

OCTOBER 1978

VOLUME 3, Number 10

\$2.00 in USA

\$2.40 in CANADA

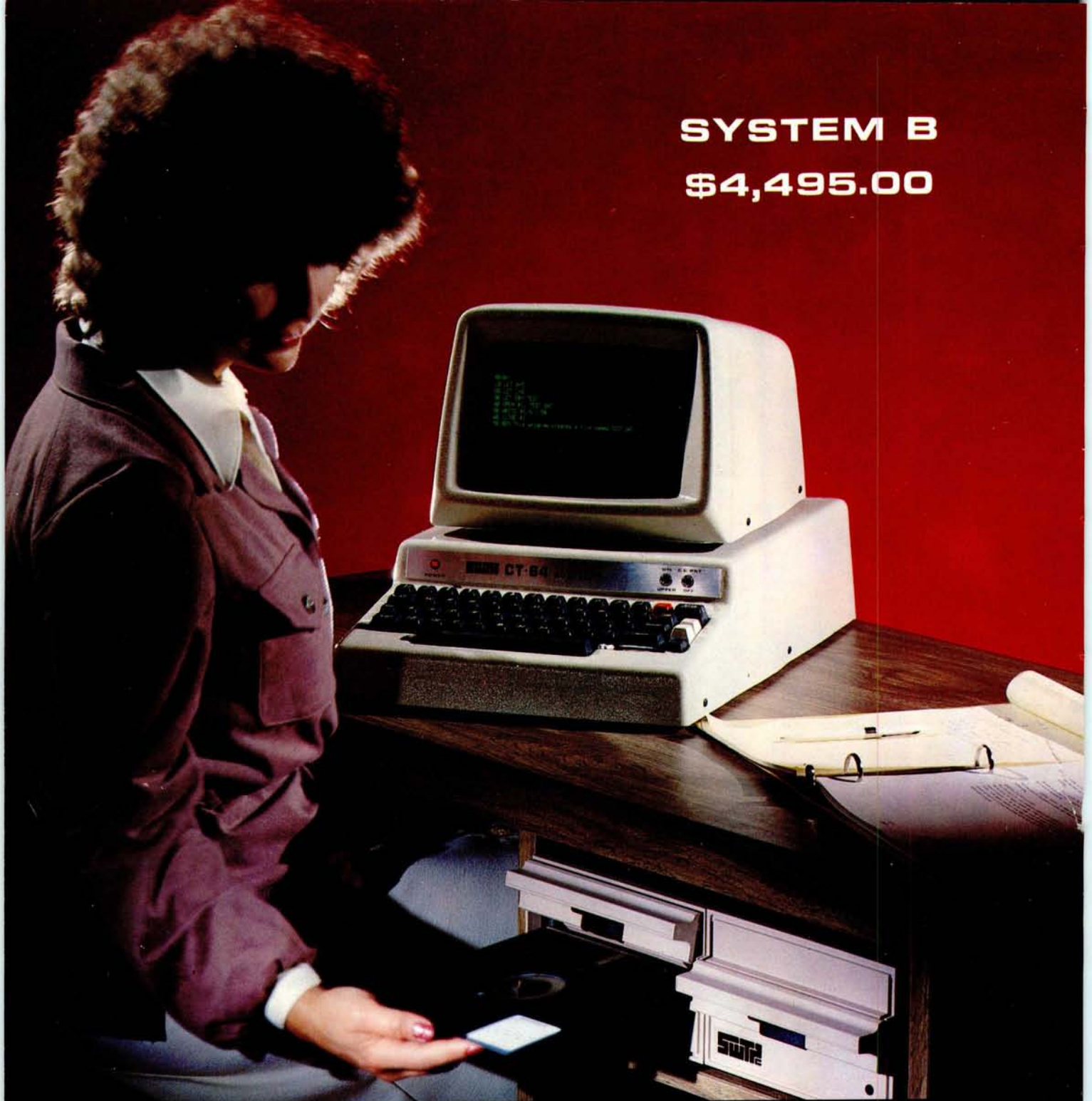
BYTE

the small systems journal

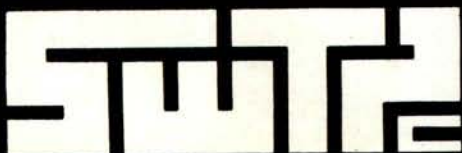


ROBERT
78 TINNEY

SYSTEM B
\$4,495.00

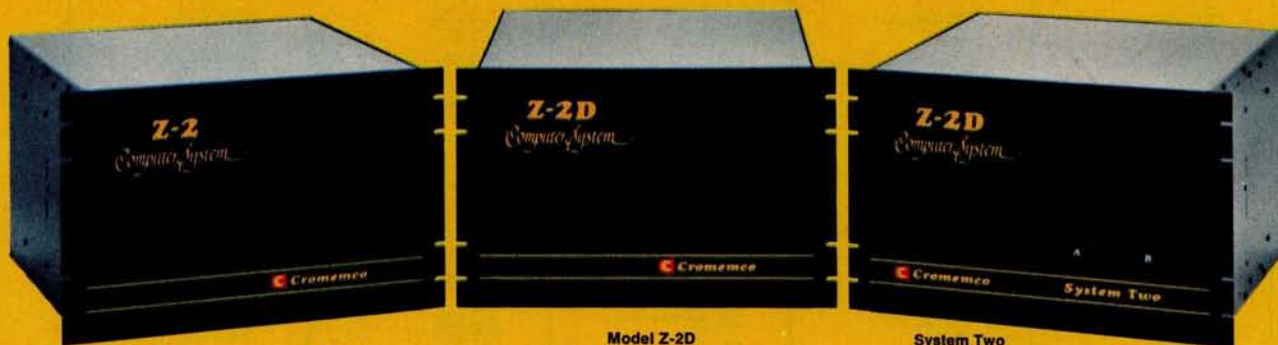


40K Bytes RAM Memory
1,200,000 Bytes Disk Storage
Desk with laminated plastic surface
DOS and BASIC with random and sequential files
TERMINAL—Upper-Lower case and full control character decoding



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

Circle 350 on inquiry card.



Model Z-2
Up to 512K of RAM/ROM

Model Z-2D
One or two disks
Up to 512K of RAM/ROM
Up to 184K of disk

System Two
Dual disk
Up to 512K of RAM/ROM
Up to 184K of disk

Fill your computer needs with the industry's most professional microcomputers

#1 IN RELIABILITY

When you choose Cromemco you get not only the industry's finest microcomputers but also the industry's widest microcomputer selection.

What's more, you get a computer from the manufacturer that computer dealers rate #1 in product reliability.*

Your range of choice includes our advanced System Three with up to four 8" disk drives. Or choose from the System Two and Z-2D with 5" drives. Then for ROM-based work there's the Z2. Each of these computers further offers up to 1/2 megabyte of RAM (or ROM).

We say these are the industry's most professional microcomputers because they have outstanding features like these:

- **Z-80A microprocessor** — operates at 250 nano second cycle time — nearly twice the speed of most others.

*Rated in *The 1977 Computer Store Survey* by Image Resources, Westlake Village, CA.

Up to 512 kilobytes of RAM and 1 megabyte of disk storage



System Three
Two to four disks
Up to 512K of RAM/ROM
Up to 1 megabyte of disk

- **30-amp power supply** — more than adequate for your most demanding application.
- **21 card slots** to allow for unparalleled system expansion using industry-standard S-100 cards.
- **S-100 bus** — don't overlook how important this is. It has the industry's widest support and Cromemco has professionally implemented it in a fully-shielded design.

- **Cromemco card support** of more than a dozen circuit cards for process control, business systems, and data acquisition including cards for A-D and D-A conversion, for interfacing daisy-wheel or dot-matrix printers, even a card for programming PROMs.
- **The industry's most professional software support**, including COBOL, FORTRAN IV, 16K Disk-Extended BASIC, Z-80 Macro Assembler, Cromemco Multi-User Operating System — and more coming.
- **Rugged, professional all-metal construction** for rack (or bench or floor cabinet) mounting. Cabinets available.

FOR TODAY AND TOMORROW

Cromemco computers will meet your needs now and in the future because of their unquestioned technical leadership, professionalism and enormous expandability.

See them today at your dealer.

There's no substitute for getting the best.

see next
page



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

Specialists in computers and peripherals

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

280 BERNARDO AVE., MOUNTAIN VIEW, CA 9404

● DENOTES SYSTEMS THREE DEALER

Foreground

- 22 NO POWER FOR YOUR INTERFACES?: Build a 5 W DC to DC Converter
Hardware—Ciarcia
- 34 A "TINY" PASCAL COMPILER, Part 2: The P-Compiler
Pascal—Chung-Yuen
- 58 TESTING MEMORY IN BASIC
Software—Adams
- 86 FIRST STEPS IN COMPUTER CHESS PROGRAMMING
Software Chess—the Spracklens
- 100 LINEAR CIRCUIT ANALYSIS
Simulation—Anderson
- 122 SOLVING THE EIGHT QUEENS PROBLEM
Software—Smith
- 142 A SIMPLER DIGITAL CASSETTE TAPE INTERFACE
Hardware—Burhans
- 144 SOUPING UP YOUR SWTPC 6800
Hardware—Hughes
- 162 A NOVEL BAR CODE READER
Hardware—Farnell
- 168 A COMPUTER CHESS TUTORIAL
Computer Chess—Whaland

Background

- 12 A MEMORY PATTERN SENSITIVITY TEST
Debugging—Kinzer
- 70 PAM/8: A New Approach to Front Panel Design
Computer Design—Letwin
- 130 ASSEMBLING THE H9 VIDEO TERMINAL
Product Description—Steeden
- 182 CREATING A CHESS PLAYER
Chess Tutorial—Frey-Atkin

Nucleus

- 4 In This BYTE
- 6 On Using a Personal Computer for a Practical Purpose
- 10 Letters
- 54 Book Reviews
- 57, 65 Technical Forum
- 68, 136, 141 Programming Quickies
- 151 BYTE's Bits
- 151 BYTE's Bugs
- 152 Clubs, Newsletters
- 154 Event Queue
- 166 Product Description: Micro-Scan Corp Bar Code Scanner
- 193 What's New?
- 222 Unclassified Ads
- 224 BOMB
- 224 Reader Service



PUBLISHERS
Virginia Londoner
Gordon R. Williamson
EDITOR IN CHIEF
Carl T. Helmers Jr.
VICE-PRESIDENT, PRODUCTION
Judith Havey
PRODUCTION MANAGER
Karen Gregory
ADVERTISING DIRECTOR
John Hayes
CIRCULATION MANAGER
Gregory Spitzfaden
COMMUNICATIONS COORDINATOR
James C. Morrisett
SENIOR EDITOR
Christopher P. Morgan
EDITORS
Raymond G. A. Cote
Blaise W. Liffick
Richard Shuford
PRODUCTION EDITORS
Nancy Salmon
David William Hayward
Peter Perin
PRODUCTION ASSISTANT
Cheryl A. Hurd
PRODUCTION ART
Stephen Kruse
Wai Chiu Li
Dorothy Shamonsky
Ellen Shamonsky
NEW PRODUCTS EDITOR
CLUBS, NEWSLETTERS
Laura A. Hanson
ASSISTANT ADVERTISING DIRECTOR
Patricia Clark
ASSISTANT PRODUCTION COORDINATOR
Thomas Harvey
ADVERTISING ASSISTANTS
Noreen Bardsley
Jill Callihan
COMPTROLLER
Kevin Maguire
ASSISTANT TO COMPTROLLER
Ruth M. Walsh
EDITORIAL ASSISTANT
Gale Britton
CIRCULATION ASSISTANTS
Christine Dixon
Ann Graves
Pamela R. Heaslip
Agnes E. Perry
DEALER SALES
Ginnie F. Boudrieau
Anne M. Baldwin
TRAFFIC MANAGER
Rick Fuetter
RECEPTIONIST
Jacqueline Earnshaw
DRAFTING
Techart Associates
DRAWING EDITOR
Kent Richard
TYPOGRAPHY
Goodway Graphics
PHOTOGRAPHY
Ed Crabtree
PRINTING
The George Banta Company
ASSOCIATE EDITOR
Daniel Fylstra
ASSOCIATES
Walter Banks
Steve Ciarcia
David Fylstra
Portia Isaacson
BOOK DIVISION:
PRODUCTION MANAGER
Edmond C. Kelly Jr.
PRODUCTION ASSISTANT
Catherine Lahive
ADVERTISING SALES REPRESENTATIVES:
EAST, MIDWEST
Hajar Associates Inc.
17 Durant St.
West Roxbury MA 02132
(617) 325-5380
100 W. Chicago Av.
Chicago IL 60610
(312) 337-8008
WEST, SOUTHWEST
Buckley/Boris Associates Inc.
912 South Barrington, Suite 202
Los Angeles CA 90049
(213) 826-4621
DISTRIBUTORS:
EASTERN CANADA
RS-232 Distribution Company
186 Queen St. W., Suite 232
Toronto ONTARIO
WESTERN CANADA
Kitronic Ltd.
26236 26th Av. RR 5
Aldergrove BC V0X 1A0

BYTE is published monthly by BYTE Publications Inc., 70 Main St., Peterborough NH 03458. Address all mail except subscriptions to above address: phone (603) 924-7217. Address all editorial correspondence to the editor at the above address. Unacceptable manuscripts will be returned if accompanied by sufficient first class postage. Not responsible for lost manuscripts or photos. Opinions expressed by the authors are not necessarily those of BYTE. Address all subscriptions, change of address, Form 3579, and fulfillment complaints to BYTE Subscriptions, PO Box 590, Martinsville NJ 08836. Second class postage paid at Peterborough NH 03458 and at additional mailing offices—USPS Publication No. 102410. Canadian second class registration No. 9321. Subscriptions are \$15 for one year, \$27 for two years, and \$39 for three years in the USA and its possessions. In Canada and Mexico, \$17.50 for one year, \$32 for two years, and \$46.50 for three years. \$25 for a one year subscription by surface mail worldwide. Air delivery to selected areas at additional rates available upon request. \$25 for a one year subscription by air delivery to Europe. Single copy price is \$2.00 in the USA and its possessions, \$2.40 in Canada and Mexico, \$3.50 in Europe, and \$4.00 elsewhere. Foreign subscriptions and sales should be remitted in United States funds. Printed in United States of America. Each separate contribution to this issue and the issue as a collective work copyright © 1978 by BYTE Publication Inc. All rights reserved.

Subscription WATS Line: (800) 258-5485

Robert Tinney's painting on the cover this month is a fanciful image of computer chess. A Knight floats above an ancient stone chessboard with the ubiquitous floppy disk beneath. Four articles in this issue are devoted to the art of computer chess, including the first part of a 4 part series by the creators of Chess 4.6, the world championship chess program.

In This **BYTE**

One cause of seemingly unexplainable program errors may be incorrectly operating memory. **A Memory Pattern Sensitivity Test** discussed by Don Kinzer will help to determine if your memory is operating correctly.

page 12

If you need -12 or +15 V for your latest hardware design, and have only +5 V, what can you do? Read **No Power for Your Interfaces? Build a 5 W DC to DC Converter** by Steve Ciarcia. Several inexpensive, practical designs are described, to give you everything from -15 to +15 V from a +5 V source.

page 22

In Part 1 of **A "Tiny" Pascal Compiler**, in the September 1978 **BYTE**, Kin-Man Chung and Herbert Yuen described the syntax of a Pascal subset and described a hypothetical stack machine, called a p-machine. This month they describe a compiler that generates codes for the p-machine.

page 34

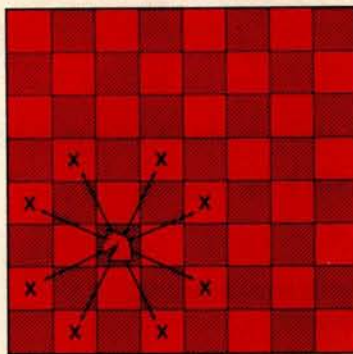
Would you like a fast and easy way to test your new memory board? Author Russell Adams shows you how in **Testing Memory in BASIC**. A simple program loads the memory locations with alternating 1s and 0s to spot those bad bits.

page 58

The H8 computer from Heath features a novel firmware front panel monitor comprised of both hardware and software elements. Gordon Letwin, Heath software designer, describes the design philosophy and the features of the system in **PAM/8**:

A New Approach to Front Panel Design.

page 70



The winning program at the Second West Coast Computer Faire's Microcomputer Chess Tournament in March of 1978 was Sargon, written in Z-80 assembler language. Sargon's creators, Dan and Kathe Spracklen, describe the move generating portion of their program in **First Steps in Computer Chess Programming**.

page 86

A computer allows you to try out a variety of ideas with nothing more than a program to see if they will work. One way to use this potential is to model electrical circuits in software. Leonard H Anderson describes how to perform **Linear Circuit Analysis** on your computer.

page 100

The eight Queens problem is a venerable puzzle in recreational mathematics. Terry Smith describes his thought processes in working out a solution in his article, **Solving the Eight Queens Problem**. An occasional dose of cleverness is often the key to solving a difficult problem, as Terry demonstrates.

page 122

For someone who is looking for a good quality video terminal which is easy to work with and will be user serviceable, the Heathkit H9 is the solution. Terry Steeden describes his pleasant experiences **Assembling the H9 Video Terminal** and having it work correctly the first time.

page 130

Digital recording of computer programs and data is an attractive alternative to standard audio cassette recording techniques because of its reliability and simplicity. Ralph Burhans de-

scribes an updated version of earlier digital recording schemes in **A Simpler Digital Cassette Tape Interface**.

page 142

If you own a SwTPC 6800 computer and want to increase the processor clock speed with a minimum of fuss, read **Souping Up Your SwTPC 6800** by Steve A Hughes. The article describes a simple circuit that plugs directly into a socket on the 6800 processor board. Changing the clock speed is then done by simply plugging in a new crystal oscillator.

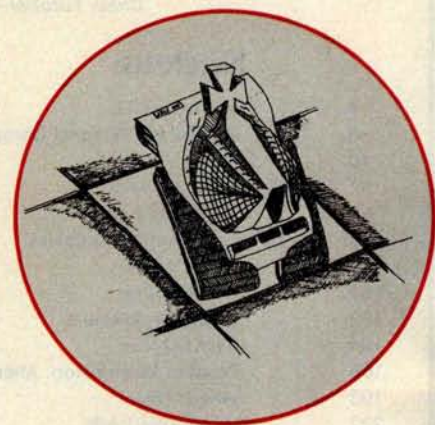
page 144

Last year we ran a contest in which readers were asked to design their own **PAPERBYTE™** bar code readers and submit them to us. One of the winning entries, by Campbell Farnell and Glen Seeds, is described in their article, **A Novel Bar Code Reader**.

page 162

For a short introduction to the world of computer chess, read Norman Whaland's **A Computer Chess Tutorial**. The basic principles of chess strategy and tactics are covered in discussions of game trees, alpha-beta pruning, minimax strategies and so on.

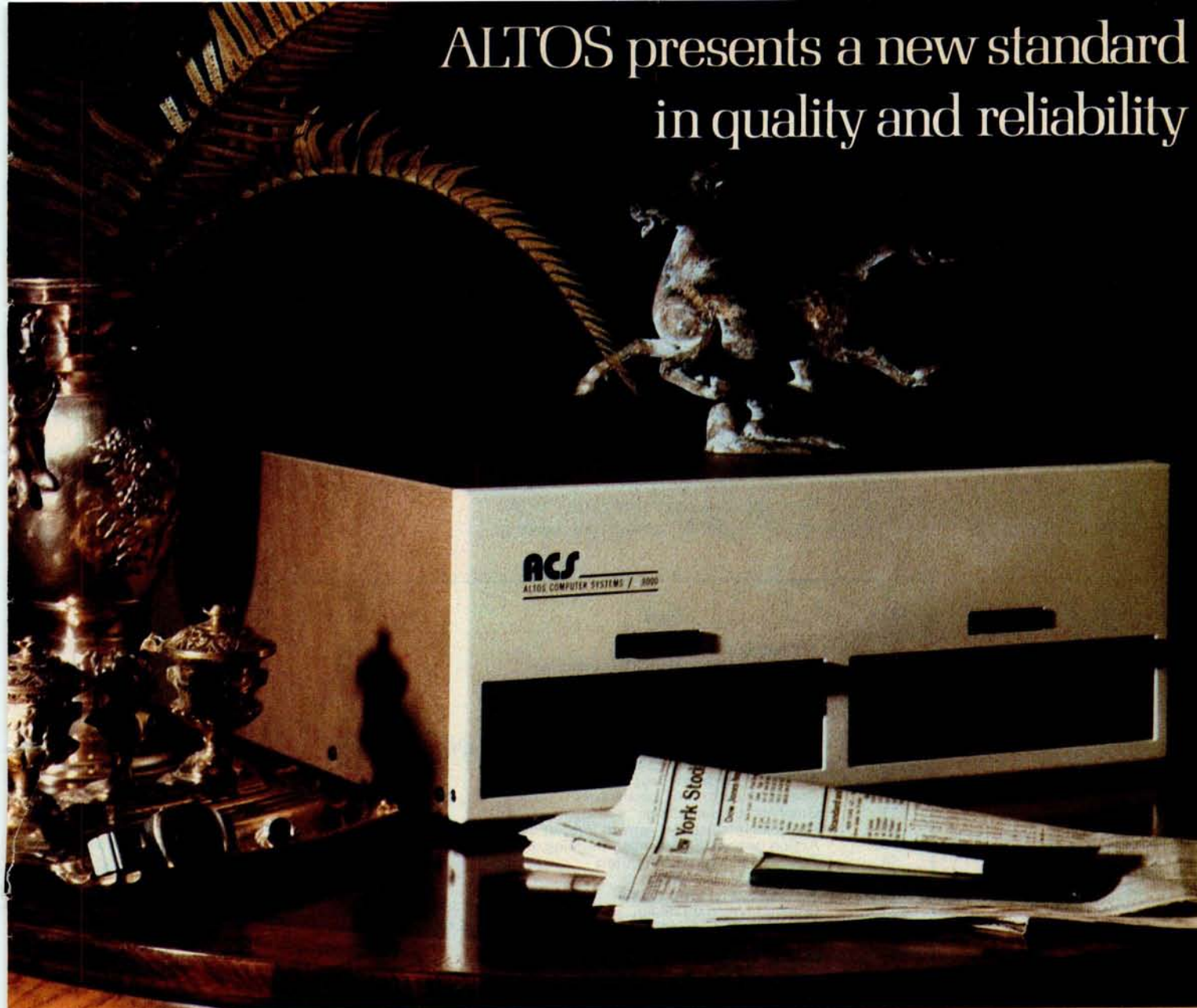
page 168



Creating a Chess Player was written by two people at the forefront of research in computer chess: David Frey, editor of *Chess Skill in Man and Machine*, and Larry Atkins, coauthor of Chess 4.6, the world champion chess program that recently beat a Grandmaster in a simultaneous exhibition. The article discusses the thinking processes in the chessplayer's mind and how such processes are transformed into a computer program.

page 182

ALTOS presents a new standard in quality and reliability



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

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

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

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

PRICE \$3,840. Standard ACS8000 system with 32 Kb RAM and ½ Mb disk. FPP, DMA and software optional. Dealer/OEM discounts available. Delivery: 3 weeks ARO.

*Z80 is a trademark of Zilog, Inc.
**CP/M is a trademark of Digital Research, Inc.
Dealer/rep inquiries invited.

ALTOS

COMPUTER SYSTEMS

2378B WALSH AVENUE • SANTA CLARA • CA 95050 • (408) 244-5766

Circle 7 on inquiry card.

On Using a Personal Computer for a Practical Purpose

Editorial

by Carl Helmers

Finally, it had to happen to me. We all know that personal computers are supposed to be a cross between a necessity and a luxury. But the critics tend to harp on our tendency to get carried away by the fun and to ignore the practical uses of our wonderful servants. As if to answer that justified criticism, I finally came up with a genuine practical use for a small computer in the monthly operations of BYTE's editorial office. Now this practical application is by no means the kind of automated editing

and type preparation facility I would like to have some day if and when I ever become rich and famous. But this is a genuine, once a month, cyclically run application program.

At BYTE, we have so far purchased two Apple II computers (among others) for use in educating our employees, and in order to have some facilities around the office. One of these Apple II computers sits in my office, and at the time of this exercise

Continued on page 147

Rank	Topic	Total Weighted Count	Standard Deviations Away from Mean
1	Applications to everyday life	12888	2.178
2	Household automation with computers	12886	2.177
3	Personal data base design and implementation	10911	1.179
4	Applications to personal business	10683	1.064
5	Voice recognition by computers	10654	1.049
6	The art of programming	10552	.997
7	Logical games (require much thinking, no dexterity)	10277	.858
8	Voice synthesis with computers	10014	.725
9	The art of hardware design	9875	.655
10	Computer control of mechanisms	9832	.633
11	Graphics software design	9707	.570
12	Artificial intelligence: general interest in AI	9523	.477
13	Action games (require much thinking, no dexterity)	9465	.448
14	Educational uses of computers	9439	.435
15	Computer system design	9311	.370
16	Text editing and processing	9233	.330
17	Graphics hardware design	8876	.150
18	Applications of computers to engineering	8766	.092
19	Experimentation with designs	8723	.073
20	General robotics: whole systems	8642	.032
21	Applications of computers to physical science	8593	0.
22	Chess and computers	8553	-.013
23	Computer communications networks	8424	-.079
24	Simulations of real or mythical situations	8315	-.134
25	AI: pattern recognition	8221	-.181
26	Design of information structures	8111	-.237
27	Use of graphic displays for artistic purposes	7556	-.517
28	Mathematical analysis and algorithm design	7551	-.520
29	Language design	7534	-.529
30	Compiler or interpreter design	7273	-.669
31	AI: representations of knowledge	6982	-.848
32	AI: Natural language parsing	6531	-1.035
33	Computers used for musical purpose: real time performance	6477	-1.062
34	Applications of computers to biological sciences	5785	-1.412
35	Amateur radio and computers	5369	-1.623
36	Computers and music: stochastic composition	5138	-1.739
37	Application of computers to social sciences	4745	-1.938
38	AI: theorem proving	4686	-1.968

Table 1: Respondents were asked to assign a numerical preference from 0 (no interest) to 10 (highest interest) for each of these 38 categories. The column labelled total weighted count contains the sum of counts in each possible response (1 to 10) multiplied by the response itself. Thus if a count of 29 were found in the interest weight 7 for some category, the contribution to the weighted sum would be $7 \times 29 = 203$. The standard deviation and mean were calculated for the data, and the deviation from the mean was expressed in the rightmost column in units of one standard deviation for each category. These data were "output" to a typewriter from the screen of the Apple II using a manual process, then typeset in the usual method.

