C151	2.49	74LS73	.45	74LS190	1.15	74LS373	2.75
8257-5	9.25	4034	3.25	4510	1.39	74C154	3.50	74LS74	.59	74LS191	1.15	74LS374	2.75
8259A	7.30	4035	.95	4511	1.39	74C157	2.10	74LS75	.68	74LS192	.98	74LS375	.69
8271	60.00	4037	1.95	4512	1.39	74C160	2.39	74LS76	.45	74LS193	.98	74LS377	1.95
8275	32.95	4040	1.29	4514	3.95	74C161	2.30	74LS78	.65	74LS194	1.15	74LS385	1.95
8279	10.80	4041	1.25	4515	3.95	74163	2.39	74LS83	.99	74LS195	.95	74LS386	.65
8279-5	10.80	4042	.95	4516	1.69	74164	2.39	74LS85	1.19	74LS196	.89	74LS390	1.95
8282	6.70	4043	.85	4519	.99	74173	2.59	74LS86	.45	74LS197	.89	74LS393	1.95
8283	6.70	4044	.85	4520	1.39	74174	2.75	74LS90	.75	74LS221	1.49	74LS395	1.70
8284	5.85	4046	1.75	4522	.99	74C175	2.75	74LS92	.75	74LS240	1.95	74LS399	2.95
8286	6.70	4047	1.25	4526	1.15	74C192	2.39	74LS93	.75	74LS241	1.90	74LS424	2.95
8287	6.70	4048	.99	4527	1.75	74C193	2.39	74LS95	.88	74LS242	1.95	74LS668	1.75
8288	25.40	4049	.69	4528	.99	74C195	2.39	74LS96	.98	74LS243	1.95	74LS670	2.29

MAIL ORDERS SHOULD BE SENT TO:  
 P.O. Box 21432 Seattle, Washington 98111  
 Telephone Orders & Inquiries (206) 453-0792  
 Minimum Order \$10.00 Add \$3.00 Shipping

**HANLEY ENGINEERING**  
 RETAIL STORE  
 1644 116th NORTHEAST  
 BELLEVUE, WASHINGTON 98005

**FOR THE FINEST IN MICROPROCESSOR SUPPORT I.C.'S**

## 10,000 WORDS IN 1 MINUTE, PROOFREAD FOR SPELLING

20,000 word user expandable dictionary, easy to use, Requires CP/M\* 8080/286 with 32K memory. Compatible w/ Magic Wand\*, WordStar\*, Electric Pencil\* and many others. **\$269.00**



**PELICAN  
PROGRAMS**

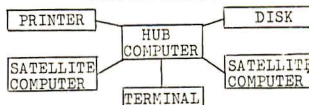
\*Trademark

Pelican Programs  
49 Pelican Court, Syosset, N.Y. 11791

New Crystal-Clear\* Operator's Training Manual for Magic Wand\* and related CP/M\* is designed for the secretary and non-computerist use. Dual column pages present instructions and explanations on left, drawings, pictures & screen displays on right. Small black circles precede user action steps for clarity and quick future reference. **\$35.00**

Free Crystal-Clear\* Operator's Training Manual with Magic Wand\* customized for your CPU, terminal, Printer & disk. **\$299.00**

## SMARTNET



### FEATURES

- Automatic spooling and despooling.
- Levels 1-15 of the hub computer are password protected.
- No modifications needed to the BIOS or XIOS.
- Block data transfer with checksum.
- Low memory requirements.
- Complete source code provided.

### REQUIREMENTS

- Hub computer must be running CP/M\*.
- Smartnet requires CP/M\* 2.2, 20k of memory and at least one disk drive.
- Dumbnet requires at least 16k of memory. Disk drives not needed.

### PRICE

SMARTNET \$150.00 DUMBNET \$175.00  
PURCHASE TOGETHER \$300.00

### LINKAR

541 Ingraham Ave.  
Calumet City, IL 60409  
312-868-4866 Ask for Mark

\* Trademark of Digital Research.

**SUBMINI DPDT  
DIP RELAY**  
AROMAT #HB2-DC6V  
• 6 VDC coil • Fits dip socket  
• Norm. op. power 580 mW  
• Contacts rated 1 amp @120V  
\$1.50 each 10 for \$13.50

**7-17vdc  
S.S. BUZZER**  
• Fits dip socket  
• CMOS compatible  
• Max. current 14mA  
• Sound output  
70dB @ 20 cm  
\$1.25 each

**40 PIN RT ANGLE P.C.B.  
HEADER**  
PRINTED CIRCUIT  
RIGHT ANGLE  
MOUNT  
\$1.50 EACH

**40 PIN RIBBON CABLE  
SOCKET CONNECTOR**  
3M # 3417  
FITS ABOVE  
HEADER  
\$1.50 EACH

**22/44 EDGE CONNECTOR**  
TIN SOLDER TAIL .156" x .200"  
LARGE QUANTITIES AVAILABLE  
\$1.35 each 10 for \$12.50

**FLAT LEVER  
HANDLE  
MINI TOGGLE  
S.P.O.T  
RATED**  
6 AMPS @ 125 V  
1/4 - 40 BUSHING  
\$1.00 each  
10 for \$8.50

**Litronix FRL-4403  
FLASHER  
LED**  
diffused red led  
with built in flashing unit  
T1 1/4 package  
pulse rate 3Hz - 5v 20 ma.  
2 for \$1.70

## ALL ELECTRONICS CORP.

905 S. Vermont Ave.  
Los Angeles, Calif. 90006  
(213) 380-8000

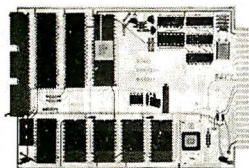
Mon. - Fri. Saturday  
9 AM - 5 PM 10 AM - 3 PM  
**SEND FOR FREE CATALOG**

Circle 305 on inquiry card.

Circle 306 on inquiry card.

Circle 307 on inquiry card.

## \$94.20\* Single Board Computer



\* 100 piece price, model MCL11

6800 MPU, serial I/O, parallel I/O, RAM,  
EROM, 44-pin 4 1/2" x 6 1/2" PCB

### EXPANSION MODULES

RAM, ROM, CMOS RAM/battery, analog  
I/O, serial I/O, parallel I/O, counter/  
timer, 488 GPIB, EROM programmer,  
power fail detect/power on reset



Wintek Corp.  
1801 South Street  
Lafayette, IN 47904  
317-742-8428

Circle 308 on inquiry card.

# SPELLING ERORS

eliminated with  
**SPELLGUARD™**

Proofreads 100 pp. per minute  
with Wordstar or Magicwand.

Spellguard	\$295
Wordstar	\$325
w/Spellguard	\$585
Magicwand	\$275
w/Spellguard	\$510

**TPA** 1635 School St.  
Moraga, CA 94557  
(415) 376-3753

Circle 309 on inquiry card.

## WANTED



The Blacksburg Group wants to evaluate your software for publication in the Blacksburg Continuing Education Series (Howard W. Sams and Co.) We're interested in circuit design, scientific application and data handling programs, among others. Please send us a copy of your original software, with documentation for our review. We'll send you a complete author kit. Competitive advances & royalties. All software treated as confidential. Let's see how we can work together.

The Blacksburg Group, Inc., P.O. Box 242,  
Blacksburg, VA 24060 (703) 951-9030.

Circle 310 on inquiry card.

## LETTER QUALITY

ASCII  
KSR  
TERMINALS



**\$1600**

PERKIN-ELMER CAROUSSELS: 132 column commercial quality word processing terminals complete with keyboard. Microprocessor controlled. Internal buffer, full ASCII, RS-232 and 20 ma. nationwide maintenance. Fully described in 6 pages of specs. call or write for copy. From \$1600 FOB

4027, 2104, 4096 75c

INTERSL 4Kx1 DYNAMIC RAM: 300ns, ceramic, low power, P/N 7005-12 equiv to 4027, 2104, 4096. Priced at 1/3 the usual hobby price. Large OEM overstock results in giveaway price. New chips, satisfaction guaranteed. Sold only in original sleeves of 24. \$18 per sleeve, incl. UPS. Full specs with order or on request

**6 OUTPUT POWER SUPPLY  
FLOPPY, EPROM, CPU ETC. \$35**

BRAND NEW NORTH: #3676, sealed boxes. Orig. used in NCR portable terminals. 5V/3A, 24V/1.2A, 16V/2.6A (all adjustable, w/OV prot. & curr. limiting). 12V/0.1A, 24V/0.3A (both w/OV prot.). 12V/0.1A (std.). Fully regulated, conservative linear design, partially encl. w/schts, assy. dwgs. & theory/service docs. 3.5 x 5.5 x 14" 115VAC. Runs an 8" floppy or drop the 16V to 12V and run 2-3 minifloppies. Guaranteed. \$35 ea + 12 lbs. UPS.

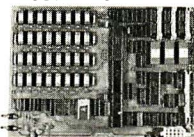
Write/call for info on other surplus bargains. Terminals, printers, power supplies, memory chips, core boards, etc.  
TERMS: UPS COD, Visa, Master Charge on approval. COD - \$2. cards - 4%. NJ add sales tax. Everything guaranteed/warranty to specs. Immediate shipment or immediate refund.

**ELECTRAVALUE INDUSTRIAL**  
P.O. BOX 157-B  
MORRIS PLAINS, NJ 07950



Phone orders  
are welcome.  
201/267-1117

## ONE BOARD CP/M SYSTEM!



only \$750  
Assm., Tested  
& Burned-In  
for one week

### Features:

- 8 1/2 by 12 inches
- 10 MHZ 8085 CPU
- 64K RAM
- 3 RS-232 channels
- 8272 Floppy Disk Controller
- Handles Single/Double Density
- One to Four Drives. 801R or 850R.

Documentation \$15.  
CP/M Floppy Disk Operating System \$150  
Check or Money Order

**autocontrol**  
INCORPORATED

11744 Westline Industrial Drive  
St. Louis, MO 63141  
(314) 432-1313

Circle 311 on inquiry card.

## BELOW DEALERS COST!

**NorthStar**  
North Star Horizon  
(FACTORY TESTED AND ASSEMBLED)

32 K DD - 2295.00  
32 K QUAD - 2600.00  
Immediate Delivery

Application Software	
North Star Pascal \$160.00	NorthWord \$335.00
Info Manager \$395.00	General Ledger \$825.00
Accounts Receivable \$475.00	Mail Manager \$245.00
	Accounts Payable \$475.00
	<b>FREE</b>

**COD - CASH IN ADVANCE - VISA / MASTER CHARGE\***  
\*ADD 4 PERCENT ON CHARGE ORDERS



**CUSTOM BUSINESS COMPUTERS**  
103 ATLANTIC AVENUE, LYNNBROOK, NEW YORK 11563 (516) 887-3340

Circle 312 on inquiry card.

# 16K MEMORY — \$24.00

FOR APPLE - TRS-80 - EXIDY

## 4116 EQUIVALENT

MITSUBISHI 4116 M58759-20 ..... 150 ns 8 for \$ 28.00  
NATIONAL MM5290N-3 ..... 200ns 8 for \$ 24.00

## 2114-300ns

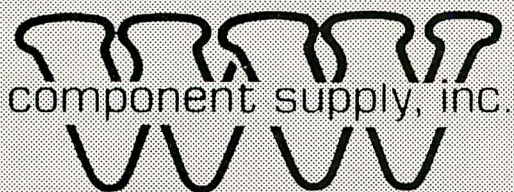
NATIONAL MM2114N-3L ..... 8 for \$ 26.00

# IMSAI COMPATIBLE PRODUCTS

STILL A GREAT DEAL!

I 8080 ENCLOSURE KIT w/o front panel ..... \$ 95.00  
(After March 31, 1981 — \$115.00)  
8015 JUMPSTART FP ..... \$ 32.50  
8035 DUAL SA400 FP ..... \$ 78.50  
PS-28D Improved 28A @ 8V and 3A @  $\pm 16V$  power supply for S-100 kit ... \$ 95.50  
PIO 4-4 4 parallel inputs and outputs ..... \$160.00  
SIO 2-2 2 serial I/O ports, good to 19,200 baud ..... \$175.00  
DIO-C/D 2 board disk controller for 8" or 5 1/4" ..... \$350.00  
CPM 2.2® For DIO including documentation ..... \$175.00  
CPA Improved Imsai style front panel works with Z80, etc. .... \$225.00  
VIO-X Improved video board w/8085 controller, 8275 crt controller, port mapped,  
on board memory, keyboard port ..... \$275.00  
MDX Dual SA400 drive enclosure ..... \$ 75.00  
DE 8 Dual 800R/801R horizontal style enclosure w/power supply and fan \$240.00

Ask about documentation, repair service, firmware and software for your system.



1771 Junction Avenue  
San Jose, California 95112  
(408) 295-7171

TERMS: (1) PREPAID Send check or M.O. for merchandise amount only - we pay the shipping.  
(2) UPS COD or Bankcard orders by phone or mail - shipping charges added.  
California Residents add 6.5% Sales Tax.

**SAVE! SAVE! SAVE!**

We have discounts, free shipping and  
a TOLL FREE NUMBER available  
Call Us! 800/531-7466

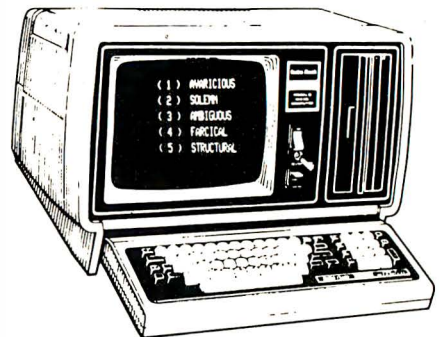
# Pan American Electronics

INCORPORATED

Dept. B  
1117 Conway, Mission, Texas 78572  
TOLL FREE ORDER NUMBER 800/531-7466  
Texas & Principal Number 512/581-2765  
Telex Number 767339

## TRS-80's

Microcomputers



## Radio Shack

AUTHORIZED SALES CENTER



**Q) What should you do if your local computer store doesn't have the products you want?**

**1) GO CRAZY or 2) GO TO HOBBYWORLD**

Hobbyworld Electronics is the nation's leading supplier of mail order electronics. We have thousands of brand name computer products in stock.



### Microsoft Z-80 Softcard \*

Double the versatility of your Apple II\* with the power of a Z-80 Microprocessor. Fully compatible with all Apple II systems. Requires 48K RAM and disk drive. Includes Microsoft BASIC 5.0. Wt. 1 lb. Cat No. 2698

**\$295<sup>00</sup>**

### Datasoft Mychess

The world champion Microcomputer chess game, winner of the Fifth West Coast Computer Faire, can now be enjoyed by Apple II owners. Mychess is the most advanced microcomputer chess game available. Requires any Apple II, 48K, disk, Z-80 softcard and CP/M. Wt. 6 oz. Cat No. 2919

**\$34<sup>95</sup>**

**Special Offer:** Purchase the Z-80 Softcard from this ad and we'll include Datasoft's Mychess at no extra charge! (a \$34.95 value)

- \* Z-80 Softcard is a registered trademark of Microsoft, Inc.
- \* Apple is a registered trademark of Apple Computer
- \* CP/M is a registered trademark of Digital Research

**HOW TO ORDER:** Pay by check, Mastercard, Visa or C.O.D. Charge cards include expiration date and bank no. Add \$1.25 addl. for C.O.D. Include \$2.25 for shipping and handling U.P.S. ground. Prices valid thru month of issue. Not responsible of typographical errors.



## HOBBYWORLD ELECTRONICS, INC.

19511 Business Center Dr. Dept. B3  
Northridge, CA 91324

Call Toll Free: (800) 423-5387

Local & Outside USA: (213) 886-9200

### Free Hobbyworld Catalog

Send for your FREE, 44 page Hobbyworld catalog today! If your local computer store doesn't have something you want, make the right choice... Come to Hobbyworld!

Name \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

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

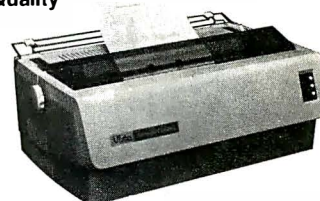
**Immediate  
Shipment  
V-300 Printer**

# VISTA.....

## Your Supermarket For Add-ons and Peripheral Products

### Vista V-300 Daisy Wheel Printer

Letter Quality



- Print Wheel — Industry standard 96-character Daisy Wheel (Including the extended-life dual plastic wheels)
- Printable columns (136)
- Proportional, bi-directional printing
- Interface — Industry standard parallel (RS232-C optional)
- Service - Prompt maintenance/service agreements available nationwide
- Warranty - 90 days parts and labor, one year parts only

V-300-25 .....	\$1895.00
V-300-45 .....	\$2195.00
Tractor Option .....	\$ 300.00

### The Vista V80/800/8000 Family Disk Drive System

- Full compatible with TRS-80, Heath/Zenith
- 120 Day Warranty
- 40 Track Patch at NO CHARGE

V-80 Single drive system (102K) ....	\$ 395.00
V-80 Two drive system (204K) .....	\$ 770.00
V-800 Single drive, B52 drive (204K) .	\$ 595.00
V-800-2 Double drive, B52 drives (408K)	\$1175.00
V-8000 Single drive, B92 drive (408K) .	\$ 775.00
V-8000-2 Double drive B92 drives (816K)	\$1450.00



### The Vista Model II

Totally Compatible with the TRS-80\*  
Model II



- Provides one, two or three drives
- Adds up to 1.5 million bytes of on-line storage
- 120 day warranty
- Does everything Radio Shack's expansion system will do... for less!

Single drive (non-expandable) ....	\$ 900.00
Single drive expansion system ....	\$1000.00
Two drive expansion system .....	\$1550.00
Three drive expansion system ....	\$2100.00
Additional drives alone .....	\$ 525.00

### Vista V-100 Printer ..... \$745.00

- 9 x 7 dot matrix
- 125 cps bi-directional print speed
- 136 column
- Industrial quality

#### Vista Music Machine 9

- NEW! Uses latest State of the Art LSI Technology
- Requires only one slot for 9 voices!
- Uses three AY3-8910's to produce 9 voices
- Plays music generated by the ALF board
- APPLE II™ compatible
- ALF™ software required

**Price:**  
\$129.95

#### Add On Drives

MPI B51	40 Track, Double Density 204K .....	\$275.00
MPI B52	Dual Head, Double Density 408K .....	\$375.00
Siemens	FDD 100-5 40 Track Double Density 204K .....	\$275.00
Siemens	FDD 100-8 8" Single Sided Drive .....	\$448.00
Shugart	801R Single Sided Drive ...	\$448.00

#### Other Products

1. 16K RAM upgrade kits .....	\$ 49.95
2. NEW DOS 80 .....	\$149.00
3. LNW 80 (computer board) .....	\$ 86.95
4. LNW expansion board .....	\$ 66.95
5. H.C. Pennington books:	
TRS-80 DISK AND OTHER MYSTERIES	\$ 18.95
MICROSOFT BASIC DECODER AND OTHER MYSTERIES .....	\$ 27.95

### The Vista V-200 for Exidy

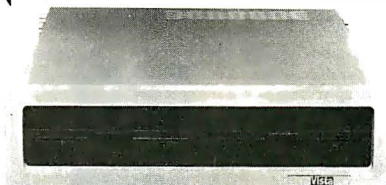
- Completely packaged system, tested and ready to plug in
  - Includes: power supply, two 40 track drives, case, double density controllers, and all cabling and total CP/M™ documentation.
  - Storage capacity from 400K to 1.2 meg.
  - System software-VISTA CP/M Disk Operating System and BASIC-E Compiler recorded on 5 1/4" diskettes
- Price: Starting as low as \$1199.00

S-100 version as low as \$699.00



**NEW**

### The Vista V-1000 Floppy Disk Drive Subsystem



- Deluxe chassis with internal slide allows easy access for drive positioning and mounting.
- Built to mechanically and electrically accommodate single sided drives, double sided drives — including, the most popular 8-inch Winchester and Shugart floppy disk drives, and 8-inch streaming tape cartridge units.

- Storage capacity from 0.5 to 40 megabytes
- Industrial quality cabinet with die cast front bezel
- Meets all UL and OSHA standards
- Additional Savings! Front and rear retma rail mounts provided at no extra charge (no external slides)
- Desk or rack mountable
- Features modular construction with removable sub-assembly that allows easy cabinet positioning and mounting
- Drives pull out for easy service and maintenance

Cabinet .....	\$ 395.00
Cabinet with (2) single sided drives	\$1595.00
(Includes power supply and cable)	
Cabinet with (2) double sided drives	\$2295.00
(Includes power supply and cable)	

# Vista

#### The Vista Computer Company

1317 E. Edinger Avenue, Santa Ana, California 92705, (714) 953-0523

**CALL TOLL-FREE 800-854-8017**

\*TRS-80 is a registered trademark of Radio Shack, a Tandy Corporation

™ Apple is a registered trademark of Apple Computer Co.

™ CP/M is a registered trademark of Digital Research

**apple II plus**

With 48K of memory!

**\$1199**

With the purchase of the APPLE II, select from the below! SPECIAL PRICING!

Base2 printer...\$599<sup>00</sup>  
 Disk II w/cont...\$585<sup>00</sup>  
 Disk II...\$475<sup>00</sup>  
 Ser. Printer Cd...\$179<sup>00</sup>  
 SupRMod...\$23<sup>00</sup>  
 3way I/O Select...\$33<sup>00</sup>  
 Video 100 12"...\$119<sup>00</sup>  
 Firmware Card...\$59<sup>00</sup>  
 UHF to RCA Cable...\$5<sup>00</sup>

**apple II / apple II plus**

With 64K of memory!

**\$1389****APPLE INTERFACE CARDS**

CENTRONICS PRINTER COMMUNICATIONS w/cable \$299  
 DMM II CONTROLLER d.a.a. 1.3 149  
 INTEGER BASIC FIRMWARE 105  
 APPLEJOY FIRMWARE 102  
 PRICAL LANGUAGE PACKAGE 404  
 PARALLEL PRINTER 173  
 PROTOTYPING/HOBBY 98

**COLOR****\$397.00 MONITOR 13"****HEATHKIT®**  
COMPUTER OWNERS  
WE HAVEH47 COMPATIBLE  
DISK OPERATING SYSTEM  
8" Dual Sided, Double Density  
Intelligent MASTER/SLAVEBY REMEX  
FULLY ASSEMBLED AND TESTED!  
**\$2450.00**

74LS00	.26	74LS155	1.15
74LS02	.26	74LS158	.75
74LS03	.26	74LS160	.95
74LS04	.26	74LS161	.85
74LS08	.28	74LS162	.95
74LS09	.26	74LS163	1.60
74LS10	.26	74LS164	.65
74LS20	.26	74LS165	.65
74LS21	.28	74LS170	1.75
74LS22	.26	74LS174	.75
74LS26	.49	74LS175	.75
74LS27	.26	74LS190	.75
74LS30	.28	74LS193	.95
74LS32	.32	74LS195	.95
74LS38	.32	74LS196	.85
74LS42	.65	74LS221	1.40
74LS48	.78	74LS240	1.65
74LS51	.25	74LS241	1.65
74LS54	.35	74LS243	1.45
74LS74	.38	74LS244	1.45
74LS75	.60	74LS245	2.25
74LS83	.44	74LS253	.95
74LS85	.95	74LS257	.95
74LS86	.95	74LS258	.95
74LS90	.69	74LS259	2.85
74LS93	.69	74LS279	.44
74LS107	.45	74LS283	1.00
74LS112	.38	74LS293	1.85
74LS113	.48	74LS298	1.20
74LS122	.48	74LS366	.95
74LS123	.95	74LS367	.55
74LS126	.69	74LS368	.55
74LS131	.69	74LS373	1.39
74LS158	.44	74LS374	1.39
74LS153	.44	74LS386	.65

**APPLE EXPANSION KIT**  
16K Memory Add-OnMEMORY ADD-ON KIT  
INCLUDES INSTRUCTIONS  
**\$39.00****MISCELLANEOUS**

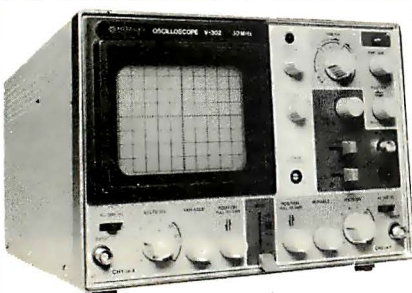
8038C	2.65
NE555V	.27
7905	
7908	
7915	
7918	.85
7805	
7806	
7808	
7812	
MC1330AIP	1.60
MC1350P	1.15
MC1358P	1.50
LM380N	1.75
NE565N	1.25
MC1458P	.50
IS410 SCR	.95
IT410 TRIAC	.95
2114 200ns	3.50
2114L 300ns	3.75
2114L 200ns	4.25
4116 300ns	4.95
4116 200ns	5.45

**video 100****\$125** 12" Leedex Corp

EPROMS	
2708 1k x 8	5.95
8 FOR 40.00	
2716 2k x 8	9.95
single p.s. 8 FOR 80.00	
2732 4k x 8	24.95
2716 2k x 8	6.95
triple p.s.	

**apple clock/calendar**  
**\$124.95**Seconds, minutes, hours, day-of-week month, date, & year.  
On board batteries with one year life.  
Uses MSM5832-crystal controlled.  
California Computer Systems**CONCORD COMPUTER COMPONENTS**  
BUY FIVE OR MORE FOR ... \$18.95 each  
WE CARRY  
T-bar  
SWITCHES1971 SOUTH STATE COLLEGE  
ANAHEIM, CALIF. 92806VISA MASTERCHARGE  
CHECK OR M.O.  
NO C.O.D.  
CAL. RES. ADD 6%  
(714) 937-0637  
MINIMUM ORDER \$10.00  
ADD \$1.50 FOR FRT. ON  
ORDERS UNDER \$50.  
5% IF OVER \$50.**MSM5832 MICROPROCESSOR**  
**\$745**  
**REAL-TIME CLOCK**

The MSM5832 is a monolithic metal gate CMOS integrated circuit that functions as a real time clock/calendar for use in bus-oriented microprocessor applications. The on-chip 32 768 Hz crystal controlled oscillator time base is counted down to provide addressable 4 bit 1.0 data of SECONDS, MINUTES, HOURS, DAY-OF-WEEK, DATE, MONTH, and YEAR. Data access is controlled by 4 bit address chip select read/write and hold inputs. Other functions include 12H/24H format selection, leap year identification and manual ~30 second correction.

**SOROC TECHNOLOGY, INC.**  
**IQ120 \$689****TRS 80**  
16 K Memory Add-On**\$4395**  
KIT CONTAINS  
DIP SWITCHES  
AND DETAILED  
INSTRUCTIONS**No "Glitches", Surges  
Or Interference**  
THE MP017 TURNS AN  
ORDINARY OUTLET INTO A  
CONTROLLED FILTERED  
POWER SOURCE FOR UP  
TO EIGHT DEVICES.  
**\$87.90****Dual Trace Oscilloscope****HITACHI 30 MHz**

- TV sync-separator circuit
- High-sensitivity 1mV/div (5MHz)
- Sweep-time magnifier (10 times)
- Z-axis input (Intensity modulation)
- Signal delay line
- X-Y operation
- Trace Rotation

Model V302B  
**\$995****More sensitive to your input****EPROMS****2708 2716**  
\$490 \$790**2114L** (450ns) \$375**4116** (200ns) \$375**ANCORNA SPECIAL****64K Dynamic RAM**  
HM4864.....\$97.00Quite Portable  
Very Affordable  
and UnbelievableVersatile  
the PET computer may  
very well be a  
lifetime investment....

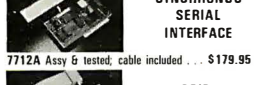
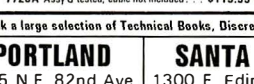
- Large Keyboard
- Separate Numeric Pad
- Graphics on Keys

Order No.  
2001-16N  
**\$995**

California Computer Systems	
32K STATIC RAM MODULE (ASSEMBLED AND TESTED)	
2032A 450ns RAM	\$710.00
2032B 300ns RAM	795.00
2032C 200ns RAM	830.00
64K DYNAMIC RAM MODULE (ASSEMBLED AND TESTED)	
2065C 200ns RAM	\$700.00
16K STATIC RAM MODULE (ASSEMBLED AND TESTED)	
2116A 450ns RAM	\$349.95
2116B 300ns RAM	389.95
2116C 200ns RAM	399.95

**MAINFRAME**2200A Assy and Tested...\$399.95  
2200K Complete Kit...349.95  
Note: Spec. color-Black/Blue, Brown, Office Cream, or Grey.**FLOPPY DISK CONTROLLER**2422A Assy & Tested...\$400.00  
4-Port Serial I/O Interface  
2710A Assy & Tested...\$340.00**Serial/Parallel I/O Interface**2718A Assy & Tested...\$360.00  
4-Port Parallel I/O Interface  
2720A Assy & Tested...\$250.00**Z-80™ CPU**

2810A Assy &amp; Tested...\$300.00

**PROGRAMMABLE TIMER**  
7440A Assembled and Tested...\$114.95**PARALLEL INTERFACE**  
7720A Assy & test; cable & std. firmware...\$119.95  
7720B Assembled and tested; cable & Centronics-type firmware included...\$119.95**ARITHMETIC PROCESSOR**  
7811B Assembled and tested; CCoast diskette included (Compatible with Apple II™ computers with a disk drive)...\$399.95  
7811C Assembled and tested; CCoast ROM included (Compatible with Apple II PLUS™ computers and Apple II™ computers with an Applesoft™ card)...\$399.95**CALENDAR/CLOCK MODULE**  
7424A Assy & Tested. Less batt...\$125.00**ASYNCHRONOUS SERIAL INTERFACE**  
7710A Assy & tested; cable included...\$159.95**SYNCHRONOUS SERIAL INTERFACE**  
7712A Assy & tested; cable included...\$179.95**GPIB (IEEE-488) INTERFACE**  
7490A Assy & tested; cable included...\$300.00**CENTRONICS™ PRINTER INTERFACE**  
7728A Assy & tested; cable not included...\$119.95**★ 16% ★  
DISCOUNT  
COUPON**Bring this COUPON into one of four stores or  
mail to our Mail Order address shown below  
and receive a **10% DISCOUNT**  
on purchases from this Ad of \$100.00 or more.  
**Offer EXPIRES on March 31, 1981**NAME.....  
ADDRESS.....  
CITY..... STATE.....  
ZIP..... PHONE NO.....