North Star Systems Go To Work

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

SOFTWARE IS THE KEY TO HORIZON MATURITY

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

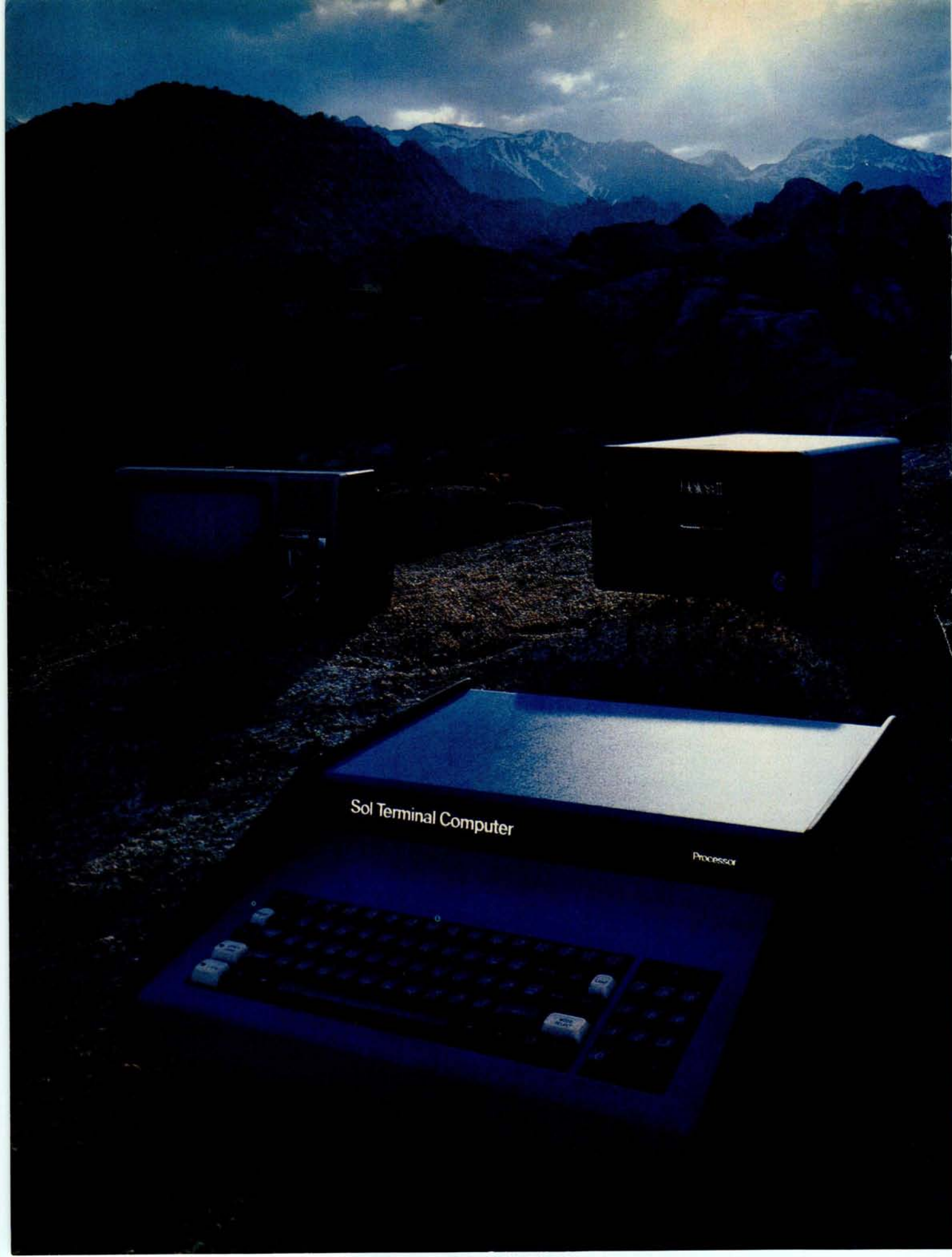
EXPAND YOUR HORIZON

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

For more information, contact your local computer store.

**NORTH ★ STAR
COMPUTERS**

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



Sol Terminal Computer

Processor

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

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

Well, the games part is true. The rest of the claims should be taken with a grain of salt. All of the personal computers will help you learn about computers and how they work in general and the kinds of things they can do for you. Only a few have the capacity to grow and handle meaningful work in a very real sense. And they don't come for peanuts.

Remember, there's no free lunch.

So before you buy any personal computer, consider Sol[®], the small computer. Consider it because it costs more at the start so in the end it costs less. Consider it because it can grow with the complexity of the tasks you ask it to perform and grow with your ability to use it. No, it's not cheap. But it's not a delusion either.

From the very beginning, Sol small computer systems were designed to be at the very top of the microcomputer spectrum. We designed them so you wouldn't have to add costly extras to do many jobs. We designed them so you could add quality peripherals and more memory to take care of more complex tasks. We designed them

to use the best fully supported disk operating system on the market today, PTDOS, which we also designed. We designed them to use our Helios II mass memory. And for Sol small computer systems we designed new and adapted existing software to give you the choice of the best on the market today.

Build computer power with our software.

No system is complete without software, and at Processor Technology we have tailored a group of high level languages, and assembler and other packages to suit the wide capabilities of our hardware.

Take a look at our exclusive Extended BASIC as an example. In cassette form, this BASIC features string and advanced file handling, special screen commands, timed input, complete matrix, logarithmic and trigonometric functions, 8 digit precision and square root. The language handles serial access files, provides tape rewind and offers cursor control for graphics capability.

The disk version has all the number crunching talents of the cassette BASIC plus instant access to data and programs on floppy disks. It includes random as well as sequential files and a unique ability to update sequential data in place.

Processor Technology FORTRAN is similar to FORTRAN IV and has a full set of extensions designed for the "stand alone" computer environment. Thousands of special application programs available through books and periodicals have

already been written in this well established language.

Processor Technology PILOT is an excellent language for teachers. It is a string-oriented language designed expressly for interactive applications such as programmed instruction, drill and testing.

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

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

Sold and serviced only by the best dealers.

Sol Systems are sold and serviced by an outstanding group of conveniently located computer stores throughout the United States and Canada. They are also available in Australia, Europe, the United Kingdom, Central America, South America, Japan and Singapore.

For more information contact your nearest dealer listed on the following page. Or write Department B, Processor Technology Corporation, 7100 Johnson Industrial Drive, Pleasanton, CA 94566. Phone (415) 829-2600.

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

Processor Technology

See Sol[®] at all these fine computer centers

AL: Birmingham: ICP Computerland, (205) 979-0707. **CA:** Berkeley: The Byte Shop, (415) 845-6366. Citrus Heights: Byte Shop, (916) 961-2983. Costa Mesa: Orange County Computer Center, (714) 646-0221. Hayward: Computerland of Hayward, (415) 538-8080. Lawndale: The Byte Shop, (213) 371-2421. Modesto: Computer Magic, (209) 527-5156. Mountain View: Digital Deli, (415) 961-2670. San Francisco: Computer Center, Inc., (415) 387-2513. San Rafael: The Byte Shop, (415) 457-9311. Walnut Creek: The Byte Shop, (415) 933-6252. **CO:** Boulder: Byte Shop, (303) 444-6550. Denver: Byte Shop, (303) 399-8995. **CT:** Bethel: Technology Systems, (203) 748-6856. **FL:** Ft. Lauderdale: Byte Shop of Ft. Lauderdale, (305) 561-2983. Miami: Byte Shop of Miami, (305) 264-2983. Tampa: Microcomputer Systems, Inc., (813) 879-4301. **GA:** Atlanta: Atlanta Computer Mart, (404) 455-0647. **IL:** Lombard: Midwest Microcomputer, (312) 495-9889. **IA:** Davenport: Computer Store of Davenport, (319) 386-3330. **KY:** Louisville: Martronic Associates, (502) 459-0500. **MD:** Towson: Computers Etc., (301) 296-0520. **MN:** Minneapolis: Computer Depot, (612) 927-5601. **MO:** Florissant: Computer Country, (314) 921-4434. **NH:** Nashua: Computerland of Nashua, (603) 887-5238. **NJ:** Cherry Hill: Computer Emporium, (609) 667-7555. Iselin: Computer Mart of New Jersey, (201) 283-0600. **NY:** Endwell: The Computer Tree, (607) 748-1223. New York: Computer Mart of New York, (212) 686-7923. White Plains: The Computer Corner, (914) 949-3282. **NC:** Raleigh: Roms 'N' Rams, (919) 781-0003. **OH:** Akron: The Basic Computer Shop, (216) 867-0808. Columbus: Byte Shop, (614) 486-7761. Dayton: Computer Mart of Dayton, (513) 296-1248. **OR:** Beaverton: Byte Shop Computer Store, (503) 644-2686. Portland: Byte Shop Computer Store, (503) 223-3496. Salem: Computer Pathways, (503) 399-0534. **PA:** King of Prussia: Computer Mart of Pennsylvania, (215) 265-2580. **RI:** Warwick: Computer Power, Inc., (401) 738-4477. **SC:** Columbia: Byte Shop, (803) 771-7824. **TN:** Kingsport: Microproducts & Systems, (615) 245-8081. **TX:** Arlington: Computer Port, (817) 469-1502. Arlington: Micro Store, (817) 461-6081. Houston: Interactive Computers, (713) 772-5257. Houston: Interactive Computers, (713) 486-0291. Lubbock: Neighborhood Computer Store, (806) 797-1468. Richardson: Micro Store, (214) 231-1096. **UT:** Salt Lake City: Home Computer Store, (801) 484-6502. **VA:** McLean: The Computer Systems Store, (703) 821-8333. **WA:** Bellevue: Byte Shop Computer Store, (206) 746-0651. Seattle: Byte Shop of Seattle, (206) 622-7196. **WI:** Madison: The Madison Computer Store, (608) 255-5552. Milwaukee: The Milwaukee Computer Store, (414) 445-4280. **DC:** Washington: Georgetown Computer Emporium, (202) 337-6545. **CANADA:** London, Ontario: Computer Circuit Ltd., 737 Richmond St., (519) 672-9370. Toronto: Computer Mart Ltd., 1543 Bayview St., (416) 484-9708. Vancouver: Basic Computer Group Ltd., 1548 West 8th Ave., (604) 736-7474. **ARGENTINA:** Buenos Aires: Basis Sistemas Digitales, Colombres 849-1-A. 93-1988 or 57-7177. **AUSTRALIA:** Sydney: Automation Statham Pty. Ltd., 47 Birch St., (02) 709 4144. Carnegie: Sontron Instruments, 17 Arawatta St., (03) 569 7867. **BELGIUM:** Bruxelles: S. P. R. L. Finncontact, Square Larousse, 5, 2/345-98-95. **COLOMBIA:** Bogota: Video National, Diagonal 34N 5-62, 326650. **GREECE:** Athens: Attikos, Inc., 41 Char. Tricoupi T.T. 145, 3604091. **JAPAN:** Tokyo: Japan Personal Computers, Ltd., Yamamoto Bldg. No. 11-18, (03) 375-5078.5079. **MEXICO:** Plateros: Industrias Digitales, S.A. de C.V., (905) 524-5132. **PHILIPPINES:** San Juan: Integrated Computer Systems, Inc., Suite 118, LIM KET KAI Bldg., Ortigas Ave. **SWEDEN:** Stockholm: Wernor Elektronik, Torsvagen 61, Box 72, (0) 8 717-62-88. **UNITED KINGDOM:** Huntingdon, England: Comart, Ltd, 24A Market Square, St. Neots, Cambridgeshire, (0480) 74356. **VENEZUELA:** Los Ruices, Caracas: Componentes Y Circuitos Electronicos, TTLCA 355591.

Processor Technology

Letters

TOP-DOWN MODULAR PROGRAMMING

I enjoyed the article, "Top-Down Modular Programming," by Albert D. Hearn in July 1978 BYTE, page 32; I thought he did a good job of explaining the subject. While I realize that he was purposely trying to simplify matters, I do take exception to his comment that a module should be no more than 50 lines long.

The concepts of structured programming are intended as guidelines, not as the dogma for a programmer's religion. All of the better known proponents of the methodology stress this point, along with the idea that you must approach the study of structured programming with your eyes open, making your own evaluation. In this light let us explore the 50 line limit.

One of the bases for breaking a program up into modules is so that a complex problem can be handled with small, easy-to-understand pieces of code. One of the thoughts about module size is, therefore, that a module ought to be able to fit on the printed page. This is so that all the information about the module is in one place and the programmer doesn't have to thumb through several pages to read the code for a single module. (Having experienced "modules" running as long as 10 to 15 pages, I heartily agree with this philosophy.)

In professional programming installations this idea has frequently been translated into a local standard of about 50 lines of code, since this is the number of lines which are printed on an 8½ by 11 inch (21.25 by 27.5 cm) page coming out of a line printer (allowing for headers, footers, etc.). For the personal computer enthusiast, however, this limit might be more conveniently set at 24, 32 or 40 lines — the size of the video display.

For many more complex problems, it is possible that a significant module cannot be constructed in 24 lines. This is no problem — just make the modules longer. The point is to try to restrict the module size to a length which enhances the programmer's ability to understand the code.

The basics of structured programming must be studied, evaluated, and possibly modified to work in each individual situation. There are a lot of great ideas included in the structured programming lore, but they should not be adopted blindly.

Jim Fleming
2220 Sims Dr
Columbus IN 47201

Continued on page 156

56 GREAT LOCATIONS

ComputerLand[®]

NOW OPEN:

ALABAMA	
Huntsville	(205) 539-1200
CALIFORNIA	
Dublin	(415) 828-8090
El Cerrito	(415) 233-5010
Hayward	(415) 538-8080
Los Altos	(415) 941-8154
Los Angeles	(213) 776-8080
Mission Viejo	(714) 770-0131
San Bernardino	(714) 886-6838
San Diego	(714) 560-9912
San Francisco	(415) 546-1592
San Jose	(408) 253-8080
San Mateo	(415) 572-8080
Santa Rosa	(707) 528-1775
Thousand Oaks	(805) 495-3554
Lawndale	(213) 371-7144
Tustin	(714) 544-0542
Walnut Creek	(415) 935-6502
COLORADO	
Colorado Springs	Call Directory Assistance
Denver	(303) 759-4685
CONNECTICUT	
Fairfield	(203) 374-2227
DELAWARE	
Newark	(302) 738-9656
FLORIDA	
Boca Raton	Call Directory Assistance
Ft. Lauderdale	Call Directory Assistance
GEORGIA	
Atlanta	(404) 953-0406
HAWAII	
Honolulu	Call Directory Assistance
ILLINOIS	
Arlington Heights	(312) 255-6488
Downers Grove	(312) 560-0193
Niles	(312) 967-1714
Oak Lawn	(312) 422-8080
Peoria	Call Directory Assistance
INDIANA	
Ft. Wayne	Call Directory Assistance
KENTUCKY	
Louisville	(502) 425-8308
MARYLAND	
Rockville	(301) 948-7676
MICHIGAN	
Grand Rapids	(616) 942-2931
Detroit	(313) 356-8111
MINNESOTA	
Bloomington	(612) 884-1474
NEW HAMPSHIRE	
Nashua	(603) 889-5238
NEW JERSEY	
Cherry Hill	(609) 795-5900
Bergen County	(201) 845-9303
Morristown	(201) 539-4077
NEW YORK	
Buffalo	(716) 836-6511
Ithaca	(607) 277-4888
NO. CAROLINA	
Charlotte	(704) 536-8500
OHIO	
Cleveland	(216) 461-1200
OREGON	
Portland	(503) 620-6170
PENNSYLVANIA	
Harrisburg	(717) 736-1116
TEXAS	
Austin	(512) 452-5701
Dallas	Call Directory Assistance
Houston	(713) 977-0909
WASHINGTON	
Bellevue	(206) 746-2070
Federal Way	(206) 838-9363
Tacoma	(206) 581-0388
WASHINGTON, D.C.	Call Directory Assistance
WISCONSIN	
Madison	(608) 273-2020
INTERNATIONAL	
Sydney, NSW Australia	29-3753
Winnipeg, Canada	Call Directory Assistance

Circle 75 on inquiry card.

BEFORE YOU BUY COMPUTER #1, VISIT #1 COMPUTERLAND

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

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

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

COMPUTERS FOR BUSINESS



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

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



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

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

COMPUTERS FOR THE HOME



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

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

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

COMPUTERS FOR INDUSTRY



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

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

ComputerLand®

WE KNOW SMALL COMPUTERS

14400 Catalina St., San Leandro, CA 94577 (415) 895-9363 • Franchise Opportunities Available

A Memory Pattern Sensitivity Test

Don Kinzer
3885 NW Columbia Av
Portland OR 97229

Faulty memory is a very difficult problem to detect. Most distributors of memory board kits supply a simple memory test designed to detect assembly errors such as misplaced components, solder bridges, etc. These tests are ineffective in detecting certain types of memory related problems. One of these problems, called pattern sensitivity, manifests itself in the very disturbing fact that accessing one memory location alters another memory location, but only when the memory contains a certain pattern of bits.

It is my intention, through this article, to make the experimenter aware of potential memory problems and to provide some information which may be helpful in

diagnosis of the problems by discussing a recent experience.

Every memory test is capable of detecting only a certain few of the many possible memory faults. Because of this, the user should be armed with a battery of memory tests and run them all at the first sign of trouble. Better yet, the tests could be run at regular intervals. A very good selection of such tests is contained in a package available from Technical Systems Consultants (POB 2574, W Lafayette IN 47906) as their SL68-23 Diagnostic Package. This package contains, among other tests, five memory tests, written in 6800 code, to expose bad bits, convergence problems and some types of pattern sensitivity. This package is highly recommended for all system users as the tests can be rewritten for the user's own machine.

As indicated before, the more tests, the better. The new test I am about to describe was discovered quite by accident. I was writing a resident assembler for my 6800 and was working on the sort routine which alphabetizes the symbol table. The sort, called a shell sort, works by comparing symbol table entries and exchanging them if they are not in alphabetical order. The process involves a tremendous amount of data shuffling. To my dismay, after the sort, the labels and their values had changed. TEMP1 became TEMQ1. Before the sort MASK was hexadecimal 3E; after the sort it was hexadecimal BE. Needless to say, I wasted a lot of time looking for a software bug before I decided to test the memory. The tests from the Technical Systems Consultants diagnostic package revealed a 2102 with pattern problems. However, replacing the bad memory did not stop the errors.

It occurred to me that writing a test program which operated in a manner similar to the sort routine would help track down

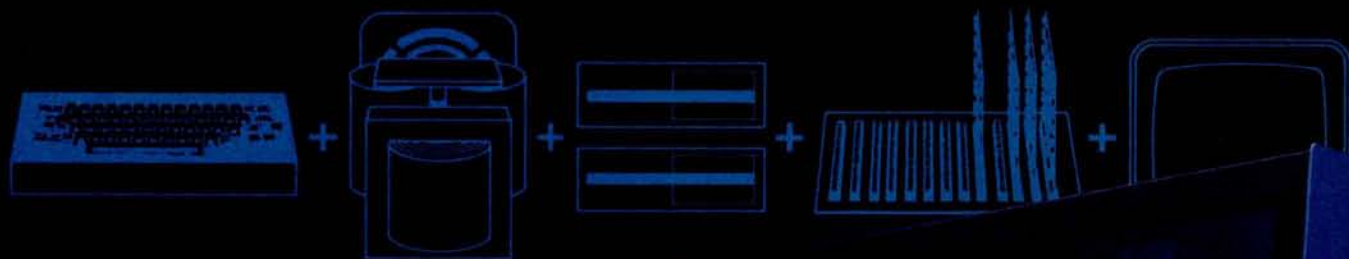
Listing 1: Memory EXCHANGE program written for the 6800 to test for memory pattern sensitivity.

		1	*
		2	*
		3	*
		4	EXCHANGE
		5	A MEMORY TEST
		6	*
		7	*
		8	* EXTERNAL ROUTINES (MIKBUG ROUTINES)
E07E		9	PDATA EQU \$E07E
E1D1		10	OUTCH EQU \$E1D1
E067		11	OUTHL EQU \$E067
E06B		12	OUTHR EQU \$E06B
		13	*
		14	*
		15	* STORAGE
0000		16	ORG 0
0000		17	BEGIN RMB 2
0002		18	END RMB 2
0004		19	XTMP1 RMB 2
0006		20	XTMP2 RMB 2
0008		21	COLCNT RMB 1
		22	*
		23	*
0009	8E A0 7F	24	INIT LDS #SA07F
000C	BD 00 9D	25	START JSR PCRLF
000F	37	26	LOOP PSHB
0010	DE 00	27	LDX BEGIN
0012	09	28	DEX
0013	08	29	INITLP INX
0014	E7 00	30	STAB 0,X
0016	5C	31	INCB
0017	9C 02	32	CPX END
0019	26 F8	33	BNE INITLP
		34	*
		35	*
001B	DF 06	36	BUBBLE STX XTMP2
001D	DE 00	37	LDX BEGIN
001F	DF 04	38	EXCHG STX XTMP1

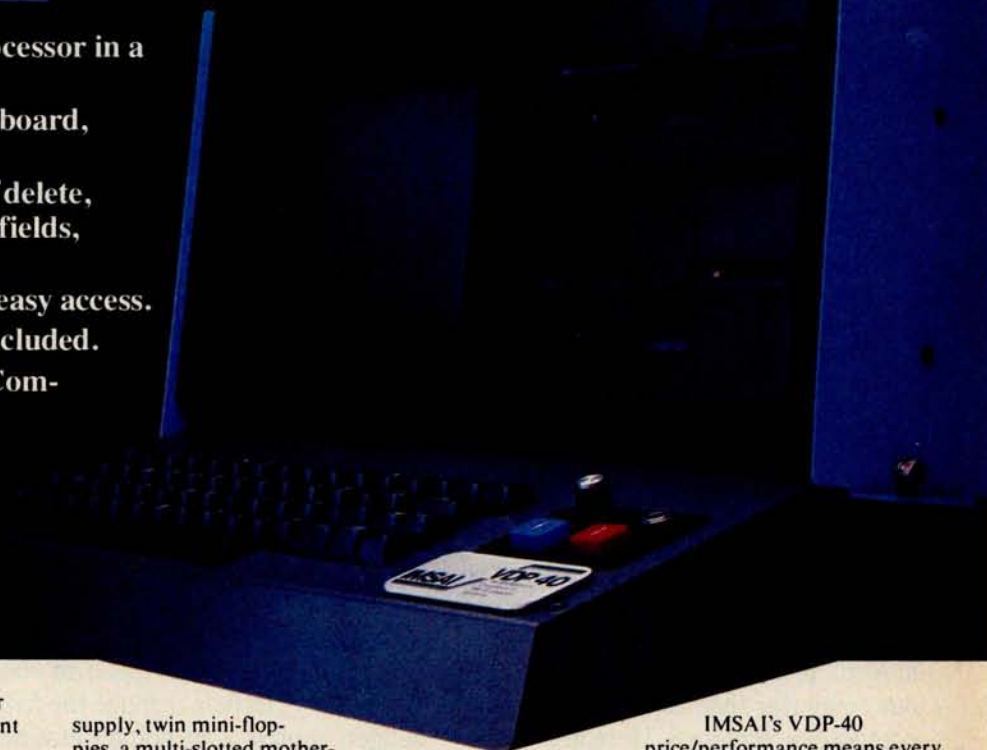
set up stack
go do CRLF
save starting point
get beginning address
adjust
point next location
initialize
set next value
see if done
if not, do again
save end pointer
save top pointer

Microcomputer System Solution.

Announcing the IMSAI VDP-40.



- Fully integrated video data processor in a single cabinet.
- Twin floppies, professional keyboard, S-100 expansion slots.
- 24 line by 80 char. CRT, insert/delete, programmable font, protected fields, inverse video.
- Handsome flip-top cabinet for easy access.
- Serial and parallel I/O ports included.
- FORTRAN IV, Extended and Commercial BASIC.
- IMDOS.
- ISAM.



You've decided you want a microcomputer DP center — but what to buy? A component system? A computer box here, a CRT box there, a keyboard box, a floppy disk box . . . A so called inexpensive \$695 system? No disk; no way to add enough memory . . . and if you could, it's not inexpensive anymore; and you still wind up with a collection of boxes.

The IMSAI VDP-40 is a fully integrated Video Data Processing system and comes equipped with your choice of 32K or 64K RAM on our own advanced RAM III board. In one cabinet, the VDP-40 combines a professional keyboard, heavy-duty power

supply, twin mini-floppies, a multi-slotted motherboard, 9-inch CRT, plus RAM at a new price/performance never before achieved.

System Expansion? Extra slots in our S-100 bus motherboard and our new power supply allow almost unlimited expansion.

Need more disk expansion? A controller option of the VDP-40 allows expansion to greater than 4.5M Bytes.

Add a line printer, an IBM compatible tape drive, a modem: all are available, with the interfaces and software to make it work for you.

IMSAI's VDP-40 price/performance means every home or business can now afford a complete DP center. Check us out. IMSAI has what you want and what you need. Visit your dealer or write us directly. Features subject to change without notice.

IMSAI®

**The Standard of Excellence
in Microcomputer Systems**

IMSAI Manufacturing Corporation,
Dept. EWN, 14860 Wicks Boulevard
San Leandro, CA 94577
(415) 483-2093 TWX 910-366-7287

IMSAI EUROPE
Europa Terrassen
8 Rue Jean Engling
Dommeldange, Luxembourg
43-67-46 Telex: 1428

Price/Performance no one else has put together.

Circle 175 on inquiry card.

BYTE October 1978 13

Why Apple II is the world's best selling personal computer.

satisfaction a personal computer can bring, today and in the future.

15 colors & hi-resolution graphics, too.

Don't settle for a black and white display! Connect your Apple to a color TV and BASIC gives you instant command of three display modes: Text, 40h x 48v Color-graphics in 15 colors, and a 280h x 192v High

Resolution array that lets you plot graphs and compose 3-D images.

Apple gives you the added

capability of combining text and graphics, too.

Back to basics, and assembly language too.

Apple speaks three languages: fast integer BASIC, floating point BASIC for scientific and financial applications, and 6502 assembly language. That's maximum programming flexibility. And, to preserve user's space, both integer BASIC and monitor are permanently stored in 8K bytes of ROM, so you have an easy-to-use, universal language instantly available. BASIC gives you graphic commands: COLOR=, VLIN, HLIN, PLOT and SCRN. And direct memory access, with PEEK, POKE and CALL commands.

Software: Ours and yours.

There's a growing selection of pre-programmed software from the Apple Software Bank — Basic Finance, Checkbook, High Resolution Graphics and more. Now there's a User Section in our bank, to make it easy for you to obtain programs developed

owners on top of what's new.

Apple is so powerful and easy to use that you'll find dozens of applications. There are Apples in major universities, helping teach computer skills. There are Apples in the office, where they're being programmed to control inventories, chart stocks and balance the books. And there are Apples at home, where they can help manage the family budget, control your home's environment, teach arithmetic and foreign languages and, of course, enable you to create hundreds of sound and action video games.

When you buy an Apple II you're investing in the leading edge of technology. Apple was the first computer to come with BASIC in ROM, for example. And the first computer with up to 48K bytes RAM on one board, using advanced, high density 16K devices. We're working to keep Apple the most up-to-date personal computer money can buy. Apple II delivers the features you need to enjoy the real

Which personal computer will be most enjoyable and rewarding for you? Since we delivered our first Apple® II in April, 1977, more people have chosen our computer than all other personal computers combined. Here are the reasons Apple has become such an overwhelming favorite.

Apple is a fully tested and assembled mainframe computer. You won't need to spend weeks and months in assembly. Just take an Apple home, plug it in, hook up your color TV* and any cassette tape deck — and the fun begins.

To ensure that the fun never stops, and to keep Apple working hard, we've spent the last year expanding the Apple system. There are new peripherals, new software, and the Apple II Basic Programming Manual. And wait till you see the Apple magazine to keep



by other Apple owners. Our Software Bank is your link to Apple owners all over the world.