Coupons accepted only with full name and address filled in.

**ANCORNA**  
STORES DO NOT ACCEPT MAIL ORDERS  
**MAIL ORDER**

P.O. BOX 2208Y CULVER CITY, CA 90230

**PHONE ORDERS (213) 641-4064**

Minimum Order \$10.00. Add \$2.00 to cover postage and handling. MasterCharge and VISA welcomed. Please include your charge card number, interbank number and expiration date. Some items are subject to prior sale. Not responsible for typos. Store pricing may vary from Mail Order pricing. We reserve the right to substitute manufacturers.

VISIT A STORE NEAR YOU TODAY - We stock a large selection of Technical Books, Discrete Components, Integrated Circuits, Test Equipment and Electronic Supplies.

ATLANTA	CULVER CITY	HOUSTON	PORTLAND	SANTA ANA	SUNNYVALE	TUCSON
3330 Piedmont Rd. N.E. Atlanta, GA 30305 (404) 261-7100	11080 Jefferson Blvd. Culver City, CA 90230 (213) 390-3595	2649 Richmond Houston, TX 77098 (713) 529-3489	1125 N.E. 82nd Ave. Portland, OR 97220 (503) 254-5541	1300 E. Edinger Ave. Santa Ana, CA 92705 (714) 547-8424	1054 E. El Camino Real Sunnyvale, CA 94087 (408) 243-4121	4518 E. Broadway Tucson, AZ 85711 (602) 881-2348



## THE STAR MODEM

From Livermore Data Systems

RS232 MODEM	SALE \$135
IEEE 488 MODEM	SALE \$245
RS232 CCITT	\$170
IEEE 488 CCITT	\$280

STAR Modem is the price performance leader with a full 2 YEAR FACTORY WARRANTY.



## WE CARRY THE BLACK APPLE



BELL & HOWELL

MADE EXCLUSIVELY FOR BELL & HOWELL BY



apple computer inc.

### EBS Business System for PET/CBM

Extremely comprehensive package for small business. Fully integrated inventory and accounts receivable system including invoices, packing slips, mail labels, statements, bank deposit slips, and 17 reports. Allows any of 10 standard letters to be merged with customer record info on either a selective or complete file basis. Demo disk and system description available for \$3.00.

### Paper-Mate Word Processor

\$29.95

PET/CBM full featured 60 command system by Michael Riley. Uses either tape or disk and any printer. Includes in-text commands, floating cursor, scrolling, etc.

### KMMM Pascal for PET

\$75

Subset of standard Pascal with true machine language translator for faster execution. 16K with tape or disk.

### EARL for PET (disk file based)

\$65

Editor, Assembler, Relocator, Linker to generate relocatable object code.

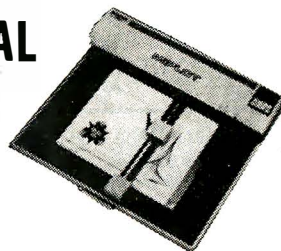
### fullFORTH+ for PET/CBM

\$65

A full-featured FORTH with extensions conforming to Forth Interest Group standards. Includes assembler, string processing capabilities, disk virtual memory multiple dimensioned arrays, floating point and integer processing.

## MIPlot Intelligent Plotter by Watanabe Instruments (Digiplot)

**SPECIAL  
\$1145**



Has all intelligent functions for producing graphs and drawings including 8 vector and 4 character commands. Solid and broken lines can be specified. Character generator for alpha, numeric, and symbols. Characters can be rotated in 4 orientations, and can be 16 sizes. Coordinate axes drawn by specifying graduation interval and number of repetitions. Parallel ASCII interface, 11 x 17 paper.

### FLEX-FILE Data Base for CBM/PET

\$60

Random file handling system with Report Writer and Mail Label Handler. By Michael Riley

## DISKS

(write for quantity prices)



SCOTCH (3M) 5 1/4"	10/2.90	50/2.80	100/2.70
SCOTCH (3M) 8"	10/2.95	50/2.85	100/2.75
Maxell 5 1/4"	10/4.25	50/4.10	100/3.95
Maxell 8" Disks	10/4.65	50/4.50	100/4.35
Verbatim 5 1/4"	10/2.45	50/2.40	100/2.35
(add 1.00 for Verbatim 5 1/4" plastic storage box)			
Verbatim 8" Dbl. Dens.	10/3.45	50/3.35	100/3.25
BASF 5 1/4"	10/2.60	20/2.50	100/2.40
BASF 8"	10/2.65	20/2.55	100/2.45
Diskette Storage Pages			10 for 3.95
Disk Library Cases	8" - 2.85	5 1/4" - 2.15	

6502	7.45	10/6.95	50/6.55	100/6.15
6502A	8.40	10/7.95	50/7.35	100/6.90
6520 PIA	5.15	10/4.90	50/4.45	100/4.15
6522 VIA	6.45	10/6.10	50/5.75	100/5.45
6532	7.90	10/7.40	50/7.00	100/6.60
2114-L450	3.45	20/3.35	100/3.25	
2114-L200	4.15	20/3.95	100/3.75	
2716 EPROM (5 volt)	9.90	5/9.45	10/8.90	
TMS 2532 EPROM			23.50	
4116-200 ns RAM			8 for 30.00	
S-100 Wire Wrap			2.65	

### CASSETTES - AGFA PE-611 PREMIUM

High output, low noise, 5 screw housing, labels.  
C-10 10/5.65 50/25.00 100/48.00  
C-30 10/7.30 50/34.00 100/66.00  
All other lengths available. Write for price list.



commodore



### CBM-PET SPECIALS

**FREE** Up to \$235 FREE merchandise with purchase of one of following CBM-PET items!

	FREE
8032 32K - 80 column CRT	\$1795 235
8050 Dual Disk Drive - 1 megabyte	1795 235
8N Full size graphics keyboard	795 75
16K Business or Graphic Keyboard	995 150
32K Business or Graphic Keyboard	1295 205
2040 Dual Disk Drive - 343,000 bytes	1295 205
2022 Tractor Feed Printer	795 100
C2N External Cassette Deck	95 12
CBM Voice Synthesizer	395 50

### WRITE FOR SYSTEM PRICES

### \*\*\*EDUCATIONAL DISCOUNTS\*\*\*

Buy 2 PET/CBM Computers, receive 1 FREE

WordPro 3 - 32K CBM, disk, printer	170
WordPro 4 - 8032, disk, printer	255
OZZ Data Base System for CBM 8032	335
VISICALC for PET, ATARI	170
BPI General Ledger, A/P, A/R for PET/CBM	270
Programmers Toolkit - PET ROM Utilities	34.90
2 Meter IEEE to IEEE Cable	43.00
PET Spacemaker Switch	24.90
Dust Cover for PET	6.90
IEEE-Parallel Printer Interface for PET	105
IEEE-RS232 Printer Interface for PET	149
The PET Revealed	17.00
Library of PET Subroutines	17.00

### Source Hookup

88

Over 1000 programs and services available.



## ATARI 800 \$777

All Atari Modules 20% OFF

### ATARI EDUCATIONAL PLAN

Write for details.

**A P Products 15% OFF**

**A P Hobby-Blox 15% OFF**



### ALL BOOK and SOFTWARE PRICES DISCOUNTED

The 8086 Book (Osborne)	\$12.75
Z8000 Assembly Language Programming	\$10.60
PET Personal Computer Guide (Osborne)	\$12.75
PET and the IEEE-488 Bus (Osborne)	\$12.75
6502 Assembly Language (Osborne)	\$ 9.90
Programming the 6502 (Zaks)	\$10.45
6502 Applications Book (Zaks)	\$10.45
6502 Software Cookbook (Scelbi)	\$ 9.45
CP/M Handbook (w/ MP/M) Zaks	\$11.85

### WRITE FOR CATALOG.

Add \$1.25 per order for shipping. We pay balance of UPS surface charges on all prepaid orders. Prices listed are on cash discount basis. Regular prices slightly higher.

115 E. Stump Road  
Montgomeryville, PA 18936

215-699-5826 **A B Computers**

### HICKOK DIGITAL MULTIMETERS



DMM +Var-Pitch +Logi-Trax MX-333 **\$210.**

Model LX304 **\$7950**

Model LX303 **\$6950**

### VIZ Tech DMM 3 1/2-Digit LCD Readout

Model WD 747 **\$7995**

### BK PRECISION 15 MHz Miniscope

■ Rise time 11.7 nS or less ■ Built-in signal delay line ■ Flat response



Model 1420

### Dual Trace 5" 30 MHz Triggered Scope

Model 1479A

### Autorangeing DMM

Model 2845

### Digital Pulsar Probe

Model DP-100

### 50 MHz Pulsar Probe

Model DP-50

### 3 1/2-Digit 0.1% Digital Capacitance Meter

Model 3001 **\$23375**

### Function Generator

Model 2001 **\$15795**

### Proto Boards

Model PB-104 Fully assembled **\$5995**

### Logic Monitor

• Automatically displays static and dynamic logic • Works with DTL, HTL, TTL, and CMOS

Model LM-1 **\$5995**

### Touch/Test 20 Multimeter

Model TT20

A portable/bench-type meter

### 15 MHz Dual Trace Triggered Miniscope

Model MS-215

### 30 MHz Dual Trace Triggered Miniscope

Model MS-230

## YOU NAME IT...WE GOT IT. AND AT DISCOUNT PRICES.

SEND FOR FREE 180 PAGE CATALOG.

### Beckman DIGITAL MULTIMETERS



Model TECH 300 **\$10995**

Model TECH 310 **\$14000**

Model TECH 330 **\$19995**

### Simpson DIGITAL MULTIMETERS

Model 462 **\$19995**

Model 463 **\$16995**



### 260 Meter

Model 260-7 **\$96.**

Complete with nickel-cadmium batteries, AC charger/adaptor, test leads

### BSR X-10



Remote Control for Lights & Appliances

PK 400 4 Pc Standard Starter Kit • One (1) Standard Command Console • Two (2) Lamp Modules • One (1) Appliance Module **\$7499**

PK500 5 Pc Ultrasonic Starter Kit • One (1) Deluxe Ultrasonic Command Console • One (1) Hand Held Remote Unit • Two (2) Lamp Modules • One (1) Appliance Unit **\$9995**

LMS01 Lamp Module **\$13.95**

AM601 Appliance Module **\$13.95**

WS701 Wall Switch Module **\$13.95**

WS711 Wall Switch Module with independent On-Off power buttons **\$15.95**

### The Timer

Model TC201 **\$5995**

### MURAPHONE Cordless Telephone System

Model 300 **\$110.**



### Miniature High Fidelity 3-Way Stereo Speakers

Model HF-9 **\$5995**

### In-Dash Car Stereos

8-Track AM/FM **\$5250**

Model JCS 420

Cassette AM/FM **\$5750**

Model JCS 505

Digital Cassette AM/FM with Clock **\$8995**

Model JCS 607

### Graphic Equalizer

Model GE 5000 **\$3995**



### LUXO Magnifier Lamp



Precision ground and polished magnification lens

Model LFM-1A **\$65.**

### FIDELITY Chess Challenger 7

Model BBC **\$7995**



### Sensory Chess Challenger

**\$110.**

### Voice Sensory Challenger

**\$24995**

### Weller WTCPN Controlled Output Soldering Station

Model WTCPN **\$5750**



### Soldering Station

Model EC 2000 **\$10950**

### VACO Super Gase

Model 70260 **\$24995**



### Wah! Cordless Soldering Iron

Model 7800 **\$2995**



### Thermal-Spat Circuit Tester

Finds faulty components quickly and easily

Model 5800 **\$2995**



### Casio Calculator-Calendar Watch

Model C-80 **\$4250**



### Service Master Tool Kit

Model 99-SM **\$4995**



### 6x9 3-Way Speakers

20 oz. magnet

Model BP2000-69 TRD **\$1295 ea.**

## FORDHAM

855 Conklin St. Farmingdale, N.Y. 11735

- Master Charge
- BankAmericard
- VISA • C.O.D.
- Money Order
- Check

N.Y. State residents add appropriate sales tax.

**TOLL FREE (800) 645-9518**

in N.Y. State call (516) 752-0050

# Add-On Disk Drive Subsystems For Apple, TRS-80, S-100 Based Computers

Expansion and enhanced capabilities are key words in achieving full utilization of your computer system. Our complete line of LOBO disk drive subsystems are the ideal, cost-effective way to provide the expansion capabilities you need to meet your system growth requirements. All of our subsystems are complete, thoroughly-tested, 100% burned-in, and feature a 1 year 100% parts/labor warranty.

## APPLE

3101	Minifloppy, 3101i Minifloppy w/interface card
8101CA	One SA800 in cabinet w/power, DDC* Controller, cable and manual
8202CA	Two SA800 in cabinet w/power, DDC* Controller, cable and manual
5101CA	One SA850 in cabinet w/power, DDC* Controller, cable and manual
5202CA	Two SA850 in cabinet w/power, DDC* Controller, cable and manual
*Double Density Controller	

## S-100 BASED COMPUTERS

MODEL NO.	DESCRIPTION
4101C	SA400 in cabinet w/power
8212C	Two SA801 in cabinet w/power
5212C	Two SA851 in cabinet w/power

## GENERAL

MODEL NO.	DESCRIPTION
8212	Two SA801 in cabinet
8212C	Two SA801 in cabinet w/power
5212	Two SA851 in cabinet
5212C	Two SA851 in cabinet w/power

## TRS80

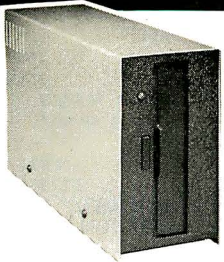
MODEL NO.	DESCRIPTION	MODEL NO.	DESCRIPTION
4101C	SA400 in cabinet w/power	C808	Cable for TRS80 Eight-inch Floppy
8101C II	One SA800 in cabinet w/power for Mod. II	LX80	Double-density expansion interface
8202C II	Two SA800 in cabinet w/power for Mod. II	RS232	Dual Serial Port Option
C802	Cable for Mod. II	16K	16K Byte RAM for LX80 (32KB max.)
C805	Cable for TRS80 Minifloppy	VTOS	4.0 Disk Operating System

**JR**

## INVENTORY CO.,

P.O. Box 185, Santa Ynez, Ca., 93460  
(805) 688-8781

# WE WILL NOT BE UNDERSOLD



## DISK DRIVES

**\$314**

40 track, 102K Bytes. Includes power supply and TRS-80\* compatible silver enclosure. Ready to plug-in and run the moment you receive it. Can be intermixed with each other and Radio Shack drive on same cable. 90 day warranty. One year on power supply. Available for 220 Vac (50 Hz) operation. **External card edge included.**

### FOR TRS-80\*

CCI-100 TEAC	5 1/4", 40 Track (102K Bytes) for Model I	<b>\$314</b>
CCI-100 MPI	5 1/4", 40 Track (102K Bytes) for Model I	<b>\$319</b>
CCI-280	5 1/4", 80 Track (204K Bytes) for Model I	<b>\$429</b>
<b>For Zenith Z89</b>		
CCI-189	5 1/4", 40 Track (102K Bytes) add-on drive	<b>\$394</b>
Z-87	Dual 5 1/4" add-on drive system	<b>\$995</b>

## NEW • S-100 CCS CARDS

MAINFRAME, Z-80 CPU, CONTROLLER,  
RAM, and 2P + 2S CARDS

**\$CALL**

## 8" SHUGART SA801R DISK DRIVES **\$425**

## DISK OPERATING SYSTEMS

PATCHPAK #4 by Percom Data	<b>\$ 8.95</b>
CP/M® for Model I, Zenith	<b>\$145</b>
NEWDOS Plus 40track	<b>\$79</b>
for Model II, Altos	<b>\$169</b>
NEWDOS 80	<b>\$135</b>

## DISKETTES — Box of 10 with plastic library case

5 1/4" Scotch	<b>\$35</b>	Maxell	<b>\$40</b>	BASF/Verbatim	<b>\$24</b>
8" Scotch	<b>\$50</b>	Maxell	<b>\$55</b>	BASF/Verbatim	<b>\$36</b>
CLEAR PLASTIC CASE—Holds 50 5 1/4" diskettes					
<b>\$19</b>					

## COMPLETE SYSTEMS

ALTOS ACS8000 Computers	<b>\$CALL</b>
APPLE II-16K	<b>\$1075</b>
•	
APPLE III-96K	<b>\$3749</b>
Call for other Apple products	
TRS-80* Model II-64K	<b>\$3499</b>
•	
Model III-16K	<b>\$899</b>
Used TRS-80* Model I Computers, tested and guaranteed	<b>\$CALL</b>
ZENITH Z89, 48K all-in-one computer	<b>\$2395</b>
ZENITH Z19	<b>\$735</b>
TELEVIDEO 920C	<b>\$748</b>
ATARI 400	<b>\$479</b>
•	
ATARI 800	<b>\$769</b>
APF Game Only	<b>\$95</b>
•	
Complete System	<b>\$489</b>
MATTEL INTELLIVISION	<b>\$229</b>

## MONITORS

LEEDEX	12" B & W Video 100	<b>\$129</b>
ZENITH	13" Color	<b>\$379</b>
SANYO	9" B & W VM4509	<b>\$155</b>
SANYO	12" B & W DM5012	<b>\$226</b>
SANYO	12" Green Screen DM5112	<b>\$238</b>
SANYO	13" Color DMC6013	<b>\$416</b>
APF	9" B & W TVM-10	<b>\$120</b>

## TELECOMMUNICATIONS

LIVERMORE STAR MODEM 2-year guarantee	<b>\$145</b>
UNIVERSAL DATA SYSTEMS UDS-103	<b>\$179</b>
D-CAT HARD WIRED DIRECT MODEM	<b>\$189</b>
AUTO-CAT Auto Answer, Direct Connect Modem	<b>\$229</b>

## PRINTERS



## NEC Spinwriter

### Letter Quality High Speed Printer

Includes TRS-80\* interface software, quick change print fonts, 55 cps, bidirectional, high resolution plotting, graphing, proportional spacing: R.O.

**\$2395**

R.O. with Tractor Feed **\$2595** KSR with Tractor Feed **\$2895**

C.I.TOH Starwriter, 25 CPS, daisy wheel printer **\$1795**

C.I.TOH Starwriter II, 45 CPS, daisy wheel printer **\$1995**

Letter quality printers. Use up to 15" paper. 1 year warranty on parts. 3 months on labor. Proportional spacing and bidirectional printing. Same as VISTA V300.

EPSON MX-80 **\$CALL**

PAPER TIGER IDS 445 Graphics and 2K buffer **\$699**

IDS 460 Bidirectional, 160 cps, graphics and 2K buffer **\$1050**

IDS 560 132 Columns, graphics **\$1599**

ANADEx DP-9500/01 **\$1345** DP-8000 **\$849**

OKIDATA Microline 80 Friction and pin feed **\$499**

Tractor Feed, friction, and pin feed **\$625**

Microline 82 Bidirectional, friction and pin feed **\$719**

Microline 83 Bidirectional, 120 cps, uses up to 15" paper **\$995**

### CENTRONICS

737 Friction & pin feed **\$780**

730 Friction & pin feed **\$595**

779 Tractor feed **\$969**

EATON LRC 7000+ 64 columns, plain paper **\$269**

TI-810 Includes TRS-80\* software and

Compressed print, vertical form control **\$1865**

## 16K RAM KITS

**2 for \$56**

**\$30**

200 ns for TRS-80\*, Apple II, (specify): **Jumpers**

**\$2.50**

## ACCESSORIES

Z-80 SOFTCARD: Your key to software expansion. The plug-in Z-80 Softcard transforms your Apple into a Z-80 while keeping all the benefits of the 6502. Comes with CP/M in two disk format, MBASIC and GBASIC, full documentation and utility programs. **\$339.00**

SCOTCH HEAD CLEANING DISKETTE: Cleans drive

Read/Write head in 30 seconds; specify 5 1/4" or 8". **\$25.00**

FLOPPY SAVER: Protection for center holes of 5 1/4" floppy

disks. Installation tools and rings for 25 diskettes. **\$ 11.95**

Re-orders of rings only **\$ 6.95**

VIDEX BOARD 80 Column, U/L case conversion card **\$279.00**

CRT FILM: Helps eliminate external glare, 9" **\$ 29.00**

RF MODULATOR: Adapts video to TV **\$ 29.00**

TRS-80 & OTHER MYSTERIES **\$ 18.95**

NEC SPINWRITER THIMBLE **\$11.95** RIBBON **\$ 6.00**

CCS CARDS: Parallel or serial printer interface cards **\$115.00**

RS232: For Radio Shack Interface. **\$ 84.00**

DISK-DRIVE EXTENDER CABLES: Fits all mini-disk drives. **\$ 16.95**

SIX (6) PRONG ISOLATOR: ISO-2 **\$ 54.00**

AC FILTER/6 PRONG POWER STRIP **\$ 39.00**

DISK DRIVE CABLES: 2 drive **\$29.00** 4 drive **\$ 35.00**

DUST COVERS: TRS-80/Apple **\$ 7.95**

PLASTIC DISKETTE HOLDER: For ring binder, holds 20 **\$ 8.00**

## COMMUNICATIONS SOFTWARE

### CCI-TELNET COMMUNICATIONS PACKAGE:

Communications with mainframes and micros. CP/M compatible

**\$149.00**

For fast delivery, send certified checks, money orders or call to arrange direct bank wire transfers. Personal or company checks require two to three weeks to clear. All prices are mail order only and are subject to change without notice.

**DEALER (NATIONAL/INTERNATIONAL) INQUIRIES INVITED**

**Send for FREE Catalogue**

# The CPU SHOP

**TO ORDER CALL TOLL FREE 1-800-343-6522**

**TWX: 710-348-1796** Massachusetts Residents call 617/242-3361

5 Dexter Row, Dept. B03M  
Charlestown, Massachusetts 02129  
Hours 10AM-6PM (EST) Mon.-Fri. (Sat. till 5)

Technical Information call 617/242-3361  
Massachusetts Residents add 5% Sales Tax  
Tandy Corporation Trademark® Digital Research





### CALIFORNIA COMPUTER SYSTEMS

32K RAM BOARD A&T.  
450 NSEC .....\$579.95, 200 NSEC .....\$629.95  
16K RAM A&T.  
450 NSEC .....\$255.95, 200 NSEC .....\$285.95  
64K DYNAMIC A&T.  
200 NSEC .....\$579.95  
Z80 PROCESSOR A&T. ....\$259.00  
DISC CONTROLLER .....\$339.95  
APPLE IEEE INSTRUMENTATION INTERFACE  
KIT 7490. A & T .....\$275.00  
ARITHMETIC PROCESSOR FOR APPLE 7811A.  
A & T .....\$342.80  
APPLE ASYNCHRONOUS SERIAL INTERFACE  
7710A. A & T .....\$137.10  
APPLE SYNCHRONOUS SERIAL INTERFACE  
7712A. A & T .....\$153.95  
ALL OTHER CCS PRODUCTS AVAILABLE



PB-1 2708 & 2716 Programming Board with provisions for 4K or 8K EPROM. No external supplies required. Textool sockets. Kit .....\$143.00  
CB-1A 8080 Processor Board. 2K of PROM 256 BYTE RAM power on/rest Vector Jump Parallel port with status. Kit .....\$146.00 PCBD .....\$31.95  
VB-3 80x24 VIDEO BOARD. Graphics included. 4MHZ. Kit .....\$379.95  
IO-4 Two serial I/O ports with full handshaking 20/60 ma current loop; Two parallel I/O ports. Kit .....\$168.00 PCBD .....\$31.95  
VB-IC 64 x 16 video board, upper lower case Greek composite and parallel video with software. S-100. Kit .....\$143.00  
CB-2 Z80 CPU BOARD. Kit .....\$199.95  
AIO APPLE SERIAL/PARALLEL Kit .....\$144.95  
ALL OTHER SSM PRODUCTS AVAILABLE



### WAMECO INC.

MEM-3 32K STATIC RAM 2114 24 bit addressing .....\$36.95  
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 .....\$43.95  
FPB-1 Front Panel. IMSAI size, hex displays. Byte, or instruction single step. PCBD .....\$48.50  
QM-12 MOTHER BOARD. 13 slot, terminated, S-100 board only .....\$39.95  
CPU-1 8080A Processor board S-100 with 8 level vector interrupt. PCBD .....\$28.95  
RTC-1 Realtime clock board. Two independent interrupts. Software programmable. PCBD .....\$25.95  
EPM-2 2708/2716 16K/32K EPROM CARD. PCBD .....\$28.95  
QM-9 MOTHER BOARD. Short Version of QM-12. 9 Slots. PCBD .....\$33.95  
MEM-2 16K x 8 Fully Buffered 2114 Board. PCBD .....\$28.95  
PTB-1 POWER SUPPLY AND TERMINATOR BOARD. PCBD .....\$28.95  
IOB-1 SERIAL AND PARALLEL INTERFACE. 2 parallel, one serial and cassette. PCBD .....\$28.95  
2708 .....\$7.50 2114L 450 NSEC .....\$4.99  
2716 .....\$25.95 2114L 200 NSEC .....\$5.99

### MARCH SPECIAL SALE ON PREPAID ORDERS

(Charge cards not included on this offer)

**A & T 8K x 8 RAM BOARD SALE**  
ON SSM, MB-6B, PCBD .....\$74.95  
ON WAMECO MEM-1, PCBD .....\$74.95  
450 NSECONDS ASSEMBLED AND TESTED.  
PART MAY BE REMARKS. 2.5 AMPS TYPICAL.

**WAMECO PCBD**  
IOB-1. CPU-1 .....\$24.95 EA.  
PTB-1. RTC-1 .....\$22.95 EA.

**MIKOS PARTS ASSORTMENT WITH WAMECO AND CYBERCOM PCBDS**  
MEM-3 less RAM .....\$ 95.95  
With 2114L-4 .....\$350.00  
With 2114L-2 .....\$390.00  
CPU-1 with MIKOS #2 8080A CPU .....\$99.95  
QM-12 with MIKOS #4 13 slot mother board .....\$110.95  
RTC-1 with MIKOS #5 real time clock .....\$65.95  
EPM-2 with MIKOS #11 16-32K EPROMS less EPROMS .....\$65.95  
QM-9 with MIKOS #12 9 slot mother board .....\$99.95  
FPB-1 with MIKOS #14 all parts for front panel .....\$144.95  
MIKOS PARTS ASSORTMENTS ARE ALL FACTORY MARKED PARTS. KITS INCLUDE ALL PARTS LISTED AS REQUIRED FOR THE COMPLETE KIT LESS PARTS LISTED. ALL SOCKETS INCLUDED.  
**LARGE SELECTION OF LS TTL AVAILABLE**  
PURCHASE \$50.00 WORTH OF LS TTL AND GET 10% CREDIT TOWARD ADDITIONAL PURCHASES.  
PREPAID ORDERS ONLY.

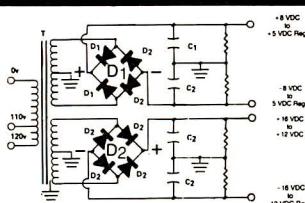
VISA or MASTERCHARGE. Send account number, interbank number, expiration date and sign your order. Approx. postage will be added. Check or money order will be sent post paid in U.S. If you are not a regular customer, please use charge, cashier's check or postal money order. Otherwise there will be a two-week 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.



(415) 728-9121

P. O. Box 955 • El Granada, CA 94018

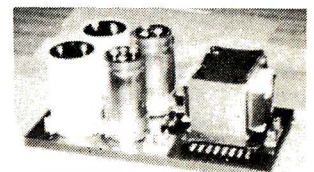
Please send for IC, Xistor and Computer parts list



## BUILD YOUR OWN LOW COST

## MICRO-COMPUTER POWER SUPPLIES

FOR S-100 BUS, FLOPPY DISKS, 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 Vac	2 x 24 Vac		
T1	1	0V, 110V, 120V	2 x 7.5A	2 x 2.5A	—	3 3/4" x 3 3/4" x 3 3/4"	21.95
T2	2	0V, 110V, 120V	2 x 12.5A	2 x 3.5A	—	3 3/4" x 4 1/2" x 3 3/4"	27.95
T3	3	0V, 110V, 120V	2 x 9A	2 x 2.5A	2 x 2.5A	3 3/4" x 4 1/2" x 3 3/4"	29.95
T4	4	0V, 110V, 120V	2 x 4A	(28V, CT)	48V, CT, @3A	3 3/4" x 3 3/4" x 3 3/4"	22.95
T5	—	0V, 110V, 120V	2 x 3A	2 x 2A	—	3" x 3" x 2 1/2"	14.95

### POWER SUPPLY KITS (OPEN FRAME WITH BASE PLATE, 3 HRS. ASSY. TIME)

ITEM	USED FOR	@ +8 Vdc	@ -9 Vdc	@ +16 Vdc	@ -16 Vdc	@ +28 Vdc	SIZE W x D x J	UNIT PRICE
KIT 1	15 CARDS SOURCE	15A	—	2.5A	2.5A	—	12" x 5" x 4 1/2"	52.95
KIT 2	SYSTEM SOURCE	25A	—	3A	3A	—	12" x 5" x 4 1/2"	59.95
KIT 3	DISK SYSTEM	15A	1A	2A	2A	4A	14" x 6" x 4 1/2"	67.95

**DISK SYSTEM PWR SUPPLY "S3"** ASSY. & TESTED, OPEN FRAME, SIZE 10"(W) x 6"(D) x 4 1/2"(H) .....\$92.95  
UNREGULATED OUTPUTS: +8V@15A, ±16V@3A.

REGULATED OUTPUTS: +5V@3A, -5V@1A, +24V@4A, SHORTS PROTECT. IDEAL FOR THE SYSTEM WITH 12 SLOTS MAINFRAME & TWO 8" DISK DRIVES, SUCH AS SHUGART 801R OR SIEMANS FDD 100-8. (OPTION: OVP for +5V @ ADD \$5.00)

**DISK DRIVE POWER SUPPLY "R3"** ASSY. & TESTED, OPEN FRAME, SIZE 9"(W) x 6 1/4"(D) x 4 1/2"(H) .....\$67.95  
SPECS: +5V @ 5A REGUL, OVP, -5V @ 1A REG., +24 @ 5A REG., SHORTS PROTECT. OPTIONS: 1. REPLACE +24V BY +12V

2. ADD ±12V @ 1A, \$12.00 MORE.

IDEAL FOR 2 SHUGART 801/851 OR SIEMANS FDD 100-8/200-8 DISK DRIVES & ROCKWELL AIM-65.

SHIPPING FOR EACH TRANSFORMER: \$4.75. FOR EACH POWER SUPPLY: \$5.00 IN CALIF. \$7.00 IN OTHER STATES. CALIF. RESIDENTS ADD 6% SALES TAX. OEM WELCOME.

### SUNNY INTERNATIONAL

(TRANSFORMERS MANUFACTURER)

(213) 328-2425 MON-SAT 9-6

SHIPPING ADDRESS:  
22129 1/2 S. VERMONT AVE  
TORRANCE, CA 90502

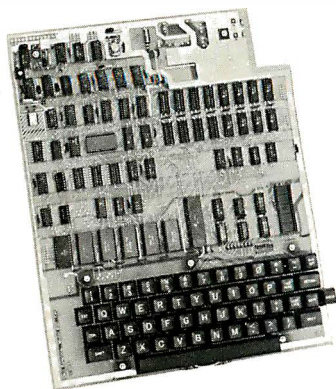


MAILING ADDRESS:  
P.O. BOX 4296  
TORRANCE, CA 90510



# HOT WINTER PRICES ON PERSONAL COMPUTERS AND COMPONENTS.

## Look at this!



## Ohio Scientific Superboard II \$299

- It's the first complete computer system on a board.
- Superboard II uses the ultra powerful 6502 Microprocessor
- 8K Microsoft BASIC-in-ROM
- 4K static RAM on board, expandable to 8K
- Full 53-key keyboard, with upper and lower case. Plus user expandability.
- Video interface and audio cassette interface.

The Ohio Scientific Superboard II at \$299 — in today's economy — has got to be the best buy by far. It will entertain you with spectacular graphics made possible by its ultra high resolution graphics and super fast BASIC. It will help you in school or industry, as an ultra powerful scientific calculator. Advanced scientific functions and a built-in "immediate" mode allow you to solve complex problems without programming.

The Superboard II can be expanded economically, for business uses, or to remotely control your home appliances and security. Even communicate with other computers.

### Read what's been written about Superboard II:

"We heartily recommend Superboard II for the beginner who wants to get into microcomputers with a minimum cost. A real computer with full expandability."

—POPULAR ELECTRONICS, MARCH 1979

"The Superboard II is an excellent choice for the personal computer enthusiast on a budget."

—BYTE, MAY 1979

## Look at these easy hardware prices:

<b>610 Board</b> For use with Superboard II and Challenger 1P. 8K static RAM. Expandable to 24K or 32K system total. Accepts up to two mini-floppy disk drives. Requires +5V @ 4.5 amps.	<b>\$ 298</b>
<b>Mini-Floppy Disk Drive</b> Includes Ohio Scientific's PICO DOS software and connector cable. Compatible with 610 expander board. Requires +12V @ 1.5 amps and +5V @ 0.7 amps. [Power supply & cabinet not included.]	<b>299</b>
<b>630 Board</b> Contact us for important details.	<b>229</b>
<b>AC-3P</b> 12" combination black and white TV/video monitor.	<b>159</b>
<b>4KP</b> 4K RAM chip set.	<b>79</b>
<b>PS-005</b> 5V 4.5 amp power supply for Superboard II.	<b>35</b>
<b>PS-003</b> 12V power supply for mini-floppies.	<b>29</b>
<b>CS-600</b> Metal case for Superboard II, 610 and 630 board and two power supplies. [While stock lasts.]	<b>49</b>
<b>CS-900B</b> Metal case for single floppy disk drive and power supply. [While stock lasts.]	<b>49</b>
<b>AC-12P</b> Wireless remote control system. Includes control console, two lamp modules and two appliance modules, for use with 630 board.	<b>175</b>
<b>AC-17P</b> Home security system. Includes console, fire detector, window protection devices and door unit for use with 630 board.	<b>249</b>
<b>C1P Sams</b> C1P Service manual	<b>8</b>
<b>C4P Sams</b> C4P Service manual	<b>16</b>
<b>C3 Sams</b> Challenger III manual	<b>40</b>
Ohio Scientific and independent suppliers offer hundreds of programs for the Superboard II, in cassette and mini-floppy form.	

**Freight Policies** All orders of \$100 or more are shipped freight prepaid. Orders of less than \$100 please add \$4.00 to cover shipping costs. Ohio residents add 5.5% Sales Tax.



Hours: Call Monday thru Friday.  
8:00 AM to 5:00 PM E.O.T.  
**TOLL FREE: 1-800-321-5805**

### Guaranteed Shipment

Cleveland Consumer Computers & Components guarantees shipment of computer systems within 48 hours upon receipt of your order. Our failure to ship within 48 hours entitles you to \$35 of software, FREE.

**To Order:** Or to get our free catalog **CALL 1-800-321-5805 TOLL FREE.** Charge your order to your **VISA** or **MASTER CHARGE** account. Ohio residents call: (216) 464-8047. Or write, including your check or money order, to the address listed below.



**CLEVELAND CONSUMER  
COMPUTERS & COMPONENTS**

**P.O. Box 46627  
Cleveland, Ohio 44146**

## Order Form: CLEVELAND CONSUMER COMPUTERS & COMPONENTS P.O. Box 46627 Cleveland, Ohio 44146

- |  |   |
|--|---|
| <input type="checkbox"/> Superboard II \$299.          | <input type="checkbox"/> 630 Board \$299.             |
| <input type="checkbox"/> 610 Board \$298.              | <input type="checkbox"/> AC-3P 12" B/W Monitor \$159. |
| <input type="checkbox"/> Mini-Floppy Disk Drive \$299. | <input type="checkbox"/> C1P Sams Manual \$8.         |

[Attach separate sheet for other items.]

NAME \_\_\_\_\_

ADDRESS: \_\_\_\_\_

CITY: \_\_\_\_\_ STATE: \_\_\_\_\_ ZIP: \_\_\_\_\_

PHONE: \_\_\_\_\_

Payment by: VISA \_\_\_\_\_ MASTER CHARGE \_\_\_\_\_ MONEY ORDER \_\_\_\_\_

Credit Card Account # \_\_\_\_\_

Expires \_\_\_\_\_ Interbank # [Master Charge] \_\_\_\_\_

TOTAL CHARGED OR ENCLOSED \$ \_\_\_\_\_ [Ohio Residents add 5.5% Sales Tax]  
Orders of less than \$100, please add \$4.00 to cover shipping costs.

All orders shipped insured UPS unless otherwise requested, FOB Cleveland, Ohio.

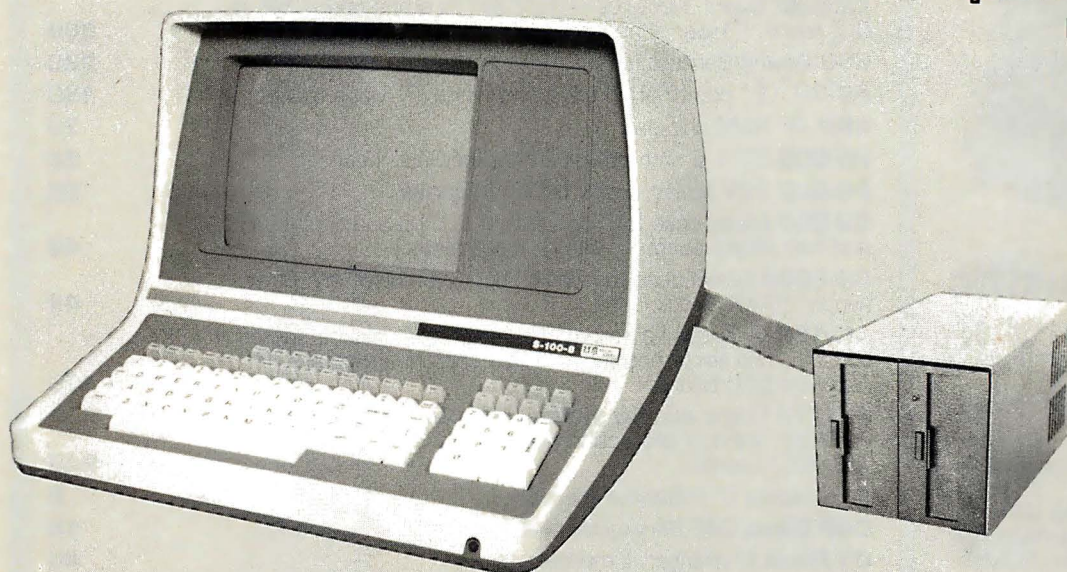
# INTRODUCING...

REGULAR \$3250.00 LIST

INTRODUCTORY  
PRICE ONLY

**\$2450.00**

INCLUDING CP/M2.2®



320K  
MINI DRIVES  
SHOWN, 8"  
and 5¼" 10MB  
HARD DISK  
OPTIONAL

IMMEDIATE DELIVERY!

**1 YEAR PARTS WARRANTY!**

(90 DAYS ON DRIVE PACKAGE, KEYBOARD AND LABOR)



**MICRO SALES**

**S-100-8**

## CHECK THESE FEATURES!

### TERMINAL

- Feather Touch Capacitance Keyboard
- 60 Key Standard ASCII  
PLUS + Hex Keypad  
PLUS + 8 Special Function Keys  
PLUS + 20 Screen Editing Keys
- SOROC Type Screen Attribute Set
- Half Intensity

### COMPUTER

- 8 Slot S-100
- 64K Dynamic Ram
- 4MHZ Z-80
- Serial Printer Port (150 - 19.2K)
- Double Density Disk Controller
- Programmable Baud Rate
- Programmable Keyboard Set

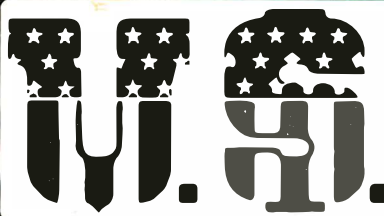
### DISK STORAGE

- Dual Double Density  
5¼ Single Sided Drives
- DOUBLE SIDED Option
- Double Sided, 77  
Track, Option
- Color Matched Enclosure
- Self Contained Power Supply

#### OPTIONS:

- ◆ Dual 5¼" Double Sided MPI B51 (640K) add \$225.00
- ◆ Dual 5¼" Double Sided MPI B91 (1.2MB) add \$360.00
- ◆ Dual 8" SIEMANS FDD120-8 Drives (1MB) add \$250.00
- ◆ Dual 8" QUME Double Sided Drives (2MB) add \$625.00

OUR BUYERS ARE IN  
CONTACT WITH EVERY MAJOR  
SUPPLIER AND O.E.M.  
BUY HERE AT 1000 PIECE



# MICRO SALES

## QUANTITY PRICES

ALL MERCHANDISE 100%  
GUARANTEED! 15 DAY FULL  
CASH REFUND!

664 N. MICHIGAN AVE. ★ SUITE 1010 ★ CHICAGO, ILLINOIS 60611  
CALL TOLL FREE: 1-800-435-9357 ★ MONDAY thru SATURDAY  
(ILLINOIS RESIDENTS CALL: 815-485-4002) ★ 8:00 a.m. to 6:30 p.m.

TERMS: Prepayment - C.O.D. up to \$100.00 - M/C, Visa  
Please allow personal check to clear before shipment.

## WRITE FOR FULL CATALOG!

### JUST HOT STUFF

#### POWER SUPPLIES

If you can beat these  
prices we will be truly  
amazed. OEM's at 500  
lot pay more than this.  
Call or write for full  
spec. sheets.



DISK POWER SUPPLIES				
PRIAM-SHUGART-CENTURY-MICROPOLIS				
+5V @ 9A	-5V @ .8A	+24V @ 7A	US-384	89.00
SHUGART-SIEMANS-MPI 5 1/2"				
+5V @ .5A	+12V @ .9A		US-340	33.50
+5V @ 2A	+12V @ 4A		US-323	56.25
SHUGART-SIEMANS-CDC 8"				
+5V @ 1A	-5V @ .5A	+24V @ 1.5A	US-205	52.50
+5V @ 2A	-5V @ .5A	+24V @ 3A	US-206	69.00
+5V @ 3A	-5V @ .6A	+24V @ 5A	US-162	89.00
+5V @ 1.7A	-5V @ 1.5A	+24V @ 2A	US-272	69.00
+5V @ 2A	+12V @ .4A	-12V @ .4A	US-HTAA	37.50

#### TELEVIDEO 912C

SOROC IQ120- \$675.00  
Televideo 912C- 665.00  
Televideo 920C- 720.00  
ADDS R-25 - 710.00

Also have 920C, SOROC,  
HAZELTINE, etc. What  
we don't have is room on  
this page. Call Toll Free  
800 number for prices.



#### C-ITOH PRINTER

**\$499.00**

Look closely at the  
photo and see other  
adds in this rag at  
\$995.00. Perfect units,  
warranted. Only 500 pcs. Same story,  
manufacturer had too many.

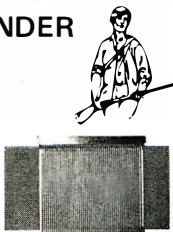


#### S-100 CARD EXTENDER

**\$12.50**

(Gold Contacts)

As long as there is a  
price war, we will fight  
your battle. Compare  
at your local Dept.  
store and buy U.S. MICRO.



#### MEMOREX - VERBATUM - WABASH BASF FLOPPIES

BOX OF 10 ONLY:

5 1/4"	SOFT	\$2.65 ea.
5 1/4"	HARD 10	2.65 ea.
5 1/4"	HARD 16	2.65 ea.
8"	SOFT 1D	3.25 ea.
8"	SOFT 2D	3.85 ea.
8"	SOFT 2DDS	5.00 ea.



### SPECIAL OF THE QUARTER

#### S1-MOD (KIT)

**\$189.00**



Complete S-100 12 Slot Computer. Ample  
system power with regulated power for drives.  
Excellent for Subsystem or Hobby use.  
4 hours to build. (6 conn. incl., less fans)

#### DUAL DRIVE SUBSYSTEM

**\$995.00**

**\$195.00 w/no Drives**

If this looks like a Lobo  
Drive System, don't be  
fooled. Just because it  
looks like one, works like  
one, smells like one, and tastes like one (?)  
doesn't mean it has to cost like one!



2 SHUGART 801R

POWER SUPPLY

#### EXPANDABLE RAM

★SPECIAL★SPECIAL★SPECIAL★

This is the best all  
around 64K board  
you can buy. If after  
you see it, you don't  
agree return for full  
refund. Bank Select  
by extended address  
lines or I.O. 40H.



★\$389.00 A & T★

#### S-100 POWER

**\$79.50**

Simple Brute Force!  
S-100 Power Supply,  
30A @ +8V,  
6A @ +16V,  
6A @ -16V,  
PC Board Design.



#### Z-80 CPU (KIT)

The first time this  
world popular CPU  
offered in Kit. 2 serial,  
3 parallel, CTC, EProm  
Z-80 at 4 mhz. Software  
buad rate, etc. (less Prom & cable) **\$212.00**



#### 12 SLOT MOTHER

We have connectors and power  
supply too. Start your system  
with quality components.  
Terminated,

**\$22.50**

CONNECTORS \$2.50 ea.

#### FANS \$14.95

These are brand new,  
in the box fans. Not  
noisy bearing pullouts.  
Never again at these low prices!



3-1/8"



4-5/8"

### SPECIALS OF THE MONTH

#### 4116s

**\$3.75**

200 NS

Expansion 16K Dynamic  
RAMs for Apple, TRS-80  
S-100 systems. T.I., Mostek  
Intel, Call for manufacturer.

#### DIP-80 \$399.00

Don't be mislead by this  
LOW price. This is a rug-  
ged 100% Duty Cycle  
7 by 7 Dot Matrix Printer.  
Brand new, factory warr.



• RS-232 ADD \$65.00  
• TRACTOR FEED ADD \$70.00

#### 2114s

**\$3.45**

200 NS

One of the world's two  
most popular STATIC  
RAMs. Factory prime  
tested units. Sold in lots of 8 only.  
FUJITSU, HITACHI, etc.



#### TMS-4044

MM-5257

INTEL 2147

**\$4.25**

250 NS

The other of the world's most popular STATIC  
RAMs. This one is 4K by 1 organization. Don't  
buy Gold, buy these, the price won't last!

#### 2716s

**\$9.50 (450 NS)**

#### 2708s

**\$6.95 (450 NS)**

Remember when 2716s were \$50.00 and hard  
to get? These units are so beautiful it's hard to  
part with them. But we will, for a small price.  
Guaranteed!

#### SHUGART DRIVE



**8" 801R**

**\$395.00**

Manufacturer had  
too many, buys at  
1000 piece rate,  
sales dropped, so we got'em. Fantastic buy, get  
them while they last! Full warranty.

**8" 851R \$585.00**

#### SIEMANS DRIVE

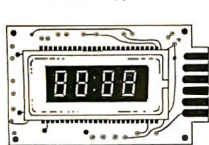
**8" 120-8**

**\$375.00**

Very Special Price on  
these BRAND NEW current production units  
Add \$10.00 for Extended 1 Year Warrantee!



## National Semiconductor Clock Modules



**12VDC  
AUTOMOTIVE/  
INSTRUMENT  
CLOCK**

**APPLICATIONS:**

- Indash autoclocks
- After-market auto/ RV clocks
- Aircraft-marine cks.
- 12VDC oper. instru.
- Portable/battery powered instruments.

Features: Bright 0.3" green display. Internal crystal time-base. ±0.5 sec./day accur. Auto. display brightness control logic. Display color filterable to blue, blue-green, green & yellow. Complete—just add switches and lens.

MA 1003 Module . . . . . \$16.95

MA1023. 7" Low Cost Digital LED Clock Module . . . . . 8.95  
MA1026. 7" Dig. LED Alarm Clock/Thermometer . . . . . 18.95  
MA5036. 3" Low Cost Digital LED Clock/Timer . . . . . 6.95  
MA1002. 5" LED Display Dig. Clock & Xformer . . . . . 9.95



## National Semiconductor RAM SALE

MM5290N-4 (MK4116/UPD416) . . . \$4.95 each  
16K DYNAMIC RAM (250NS)

(8 EACH \$39.95) (100 EACH \$450.00/lot)

MM5290J-2 (MK4116/UPD416) . . . \$6.95 each

16K DYNAMIC RAM (150NS)

(8 EACH \$49.95) (100 EACH \$550.00/lot)

MM5298J-3A . . . . . \$3.25 each

8K DYNAMIC RAM (LOW HALF OF MM5290J) 200NS

(8 EACH \$23.95) (100 EACH \$250.00/lot)

MM2114-3 . . . . . \$5.95 each

4K STATIC RAM (300NS)

(8 EACH \$43.95) (100 EACH \$450.00/lot)

MM2114L-3 . . . . . \$6.25 each

4K STATIC RAM (LOW POWER 300NS)

(8 EACH \$47.00) (100 EACH \$475.00/lot)

## EPROM Erasing Lamp



- Erases 2708, 2716, 1702A, 5203Q, 5204Q, etc.
- Erases up to 4 chips within 20 minutes.
- Maintains constant exposure distance of one inch.
- Special conductive foam liner eliminates static build-up.
- Built-in safety lock to prevent UV exposure.
- Compact — only 7-5/8" x 2-7/8" x 2"
- Complete with holding tray for 4 chips.

UVS-11E . . . . . \$79.95

## Jumbo 6-Digit Clock Kit

- 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
- 115VAC 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 . . . . . \$29.95

## 6-Digit Clock Kit

- Bright .300 ht. comm. cathode display
- Uses MM5314 clock chip
- Switches for hours, minutes and hold modes
- Hrs. easily viewable to 20 ft.
- Simulated walnut case
- 115VAC operation
- 12 or 24 hr. operation
- Incl. all components, case & wall transformer
- Size: 6 3/4" x 3 1/8" x 1 3/4"

JE701 . . . . . \$19.95

## Regulated Power Supply

Uses LM309K. Heat sink provided. PC board construction. Provides a solid 1 amp @ 5 volts. Can supply up to ±5V, ±9V and ±12V with JE205 Adapter. Includes components, hardware and instructions. Size: 3 3/4" x 5" x 2 1/4"

JE200 . . . . . \$14.95



**ADAPTER BOARD**  
—Adapts to JE200—  
±5V, ±9V and ±12V

DC/DC converter with +5V input. Toroidal hi-speed switching XFMR. Short circuit protection. PC board construction. Piggy-back to JE 200 board. Size: 3 3/4" x 2" x 9/16" H

JE205 . . . . . \$12.95

## MICROPROCESSOR COMPONENTS

### 8080A/8080A SUPPORT DEVICES

INS8080A	CPU	6.50
DP222	8-Bit Input/Output	3.50
DP224	Priority Interrupt Control	3.50
DP226	BI-Directional Bus Driver	3.49
DP228	Clock Generator/Driver	3.99
DP229	Bus Driver	3.49
DP228	System Controller/Bus Driver	4.95
DP228	System Controller	5.95
INS8243	I/O Expander for 8080 Series	8.95
INS8250	Asynchronous Comm. Element	16.95
DP251	Prog. Comm. I/O (USART)	7.95
DP252	Prog. Interval Timer	3.95
DP255	Prog. Peripheral I/O (PPI)	9.95
DP257	Prog. DMA Control	19.95
DP259	Prog. Interrupt Control	19.95
DP279	Prog. CRT Controller	49.95
DP279	Prog. Keyboard/Display Interface	19.95
DP280	Octal Bus Receiver	6.95
DP303	System Timing Element	6.95
DP304	8-Bit BI-Directional Receiver	3.95
DP307	8-Bit BI-Directional Receiver	3.95
DP308	8-Bit BI-Directional Receiver	3.95

### 6800/6800 SUPPORT DEVICES

MC6800	MPU with Clock and RAM	14.95
MC6800CP	MPU with Clock and RAM	14.95
MC6801AP	128x8 Static RAM	4.95
MC6801	Peripheral Interf. Adapt. (MC6800)	7.49
MC6805	Priority Interrupt Controller	10.95
MC6805L	1024x8-Bit ROM (MC6805A-3)	14.95
MC6805	Asynchronous Comm. Adapter	6.95
MC6805	Synchronous Serial Data Adapter	6.95
MC6805	600bps Digital MODEM	10.95
MC6805	2400bps Modulator	12.95
MC6805A	Quad 5-State Bus Trans. (MC6805)	2.25

### MICROPROCESSOR CHIPS

Z80 (80C)	CPU (MK380N) (27.4Hz)	13.95
Z80A (780-1)	CPU (MK380N-4) (4MHz)	15.95
CDP1802	CPU	15.95
2650	MPU	16.95
IMD2650ADC	CPU—4-Bit Slice (Com. Temp. Grade)	19.95
INS55602	MPU w/Clock (16K Bytes Memory)	11.95
INS55603-4	MPU—8-Bit (5MHz)	16.95
INS55603N-4	CPU—5.5V Chib-Bit (17.5 Bytes RAM)	19.95
INS55604N-6	CPU [26 Bytes RAM]	24.95
INS55604N-6	CPU—64 Bytes RAM	24.95
INS55603N	CPU w/Basic Micro Interpreter	29.95
PM6805	CPU—16-Bit	29.95
INS55600	CPU—16-Bit	29.95
TM55900JL	MPU—16-Bit	49.95

### SHIFT REGISTERS

MM5500H	Dual 8-Bit Dynamic	.50
MM5501H	Dual 16-Bit Dynamic	.50
MM5500H	Dual 100-Bit Static	.50
MM5501H	Dual 64-Bit Accumulator	.50
MM5502	256-Bit Dynamic	3.95
MM5503	1024-Bit Dynamic/Accumulator	1.95
MM5501H	500/512-Bit Dynamic	.49
MM5504N	Octal 80-Bit	9.95
MM5505N	Octal 80-Bit	9.95
2506 V1 (40A)	1024-Bit Dynamic	3.95
2516N	Hex 30-Bit Static	4.95
2522V	Dual 132-Bit Static	2.95
2524V	512-Bit Dynamic	.79
2525V	1024-Bit Dynamic	2.95
2527V	Dual 264-Bit Static	2.95
2528V	Dual 264-Bit Static	4.00
2529V	Dual 264-Bit Static	4.00
2532V	Quad 80-Bit Static	2.95
3341PC	Fifo (Dual 80)	6.95

### DATA ACQUISITION

AF100-1CN	Universal Active Filter: 25%	5.95
AF121-1CJ	Touch Tone Low Pass Filter	19.95
AF122-1CJ	Touch Tone Low Pass Filter	19.95
LF236N	Super Gain Op Amp	1.00
LM334Z	Constant Current Source	1.30
LM335Z	Temperature Transducer	1.40
LF236N	JFET Input Op Amp	1.10
LF359N	Sample & Hold Amplifier	3.95
LM399H	Temp. Comp. Prec. Ref. (50ppm/°C)	4.95
CD4060AL	CM 8-Bit A/D Converter (1 LSb)	4.95
DAC0606LCN	8-Bit D/A Converter (0.05% Lin.)	2.25

### DATA ACQUISITION (CONTINUED)

ADC0809CCN	8-Bit A/D Converter (8-Ch. Mult.)	5.25
ADC0811CCN	8-Bit A/D Converter (16-Ch. Mult.)	10.95
DAC1001CCN	10-Bit D/A Conv. Micro. Comp. (0.05% Lin.)	8.95
DAC1002CCN	10-Bit D/A Conv. Micro. Comp. (0.20% Lin.)	8.49
DAC1003CCN	10-Bit D/A Converter (0.20% Lin.)	5.95
DAC1004CCN	12-Bit D/A Converter (0.20% Lin.)	9.95
CD4051N	8-Channel Multiplexer	1.19
AV-5103	30x D/A D/A R/T	5.95

### RAMS

1101	26x1 Static	1.49
1102	16x1 Dynamic	3.95
2101 (8101)	26x1 Static	1.75
2102	10x1 Static	1.95
2110	10x1 Static	1.95
2111 (8111)	26x1 Static	3.95
2112	26x4 Static MOS	4.95
2114	1024x4 Static 450ns	5.95
2114L	1024x4 Static 450ns Low Power	6.95
2114J	1024x4 Static 300ns	7.49
2114L-1	1024x4 Static 300ns Low Power	7.95
2117	16384x1 Dynamic 550ns (housemarked)	4.95
2114L	1024x4 Static 450ns	6.95
MM5417J	40x1 Fast 70ns	19.95
5101	26x1 Static	.79
MM5551	1024x1 Dynamic Fully Decoded	9.95
MM5552	2x1 Dynamic	.25
MM5553 (2101)	40x1 Dynamic	4.95
MM5553 (2101)	10x1 Dynamic 300ns (UPD416)	1.95
MM5553A-3A	8x1 Dyn. 200ns (lower to of MM5529J)	1.95
7489	14x1 Static	4.95
UPD414 (MK4027)	8x1 Dynamic 16-pin	14.95
TM55404-45N	4K Static	14.95
TM55405	1024x4 Static	14.95

### PROMS/EPROMS

1702A	2Kx8 Erasable PROM	5.95
2708	8K EPROM	9.95
2716	16K EPROM (5V, +5V, +12V)	19.95
2716 (2516T)	16K EPROM (Single +5V)	17.95
2721 (2521T)	32K EPROM	49.95
2732	64K EPROM (450ns) (Single +5V)	7.95
5202	256K PROM	14.95
5252 (4518)	32x8 PROM (Open Collector)	4.95
82515	40x8 Bipolar PROM	19.95
82512 (4528)	32x8 Tri-State Bipolar PROM	4.95
82516	8K PROM	29.95

### ROMS

2513 (240)	Character Generator (Upper Case)	9.95
2513 (202)	Character Generator (Lower Case)	9.95
2514	Character Generator	10.95
MM5520N	2048-Bit Read Only Memory	1.95

### NMOS READ ONLY MEMORIES

MC1M610P	128x8x7 ASCII Shifted w/Greek	12.50
MC1M610P	128x8x7 Math Symbol & Pictures	13.50
MC1M610P	128x8x7 Alpha Control Char. Gen.	13.50

### MICROPROCESSOR MANUALS

M-240	User Manual	7.50
MC-P1802	User Manual	7.50
M-250	User Manual	5.00

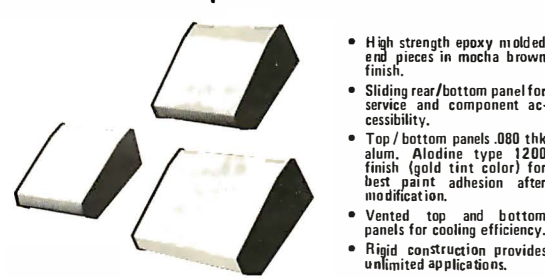
### SPECIAL FUNCTION

DS0502CN	Dual MOS Clock Driver (SMZ)	3.50
DS0502CN	Dual MOS Clock Driver (SMZ)	1.95
INS171N-1	Fluxless Dip. Controller	24.95
INS1515N	Communication Chip	19.95
MM5816T	Microprocessor Real Time Clock	4.95
MM5817N	Microprocessor Compatible Clock	11.95
CD4022N	Microcontroller with 64-Digit RAM and Direct LED Drive	6.95
CD4022N	Microcontroller with 64-Digit RAM & Direct LED Drive w/n Bus Int.	7.49
CD4022N	32-Bit VAC I/O Driver (250 pin pkg.)	3.25

### TELEPHONE/KEYBOARD CHIPS

A-5-4100	Push Button Telephone Dialer	14.95
A-5-4200	Reentry Dialer	14.95
A-5-5000	CMOS Clock Generator	4.95
A-5-2376	Keyboard Encoder (88 keys)	11.95
100816-5	Keyboard Encoder (16 keys)	7.95
74C20	Keyboard Encoder (16 keys)	5.49
74C23	Keyboard Encoder (20 keys)	5.75
MM53190N	Push Button Pulse Dialer	7.95
MM5499N	96/144-Key Serial Keyboard Encoder	8.95

## DESIGNERS' SERIES Blank Desk-Top Electronic Enclosures



- High strength epoxy molded end pieces in mocha brown finish.
- Sliding rear/bottom panel for service and component accessibility.
- Top/bottom panels .080 thk. aluminum. Anodized type 1200 finish (gold tint color) for best paint adhesion after modification.
- Vented top and bottom panels for cooling efficiency.
- Rigid construction provides unlimited applications.