Alive with the sound of music.

Apple's exclusive built-in speaker delivers the added dimension of sound to your programs. Sound to compose electronic music. Sound to liven up games and educational programs. Sound, so that any program can "talk" back to you. That's an example of Apple's "people compatible" design. Another is its light, durable injection-molded case, so you can take Apple with you. And the professional quality, typewriter-style keyboard has n-key rollover, for fast, error-free operator interaction.

Apple is the proven computer.

Apple is a state-of-the-art single board computer, with advanced LSI design to keep component count to a minimum. That makes it more reliable. If glitches do occur, the fully socketed board and built-in diagnostics simplify troubleshooting. In fact, on our assembly line, we use Apples to test new Apples.

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

**In California, call 408/996-1010.

Apple peripherals are smart peripherals.

Watch the far right column of this ad each month for the latest in our growing family of peripherals. We call them "intelligent interfaces." They're smart peripherals, so you can plug them in and run them from BASIC without having to develop custom software. No other personal computer comes close to Apple's expandability. In addition to the built-in video interface, cassette I/O, and four A/D inputs with two continuously variable game paddles, Apple has eight peripheral slots, three TTL inputs and four TTL outputs. Plus a powerful, state-of-the-art switching power supply that can drive all your Apple peripherals.

Available now.

Apple is in stock and ready for delivery at a store near you. Call us for the dealer nearest you. Or, for more details and a copy of our "Consumer's Guide to Personal Computers," call

800/538-9696**
or write Apple Computer, Inc.,
10260 Bandle Drive, Cupertino, CA 95014.



Circle 14 on inquiry card.



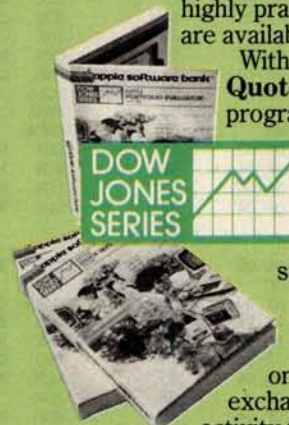
Programming is a snap!
I'm halfway through Apple's BASIC
manual and already I've programmed
my own space wars game.

Those math programs I wrote
last week—I just rewrote them using
Apple's mini-assembler and got them
to run a hundred times faster.

New from Apple.

Valuable new series of software packages for investors

Now private investors can generate their own stock market reports and perform critical investment analysis instantly with Apple II. Just log your Apple II computer on to Dow Jones' central data bank with powerful Apple software: the Dow Jones Series. The first two of these highly practical programs are available now.



With Apple's Stock Quote Reporter program, a local telephone call links you to Dow Jones' continuously updated

stock quotes for more than 6000 companies listed on six major U.S. exchanges. Current

activity for stocks in the investors portfolio is delivered automatically: ask/open, bid/close, high, low and last prices, and volume traded.

Our **Portfolio Evaluator** enables you to analyze current value of your portfolio, and short- and long-term gain/loss for each stock—or for your entire portfolio.

Cost of Apple's Dow Jones service is a one time contract fee of \$25, which includes the Stock Quote Reporter program. An additional \$3 charge is made for the first three minutes of any transaction and 50¢ per minute thereafter.

To take advantage of Apple's new financial services, Apple II users need only a communications card, a modem and an ordinary telephone. This equipment, the Dow Jones Series, and a broad selection of other Apple software are now in stock at your local Apple dealer.

Circle 15 on inquiry card.

Apple's smart peripherals make expansion easy. Just plug 'em in and they're ready to run. I've already added two disks, a printer and the communications card.



Listing 1, continued:

```

0021 A6 00 39 LDAA 0,X      get byte
0023 DE 06 40 LDX XTEMP2
0025 E6 00 41 LDAB 0,X      get other
0027 A7 00 42 STAA 0,X      put alternate
0029 09 43 DEX
002A DF 06 44 STX XTEMP2
002C DE 04 45 LDX XTEMP1      get other pointer
002E E7 00 46 STAB 0,X      put byte
0030 9C 06 47 CPX XTEMP2      check done
0032 27 05 48 BEQ CHK1
0034 08 49 INX
0035 9C 06 50 CPX XTEMP2      check done
0037 26 E6 51 BNE EXCHG
0039 32 52 CHK1 PULA
003A 36 53 PSHA      get starting value
003B 4A 54 DECA      adjust
003C DE 02 55 LDX END      get end pointer
003E DF 06 56 STX XTEMP2      set end pointer
0040 DE 00 57 LDX BEGIN      get begin pointer
0042 DF 04 58 STX XTEMP1      save
59 *
60 *
0044 DE 06 61 CHECK LDX XTEMP2      get current pointer
0046 4C 62 INCA      set value
0047 A1 00 63 CMPA 0,X      check match
0049 26 1F 64 BNE ERROR      if not, error
004B 9C 00 65 CONTIN CPX BEGIN      see if checked all
004D 27 0C 66 BEQ GOOD      if so, good pass
004F DE 04 67 LDX XTEMP1
0051 08 68 INX
0052 DF 04 69 STX XTEMP1      advance pointer
0054 DE 06 70 LDX XTEMP2
0056 09 71 DEX
0057 DF 06 72 STX XTEMP2      retard pointer
0059 20 E9 73 BRA CHECK      go check next
74 *
75 *
005B 86 21 76 GOOD LDAA #' '
005D 8D 33 77 BSR PRINT      signal good pass
005F 7A 00 08 78 DEC COLCNT      need CRLF?
0062 26 02 79 BNE PASS      if not, skip
0064 8D 37 80 BSR PCRLF      perform CRLF
0066 33 81 PASS PULB      get old value
0067 5C 82 INCB      set new value
0068 20 A5 83 BRA LOOP      do again
84 *
85 *
006A E6 00 86 ERROR LDAB 0,X      get contents
006C 37 87 PSHB      save
006D 36 88 PSHA      save check value
006E 8D 2D 89 BSR PCRLF      new line
0070 96 06 90 LDAA XTEMP2
0072 8D 21 91 BSR OUT2H
0074 96 07 92 LDAA XTEMP2+1
0076 8D 16 93 BSR OUT2HS      print address
0078 96 04 94 LDAA XTEMP1
007A 8D 19 95 BSR OUT2H
007C 96 05 96 LDAA XTEMP1+1
007E 8D 0E 97 BSR OUT2HS      print alternate address
0080 32 98 PULA
0081 16 99 TAB
0082 8D 0A 100 BSR OUT2HS      print check value
0084 32 101 PULA
0085 8D 07 102 BSR OUT2HS      print contents
0087 8D 14 103 BSR PCRLF      new line
0089 17 104 TBA
008A DE 06 105 LDX XTEMP2      get pointer back
008C 20 BD 106 BRA CONTIN      start new pass
107 *
108 *
008E 8D 05 109 OUT2HS BSR OUT2H      print 2 characters
0090 86 20 110 LDAA #' '
0092 7E E1 D1 111 PRINT JMP OUTCH      print character
112 *
113 *
0095 36 114 OUT2H PSHA      save byte
0096 8D E0 67 115 JSR OUTHL      print left hexadecimal digit
0099 32 116 PULA
009A 7E E0 6B 117 JMP OUTHR      print right hexadecimal digit
118 *
119 *
009D CE D0 A7 120 PCRLF LDX #CRLF      point to string
00A0 86 20 121 LDAA #32
00A2 97 08 122 STAA COLCNT      set column count
00A4 7E E0 7E 123 JMP PDATA      go print string
124 *
125 *
00A7 0D 0A 126 CRLF FCB $D,$A
00A9 00 00 127 FCB 0,0
00AB 00 00 04 128 FCB 0,0,4
129 *
130 *
00AE 131 END

```

the trouble. The result is a program called EXCHANGE which is shown in listing 1. The program works by initializing the memory to be tested to a sequence of the 256 eight bit numbers. Then pointers are set to the beginning and end of that same block of memory, XTEMP1 and XTEMP2 respectively. Next, the data at each of the pointers is exchanged. The pointers are then moved toward one another. The process of exchanging and moving repeats until the pointers meet. The inverted sequence is then checked for accuracy. Any discrepancies are reported by printing the memory location which is incorrect, the location where the data resided before the exchange, what the data was supposed to be and what the data actually was.

The first time I ran the test, the program crashed. The memory problem had caused a byte of the program to change. After several tries with the same results, I took my machine to work and attached an oscilloscope to the data bus. I found that the data lines had an unbelievable amount of noise. At the advice of a friend, I installed resistive terminations on the data lines, which immediately cleaned up the signals. This eliminated the majority of the memory problem and even allowed the EXCHANGE program to run without crashing. Several hours of further testing using EXCHANGE exposed three more malfunctioning 2102s in my 12 K byte system.

After all of this I am happy to say that the sort routine was in fact working properly. Furthermore, the pattern sensitivity problem explains away several bugs in other programs I have worked on.

Before closing I would like to offer a few pointers on using EXCHANGE. If you suspect memory problems, run a bit test or convergence test to rule out physical problems (like shorted wires) and bad bits (nonfunctioning memory parts). If the problem persists, run EXCHANGE on the entire contiguous memory (except, of course, where EXCHANGE is located) noting any errors as they are printed. Next, run EXCHANGE on smaller areas corresponding to each set of 2102s. Replace the memory chips as necessary but don't throw them away yet. If the memory is still bad in the same area then the memory chips are not to blame and it is time to put an oscilloscope on your system to see what the problem is.

Based on my own experience with a homebrew computer I recommend running a battery of tests after any system hardware changes to uncover memory problems before they turn up as a bug in your next program. ■



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

FREE!

HEATHKIT CATALOG

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

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

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

You can start with our low-cost 8-bit H8 Computer and just 4K of memory as an introduction to computing. Its easy to use octal data entry and 9-digit octal read-out make learning a simple matter. As your abilities grow, so can your computer. Add more memory and one or more peripherals like the H9 Video Terminal with its ASCII keyboard for convenient entry and display of your programs. And you can store your programs in one of three ways too! Choose our new WH17 Floppy Disk System (single and dual drives available) for the ultimate storage mode. Its expanded 40-track hard sectored diskette has 102K Bytes of available storage so you can store hundreds of programs on one disk. If paper tape storage is your preference, choose our H10 Paper Tape Reader/Punch. For the most in economy, we offer a cassette player/recorder too. The H8 is indeed a complete system.



WH27
Controller

Send for your FREE copy today!

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

Heath Co., Dept. 334-460, Benton Harbor, MI 49022

on inquiry card.



The ultimate personal computer is our 16-bit H11. Very few people will ever need more computing power than our H11 has to offer. Based on the world-famous DEC® PDP-11/03, it has enough capability for virtually any program—small business or hobby. The H11 offers unequalled software, too, so the number of useful applications is virtually unlimited. The H11 will soon have its own Floppy Disk System, the WH27. And what a floppy it is! Fully-compatible with the DEC RX01® floppy for the PDP-11/03, the WH27 lets you take advantage of all existing PDP-11/03 software in addition to those you develop on your own. Dual drives give you 512K Bytes of program and data storage. The WH27's Z80 microprocessor-based controller permits a head motion of only 6 mS (versus DEC's 10 mS) for data access times that are almost twice as fast. Other features include built-in self test on power-up; mechanical interlock to prevent disk damage; write protect function that precludes written-over disks; complete HT11 disk operating system software that includes extended BASIC with files and virtual arrays, utilities (with macro-assembler), text editor and more. An extended FORTRAN which supports the ANSI standard (1966 FORTRAN IV) will be optionally available soon.

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

Specifications subject to change without notice.

HEATH

Schlumberger

Heath Company, Dept. 334-460
Benton Harbor, Michigan 49022

Please send me my FREE Heathkit Catalog.
I am not on your mailing list.

Name _____

Address _____

City _____ State _____

CP-155 _____ Zip _____

Considering a Microcomputer?

Be Sure to Check Out the Product Offerings of the World's Largest Full Line Microcomputer Company.

All Ohio Scientific machines come with microcomputing's fastest full feature BASIC-in-ROM or on-Disk for instant use.

Challenger I Series

Economical computer systems that talk in BASIC. Ideal for hobbyists, students, education and the home.

	Minimum Configuration	Base Price
Superboard II — World's first complete system on a board including keyboard, video display, audio cassette, BASIC-in-ROM and up to 8K RAM	4K RAM	\$ 279
Challenger IP — Fully packaged Superboard II with power supply	4K RAM	\$ 349
Challenger IP Disk — Complete mini-floppy system expandable to 32K RAM	16K RAM	\$1190

Challenger IIP Series

Ultra high performance BUS oriented microcomputers for personal, educational, research and small business use.

C2-4P — The professional portable	4K RAM	\$ 598
C2-8P — The world's most expandable personal machine for business or research applications	4K RAM	\$ 799
C2-4P Disk — The ultimate portable	16K RAM	\$1464
C2-8P Single Disk — Ideal for education, advanced personal users, etc.	16K RAM	\$1738
C2-8P Dual Disk — Most cost effective small business system	32K RAM	\$2597

Challenger II Serial Interface Series

Same great features as Challenger IIP Series for those who have serial terminals: small business, education, industry.

C2-0 — Great starter for users with a terminal	4K RAM	\$ 298
C2-1 — Great timeshare user accessory; cuts costs by running simple BASIC programs locally	4K RAM	\$ 498
C2-8S — Highly expandable serial machine, can add disks, etc.	4K RAM	\$ 545

Challenger III The Ultimate in Small Computers

The unique three processor system for demanding business, education, research and industrial development applications.

C3-S1 — World's most popular 8" floppy based microcomputer	32K RAM dual floppys	\$3590
C3-OEM — Single package high volume user version of C3-S1	32K RAM dual floppys	\$3590
C3-A — Rack mounted multi-user business system directly expandable to C3-B	48K RAM dual floppys	\$5090
C3-B — 74 million byte Winchester disk based system. World's most powerful microcomputer	48K RAM dual floppys	\$11,090

OHIO SCIENTIFIC also offers you the broadest line of expansion accessories and the largest selection of affordable software!

Compare the closest Ohio Scientific Model to any other unit you are considering. Compare the performance, real expansion ability, software and price, and you will see why we have become the world's largest full line microcomputer company.

I'm interested in OSI Computers. Send me information on:

- ☐ Personal Computers ☐ Small Business Computers
☐ Educational Systems ☐ Industrial Development Systems

☐ I'm enclosing \$1.00 for your 64-page small computer buyer's guide.

Ohio residents add 4% tax.

Name _____
Address _____
City _____
State _____ Zip _____
Phone _____

OHIO SCIENTIFIC
1333 S. Chillicothe Road
Aurora, Ohio 44202
(216) 562-3101



The C2-4P
The Professional Portable by Ohio Scientific

Ohio Scientific now offers you the world's most powerful portable personal computer in both BASIC-in-ROM and mini-floppy configurations.

C2-4P Real & Standard Features:

- Microprocessor equipped with 64K BASIC-in-ROM, 4K RAM, and up to 16K expandable memory. Includes cassette interface and expanded audio output (16K color display, 16K audio, and 16K video).
- The fastest full featured BASIC in the microcomputer world.
- The C2-4P is the most sophisticated system capable of performing complex tasks in 16 minutes of user time. Includes 16K audio and 16K video output (256 to 16K).
- The C2-4P disk version is compatible with all other 5 1/4" disk drives.
- The C2-4P disk version is compatible with all other 5 1/4" disk drives.
- The C2-4P disk version is compatible with all other 5 1/4" disk drives.

For more information, contact your local Ohio Scientific dealer or the factory at (216) 562-3101.

1333 S. Chillicothe Road • Aurora, Ohio 44202



The C2-8P
An exceptional value in personal computing

If you are interested in an ultra high performance personal computer which can be fully expanded to a mainframe class microcomputer system, consider the C2-8P.

Features:

- Microprocessor equipped with 64K BASIC-in-ROM, 4K RAM, and up to 16K expandable memory. Includes cassette interface and expanded audio output (16K color display, 16K audio, and 16K video).
- The fastest full featured BASIC in the microcomputer world.
- The C2-8P is the most sophisticated system capable of performing complex tasks in 16 minutes of user time. Includes 16K audio and 16K video output (256 to 16K).
- The C2-8P disk version is compatible with all other 5 1/4" disk drives.
- The C2-8P disk version is compatible with all other 5 1/4" disk drives.
- The C2-8P disk version is compatible with all other 5 1/4" disk drives.

For more information, contact your local Ohio Scientific dealer or the factory at (216) 562-3101.

1333 S. Chillicothe Road • Aurora, Ohio 44202



The C3-B
by Ohio Scientific
The world's most powerful microcomputer system in low volume affordable than you may think

STANDARD FEATURES:

- 74 million byte Winchester disk drive with 16K expandable memory.
- High speed data for software makes high performance in the microcomputer world.
- The C3-B is the most sophisticated system capable of performing complex tasks in 16 minutes of user time. Includes 16K audio and 16K video output (256 to 16K).
- The C3-B disk version is compatible with all other 5 1/4" disk drives.
- The C3-B disk version is compatible with all other 5 1/4" disk drives.
- The C3-B disk version is compatible with all other 5 1/4" disk drives.

For more information, contact your local Ohio Scientific dealer or the factory at (216) 562-3101.

1333 S. Chillicothe Road • Aurora, Ohio 44202

The C3-S1

by Ohio Scientific

**Possibly the world's
most popular
floppy disk based
microcomputer.**



Since its introduction in August, 1977, the Challenger III has gained tremendous acceptance in small business, educational and industrial development applications. Thousands of C3-S1's have been delivered and today hundreds of C3-S1 demonstrator units are set up at computer retailers around the country.

Why has the Challenger III become so successful in the fiercely competitive microcomputer industry? Here are just a few of the possible reasons.

- The Challenger III is the fastest microcomputer in BASIC (see "BASIC Timing Comparisons," *Kilobaud*, October, 1977, where Ohio Scientific out benchmarks all competitors).

- The Challenger III is the only computer system with a 6502A, 6800 and Z-80 offering the programmer all popular micros for maximum versatility.

- The C3 is backed by the largest base of systems level software for any microcomputer system including:

For the 6502A:

- Microsoft 6 and 9 Digit BASIC
- Assembler Editor
- Word Processor
- OS-65D Development DOS
- OS-65U End User DOS with Extended BASIC
- For Floppys
- Winchester Hard Disks
- Multi-users (Level 2)
- Distributed Processing (Level 3)

For the 6800:

- Floppy DOS
- Assembler Editor

For the Z-80:

- Floppy DOS
- Microsoft Disk Extended BASIC
- Microsoft FORTRAN
- Microsoft COBOL
- Macro Assembler and Editor
- And Much More

- The C3 supports OS-65U, the ultra high performance "virtual data memory" DOS for floppys and hard disks which makes complex file structures like multi-key ISAM easy to use.

- The C3 is backed by a large library of applications programs

and can make use of the tremendous amount of BASIC programs offered by independent suppliers and publishers because it uses Microsoft BASIC, the standard of the industry. Complete turnkey and custom business packages are available for the C3 from most OHIO SCIENTIFIC DEALERS.

- The C3 electronics and software are available in alternate mechanical configurations for special applications including the C3-OEM for volume users and the C3 letter series (C3-A, C3-B) which are optimized for use with hard disks.

- C3 systems are always delivered ready to use with 32K static RAM, dual floppys for 500K bytes of on-line storage and an RS-232 port strappable from 75 to 19,200 baud all *standard* in the minimum configuration.

- C3 systems offer the greatest expansion capability in the microcomputer industry. The C3 series supports OHIO SCIENTIFIC'S full line of over 40 expansion accessories. The maximum configuration is 768K bytes RAM, four 74 million byte Winchester hard disks (CD-74), 16 communications ports, real time clock, line printer, Word Processing printer and numerous control interfaces.

- C3 systems have phenomenal performance-to-cost ratios. The C3-S1 base price with 32K RAM, dual floppys, RS-232 port complete with 8K BASIC and DOS is under \$3600 and expansion accessories are comparably priced. For example, the CD-74, 74 million byte Winchester disk complete with interface and OS-65U operating system at about \$6000.

The C3 series is quite possibly so successful because it offers the highest hardware performance, best software support, most versatility and greatest expandability in the microcomputer systems market at nearly the lowest price in the industry.

For more information, contact your local OHIO SCIENTIFIC DEALER or the factory at (216) 562-3101.

OHIO SCIENTIFIC

1333 S. Chillicothe Road • Aurora, Ohio 44202

There's an Ohio Scientific dealer near you.

ALABAMA

M.C.S. Corp.
Pelham Mall
Pelham, AL 35124
(205) 663-1287

ALASKA

Scientific Business Instr's
500 W. 27th
Anchorage, AK 99503
(907) 277-2650

CALIFORNIA

Expansion Techniques
2534 Ganesha
Altadena, CA 91001
(213) 794-0476
Shuey Aircraft
1009 E. Vermont
Anaheim, CA 92805
(714) 991-3940
Professional Services
139 S. Beverly, #308
Beverly Hills, CA 90212
(213) 550-1560
Olson Electronics
11332 East South
Cerritos, CA 90701
(213) 860-0060

Adventures in Computing
8756 Warner
Fountain Valley, CA 92706
(714) 848-8388

Olson Electronics
4642 West Century
Inglewood, CA 90304
(213) 674-5740

Computers Are Fun-Westwood
2268 Westwood
Los Angeles, CA 90064
(213) 475-0566

The Computer Center
3205 Ronson
San Diego, CA 92111
(714) 292-5302

Olson Electronics
Kearny Mesa, 4840 Convoy
San Diego, CA 92111
(714) 292-1100

Systems Engineering
900 3rd Street
San Francisco, CA 94107
(415) 777-3150

Olson Electronics
2125 El Camino Real
Santa Clara, CA 95051
(408) 248-4886

COLORADO

Byte Shop, Inc.
3464 South Acoma
Englewood, CO 80110
(303) 761-6232

Total Data Systems
125 Fairway Lane
Fort Collins, CO 80521
(303) 491-5692

Tricom/Computer Country
7115 N. Federal
Westminster, CO 80030
(303) 426-7743

DELAWARE

Delaware Microsystems
92 East Main #1
Newark, DE 19711
(302) 736-3700 (after 7 PM)

DISTRICT OF COLUMBIA

Newtronics
1647 Lamont NW
Washington D.C. 20034
(202) 234-6646

FLORIDA

Olson Electronics
5833 Ponce de Leon
Coral Gables, FL 33146
(305) 666-3327

Olson Electronics
1644 N. E. Second
Miami, FL 33132
(305) 374-4121

Calculator Place
12 South Orange
Sarasota, FL 33577
(813) 366-7449

Olson Electronics
6901 22nd Avenue, N.
Tyrone Square Mall
St. Petersburg, FL 33710
(813) 345-9119

Olson Electronics
1215 South Dale Mabry
Tampa, FL 33609
(813) 253-3129

GEORGIA

Electronic Information
120 Heatherwood
Athens, GA 30601
(404) 353-2858

Secom Systems
5241-F New Peach Tree
Chamblee, GA 30341
(404) 455-0672

Columbus Software Center
4723 Northgate, Box 8088
Columbus, GA 31908
(404) 563-7729

Olson Electronics
2571 N. Decatur
Decatur, GA 30033
(404) 378-4201

HAWAII

Small Computer Systems
3149c Wailalea
Honolulu, HI 96816
(808) 732-5246

ILLINOIS

American Microprocessors
1100 E. Broadway
Alton, IL 62002
(618) 465-4489

Tech-Tronics
714 S. University
Carbondale, IL 62901
(618) 549-8495

Adonis Computing
2855 W. Nelson
Chicago, IL 60618
(312) 463-0847

Electronic Systems
611 N. Wells
Chicago, IL 60610
(312) 944-6565

Olson Electronics
4101 N. Milwaukee
Chicago, IL 60641
(312) 545-7336

Olson Electronics
1734 Ogden
Downers Grove, IL 60515
(312) 852-9650

A & H Associates, Ltd.
2530 Crawford
Evanston, IL 60062
(312) 328-2800

No-Name
2701 Grand
Galesburg, IL 61401
(309) 343-6135

Processor Systems
228 School
Geneva, IL 60134
(312) 232-7195

Computer Terminal Systems, Inc.
1132 Waukegan
Glenview, IL 60025
(312) 724-3690

Tek-Aids Industries
1711 Chestnut
Glenview, IL 60025
(312) 724-2620

American Microprocessors
6934 N. University
Peoria, IL 61614
(309) 692-5852

American Microprocessors
20 N. Milwaukee
Prairieville, IL 60069
(312) 634-0076

Wysocki Electric
3080 South Blvd.
Rockford, IL 61109
(815) 874-4846

Data Domain
1612 E. Algonquin
Schaumburg, IL 60195
(312) 397-8700

INDIANA

Data Domain
406 S. College
Bloomington, IN 46401
(812) 334-3607

American Microprocessors
146 N. Broad
Griffith, IN 46319
(219) 924-7901

American Microprocessors
3602 East Washington
Indianapolis, IN 46201
(317) 359-7445

Data Domain
7027 N. Michigan
Indianapolis, IN 46268
(317) 251-3139

Olson Electronics
5353 N. Keystone
Indianapolis, IN 46220
(317) 253-1584

Data Domain
10 N. Third
LaFayette, IN 47902
(317) 423-2548

Computer Management
610 Monroe
LaPorte, IN 46350
(219) 362-5812

American Microprocessors
2655 Irving
Portage, IN 46368
(219) 760-2278

IOWA

Microbus
1910 Mt. Vernon, S. E.
Cedar Rapids, IA 52403
(319) 364-5073

American Microprocessors
102 E. 4th
Waterloo, IA 50703
(319) 296-2255

KANSAS

Barney & Associates
425 N. Broadway
Pittsburg, KS 66762
(316) 231-1970

Technographics
5811 Clarendon
Wichita, KS 67220
(316) 744-2443

KENTUCKY

Olson Electronics
117 Southland
Lexington, KY 40503
(606) 278-9413

Data Domain
3028 Hunsinger
Louisville, KY 40220
(502) 456-5242

Olson Electronics
4137 Shelbyville
Louisville, KY 40207
(502) 893-2562

MARYLAND

The Mathbox
4431 Lehigh
College Park, MD 20740
(301) 277-6828

Systems Engineering
1749 Rockville Pike #307
Rockville, MD 20842
(301) 468-1822

MASSACHUSETTS

Computer Shop-Aircom
288 Norfolk
Cambridge, MA 02139
(617) 661-2670

Bradshaw Enterprises
18 Harborview
Hingham, MA 02043
(617) 749-6844

MICHIGAN

The Abacus
Route 1, Box 193
Niles Road
Berrien Springs, MI 49103
(616) 429-3034

Kimble Terminals
451 S. Eton
Birmingham, MI 48008
(313) 645-5553

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

Concept Engineering
3706 Malibu
Lansing, MI 48910
(517) 394-0585

Olson Electronics
29121 DeQuindre
Madison Heights, MI 48071
(313) 546-0190

Great Lakes Photo
5001 Eastman
Midland, MI 48640
(517) 631-5461

MINNESOTA

Custom Computer Systems
1823 Lowry
Minneapolis, MN 55411
(612) 588-3944

Micro Business Sales
4345 Lyndale N.
Minneapolis, MN 55412
(612) 871-9230

A.B.S.