### CONSTRUCTION:

The "DTE" Blank Desk Top Electronic Enclosures are designed to blend and complement today's modern computer equipment and can be used in both industrial and home. The end pieces are precision molded with an internal slot (all around) to accept both top and bottom panels. The panels are then fastened to 1/4" thick tabs inside the end pieces to provide maximum rigidity to the enclosure. For ease of equipment servicing, the rear/bottom panel slides back on slotted tracks while the rest of the enclosure remains intact. Different panel widths may be used while maintaining a common profile outline. The molded end pieces can also be painted to match any panel color scheme.

Enclosure Model No.	Panel Width	PRICE
---------------------	-------------	-------

DTE-8	8.00"	\$29.95
-------	-------	---------

DTE-11	10.65"	\$32.95
--------	--------	---------

DTE-14	14.00"	\$34.95
--------	--------	---------

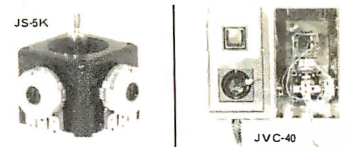
\$10.00 Min. Order — U.S. Funds Only  
Calif. Residents Add 6% Sales Tax  
Postage—Add 5% plus \$1 Insurance

Spec Sheets — 25¢  
Send 41¢ Postage for your  
FREE 1981 JAMECO CATALOG

**Jameco ELECTRONICS**  
PHONE ORDERS WELCOME  
(415) 592-8097

MAIL ORDER ELECTRONICS — WORLDWIDE  
1355 SHOREWAY ROAD, BELMONT, CA 94002  
PRICES SUBJECT TO CHANGE

## JOYSTICKS



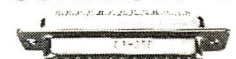
JS-5K 5K Linear Taper Pots . . . . . \$5.25  
JS-100K 100K Linear Taper Pots . . . . . \$4.95  
JVC-40 40K (2) Video Controller in case . . . . . \$5.95

## AC and DC Wall Transformers



Part No.	Input	Output	Price
AC 250	117V/60Hz	12 VAC 250mA	\$3.95
AC 500	117V/60Hz	12 VAC 500mA	\$4.95
AC1000	117V/60Hz	12 VAC 1 amp	\$5.95
DV9200	117V/60Hz	9 VDC 200mA	\$3.25
DC 900	120V/60Hz	9 VDC 500mA	\$3.95

## CONNECTORS



DB25P	D-Subminiature Plug	\$2.95
DB25S	D-Subminiature Socket	\$3.50
DB25226	Cover for DB25P/S	\$1.75
22/44E	P.C. Edge (22/44 Pin)	\$2.95
UG88/U	BNC Plug	\$1.79
UG89/U	BNC Jack	\$3.79
UG175/U	UHF Adapter	\$.49
SO239	UHF Panel Recept.	\$1.29
PL259	UHF Adapter	\$1.60
UG260/U	UHF Plug	\$1.60
UG1094/U	BNC Bulkhead Recept.	\$1.29

## TRS-80 16K Conversion Kit

Expand your 4K TRS-80 System to 16K.  
Kit comes complete with:  
\* 8 ea. MM5290 (UPD416/416) 16K Dyn. Rams (\*NS)  
\* Documentation for Conversion

TRS-16K2 \*150NS . . . . . \$49.95

TRS-16K4 \*250NS . . . . . \$39.95

## JE610 ASCII Encoded Keyboard Kit



The JE610 ASCII Keyboard Kit can be interfaced into most any computer system. The kit comes complete with an industrial grade keyboard switch assembly (62-keys), IC's, sockets, connector, electronic components and a double-sided printed wiring board. The keyboard assembly requires +5V @ 150mA and -12V @ 10 mA for operation. Features: 60 keys generate the 126 characters, upper and lower case ASCII set. Fully buffered. Two user-definable keys provided for custom applications. Caps lock for upper-case-only alpha characters. Utilizes a 1346 (40-pin) encoder read-only memory chip. Outputs directly compatible with TTL/DTL MOS logic arrays. Easy interfacing with a 16-pin dip or 18-pin edge connector. Size: 3 3/4" H x 8 1/4" W x



# COMPUTER SYSTEMS INC.

15620 South Inglewood Avenue  
Lawndale, California 90260  
(213) 970-0952

PLACE ORDERS TOLL FREE  
1-800-421-5150  
(CONTINENTAL U.S. ONLY)  
(EXCEPT CALIFORNIA)

Retail Store Open  
10:00 A.M. to 6:00 P.M.  
Daily **Except** Sunday  
**QT CATALOG NOW AVAILABLE**

## QT SYSTEM +

The QT System+ is designed for both businessmen and engineers in accordance with latest IEEE standards. Among other functions, it can be used for accounting and word processing, as well as a variety of scientific applications. The system will soon be available with MP/M® to allow multi-user, multi-tasking operations. This means, for example, that an engineer could be working on scientific applications in the lab while an accountant is writing payroll checks in the office. QT also offers a full line of

business and applications software, ranging from a business package to word processing.

Technical specifications: 4MHz Z-80A CPU • Dbl-sided, dbl-den. 5¼" & 8" floppy disk controller (handles both drives simultaneously) • Includes tele-video terminal • Two 8" dbl-den., sgl. or dual sided disk drives, expandable to 4 floppy drives • CP/M® 2.2 included • 64K RAM, expandable per your requirements • Comes complete in single mainframe •

EPROM/ROM in any combination to 8K • Two RS232C serial I/O ports • Two parallel I/O ports • Hard disk compatible • Real time clock • Std. 2K monitor program & disk routines included on ROM • Power-on/Reset jump to monitor program • 2716 (5V) EPROM programmer (software incl. on monitor ROM; ext. 25.5V @ 50ma req.) • Uses Z-80A CPU vectored interrupts • Assembled, tested & burned in at factory • Documentation included.

### SYSTEM + I (1MB+)

SYS+SS Computer System with 8" Single Sided Drives (801R) without Terminal  
A&T (6 slot) ..... \$3495.00  
A&T (8 slot) ..... \$3595.00  
A&T (12 slot) ..... \$3695.00

With Terminal Add \$900.00

### MINI-SYSTEM + I (½MB+)

Computer System with 5¼" Single Sided Drives (uses B-51 Disk Drives) No Terminal  
A&T (6 slot) ..... \$2495.00  
A&T (8 slot) ..... \$2595.00  
A&T (12 slot) ..... \$2695.00

### SYSTEM + II (2MB+)

SYS+DS Computer System with 8" Dual-Sided Drives (Qume DT-8) without Terminal  
A&T (6 slot) ..... \$4195.00  
A&T (8 slot) ..... \$4295.00  
A&T (12 slot) ..... \$4395.00

With Terminal Add \$900.00

### MINI-SYSTEM + II (1MB+)

Computer System with 5¼" Double Sided Drives (uses B-52 Disk Drives) No Terminal  
A&T (6 slot) ..... \$2795.00  
A&T (8 slot) ..... \$2895.00  
A&T (12 slot) ..... \$2995.00

## S-100 PRODUCTS

**Double Density - Cal Comp Sys**  
5¼" or 8" disk controller with free CP/M 2.2  
CCS-2422A A&T ..... \$374.95

**SALE SBC-100-SD Systems**  
2.5 MHz Z80 CPU with serial & parallel I/O ports  
SDS-SBC100K Kit ..... \$280.00  
SDS-SBC100AT A&T ..... \$350.00

**SBC-200 - SD Systems**  
4 MHz Z80 CPU with serial & parallel I/O ports  
SDS-SBC200K Kit ..... \$348.00  
SDS-SBC200AT A&T ..... \$408.00

**SALE CB2 - S.S.M.**  
2 or 4 MHz switchable Z80 CPU with RAM, ROM & I/O  
SSM-CB2K Kit ..... \$200.00  
SSM-CB2AT A&T ..... \$275.00

**2810 Z-80 CPU - Cal Comp Sys**  
2 or 4 MHz Z80A CPU w/serial I/O port  
CCS-2810 A&T ..... \$275.00

**Expando RAM II - SD Systems**  
4 MHz RAM board expandable from 16K to 256K  
SDS-RAM216K 16K kit ..... \$289.95  
SDS-RAM216AT 16K A&T ..... \$339.95  
SDS-RAM232K 32K kit ..... \$329.95  
SDS-RAM232AT 32K A&T ..... \$379.95  
SDS-RAM248K 48K kit ..... \$369.95  
SDS-RAM248AT 48K A&T ..... \$419.95  
SDS-RAM264K 64K kit ..... \$409.95  
SDS-RAM264AT 64K A&T ..... \$459.95

**PROM-100 - SD Systems**  
2708, 2716, 2732, 2758 & 2516 EPROM programmer  
SDS-PROM-100K kit ..... \$220.00  
SDS-PROM-100AT A&T ..... \$275.00

**I/O-4 - S.S.M.**  
2 serial I/O ports plus 2 parallel I/O ports  
SSM-I04K kit ..... \$179.95  
SSM-I04AT A&T ..... \$259.95  
SSM-I04BB Bare board ..... \$ 35.00

**Versafloppy II - SD Systems**  
New double density controller for both 8" & 5¼"  
SDS-VF2K kit ..... \$385.00  
SDS-VF2AT A&T ..... \$450.00

**VDB-8024 - SD Systems**  
80 x 24 I/O mapped video board with keyboard I/O  
SDS-VDBK kit ..... \$406.00  
SDS-VDBAT A&T ..... \$475.00

**VB3 - S.S.M.**  
80 x 24 x 48 memory mapped with graphics  
SSM-VB3-4mhzK kit, 4 MHz ..... \$399.95  
SSM-VB3-4mhzAT A&T, 4 MHz ..... \$464.95  
SSM-VB3-4mhzUPG 80 x 48 upgrade, 4 MHz ..... \$ 89.00

**T1 Active Terminator**  
SSM-T1K kit ..... \$ 34.00  
SSM-T1AT A&T ..... \$ 64.00

**VB2 I/O Mapped Video Interface**  
SSM-VB2K kit ..... \$160.00  
SSM-VB2AT A&T ..... \$210.00

**XB1 Extender Board**  
SSM-XB1K kit (with Connector) ..... \$ 22.00  
SSM-XB1AT Assembled & tested ..... \$ 30.00

**Z-80 STARTER KIT - SD Systems**  
Z-80 computer with RAM, ROM, I/O & keyboard  
SDS-Z80K kit ..... \$374.00  
SDS-Z80AT A&T ..... \$454.00

## PARTS

**MICROPROCESSORS**  
Z80 (2MHz) ..... \$10.95  
Z80A (4MHz) ..... \$12.95  
6502 ..... \$11.25  
6800 ..... \$12.50  
6802 ..... \$18.00  
8035 ..... \$20.00  
8080A ..... \$ 3.50  
8085A ..... \$20.00  
8086-4 ..... \$60.00  
8088 ..... \$60.00  
8748 ..... \$60.00  
TMS 9900 JL ..... \$29.95

**EPROMS**  
1702A ..... \$ 4.95  
2708 ..... \$ 6.25  
2516 (5V) ..... \$18.00  
2716 (5V) ..... \$13.50  
2716 (5 & 12V) ..... \$13.50  
2758 ..... \$19.95  
2532 ..... \$55.00  
2732 ..... \$55.00

**USRT**  
S2350 ..... \$ 7.95

**MISCELLANEOUS  
OTHER COMPONENTS**  
N8T20 ..... \$ 3.25  
N8T26 ..... \$ 2.50  
N8T97 ..... \$ 2.00  
N8T98 ..... \$ 2.00  
1488 ..... \$ 1.25  
1489 ..... \$ 1.25  
D3205 ..... \$ 3.00  
D3242 ..... \$14.00  
P3404 ..... \$ 6.75  
TMS5501 ..... \$19.00  
DM8131 ..... \$ 3.00

**UARTS**  
TR1602B ..... \$ 4.50  
AY5-1013A ..... \$ 4.50

**CHARACTER  
GENERATORS**  
2513 ..... \$10.95  
UP CASE (5&12V) ..... \$18.25  
2513 ..... \$10.95  
LWR CASE (5&12V) ..... \$ 9.75  
2513 ..... \$10.95  
UP CASE (5V) ..... \$10.95  
LWR CASE (5V) ..... \$ 7.40

**8080A SUPPORT**  
8212 ..... \$ 3.50  
8214 ..... \$ 4.50  
8216 ..... \$ 2.95  
8224 ..... \$ 4.00  
8228 ..... \$ 6.00  
8238 ..... \$ 6.00  
8243 ..... \$ 5.00  
8251 ..... \$ 7.00  
8253 ..... \$19.00  
8253-5 ..... \$20.25  
8255 ..... \$ 6.25  
8257 ..... \$17.95  
8257-5 ..... \$19.00  
8259 ..... \$19.95  
8275 ..... \$69.95  
8279 ..... \$17.50  
8279-5 ..... \$18.00  
8295 ..... \$16.50

**KEYBOARD CHIPS**  
AY5-2376 ..... \$13.75  
AY5-3600 ..... \$13.75

**BAUD RATE  
GENERATORS**  
MC14411 ..... \$11.00  
1.8432 XTAL ..... \$ 4.95

**DISK CONTROLLER**  
1771B01 ..... \$24.95  
1791A01(CER) ..... \$37.95

**6800 PRODUCTS**  
6802P ..... \$18.00  
6821P ..... \$ 5.25  
6840P ..... \$18.25  
6845P ..... \$22.00  
6850P ..... \$ 4.80  
6860P ..... \$11.55  
6875P ..... \$ 7.40

### ITHACA AUDIO REV 2.0 Z-80 BD

Bare Board ..... \$35.00 each  
10 for \$300.00

### SEALS ELECTRONICS 32K STATIC BD

Uses TMS-4044 or 5257L ..... \$35.00 each

### QT MEMORY EXPANSION KITS

#### TRS-80 • APPLE • EXIDY

4116 200 ns ..... 8 for \$32.00  
2716 (5V-450 ns) ..... \$ 9.00  
2716 (5 & 12V-450 ns) ..... \$ 9.00  
2732 (5V) ..... \$40.00  
2114L 300 ns ..... 8 for \$36.00  
100 - \$3.50 ea.

# QT PRODUCTS

## SBC+2/4 SINGLE BOARD COMPUTER

Features: 1K RAM (which can be located at any 1K boundary) plus one each Parallel and Serial I/O parts on board • Power on jump to on-board EPROM (2708 or 2716) • EPROM addressable on any 1K or 2K boundary • Full 64K use of RAM allowed in shadow mode • Programmable Baud rate selection, 110-9600 • 2 or 4MHz switch selectable • DMA capability allows MWRT signal generation on CPU board or elsewhere in system under DMA logic or front panel control • Two programmable timers available for use by programs run with the SBC+2/4 (timer output and controls available at parallel I/O connector; parallel input and output ports available for use on CPU board).

Bare Board ..... \$ 60.00  
Kit ..... \$190.00  
A&T ..... \$295.00

## Z+80 CPU

Features: Power on jump to on-board EPROM (2708, 2716 or 2732) • EPROM addressed on any 1K or 2K boundary; also shadow mode allows full 64K use of RAM • On-board USART for Synchronous or Asynchronous RS-232 Operation (Serial I/O port) • Programmable Baud rate selection, 110-9600 • Switch selectable 2 or 4 MHz • MWRITE signal generated if used without front panel • Front panel compatible.

Bare Board ..... \$ 50.00  
Kit ..... \$150.00  
A&T ..... \$210.00

## CLOCK/CALENDAR+ FOR APPLE II, S-100 OR TRS-80

Features: Date/Month/Year • Day of week • 24 hour time or 12 hour (a.m./p.m.) selectable • Leap year (perpetual calendar) • 4 interval interrupt timer; 1024Hz (approx. 1 millisecond), 1 sec., 1 min., 1 hr. • On-board battery backup • Simple time and date setting • Simple software interface • Time advance protection while reading.

**S-100 or Apple**      **TRS-80**  
A&T ..... \$150.00    A&T Only ... \$150.00  
Kit ..... \$100.00  
Bare Bd. .... \$ 60.00

## SMART PROTO BOARD+

Features: Wire-wrap or solder sockets • Accepts all std. sockets — .30" & .60" center • Allows grid distributed power • Three voltage regulators • Kluge area for discretes, ext. drives • Two bus bars for  $\pm$  voltages — int. & ext. • Accepts std. edge connector on .1" center • Kit includes 3 regulators/3 heat sinks/filter capacitors/2 bus bars/Manual.

Bare Board ..... \$ 35.00  
Kit ..... \$ 60.00

## EXPANDABLE+ REV II <sup>NEW</sup> DYNAMIC MEMORY BOARD

Features: Runs at 4MHz • 3242 refresh controller with delay line • Four layer PC board insures quiet operation • Supports 16K, 32K, 48K or 64K of memory • 24 IEEE-specified address lines • Optional M1 wait state allows error free operation with faster processors • Optional Phantom disable • Uses Z-80 or on-board refresh signal • Bank on/off signal selected by industry standard I/O port 40 (Hex) • Convenient DIP switch selection of data bus bits determines bank in use • 3 watts low power consumption • Convenient LED indication of bank in use.

Definitely works with  
Cromemco and North Star.

Bare Board .....	\$ 75.00
<b>KIT</b>	<b>A&amp;T</b>
No RAM ..... \$230.00	16K ..... \$350.00
16K ..... \$280.00	32K ..... \$450.00
32K ..... \$360.00	48K ..... \$575.00
48K ..... \$480.00	64K ..... \$675.00
64K ..... \$525.00	

## RAM+16

Features: S-100, 16K x 8 bit static RAM • 2 or 4 MHz • Uses 2114 1K x 4 static RAM chip • 4K step addressable • 1K increment memory protection, from bottom board address up or top down • Deactivates up to six 1K board segments to create "holes" for other devices • DIP switch selectable wait states • Phantom line DIP switch • Eight bank select lines expandable to 1/2 million byte system • Data, address and control lines all input buffered • Ignores I/O commands at board address.

Bare Board ..... \$ 35.00  
4MHz Kit ..... \$180.00  
4MHz A&T ..... \$210.00

## WATCH FOR THE FOLLOWING NEW BDS:

- 4 Port Serial Bd (FEB)
- E-PROM Programmer (MAR)
- Floppy Disk Controller (APR)
- Hard Disk Controller (MAY)
- Color Video Bd (JUN)

## I/O+

### INDUSTRIAL GRADE I/O BD

Has two serial Sync/Async ports (RS-232, current loop or TTL) with individual Xtal controlled programmable baudrate generators • Four 8-bit Parallel ports; one latched input port and other three can be programmed in combinations of input, output or bidirectional • Also, has three 16-bit Programmable Timers and an 8-level Programmable Interrupt Controller w/Auto restart (8080/ Z80) • Other features include; on-board clock divisor for timers, completely socketed, wire wrap posts for easy port configuration plus more.

Bare Board ..... \$ 70.00  
Kit ..... \$200.00  
A&T ..... \$375.00

## SILENCE+ MOTHERBOARDS

These motherboards are among the quietest on the market. A unique grounding matrix — with each line completely surrounded by ground shielding — eliminates need for termination and gives high crosstalk rejection • They're customer-proven, without crosstalk sometimes operating at 14MHz • A LED power indicator helps eliminate zapped circuits • IEEE-100 std. compatible, available with 6, 8, 12, 18 or 22 slots • (The 22 slot board fits Imsai chassis and has slot for front panel.)

<b>6 Slot</b>	
Bare Board .....	\$ 25.00
Kit .....	\$ 40.00
A&T .....	\$ 50.00
<b>8 Slot</b>	
Bare Board .....	\$ 27.00
Kit .....	\$ 55.00
A&T .....	\$ 70.00
<b>12 Slot</b>	
Bare Board .....	\$ 30.00
Kit .....	\$ 70.00
A&T .....	\$ 90.00
<b>18 Slot</b>	
Bare Board .....	\$ 50.00
Kit .....	\$100.00
A&T .....	\$140.00

## QT MAINFRAMES

**5 1/4" Disk Mainframe with 18A Pwr Sup**  
MF+MD12 (12 slot M/B) ..... \$500.00  
MF+MD6 (6 slot M/B) ..... \$450.00  
MF+MD w/o M/B ..... \$400.00

**Q.T. Mainframe**  
MF+12 (12 slot M/B) ..... \$450.00  
MF+18 (18 slot M/B) ..... \$500.00  
MF+22 (22 slot M/B) ..... \$600.00

## MAINFRAME+ DISK DRIVE

Includes cabinet, 30 amp power supply, IEEE S-100 compatible 6, 8 or 12 slot motherboard and dual 8" disk drive with disk drive power supply.

MF+DD6 ..... \$625.00  
MF+DD8 ..... \$650.00  
MF+DD12 ..... \$675.00

## DDC-8

### SINGLE 8" DISK CABINET

Accepts one 8" disk drive (Shugart, Remex, PerSci, Siemens, etc.) • Fan cooled, with data cable and AC line filter to eliminate EMI • Operates from 100-125VAC/200-250VAC at 50-60Hz • Disk drive NOT included.

DDC+8 ..... \$175.00

PLACE ORDERS TOLL FREE  
1-800-421-5150  
(CONTINENTAL U.S. ONLY)  
(EXCEPT CALIFORNIA)

Apple is a trademark of Apple Computer, Inc.  
CP/M and MP/M are trademarks of Digital Research.  
TRS-80 is a trademark of Radio Shack.

Circle 329 on inquiry card.



COMPUTER  
SYSTEMS  
INC.

15620 South Inglewood Avenue  
Lawndale, California 90260  
(213) 970-0952

TERMS OF SALE: Cash, checks, money orders, credit cards accepted. Also C.O.D. orders under \$100.00. Minimum order \$10.00. California residents add 6% sales tax. Minimum shipping and handling charge \$3.00. Prices subject to change without notice. International sales in American dollars only.



# SALE SALE SALE

## Disk Drives



JADE's new dual disk sub-assemblies include: Handsome metal cabinet with proportionally balanced air flow system, rugged dual drive power supply, cooling fan, cable kit, lighted power switch, approved fuse assembly, line cord, Never-Mar rubber feet, and all necessary hardware to mount 2-8" disk drives - it's all American made, guaranteed for six months, and it's in stock!

Dual 8" Sub-Assembly Cabinet

END-000421 Cabinet kit ..... \$225.00  
END-000420 Bare cabinet ..... \$59.95

Single sided, double density disk drive sub-system  
END-000423 Kit w/2 8" drives .... \$975.00  
END-000424 A & T w/2 8" drives \$1195.00

Double sided, double density disk drive sub-system  
END-000426 kit w/2 8" drives .... \$1495.00  
END-000427 A & T w/2 8" drives \$1695.00

## JADE DISK PACKAGE

Double density controller, two 8" double density floppy disk drives, CP/M 2.2 (configured for controller), hardware and software manuals, boot PROM, cabinet, power supply, fan, & cables

Special package price ..... \$1395.00

## 8" Disk Drive Sale

Highly reliable double density floppy disk drives

Shugart 801R single sided, double density

MSF-10801R SA-801R ..... \$425.00  
Special Sale Price ..... 2 for \$790.00

Siemens FDD100-8D2 single sided, double density  
MSF-201120 6 mo warranty ..... \$385.00  
Special sale price ..... 2 for \$750.00

## Real Double-Sided Drives 8" Double-Sided Double-Density Sale

\*\*\*\*\*  
\* Shugart SA-851R double-sided, double-density \*  
\* only \$625.00 ea ..... 2 for \$1190.00 \*  
\*\*\*\*\*

MFE M701 8" double-sided, double-density drives  
only \$525 ea ..... 2 for \$1040.00

Qume Data Track 8 double-sided, double-density drives  
only \$575.00 ..... 2 for \$1100.00

## Printers

### CENTRONICS 737-1

9 x N dot matrix, letter quality, proportional spacing  
PRM-15737 Parallel ..... \$795.00  
With interface for Apple ..... \$895.00

### MX-80 - Epson

132 column, 9 x 9 dot matrix, multiple fonts  
PRM-27080 Save \$100.00 ..... \$545.00  
Interface for Apple ..... \$110.00



### SPINWRITER - NEC

65 cps, bi-directional, letter quality printer with deluxe tractor mechanism, both parallel and serial interfaces on-board, 16K buffer, ribbon, print thimble, graphics, micro space justification, data cable, and self test/diagnostic ROM.

PRD-55511 without 16K buffer ... \$2795.00  
PRD-55512 with 16K buffer ..... \$2895.00

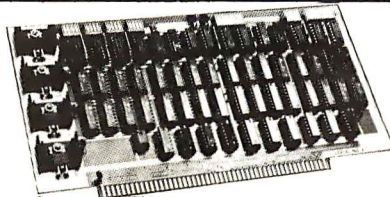
## S-100 Systems

### S-100 SYSTEM - Calif Computer Sys

Complete S-100 system including 12 slot mainframe, 4 MHz Z-80 CPU, 64K RAM memory, double density disk controller, RS-232 cable, 8" & 5 1/4" disk drive cables, CP/M 2.2, manuals, auto boot ROM, completely assembled & tested.

2210A Integrated & tested ..... \$1995.00  
2210B Not integrated ..... \$1795.00

## S-100 Memory



### 64K RAM - Calif Computer Sys

4 MHz bank port / bank byte selectable, extended addressing, 16K bank selectable, PHANTOM line allows memory overlay, 8080 / Z-80 / front panel compatible.

MEM-64565A A & T ..... \$449.95

### MEMORY BANK - Jade

4 MHz, 1EEE S-100, bank selectable, 8 or 16 bit

MEM-99730B Bare board ..... \$55.00  
MEM-99730K Kit, no RAM ..... \$219.95  
MEM-16730K 16K kit ..... \$249.95  
MEM-32731K 32K kit ..... \$289.95  
MEM-48732K 48K kit ..... \$324.95  
MEM-64733K 64K kit ..... \$359.95  
Assembled & tested ..... add \$50.00

### EXPANDORAM II - S D Systems

4 MHz RAM board expandable from 16K to 256K

MEM-16630K 16K kit ..... \$275.95  
MEM-32631K 32K kit ..... \$295.95  
MEM-48632K 48K kit ..... \$315.95  
MEM-64633K 64K kit ..... \$335.95  
Assembled & tested ..... add \$50.00

### 32K STATIC RAM - Jade

2 or 4 MHz expandable static RAM board uses 211 H's  
MEM-16151K 16K 4 MHz kit ..... \$169.95  
MEM-32151K 32K 4 MHz kit ..... \$299.95  
Assembled & tested ..... add \$50.00

### 16K STATIC RAM - Cal Comp Sys

2 or 4 MHz 16K static RAM board, IEEE S-100, bank selectable, Phantom capability, addressable in 4K blocks  
MEM-16160A 16K 2 MHz A & T ... \$286.95  
MEM-16162A 16K 4 MHz A & T ... \$289.95  
MEM-16160B Bare board ..... \$50.00

### PB-1 - S.S.M.

2708, 2716 EPROM board with built-in programmer  
MEM-99510K Kit ..... \$154.95  
MEM-99510A A & T ..... \$229.95

### PROM-100 - SD Systems

2708, 2716, 2732, 2758, & 2516 EPROM programmer  
MEM-99520K Kit ..... \$219.95  
MEM-99520A Jade A & T ..... \$269.95

## S-100 Video

### VB-3 - S.S.M.

80 characters x 24 lines expandable to 80 x 48 for a full page of text, upper & lower case, 256 user defined symbols, 160 x 192 graphics matrix, memory mapped, has key board input.

IOV-1095K 4 MHz kit ..... \$375.00  
IOV-1095A 4 MHz A & T ..... \$450.00  
IOV-1096K 80 x 48 upgrade ..... \$39.95

### VIDEO BOARD - Jade

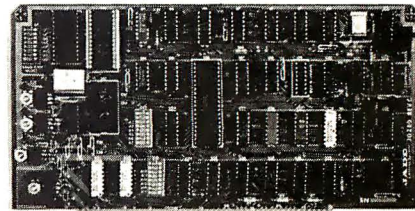
64 characters x 16 lines, 7 x 9 dot matrix, full upper/lower case ASCII character set, numbers, symbols, and greek letters, normal/reverse/blinking video, S-100.

IOV-1050K Kit ..... \$99.95  
IOV-1050A A & T ..... \$125.00  
IOV-1050B Bare board ..... \$19.95

## S-100 CPU

### 2810 Z-80\* CPU - Cal Comp Sys

2.4 MHz Z-80A\* CPU with RS-232C serial I/O port and on-board MOSS 2.2 monitor PROM, front panel compatible.  
CPU-30400A A & T ..... \$269.95



### THE BIG Z\* - Jade

2 or 4 MHz switchable Z-80\* CPU with serial I/O, accommodates 2708, 2716, or 2732 EPROM, baud rates from 75 to 9600

CPU-30201K Kit ..... \$145.00  
CPU-30201A A & T ..... \$199.00  
CPU-30200B Bare board ..... \$35.00

### CB-2 Z-80 CPU - S.S.M.

2 or 4 MHz Z-80 CPU board with provision for up to 8K of ROM or 4K of RAM on board, extended addressing, IEEE S-100, front panel compatible.

CPU-30300A A & T ..... \$229.95

### SBC-200 - SD Systems

4 MHz Z-80\* CPU with serial & parallel I/O ports, up to 8K of on-board PROM, software programmable baud rate generator, 1K of on-board RAM, Z-80 CTC.

CPC-30200K Kit ..... \$339.95  
CPC-30200A Jade A & T ..... \$399.95

## S-100 Disk Controller

### DOUBLE DENSITY - Cal Comp Sys

5 1/4" and 8" disk controller, single or double density, with on-board boot loader ROM, and free CP/M 2.2\* and manual set.

IOD-1300A A & T ..... \$369.95

### DOUBLE-D - Jade

Double density controller with the inside track, on-board Z-80A\*, printer port, IEEE S-100, can function on an interrupt driven buss

IOD-1200K Kit ..... \$299.95  
IOD-1200A 8" A & T ..... \$389.95  
IOD-1205A 5 1/4" A & T ..... \$389.95  
IOD-1200B Bare board ..... \$65.00

### VERSAFLOPPY II - SD Systems

New double density controller for both 8" & 5 1/4"

IOD-1160K Kit ..... \$379.95  
IOD-1160A Jade A & T ..... \$439.95

## Motherboards

### ISO-BUS - Jade

Silent, simple, and on sale - a better motherboard

6 Slot (5 1/4" x 8 3/4")

MBS-061B Bare board ..... \$19.95  
MBS-061K Kit ..... \$39.95  
MBS-061A A & T ..... \$49.95

12 Slot (9 1/4" x 8 3/4")

MBS-121B Bare board ..... \$29.95  
MBS-121K Kit ..... \$69.95  
MBS-121A A & T ..... \$89.95

18 Slot (14 1/2" x 8 3/4")

MBS-181B Bare board ..... \$49.95  
MBS-181K Kit ..... \$99.95  
MBS-181A A & T ..... \$139.95

## Card Cages

### S-100 CARD CAGE - Jade

Metal cage with card guides & fan mounting

ENX-106001 Six slot ..... \$29.95

### S-100 CARD CAGE - Vector

19" rack mountable, adjustable, holds 21 cards

VCT-CKK100 Anodized Al ..... \$49.95

# SALE

## S-100 I/O

### S.P.I.C. - Jade

Our new I/O card with 2 SIO's, 4 CTC's, and 1 PIO

IOI-1045K 2 CTC's, 1 SIO, 1 PIO .. \$199.00  
 IOI-1045A A & T ..... \$259.00  
 IOI-1046K 4 CTC's, 2 SIO's, 1 PIO ..... \$259.00  
 IOI-1046A A & T ..... \$319.00  
 IOI-1045B Bare board w/ manual ... \$59.95  
 IOI-1045D Manual only ..... \$20.00

### I/O-4 - S.S.M.

2 serial I/O ports plus 2 parallel I/O ports

IOI-1010K Kit ..... \$179.95  
 IOI-1010A A & T ..... \$249.95  
 IOI-1010B Bare board ..... \$35.00

### TERMINATOR - S.S.M.

Active terminator for S-100 bus

TSX-195K Kit ..... \$29.95  
 TSX-195A A & T ..... \$54.95  
 TSX-195B Bare board ..... \$22.95

### S-100 EXTENDER - Cal Comp Sys

Put those problem boards (the ones you probably bought from one of our competitors) within easy reach.

TSX-160A A & T ..... \$37.95

### S-100 PROTO BOARD - Jade

Universal design, plated thru holes, gold fingers

TSX-140B Bare board ..... \$24.95

### TERMINATOR & EXTENDER - C.C.S.

Can be used as both an S-100 extender and terminator

TSX-150K Kit ..... \$43.95

## Diskettes

### DISKETTES - Jade

Bargain prices on magnificent magnetic media

5 1/4" single sided, single density, box of 10

MMD-5110103 Soft sector ..... \$27.95  
 MMD-5111003 10 sector ..... \$27.95  
 MMD-5111603 16 sector ..... \$27.95

5 1/4" double sided, double density, box of 10

MMD-5220103 Soft sector ..... \$39.95

8" single sided, single density, box of 10

MMD-8110103 Soft sector ..... \$33.95

8" single sided, double density, box of 10

MMD-8120103 Soft sector ..... \$39.95

8" double sided, double density, box of 10

MMD-8220103 Soft sector ..... \$49.95

## Video Monitors

### 9" B & W MONITOR - A.P.F.

High quality, high resolution video monitor

VDM-750900 9" monitor ..... \$159.95

### 13" COLOR MONITOR - Zenith

The hi res color you've been promising yourself

VDC-201301 ..... \$449.00

### 12" GREEN SCREEN - NEC

20 MHz, P31 phosphor video monitor with audio, exceptionally high resolution - A fantastic monitor at a very reasonable price

VDM-651200 12" monitor ..... \$259.95

## Mainframes

### MAINFRAME - Cal Comp Sys

12 slot S-100 mainframe with 20 amp power supply

ENC-112105 Kit ..... \$359.95  
 ENC-112106 A & T ..... \$419.95

### DISK MAINFRAME - NNC

Holds 2 8" drives and an 8 slot S-100 system. Attractive metal cabinet with 8 slot motherboard, power supply, fan, key switch, and other professional features

ENS-112320 with 30 amp p.s. .... \$699.95

# SALE

## Accessories-Apple/TRS-80



### 16K MEMORY UPGRADE

Add 16K of RAM to your TRS-80, Apple, or Exidy in just minutes. We've sold thousands of these 16K RAM upgrades which include the appropriate memory chips (as specified by the manufacturer), all necessary jumper blocks, fool-proof instructions, and our 1 year guarantee.

MEX-16100K TRS-80 kit ..... \$29.00  
 MEX-16101K Apple kit ..... \$29.00  
 MEX-16102K Exidy kit ..... \$29.00

### DISK DRIVE for APPLE

5 1/4" disk drive with controller for your Apple

MSM-12310C with controller ..... \$499.95  
 MSM-123101 w/out controller ..... \$375.00

### DISK DRIVES for TRS-80

23% more storage, 8 times faster, 40 track with free patch, 120 day warranty, includes case, power supply, and cable

MSM-12410C Save \$125.00 !!! ..... \$299.95

### DOS 3.3 UPGRADE - Apple

Upgrade your old DOS to the improved 3.3

IOD-2233A Complete kit ..... \$64.95

### APPLE STICK - Micromate

Joy stick with pots for Apple II

SYA-1510A A & T ..... \$35.95

### Z-80\* CARD for APPLE

Z-80\* CPU card with CP/M 2.2 for your Apple

CPX-30800A A & T ..... \$279.95

### AIO - S.S.M.

Parallel & serial interface for your Apple

IOI-2050K Kit ..... \$155.95  
 IOI-2050A A & T ..... \$194.95

### PRINTER INTERFACE - C.C.S.

Centronics type I/O card w/ firmware

IOI-2041A A & T ..... \$99.95

### APPLE CLOCK - Cal Comp Sys

Real time clock w/ battery back-up

IOK-2100A A & T ..... \$109.95

## Modems

\*\*\*\*\*

**LEX-11 MODEM - Lexicon**

A real star! 300 baud, answer/originate, RS 232C

IOM-5511A Best buy !!! ..... \$128.00

\*\*\*\*\*

### NOVATION CAT

300 baud, answer/originate acoustic modem

IOM-5200A 1 year warranty ..... \$179.00

### D-CAT 300 baud, direct connect modem

IOM-5201A Special sale price ..... \$189.00

### AUTO-CAT Auto answer/originate, direct connect

IOM-5230A Special sale price ..... \$239.95

### MICROMODEM - D.C. Hayes

Auto answer/dial modem card for Apple or S-100

IOM-2010A Apple modem ..... \$349.95  
 IOM-1100A S-100 modem ..... \$375.00

### MICRONET MODEM - Micromate

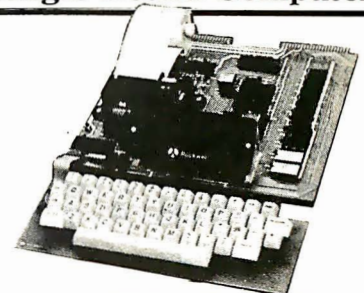
Direct connect with extra features - a best buy

IOM-2020A Best Apple modem .... \$275.00

\* Z-80, Z-80A, and the letter Z are recognized trademarks of Zilog, Inc. \*CP/M is a registered trademark of Digital Research Corp. \*CBASIC is a trademark of Compiler Systems, Inc.

# SALE

## Single Board Computers



### AIM-65 - Rockwell

6502 computer with alphanumeric display, printer, & keyboard, and complete instructional manuals

CPK-50165 1K AIM ..... \$374.95  
 CPK-50465 4K AIM ..... \$449.95  
 SFK-74600008E 8K BASIC ROM ... \$99.95  
 SFK-64600004E 4K assembler ROM \$84.95  
 PSX-030A Power supply ..... \$64.95  
 ENX-000002 Enclosure ..... \$49.95

4K AIM, 8K BASIC, power supply, & enclosure

Special package price ..... \$625.00

### Z-80\* STARTER KIT - SD Systems

Complete Z-80\* computer with RAM, ROM, I/O, display, keyboard, manual, and kluge area.

CPS-30010K Kit ..... \$369.95  
 CPS-30010A Jade A & T ..... \$459.95

### MICROPROCESSORS

Z-80	10.95	2708 450ns	6.25
Z-80A	12.95	10 for \$4.90 ea	
6502	11.50	2714L 2 MHz	11.95
6800	11.95	2716 5v	11.95
6802	17.95	10 for \$8.90 ea	
6809	39.95	2532 5v	39.95
8035	24.00	2732 5v	39.95
8080A	6.59	2758 5v	9.95
8085	15.95		
8748	59.95		

### PROMS

Z-80 SUPPORT		RAMS	
3881 PIO	9.50	21102 2 MHz	1.25
3881A PIO 4 MHz	14.50	21102A 4 MHz	1.50
3882 CTC	9.50	2114L 2 MHz	3.75
3882-4 CTC 4 MHz	14.95	2114LA 4 MHz	3.95
3883 SIO	29.50	4116	4.25
3884 SIO	49.50	4164 61K x1	59.95
		5257 2 MHz	6.75
		5257A 4 MHz	7.25
		MK4118	18.95

### BAUD RATE GENERATORS

MC14411	10.00	SUPPORT DEVICES	
1.843 MHz xtal	4.95	8212	3.25

### UARTS

AY5-1013A	5.25	8214	4.65
AY3-1014A	8.25	8216	2.95
TR1602B	5.25	8221	3.25
TMS6011	5.95	8224-4	5.75
IM6402	9.00	8226	3.85
		8228	4.95
		8238	4.95
		8243	8.00
		8250	14.95
		8251	6.50
		8253	17.95
		8255	6.50
		8257	19.95
		8259	17.95
		8275	49.95
		8279	15.95

## PLACE ORDERS TOLL FREE

Continental U.S. Inside California

800-421-5500 800-262-1710

For Technical Inquiries or Customer Service call

213-973-7707

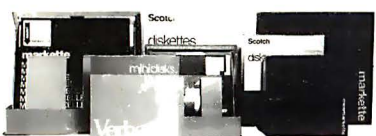
**JADE**  
Computer Products

4901 W. Rosecrans, Hawthorne, Ca 90250

TERMS OF SALE: Cash, checks, credit cards, or Purchase Orders from qualified firms and institutions. Minimum order \$15.00. California residents add 6% tax. Minimum shipping and handling charge \$3.00 Pricing and availability subject to change without notice.

# California Digital

Post Office Box 3097 B • Torrance, California 90503



## DISKETTES

FREE PLASTIC LIBRARY CASE INCLUDED WITH THE PURCHASE OF EVERY BOX OF DISKETTES

Private labeled for California Digital by one of the most respected producers of magnetic media. Each diskette is certified double density at 40 tracks. To insure extended media life each diskette is manufactured with a reinforced hub-hole. And of course, a plastic library case is included with every box of diskettes. MCD-CDS(01/10) Please specify computer or required sectors.

**\$24.95**  
BOX

Ten boxes \$22.75 One hundred boxes \$21.50

MINIDISKETTES	Box	10 boxes	Box	10 boxes
Memorex 3401	\$27.00	\$25.00	Box	\$20.00
Verbatim 525(01/10)	20.00	27.00	Box	43.00

EIGHT INCH	Scotch box	10 bx.	Dynas box	10 bx.	MRX box	10 bx.
Single side/single den.	740-0	\$35. \$33.	3740/1	\$49. \$47.	3060	\$5. \$3.
Single side/double den.	741-0	45. \$43.	3740/1d	75. \$73.	3090	37. \$35.
Single side/32 sector	742-0	25. \$23.	na.	na.	na.	na.
Double side/double D.	743-0	65. \$59.	na.	3115	49. \$45.	na.

SCOTCH brand head cleaning kit. \$24.95 MMA-CK(5/8) please specify 5 1/4" 8"

Prices available on request for: tape, cartridges, diskpacks, volum diskettes.

## MEMORY

TRS-80 \$29  
APPLE II  
16k memory (8) 4116's

Installation is simple. Anyone who has ever changed a spark plug should be able to up-grade his microcomputer. How can California Digital offer these memory up-grade sets at 25% below our competition? Simple, we buy in volume, wholesale to dealers and sell the balance directly to owners of personal microsystems. These 16K dynamic memory circuits are factory prime and unconditionally guaranteed for one full year. NOW, before you change your mind, pick up the telephone and order your up-grade memory from California Digital. Add \$3 for TRS80 jumpers.

STATIC	1-31	32-99	100-5C	-999	1K+
21L02 450nS.	1.19	.99			
21L02 250nS.	1.49	1.39			
2114 1Kx4 450	5.95	5.50	5.25	4.75	4.50
2114 1Kx4 300	8.95	8.50	8.00	*	*
4044 4Kx1 450	5.95	5.50	5.25	*	*
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.	5.95	5.50	5.00	4.80	4.60

## 2716 EPROM SALE \$9.95

We have slashed price in an effort to reduce our over stocked inventory. These are single five volt EPROMs manufactured by one of the Worlds largest producers of semiconductors. All are first quality prime devices. Ceramic 450nS.

## FREE ULTRA-Violet Products UVS 11-E UV EPROM ERASER

With purchase of FORTY 2716 EPROM's \$79 value

NEW from Shugart Technology

## 5 Megabyte Hard Disk Drive

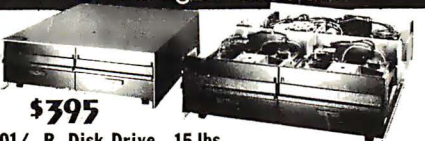


Packaged in the same physical size as the industry standard 5 1/4" minifloppy disk drive. The micro-Winches-ter stores thirty times as much data (6.38 megabytes unformatted), accesses data twice as fast (170 milliseconds) and transfers data twenty times faster (5.0 megabits per second.)

The ST506 is factory sealed to protect the media from environmental contaminants. Requires only DC voltage. Dual California Digital 5 1/4" enclosure. **\$1500**

Shugart Associates SA400 removable media disk drive for above package. add: **\$300**  
S-100 & Apple controller scheduled for spring release.

Shugart Associates



## 801/R Disk Drive 15 lbs.

Shugart 801/R with CP 206 power supply, muffin exhaust fan, complete in dual enclosure with all the necessary harnessing cables. Documentation included. 30 pounds. MSD-1801  
Same as above but with two Shugart 801H disk drives. **\$795**  
50 pounds. MSD-2801  
Disk drive cable, 6 feet 50 conductor with edge card connector at both ends. WCA-650S \$25.00  
Export Disk drives. 220V, 50Hz add \$50.00 per disk drive. **\$1195**



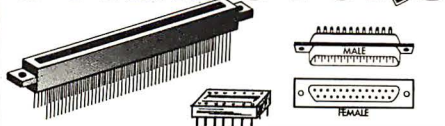
The new BSR timer runs your home just like clockwork. Turns on lamps and appliances while you're away from home. Completely compatible with your existing System X-10 devices.  
BSR Timer eight channel \$85.00  
Master control console 34.95  
Ultrasonic Controller 19.95  
Appliance Module 500 W. \$13.95  
Lamp Module 300 Watts 13.95  
NEW full control wall switch 14.50



## Rotron Wisper Fan \$14.77

115 VAC. 7 Watts WR2A1  
Factory fresh Muffin fans  
NOT pull-outs. EMF-4M

## CONNECTORS



GOLD EDGE CONNECTORS	each	each	each	each	each
5-100 .125" centers	10+	\$2.55	\$2.50		
Imasi solder, .250" row		3.95	3.50		
Imasi wire wrap (TI)		4.50	4.00		
Sullins Hi-Rel. .250"		5.25	4.00		
Sullins Hi-Rel. W/W		4.95	4.50		
Sullins Altair. .140"					
.156" Centers (standard)					
22/44 Mini Eyelet	2.50	2.15			
36/72 Digital Group S/T	5.50	5.50			
36/72 Digital Group W/W	6.60	6.15			
43/86 Motorola 6800S/T	6.60	6.15			
43/86 Moto. 6800 W/W	7.00	6.65			
INTEGRATED CIRCUIT SOCKETS	each	each	each	each	each
Low Profile	each	100+	each	100+	each
8 pin	\$1.00	\$1.00	\$1.40	\$1.40	
14 pin	.10	.09	.45	.45	
16 pin	.12	.11	.50	.50	
18 pin	.15	.13	.60	.61	
24 pin	.26	.24	.94	.87	
40 pin	.42	.40	1.60	1.47	
"D" Type	each	10-21	25+		
DE9P male	\$1.60	\$1.40	\$1.30		
DE9S female	2.25	2.00	1.80		
DE hood	1.50	1.25	1.20		
DA15P male	2.25	2.15	2.00		
DA15S female	3.25	3.10	2.80		
DA hood 2/P	1.60	1.25	1.20		
DB25P male	2.50	2.35	2.25		
DB25S female	3.35	3.15	3.05		
DB hood 2/P	1.35	1.15	1.05		
BC15P male	4.20	4.00	3.70		
UC37S female	6.00	5.75	5.50		
DC hood 2/P	2.25	2.00	1.75		
DD50P male	5.50	5.10	4.75		
DD50S female	8.40	8.60	8.00		
DD50 hood 2/P	2.60	2.40	2.10		
CENTRONICS	each	7.95	6.75	5.75	
37-30360					
RIBBON CABLE CONNECTORS	each	each	each	each	each
17/24 8" disk	4.85	4.15	3.55		
20/40 TRS-80	5.65	5.05	4.70		
25/50 8" disk	5.90	5.15	4.90		

## SURPLUS



**S-100 POWER SUPPLY KIT \$59**  
18V. ct  
9VDC  
22V. ct  
24V. disk  
15V.  
15V.  
Fan

Kit contains five high current bridge rectifiers, five computer grade electrolytic capacitors and a 700+ watt split primary transformer (110/220V). The supply is capable of supporting a full 30 amp S-100 system along with (2) eight inch disk drives.  
Electrolytic capacitors consist of: one each 63,000 uF/15V; 34,000 uF/40V; 26,000 uF/50V; and two 12,000 uF/50V.  
All components are surplus acquired from excess inventory of the National Cash Register Company.  
Please place your order early, at this low price we expect this kit to be a quick sell out. SPC-1W100. ... Shipping: East of Mississippi add \$15.00 California add \$8.00 all other states please add \$11.00 Foreign \$21.00



## DATA INPUT TERMINAL

This Keystroke terminal was recently acquired from the CMC division of the Partron Corporation. The unit was originally designed for inputting data directly onto magnetic tape.

The system is comprised of a premium cast aluminum and fiberglass enclosure, along with a Honeywell Microswitch hall effect keyboard. Thirty display lamps advise the operator of the systems status. Four inch loud speaker acknowledges acceptance of data and alerts the operator of pending problems.  
But most of all this "USER" terminal, with a little imagination, can be engineered to make the perfect home for an S-100 computer and video display; or with slight modification will accept the Rockwell AIM-85 micro computer.  
Five volt regulated power supply is available for an additional \$20. (see June Byte) All units are in excellent condition. Original acquisition over \$700. 22 lbs.



## PORTABLE DATA ENTRY SYSTEM

These used data terminals were originally designed for retail store order entry systems. The operator enters the inventory control number, merchandise on hand and the unit price. After all pertinent data has been entered, the main warehouse is telephoned, the handset is placed in the acoustic coupler and all the recorded information is transmitted back the master computer.  
Each system includes: Cassette drive unit; Removable hex keyboard with LED display; Five Genuy's with charger; Acoustical coupler and DB25 cable.  
All units removed from service in working condition. Original cost over \$500.



## Regulated Power Supply \$1195 5 VOLT 5AMP

This USED surplus power supply was removed from working equipment. Pass transistor regulation outputs five volts at a conservative five amps. Suitable for T T L hobby applications. SPC-PSI 8 pounds.



## \$59 Sankyo Magnetic Card Transport

This Sankyo card transport is capable of storing and retrieving over 400 characters of data from a single 2x4" HP style magnetic data card. Motorized mechanism pulls the magnetic card across the four channel read/write head in under two seconds. Ideal for any data processing application where small amounts of information must be randomly retrieved. Original cost over \$200.00 Documentation and sample card included. New surplus. SPC-SCR



**WESTERN UNION ENCLOSURE \$24.95**  
These enclosures were manufactured for Western Union by Universal Technology. The exact purpose of the product is still a mystery but the enclosure is ideally suited for an S-100 mother board with shielded power supply. Removable hood and piezoelectric front make this enclosure an attractive home for any hobby product.  
New surplus in factory boxes supplied with three 27/44 edge connectors; DB 25S communications connector; six foot grounded power cord and more. Inside dimensions: 19" x 10 1/2" x 6 7/8" Shipping weight 8 lbs.

TOLL FREE ORDER LINE  
**(800) 421-5041**  
TECHNICAL & CALIFORNIA  
**(213) 679-9001**



All merchandise sold by California Digital is premium grade. Shipping: First five pounds \$2.00; each additional add \$.40 Foreign orders 10% shipping. Excess will be refunded. California residents add 6% sales tax. COD's discouraged. Open accounts extended to state supported educational institutions and companies with a "Strong Dun & Bradstreet." Warehouse: 15608 Inglewood Blvd. Visitors by appointment.

# California Digital

Post Office Box 3097 B • Torrance, California 90503



## MEMOREX 8" DISKETTES

**\$25** WITH  
FREE  
LIBRARY  
CASE

Recently the Memorex Corporation had a cancellation on a contract for a truck load of eight inch diskettes. California Digital was fortunate to be offered this load of prime magnetic media.

These diskettes are "UNHANDLED" by any guaranteed first quality Memorex Brand. (3000 single don.) Like all diskettes sold by California Digital, a library case is supplied free with the purchase of every box. This offer is subject to remaining inventory on hand.

## IBM 3101 DISPLAY TERMINAL

The new 3101 display terminal is the IBM entry into the plug compatible micro computer industry.

This modularly constructed CRT terminal has been engineered with the user in mind. The video display module service and tilt to provide the operator with a comfortable viewing posture.

Twelve inch P-39 green phosphor screen boasts a crisp 7 by 14 character matrix.

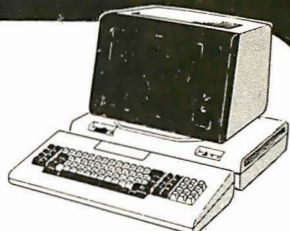
Standard 80 by 24 line screen format with a 23kh line to display machine status and aid in the diagnostics in the event of a system malfunction.

87 key Selectric style keyboard arrangement along with numeric entry pad. Eight user definable function keys.

The 3101 video terminal is RS232C compatible and displays all 128 ASCII characters including control codes.

Accessible customer setup switches aid in choosing such options as line speed, parity, scroll, and reverse video.

But most of all, built into every 3101 terminal is the quality that you have learned to expect from the IBM Corporation. YDT-3101



IBM direct price \$1295  
CALIFORNIA DIGITAL  
discount price  
**\$1195** immediate  
deliver



## SUPER BUY



## NEW from INTEGRAL DATA 460 Paper Tiger with GRAPHICS \$1150

The 460 Paper Tiger uses a dot matrix character formation technique in which the placement of the dots overlap both horizontally and vertically to achieve a correspondence quality printing.

The printer is nine-wire print head uses staggered needle rows to create the vertically overlapping dots. The head is driven bi-directionally under microprocessor control by a stepper motor driven mechanism.

"Two K" buffer allows the printer to accept the entire content of a 1,920 character CRT screen. With graphics suggested retail price \$1,395 27 lbs. PRG-1600

## NEC Spinwriter 5510P/S \$2795



The word processing quality Spinwriter prints at speeds up to 55 characters per second. The Model 5510P/S is supplied with both parallel and RS-232 serial interfaces. Also included is the tractor feed mechanism, along with print thickness and ribbon. PRN-3310P/S 70 lbs. Keyboard (KSH) Model 5520P/S available \$2995. PRN-3520P/S 75 lbs.



## TEC V-300 Word Processing Daisy Wheel Printer \$1595

Finally a reasonably priced letter quality printer... Bi-directional printing at 25 characters per second. Full 136 print positions wide. Proportional spacing 1/120" horizontal, 1/48" vertical. Uses standard Diablo brand interchangeable daisy print wheels. Standard Diablo brand interchangeable daisy print wheels. Interfaces via Centronics parallel connector. Shipping 58 lbs. PRV-300.

## TELETYPE MODEL 43

### 4320 KEYBOARD MODELS

TTL serial output	AAA	\$ 995
RS232 serial	AAK	1050
Friction 80 column	AAE	1100
Friction 80 RS232	AAL	1195
Bell 103 Modem	AAB	1495



## EPSON MX-80 \$495

The MX-80 is a 9x9 80 character per second dot matrix printer. Tractor feed mechanism adjusts to accept ten inch wide continuous paper. Requires "Eight bit" Centronics type parallel interfacing. PRE-MX80 17 lbs.

## CENTRONICS

730	\$595
737	\$750



Both the Centronics 730 and the 737 are capable of accepting standard office letterhead or pin feed continuous forms. For higher resolution the 737 implements a nine wire dot matrix print head. Parallel interfacing. Add \$65 for RS232. PRC-730P (S). PRC-737P (S) 17 lbs.



## HEWLETT PACKARD \$2650



The Hewlett-Packard HP-85 is a complete, low cost portable computer system. This self contained package includes CPU, keyboard, printer, CRT display and cassette tape drive. SYS-HP85 30 lbs.



## 26 Megabyte Hard Disk Drive from GEORGE MORROW'S Thinker Toys \$3950

Other Morrow Products.  
Additional hard disk 33450  
3126 hard disk controller 825  
Discus 2D 1 drive 1027  
Discus 2D 2 drives 1210  
Discus 2D 1 drive 2237  
Discus 2D 2 drives 2237

Disc Jockey 2D controller \$345  
Disk Jockey 1 Controller 195  
3126 hard disk controller 825  
Switchboard interface 219  
3126 Multi-board 275  
31-10 Ten Megabyte hard 1350



## AMPEX DIALOGUE 80 CRT TERMINAL \$995

New from the Amplex Corporation. The Dialogue 80 features removable keyboard, displayable two pages (four optional) dual program keys, half intensity protected fields and status line. Transmits data either block, line or character mode. Excellent value. YDT-D80 shipping 47 lbs.



## BMC VIDEO MONITOR \$259

Green phosphor with 18 MHz bandwidth, composite video input make the BMC KG-12C an ideal monitor for anyone requiring a high resolution 12" display. High impact plastic enclosure assures that the BMC monitor is a rugged piece anywhere in the instrument. For added protection the unit is equipped with a removable smoked non-flare polycarbonate screen. VBM-BMC 18 lbs.



## direct connect MODEM Your Choice \$169

Direct connect modems eliminate loss of information due to the compression associated with acoustic modems. Choose either of these two great units.

The Universal Data Systems 103LP is switch selectable between answer and originate modes. Fully Bell 103 compatible. Directly connects to the new modular telephone jack. 100% powered from the telephone line. No need to locate modem in proximity to A.C. power receptacle. MOD-103LP 2 pounds.

Novation "D" Cat connects to most of the new "Bell" modular handsets. Ideal for multiple line office telephones. Requires external A.C. power. MOD-DCAT 2 lbs.

## ACCESSORIES FOR THE APPLE COMPUTER

### CALIFORNIA COMPUTER SYSTEMS

Arithmetic Processor 7811 B/C	\$319
Asynchronous serial interface 7710	129
Centronics interface card 7728	95
12K PRGM Memory 7113	69
Calendar/Clock, Bat. back-up 7424	99
Parallel interface 7729A	99
Programmable Timer 7740A	99
Analog/Digital converter 7470A	99

### MICROSOFT PRODUCTS

Apple to Z-80 CPU card 379

### D.C. HAYES PRODUCTS

Micro modem for Apple 319

### COMPUTER STOP PRODUCTS

Double Vision / 40 Column Video 250

### INTERACTIVE STRUCTURES

16 Channel A/D card AIO/2 275

### MOUNTAIN COMPUTER PRODUCTS

Intro X-10 system for BSR \$239

Intro X-10 card only 165

16 channel AD/DA 8 bit 319

Apple Clock battery back-up 225

Supertalker SD200 245

ROM Plus with filter 165

ROM Writer/Programmer 119

### APPLE BRAND PRODUCTS

Apple Language card 450

Floppy disk with controller 500

Floppy disk without controller 495

Apple parallel interface 175

SSM MICROCOM DIGITAL 475

Dual serial parallel interface AIO 250

SORRENTO VALLEY ASSOCIATES 275

8" floppy controller (Pascal) 360

## S-100 BOARDS

Assembled • Tested • Burned-in

### MEASUREMENT SYSTEMS

Dynamic memory DMB-6100 \$770

Dynamic memory DMB-3200 700

### GOBOUT/COMPUPRO

Dual 8088/8085 16 bit CPU 375

Z-80 CPU 24 bit address 4 MHz 239

Static RAM 32K (Alphac Micro) 575

Spectrum color graphics board 329

Interface II I/O board 189

### SEATTLE COMPUTER PRODUCTS

8086 16 bit CPU 2 card 48 pins 595

### CALIFORNIA COMPUTER SYSTEMS

S-100 Mainframe 2200A 329

Disk controller/2 2 CPAN 2422 329

Z-80 CPU 4MHz DMB 2810A 250

### DIGITAL RESEARCH

32K 2716 EPROM board 99

EPROMs for above 2716 16 req. 13

### CALIFORNIA DATA CORPORATION

A/D board 16 channel 12 bit 135

### QT COMPUTER SYSTEMS

Real time clock/calendar 135

### MORROW / THINKER TOYS

Multi-board "NEW" Daisy wheel port, real time clock, power on dump, program interrupt con't 3P/3S \$275

Switchboard interface 4P/2S 219

Disk Jockey I disk controller 195

Disk Jockey II double density 375

### SD SALES

PROXI-100 programmer 189

Video display board 8024 Versateasy 3740 controller 375

### MULLEN PRODUCTS

Extender board/Logic probe (kit) 49

Relay Opto-control board 145

### D.C. HAYES PRODUCTS

Micro modem S-100 FCC register 375

### ARTEC ELECTRONICS

Wire Wrap proto board WW/100 22

General Purpose proto GP/100 22

### CALIFORNIA DIGITAL

8086 CPU 4K on board static RAM 430

## TELETEK

## SINGLE BOARD COMPUTER FLOPPY DISK CONTROLLER

The TDC-1 features the Z-80 CPU along with the NEC 765 floppy disk controller. The board supports both single or double density 5 1/4 or 8" disk drives. Two serial (45-9500b) and two parallel ports add to the flexibility of this single board computer. Other standard features are real time clock, reset jump to monitor, vectored interrupt and potential for controlling a Winchester hard disk drive. With the addition of an external 25 volt power supply the Teletex board becomes capable of programming 2716 EPROMS. (DCC-1DC1)



\$695

## S-100 Mother Board \$35

## Quiet Buss

8803-18  
18 slot  
1MSAI



The Quiet Buss from California Digital 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 epoxy glass.