547-25th N.
St. Cloud, MN 56301
(612) 253-8722

Frisch Computer Systems
1415 Arcade
St. Paul, MN 55106
(612) 771-7569

Ronald D. Frisch
3034 Marine Circle
Stillwater, MN 55082
(612) 439-8212

Westronics
716 NW 8th St.
Willmar, MN 56201
(612) 235-6096

MISSISSIPPI

Jack Fisher Sales
100 Main
Michigan City, MS 38647
(601) 224-6470

MISSOURI

Four State Microcomputer
402 Wall
Joplin, MO 64801
(417) 782-1285

Impact Systems
Decker Building
613 W. 3rd
P.O. Box 478
Lee's Summit, MO 66463
(816) 524-5919

The Computer Bit
1320 S. Glenstone
Springfield, MO 65804
(417) 883-2709

Futureworld
1909 Seven Pines
St. Louis, MO 63141
(314) 434-1121

Sauer Computer Systems
1750 South Brentwood
Suite 601
St. Louis, MO 63144
(314) 962-0382

MONTANA

Linco
P.O. Box 2418
Cut Bank, MT 59427
(406) 336-3117

NEBRASKA

Intelligent Sys. & Robotics
2335 S. 35th
Lincoln, NE 68506
(402) 483-1989

Omaha Computer Store
4540 South 84th
Omaha, NE 68127
(402) 592-3590

J.B.A. Associates
3316 N. Garehime
Las Vegas, NV 89108
(702) 648-2069

NEVADA

J.B.A. Associates
3316 N. Garehime
Las Vegas, NV 89108
(702) 648-2069

NEW JERSEY

Computer Power
235 Nutley
Nutley, NJ 07110
(201) 667-5502

Computer Corner
240 Wanaque
Pompton, NJ 07442
(201) 835-7080

Garden State Computer
223 Park
Scotch Plains, NJ 07076
(201) 322-9195

NEW YORK

Associated Consultants
33 Ogden
East Williston, NY 11596
(516) 746-1079

Computer Mart of N. Y.
118 Madison
New York, NY 10016
(212) 686-7923

Yingco
Two World Trade Center
Penthouse 107th Floor
New York, NY 10048
(212) 775-9000

Brag Microcomputers
19 Cambridge
Rochester, NY 14607
(716) 442-5861

Universal Data Research
234 Tennyson Terrace
Williamsport, NY 14221
(716) 632-8770

NORTH DAKOTA

General Sys. Programming
Box 8032, University Sta.
Grand Forks, ND 58202
(218) 773-1239

OHIO

Olson Electronics
69 West State
Akron, OH 44308
(216) 762-0301

Olson Electronics
1994 Brittain
Akron, OH 44310
(216) 633-4338

Olson Electronics
3265 W. Market
Akron, OH 44313
(216) 864-3407

Lucas Office Equipment
& Service
869 E. Franklin
Centerville, OH 45459
(513) 433-8484

Econo Data
580 Walnut
Cincinnati, OH 45202
(513) 421-7071

Olson Electronics
2020 Euclid
Cleveland, OH 44115
(216) 621-6387

Olson Electronics
6813 Pearl
Cleveland, OH 44130
(216) 845-2424

Olson Electronics
6153 Mayfield
Cleveland, OH 44124
(216) 449-2690

Olson Electronics
21850 Center Ridge
Cleveland, OH 44116
(216) 331-4600

Small Computer Co.
6685 Beta
Cleveland, OH 44143
(216) 461-7650

Byte Shop
2432 Chester
Columbus, OH 43221
(614) 486-7761

Olson Electronics
1975 Henderson
Columbus, OH 43220
(614) 451-3245

Johnson Computer
123 W. Washington
Medina, OH 44256
(216) 725-4560

Micro Systems Sales
7841 Glenallen
Northfield, OH 44067
(216) 467-0003

Olson Electronics
7401 Market
Southern Park Mall
Youngstown, OH 44512
(216) 758-3828

OKLAHOMA

Gauger Engineering
910 Orient
Clinton, OK 73601
Accounting Systems
2709 Orlando
Oklahoma City, OK 73120
(405) 751-1537

Gauger Engineering
3824 S. 79th East
Tulsa, OK 74145
(918) 627-1064

OREGON

Fial Computer
11013 S. E. 52nd
Milwaukie, OR 97222
(503) 654-9574

PENNSYLVANIA

Broad Enterprises
550 N. Derr/Rt. 15
Lewisburg, PA 17837
(717) 523-9864

Olson Electronics
5918 Penn
Pittsburgh, PA 15206
(412) 362-1333

Olson Electronics
3405 Saw Mill Run
Pittsburgh, PA 15227
(412) 881-0702

Olson Electronics
4778 McKnight
Pittsburgh, PA 15237
(412) 366-7298

Abacus Data Systems
Route 8
Reno, PA 16343
(814) 677-6502

SOUTH CAROLINA

Island Business Machines
21 Kingbird
Hilton Head Is., SC 29928
(803) 785-3631

SOUTH DAKOTA

Exe Engineering
804 E. Lewis
Vermillion, SD 57069
(605) 624-6411

TENNESSEE

Computer Power of Memphis
3065 James
Memphis, TN 38128
(901) 386-9905

Smart Machine Mart
5151 Hillson
Nashville, TN 37211
(615) 833-9773

Computer Power of Oak Ridge
800 Oak Ridge Turnpike
Oak Ridge, TN 38730
(615) 482-9031

TEXAS

Personnel Cost Control
1111 W. Mockingbird
Dallas, TX 75247
(214) 634-1230

S.I.C.
Mr. Computer
744 FM 1960 W., Suite E
Houston, TX 77090
(713) 444-7419

Kay Computers
1230 Main
League City, TX 77573
(713) 332-5555

UTAH

Home Computer Store
2343 East 3300 South
Salt Lake City, UT 84109
(801) 484-6502

VIRGINIA

Community General Store
2704 N. Pershing
Arlington, VA 22201
(703) 527-4600

H/B Computers
217 E. Main
Charlottesville, VA 22101
(804) 295-1975

Microsystems, Inc.
5320 Williamson
Roanoke, VA 24012
(703) 563-0693

WASHINGTON

Ye Olde Computer Shoppe
1301 George Washington
Richland, WA 99352
(509) 946-3330

Ye Olde Computer Shoppe
546 North 6th
Walla Walla, WA 99362
(509) 529-9566

WEST VIRGINIA

Interactive Operations
Box 1322
Bluefield, WV 24701
(304) 327-6583

WISCONSIN

MicroComp
785 S. Main
Fond du Lac, WI 54935
(414) 922-2515

Specialty Office Machines
20 East Second
Fond du Lac, WI 54935
(414) 922-5440

Computer Consultants
206 Hood, Box 1027
La Crosse, WI 54601
(608) 784-7979

Madison Computer Store
1863 Monroe
Madison, WI 53711
(608) 255-5552

Milwaukee Magnetic Media
1750 West Silver Spring
Milwaukee, WI 53209
(414) 228-8930

The C3-B

by Ohio Scientific

**The world's most powerful
microcomputer system
is far more affordable
than you may think:**

STANDARD FEATURES:

- 74 million byte Winchester technology disk drive yields mainframe class file access speeds and capacity.
- High level data file software makes high performance file structures like multikey ISAM easy to use.
- Triple processor CPU with 6502A, 6800 and Z-80 gives the programmer the best of all worlds in performance and versatility.
- The included 6502A based extended disk BASIC by Microsoft out-benchmarks every micro available, including 4 MHz Z-80 and LSI-11 with extended arithmetic.
- 48K of high reliability static RAM is standard.
- High density 8" floppys provide program and data mobility from machine to machine.
- Completely integrated mechanical system with UL-recognized power supplies; continuous duty cycle cooling; modular construction and rack slide mounted subassemblies.
- Based on a 16 slot Bus-oriented architecture with only 7 slots used in the base machine.
- Directly expandable to 300 megabytes of disk, 768K of RAM in 16 partitions, 16 communication ports, plus console and three printers.

■ C3-B's have been in production since February, 1978, and are available now on very reasonable delivery schedules.

The C3-B was designed by Ohio Scientific as the state of art in

Circle 290 on inquiry card.

small business computing. The system places its power where it's needed in the small business environment; in the data files. The C3-B's advanced Winchester technology disk, coupled with its smart controller and dedicated high speed memory channel, gives the C3-B data file performance comparable with today's most powerful maxi-computers.

Yet, the C3-B costs only slightly more than many floppy only computers but offers at least a thousand times performance improvement over such machines (50 times storage capacity multiplied by 20 times access speed improvement).

But what if your business client cannot justify starting with a C3-B?

Then start with Ohio Scientific's inexpensive C3-S1 floppy disk based system running OS-65U. When he is ready, add the CD-74 big disk and directly transfer programs and files from floppy to big disk with NO modifications.

That's upward expandability!

*Rack as shown above complete with 74 megabyte disk, dual floppys, 48K of static RAM, OS-65U operating system and one CRT terminal under \$13,000.

Multiple terminal systems with printers and applications software are priced in the mid-20's.

OHIO SCIENTIFIC

1333 S. Chillicothe Road • Aurora, Ohio 44202
(216) 562-3101



No Power for Your Interfaces?

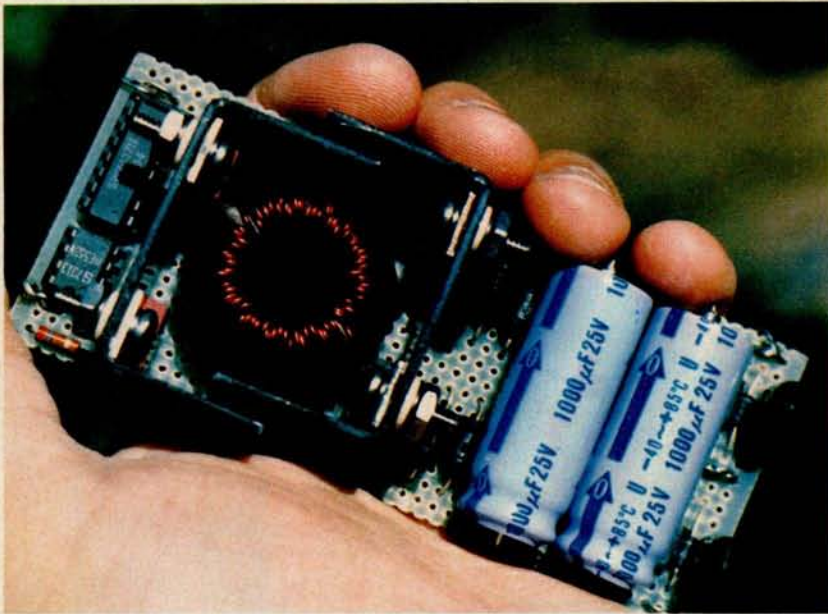


Photo 1: 5 W DC to DC converter, which produces 0.2 A at +12 and -12 VDC from a 5 VDC source. The circuit uses a special custom wound toroidal transformer (see figures 5a and 5b). Note: the prototype shown uses 1000 μ F 25 V capacitors, which were later replaced with 100 μ F 25 V versions.

Build a 5 W DC to DC Converter

Steve Ciarcia
POB 582
Glastonbury CT 06033

Recently I attended a local computer club meeting where we discussed the question of power supplies. Many people were remarking that, while they enjoyed building the projects in my articles, often their power supplies were not compatible with the multiple voltages I required. Many of the newer single board computers that some members owned contained only a hefty +5 V supply and a note that the user should add additional supplies if the basic board is expanded.

This is not an industry copout by any means. The newest digital designs from companies like Intel are made to run on +5 V and this is considered an advance in technology. The 8080A processor requires

Ciarcia's Circuit Cellar

+12, +5 and -5 V for operation, while the new 8085 uses only a single +5 V supply. As long as all other components such as universal asynchronous receiver-transmitters (UARTs), programmable memories, erasable read only memories (EROMs) and read only memories (ROMs) in the computer are all +5 V, we can eliminate additional power supplies and save money. Computer manufacturers have done just that.

This situation does not cause any problems as long as the user stays with the basic unit, or expands it using single +5 V supply devices. Erasable read only memories such as the Intel 2716 and programmable peripheral interfaces such as the 8255 are designed specifically for this application.

The problem arises when the single supply computer tries to be communications compatible with the rest of the world, or when a bipolar analog interface is added. The RS-232C interface generally requires + and -12 V potentials, and digital to analog converters such as the Motorola 1408L8, which run on +5 and -12 to -15 V.

The Whole World Isn't TTL Compatible

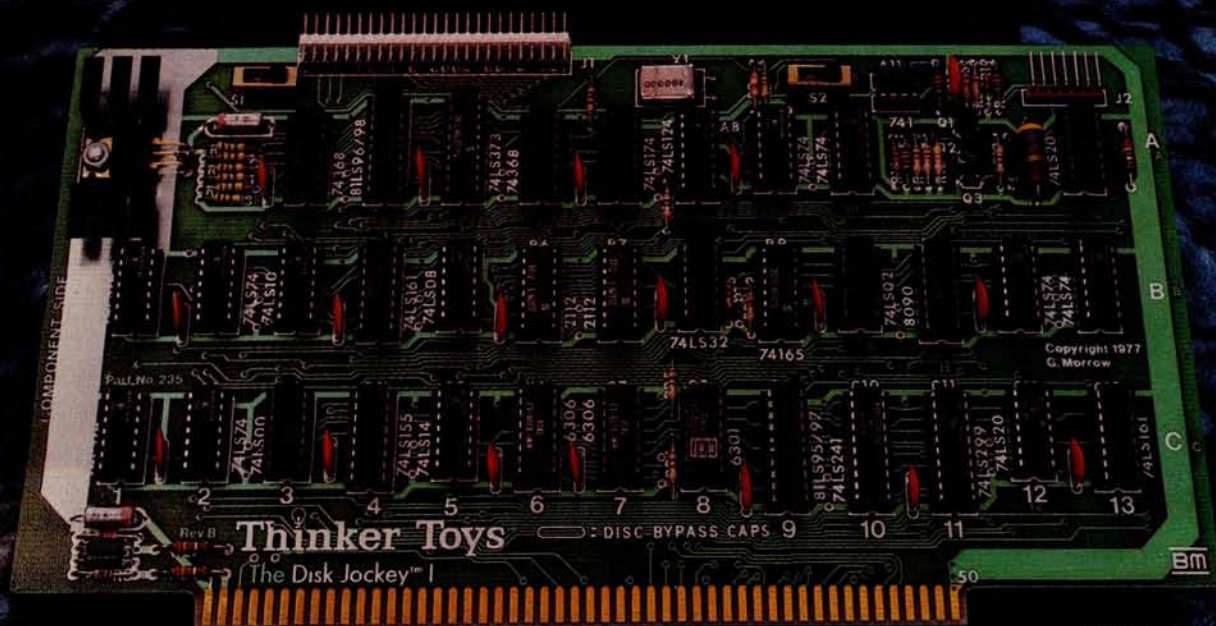
What is the experimenter to do when a -15 V supply is needed and the computer has only +5 V, or when one wishes to tie an RS-232 terminal into a system? Obviously the answer is to add an additional power supply or two—but, what kind?

Power supply requirements should be based on load requirements. If 0.5 A at +15 V is needed to power a particular interface, then perhaps a 1 A traditional transformer-rectifier-filter-regulator design is in order. More often than not, though, the interface might use one or two dual supply

Your \$995 DISCUS I™ system includes a Shugart 800R full-size drive with power supply in a handsome freestanding cabinet, our 8-drive capacity S-100 controller with on-board buffer and serial interface, all cables and connectors, and all the software you need.

Your software library includes DOS, text editor, 8080 assembler (all integrated in DISK/ATE™); our BASIC-V™ advanced virtual disk BASIC able to handle a wide variety of data formats and address up to 2 megabytes; and patches for CP/M*. And it's all interfaced to your controller's serial I/O port to avoid I/O guesswork.

And it's all yours for \$995. We even offer CP/M for just \$70, Micro-Soft Extended Disk Basic for just \$199 and Micro-Soft Fortran for just \$349 as nice options to add to your library. No wonder it's an overnight success! See DISCUS I™ today at your local computer shop. Or if unavailable locally, send your check or money order direct to Thinker Toys™ (add \$7 for handling; California residents add tax.) Or call (415) 524-5317, 10-5 Pacific Time.



*CP M is a trademark of Digital Research

duct of Morrow's
Stuff for

circle 255 on inquiry card

Thinker Toys

1201 10th Street
Berkeley, CA 94710

HY 11 October 1978 23

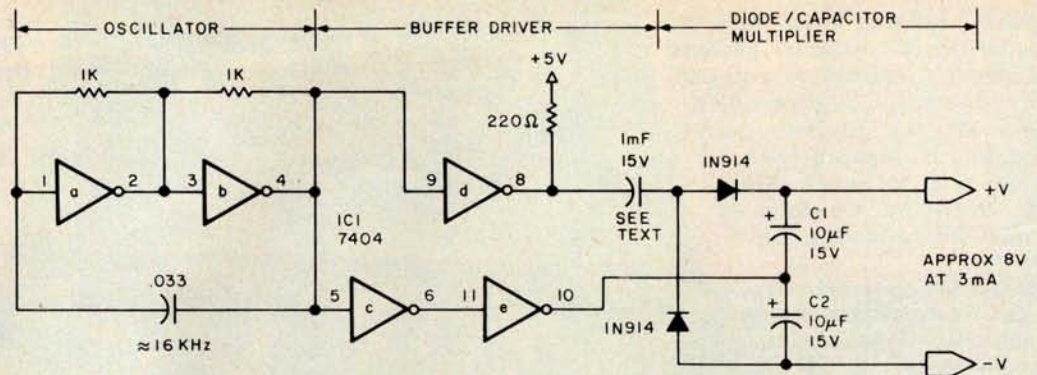


Figure 1: Typical DC to DC converter, a device used to convert one DC voltage into another. The oscillator section supplies a train of square waves to the buffer drivers. On the first half cycle, capacitor C1 is charged to approximately 4 V, and on the second half cycle, C2 is charged to -4 V. The voltage across the two capacitors is twice the input voltage, or approximately 8 V (open circuit). The 1 mF capacitor between IC1d and the two diodes isolates the circuit so that the 8 V can be referenced to ground.

integrated circuits and require only 50 mA, or if the interface is designed with CMOS circuitry, the current requirement could be 5 mA or less. While the 60 Hz transformer design may be more than adequate, the volume and weight of the low frequency magnetics is bulky and may not fit easily within the present enclosure.

The DC to DC Converter

In an application that requires higher voltage at low current, the DC to DC converter is the natural choice for the designer. As its name implies, it converts one DC voltage to another, usually a higher one. All DC to DC converters incorporate oscillator sections to provide AC either to drive transformers or to drive diode-capacitor

voltage multipliers. The converters operate at high frequencies to reduce transformer weight. We'll explore the particulars later.

A DC to DC converter need not be low power, but the designs and applications presented here are specifically for low current and limited space applications. The majority of the circuits occupy less than 2 square inches (12.9 square cm).

A DC to DC converter draws its power from some major power bus, such as a +5 V or +12 V computer supply, and converts this source voltage to a higher level of either the same or reversed polarity. The simplest configuration is shown in figure 1. IC1a and IC1b form the oscillator which is common to all DC to DC converters. IC1c, IC1d and IC1e are buffers with the outputs of IC1d and IC1e 180 degrees out of phase,

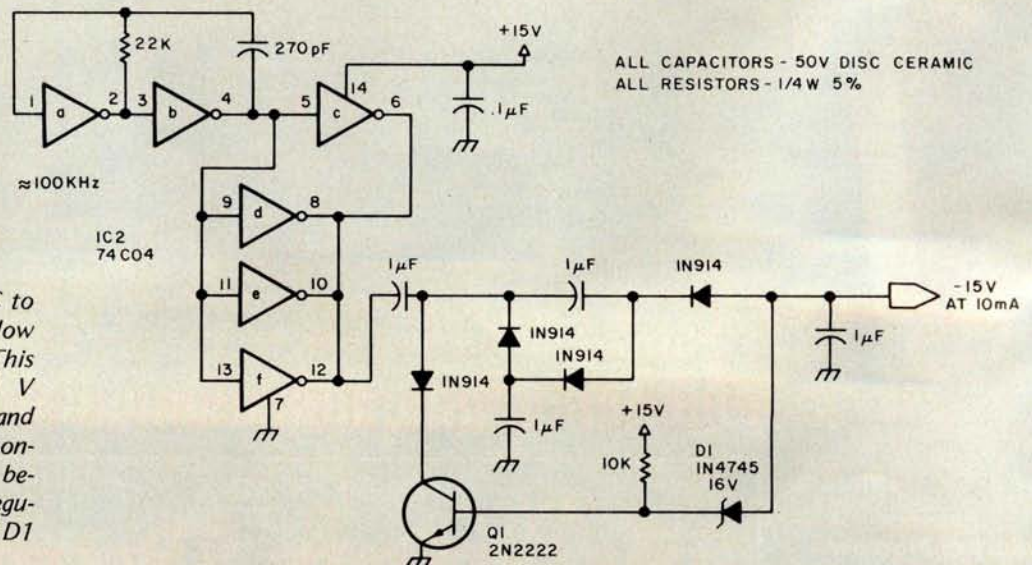
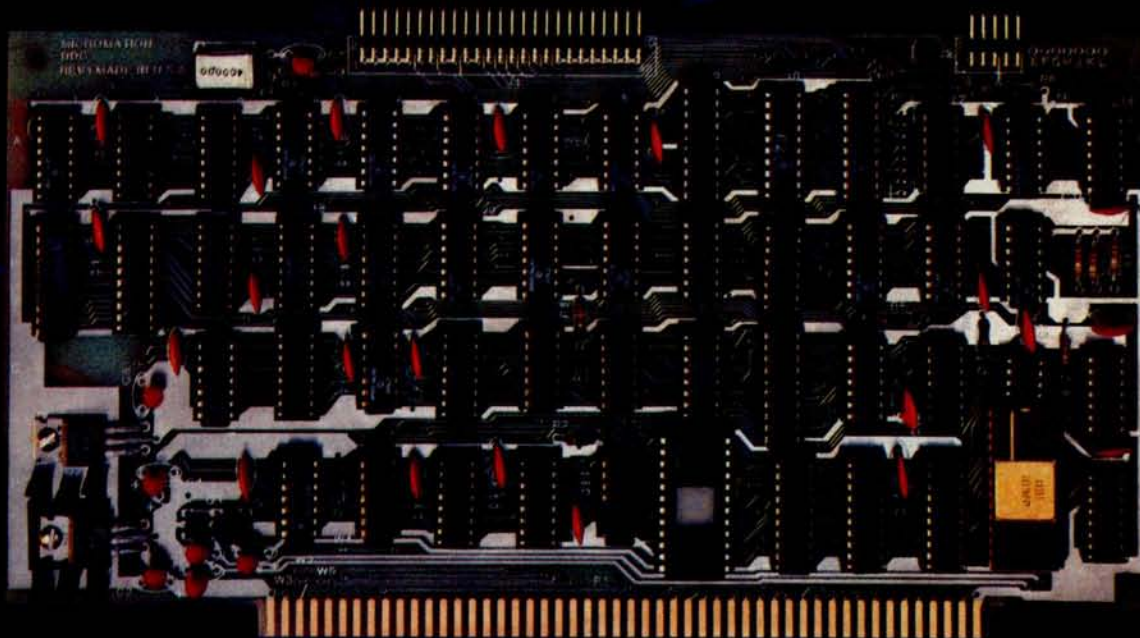


Figure 2: A CMOS DC to DC converter used for low current applications. This circuit produces -15 V from a +15 V source and provides a relatively constant output voltage because of the shunt regulator formed by diodes D1 and Q1.

Micromation has done for the S-100 bus what IBM did for the floppy disk.



Reliably doubled capacity.

Double Capacity

The DOUBLER — Micromation's latest advance in floppy disk technology — doubles the capacity of floppy disk systems. Over 500 KBytes are recorded on each side of an 8" disk. This means bigger files for more powerful systems.

Double Speed

Data transfer with the DOUBLER is twice as fast — 500 Kbits per second. And since there is twice as much data on each track, your drive steps only half as much — so your system runs faster than it ever has before!

Increased Reliability

That's right — even better reliability. Why? Because we did it the IBM way. IBM designed 2D formatting — so it has to be reliable. Micromation's innovative, state-of-the-art design incorporates write precompensation electronics and a phase lock oscillator on a single, all digital, S-100 circuit board. So we guarantee the DOUBLER will be more dependable than your present single density controller — and we warrant the DOUBLER for a full year.

Unbeatable Convenience

It couldn't be easier to step up to double density. The DOUBLER operates automatically in either single or double density. Just insert a diskette and you're running properly. You can transfer files between single or double density diskettes without any software or hardware changes — or even operate with one single and one double density diskette.

Installation is a snap. There's a hardware UART on board

and the software is all ready to go. An onboard 2708 EPROM contains the bootstrap. There's even jump-on-reset circuitry so you can operate without a front panel. And, of course, we include utilities to format diskettes.

Universally Versatile

The DOUBLER will operate with all industry-standard mini and full-sized drives. And it will work in any 8080 or Z-80 S-100 computer operating at 2 to 4 MHz. The DOUBLER will support up to four double or single headed drives.

Fully Compatible

The DOUBLER is compatible with CP/M* version 1.4. If you have a CP/M* 1.4 system, just add our CBIOS — or you can buy our ready-to-boot version. Install the new controller, connect any terminal to the RS-232 interface, and boot off your new double-sized, double-speed system. You still can use all your old software without any changes.

Completely Affordable

All Micromation products are fully assembled, thoroughly tested, include complete documentation, and are priced for value:

DOUBLER double density controller	\$ 495.
MEGABOX dual drive double density system	2,295.
ZEPHER — Per Sci double density system	2,595.
Z-PLUS — MEGABOX 32 KZ-80 computer	4,295.

Available

The DOUBLER is available NOW at your local computer store.

Micromation Inc. 524 Union Street San Francisco California 94133 / 415 398-0289

MICROMATION

Where there's always more in store.

*CP/M is a trademark of Digital Research.

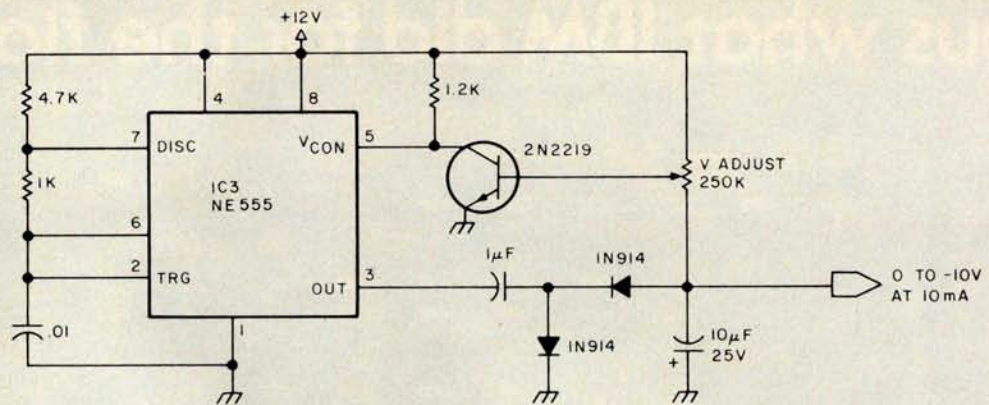


Figure 3: A variable output DC to DC converter capable of producing 0 to -10 V.

simulating a pseudo AC signal to the voltage multiplier. During the first half cycle, the capacitor, C1, is charged to approximately 4 V, and during the second half cycle, C2 is oppositely charged. The voltage across the two capacitors is twice the input voltage, or approximately 8 V (open circuit). If this circuit were not isolated from the drivers (IC1d and IC1e), neither +V nor -V line can be grounded or the multiplier section will be shorted out. The 1 mF 15 V capacitor between pin 8 and the junction of the two IN914 diodes provides isolation and allows the -V lead to be grounded. The output is then approximately 8 V, referenced to ground.