TOLL FREE ORDER LINE  
**(800) 421-5041**  
TECHNICAL & CALIFORNIA  
**(213) 679-9001**

All merchandise sold by California Digital is premium grade. Shipping: First five pounds \$2.00; each additional add \$3.40 Foreign orders 10% shipping. Excess will be refunded. California residents add 6% sales tax. COD's discouraged. Open accounts extended to state supported educational institutions and companies with a "Strong Dun & Bradstreet." Warehouse: 15608 Inglewood Blvd. Visitors by appointment.

Circle 321 on inquiry card.

# IMAGINE THE 8 INCH FLOPPY

315K BYTES PER SIDE ON 5 1/4" OF COURSE! Micropolis, the worlds largest manufacturer of high density 5 1/4" disk drives, has been doing it for years. And reliably at that.

An ordinary 5 1/4" floppy provides just 35 tracks per side and stores only 70K bytes. This is not nearly enough for anything useful, so instead, Micropolis uses 77 tracks per side. Each track is then formatted with 16 sectors (hard) at 256 bytes per sector yielding an impressive 315K bytes per side.

Micropolis drives have a larger capacity than many 8" disk drives, though it only occupies the space of a 5 1/4" floppy. The 315K byte capacity is roughly 4 times the capacity of a standard 5 1/4" drive. This is what we call QUAD DENSITY.

To achieve the high density capability, you may think Micropolis had to sacrifice speed or reliability. NOT SO! The track to track access time is only 30us with a high speed data transfer rate of 250,000 bits per second.

By creating this high density format, Micropolis is able to keep your initial subsystem costs to a minimum. Your cost is less than \$.002 per byte. That's a BIG VALUE in a small package.

MICROPOLIS disk subsystems are expandable to keep up with your ever increasing needs. Up to four drives/heads may be daisy-chained on one S-100 controller board. With all four drives/heads in operation, you have access to over 12 MEGABYTES of on-line storage.

WITH MICROPOLIS, complete means COMPLETE. Each subsystem comes complete with controller interface, cable, and software. The software includes the MDOS operating system, extended basic, assembler and editor. Everything you need to get "On Line" in one complete package.

MICROPOLIS provides total integration which means they control everything from beginning to end. The result is a better drive for you, backed by a full 120 day factory guarantee.

Anyone can cut price by cutting out capacity or valuable features. But there's no long term advantage in it. Not for the user. Or the builder.

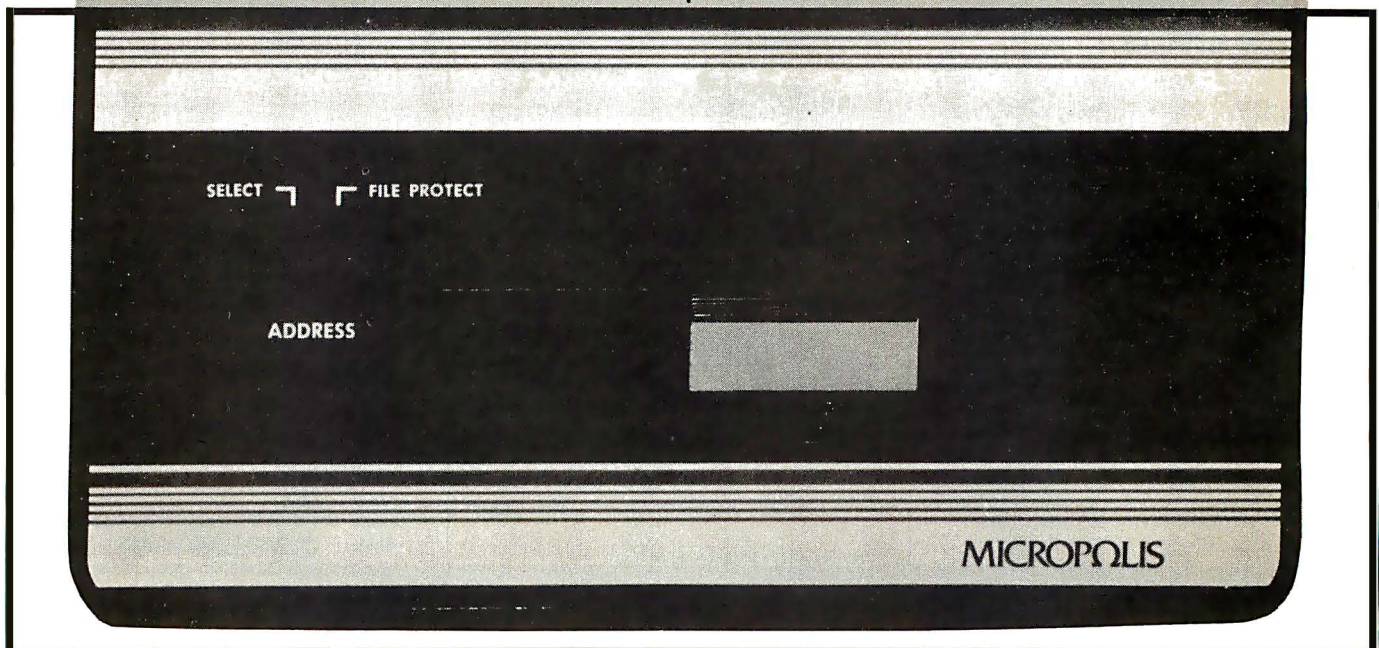
MICROPOLIS takes a better approach, even though it's harder, using advanced design to provide more capability while also lowering cost.

For example, most 5 1/4-inch floppy disks cut costs by using a cheap, less accurate plastic cam or cam follower to position the read/write head. Most 8-inch floppy disks use a better approach, with a rolled steel lead screw for this function.

We go them one better and use an all-steel system, with a precision-ground steel lead screw and steel follower. It costs more but gives us greater storage capacity with lower cost per thousand bytes. Not so incidentally, our steel construction (compared to plastic) significantly increases reliability, too. There's even a built-in File Protect feature that prevents accidental loss of valuable data. (A file protected diskette cannot be written on.)

Heat can cause numerous read and write errors that can become hazardous to your data. The major heat producing power supply components are mounted to a large heat sink, external to the cabinet, by the power switch and fuse (located at the rear of the cabinet). This design is to assure that the drive components are kept as cool as possible to assure reliable data recovery.

MICROPOLIS has a reputation for getting along with most everybody. Compatability is not a problem with MICROPOLIS. Their disk drives and/or subsystems can be easily integrated into systems such as Polymorphic, Cromemco, CCS, Ithica Intersystems, Godbout, Northstar, Jade Big Z, QT SBC 2/4, and many others. Many OEM manufacturers rely on MICROPOLIS to get the job done efficiently. Companies like Commodore, Exidy, Harris, and Vector Graphics to name just a few. Years from now, you can look back with a secure feeling knowing you made the best choice. MICROPOLIS.

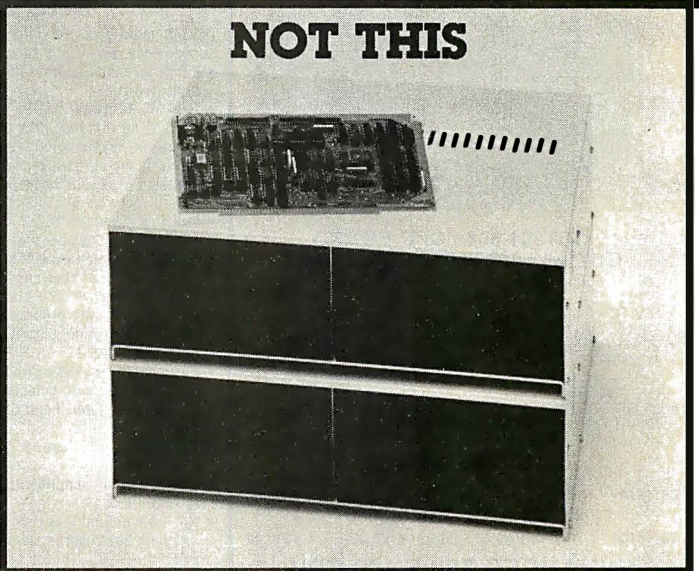


# CAPACITY OF AN IN 5 1/4" FORMAT

## THIS



## NOT THIS



Because of our incredible purchasing power, PRIORITY ONE ELECTRONICS is able to buy MICROPOLIS disk drives by the thousands and receive special pricing. That special pricing we receive is passed on to you in the form of tremendously discounted prices. Now all that remains is for you to take advantage of this truly incredible buy.

MODEL	DESCRIPTION	LIST	SALE PRICE
<b>S-100 SUB-SYSTEMS</b>			
MCP-1053-4	1.2 MB 2 HEAD DUAL	\$2605.00	\$1395.00
MCP-1053-2	630 KB DUAL	\$1895.00	\$995.00
MCP-1043-2	315 KB SINGLE	\$1145.00	\$695.00
MCP-1041-2	315 KB SINGLE, NO PS	\$1045.00	\$639.00
MCP-1042-1	143 KB SINGLE	\$795.00	\$625.00
MCP-1041-1	143 KB SINGLE, NO PS	\$695.00	\$595.00

COMPLETE W/S-100 CONTROLLER, CABLES,  
MANUALS AND MICROPOLIS MDOS AND BASIC

### ADD-ON DRIVES

MCP-1033-2	630 KB DUAL	\$1395.00	\$895.00
MCP-1023-2	315 KB SINGLE	\$645.00	\$495.00
MCP-1021-2	315 KB SINGLE, NO PS	\$545.00	\$475.00
MCP-1022-1	143 KB SINGLE	\$545.00	\$375.00
MCP-1021-1	143 KB SINGLE, NO PS	\$445.00	\$360.00

REQUIRES ACCESSORY ADD-ON CABLES

## GOOD NEWS FOR TRS-80\* OWNERS

We now have a complete line of TRS-80\* Model I compatible MICROPOLIS add on drives in matching colors. These drives simply plug into the expansion interface via a disc data cable.

197K BYTES PER SIDE FOR YOUR TRS-80\*, that's easy! Just order a 77 track add on drive and the New DOS-80 operating system. Among the many features of New DOS-80, is its ability to control any mix of 35, 40, or 77 track drives on the same cable.

### TRS-80® DISK DRIVES

MCP-1027-1	35 TRACK SINGLE	\$545.00	\$279.95
MCP-1037-1	35 TRACK DUAL	\$1195.00	\$695.00
MCP-1027-2	77 TRACK SINGLE	\$645.00	\$439.00
MCP-1037-2	77 TRACK DUAL	\$1395.00	\$795.00

### ACCESSORIES

APP 395M	NEW DOS/80 TRS-80*	SUPPLIED	ON
	35 thru 77		
PR1-34CEEE-2	TRACK OPERATING	35 TRACK	77 TRACK
	SYSTEM		
PR1-34CEEE-4	Two Drive Data Cable	\$149.00	\$159.00
	Four Drive Data Cable		

GOOD THRU MARCH 1981

## THIS COULD BE THE START OF SOMETHING SMALL.



1-800-423-5633

PRIORITY ONE ELECTRONICS

(213) 894-8171

16723 B ROSCOE BLVD. • SEPULVEDA, CA. 91343

Terms: Visa, MC, BAC, Check, Money Order, U.S. Funds Only. CA residents add 6% sales tax. Minimum order \$15.00 Prepaid U.S. orders less than \$75.00 include 5% shipping and handling. MINIMUM \$2.50. Excess refunded. Just in case ... please include your phone no. Prices subject to change without notice. We will do our best to maintain prices thru March 1981.

\*SOCKET and CONNECTOR prices based on GOLD, not exceeding \$700 per oz.

\*Sale Prices are for prepaid orders only. Credit card orders will be charged appropriate freight

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

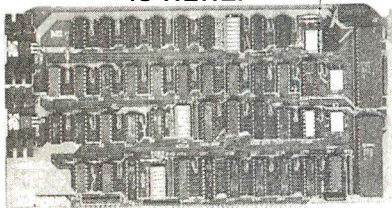
Circle 322 on inquiry card



# S-100 HEADQUARTERS

## GODBOUNT

THE DUAL PROCESSOR BOARD IS HERE!



**GBT161 8085 CPU BOARD**  
**GBT1612 8085/8088 CPU BOARD**

- 8088 & 8085A CPU
- S-100 IEEE COMPATIBLE
- SWITCHABLE CPU'S
- 5 MHZ OR 2 MHZ SWITCHABLE
- POWER ON JUMP TO ANY 256 BYTE BOUNDARY
- POWER ON JUMP CAN BE DISABLED
- CPU CAN JUMP ON POWER ON ONLY OR POWER ON AND RESET.
- 24 BIT EXTENDED ADDRESSING
- IMSAI FRONT PANEL COMPATIBLE
- AVAILABLE WITH 8085A ONLY

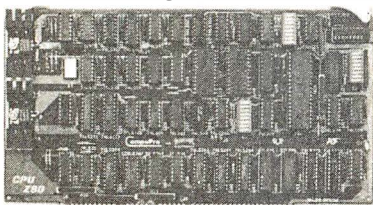
### BOARD WITH 8085 ONLY

		List Price	Our Price
GBT161A	Assembled & Tested	\$325.00	\$305.00

### BOARD WITH 8085 & 8088

GBT1612A	Assembled & Tested	\$425.00	\$399.00
----------	--------------------	----------	----------

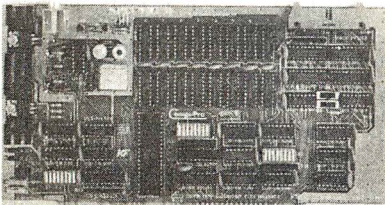
### ENHANCED Z80 S-100 CPU BOARD



**GBT160 Z80 CPU**

- 4-6 MHz Z80 CPU
- IEEE S-100 Bus Compatible
- On Board Prom Sockets For Up To 8K Prom
- Power On Jump Start To Any 256Byte Boundary
- On Board Memory Manager For Direct Addressing For Up To 16 M-Bytes
- Fully Maskable Vectored Interrupts
- Wait State Generation For All Machine Cycles
- Bypassing Of All Supply Line To Suppress Transients
- All IC's Are Socketed

		List Price	Our Price
GBT160U	Unkit		\$225.00
GBT160A	Assembled & Tested	\$295.00	\$280.00



### SPECTRUM S-100 COLOR GRAPHICS BOARD

- Uses the MC6847 LSI IC
- Uses 1372 color encoded/generator
- Alphanumeric/graphics in 8 colors
- Ultra dense 256 x 192 full graphics
- 8K bytes on-board low power RAM
- One full duplex parallel I/O port with attention, enable & strobe bits with power for running joysticks, keyboards, etc.
- A parallel port for graphics mode control
- Board may be used as a 4MHz RAM for program storage

		LIST PRICE	OUR PRICE
GBT144U	UNKIT		\$299.00
GBT144A	A&T	\$399.00	\$349.00
GBT2D	SUBLOGIC UNIVERSAL GRAPHICS INTERPRETER SOFTWARE		\$35.00

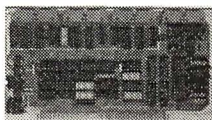


### INTERFACER I

Our I/O board gives you unparalleled flexibility and operating convenience. We include such features as:

- 2 independently addressable serial ports (dip switch selectable addresses)
- Real LSI Hardware UARTs for minimum CPU housekeeping
- RS232C, current loop (20mA), & TTL signals on both ports
- Precision, crystal-controlled Baud rates up to 19.1 KBAud (Individually dip switch selectable)
- Transmit & 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 & off-board current sources
- UART parameters, interrupt enables, & 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 & DB25 connectors in standard pinouts
- RS232 lines will conform to either master or slave configurations
- Board gives full feature operation with both 2 & 4 MHz systems
- Low power consumption: +8V @ 450mA; +16V @ 150mA; -16V @ 70mA max.
- No software initialization required for board operation, although board parameters may be altered by software

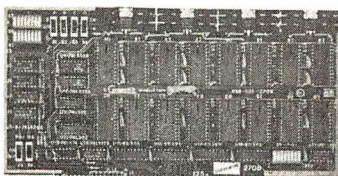
		LIST PRICE	OUR PRICE
GBT133U	UNKIT		\$199.00
GBT133A	A&T	\$249.00	\$219.00



### INTERFACER II 3PTS

- 1 independently addressable serial port
- RS232C, 20mA current loop, & TTL signals
- Precision crystal controlled Baud rate generator
- Up to 19.2K Baud
- Transmit and receive interrupts, jumperable to and vectored interrupt line
- Five RS232 handshaking lines
- Optically isolated current loop
- 3 parallel I/O
- Utilizes LSTTL octal latches for latched I/O data with 24mA drive current
- Enable & strobe bits on each port (each with selectable polarity)
- Interrupts for each input port
- Separate 25 pin connector with power for each channel and a status port for interrupt mask & port status

		LIST PRICE	OUR PRICE
GBT150U	UNKIT		\$199.00
GBT150A	A&T	\$249.00	\$219.00



### ECONORAM 2708

Has provisions for wait states for 4MHz operations. Configured as four 4K blocks—each independently addressable and disableable. Power-on jump. Does NOT include 2708s. Includes all support chips, sockets, regulators, heat sinks, etc. Sold in UNKIT form only. Shipping Weight 2 lbs.

GBT125U Unkit	\$85.00
---------------	---------



Order No. GBT129A32

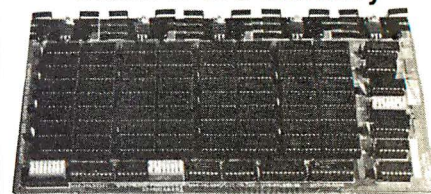
### ECONORAM XA 32K RAM

Reg. \$689.00

**Sale Priced \$429.00**

- 4MHz with Z80
- 5MHz with 8085
- Assembled and Tested
- S-100 Compatible
- Fully Static
- 24 Bit Extended Addressing

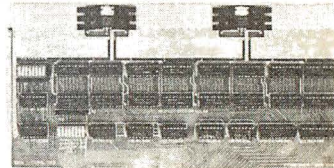
### Static S-100 Memory



### 32K ECONORAM XX

32K Bank Select. IEEE S-100 compatible. Features one 32K block that can be addressed on 4K boundaries. Compatible with the IEEE proposed standard of 24 address lines as well as all currently used bank select configurations. Any or all of the eight 4K byte blocks may be disabled to create as many windows in memory to avoid any system memory conflicts.

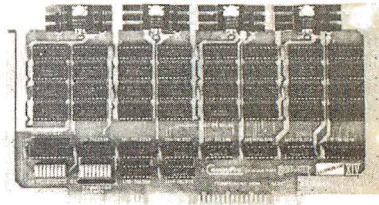
	List Price	Our Price
GBT164A16 16K RAM A & T	\$399.00	\$329.00
GBT164A24 24K RAM A & T	\$539.00	\$455.00
GBT164A32 32K RAM A & T	\$699.00	\$569.00



### 8K ECONORAM IIA

We realize that this may not look like the 8K. Econoram II board you've known and loved for so many years; however, at Godbout, good things don't come to an end—they just get better! Our NEW 8K Econoram IIA board retains all the best selling features of the old Econoram II PLUS is now 4 MHz STANDARD—still static—with ultra low power consumption. S-100 compatible. Single supply required—guaranteed maximum current under 900mA. Typical boards draw 700 to 800mA. Phantom feature is included on the new Econoram IIA & is switch selectable. Organized as two 4K independently addressable blocks. Includes switched WRITE protect—block & board disable. Also, has provision for memory management. Shipping Weight 2 lbs.

	List Price	Our Price
GBT139U Unkit		\$159.00
GBT139A A&T	\$189.00	\$179.00



### ECONORAM XIV

16K x 8 for S-100. Addressable on any 4K boundary. Direct addressing on up to 24 address lines. Fully meets IEEE S-100 buss specs. Low power, hi-speed static memory. Operates up to 5 MHz with newest 8085/8086/8088 CPUs. Can be used with 8080, Z80, 8085, 8086, 8088, Z8000, etc.

	List Price	Our Price
GBT143U Unkit		\$279.00
GBT143A A&T	\$349.00	\$299.00

## PRIORITY ONE ELECTRONICS

16723 B ROSCOE BLVD. • SEPULVEDA, CA. 91343

Terms: Visa, MC, BAC, Check, Money Order, U.S. Funds Only. CA residents add 6% sales tax. Minimum order \$15.00 Prepaid U.S. orders less than \$75.00 include 5% shipping and handling. MINIMUM \$2.50. Excess refunded. Just in case... please include your phone no. Prices subject to change without notice. We will do our best to maintain prices thru March 1981. \*SOCKET and CONNECTOR prices based on GOLD, not exceeding \$700 per oz.

\*Sale Prices are for prepaid orders only. Credit card orders will be charged appropriate freight

ORDER TOLL FREE 1-800-423-5633 ORDER TOLL FREE 1-800-423-5633

DETACH OUR CATALOG FROM THE NOV. BYTE

DETACH OUR CATALOG FROM THE NOV. BYTE

DETACH OUR CATALOG FROM THE NOV. BYTE

# BITS & PIECES

## TRS-80/APPLE MEMORY EXPANSION KITS

100%  
GUARANTEED

4116's RAMS  
from Leading Manufacturers  
(16Kx1 200ns)

1,000's  
SETS SOLD

**8 for \$29<sup>00</sup>**

ADD \$3.00 FOR PROGRAMMING JUMPERS  
FOR TRS-80 KEYBOARD

4116's 100 pcs & UP \$3.00 each  
1000 pcs & UP \$2.75 each

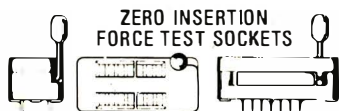
**2114-3L**  
4096 BIT (1024x4) 300ns  
LOW POWER STATIC RAM  
8/\$30<sup>00</sup>  
100 + \$3<sup>00</sup>

**2716**  
450ns 5 Volt only  
16 K EPROM  
\$11<sup>95</sup> each  
or 10/\$85<sup>00</sup>

**5257-3L**  
(TMS 4044)  
4096x1 300ns  
LOW POWER STATIC RAM  
8/\$50<sup>00</sup>  
100 pcs. + \$4<sup>75</sup>

**2708**  
450ns 8K  
EPROM  
\$8<sup>50</sup> each  
or 8/\$54<sup>00</sup>

**2732**  
450ns 5 Volt only  
32 K EPROM 8x4K  
\$25.00  
8/\$160.00



ZERO INSERTION  
FORCE TEST SOCKETS

	1-9	10-24	25-99
ZIP-16DIP	\$5.50	5.35	4.95
ZIP-24DIP	\$7.50	7.25	6.95
ZIP-40DIP	\$10.25	9.85	9.50

### 3 LEVEL GOLD WIRE WRAP SOCKETS PRICE\*

PART NO.	PINS	1-9	10-24	25-99	100-249	250-999
RNS-08WWG	8	.50	.42	.40	.37	.33
RNS-14WWG	14	.60	.49	.47	.45	.42
RNS-16WWG	16	.65	.52	.50	.47	.44
RNS-18WWG	18	.85	.75	.70	.65	.60
RNS-20WWG	20	1.00	.90	.80	.75	.70
RNS-22WWG	22	1.25	1.15	1.10	1.05	1.00
RNS-24WWG	24	1.25	1.15	1.10	1.05	1.00
RNS-28WWG	28	1.60	1.50	1.40	1.30	1.20
RNS-40WWG	40	1.85	1.65	1.55	1.45	1.35



DIP SWITCHES  
SPST

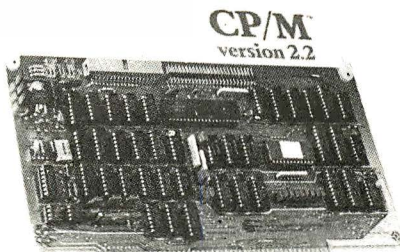
PART NO.	NO. OF POSITIONS	1-9	10-24	25-99
DIP-SW4	4	\$1.50	\$1.40	\$1.28
DIP-SW5	5	\$1.60	\$1.49	\$1.36
DIP-SW6	6	\$1.70	\$1.59	\$1.45
DIP-SW7	7	\$1.80	\$1.68	\$1.53
DIP-SW8	8	\$2.00	\$1.86	\$1.70
DIP-SW9	9	\$2.25	\$2.10	\$1.92
DIP-SW10	10	\$2.50	\$2.33	\$2.12

## Shugart SA801R SALE



SHU-SA801R \$410<sup>00</sup>  
2 OR MORE \$395<sup>00</sup> ea.

Capacity	Single Density	Double Density
Unformatted	3.2 megabits	6.4 megabits
Per Disk	41.7 kilobits	83.4 kilobits
IBM Format		
Per Disk	2.0 megabits	n/a
Per Track	26.6 kilobits	n/a
Transfer Rate	250 kilobits/sec.	500 kilobits/sec.
Latency (average)	83 ms	83 ms
Access Time		
Track to Track	8 ms	8 ms
Average	260 ms	260 ms
Setting Time	8 ms	8 ms
Head Load Time	35 ms	35 ms



California  
Computer  
Systems

California Computer Systems LIST \$400.00  
**CCS2422A**  
FLOPPY DISK CONTROLLER  
WITH CP/M VERSION 2.2 **SALE \$375.00**

IEEE S-100 COMPATIBLE SINGLE/DOUBLE DENSITY  
5 1/4" 78" DISK DRIVES  
SINGLE/DOUBLE HEADED  
ASSEMBLED & TESTED



Part No.	Sectoring	Application	Box of 10
VRB-MD 525-01	Soft Sector	TRS-80 Apple	\$29.95
VRB-MD 525-10	Hard 10 Sector	North Star	\$29.95
VRB-MD 525-16	Hard 16 Sector	Micropolis	\$29.95
VRB-MD 577-01	Soft Sector	77 Track Cert	\$48.00
VRB-MD 577-16	Hard 16 Sector	77 Track Cert	\$48.00
VRB-F032-1000	Hard Sector	Shugart 801R	\$37.00
VRB-F034-1000	Soft Sector	IBM 3740	\$37.00

## MODEM SALE

\$129.00

THE STAR  
MODEM  
from LIVERMORE

FEATURE  
FITS GTE HANDSETS!

2 YEAR WARRANTY



### EXCLUSIVE ACOUSTIC CHAMBERS

The exclusive triple seal of Livermore's new flat mounted cups locks the handset into the acoustic chamber yielding superior acoustic isolation and mechanical cushioning. Designed to adapt to most common handsets used throughout the world, the STAR offers the utmost in flexibility and transmission reliability.

- **Specifications:**
- Data Rate: 0 to 300 baud
- Compatibility: Bell 103 and 113; CCITT
- Frequency Stability:  $\pm 0.3$  percent. Crystal controlled
- Receiver Sensitivity:  $-50$  dBm ON,  $-53$  dBm OFF
- Modulation: Frequency shift keyed (FSK)
- Carrier Detect Delay: 1.2 seconds ON; 120 msec OFF
- EIA Terminal Interface: Compatible with RS 232 specifications
- Teletype Interface: 20 milliamper current loop
- Optional Interfaces: IEEE 488; TTL; TTY 43
- International (CCITT) frequencies available
- Switches: Originate/Off/Answer; Full Duplex/Test/Half Duplex
- Indicators: Transmit Data, Receive Data, Carrier Ready, Test
- Power: Supplied by 24 VAC/150 MA UL/CSA listed wall-mount transformer. Input 115 VAC, 2.5 watts. (A 220 VAC, 50 Hz adaptor is available upon request.)
- Dimensions: 10" x 4" x 2"
- Weight: 1.74 lbs. (3 lbs. shipping weight including AC adaptor.)
- Warranty: Two years on parts and labor, excluding the AC adaptor which carries the manufacturer's warranty

Part No.	Description	List Price	SALE PRICE
LIV-STAR	RS232, TTL Modem	\$199.00	\$129.00
LIV-STAR20M	RS232, 20MA Current Loop	\$199.00	\$129.00
LIV-STAR-V21	CCITT European Standard	\$229.00	\$209.00
LIV-IEEE	IEEE 488 Standard	\$395.00	\$249.00
LIV-IEEE-V21	IEEE 488, CCITT Standard	\$465.00	\$388.00

### CABLES

Part No.	Description	Price
CND-RS232BF	RS232 8 Cond 8 ft.	\$19.95
LIV-I21 IEEE	to IEEE 2 Meter	\$59.95
LIV-I2PET IEEE	to Pet 2 Meter	\$59.95

PROTECT YOUR INVESTMENT  
PROTECT YOUR DATA WITH



**ISOBAR**

GOF-IBAR46

LIST PRICE \$79<sup>95</sup>

SALE PRICE \$39<sup>95</sup>



### GOLD S-100 CONNECTORS

PRIORITY ONE distributes the TI S-100 Card Edge Connectors at tremendous volume for prices others only wish they could duplicate.

Part No.	1-9	10-24	25-99	100-249
TI-S100 STG	3.20	2.90	2.50	2.20
Part No.	1-9	10-24	25-99	100-249
TI-S100 WWG	4.00	3.75	3.50	3.25

## PRIORITY ONE ELECTRONICS

16723 B ROSCOE BLVD. • SEPULVEDA, CA. 91343

Terms: Visa, MC, BAC, Check, Money Order, U.S. Funds Only. CA residents add 6% sales tax. Minimum order \$15.00 Prepaid U.S. orders less than \$75.00 include 5% shipping and handling. MINIMUM \$2.50. Excess refunded. Just in case ... please include your phone no. Prices subject to change without notice. We will do our best to maintain prices thru March 1981.

\*SOCKET and CONNECTOR prices based on GOLD, not exceeding \$700 per oz.

\*Sale Prices are for prepaid orders only. Credit card orders will be charged appropriate freight

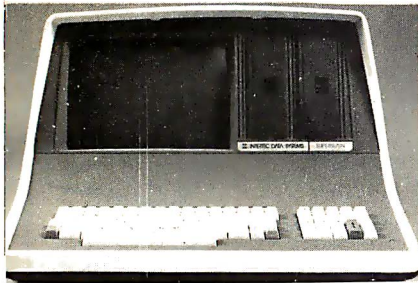
ORDER TOLL FREE 1-800-423-5633 ORDER TOLL FREE 1-800-423-5633

Circle 323 on inquiry card.

DETACH OUR CATALOG FROM THE NOV. BYTE

# Best Prices and Delivery!

## SUPERBRAIN<sup>®</sup> by Intertec



Self-contained computer with dual disks and two RS232C ports. Complete with CP/M<sup>®</sup> 2.2 and BASIC.

32K Double Density, List \$2995 ..... **\$2685**  
 64K Double Density, List \$3345 ..... **\$2883**  
 64K Upgraded to Quad Density w/ Special MiniMicroMart Warranty ..... **SPECIAL \$3395**

## VIDEO TERMINALS

**NEWEULATOR** (Intertec), List \$895 **\$ 749**  
**NEW INTERTUBE III** List \$895 ..... **ONLY \$ 749**  
**SOROC 120**, List \$995 ..... **SPECIAL \$ 729**  
 1Q140, List \$1495 ..... **SPECIAL \$1149**  
**PERKIN-ELMER 550**, List \$997 ..... **\$ 799**  
 with anti-glare screen, \$1027 ..... **\$ 829**  
**HAZELTINE 1410**, List \$900 ..... **\$ 749**  
 1420 ..... **\$ 849**  
 1500, List \$1225 ..... **\$ 879**  
 1510, List \$1395 ..... **\$1089**  
 1520, List \$1650 ..... **\$1389**  
**LEAR SIEGLER ADM3A**, Assembled ..... **\$ 849**  
**TELEVIDEO 912C**, List \$950 ..... **\$ 789**  
 920C, List \$1030 ..... **\$ 849**  
 950C, List \$1195 ..... **NEW \$1039**

## PRINTERS

**ANADEx DP-8000** ..... **\$ 849**  
 DP-9500, List \$1650 ..... **\$1399**  
 DP-9501, List \$1650 ..... **\$1399**  
**PAPER TIGER IDS-445**, List \$995 ..... **\$ 695**  
 w/graphics op., incl. buffer, \$1195 .. **\$ 789**  
**PAPER TIGER IDS-460**, List ..... **1149**  
**PAPER TIGER IDS-460G** ..... **1199**  
**NEW IDS PAPERTIGER 460** . List 1295 **\$1149**  
**NEW IDS PAPERTIGER 460G** List \$1394 **\$1199**  
**NEC Spinwriters** ..... Call for Price  
**TELETYPE 43 KSR** ..... **\$1087**  
**CENTRONICS**  
 730-1 parallel interface .. **NEW LOW \$ 649**  
 737 parallel interface .. **SUPER VALUE \$ 829**  
 779 w/Tractor, List \$1350 ..... **\$1049**  
 703 w/Tractor, VFU, List \$2975 ..... **\$1695**  
 704 w/Tractor, VFU, List \$2350 ..... **\$1595**

**TI 810 Basic**, List \$1895 ..... **\$1695**  
 810/serial & Centronics-style parallel interface, List \$1940 ..... **\$1735**  
 810 w/full ASCII (U/LC), Vertical Forms Control, Compressed Print .. **\$1895**  
**TI 820 KSR**, List \$2165 ..... **\$1895**  
**TI 745 w/full ASCII**, List \$1695 ..... **\$1399**  
**COMPRINT 912** w/parallel interface .. **\$ 559**  
 912 w/serial interface, List \$699 ..... **\$ 589**  
**AXIOM IMP I** ..... **\$ 699**  
**MICROTEK**, List \$750 ..... **\$ 675**  
**OKIDATA Microline 80**, List \$949 ..... **\$ 599**  
 Tractor Feed Option ..... **\$109**  
 RS232 Serial Interface ..... **\$ 99**

## NORTH STAR HORIZON<sup>®</sup>

**HORIZON 1 ASSEMBLED & TESTED**  
 32K, Double Density, List \$2695 ..... **\$2279**  
 32K, Quad Density, List \$2995 ..... **\$2539**

**HORIZON 2 ASSEMBLED & TESTED**  
 32K, Double Density, List \$3095 ..... **\$2619**  
 32K, Quad Density, List \$3595 ..... **\$3049**  
 48K, Double Density, List \$3590 ..... **\$3039**  
 48K, Quad Density, List \$4090 ..... **\$3469**  
 64K, Double Density, List \$3830 ..... **\$3239**  
 64K, Quad Density, List \$4330 ..... **\$3669**

## FLOPPY DISK SYSTEMS

**NORTH STAR MDS-A**  
 Assembled, List \$899 ..... **SPECIAL \$ 719**

**MORROW THINKER TOYS<sup>®</sup>** Discus 2D,  
 List \$1199 ..... **OUR PRICE \$ 998\***  
 Discus 2D, dual-drive, List \$1994 ..... **\$1694\***  
 Discus 2 + 2, A&T, List \$1549 ..... **\$1319\***  
 Dual Discus 2 + 2, A&T, List \$2748 ..... **\$2335\***  
 \*Now includes CP/M<sup>®</sup> 2.2

## Prom Programers

**SSM PB1 Kit** List \$125 ..... **\$106**  
**SSM PB1 A&T** List \$190 ..... **\$161**  
**SD Computer Prom 100 Kit** \$236 ..... **\$201**  
**SD Computer Prom 100A&T** List \$311 ..... **\$264**

## FLOPPY DISK CONTROLLER BOARDS

**NORTH STAR, DD**,  
 Assembled, List \$499 ..... **\$399**  
**MORROW Disk Jockey 1, A&T (\$213)** ..... **\$189**  
 Disk Jockey 2D, A&T, List \$479 ..... **\$429**  
**SD Versafloppy 1, Kit**, List \$284 ..... **\$239**  
 Versafloppy II, DD Kit, List \$413 ..... **\$349**  
 Versafloppy II, DD, A&T, List \$507 ..... **\$429**  
**DELTA double density A&T (\$385)** ..... **\$345**  
**CONDUCTOR**, double density A&T ..... **\$269**  
**INTERSYSTEMS FDC-2, A&T**, \$495 ..... **\$439**  
**MICROMATION Doubler, DD, A&T** ..... **\$429**  
**TARBELL Floppy Disk Interface Kit** ..... **\$199**  
 double density, A&T, List \$495 ..... **\$444**

## ESCON CONVERSION FOR IBM SELECTRIC

Complete w/microprocessor controller and power supply. Factory built. User installs solenoid assembly or it can be done at Esccon factory at nominal cost.

Parallel (TRS-80, Sorcerer, etc.), \$575 **\$514**  
 RS232 Standard Serial, List \$599 ..... **534**  
 IEEE-488 (for PET), List \$660 ..... **584**  
 TRS-80 Cable ..... **25**

## CALIFORNIA COMPUTER SYSTEMS

**Z80 CPU BOARDS** List \$299 ..... **\$269**  
**DISK CONTROLLER 2422** List \$399 ..... **\$359**  
**16K Static, A&T**, List \$349.95 ..... **\$259**  
**32K STATIC** List \$710 ..... **\$599**  
**64K DYNAMIC BOARD** List \$699 ..... **\$589**

## CPU BOARDS (assembled unless noted)

**NORTH STAR Z80A (ZPB-A/A)**, \$299 **\$254**  
**CROMEMCO 4 MHz (ZPU-W)**, List \$395 **\$335**  
 4 MHz (SCC-W), List \$450 ..... **\$382**  
**INTERSYSTEMS** (formerly Ithaca Audio)  
 new Series II Z-80, 4 MHz. List \$395 ..... **\$349**  
**SSM CB1 8080 A&T** List \$252 ..... **\$214**  
 CB1A Kit, List \$183 ..... **\$156**  
 CB2 Z-80, A&T, List \$344 ..... **\$289**  
 CB2 Kit, List \$60 ..... **\$221**  
**DELTA Z-80**, with I/O ..... **\$289**  
**SD SBC-100**, List 413 ..... **\$349**  
 SBC-100 Kit, List \$341 ..... **\$289**  
 SBC-200, List \$471 ..... **\$399**  
 SBC-200 Kit, List \$373 ..... **\$317**

## MEMORY BOARDS

### 32K SD ExpandoRAM Kit

### CALL FOR PRICES

**NORTH STAR 16K Dynamic RAM Board**,  
 A&T (RAM-16-A/A), List \$499 ..... **\$420**  
 32K A&T (RAM-32/A), List \$739 ..... **\$620**  
**CROMEMCO 16KZ-W**, List \$495 ..... **\$419**  
 64KZ-W, List \$1795 ..... **\$1269**

**MEASUREMENT SYSTEMS & CONTROLS**  
 (Guaranteed performance, incl. labor/parts 1 yr)  
**DM6400 64K Board w/all 64K**, \$795 ..... **\$659**  
 DM4800 with 48K, List \$695 ..... **\$650**  
 DM3200 with 32K, List \$595 ..... **\$509**  
**DMB6400 64K Board w/all 64K** ..... **\$859**  
 DMB4800 with 48K ..... **\$789**

**MORROW SuperRAM** — all static, all A&T  
 16K, 4 MHz or 2 MHz, List \$349 ..... **\$299**  
 32K, 4 MHz, List \$699 ..... **\$629**  
 16K Memory Master, List \$399 ..... **\$339**  
 24K Memory Master, List \$549 ..... **\$465**

**INTERSYSTEMS** (formerly Ithaca Audio)  
 8K Static 2 MHz, A&T, List \$165 ..... **\$149**  
 8K Static 4 MHz, A&T, List \$195 ..... **\$176**  
 16K Static 2 MHz, A&T, List \$475 ..... **\$427**  
 16K Static 4 MHz, A&T, List \$495 ..... **\$445**  
 64K Dynamic, List \$995 ..... **\$895**

**CALIFORNIA COMPUTER**  
 16K Static, A&T, List \$349.95 ..... **\$259**

## VIDEO BOARDS

### I/O Mapped

**SD COMPUTER VDB-8024**, kit, List \$437 ..... **\$369**  
 Assembled, List \$556 ..... **\$469**  
**XITEX SCT-100K**, Kit ..... **ONLY \$169.95**  
 SCT-100A Assembled ..... **\$189.95**  
**SSM VB2 I/O**, Kit, List \$199 ..... **\$169\***  
 Assembled & Tested, List \$269 ..... **\$229\***

### Memory Mapped

**SSM VB1C**, 16x64, Kit, List \$179 ..... **\$152\***  
 Assembled & Tested, List \$242 ..... **\$206\***  
**SSM VB3**, 80-Char., 4MHz, Kit, List \$425 ..... **\$359\***  
 4 MHz, A&T, List \$499 ..... **\$424**  
**INTERSYSTEMS**, 16x64, A&T, List \$165 **\$149**

\*Subject to change.

## NEW CROMEMCO 16FDC DOUBLE DENSITY DISK CONTROLLER

List \$595 ..... **OUR PRICE \$505**

SHIPPING AND INSURANCE: Add \$2.50 for boards, \$6 for Selectric Converter or Floppy Disk Drives, \$7.50 for Floppy Disk Systems, \$15 for Horizon. SHIPPED FREIGHT COLLECT: SuperBrain, Centronics and T.I. printers. Contact us for shipping information on other terminals and printers.

Above prices reflect a 2% cash discount (order prepaid prior to shipment). Add 2% to prices for credit card orders, C.O.D.'s, etc. Prices are subject to change and offers subject to withdrawal without notice.

— WRITE FOR FREE CATALOG —

Circle 324 on inquiry card.

# MiniMicroMart, Inc.

1618 James Street, Syracuse NY 13203 (315) 422-4467 TWX 710-541-0431

# Terminals and Printers!

## TELEVIDEO TVI-912C



Upper and lower case, 15 baud rates: 75 to 19,000 baud, dual intensity, 24 x 80 character display, 12 x 10 resolution. Numeric pad. Programmable reversible video, auxiliary port, self-test mode, protect mode, block mode, tabbing, addressable cursor. Microprocessor controlled, programmable underline, line and character insert/delete. "C" version features typewriter-style keyboard. List \$950

OUR PRICE \$789

920C (with 11 function keys, 6 edit keys and 2 transmission mode keys, List \$1030

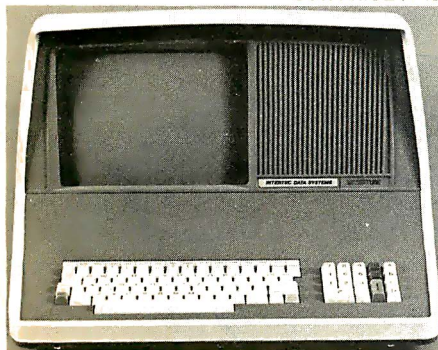
ONLY \$849

New 950C \$1195..... \$1039

## Intertec EMULATOR

Software compatible with a Soroc IQ-120, Hazeltine 1500, ADM-3A or DEC VT-52. Features block mode transmission and printer port; 12" anti-glare screen; 18-key numeric keypad; full cursor control. List \$895

OUR PRICE \$749



## NEW INTERTUBE III

List \$995 ONLY \$749

12" display, 24 x 80 format, 18-key numeric keypad, 128 upper/lower case ASCII characters. Reverse video, blinking, complete cursor addressing and control. Special user-defined control function keys, protected and unprotected fields. Line insert/delete and character insert/delete editing, eleven special line drawing symbols.

## SOROC



### IQ-120

List \$995

SPECIAL  
\$729

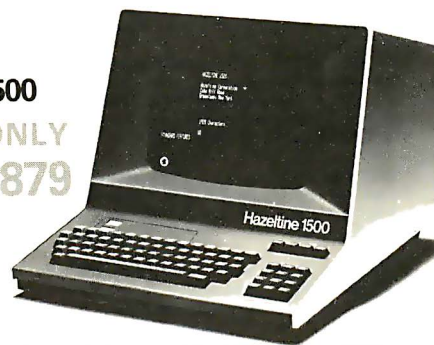
IQ-140 List \$1495

SPECIAL \$1149

## HAZELTINE

1500

ONLY  
\$879



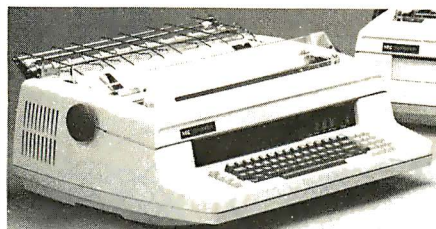
1410 w/numeric keypad, List \$900 ..... \$749

1420 w/lower case and numeric pad ..... 849

1510, List \$1395 ..... 1089

1520, List \$1650 ..... 1389

## NEC SPINWRITER™



Terminal/Keyboard as well as RO Printer Only models available.

CALL FOR PRICES!

## CENTRONICS PRINTERS

NEW 730-1, parallel, friction, tractor .. \$649

NEW 730-3 RS-232 friction, tractor .... \$699

NEW 737-1 parallel, friction, tractor .... \$829

NEW 737-3 RS-232 friction, tractor .... \$899

779-2 w/ tractor (Same as TRS-80 Line

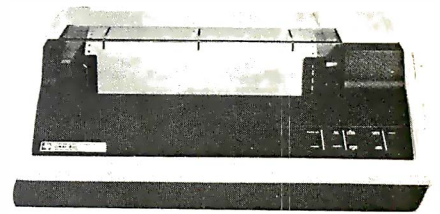
Printer I), List \$1350 ..... \$849

704-11 parallel 180 cps ..... \$1698

704-9 RS232 serial version, \$2350 .. \$1595

Above prices reflect a 2% cash discount (order prepaid prior to shipment). Add 2% to prices for credit card orders, C.O.D.'s, etc. Prices are f.o.b. shipping point. Prices are subject to change and offers subject to withdrawal without notice. WRITE FOR FREE CATALOG.

## TI-810



TI-810 Basic Unit, \$1895 . ONLY \$1595

TI-810 w/full ASCII (Lower case), vertical forms control, and compressed print. \$1795

TI-745 Complete printing terminal with acoustic coupler, List \$1695 .... \$1399

## ANADEx

### DP9500/DP9501 PRINTERS

DP-9500, List \$1650 ..... \$1349

DP-9501, List \$1650 ..... \$1349

## OKIDATA Microline 80

ONLY \$599

Tractor Feed Option ..... \$109

Serial interface ..... \$ 99

AXIOM IMP I ..... \$699

COMPRINT 912 w/parallel interf. \$559

912 w/serial interface, List \$699 ..... \$589

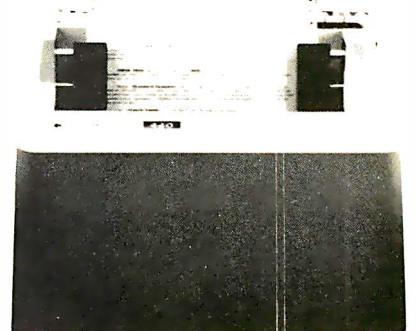
MICROTEK, List \$750 ..... \$675

NEW MODELS!!!

DP 9500 ..... \$1349

DP 9501 ..... \$1349

## PAPER TIGER



IDS-445 Paper Tiger, ..... \$695

w/graphics option, incl. buffer, \$1194 .. \$789

TRS-80 cable ..... \$ 45

NEW IDS PAPERTIGER 460 List \$1295 .. \$1099

NEW IDS PAPERTIGER 460G List \$1394 .. \$1149

## NEW IDS 460

QUALITY PRINTING AT MATRIX

SPEED—LOGIC SEEKING

PROPORTIONAL SPACING

w/auto text justification

# MiniMicroMart, Inc.

1618 James Street, Syracuse NY 13203 (315) 422-4467 TWX 710-541-0431

Circle 325 on Inquiry card.



# Unclassified Ads

**UNCLASSIFIED POLICY:** Readers who are soliciting or giving advice, or who have equipment 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.

**FOR SALE:** Two cassette interfaces: Tarbell; \$75, DaJen; \$120. Seven 8 K static programmable memory boards; \$90 each. Expandom 2708/16 (less PROMs); \$50. Two SSM 4 K 1708 boards; \$35 each. 8-Inch single disk drive cabinet with power supply which will run two drives, Shugart Siemens compatible; \$175. PTC VDM-1 video driver board; \$150. All working and assembled. All S-100 bus. Dick Drain, 6730 Alter Rd, Dayton OH 45424, (513) 233-8055.

**FOR SALE:** S-100 and other items; Cromemco: ZPU processor board, 8 K Bytesaver, 16 K programmable memory, PRI printer interface, D+7A analogue I/O. IM-SA: card cage and 28 A supply, 16 K programmable memory board, 32 K programmable memory board, MIO multiple I/O, VIO-C video with all read-only memories. TDL: 16 K programmable memory Z16. OAE paper-tape reader. Radio Shack keyboard. Keytronic capacitive keyboard. All items like new and guaranteed working. Very reasonable prices. Bob Waber, 2590 #14 E Michigan, Ypsilanti MI 48197, (313) 484-1826.

**WANTED:** Assembly/Applesoft graphics programs, game programs, subroutines. All welcome for experiments with graphics. Stamps for interesting responses. Alan M Leder, 246 Lenox Ave, Paterson NJ 07502.

**FOR SALE:** Used S-100 boards: TDL Z80 processor board; \$100, Scitronics control board; \$100, MITS parallel I/O board (one port); \$50, 8080 processor; \$80. Paul Jacobs, 5201 E 3rd St, Tucson AZ 85711, (602) 795-2366.

**NEEDED:** Information, kit, schematics, or advice for adapting CP/M or equivalent operating system to the Intel SBC 80/10. Goal is to run Pascal on the 80/10. Also, have DEC LA-36 for trade or sale. Scott Nintzel, 3843 Granada Ln N, Oakdale MN 55109, (612) 770-6926.

**FOR SALE:** Pen plotter: Houston Instruments HIPL0T (tm) plotter. Uses 8 by 11 paper. Has serial and parallel interfaces. Perfect shape; \$900. (New price is \$1100.) Will ship COD. Harold Hedelman, 1020 Triphammer Rd, Ithaca NY 14853, (607) 256-4880.

**FOR SALE:** Jade Z80 processor board, 4 MHz, assembled and tested, unused, \$140; GRI keyboard #753 (5 V), \$50. K B Clark, 158 Creel, Palm Bay FL 32905, (305) 725-5130.

**WANTED:** Radio Shack expansion interface with or without RS-232C board. 0 K or 16 K memory. Marc Gedert, 619 W Broadway, Maumee OH 43537, (419) 893-0544.

**WANTED:** Need SwTPC MP-A or MP-A2 processor card or similar for S-50 bus. Prefer to have operating card, but will consider one that needs repair if necessary. (US Post Office domestic rates, \$0.15 letters) George Keim, POB 160, Yap Island GU 96910.

**FOR SALE:** Used and unused hardware and software for TRS-80 Model I and CP/M systems. Send SASE for complete list. R Lee, 25 Amayllis Ave, Waterbury CT 06710.

**FOR SALE:** Two EXECuport portable terminals: 10 thru 30 cps, 80-column printer modems. Both parallel and serial I/O ports for use as printer. See ad on page 217 of the March 1980 BYTE for details. Both units in good working condition. Will ship UPS COD, no risk, pay on delivery. Model #300-\$375, #320-\$475. Warren V Bell, 1604 N Smith St, Spokane WA 99207, (509) 534-8088 evenings.

**WANTED:** Apple, Pascal, and dual disks are the base of our research project to develop automated tools for high-level software and systems design architecture. Based on the Design by Objectives methods. We seek contact with hard-working colleagues prepared to contribute to development. MARK I system exists. Tom Glib and Lech Krzanik, Box 102, N-1411 Kolbotn, Norway.

**FOR SALE:** CAT-100 video digitizer with frame capture, full instructions, CP/M software, and source listing. It is a two-board system for S-100 bus and includes 32 K of programmable memory with full video and software I/O capability. It has sixteen levels of gray scale or sixteen colors arranged as 240 lines of 256 pixels. \$1600 invested. \$950/offer. John Underwood, 1171 NE 72nd, Portland OR 97213, (503) 252-7394.

**FOR SALE:** Ithaca Audio Z80 processor. 2.5 MHz with power on jump and selectable wait states, 2708 not included; \$99. Vector 8803 motherboard with active termination and three S-100 connectors; \$35. Roy Ortiz, 265 Beech St #21, Hackensack NJ 07601, (201) 488-5405.

## The Sight of Music

### Digital Harmony by John Whitney

BYTE BOOKS is pleased to offer **DIGITAL HARMONY** a major new work by John Whitney, a pioneer of the special effects technology used in **STAR WARS** and **2001: A SPACE ODYSSEY**. His book explores the special union of music and computer graphics, and expands the frontier between sight and sound, synthesizing the two to create a new art form. Whitney tells how it's done, provides a thorough theoretical background, and includes listings and programs for those interested in joining in the discovery of this new art form. **DIGITAL HARMONY** lays the foundation for audio-visual art made possible by microcomputers. It is must reading for all art, music and home computer enthusiasts.

Illustrated in Color.



Please remit in U.S. funds or draw on a U.S. Bank

Please send ☐ \_\_\_\_\_ copies of  
**Digital Harmony**

Name _____	Title _____	Company _____
Street _____	City _____	State/Province _____
		Code _____

☐ Check enclosed in the amount of \$ \_\_\_\_\_  
☐ Bill Visa ☐ Bill Master Charge  
 Card No. \_\_\_\_\_  
 Exp. Date \_\_\_\_\_  
 Add 75¢ per book to cover postage and handling.

B3  
 ISBN 07-070015-X  
 Price \$21.95



Call TOLL FREE: 800-258-5420  
 or Mail To:  
 70 Main Street,  
 Peterborough, N.H. 03458

**FOR SALE OR TRADE:** Current model Minlterm portable computer. BASIC, 6800 programming, resident debugger and editor, 32 K programmable memory, built-in microcassette (60 K storage), acoustic coupler, and serial interface. Also has all the features of a portable printing terminal. Disk system available. Other features too numerous to list. Will supply information. Sells new for \$5000; will sell for \$2500 or trade for 48 K Apple II with two disks and Pascal or similar system. Bob Edison, 215 Newton St, Waltham MA 02154, (617) 891-5618.

**SWAP:** KIM-1 microcomputer with manuals, barely used, for a pair of Acoustic Research AR-3 speakers (not AR-3a). Will pay shipping both ways. C Lee, 1021 Merritt Dr, Tallahassee FL 32301, (904) 878-1983.

**FOR SALE:** S-100 compatible, 16-bit 8088 single-board computer; all documents included. Never been used. Original cost of \$400, will sell for \$300. Trung Dac Lieu, Box 292, 303 Stadium Pl, Syracuse NY 13210.

**FOR SALE:** Two Pertec disk drives and controller. The drives worth \$5000 when new; I will take \$1500 or best offer. Both of the drives need some work. Comes complete with power supply, multiplexer boards, 8-inch DOS disk, and complete documentation. (MCI—if wanted.) Will work on various microprocessors. Heinan Landa, 12109 Greenleaf Ave, Potomac MD 20854, (301) 279-9356.

**FOR SALE:** Computer Mart PME1 32 K memory board, which lifts an 8 K PET to a full 40 K. 8 K of this is addressable through machine language only. The PME1 board installs entirely inside the PET. I used it lightly for three months. Cost \$750; asking \$350. Philip Restagno, 2910 DeWitt Pl, Bronx NY 10469, (212) 231-2753.

**FOR SALE:** Back issues of BYTE, postpaid. Also, want 1975 and 1976 issues of BYTE. P Gray, 1505 NW 124th Ave, Portland OR 97229, (503) 641-2747.

**FOR SALE:** Centronics P-1 printer, parallel, with cable; \$250. SwTPC CT-64 terminal; \$250. Hitachi 9-inch monitor; \$75. SwTPC AC-30 tape controller; \$75. All include manuals. Send 10% for COD, ppd orders sent ppd. Charles Shilling, 2003 Fair Meadow, Arlington TX 76012, (817) 461-2239.

**FOR TRADE:** Want to swap cassette programs for TRS-80 Level II. Games, educational, and mathematics. No business programs. Send cassette with your address. Bob Trent, POB 298, Hardinsburg KY 40143.

**FOR SALE:** TRS-80 disk drive. Less than six hours use. Includes cable. \$225. K J Morrison, 10513 Silverdale Way NW, Silverdale WA 98383.

**FOR SALE OR TRADE:** Assembler for 8080/85. Runs under North Star DOS V5.0. Written in BASIC, creates object file in North Star format. Included are source creator/editor and file dump programs (also in BASIC). Requires one minifloppy drive plus 32 K. Cost: \$25; manual only: \$5. W T Shaw, 13521 Blenheim Rd N, Phoenix MD 21131, (301) 667-4800.

**USED COMPUTERS:** Send information on microcomputers you or a friend have sold—make, model, configuration, month sold, price. I'll send a summary of other people's prices in return. Bruce Lynch, 2905 Blue Robin, Herndon VA 22071.

**FOR SALE:** ESCON Universal Interphase RS-232 for IBM Selectric II typewriter. B K Parekh, (406) 365-3393.

**FOR SALE:** Novation Model 4202B modem, 1200 bps, originate/auto-answer, direct connect, 2-wire dial-up or 4-wire; \$496. Philip Nunn, 201 Netherfield, Comstock Park MI 49321, (616) 361-8681.

**FOR SALE:** Heath H-9 video terminal expertly assembled, in very good condition; \$200. Also, YAESU FR-101, FL-101 with converter boards, filters, clock, and all documentation in English; \$900. Mint condition. Mark Miller, 9573 Walley Ave, Philadelphia PA 19115, (215) 698-1905.

**FOR SALE:** Apple graphics tablet, cost \$795, sell \$600. Mountain Hardware 388 day clock, cost \$199, sell \$140. Mountain Hardware Romplus with keyboard filter, cost \$169, sell \$125. Above items in like new condition and were used less than three hours each. Will be shipped in original cartons with all documentation. Earl A Loobey, FS/POB 487, Fairbanks AK 99701.

**FOR SALE:** Digital Group microcomputer. Z80 and 6800 processors, 50 K memory, sixteen parallel ports, front panel, 16 by 64 video display, Marantz tape deck, keyboard, Sanyo monitor, Maxi-BASIC, Super Games, Fig-FORTH documentation, plus much more software and full hardware documentation. Complete system \$2000 or best offer. Dennis Ruffer, 423 Garfield St, Kalamazoo MI 49001, (616) 381-8747.