Inverting Supplies

Most often DC to DC supplies are used where a negative voltage is required to power a bipolar linear interface or a dual supply large scale integrated circuit such as a keyboard encoder.

Figures 2 and 3 are examples of converters which would be suitable for these low current applications. Figure 2 produces -15 V from a +15 V source and provides a relatively constant output voltage because of the shunt regulator formed by the diode, D1, and the transistor, Q1. Changing the zener diode, D1, to 13 V makes the output -12 V instead of -15 V. The circuit outlined in figure 3 uses the voltage control input of an NE555 timer circuit to produce a variable output of 0 to -10 V.

Dual Voltage Converters

In most cases single voltage converters use diode steering and charged capacitor voltage multiplication. Transformers or other inductive devices must be incorporated if dual outputs are a requirement. Figure 4 is a very simple ± 15 V converter which is powered from a +5 V supply.

Type	Function	+5 V	-5 V	-12 V	+12 V
Ay-5-1013A	UART	20 mA		18 mA	
2708	1 K x 8 EROM	10 mA	45 mA		65 mA
2716 (Intel)	2 K x 8 EROM	100 mA			
2716 (TI)	2 K x 8 EROM	22 mA		12 mA	45 mA
MC1408L8	8 bit digital to analog converter	8 mA		20 mA	
LM301	op amp			3 mA	3 mA
LM741	op amp			2.8 mA	2.8 mA

Table 1: Worst case current requirements for a variety of integrated circuits.

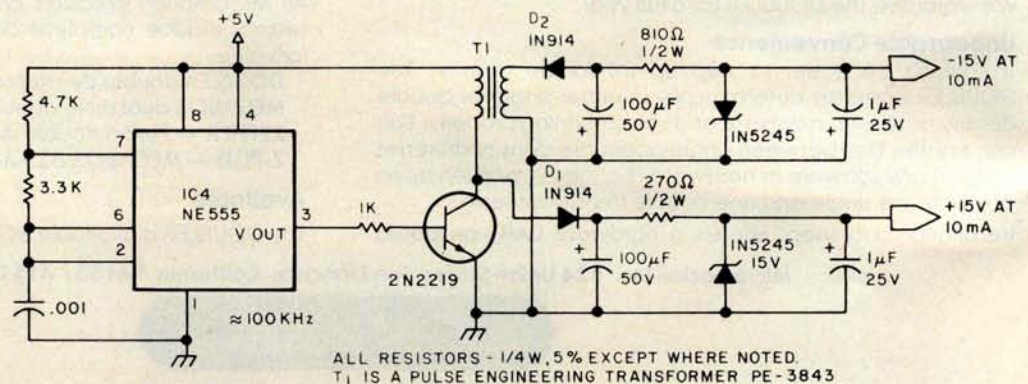
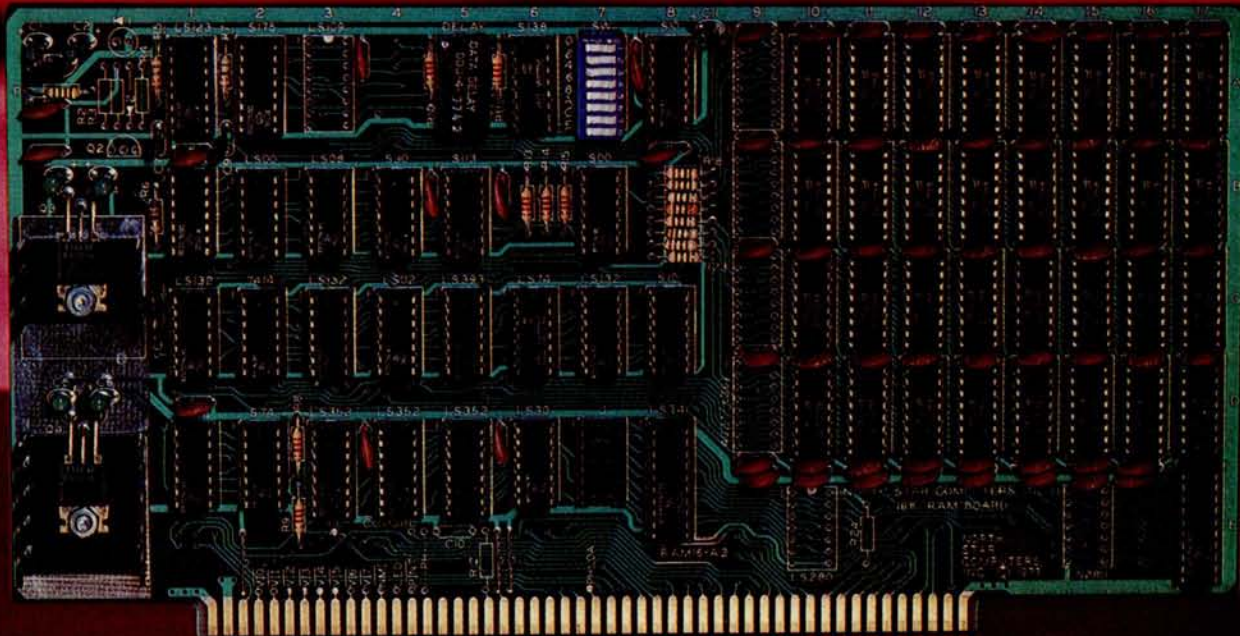


Figure 4: Low current dual voltage output DC to DC converter which supplies -15 and +15 V from a +5 V input.

ALL RESISTORS - 1/4W, 5% EXCEPT WHERE NOTED.
T₁ IS A PULSE ENGINEERING TRANSFORMER PE-3843

NORTH STAR 16K RAM

A star from our Horizon



The North Star 16K RAM board is a star performer in our HORIZON computer. Just as important, it is the ideal memory for most other S-100 bus systems. No other RAM board can surpass the speed, reliability, and quality features of the North Star 16K RAM at any price.

SPEED — The North Star 16K RAM is the fastest S-100 bus memory board available. No wait states are required, even with a Z80 at 4MHz. And, of course, this outstanding 16K RAM will operate with both 8080 and Z80 processors at 2MHz. Industry standard 200ns dynamic RAM chips are used. Invisible on-board refresh circuitry allows the processor to run at full speed.

RELIABILITY — The North Star 16K RAM is designed to match the same high standards as our MICRO DISK SYSTEM and HORIZON computer. For example, all address and data signals are fully buffered. A parity check option is available with the 16K RAM for applications requiring immediate hardware error detection. If a memory

error occurs, a status flip/flop is set and an interrupt can inform the processor. Or, if preferred, an error status light will go on.

FEATURES — The North Star 16K RAM offers many desirable features. Addressability is switch-selectable to start at any 8K boundary. The board can perform bank switching for special software applications, such as time-sharing. Also, bank switching can be used to expand the amount of RAM beyond 64K bytes. Power consumption is minimal — the maximum power requirements are: .6A @ 8V; .4A @ +16V, and .1A @ -16V.

PRICES — \$399 kit. \$459 assembled, tested and burned-in. Parity option: \$39 Kit. \$59 assembled, tested and burned-in.

Write for free color catalog or visit your local computer store.

NORTH STAR ★ COMPUTERS

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

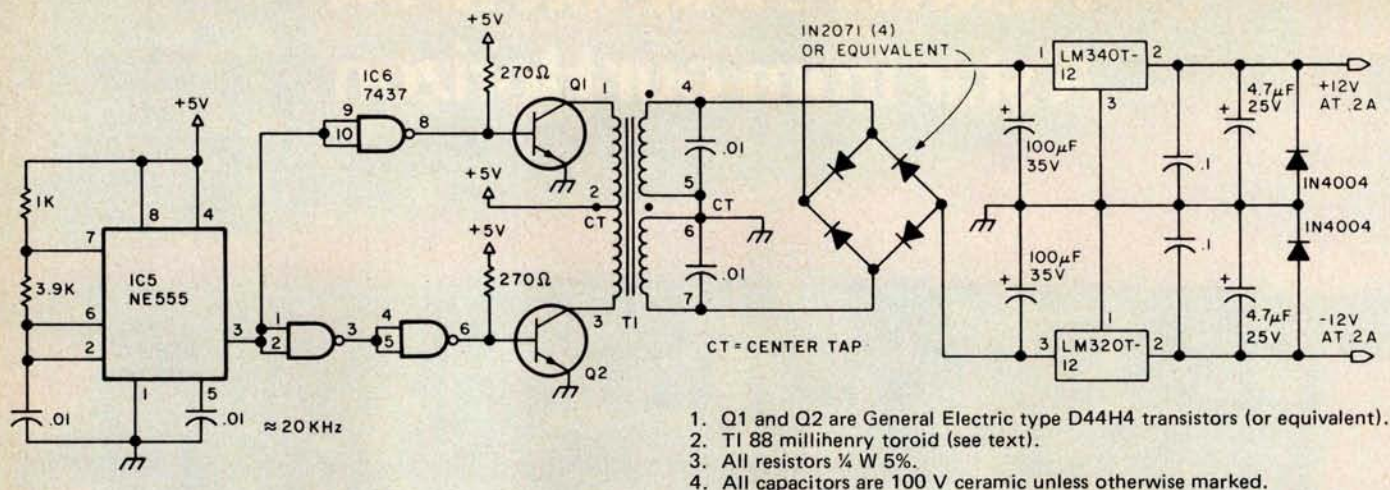
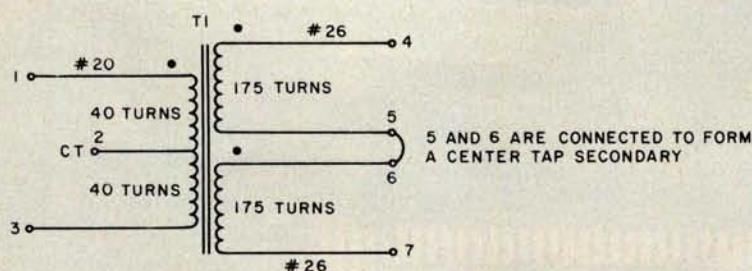


Figure 5a: 5 W DC to DC converter pictured in photo 1, which produces 0.2 A at +12 and -12 V from a 5 V source. See figure 5b for details of winding a toroidal transformer for this circuit.



1. Use enamel or Fomvar coated wire for each winding.
2. Be careful when winding not to scratch protective insulation.
3. Primary consists of 80 turns of #20 wire with center tap.
4. Secondaries can be wound as two #26 wire, 175 turn windings or as a single 350 turn winding with center tap.
5. For toroid source see text.
6. Use sandpaper or similar material to remove insulation from terminal wires before soldering.

Figure 5b: Toroid winding details for the custom transformer used in the circuit of figure 5a (see photos 2 thru 5).

Number	Type	+5 V	Gnd
IC1	7404	14	7
IC2	74C04	14	7
IC3	555	8	1
IC4	555	8	1
IC5	555	8	1
IC6	7437	14	7

Table 2: Power wiring table for figures 1 thru 5.

A 100 kHz oscillator switches a transistor on and off, inducing a current into the primary of transformer, T1. The voltage produced at the secondary is rectified and regulated to -15 V.

As with all inductive devices which are pulsed, a high voltage spike is reflected back to the collector of the transistor. Rather than shunting this voltage, as would be the case when we put a diode across a coil, D1 routes this spike to a filter and regulator combination to provide a +15 V output.

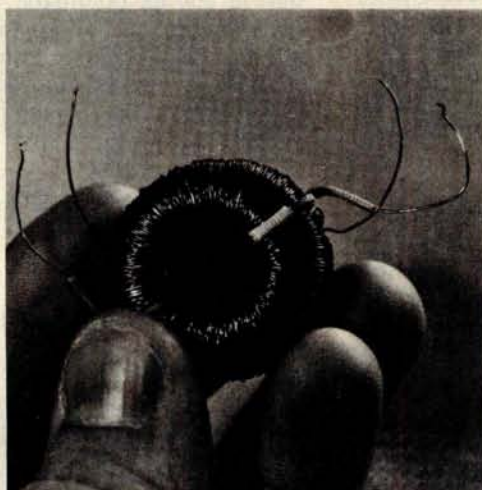
Building a DC to DC Converter

One of the first things to determine after deciding to use a DC to DC converter in your system is just how much current it must provide. Table 1 lists the typical voltages and operating current requirements (worst case) of a sampling of devices.

It should be apparent from this listing that EROMs are power-hungry devices and will use more than the 10 mA that the converters discussed thus far can supply. For this reason the unit described in figure 5 is designed to produce a full 200 mA at ±12 V.

This design uses a push/pull inverter technique to create AC which drives transformer, T1. T1 is a toroid transformer and

Photo 2: Surplus 88 milli-henry toroidal transformer rewound with two secondaries of 175 turns of #26 wire each (after first unwinding the existing two windings of approximately 350 turns each). The unit is used in the circuit of figure 5a.



"Our goal was to produce 100% reliable business programs."



"What do we mean by reliable programs? Three things: good program design, documentation, and full support.
DESIGN Good program design meets a wide variety of customer needs without reprogramming.



Keith Parsons, President
 Alan Cooper, VP, Systems Development
 Circle 351 on inquiry card

Our programs are comprehensive yet retain their flexibility. They allow convenient backup, are easy to use and have been thoroughly tested and field proven.

DOCUMENTATION We consider the quality of the documentation to be as important as the programs themselves. That's why our manuals are clear, concise and complete.

SUPPORT And when it comes to support we're second to none. We release periodic updates, answer your questions and are available to provide technical assistance. Now that's reliable!

Our growing Business Systems series currently includes: **GENERAL LEDGER, ACCOUNTS RECEIVABLE, NAD** (Name and Address File system), **Q/SORT** (full disk sort/merge), and **CBASIC** (a powerful business Basic). For details, contact our sales manager, Richard Ellman.

Structured Systems Group

5615 KALES AVE. DEPT. B6 OAKLAND, CA 94618 (415) 547-1367
 All systems are compatible with any Z 80 or 8080 CP/M™ system.

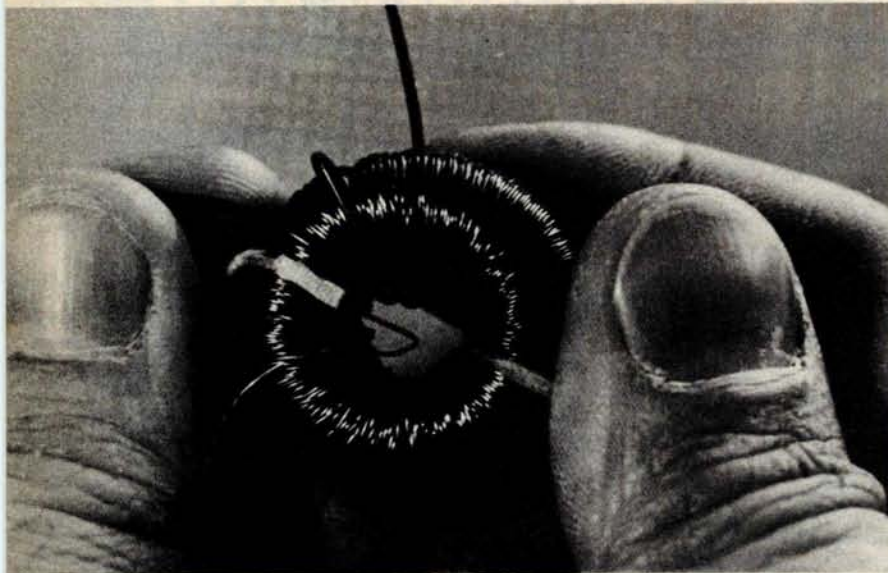


Photo 3: Adding the primary winding, step 1: wind 40 turns of #20 wire evenly around the toroid.

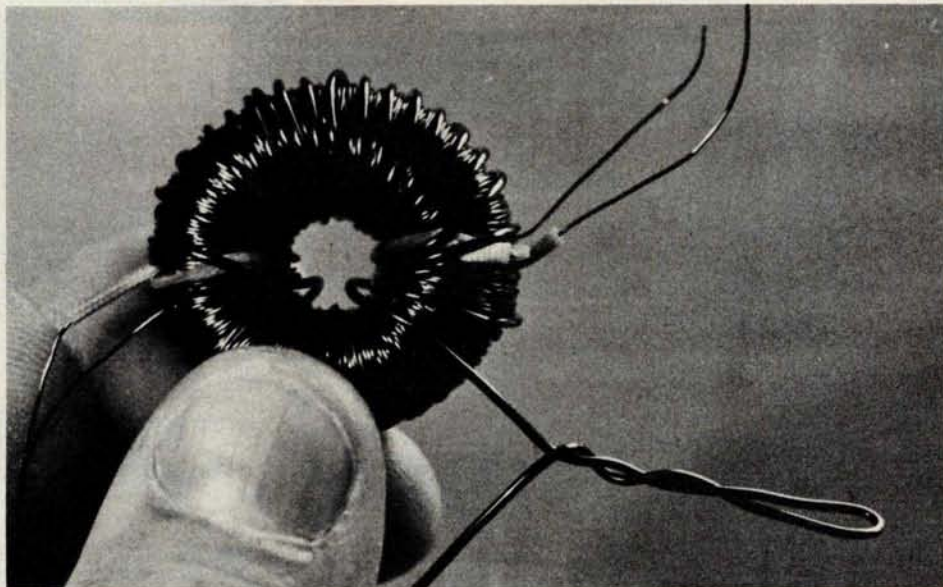
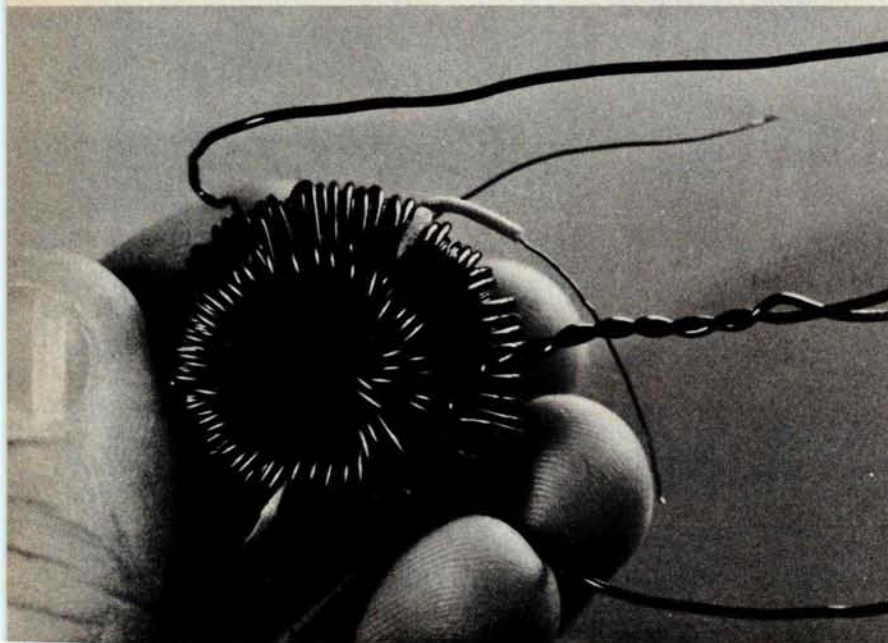


Photo 5: The completed transformer. The ends of all enameled wires should be cleaned of insulation before soldering.



its doughnut shape is quite unlike the more common rectangular filament transformers. The shape and style of the toroid are specifically designed for high frequency operation, which is the main attribute of this inverter design. Heavy magnetic cores are necessary only for low frequencies such as 60 Hz. Since this converter's switching speed is 20 kHz, relatively little magnetic material is necessary, and high power output can be obtained.

The toroid in this design is a surplus 88 millihenry toroid, frequently advertised in the amateur radio magazines. A source I

Photo 4: Adding the primary winding, step 2: make a loop for the center tap and continue with 40 additional turns.

have found is: M Weinschenker, POB 353, Irwin PA 15642. Order 88 millihenry unpotted toroids. The price is five for \$2.95 plus \$1 postage.

There are two ways to wind this toroid. Since it presently contains two windings of approximately 350 turns each, adding a primary sounds most logical. In reality though, 180 turns of #20 wire couldn't possibly fit in the remaining space, and the number of windings seems to vary from source to source. To obtain a properly wound toroid, it is best to first completely unwind the toroid and then rewind two 175 turn secondaries. The rewind toroid looks like photo 2. Since inductors exhibit an output polarity that is important when tying two secondaries in series, it is advisable to

mark the starting lead on each coil and wind each in the same direction. It is not catastrophic if you don't. Polarity can be determined empirically later.

The primary is wound with #20 wire over the two secondaries as in photo 3, and should be distributed evenly around the toroid. When 40 turns have been wound, make a loop in the wire so that it will stick out (as shown in photo 4) and then continue winding the next 40 turns in the same direction. The complete toroid should look like photo 5.

The design outlined in figure 5a is a DC inverter. The NE555 20 kHz oscillator sources the high current 7437 buffers which are necessary to drive the push/pull transistor combination of Q1 and Q2. The continuous on/off action of the transistors produces an alternating current of 20 kHz in the primary winding of the toroid. This in turn induces a voltage proportional to the ratio of the primary to secondary turns, times the primary input voltage into the secondary winding. With approximately 4 V into the primary (taking into account the collector to emitter voltage drop, V_{CE} , transistors Q1 and Q2), 18 to 20 V should be present on each secondary.

The output of the toroid is treated as it would be in a traditional DC regulator design. The two secondaries are connected in series (terminals 5 and 6 connected) to produce 45 V between terminals 4 and 7. If a low voltage is obtained instead of 45 V, then the secondaries are out of phase and the terminals of one of the coils should be reversed. The two terminals which are connected at this point are the center tap and should be grounded.

Four diodes and two capacitors function as the full wave rectifier and filter input to a pair of 3 terminal voltage regulators. The result is a well-regulated + and -12 V supply with output current in excess of 200 mA on each. Overall conversion efficiency is better than 50%.

One note to keep in mind when testing this device: since the output is 5 W with 50% efficiency, the continuous input current to the converter will be approximately 2 A (at 5 V). Peak current will be higher at each clock transition. Use a supply with sufficient current capabilities or it will degrade the performance of the converter and possibly not even work.

In next month's BYTE: build an inexpensive infrared detection system. ■



WIRE FOR WIRE-WRAPPING



CUT TO LENGTH AND PRE-STRIPPED ON BOTH ENDS

AWG 30 (0.25MM) KYNAR® WIRE				
INSULATION DIAMETER .0195 INCH (0.50MM) STRIP-OFF LENGTH BOTH ENDS 1 INCH (25MM) 500 WIRES PER PACKAGE				
LENGTH "L" INCH	BLUE PART NO.	WHITE PART NO.	YELLOW PART NO.	PRICE PER 500
1	30B-010	30W-010	30Y-010	\$4.88
1.5	30B-015	30W-015	30Y-015	5.19
2	30B-020	30W-020	30Y-020	5.50
2.5	30B-025	30W-025	30Y-025	5.82
3	30B-030	30W-030	30Y-030	6.13
3.5	30B-035	30W-035	30Y-035	6.44
4	30B-040	30W-040	30Y-040	6.75
4.5	30B-045	30W-045	30Y-045	7.07
5	30B-050	30W-050	30Y-050	7.38
6	30B-060	30W-060	30Y-060	8.00
7	30B-070	30W-070	30Y-070	8.63
8	30B-080	30W-080	30Y-080	9.25
9	30B-090	30W-090	30Y-090	9.88
10	30B-100	30W-100	30Y-100	10.50

AWG 28 (0.32MM) KYNAR® WIRE				
INSULATION DIAMETER .023 INCH (0.59MM) STRIP-OFF LENGTH BOTH ENDS 1 INCH (25MM) 500 WIRES PER PACKAGE				
BLUE PART NO.	WHITE PART NO.	YELLOW PART NO.	PRICE PER 500	
28B-010	28W-010	28Y-010	\$5.25	
28B-015	28W-015	28Y-015	5.63	
28B-020	28W-020	28Y-020	6.00	
28B-025	28W-025	28Y-025	6.38	
28B-030	28W-030	28Y-030	6.75	
28B-035	28W-035	28Y-035	7.13	
28B-040	28W-040	28Y-040	7.50	
28B-045	28W-045	28Y-045	7.87	
28B-050	28W-050	28Y-050	8.25	
28B-060	28W-060	28Y-060	9.00	
28B-070	28W-070	28Y-070	9.75	
28B-080	28W-080	28Y-080	10.50	
28B-090	28W-090	28Y-090	11.25	
28B-100	28W-100	28Y-100	12.00	

AWG 26 (0.40MM) KYNAR® WIRE				
INSULATION DIAMETER .027 INCH (0.69MM) STRIP-OFF LENGTH BOTH ENDS 1 INCH (25MM) 500 WIRES PER PACKAGE				
BLUE PART NO.	WHITE PART NO.	YELLOW PART NO.	PRICE PER 500	
26B-010	26W-010	26Y-010	\$5.75	
26B-015	26W-015	26Y-015	6.23	
26B-020	26W-020	26Y-020	6.68	
26B-025	26W-025	26Y-025	7.13	
26B-030	26W-030	26Y-030	7.60	
26B-035	26W-035	26Y-035	8.05	
26B-040	26W-040	26Y-040	8.50	
26B-045	26W-045	26Y-045	8.98	
26B-050	26W-050	26Y-050	9.43	
26B-060	26W-060	26Y-060	10.35	
26B-070	26W-070	26Y-070	11.25	
26B-080	26W-080	26Y-080	12.18	
26B-090	26W-090	26Y-090	13.55	
26B-100	26W-100	26Y-100	14.00	

ROLLS OF WIRE

	BLUE PART NO.	WHITE PART NO.	YELLOW PART NO.	PRICE PER 500
100 ft. roll	R30B-0100	R30W-0100	R30Y-0100	\$3.65
500 ft. roll	R30B-0500	R30W-0500	R30Y-0500	10.40
1000 ft. roll	R30B-1000	R30W-1000	R30Y-1000	16.82

	BLUE PART NO.	WHITE PART NO.	YELLOW PART NO.	PRICE PER 500
100 ft. roll	R28B-0100	R28W-0100	R28Y-0100	\$4.05
500 ft. roll	R28B-0500	R28W-0500	R28Y-0500	12.85
1000 ft. roll	R28B-1000	R28W-1000	R28Y-1000	21.10

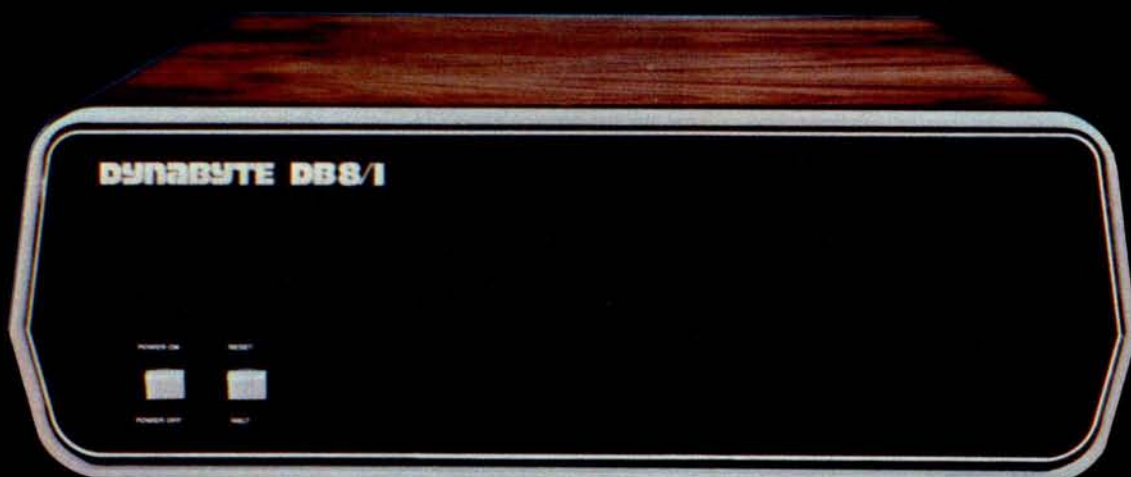
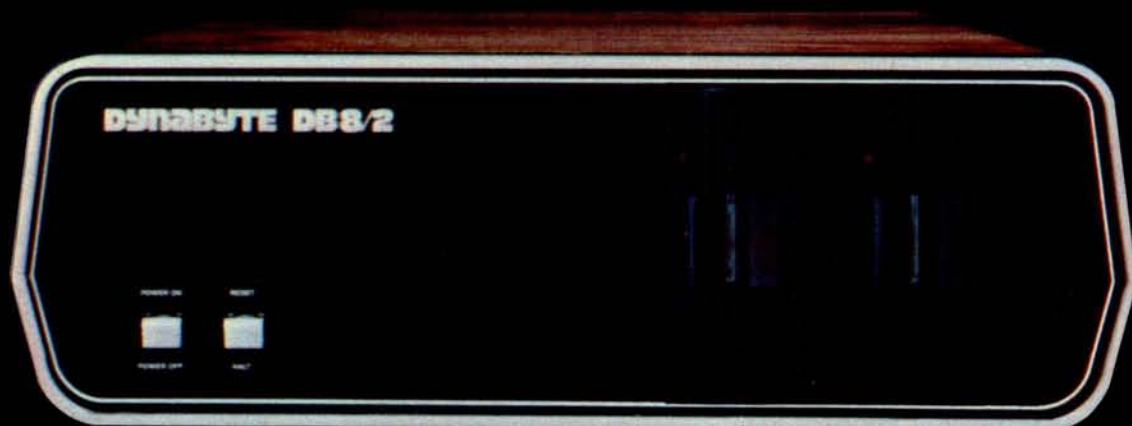
	BLUE PART NO.	WHITE PART NO.	YELLOW PART NO.	PRICE PER 500
100 ft. roll	R26B-0100	R26W-0100	R26Y-0100	\$4.35
500 ft. roll	R26B-0500	R26W-0500	R26Y-0500	13.80
1000 ft. roll	R26B-1000	R26W-1000	R26Y-1000	23.15

© KYNAR - PENNVAL

MINIMUM BILLING \$25.00. ADD SHIPPING CHARGE \$1.00. NEW YORK RESIDENTS ADD APPLICABLE TAX.

OK MACHINE & TOOL CORPORATION

3455 CONNER STREET, BRONX, N.Y. 10475 (212) 994-6600 Telex 125091



DYNABYTE COMPUTERS ARE ALL BUSINESS INSIDE AND OUT.

When we designed our new small business computers, we meant business.

As basic as that seems, it is unique. Just about every other microcomputer being sold as a small business system today was originally designed as a kit for hobbyists.

Every design decision was made with quality and reliability in mind. The result is dependable performance and a solid appearance for business, professional and scientific applications.

FIRST SMALL SYSTEM WITH BIG SYSTEM STORAGE

Many applications handle large quantities of information, so the DB8/2 uses two quad density 5-inch disk drives with our exclusive Dual Density Disk Controller for up to 1.2 megabytes of formatted storage. That's more capacity than two single density 8-inch drives.

If you need more storage, our DB8/4 has two 8-inch drives with up to 2 megabytes capacity, more than any other dual floppy disk system on the market.

OUR SOFTWARE IS BIG ON BUSINESS

Dynabyte helps you get down to business immediately. The DB8/2 is the first microcomputer to offer enough storage capacity on 5-inch drives to fully utilize CP/M,* the most widely accepted disk operating system. We also supply and support BASIC, FOR-

* CP/M is a trademark of Digital Research.

TRAN and COBOL programming languages. Our applications packages include general ledger, accounts receivable, word processing and many other CP/M compatible programs.

Reliability is a big consideration in buying a business computer, so we built it in. Our edge connectors meet military specifications, the toughest electronics manufacturing standard. Our regulated power supply is designed to meet U.L. standards, which means the entire system runs cool and dependable. And our cast aluminum enclosures are rugged as well as attractive.

AND THE BIGGEST THING OF ALL

Customer support. Our support starts at the factory with testing and burn-in programs that assure the *entire* integrated system is reliable prior to shipment. Our completely modular design allows continuing support in the field. We maintain a bonded inventory of all sub-system modules which means we can deliver replacement sub-assemblies overnight nearly anywhere in the continental U.S.

Dynabyte built in little things, too. Like a fully-populated 12-slot backplane, switched AC outlets for accessories, an option for European power, quiet whisper fans with long-life metal construction, lighted indicator switches for Power On and Halt, a shielded enclosure to protect disk drives from electro-mechanical interference, and a fully enclosed power supply for

operator safety.

Since we didn't cut corners in design, the price/performance ratios of our systems make good business sense.

THE INSIDE FACTS

The DB8/2 Computer System includes two 5-inch disk drives either single or double sided for up to 1.2 megabytes of mass storage; a 4MHz Z-80 processing module with one parallel and two serial ports, an EPROM programmer and up to 4k ROM; 32k of RAM, a 12-slot fully-populated backplane; our exclusive Dual Density Disk Controller, and CP/M.

The DB8/1 Computer includes a 4MHz Z-80 processor with one parallel and two serial I/O ports, an EPROM programmer and up to 4k of ROM; 32k RAM, and a 12-slot fully-populated backplane.

The DB8/4 Disk System, designed to be the mass storage companion to the DB8/1, includes two 8-inch floppy disk drives in either single or double sided configuration for up to 2 megabytes of mass storage, our Dual Density Disk Controller, and CP/M.

All three units will be available in rack mount models.

For a descriptive brochure and price list, call or write Dynabyte, 1005 Elwell Court, Palo Alto, CA 94303. Phone (415) 965-1010.

Or better yet, see your local dealer.

DYNABYTE

YOU CAN DEPEND ON IT.

A "Tiny" Pascal Compiler

Part 2: The P-Compiler

Kin-Man Chung
124 Scottswood Dr
Urbana IL 61801

Herbert Yuen
POB 2591 Station A
Champaign IL 61820

When Niklaus Wirth introduced Pascal in 1971, one of the design objectives was to allow efficient program compilation. As far as we know, all existing Pascal compilers use the one pass compilation technique.

Newcomers to Pascal sometimes criticize features of the language such as declaring variables before use, and having constant and type declarations precede variable declarations. But such features are necessary

to make a one pass compiler work (aside from the fact that it is also good programming practice to declare identifiers before use). Compared with multipass compilers, the job of writing a one pass compiler is relatively simple, since there is no need to store the program in its intermediate form.

Figure 1 shows the structure of our one pass Pascal compiler. The main portion is made up of the scanner, syntax analyzer, semantic analyzer and code generator. A brief overview of these functional portions of the compiler follows. Detailed descriptions will be given later.

The syntax analyzer is commonly called the *parser*. Its main function is to detect syntactical errors in the source program. The smallest unit of the source program that the parser looks at is called a *token*. For instance, the reserved word *while*, the symbol *:=*, or the identifier *idname* would be tokens. The main job of the scanner is to read the source program and output a token when needed by the parser. Irrelevant information such as blanks, comments and line boundaries are ignored.

To further simplify the work of the parser, the values of numeric constants are also evaluated by the scanner. The parser then parses the program according to the rules laid down by the syntax diagrams which were described in part 1 ("A Tiny Pascal Compiler," September 1978 BYTE, page 58) and generates error messages if illegal constructs are found. Identifier names are entered into a symbol table as they are declared. The symbol table is consulted by the parser as well as the semantic analyzer. After a Pascal construct is recognized, its meaning is analyzed by the semantic analyzer and appropriate p-codes are generated. Occasionally, there are forward references whose addresses cannot be determined at the time the codes are generated, but have to be resolved at a later time. Thus updates to the object program have to be done at the appropriate time.

This may sound complicated, but in fact a one pass compiler is actually the simplest compiler imaginable. The technique used by our parser is usually referred to as *top-down* parsing or goal oriented parsing. The top-down parsing algorithm assumes a general goal at the beginning. This goal is then broken down into one or more subgoals, depending on input strings and the rules in the syntax diagrams. The subgoals are realized by breaking them down into finer subgoals.

This is usually not a very efficient algorithm if backups are needed. The need for backups occurs if at some point we choose one subgoal from several others and find

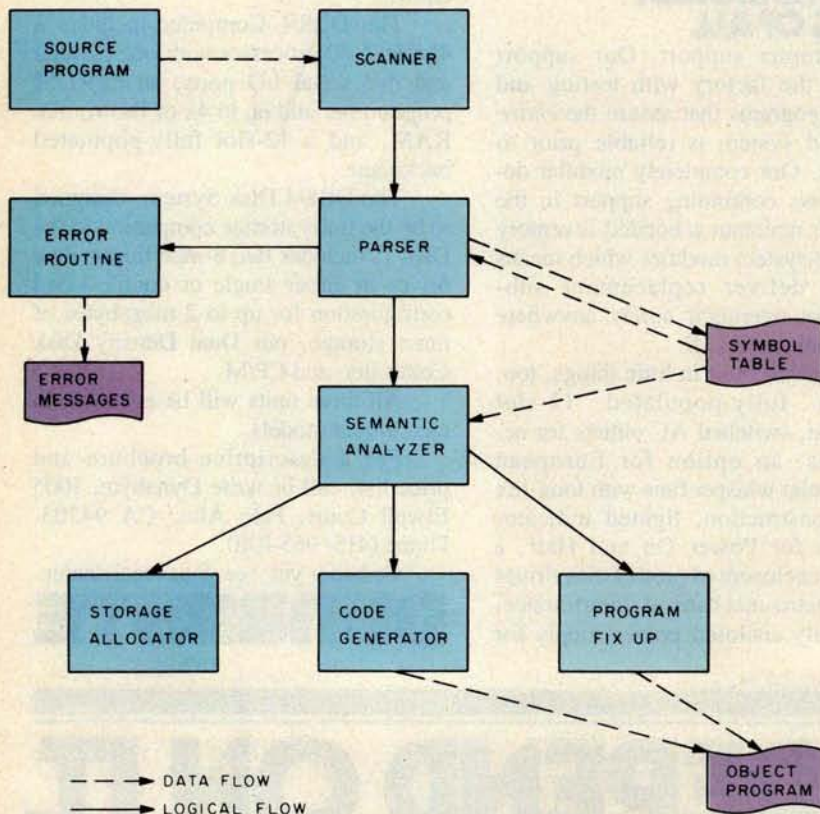


Figure 1: Logical arrangement and interconnections of the p-compiler modules.

Concerto in A Flat Mini.

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

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

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

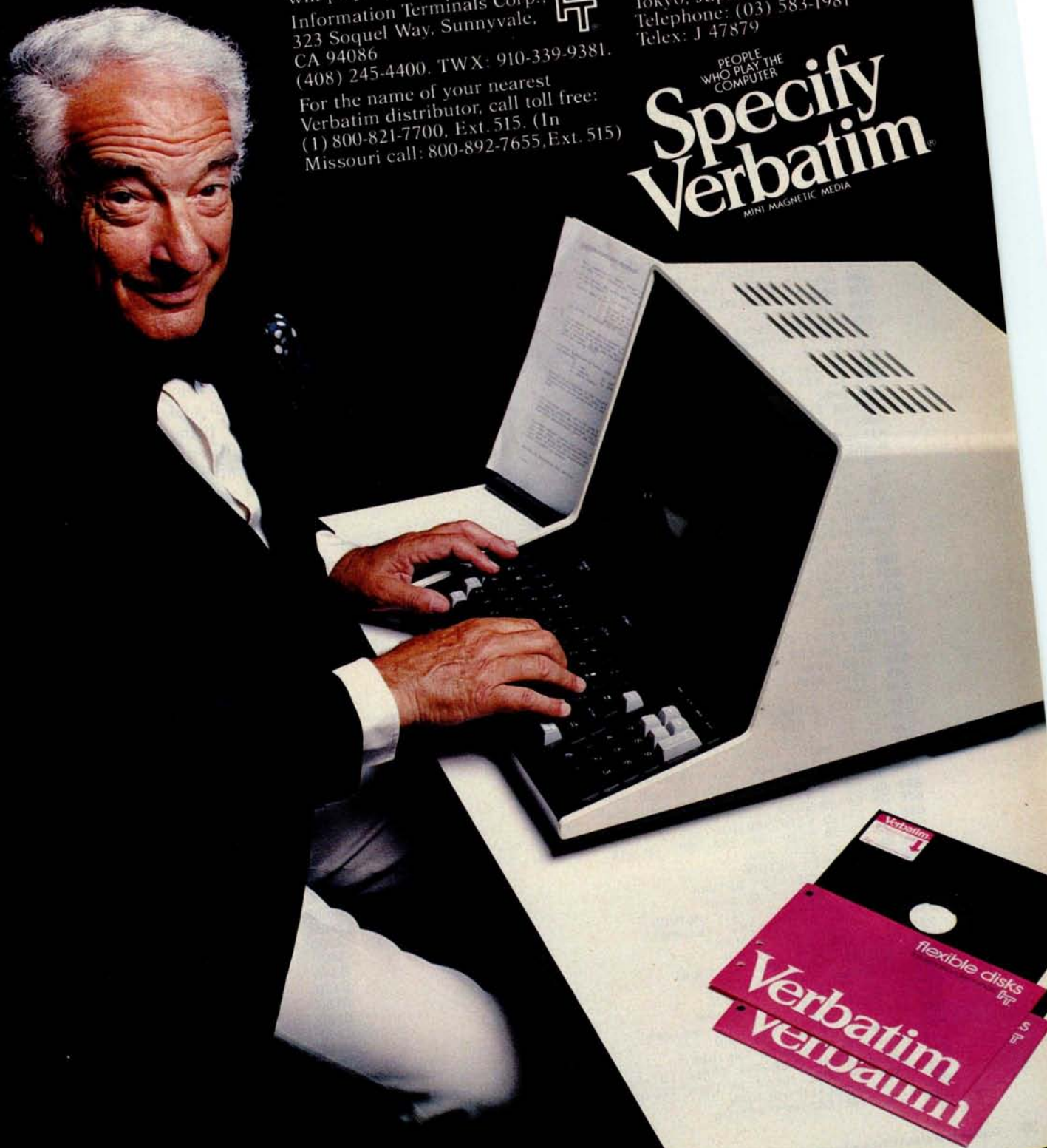
Information Terminals Corp.,
323 Soquel Way, Sunnyvale, CA 94086
(408) 245-4400. TWX: 910-339-9381.

For the name of your nearest Verbatim distributor, call toll free: (1) 800-821-7700, Ext. 515. (In Missouri call: 800-892-7655, Ext. 515)

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

In the Far East:
ITC - Far East
404 Roppongi Skyheights
3-2-21 Roppongi, Minatoku
Tokyo, Japan
Telephone: (03) 583-1981
Telex: J 47879

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



Listing 1: BASIC version of the p-compiler. This program takes the Pascal program and compiles it into p-code. The term p-code stands for pseudocode, an assembler language code for a hypothetical computer which can be converted into an existing assembler language. Listing continues thru page 48.

```

10REM PASCAL SUBSET COMPILER FOR P-MACHINE
20REM BY KIN-MAN CHUNG
30REM 1/78. LAST VERSION 4/78.
40 N0=32\REM # OF RESERVED WORDS
50 T0=50\REM SYM TABLE SIZE
60 N1=32767\REM LARGEST INT
70 N2=8\REM IDENT LEN
80 DIM W0$(5*N0)\REM RESERVED WORDS
90 DIM T$(T0*N2)\REM SYMBOL TABLE
100 DIM T0$(T0)\REM KIND OF IDENT IN SYM TAB\O,U,P
110 DIM L$(64)\REM LINE BUFFER
120 DIM A$(N2),B$(5)
130 DIM S(100),S$(100)\REM STACKS
140 DIM T1(T0)\REM LEVEL OF ID IN SYM-TBL
150 DIM T2(T0)\REM VAL(FOR CONST) OR ADDR(FOR INT)OF ID IN S T
160 DIM T3(T0)\REM ARRAY DIM OR# OF PROC PARAMETERS
170 W0$(1,40)="AND ARRAYBEGINCALL CASE CONSTDIV DO "
180 W0$(41,80)="DOWNTLSE END FOR FUNC IF INTEGEM "
190 W0$(81,120)="MOD NOT OF OR PROC READ REPEASHL "
200 W0$(121,160)="SHR THEN TO TYPE UNTILVAR WHILEWRITE"
210 DIM M$(27),C$(80)
220 M$="LITOPRLODSTOCLINTJMPJPCSP"\REM P-CODE MNEMONICS
230 P8=1
240 P7=0\P9=P7\REM START CODE=0000
250 !"P-CODES STARTS AT 0000"
260 Q9=4096+2\REM LAST USABLE MEM
270 F5=-1
280 INPUT "WANT CODE PRINTED?",Y$
290 IF Y$="Y" THEN Y9=0 ELSE Y9=1
300 X$=" "\GOSUB 1240\REM GET A TOKEN
310 GOSUB 5340\REM BLOCK
320 Z=FNE1(" ",9)
330 FILL P9,255\FILL P9+1,255\REM FILL IN EOF MARK
340 INPUT"INTERPRET(I), OR TRANSLATE(T)?",Y$
350 IF Y$="" THEN END
360 IF Y$="I" THEN CHAIN "INTERP"
370 IF Y$="T" THEN CHAIN "TRANS"
380 END
390REM *****
400REM ERROR ROUTINES
410REM ***
420REM FNE1..IF CURRENT TOKEN<K$ THEN ERROR #E
430 DEF FNE1(K$,E)
440 IF S0<>K$ THEN Z=FNE(E)
450 RETURN 0
460 FNE1
470REM ***
480REM FNE2..IF NEXT TOKEN<K$ THEN ERROR #E
490 DEF FNE2(K$,E)
500 GOSUB 1240
510 IF S0<>K$ THEN Z=FNE(E)
520 RETURN 0
530 FNE2
540REM ***
550REM PRINT ERROR MSG
560 DEF FNE(E9)
570 !TAB(C0+4),"+",E9
580 GOSUB 610
590 STOP
600 RETURN 0\FNE2
610REM ERROR MSGS
620 ON INT((E9-1)/5)+1 GOTO 630,640,650,660,670,680,690,700
630 ON E9 GOTO 710,720,730,740,750
640 ON E9-5 GOTO 990,990,990,990,760,770
650 ON E9-10 GOTO 780,790,800,990,990
660 ON E9-15 GOTO 810,820,830,840,850
670 ON E9-20 GOTO 860,870,880,990,890
680 ON E9-25 GOTO 900,910,920,990,930
690 ON E9-30 GOTO 940,990,950,960,970
700 ON E9-35 GOTO 980
710 !"MEM FULL"\RETURN
720 !"CONST EXPECTED"\RETURN
730 !" '=' EXPECTED"\RETURN
740 !"IDENTIFIER EXPECTED"\RETURN
750 !" ' ' OR ' ' MISSING"\RETURN
760 !" ' ' EXPECTED"\RETURN
770 !" ' ' MISSING"\RETURN
780 !"UNDECLARED IDENT"\RETURN
790 !"ILLEGAL IDENT"\RETURN
800 !" ' ' EXPECTED"\RETURN
810 !" THEN' EXPECTED"\RETURN
820 !" ' ' OR 'END' EXPECTED"\RETURN
830 !" DO' EXPECTED"\RETURN
840 !"INCORRECT SYMBOL"\RETURN
850 !"RELATIONAL OPERATOR EXPECTED"\RETURN
860 !"USE OF PROC IDENT IN EXPR"\RETURN
870 !" ' ' EXPECTED"\RETURN
880 !"ILLEGAL FACTOR"\RETURN

```

after some processing that we have made the wrong choice. We would then have to undo what had been done by the wrong choice and back up to the point where we could try other alternatives. This is usually a messy business and involves a lot of bookkeeping. Fortunately, in the parsing of Pascal, no backup is necessary. A keyword is present at each decision point, and it determines what subgoal we should choose. An example will make this clear.

Suppose our goal is to recognize a *statement*. A statement can be a number of basic constructs: it can be an assignment statement, an if statement, a case statement or any other construct defined by the syntax diagram. The Pascal grammar is so designed that we know which type of statement we should choose by just looking at the next token. If the token is if, then we know it is going to be an if statement; if the token is case, it is going to be a case statement, etc. There would seem to be a problem if the token is an identifier, since the statement can be the beginning of an assignment statement or a procedure call. But this can be easily resolved by consulting the symbol table, where we also keep the attributes (data types, addresses, etc) of the identifiers. This is one of the reasons why identifiers and procedures must be declared before use: it makes compiler writing easier.

A top-down parser without backup can be implemented by using a technique called *recursive descent*. Such a parser uses a recursive procedure for each nonterminal in the syntax diagrams. A call is made to this procedure whenever a parse for such

Line Number	Remark
400	Error routines — FNE, FNE1, FNE2
1030	Get a character
1090	Input a line
1240	Get a token
1950	Enter entry into symbol table
2060	Search symbol table
2170	Constant declaration
2240	Get constant
2340	Variable declaration
2380	Simple expression
2610	Term
2850	Factor
3290	Expression
3490	Statement
5340	Block
6120	Push numeric
6150	Pop numeric
6180	Push string
6240	Pop string
6310	Code Generation — FNG
6520	Fixup forward references

Table 1: For easy reference the main sub-routines of the p-compiler are listed here along with remarks regarding their uses.



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

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

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

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

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

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

We can help you understand microprocessors.

signetics

a subsidiary of U.S. Philips Corporation

Signetics Corporation
811 East Arques Avenue
Sunnyvale, California 94086
Telephone 408/739-7700




```

890 !'"BEGIN' EXPECTED"\RETURN
900 !'"OF' EXPECTED"\RETURN
910 !'"ILLEGAL HEX CONST"\RETURN
920 !'"TO' OR 'DOWNT0' EXPECTED"\RETURN
930 !'"NUMBER OUT OF RANGE"\RETURN
940 !'"(' EXPECTED"\RETURN
950 !'"[' EXPECTED"\RETURN
960 !'"{' EXPECTED"\RETURN
970 !'"PARAMETERS MISMATCHED"\RETURN
980 !'"DATA TYPE NOT RECOGNIZED"\RETURN
990 !'"BUG"\RETURN
1000REM *****
1010REM SCANNER
1020REM *****
1030REM GETCHAR
1040 IF C0<L0 THEN 1060
1050 GOSUB 1090\GOTO 1040
1060 C0=C0+1\X=L*(C0,C0)
1070 RETURN
1080REM *****
1090REM INPUT A LINE
1100 !%4I,C1," ",
1110 IF F5<0 THEN INPUT L$ ELSE 1160
1120 IF L$="" THEN 1100
1130 IF L$(1,1)="$" THEN 1210\REM MACRO FILE?
1140 L$=L$+" "\C0=0
1150 L0=LEN(L$)\RETURN
1160 IF TYP(F5)<>0 THEN 1190\REM EOF IF TYP=0
1170 CLOSE #F5\F5=F5-1\REM RETURN TO LAST ACTIVE FILE
1180 GOTO 1110
1190 READ #F5,L$\!L$
1200 GOTO 1130
1210 F5=F5+1\OPEN #F5,L$(2,LEN(L$))
1220 GOTO 1090
1230REM *****
1240REM GET A TOKEN
1250REM RETURN S0$=TOKEN, A$=STRING, N3=NUMERIC
1260 IF X$<>" " THEN 1280
1270 GOSUB 1030\GOTO 1260\REM FLUSH BLANKS
1280 IF X$<"A" THEN 1460\REM IDENTIFIER?
1290 IF X$>"Z" THEN 1460
1300 K=0\A$=""
1310 IF K>N2 THEN 1330\REM ONLY 1ST N2 LETTERS ARE USED
1320 K=K+1\A$(K,K)=X$
1330 GOSUB 1030
1340 T=ASC(X$)
1350 IF T>47 AND T<58 OR T>64 AND T<91 THEN 1310\REM DGT OR LTR
1360REM BIN SEARCH FOR RES WORDS
1370 I=1\J=N0*5-4
1380 B$=A$
1390 K=INT((I+J)/10)*5+1
1400 Z$=W0$(K,K+4)
1410 IF B$<Z$ THEN J=K-5
1420 IF B$>Z$ THEN I=K+5
1430 IF I<=J THEN 1390
1440 IF I=J THEN S0$=B$ ELSE S0$="IDENT"
1450 RETURN
1460 Z$=""
1470 IF X$<"0" THEN 1580\REM AN INTEGER?
1480 IF X$>"9" THEN 1580
1490 S0$="NUM"
1500 Z$=Z$+X$
1510 GOSUB 1030
1520 IF ASC(X$)>=48 AND ASC(X$)<=57 THEN 1500
1530 N3=VAL(Z$)
1540 IF N3<=N1 THEN RETURN
1550 E9=30\GOSUB 550
1560 N3=N1\RETURN
1570REM CHECK FOR SPECIAL SYMBOL
1580 IF X$<>"-" THEN 1640
1590 GOSUB 1030
1600 IF X$<="=" THEN 1620
1610 S0$=":"\RETURN
1620 S0$="="
1630 GOSUB 1030\RETURN
1640 IF X$<>"<" THEN 1710
1650 GOSUB 1030
1660 IF X$<=">" THEN 1690
1670 IF X$<="=" THEN 1700
1680 S0$="<"\RETURN
1690 S0$="<"\GOSUB 1030\RETURN
1700 S0$="<="\GOSUB 1030\RETURN
1710 IF X$<>">" THEN 1750
1720 GOSUB 1030\S0$=">"
1730 IF X$<="=" THEN RETURN
1740 S0$=">"\GOSUB 1030\RETURN
1750 IF X$<>"'" THEN 1790
1760 S0$="STR"\C$=""
1770 GOSUB 1030\IF X$="'" THEN 1830
1780 C$=C$+X$\GOTO 1770
1790 IF X$<>"(" THEN 1820\REM IGNORE COMMENTS
1800 GOSUB 1030\IF X$<>")" THEN 1800
1810 GOSUB 1030\GOTO 1240
1820 IF X$<>"%" THEN 1930\REM HEX CONSTANT
1830 GOSUB 1030\S0$="NUM"\N3=0
1840 FOR I=1 TO 4

```

a nonterminal is required. It is easy to see why such a scheme would work. The stacking mechanism of the run time procedures ensures that we get back to the correct position in the syntax diagram after completing the parse of the nonterminal.