**FREE PROGRAMS:** As a high school science teacher using a 16 K Apple II Plus, I have had difficulty in locating programs for class use. Since commercial programs are expensive and often not suited for use with high school students, I have written several programs in Applesoft BASIC for use in my physical science, biology, and chemistry classes. If anyone is interested in obtaining a copy of one of these programs, please send me a SASE and I will send you a complimentary copy. William R Ground, J L Mann High School, 61 Isbell Ln, Greenville SC 29607.

**FOR SALE:** Heath H-11 system, LSI-11 with 40 K bytes memory, CRDS double-density floppies, H-10 paper-tape reader/punch, serial and parallel interfaces. \$6400 value, asking \$4800. Add \$650 for factory-assembled H-19 terminal. Jeff Goldberg c/o CRDS, 4 Tech Cir, Natick MA 01760, (617) 655-1800.

**FOR SALE:** Apple II DOS 3.3 upgrade kit, including read-only memories, disks, and manual; \$35. Joel Buckley, 1212 Broadway, Hanover PA 17331.

**FOR SALE:** Heathkit ET-3400 and program for same. Good condition. Will sell to the best offer. Ralph Swearingen, 7213 Loras Ln, Wonder Lake IL 60097, (815) 653-7821.

**FOR SALE:** North Star disk controller board. Single-density, excellent condition. Selling due to an upgrade on my present system. Lots of software, including North Star DOS and BASIC, CP/M, assemblers, games, and lots more. Will run Pascal, FORTRAN, ALGOL, C, and many others. Asking \$250. Mark Sauerwald, 7872 Caminito Huerta, San Diego CA 92122, (714) 453-1206.

**FOR SALE:** North Star controller and software (fifty diskettes); \$350. Eprom board, holds sixteen 2708s; \$60. Rack-mountable Integrant cabinet; \$120. Vector eleven-slots motherboard with connectors; \$50. TDL processor; \$100. TDL monitor board; \$150. TDL cassette software (Assembler, 12 K BASIC, Text Editor, text output processor); \$200. Mohammad Mandurah, POB 4272, Stanford CA 94305, (415) 328-3959.

**WANTED:** Apple II with at least 32 K memory and disk drive. Prefer dual-disk drive. All replies will be answered. Send complete name, address, and phone. Scott Emmons, 1225 Nord Ave #166, Chico CA 95926, (916) 893-5311.

**WANTED:** Data for Processor Technology GPM-1 board (9 K read-only memory, 1 K programmable memory). Also require for S-100 bus, a cassette I/O prom programmer and disk controller, any make. Consider anything from bare board with data, to working. Please state price required. Larry Dass, 4, Nancevallon, Brea, Camborne, Cornwall, England, phone 0209 714475.

**FOR SALE:** Heathkit H-14 printer ready to connect to Heathkit, Zenith, or North Star Horizon computer. Features include RS-232 interface, uppercase/lowercase, up to 132 columns wide, adjustable tractor feed to 9.5 inches wide, maximum 165 cps print speed. Unit is in perfect condition. Full documentation and original carton included; \$575. Brian Stotesbery, 2544 Second Ave S, Minneapolis MN 55404, (612) 872-0804.

**SWAP:** TRS-80 machine language and BASIC programs, Level II and Disk BASIC. Send your list of programs to trade, and I'll send mine. Steven Kiewe, 9005 Vickery Rd, Tacoma WA 98446.

**FOR SALE:** Hewlett-Packard 608D VHF signal generator. Like new, \$350. Also, eight computer power supplies, four chart recorders, pulse generator, square-wave generator. W L Pierce, 703 23rd St S, Arlington VA 22202, (703) 525-3223.

**WANTED:** Processor board for SwTPC 6800 computer. Garth Fisher, Department of Industrial Technology, Walla Walla College, College Place WA 99324.

## Opinions and Games Win December BOMB

Computer games of all kinds caught our readers' fancy. Jerry Pournelle's popular User's Column won first place in the December 1980 BOMB; this time, Jerry wrote about "BASIC, Computer Languages, and Computer Adventures." P David Lebling's article "Zork and the Future of Computerized Fantasy Simulations" captured second. The next three places went to "Multimachine Games" (Ken Wasserman and Tim Stryker), "On the Road to Adventure" (Bob Liddil), and "Pirate's Adventure" (Scott Adams).

## BOMB

### BYTE's Ongoing Monitor Box

Article #	Page	Article	Author(s)
1	20	Structured Programming and Structured Flowcharts	Williams
2	36	Build the Disk-80: Memory Expansion and Floppy-Disk Control	Ciarcia
3	54	Three-Dimensional Computer Graphics, Part 1	Crow
4	84	The Micro Matrix Photopoint Light Pen	Gray
5	90	What's Inside Radio Shack's Color Computer?	Ahrens, Browne, and Scales
6	132	What Is Good Documentation?	Howard
7	166	A Beginner's Guide to Spectral Analysis, Part 2	Zimmermann
8	262	A Simple Approach to Data Smoothing	Ruckdeschel and Krinsky
9	300	The New Literacy: Programming Languages as Languages	Handel
10	317	Computer Music: A Design Tutorial	Orlofsky

# Reader Service

Inquiry No.	Page No.
63	Aardvark Software Inc 117
91	Aardvark Software Inc 162
320	AB Computers 361
*	Abbott, Robert 354
141	ABM Products 222
256	Ackerman Digital 339
272	ACOM Electronics 277
36	Action Computer 63
82	Adaptive Data & Energy Sys 146
275	Advanced Comp Prod 348, 349
307	ALL Electronics 356
32	Alpha Byte Storage 59
263	Alpha Omega Comp Sys 275
123	Am Micro Prod Inc 198
148	American Square Comp 231
48	Anadex 89
319	Anconra 360
12	Anderson Jacobson 16
192	Anderson Jacobson 279
147	Andromeda Systems Inc 230
9	Apple Computer 13
*	Applied Analytics 318
244	Artec Electronics 328
116	ASAP 187
131	Ashton-Tate 211
268	Atlantis Computerized Serv 277
*	ATV Research 354
311	autocontrol Inc 356
188	Automated Equip Inc 274
199	Automated Equip Inc 283
150	BASF Systems 233
*	John Bell Engineering 347
115	Beta Comp Devices 186
298	Bit Bucket, The 354
310	Blacksburg Grp Inc, The 356
128	Bower-Stewart & Assoc 204
*	BYTE Books 51, 201, 382
*	C & A Associates 350
16	Calif Comp Systems 21
321	Calif Digital 374, 375
202	Cambridge Develop Labs 285
248	Cawthon Scientific Grp 330
296	CBAS 354
162	Central Data 251
117	Cexec Inc 190
168	Chrislin Industries 255
17	C.I.T.O.H. Electronics Inc 23
326	Clev Con Comp & Compts 365
223	Cognitive Systems 297
39	CompuMart 68, 69
217	Computer Age Inc 293
206	Computer Case Co 287
100	Computer Disc of Am 174
*	Computer Factory, The 115
120	Computer Furn & Access 194
238	Computer Marketing Corp 320
181	Computer Plus 268
*	Comp Prof Book Club 208, 209
299	Computer Shopper 354
292	Computer Society 352
43	Computer Specialties 76, 77
243	Computer Tech Inc 326
*	Computer Warehouse 85
291	Computers Plus Inc 352
59	Computers R Us 108, 109
227	Compuview 302
38	Compuview Products Inc 67
318	Concord Comp Components 360
59	Consumer Computers 108, 109
42	Corvus Systems 73
221	Cover Craft 295
64	CPI 119
323	CPU Shop, The 363
1	Cromemco 1, 2
4	Crystal Computer 79
312	Custom Business Comp 356
278	Custom Peripherals 350
*	Cybernetics Inc 98
*	Data Discount Center 327
35	Datamax 62
18	Data Safe Products 24
251	Datasouth Computer Corp 333
57	Decision Master 105
118	Delta Products 191
97	Denver Software Co, The 171
157	DG Electronics 245
130	Diablo (Div of Xerox) 207
61	Digiac Corp 112
166	Digital Graphic Systems 254
156	Digital Marketing 243
72	Digital Pathways 133
19	Digital Research 25
*	Digital Research Computers 351
137	DIP Inc 217
231	Discount Sftw Grp, The 312
*	Disk Supply Co 248
250	DMA 332
138	Dual System Control Corp 218
*	DWP 277
210	Dymarc Industries 289
329	Dynabyte C III
176	Dynacomp Inc 263

Inquiry No.	Page No.
47	Ecosoft 88
104	Edmund Scientific 178
*	Electravalue Industrial 356
132	Electronic Control Tech 212
279	Electronic Equip Unltd 350
191	Electronic Specialists 279
213	Ellis Computing 291
94	Epson America Inc 165
69	Escon 128
20	ESP Comp Resources Inc 26
241	Essex Publishing Co 324
80	Exatron Inc 143
240	Faircom 322
198	Farnsworth Comp Center 283
260	Feith Software 275
51	John Fluke Mfg Co 97
321	Fordham 362
222	Frederick Comp Prod 297
*	Game-A-Tron 352
79	General DataComm Ind 139
78	GNT Automatic Inc 138
140	Godbout Electronics 220, 221
10	Mark Gordon Computers 14
122	H & E Computronics 196, 197
165	H & E Computronics 253
304	Hanley Engineering 355
288	Harris Corp 352
184	Hayden Book Co Inc 271
34	Hayes Microcomp Prod Inc 61
207	Hayes Microcomp Prod Inc 287
121	Hazeltine Corp 195
13	Heath Company 17
74	Hewlett-Packard 135
33	High Technology Inc 60
316	Hobbyworld Electronics 358
40	Houston Instruments 71
41	Houston Instruments 71
284	IDM 350
*	Illinois Comp Mart Inc 275
68	IMS International 127
14	Info Unltd Software 18
177	Innovative Sftw Appl 265
66	Integral Data Sys 121
169	Integrand 256
29	Intel 53
201	Intelligent Control Sys 285
151	International Microsystems 235
56	Intertec Data Systems 103
204	Ipx Int'l Inc 286
5	Ithaca Intersystems 8
6	Ithaca Intersystems 9
281	J & S Computers 350
330	Jade Computer Prod 372, 373
328	Jameco Electronics 368, 369
233	JDR MICRODEVICES 314
322	JR Inventory Control 362
179	KeeSoft 266
*	Konan Corp 145
164	Lax Computer Products 252
235	Lax Computer Products 316
*	Leading Edge Products 91
76	Lifeboat 125
145	Lifeboat 228
174	Lifeboat 260
*	Lifelines 131
306	Lin mar 356
149	Livermore Data Sys Inc 232
203	LNW Research 285
71	Lobo Drives Int'l 136
77	Lobo Drives Int'l 137
46	Lomas Data Prod 84
163	McClintock Corp 252
277	Macrotronics Inc 350
187	Mann, Charles & Assoc 274
194	Marymac Industries Inc 281
200	Mattel Inc 284
183	MBC Systems Inc 270
*	Meas Sys & Controls 29, 129
255	Meta Technologies Corp 336
212	MFJ Enterprises Inc 290
85	Micro Age Computer Store 151
195	Micro Architect 281
215	Micro Business World 291
*	Micro Comp Discount Co 304
245	Micro Comp Store, The 329
96	Micro Data Base Sys 169
155	Micro Management Sys 241
26	Micro Mikes 49

Inquiry No.	Page No.
182	Micro Pro International 269
265	Micro Products Unltd 275
237	Micro Works, The 319
67	MicroAce 123
107	MicroByte 183
106	Microcomp Tech Inc 180, 181
90	MicroDaSys 161
249	Microhouse 331
242	Micromail 325
173	MICROMATE ELECT 260
175	Micropolis Corp 261
257	MicroTech Exports 275
161	Microware Sys Corp 250
324	Mikos 364
53	Miller Microcomputer Serv 100
196	Mini Computer Suppliers 281
324	Mini Micro Mart 380
325	Mini Micro Mart 381
62	Morrow Designs 113
15	Mountain Computer Inc 19
89	mpi 159
*	MT Micro SYSTEMS 83
185	MTI Inc 272
220	MT View Press 295
70	MUSYS 130
183	Multi Business Comp Sys 270
186	NCC '81 273
136	NCE Supply Corp 216
95	NEECO 167
*	Netronics 303, 305
236	Noesis Computing Co 317
*	NRI Schools 193
52	Ohio Data Products Corp 82
330	Ohio Scientific Instr C IV
60	OK Machine & Tool 111
216	Olympic Sales Co 293
230	Omega Micro Computers 310
126	Omega Research 202
139	Omega Sales Co 219
228	Omikron 306
*	onComputing 225
197	Optimal Technology 283
83	Orange Micro 147
84	Osborne/McGraw-Hill 148, 149
171	OSM Computer 258
*	Owens Associates 28, 308, 309
285	P & S Electronics 352
264	Pace Age Tech 275
247	Pacific Exchanges 330
289	Pacific Exchanges 352
294	Page Digital 353
315	Pan American Elec 358
3	PCD Systems Inc 6
300	PC Newsletter, The 354
305	Pelican Programs 356
11	Percom Data 15
25	Percom Data 35
109	Percom Data 185
110	Percom Data 185
111	Percom Data 185
112	Percom Data 185
113	Percom Data 185
114	Percom Data 185
133	Personal Micro Computers 213
22	Personal Software 31
160	Phase One Systems 249
167	Pickles & Trout 254
178	pk systems inc 266
93	Potomac Micro Magic 164
73	Power One Inc 134
322	Priority One 376, 377
323	Priority One 378, 379
253	Professional Business Sftw 334
270	Professional Comp Store 277
239	Prometheus Products Inc 321
267	Purchasing Agent, The 277
246	Purchasing Agent, The 330
290	Purchasing Agent, The 352
283	Q Systems 350
229	QT Computer Systems 310
329	QT Computer Systems 370, 371
142	Qantex 223
261	Quality Computer Parts 275
105	Quality Software 179
154	Quasar Data Products 239
81	Quest 345
258	Quintrex Inc 275
8	R & B Computer Systems 12

Inquiry No.	Page No.
211	Racet Computes 289
209	Radgo Sales Co 289
45	Radio Shack 81
*	Rainbow Computing 258
119	RCA Solid State 192
108	REI Sales Co 184
252	RNB Enterprises 334
159	Rochester Data 299
21	S & M Systems 30
219	S-100 Inc 295
103	Howard W Sams Co 177
271	SC Digital 277
190	Scientific Eng Labs 279
2	Scion Corp 5
226	SciTronics Inc 299
*	Scottsdale Systems 144
180	Seattle Computer Prod 267
*	Shugart 7
214	Silverman Assoc 291
*	Sinclair Research 87
295	Skyles Electr Works 354
259	Sluder 275
234	Small Business Appl 315
54	Snapp Inc 101
88	Softech Microsystems 157
134	Softtech Microsystems 214
102	Software Toolworks, The 176
232	Solid State Sales 313
153	Sorcim 238
205	Sorrento Valley Assoc 286
144	Southern Semiconductors 227
328	Southwest Tech Prod Corp CII
129	Spectrum Software 205
7	SSM 11
92	Standard & Poors 163
208	Street Electronics 287
218	SubLOGIC 293
28	Summagraphics 52
325	Sunny Int'l 364
*	SuperSoft 10, 92, 93, 102, 311
*	Super Star Int'l Corp 155
27	Sybox 107
*	Synchro Sound 75, 292
172	Systems Plus 259
225	Tarbell Electronics 299
30	Tech Sys Consultants (TSC) 55
287	Technical Innovations 352
152	TecMar Inc 237
276	Terminal Data Sys 350
4	Texas Instruments 27
254	3G Company 335
50	3M Company 95
189	Thunderware 276
301	Mitchell E Timin Eng Co 354
309	TPA 356
170	TNW Corp 256
266	Toolsmith, The 277
143	TransNET 226
98	TSE/Hardside 172
99	TSE/Hardside 173
*	United Software of Am 140, 141
24	Urban Software Corp 34
327	US Micro Sales 366, 367
146	US Robotics 229
269	Vamp 277
87	VANDATA 104
31	Vector Graphics 57
297	Vertical Data 354
135	Victor Data 215
158	Videx 247
86	Vista Computer Co 153
317	Vista Computer Co 359
*	Westico Inc 188, 189
23	White Computer Sys 33
75	Whitesmith's Ltd 99
125	CJ Wigglesworth Software 200
193	Wild Hare Comp Sys 280
224	John Wiley & Sons 297
308	Wintek Corp 356
65	Winterhalter & Assoc 120
286	Winchendon Group, The 352
280	Worldwide Electronics 350
314	WW Component Supply Inc 357
101	Xerox 175
*	XPS Inc 277
*	Zobex 257

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. The index is provided as an additional service by the publisher, who assumes no liability for errors or omissions. \*Correspond directly with company.

# BYTE READER SERVICE

March 1981  
4131

For fastest service transfer mailer label from wrapper to coupon provided at the right. Requests cannot be honored unless zip code is given. This card valid for 90 days only.

**NOTE**—If label is missing or defaced fill out coupon carefully—**PLEASE PRINT**—this is the only way to get requested material to you.

Name \_\_\_\_\_

(Title) \_\_\_\_\_ (Company) \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

1 21 41 61 81	101 121 141 161 181	201 221 241 261 281	301 321 341 361 381	401 421 441 461 481	501 521 541 561 581	601 621 641 661 681
2 22 42 62 82	102 122 142 162 182	202 222 242 262 282	302 322 342 362 382	402 422 442 462 482	502 522 542 562 582	602 622 642 662 682
3 23 43 63 83	103 123 143 163 183	203 223 243 263 283	303 323 343 363 383	403 423 443 463 483	503 523 543 563 583	603 623 643 663 683
4 24 44 64 84	104 124 144 164 184	204 224 244 264 284	304 324 344 364 384	404 424 444 464 484	504 524 544 564 584	604 624 644 664 684
5 25 45 65 85	105 125 145 165 185	205 225 245 265 285	305 325 345 365 385	405 425 445 465 485	505 525 545 565 585	605 625 645 665 685
6 26 46 66 86	106 126 146 166 186	206 226 246 266 286	306 326 346 366 386	406 426 446 466 486	506 526 546 566 586	606 626 646 666 686
7 27 47 67 87	107 127 147 167 187	207 227 247 267 287	307 327 347 367 387	407 427 447 467 487	507 527 547 567 587	607 627 647 667 687
8 28 48 68 88	108 128 148 168 188	208 228 248 268 288	308 328 348 368 388	408 428 448 468 488	508 528 548 568 588	608 628 648 668 688
9 29 49 69 89	109 129 149 169 189	209 229 249 269 289	309 329 349 369 389	409 429 449 469 489	509 529 549 569 589	609 629 649 669 689
10 30 50 70 90	110 130 150 170 190	210 230 250 270 290	310 330 350 370 390	410 430 450 470 490	510 530 550 570 590	610 630 650 670 690
11 31 51 71 91	111 131 151 171 191	211 231 251 271 291	311 331 351 371 391	411 431 451 471 491	511 531 551 571 591	611 631 651 671 691
12 32 52 72 92	112 132 152 172 192	212 232 252 272 292	312 332 352 372 392	412 432 452 472 492	512 532 552 572 592	612 632 652 672 692
13 33 53 73 93	113 133 153 173 193	213 233 253 273 293	313 333 353 373 393	413 433 453 473 493	513 533 553 573 593	613 633 653 673 693
14 34 54 74 94	114 134 154 174 194	214 234 254 274 294	314 334 354 374 394	414 434 454 474 494	514 534 554 574 594	614 634 654 674 694
15 35 55 75 95	115 135 155 175 195	215 235 255 275 295	315 335 355 375 395	415 435 455 475 495	515 535 555 575 595	615 635 655 675 695
16 36 56 76 96	116 136 156 176 196	216 236 256 276 296	316 336 356 376 396	416 436 456 476 496	516 536 556 576 596	616 636 656 676 696
17 37 57 77 97	117 137 157 177 197	217 237 257 277 297	317 337 357 377 397	417 437 457 477 497	517 537 557 577 597	617 637 657 677 697
18 38 58 78 98	118 138 158 178 198	218 238 258 278 298	318 338 358 378 398	418 438 458 478 498	518 538 558 578 598	618 638 658 678 698
19 39 59 79 99	119 139 159 179 199	219 239 259 279 299	319 339 359 379 399	419 439 459 479 499	519 539 559 579 599	619 639 659 679 699
20 40 60 80 100	120 140 160 180 200	220 240 260 280 300	320 340 360 380 400	420 440 460 480 500	520 540 560 580 600	620 640 660 680 700

**BYTE'S BOMB** is your direct line to the editor's desk. Each month, the two top-rated authors receive bonuses based on your votes. To cast your vote, first look at the list of this month's articles and corresponding article numbers (located in the unclassified ads section on the page preceding the Reader Service list), then rate each article as **Excellent**, **Good**, **Fair**, or **Poor** by circling the appropriate number in each column below. Your feedback helps to produce the best possible magazine each month.

Article No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Excellent	801	805	809	813	817	821	825	829	833	837	841	845	849	853	857	861	865	869	873	877
Good	802	806	810	814	818	822	826	830	834	838	842	846	850	854	858	862	866	870	874	878
Fair	803	807	811	815	819	823	827	831	835	839	843	847	851	855	859	863	867	871	875	879
Poor	804	808	812	816	820	824	828	832	836	840	844	848	852	856	860	864	868	872	876	880

Comments \_\_\_\_\_

# BYTE READER SERVICE

March 1981  
4131

For fastest service transfer mailer label from wrapper to coupon provided at the right. Requests cannot be honored unless zip code is given. This card valid for 90 days only.

**NOTE**—If label is missing or defaced fill out coupon carefully—**PLEASE PRINT**—this is the only way to get requested material to you.

Name \_\_\_\_\_

(Title) \_\_\_\_\_ (Company) \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

1 21 41 61 81	101 121 141 161 181	201 221 241 261 281	301 321 341 361 381	401 421 441 461 481	501 521 541 561 581	601 621 641 661 681
2 22 42 62 82	102 122 142 162 182	202 222 242 262 282	302 322 342 362 382	402 422 442 462 482	502 522 542 562 582	602 622 642 662 682
3 23 43 63 83	103 123 143 163 183	203 223 243 263 283	303 323 343 363 383	403 423 443 463 483	503 523 543 563 583	603 623 643 663 683
4 24 44 64 84	104 124 144 164 184	204 224 244 264 284	304 324 344 364 384	404 424 444 464 484	504 524 544 564 584	604 624 644 664 684
5 25 45 65 85	105 125 145 165 185	205 225 245 265 285	305 325 345 365 385	405 425 445 465 485	505 525 545 565 585	605 625 645 665 685
6 26 46 66 86	106 126 146 166 186	206 226 246 266 286	306 326 346 366 386	406 426 446 466 486	506 526 546 566 586	606 626 646 666 686
7 27 47 67 87	107 127 147 167 187	207 227 247 267 287	307 327 347 367 387	407 427 447 467 487	507 527 547 567 587	607 627 647 667 687
8 28 48 68 88	108 128 148 168 188	208 228 248 268 288	308 328 348 368 388	408 428 448 468 488	508 528 548 568 588	608 628 648 668 688
9 29 49 69 89	109 129 149 169 189	209 229 249 269 289	309 329 349 369 389	409 429 449 469 489	509 529 549 569 589	609 629 649 669 689
10 30 50 70 90	110 130 150 170 190	210 230 250 270 290	310 330 350 370 390	410 430 450 470 490	510 530 550 570 590	610 630 650 670 690
11 31 51 71 91	111 131 151 171 191	211 231 251 271 291	311 331 351 371 391	411 431 451 471 491	511 531 551 571 591	611 631 651 671 691
12 32 52 72 92	112 132 152 172 192	212 232 252 272 292	312 332 352 372 392	412 432 452 472 492	512 532 552 572 592	612 632 652 672 692
13 33 53 73 93	113 133 153 173 193	213 233 253 273 293	313 333 353 373 393	413 433 453 473 493	513 533 553 573 593	613 633 653 673 693
14 34 54 74 94	114 134 154 174 194	214 234 254 274 294	314 334 354 374 394	414 434 454 474 494	514 534 554 574 594	614 634 654 674 694
15 35 55 75 95	115 135 155 175 195	215 235 255 275 295	315 335 355 375 395	415 435 455 475 495	515 535 555 575 595	615 635 655 675 695
16 36 56 76 96	116 136 156 176 196	216 236 256 276 296	316 336 356 376 396	416 436 456 476 496	516 536 556 576 596	616 636 656 676 696
17 37 57 77 97	117 137 157 177 197	217 237 257 277 297	317 337 357 377 397	417 437 457 477 497	517 537 557 577 597	617 637 657 677 697
18 38 58 78 98	118 138 158 178 198	218 238 258 278 298	318 338 358 378 398	418 438 458 478 498	518 538 558 578 598	618 638 658 678 698
19 39 59 79 99	119 139 159 179 199	219 239 259 279 299	319 339 359 379 399	419 439 459 479 499	519 539 559 579 599	619 639 659 679 699
20 40 60 80 100	120 140 160 180 200	220 240 260 280 300	320 340 360 380 400	420 440 460 480 500	520 540 560 580 600	620 640 660 680 700

PLACE  
FIRST  
CLASS  
POSTAGE  
STAMP  
HERE

**BYTE**

READER SERVICE  
PO BOX 2114 GPO  
NEW YORK NY 10116  
USA

PLACE  
FIRST  
CLASS  
POSTAGE  
STAMP  
HERE

**BYTE**

READER SERVICE  
PO BOX 2114 GPO  
NEW YORK NY 10116  
USA

# THE DYNABYTE DIFFERENCE

No one has a broader line of micro-based business computers than Dynabyte. Memory to 400KB. Mini-floppies, eight inch floppies, Winchester and cartridge module hard disks; capacity from 630KB to 96MB. Satisfy all your clients' needs with Dynabyte. Start small, expand the system as computing needs grow, with modular add-ons from Dynabyte. With complete software and hardware compatibility across the entire line.

But expandable memory and the broad range of storage capacities are only part of the DYNABYTE DIFFERENCE. How about multiple terminals? Foreground/background? With Dynabyte you can have up to eight partitions, driven from up to eight terminals. And each terminal can have its own spooler; or all can share a system spooler. How about up to sixteen printers, and they don't require any partition space either. The DYNABYTE DIFFERENCE.

Our operating systems are the standard CP/M™ for single user sites and Dynabyte-enhanced MP/M™ for multiple user sites. As a seller of business systems you already have a whole library of applications

software. So to help protect your software investment we offer COBOL and BASIC and FORTRAN and PASCAL and PL/1.

Or you can use BUSINESS MANAGER™ Dynabyte's fully integrated accounting system. Menu driven, well documented, easy to install; it fits the needs of most wholesalers and distributors as is.

With no direct sales outlets, we are totally committed to our resellers. We don't compete with them. We support them with full service others only promise. Another DYNABYTE DIFFERENCE.

If you're tired of only promises from your computer suppliers; if you're losing sales because of price or limited storage capacity, or lack of modular expansion capability, call Dynabyte. Ask about the DYNABYTE DIFFERENCE. Ask about our advertising and lead referral programs. Ask about our warranty program. You'll be surprised.

Call our toll-free hotline: (800) 227-8300. In California (415) 329-8021. Dynabyte, 115 Independence Drive, Menlo Park, California 94025. Call or write today for the DYNABYTE DIFFERENCE.

er is a registered trademark of Dynabyte.  
are registered trademarks of Digital Research Corporation.

Circle 329 on inquiry card.



# Ohio Scientific: The leader in Winchester based micro- computers.

Ohio Scientific produced the first large capacity fixed media hard disk (Winchester) based microcomputers in 1977. Since then we have shipped more of these systems than the rest of the microcomputer industry combined.

## Family Features

All standard C3 features including:

- 3-processor CPU with 6502, Z80 and 6800
- .7 MIPS 6502A
- 48K static RAM
- Dual 8" floppies
- Free standing rack for direct expansion capabilities
- 17-slot OSI 48 line BUS architecture for large system expansion
- Directly accepts up to 8 users with currently available memory boards, more with higher density boards in the future
- Directly expandable for use as Network data bases
- Slide-mounted subassemblies, removable side panels and locking rear door for easy expansions and service.

## C3-A

The floppy only rack based C3 for users who anticipate expansion to hard disk, multi-user and/or networking in the future.

**Under \$7000.**

## C3-B

The world's most powerful microcomputer (when GT equipped). Features the highly advanced and extensively field proven OKIDATA 3306 Winchester disk.

## Features

- System boots from floppies or hard disk on power up
- 74 megabytes end user workspace under OS-65U, 80 megabytes unformatted
- Ultra-high performance disk
  - 74 millisecc worst case access
  - 38 millisecc average
  - 10 millisecc access on cylinder (215K user workspace)
  - 8 megabits per second transfer rate
- Simple on/off disk operation with elaborate internal protection from improper temperature, line voltage and controller failures
- Features spindle brake and designated head landing areas for much longer operational life than the newer low-cost Winchester
- Highly advanced OS-65U operating system:
  - Multiple level pass word security
  - Multiple operating systems on disk
  - Ultra-high speed "FIND" command for high speed string searches (Associative Access)
  - Upward compatible with multi-user and network systems with full file, peripheral and communications arbitration between users



- Available factory configured for up to 8 users and network data base operation
- Expandable to CP/M operation by adding 4K (CM-2 memory) **Under \$14,000**

## C3-C

A medium performance Winchester disk based system which provides the ideal cost/performance ratio in typical small business applications. The C3-C uses the Shugart SA4008 29 megabyte Winchester disk.

Performance specifications, hardware configuration and software is identical to the C3-B with the following exceptions:

- 23 megabytes of end user workspace under OS-65U
- 29 megabytes unformatted capacity
- Medium performance Winchester
  - 240 millisecc worst case access
  - 87 millisecc average access
  - 10 millisecc access on cylinder (110K user workspace)
- Simple on/off disk operation **Under \$11,000**

**Ohio Scientific has a new OEM program that is easy to start with, and provides generous discounts for quantity purchases.**

**For literature and the name of your local dealer, CALL 1-800-321-6850 TOLL FREE.**

**OHIO SCIENTIFIC**  
1333 SOUTH CHILLICOTHE ROAD  
AURORA, OH 44202 • (216) 831-5600