If you look at the syntax diagrams carefully, you will see that diagrams for certain nonterminals actually contain the nonterminal itself, either immediately or after several expansions. In terms of compiler writing this means that the procedures corresponding to these nonterminals would call themselves recursively.

BASIC Recursive Subroutines

Most versions of BASIC do not adequately support recursive subroutine calls. In North Star BASIC, the multiline function call can be invoked recursively, in a limited fashion. This is because the function parameters are local within the function definition and are pushed onto a stack when making a call.

The surprising fact is that most BASICs do not forbid a recursive call if one is made. For instance, the following BASIC subroutine, which is an inefficient way of printing the first N integers in descending order, is probably permitted in most BASICs:

```

100 PRINT N
200 IF N=0 THEN RETURN
300 N=N-1
400 GOSUB 100
500 RETURN

```

The problem of doing recursive calls in BASIC is that of preserving the values of the identifiers in the subroutines. This can be done by using a stack. The values of the identifiers are pushed onto the stack before a recursive call, and popped out of the stack in the reverse order when returning from the call. In BASIC, the stack can be simulated by an array:

```

10 DIM S(100)
11 P=0
12 REM INITIALIZE STACK POINTER
.
.
.
1000REM PUSH X INTO STACK
1010 S(P)=X
1020 P=P+1
1030 RETURN
2000REM POP X FROM STACK
2010 P=P-1
2020 X=S(P)
2030 RETURN

```


BOOKS ... ADDICTIVE?



SYBEX C-Books are leading University and Industry textbooks, used worldwide, and now translated into most major languages.

They are the result of years of experience in actual education, and have consistently been qualified as 'best pedagogic text ever used'.

"Well planned and executed text (C201)...a complete treatment...self-contained and self-defined...The chapter on 'Internal Operation of a Microprocessor' is the best explanation we have thus far seen in print." (Elementary Electronics, Sept. 78)

WARNING: Readers have Determined that C-series Books May be Addictive. Please let us Know.

C200: AN INTRODUCTION TO PERSONAL AND BUSINESS COMPUTING

Rodnay Zaks, 250 pp, \$6.95

A comprehensive introduction to personal computers, for home or business use: the hardware, the software, the peripherals, the costs. BASIC. How to fail with a business system. How to select a system. Will it be sufficient? Which one to buy. Now on cassettes: 3 hrs, ref \$10, \$14.95

C201: MICROPROCESSORS: From Chips to Systems

Rodnay Zaks, 416 pp, \$9.95

A complete, progressive, educational introduction to all aspects of microprocessors, and the assembly of a system: basic concepts, internal operation, the chips, system interconnect, programming, system development.

This book has been qualified as 'best text ever written on microprocessors.'

C202: MICROCOMPUTER PROGRAMMING: 6502

Rodnay Zaks, 250 pp, \$9.95

A step by step introduction to microcomputer programming, using the 6502 microprocessor, with a detailed analysis of all basic programming techniques, from arithmetic to Input-Output, including interrupts.

Also available: 6502 APPLICATIONS BOOK

C207: MICROPROCESSOR INTERFACING TECHNIQUES

A. Lesea & R. Zaks, 416 pp, \$9.95

How to interface a microprocessor to the external world, including all common peripherals: dynamic memory, keyboard, LED, floppy disk, CRT display, cassette.

Includes the standard busses: RS232, IEEE 488, SIOO.

SELF-STUDY COURSES

Includes Book and Cassettes

INTRODUCTION

TO MICROPROCESSORS (2.5 hrs) ref. \$1, \$29.95
TO PROGRAMMING (2.5 hrs) ref. \$2, \$29.95
COMPREHENSIVE (6 hrs) ref. \$B1, \$59.95

SPECIALIZED

MILITARY (6 hrs) ref. \$B3, \$49.95
BIT-SLICE (6 hrs) ref. \$B5, \$49.95
INDUSTRIAL (4.5 hrs) ref. \$B6, \$49.95
INTERFACING (6 hrs) ref. \$B7, \$49.95

OTHER BOOKS

Z10-APL IMPLEMENTATION \$25.00
X1-MICROPROCESSOR LEXICON \$1.95
AND MORE ... ASK FOR FREE CATALOG

Circle 358 on inquiry card.

TO ORDER

BY PHONE: call 415/848-8233
BankAmericard/Mastercharge accepted

SHIPPING: no charge when payment included (except add \$5.00 on orders for \$7.00 or less); all orders under \$50.00 must be prepaid

ADD: \$1.50/book for fast shipping

OVERSEAS:
SYBEX-EUROPE

313 rue Lecourbe, 75015-Paris, France Tel: (1) 828 25 02



2020 Milvia St.
Berkeley, CA 94704
Tel: 415/848-8233

NAME	POSITION
COMPANY	
ADDRESS	
CITY	STATE/ZIP
C200 C201 C202 C207 Other	
Payment enclosed	Bill me (over \$50) C.O.D.
Charge my Visa	Mastercharge/Interbank nbr
Number	Exp date
SIGNATURE	

☐ **FREE CATALOG/ORDER FORM** ☐


```

1850 T=ASC(X$)
1860 IF T>=48 AND T<=57 THEN 1880
1870 IF T>=65 AND T<=70 THEN T=T-7 ELSE 1910
1880 I=T-48
1890 N3=N3*16+T\GOSUB 1030\NEXT
1900 RETURN
1910 IF I>1 THEN Z=FNE(27)
1920 S0$="X"\RETURN
1930 S0$=X$\GOTO 1030
1940REM *****
1950REM ENTER SYMBOL INTO TABLE
1960 T1=T1+1
1970 T$(T1-1)*N2+1,T1*N2)=T$
1980 T0$(T1,T1)=K$\REM STORE TYPE
1990 IF K$<>"C" THEN 2010
2000 T2(T1)=N3\RETURN\REM STORE VALUE
2010 T1(T1)=L1\REM STORE LEVEL OF IDENT
2020 IF K$<>"U" THEN RETURN
2030 IF NOT FY THEN RETURN\REM SP WAS ALLOCATED FOR PROC PARS
2040 T2(T1)=D0\D0=D0+1\RETURN\REM STORE OFFSET
2050REM *****
2060REM FIND IDENT A$ IN T$, STARTING FROM T1 AND UP
2070REM RETURN POINTER TO TABLE IF FOUND, ELSE RETURN 0
2080 J=(T1-1)*N2+1
2090 FOR I=T1 TO 1 STEP -1
2100 IF A$=T$(J,J*N2-1) THEN EXIT 2130
2110 J=J-N2\NEXT
2120 I=0
2130 RETURN
2140REM *****
2150REM PARSER AND CODEK
2160REM *****
2170REM CONSTANT DECLARATION
2180 Z=FNE1("IDENT",4)
2190 Z=FNE2("=",3)
2200 GOSUB 1240\GOSUB 2240
2210 K$="C"\GOSUB 1950
2220 GOTO 1240
2230REM *****
2240REM CONSTANT
2250 IF S0$="NUM" THEN RETURN
2260 IF S0$="IDENT" THEN 2290\REM CONST?
2270 Z=FNE1("STR",2)
2280 N3=ASC(C$)\RETURN\REM TAKE 1ST CHAR
2290 GOSUB 2060\IF I=0 THEN FNE(2)
2300 IF T0$(1,1)<>"C" THEN FNE(2)
2310 N3=T2(1)\RETURN
2320 GOTO 1240
2330REM *****
2340REM VARIABLE DECLARATION
2350 Z=FNE1("IDENT",4)
2360 K$="U"\GOSUB 1950\GOTO 1240
2370REM *****
2380REM SIMPLE EXPRESSION
2390 IF S0$="+" THEN 2420
2400 IF S0$<>"-" THEN 2590
2410 Y$=S0$\GOSUB 6180
2420 GOSUB 1240
2430 GOSUB 2610
2440 GOSUB 6240
2450 IF Y$="-" THEN Z=FNG(1,0,1)
2460 IF S0$="+" THEN 2500
2470 IF S0$="-" THEN 2500
2480 IF S0$="OR " THEN 2500
2490 RETURN
2500 Y$=S0$\GOSUB 6180
2510 GOSUB 1240
2520 GOSUB 2610
2530 GOSUB 6240
2540 IF Y$="-" THEN 2570
2550 IF Y$="+" THEN 2580
2560 Z=FNG(1,0,14)\GOTO 2460
2570 Z=FNG(1,0,3)\GOTO 2460
2580 Z=FNG(1,0,2)\GOTO 2460
2590 GOSUB 2610\GOTO 2460
2600REM *****
2610REM TERM
2620 GOSUB 2850
2630 IF S0$="*" THEN 2700
2640 IF S0$="/ " THEN 2700
2650 IF S0$="AND " THEN 2700
2660 IF S0$="MOD " THEN 2700
2670 IF S0$="SHL " THEN 2700
2680 IF S0$="SHR " THEN 2700
2690 RETURN
2700 Y$=S0$\GOSUB 6180\REM PUSH
2710 GOSUB 1240\GOSUB 2850
2720 GOSUB 6240
2730 IF Y$="/ " THEN 2790
2740 IF Y$="MOD " THEN 2800
2750 IF Y$="*" THEN 2810
2760 IF Y$="SHL " THEN 2820
2770 IF Y$="SHR " THEN 2830
2780 Z=FNG(1,0,15)\GOTO 2630\REM "AND"
2790 Z=FNG(1,0,5)\GOTO 2630
2800 Z=FNG(1,0,7)\GOTO 2630

```

One important part missing from our compiler is the ability to recover from errors. Of course all syntactical errors are caught by our compiler and somewhat meaningful messages are printed to indicate errors. However, if an error is found, the compiler is aborted prematurely and will not resume compiling. Such a compiler is, of course, not acceptable in practice. But with the understanding that this compiler will be used as a bootstrap compiler, as discussed in part 1, it is tolerable. A compiler with simple error recoveries would not be particularly difficult to implement but would involve a lot of programming codes and processing time. We hesitate to add things to an already big and slow program.

It is generally difficult to implement a compiler with sophisticated error recovery features. Such a compiler would not only detect errors, but would also try to repair the damages caused by such errors. The compiler has to make some assumptions about the nature of the errors and the intention of the author. This is usually difficult.

If our concern is solely that of locating all errors in a single parse of the source program, there are simple ways of doing it. Upon detecting an error, the compiler simply skips the input text until it can safely resume the compilation process. To do this the compiler looks for certain keywords or *stopping* symbols for hints to resume the parsing process. For instance, if we find an error while parsing a conditional expression, we skip the input tokens and search for symbols, such as =, >=, etc, and keywords such as then and do or perhaps begin. If we do this for all the parts of the language constructs, we will at least have a compiler that would resume compilation after an error is encountered in the hope of finding all syntactic errors in one pass, and which would give meaningful diagnostics for most errors.

To reduce the size of the program shown in listing 1, comments are kept to a minimum. Each module or subroutine is clearly identified. To facilitate easy reference, the important subroutines and variables are shown in table 1 and table 2, respectively.

Scanner and Symbol Table Management

Each time the p-compiler calls the scanner (line 1260, listing 1), the input text is scanned and a new token is produced. This is done by calling a subroutine (line 1040) that returns a character from the input string. Since the input/output (IO) routines are line oriented instead of character oriented, a line buffer (L\$) is used to

DEAR BOSS

JUST THOUGHT I'D LET YOU KNOW THAT I'M BACK FROM THE COMPUTER SHOW. THE TERMINAL WE WANT IS THE IQ120 FROM SOROC (SEE SNAPSHOT). THIS UNIT IS NOT ONLY SMART LOOKING, BUT HAS ALL THE FEATURES WE NEED IN THE BASIC PRICE. FOR EXAMPLE: THE IQ 120 INCLUDES NUMERIC KEYPADS AND PROTECT FIELDS AS STANDARD.

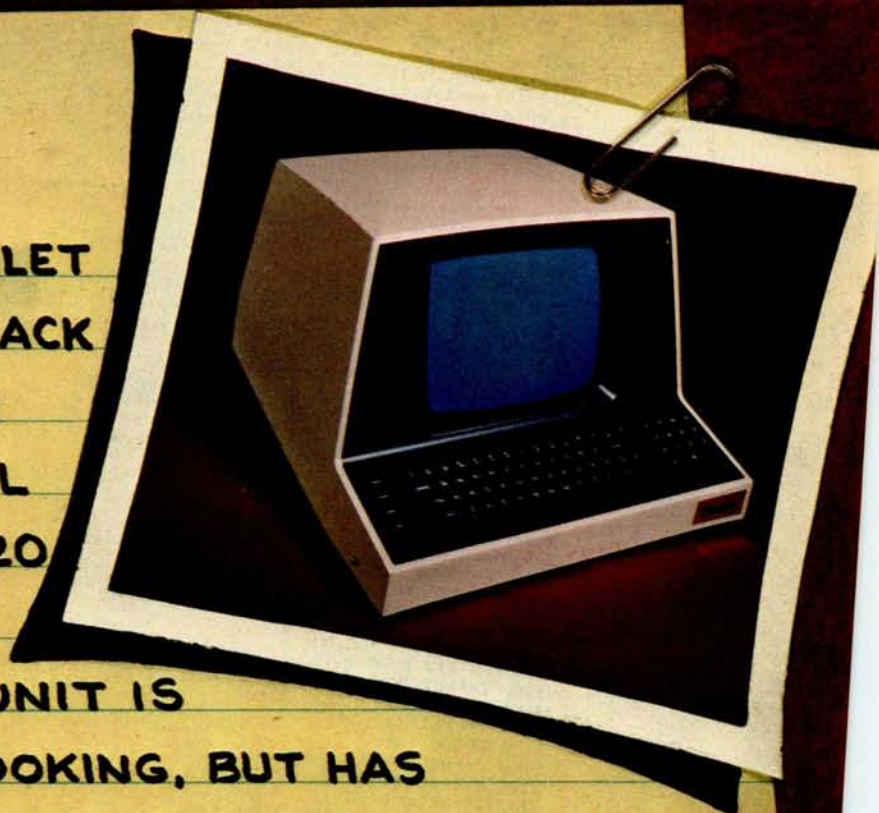
I LOOKED AT THE OTHER TERMINALS AS YOU SUGGESTED, BUT FOUND THEM TO BE EITHER "PAPER TIGERS", OR TOO "DUMB" FOR OUR CONSIDERATION.

ANYWAY, YOU ASKED ME TO DECIDE AND AT \$995* FOR THE IQ 120, IT WAS THE EASIEST ASSIGNMENT I'VE HAD.

REGARDS

Chief Buyer

* P.S. 1-4 \$995 / 5-49 \$800 / 50-99 \$750




```

2810 Z=FNG(1,0,4)\GOTO 2630
2820 Z=FNG(1,0,17)\GOTO 2630
2830 Z=FNG(1,0,18)\GOTO 2630
2840REM *****
2850REM FACTOR
2860 IF S0$="IDENT" THEN 2940
2870 IF S0$="NUM" THEN 3060
2880 IF S0$="STR" THEN 3080
2890 IF S0$="(" THEN 3100
2900 IF S0$="MEM" THEN 3140
2910 IF S0$="NOT" THEN 3260
2920 Z=FNE(23)
2930REM *** IDENTIFIER
2940 GOSUB 2060
2950 IF I=0 THEN Z=FNE(11)
2960 IF T0$(1,1)="P" THEN Z=FNE(21)\REM PROC NAME
2970 IF T0$(1,1)<>"Y" THEN 3000
2980 Z=FNG(5,0,1)\REM FUNC
2990 I=1\GOTO 4290\REM T2(1)=ADD OF FUNC
3000 IF T0$(1,1)="A" THEN 3190\REM ARRAY
3010 IF T0$(1,1)<>"C" THEN 3030
3020 Z=FNG(0,0,T2(1))\GOTO 1240\REM CONST
3030 Z=FNG(2,L1-T1(1),T2(1))\REM I0
3040 GOTO 1240
3050REM *** NUMERIC CONST
3060 Z=FNG(0,0,N3)\GOTO 1240
3070REM *** STRNG CONST
3080 Z=FNG(0,0,ASC(C#))\GOTO 1240
3090REM *** PAREN EXPR
3100 GOSUB 1240\GOSUB 3290
3110 IF S0$=")" THEN 1240
3120 Z=FNE(22)\RETURN
3130REM *** READ MEMORY
3140 Z=FNE(2("I",33)
3150 GOSUB 1240\GOSUB 3290
3160 Z=FNE(1("I",34)
3170 GOSUB 1240
3180 Z=FNG(2,255,0)\RETURN
3190 X=1\GOSUB 6120
3200 Z=FNE(2("I",33)
3210 GOSUB 1240\GOSUB 3290
3220 Z=FNE(1("I",34)
3230 GOSUB 6150\Z=FNG(18,L1-T1(X),T2(X))
3240 GOTO 1240
3250REM *** NEGATE
3260 GOSUB 1240\GOSUB 2850
3270 Z=FNG(1,0,16)\RETURN
3280REM *****
3290REM EXPRESSION
3300 GOSUB 2390\REM SIMPLE EXP
3310 IF S0$="=" THEN 3380
3320 IF S0$="<" THEN 3380
3330 IF S0$="<" THEN 3380
3340 IF S0$="<=" THEN 3380
3350 IF S0$=">" THEN 3380
3360 IF S0$=">=" THEN 3380
3370 RETURN
3380 Y$=S0$\GOSUB 6180\REM PUSH
3390 GOSUB 1240\GOSUB 2390
3400 GOSUB 6240\REM POP
3410 IF Y$="=" THEN Z=FNG(1,0,8)
3420 IF Y$="<" THEN Z=FNG(1,0,9)
3430 IF Y$="<" THEN Z=FNG(1,0,10)
3440 IF Y$=">" THEN Z=FNG(1,0,11)
3450 IF Y$=">" THEN Z=FNG(1,0,12)
3460 IF Y$="<=" THEN Z=FNG(1,0,13)
3470 RETURN
3480REM *****
3490REM STATEMENT
3500 IF S0$="IDENT" THEN 3630
3510 IF S0$="IF" THEN 4440
3520 IF S0$="FOR" THEN 5170
3530 IF S0$="WHILE" THEN 4800
3540 IF S0$="CASE" THEN 4890
3550 IF S0$="REPEAT" THEN 4730
3560 IF S0$="BEGIN" THEN 4590
3570 IF S0$="READ" THEN 4040
3580 IF S0$="WRITE" THEN 3870
3590 IF S0$="MEM" THEN 4650
3600 IF S0$="CALL" THEN 4240
3610 RETURN
3620REM *** ASSIGNMENT
3630 GOSUB 2060
3640 IF I=0 THEN Z=FNE(11)
3650 IF T0$(1,1)="A" THEN 3700\REM ARRAY
3660 IF T0$(1,1)="U" THEN 3760\REM INT VAR
3670 IF T0$(1,1)="Y" THEN 3760\REM FUNC RETURN VALUE
3680 IF T0$(1,1)="P" THEN 4290\REM PROC CALL
3690 Z=FNE(12)
3700 X=1\GOSUB 6120\REM PUSH TBL ADD
3710 X=16\GOSUB 6120\REM INDEX ADD MODE
3720 Z=FNE(2("I",33)
3730 GOSUB 1240\GOSUB 3290
3740 Z=FNE(1("I",34)
3750 GOTO 3780
3760 X=1\GOSUB 6120

```

hold a line, and a counter (C0) is used to indicate the character just read. When the end of a line is reached, the line input routine (line 1100) is called to read in a new line.

In our compiler we also provide the capability of invoking or recalling a file of Pascal text from disk. This is initiated by a command that starts with a dollar sign (\$) in the first column followed immediately by the name of the disk file to be inserted and compiled. Since North Star BASIC allows four disk files to be open at the same time, there can be four levels of file nesting. The variable F5 is used to indicate this level. If it is equal to -1, then input is taken from the keyboard. The initial input is from the keyboard. This feature is quite useful, since we can store procedures that are commonly used in a disk library, and have them recalled when needed.

Usually, the token that the scanner returns is a number that represents the token class the symbol is in. To make the program more readable, we use string variable S0\$. Possible values returned by the scanner are: ; , :=, BEGIN, IDENT, and NUM. The last two tokens, which are tokens for identifiers and numbers, require some further information. A\$ and N3 are also used to store the textual representation of the identifier and the value of the number, respectively.

The recognition of a valid token is a straightforward process and will not be detailed here. Since : and := are both valid tokens, the scanner, after seeing the : , must also look at the next character to determine the correct token. This can be done by using a one character look ahead. When the scanner is entered, a character is assumed to have been read, and upon exit from the scanner, a character beyond the current token is read.

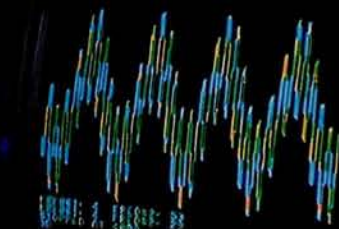
Another problem that the scanner may have is that of recognizing reserved words. The reserved words are stored in a table in sorted order. When an identifier is found, it is compared with the entries in the table, by performing a binary search. If it is not in the table, it is assumed to be a user defined identifier.

In Pascal programs, identifiers are declared at the beginning of each procedure block. The scope of an identifier covers the entire block containing it (and any of the blocks inside that block). A simple symbol management scheme that reflects such scope rules makes use of a stack. When the compiler enters a procedure block, a segment of the stack is used to store identifiers for the block. If the procedure block contains another procedure block, then another

DIGI-KIT-IZER

What it means to you.

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



\$449.



No adjustments. No calibration.

OPTIONS

- **APPLE Interface**
- **IMSAI Interface (Nov. 78)**
- **TRS-80 Interface (Dec. 78)**
- **RS 232**
- **Power Supply**
- **IC Sockets**
- **Unit Enclosure**

Dealer inquiries invited

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

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



by **talos**

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


```

3770 X=0\GOSUB 6120
3780 GOSUB 1240
3790 IF S0$=":" THEN 3810
3800 Z=FNE(13)\GOTO 3820
3810 GOSUB 1240
3820 GOSUB 3290\GOSUB 6150
3830 K=X\GOSUB 6150
3840 Z=FNG(3+K,L1-T1(X),T2(X))
3850 RETURN
3860REM *** WRITE
3870 Z=FNE2("(",31)
3880 GOSUB 1240\IF S0$<>"STR" THEN 3950
3890 L=LEN(C$)\IF L>1 THEN 3910
3900 Z=FNG(0,0,ASC(C$))\Z=FNG(8,0,1)\GOTO 3940
3910 FOR I=1 TO L
3920 Z=FNG(0,0,ASC(C$(I,1)))\NEXT
3930 Z=FNG(0,0,L)\Z=FNG(8,0,8)
3940 GOSUB 1240\GOTO 4000
3950 GOSUB 3290\K=1
3960 IF S0$="#" THEN K=3\REM DEC
3970 IF S0$="%" THEN K=5\REM HEX
3980 IF K>1 THEN GOSUB 1240
3990 Z=FNG(8,0,K)
4000 IF S0$="," THEN 3880
4010 Z=FNE1(")",22)
4020 GOTO 1240
4030REM *** READ
4040 Z=FNE2("<",31)
4050 Z=FNE2("IDENT",4)
4060 GOSUB 2060\IF I=0 THEN Z=FNE(11)
4070 X=I\GOSUB 6120
4080 IF T0$(I,1)="A" THEN 4190
4090 IF T0$(I,1)="U" THEN L=0 ELSE Z=FNE(4)
4100 GOSUB 1240\K=0
4110 IF S0$="#" THEN K=2\REM DEC
4120 IF S0$="%" THEN K=4\REM HEX
4130 Z=FNG(8,0,K)
4140 IF K>0 THEN GOSUB 1240
4150 GOSUB 6150\Z=FNG(L+3,L1-T1(X),T2(X))
4160 IF S0$="," THEN 4050
4170 Z=FNE1(")",31)
4180 GOTO 1240
4190 Z=FNE2("[",33)
4200 GOSUB 1240\GOSUB 3290
4210 Z=FNE1("]",34)
4220 L=16\GOTO 4100
4230REM *** ABSOLUTE MEM CALL
4240 Z=FNE2("<",31)
4250 GOSUB 1240\GOSUB 3290
4260 Z=FNE1(")",22)
4270 Z=FNG(4,255,0)\GOTO 1240
4280REM *** PROC OR FUNC CALL
4290 K2=0\K3=1
4300 IF T3(I)=0 THEN 4400\REM NO PARAMETER
4310 Z=FNE2("<",31)
4320 X=K2\GOSUB 6120
4330 X=K3\GOSUB 6120
4340 GOSUB 1240\GOSUB 3290
4350 GOSUB 6150\K3=X
4360 GOSUB 6150\K2=X\K2=K2+1
4370 IF S0$="," THEN 4320
4380 IF K2<>T3(K3) THEN Z=FNE(35)
4390 Z=FNE1(")",22)
4400 Z=FNG(4,L1-T1(K3),T2(K3))
4410 IF K2<>0 THEN Z=FNG(5,0,-K2)
4420 GOTO 1240
4430REM *** IF
4440 GOSUB 1240
4450 GOSUB 3290
4460 Z=FNE1("THEN ",16)
4470 GOSUB 1240
4480 X=C1\GOSUB 6120\REM FORWARD REF POINT
4490 Z=FNG(7,0,0)\REM JPC
4500 GOSUB 3490
4510 IF S0$<>"ELSE " THEN 6520
4520 GOSUB 6150\K=X
4530 X=C1\GOSUB 6120
4540 Z=FNG(6,0,0)\REM JMP
4550 X=K\GOSUB 6540\REM FIXUP FORWD REF
4560 GOSUB 1240\GOSUB 3490
4570 GOTO 6520
4580REM *** COMPOUND STMTNT
4590 GOSUB 1240
4600 GOSUB 3490
4610 IF S0$="," THEN 4590
4620 IF S0$="END " THEN 1240
4630 Z=FNE(17)\RETURN
4640REM *** WRITE MEM
4650 Z=FNE2("[",33)
4660 GOSUB 1240\GOSUB 3290
4670 IF S0$<>"I" THEN Z=FNE(34)
4680 Z=FNE2("=",13)
4690 GOSUB 1240\GOSUB 3290
4700 Z=FNG(3,255,0)
4710 RETURN
4720REM *** REPEAT ... UNTIL

```

segment of the stack on top of the existing segments is used for identifiers of this block. After successful compilation of a procedure, its segment of the stack can be discarded, since there is no further use for this part of the symbol table. In this way, we can also eliminate possible interference with identifiers in some other blocks. We also see that since the block delimiting mechanism is hierarchical, use of stack is also appropriate. Figure 2 illustrates two-level block nesting.

Readers may have noticed the similarities between this symbol table stacking scheme and the run time storage allocation scheme discussed in part 1. Since the symbol table deals with a static structure, it is much simpler.

Within the segment of the symbol table for a procedure block, further data structures can be set up for storing the identifiers. We chose to use what we feel is the simplest method: store the identifiers sequentially, in their order of appearance. This means that search also has to be done sequentially. Since most procedures have only a small number of identifiers, this should work well in most cases. Other more sophisticated structures such as a balanced binary tree or hashed table are commonly used in larger compilers.

The symbol table also contains some information about the identifiers. The identifier type has to be kept with the symbol table. Specific information is needed

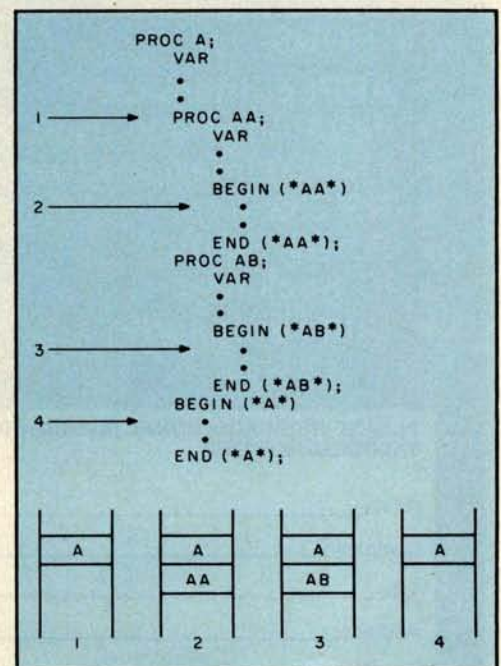


Figure 2: Example symbol table at various points of compilation.

Software for the Percom LFD-400

Disk Operating and File Management Systems

INDEX™: The most advanced Disk Operating and File Management System available for the 6800. Interrupt Driven EXecutive operating system features file-and-device-independent, queue-buffered character stream I/O. Linked-File disk architecture, with automatic file creation and allocation for ASCII and binary files, supports sequential and semi-random access disk files. Multilevel file name directory includes name, extension, version, protection, and date. Requires 8K RAM at \$A000. Diskette includes numerous utilities. \$99.95

MINIDOS-PLUSX: An easy to use DOS for the small computing system. Supports up to 31 named files. Available on ROM or diskette complete with source listing. \$39.95

Basic Interpreters and Compilers

SUPER BASIC: a 10K extended disk BASIC interpreter for the 6800. Faster than SWTP BASIC, 9-digit accuracy, program CHAINing, BASE 0 subscripting, improved error reporting, disk data files, and print column alignment. Program and data files may be prepared using one of the Text Editors described below \$49.95

BASIC BANDAID™: Turn SWTP 8K BASIC into a respectable random access data file disk BASIC. Includes many speed improvements and program CHAINing. When ordering, specify version (2.0, 2.2, or 2.3). Complete with listing. \$17.95

STRUBAL™: A STRUctured BASic Language Compiler for the serious professional programmer. Includes elements of BASIC, PL/M, and assembly language. Features 10-digit floating point, strings, scientific functions, and 2-dimensional arrays. Requires 16K RAM memory and LINKING LOADER (see below). Complete with RUN-TIME and FLOATING POINT packages \$99.95

Text Editors

EDIT68: Hemenway Associates powerful disk-based text editor. May be used to create programs and data files. In addition to SEARCH, CHANGE, DELETE, and MOVE functions, EDIT68 supports MACROS which perform complex repetitive editing functions efficiently. Runs in only 6K RAM. "Spooling" permits text files much larger than the available RAM memory to be created and edited. \$29.95

TOUCHUP™: If you already have the TSC Text Editor, TOUCHUP will convert it into a disk-based text editor. ROLL function permits text files much larger than the available RAM memory to be created and edited. TOUCHUP is supplied on diskette complete with source listing. \$17.95

ASSEMBLERS

PERCOM 6800 SYMBOLIC ASSEMBLER: Requires only 8K of RAM memory to assemble programs with 200 labels. More convenient to use than most assemblers; assembly options may be specified at time of assembly. \$29.95

Complete listing of above assembler \$29.95

MACRO-RELOCATING ASSEMBLER: This Hemenway Associates assembler is for the programming professional. Generates relocatable and linkable object code. MACRO facility permits nested macro calls. Permits conditional assembly. Requires 16K RAM \$49.95

LINKING LOADER for STRUBAL and the above assembler \$19.95

Business Applications

GENERAL LEDGER SYSTEM \$199.95

FULL-FUNCTION MAILING LIST \$ 99.95

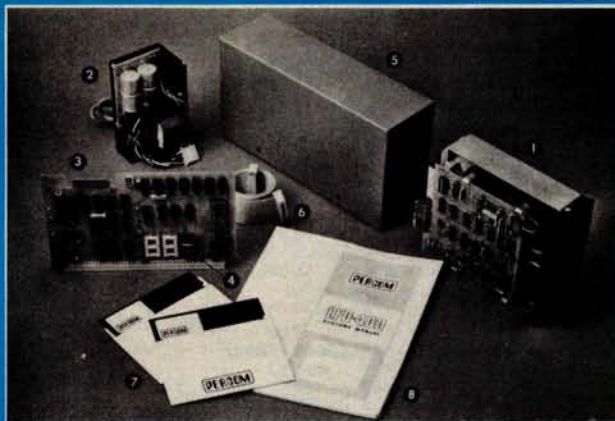
Write or call for our complete software catalog.

PERCOM DATA COMPANY, INC.

Dept BP • 318 Barnes • Garland TX 75042

(214) 272-3421

For Your SWTP 6800 Computer ...



PERCOM'S™ Assembled and Tested FLOPPY DISK SYSTEM the LFD-400

only

\$599⁹⁵

shipping paid

The LFD-400 is ready to plug in and run the moment you receive it. Nothing else to buy! Not even extra memory!

YOU GET:

- ① The popular Shugart SA 400 minifloppy™ drive. Drive alignment is double checked by PerCom before shipment.
- ② The drive power supply—fully assembled and tested.
- ③ LFD-400 Controller/Interface—plugs into the SS-50 bus • accommodates three 2708 EPROMs • fully assembled and tested.
- ④ MINIDOS™—the remarkable LFD-400 disk operating system on a 2708 EPROM • plugs into the LFD-400 Controller card • no extra memory required • no "booting" needed.
- ⑤ Attractive metal enclosure.
- ⑥ Interconnecting cable—fully assembled and tested.
- ⑦ Two diskettes—one blank, the other containing numerous software routines including patches for SWTP 8K BASIC and the TSC Editor/Assembler.
- ⑧ 70-page instruction manual—includes operating instructions, schematics, service procedures, and the complete listing of MINIDOS™.
- ⑨ Technical Memo updates—helpful hints which supplement the manual instructions.
- ⑩ 90-day limited warranty.

Minifloppy is a trademark of Shugart Associates.
MINIDOS is a trademark of PERCOM Data Company, Inc.

The LFD-400 is readily expanded to either two or three drives. Write for details. Send for our free brochure for more information about the LFD-400 Floppy Disk System and LFD-400 software.

To save you money, the LFD-400 Floppy Disk System is available only from PerCom. Because of the special pricing, group and dealer discounts are not available.

MC and VISA welcome. COD orders require 30% deposit plus 5% handling charge. Allow three extra weeks if payment is by personal check. The LFD-400 Floppy Disk System is available immediately. Allow three weeks for testing and transportation. Texas residents add 5% sales tax.

PERCOM™

PERCOM DATA COMPANY, INC.

Dept B 318 BARNES • GARLAND, TX. 75042

(214) 272-3421

PERCOM™ 'peripherals for personal computing'


```

4730 X=C1\GOSUB 6120
4740 GOSUB 1240\GOSUB 3490
4750 IF S0$=";" THEN 4740
4760 Z=FNE1("UNTIL",10)
4770 GOSUB 1240\GOSUB 3290
4780 GOSUB 6150\Z=FNG(7,0,X)\RETURN
4790REM *** WHILE ... DO
4800 GOSUB 1240\X=C1\GOSUB 6120
4810 GOSUB 3290\X=C1\GOSUB 6120
4820 Z=FNG(7,0,0)
4830 Z=FNE1("DO",18)
4840 GOSUB 1240\GOSUB 3490
4850 GOSUB 6150\K=X\GOSUB 6150
4860 Z=FNG(6,0,X)
4870 X=K\GOTO 6540
4880REM *** CASE ... OF
4890 GOSUB 1240\GOSUB 3290
4900 Z=FNE1("OF",25)
4910 I2=1\REM # OF CASE STATEMENTS
4920 I1=0\REM # OF CASE LABELS
4930 GOSUB 1240\GOSUB 2240
4940 Z=FNG(1,0,21)\Z=FNG(0,0,N3)\Z=FNG(1,0,8)
4950 GOSUB 1240\IF S0$=":" THEN 4990
4960 Z=FNE1(":",5)
4970 X=C1\GOSUB 6120\Z=FNG(7,1,0)\REM A MATCH FOUND?
4980 I1=I1+1\GOTO 4930
4990 K=C1\Z=FNG(7,0,0)\REM GOTO NEXT CASE STMT IF NO MATCH
5000 FOR I=1 TO I1\GOSUB 6520\NEXT\REM FIXUP FORWD REFS
5010 X=K\GOSUB 6120
5020 GOSUB 1240\X=I2\GOSUB 6120
5030 GOSUB 3490\GOSUB 6150\I2=X
5040 IF S0$="ELSE" THEN 5090
5050 IF S0$("<"); THEN 5130
5060 K=C1\Z=FNG(6,0,0)\REM EXIT AFTER A CASE STMT
5070 GOSUB 6520
5080 X=K\GOSUB 6120\I2=I2+1\GOTO 4920
5090 K=C1\Z=FNG(6,0,0)\GOSUB 6520
5100 X=K\GOSUB 6120
5110 GOSUB 1240\X=I2\GOSUB 6120
5120 GOSUB 3490\GOSUB 6150\I2=X
5130 Z=FNE1("END",17)
5140 FOR I=1 TO I2\GOSUB 6520\NEXT\REM FIXUP FORWD REFS
5150 Z=FNG(5,0,-1)\GOTO 1240\REM POP VAL OF CASE EXP
5160REM *** FOR
5170 Z=FNE2("IDENT",4)
5180 GOSUB 3630\GOSUB 6120
5190 F9=1\IF S0$="TO" THEN 5210\REM REMEMBER UP OR DOWN
5200 Z=FNE1("DOWN",28)\F9=0
5210 GOSUB 1240\GOSUB 3290
5220 GOSUB 6150\K=X\X=C1\GOSUB 6120
5230 Z=FNG(1,0,21)\Z=FNG(2,L1-T1(K),T2(K))
5240 Z=FNG(1,0,13-F9-F9)\X=C1\GOSUB 6120\Z=FNG(7,0,0)
5250 X=F9\GOSUB 6120\X=K\GOSUB 6120
5260 Z=FNE1("DO",18)\GOSUB 1240
5270 GOSUB 3490\GOSUB 6150\Z=FNG(2,L1-T1(X),T2(X))
5280 K=X\GOSUB 6150\Z=FNG(1,0,20-X)
5290 Z=FNG(3,L1-T1(K),T2(K))
5300 GOSUB 6150\K=X\GOSUB 6150\Z=FNG(6,0,X)
5310 X=K\GOSUB 6540
5320 Z=FNG(5,0,-1)\RETURN\REM POP OFF VAL OF LOOP CNTRL VAR
5330REM *****
5340REM BLOCK
5350 D0=3\REM RESERVED FOR STATIC LINK,DYNAMIC LINK & RETN ADD
5360 T2(T1-K1)=C1\REM INIT ADD OF THE PROC BLOCK
5370 Z=FNG(6,0,0)\REM JMP TO STARTING BLK ADD
5380 X=T1-K1\GOSUB 6120
5390 IF S0$="CONST" THEN 5460
5400 IF S0$="VAR" THEN 5550
5410 IF S0$="PROC" THEN 5730
5420 IF S0$="FUNC" THEN 5770
5430 IF S0$="BEGIN" THEN 5980
5440 Z=FNE(25)
5450REM *** CONST DCL
5460 GOSUB 1240
5470 GOSUB 2170
5480 Z=FNE1(":",5)\GOSUB 1240
5490 IF S0$="VAR" THEN 5550
5500 IF S0$="PROC" THEN 5730
5510 IF S0$="FUNC" THEN 5770
5520 IF S0$="BEGIN" THEN 5980
5530 GOTO 5470
5540REM *** VARIABLE DCL
5550 L=0\F9=1
5560 GOSUB 1240\GOSUB 2340
5570 L=L+1\IF S0$=":" THEN 5560
5580 Z=FNE1(":",5)
5590 GOSUB 1240\IF S0$="ARRAY" THEN 5610
5600 Z=FNE1("INTEG",36)\GOTO 5670
5610 Z=FNE2("I",33)\GOSUB 1240\GOSUB 2240
5620 Z=FNE2("J",34)\Z=FNE2("OF",26)\Z=FNE2("INTEG",36)
5630 D0=D0-L
5640 FOR I=T1-L+1 TO T1
5650 T0(I,I)="A" T3(I)=N3+1
5660 T2(I)=D0\D0=D0+N3+1\NEXT

```

for each type of identifier. For constants, the information is the values of the constants; for program variables, the information is the address pair (level, offset from base address); for procedures and functions, it is the address pairs and the number of parameters; and, lastly, for array variables, the information is the address pair as well as array sizes. See table 2 for actual variables that are used to store these quantities.

The symbol table is used by both the parser and the semantic analyzer. The information in the symbol table is used in a number of ways. The type of identifier is used, for instance, to check the type consistency in an expression. When a variable is referenced or a procedure or function called, the symbol table is searched to obtain the level and relative address from the base address. The number of parameters in a procedure or function is used to check the correct matching of parameters in actual procedure or function calls.

An identifier is searched for by starting from the end of the symbol table and working towards the beginning. (Viewing the table as a stack, we say that we search from the *top* of the stack down to the *bottom*.) There are two reasons for this searching direction. First, identifiers in the current block are more likely to be referenced and should be searched first. Secondly, suppose that a variable X is declared in both an outer and an inner block: by searching for X from top to bottom of the stack, we can be sure that we will find X of the inner block first, in accordance with the scope rule.

Parser, Semantic Analyzer, and Coder

The parser, the semantic analyzer and the coder are not separate routines, but are intermixed in a large routine. In most cases, after the successful parsing of a statement, its meaning is also understood by the compiler. Thus the semantic analyzer either requires minimal extra processing or is implicit in the parser and disappears altogether.

The parser, as we have mentioned before, uses a top-down technique called recursive descent. Since there is a close correspondence between the parser and the syntax diagrams of the Pascal grammar, there should be no difficulties in understanding the parsing process. The parser adopts the convention of one token look ahead which is similar to the one character look ahead convention used by the scanner. The variable S0\$ is used to hold the next token to be read by the parser.

There is a part of the Pascal grammar, commonly referred to as the dangling

Small in size, big in performance. . .and priced at only \$1085*

HI PLOT is a digital plotter designed for the personal computer market. Inexpensive to own and simple to operate, it still incorporates the same quality components, technology and skillful workmanship found in Houston Instrument's larger plotters used throughout industry.

Not a kit, the HI PLOT is assembled and ready to use, with both a RS-232C and a parallel interface built in for creating graphic output from your system.

- Converts data to easy to read graphical format
- Both serial and parallel inputs built-in
- Uses standard 8½ x 11" paper
- Plotting speed up to 2.4 ips
- Resolution of both 0.01 and 0.005 inch
- Baud rate and step size easily changed

HI PLOT™

The Perfect Digital Plotter for the Personal Computing Enthusiast



*U.S. Domestic Price only

**houston
instrument**

ONE HOUSTON SQUARE
(512) 837-2820

EUROPEAN HEADQUARTERS

DIVISION OF
BAUSCH & LOMB

AUSTIN, TEXAS 78753
TWX 910-874-2022

Rothematten 5 8240 Grenz, Belgium
Phone 080/277445 Telex Bausch 81390

"the recorder company"

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


```

5670 Z=FNE2(" ",5)
5680 GOSUB 1240\IF S0$="PROC " THEN 5730
5690 IF S0$="FUNC " THEN 5770
5700 IF S0$="BEGIN" THEN 5980
5710 L=0\F9=1\GOSUB 2340\GOTO 5570
5720REM *** PROC DCL
5730 Z=FNE2("IDENT",4)
5740 K1=0\K$="P"\GOSUB 1950
5750 L1=L1+1\GOTO 5810
5760REM *** FUNC DCL
5770 Z=FNE2("IDENT",4)
5780 K$="F"\GOSUB 1950\REM FUNC ADDRESS
5790 L1=L1+1\K1=1
5800 K$="Y"\GOSUB 1950\REM FUNC VALUE
5810 K2=K1\GOSUB 1240
5820 X=T1\GOSUB 6120
5830 X=D0\GOSUB 6120
5840 IF S0$<>" " THEN 5890
5850 GOSUB 1240\F9=0\GOSUB 2340\K1=K1+1
5860 IF S0$=" " THEN 5850
5870 Z=FNE1(" ",22)
5880 GOSUB 1240\T3(T1-K1)=K1-K2
5890 Z=FNE1(" ",5)
5900 FOR I=1 TO K1\REM FUNC VALUE & PARS HAVE - OFFSET
5910 T2(T1-I+1)=-I\NEXT
5920 GOSUB 1240\GOSUB 5340\L1=L1-1
5930 GOSUB 6150\D0=X
5940 GOSUB 6150\T1=X
5950 Z=FNE1(" ",5)
5960 GOSUB 1240\GOTO 5410
5970REM *** START OF EXECUTIBLE STMTS
5980 GOSUB 1240\GOSUB 6150\K=X
5990 X=T2(K)\GOSUB 6540
6000 T2(K)=C1\REM START BLOCK ADDR
6010 Z=FNG(5,0,D0)
6020 GOSUB 3490
6030 IF S0$<>" " THEN 6050
6040 GOSUB 1240\GOTO 6020
6050 IF S0$<>"END " THEN Z=FNE(17)
6060 GOSUB 1240
6070 Z=FNG(1,0,0)
6080 RETURN
6090REM *****
6100REM END PARSER AND CODER
6110REM *****
6120REM PUSH X INTO STACK
6130 S(S9)=X\S9=S9+1\RETURN
6140REM *****
6150REM POP X FROM STACK
6160 S9=S9-1\X=S(S9)\RETURN
6170REM *****
6180REM PUSH Y$ INTO STACK
6190 L=LEN(Y$)
6200 S(P8,P8+L-1)=Y$
6210 X=P8\GOSUB 6120\REM PUSH START & END STRNG POS
6220 X=P8+L-1\GOSUB 6120
6230 P8=P8+L\RETURN
6240REM POP Y$ FROM STACK
6250 GOSUB 6150
6260 L=X\GOSUB 6150
6270 Y$=S(X,L)
6280 P8=P8-L+X-1
6290 RETURN
6300REM *****
6310REM GENERATE CODES
6320 DEF FNG(X1,X2,X3)
6330 B$=" "
6340 FILL P9,X1\FILL P9+1,X2
6350 FILL P9+2,FNA(X3)\FILL P9+3,FNB(X3)
6360 IF Y9 THEN 6400\REM IF INPUT FROM KEYBOARD THEN DONT ECHO
6370 IF X1<16 THEN 6390
6380 B$(1,1)="X"\X1=X1-16\REM INDEX
6390 I%41,C1," ",M$(X1*3+1,X1*3+3),B$,X2,X3
6400 C1=C1+1\X1=X1+1
6410 IF P9>09 THEN Z=FNE(1)
6420 RETURN 0
6430 FEND
6440REM *****
6450 DEF FNB(Z)
6460 N=INT(Z/256)
6470 IF N<0 THEN N=256+N
6480 RETURN N
6490 FEND
6500 DEF FNA(Z)=Z-INT(Z/256)*256
6510REM *****
6520REM FIXUP FORWARD REF
6530 GOSUB 6150
6540 N=P7+X*4
6550 FILL N+2,FNA(C1)\FILL N+3,FNB(C1)
6560 IF Y9 THEN RETURN
6570 !"ADD AT",X," CHANGED TO",C1
6580 RETURN
READY

```

else, that is ambiguous. The statement:

if cond1 then if cond2 then stat1 else stat2;

can be parsed in two ways. The else statement can be associated with the first if or with the second if, producing entirely different results.

We resolve this difficulty by always associating the else statement with the most recent if. If an else statement with the first if is desired, one of these two methods should be used:

```

if cond1 then
  if cond2 then stat1 else
  else stat2;

```

or:

```

if cond1 then begin
  if cond2 then stat1
  end
else stat2;

```

The situation is similar to the case statement with the added feature of an optional else statement. If the statement for the last case label is an if statement, we then have the dangling else problem. This is resolved in the same manner.

There are three functions used to print messages when errors are detected. The function FNE(X) prints the error message corresponding to error code X. FNE1(A\$,X) checks to see if the current token is equal to A\$, and prints the error message corresponding to error code X if not. FNE2 is similar to FNE1 except that the scanner is first called to get a new token. As we mentioned earlier, the compiler aborts as soon as an error is found. Therefore these error routines do not return to the calling procedure.

The code generator requires more work: care must be taken to store important values in stacks due to the inability of BASIC to fully support recursive subroutine calls. Otherwise the coder is more or less straightforward, since the p-codes are so designed (see part 1) that there is a direct correspondence between simple Pascal statements and p-codes. Table 3 shows the almost direct translation of Pascal statements into p-codes.

The declarative statements (const, var, proc, and func) do not produce any executable statements; they merely provide information about declared identifiers. The first executable code encountered when entering a procedure or function block is a forward jump instruction to the main body of the block. This jump is necessary since in general there may be procedures and func-

MicroPro International Corporation™

an affiliate of Prodata International Corporation established 1968
professional quality you can count on!
proudly announces

SUPER-SORT®

The ultimate in high performance
sort/merge

Specifications

- ☐ High Performance Tournament/Heapsort Algorithm
- ☐ Multiple Input Files Read in Parallel for True Merge Operation.
- ☐ Dynamically Invokable User Exit Routines
- ☐ Record Selection via SELECT/EXCLUDE Statements
- ☐ Handles Fixed and Variable Length Records
- ☐ Handles Fixed and Variable Length Fields
- ☐ Handles up to 16 Sort Keys with Intermixed Sequence Indicators and Data Types
- ☐ Handles Alternate Collating Sequences
- ☐ Compatible with CP/M* and any Derivative Including ADOS, IMDOS, CDOS, etc.
- ☐ 8080/8085/Z-80 Compatible
- ☐ Specialized Optimizations for Floppy Disk Environment
- ☐ Keyword Command Input For Easy Operator Entry
- ☐ Benchmarked at Over 560 Records per Minute!
- ☐ Invokable as a Subroutine from FORTRAN, COBOL and Assembler
- ☐ Furnished in Relocatable and Executable Form for Easy Load-Address Definition
- ☐ Optional TAGSORT Operation
- ☐ Data Types Include ASCII, EBCDIC, Binary, BCD (COBOL packed Decimal), etc.
- ☐ Supports CP/M-compatible Diskette Files under BASIC, FORTRAN, COBOL and Assembler.

Price \$250** includes manual and single density diskette. Manual only \$9.00 refundable with purchase.

WORD-MASTER®

The last word in text editing

Specifications

- ☐ Compatible with any "dumb" CRT possessing addressable cursor and backspace (includes Hazeltine - all models, SOROC, Lear Siegler, IMSAI-VIOC, ADDS Regent, etc.)
- ☐ Bi-directional word tab, line tab, screen tab
- ☐ Bi-directional word delete, line delete and character delete
- ☐ Quad-directional cursor movements
- ☐ Mid-line insert and delete
- ☐ Automatic RAM/Diskette buffering with no user intervention
- ☐ Nested command looping with conditional execution
- ☐ Global String search, Global String Replace
- ☐ Queue Buffer for text movement, global replication, and string command storage
- ☐ Multiple input file merging with user-controlled insertions
- ☐ Multiple output file control by section under user control

Price \$150** includes manual and single density diskette. Manual only \$9.00 refundable with purchase.

* CP/M is a trademark of Digital Research

** Prices and Specifications subject to change without notice.

©1978, MicroPro International Corporation. All rights reserved.

Dealer Inquiries Invited: Call (Northern California) (707) 544-2865, (415) 398-7062, (209) 445-0511, (408) 279-8980, (916) 485-7619 (Southern California) (213) 224-1619, (714) 634-2908. Outside California Call Collect (707) 544-2865. Principal offices located at 5810 Commerce Blvd., Rohnert Park, CA 94928

Circle 224 on inquiry card.


```

P-CODES START AT 0000
WANT CODE PRINTFD?N
0 ?$LST2.2
0 CONST CR=13;LF=10;
1 VAR A,B,C,D:INTEGER;
1 FUNC MAX4(X1,X2,X3,X4); {LARGEST OF 4 NUMBERS}
1   FUNC MAX2(X1,X2); {LARGEST OF 2 NUMBERS}
2     BEGIN
3       IF X1>X2 THEN MAX2:=X1
9       ELSE MAX2:=X2
12      END;
14     BEGIN
14       MAX4:=MAX2(MAX2(X1,X2),MAX2(X3,X4))
28     END;
30 BEGIN
30 REPEAT
31   READ (A#,B#,C#,D#);
39   WRITE ('THE LARGEST IS',MAX4(A,B,C,D)#,CR,LF)
67   UNTIL A<0
69 END.
INTERPPT(I), OR TRANSLATE(T)?N
RDADY
LOAD DECODF
RDADY
RUN
0 JMP 0 3D JMP 0 14 JMP 0 3 INT 0 3
4 LOD 0 -2 LOD 0 -1 OPR 0 > JPC 0 11
8 LOD 0 -2 STO 0 -3 JMP 0 13 LOD 0 -1
12 STO 0 -3 OPR 0 RET INT 0 3 INT 0 1
16 INT 0 1 LOD 0 -4 LOD 0 -3 CAL 0 3
20 INT 0 -2 INT 0 1 LOD 0 -2 LOD 0 -1
24 CAL 0 3 INT 0 -2 CAL 0 3 INT 0 -2
28 STO 0 -5 OPR 0 RET INT 0 7 CSP 0 INNUM
32 STO 0 3 CSP 0 INNUM STO 0 4 CSP 0 INNUM
36 STO 0 5 CSP 0 INNUM STO 0 6 LIT 0 84
40 LIT 0 72 LIT 0 69 LIT 0 32 LIT 0 76
44 LIT 0 65 LIT 0 82 LIT 0 71 LIT 0 69
48 LIT 0 83 LIT 0 84 LIT 0 32 LIT 0 73
52 LIT 0 83 LIT 0 14 CSP 0 OUTST INT 0 1
56 LOD 0 3 LOD 0 4 LOD 0 5 LOD 0 6
60 CAL 0 14 INT 0 -4 CSP 0 OUTNM LIT 0 13
64 CSP 0 OUTCH LIT 0 10 CSP 0 OUTCH LOD 0 3
68 LIT 0 0 OPR 0 < JPC 0 31 OPR 0 RET

```

Variable Name	Remark
AS	String of the token returned by the scanner
C0	Input buffer pointer
C1	P-code address pointer
D0	Run time storage counter
E9	Error code
F5	Active input file unit number; keyboard=-1
K1	Number of parameter in the previous block
L0	Length of the input line
L1	Static level of procedure
LS	Input line buffer
MS	P-code mnemonics
N0	Reserved word table size
N1	Largest integer
N2	Length of identifier name
N3	Numeric value of token (token = "NUM") or ASCII value of string (token = "STR")
P8	Stack pointer for S\$
P9	P-code absolute memory address counter
S	Stack for numeric values
S9	Stack pointer for S
S\$	Stack for strings
S0\$	Next token
T0	Symbol table size
T1	Symbol table pointer
T\$	Symbol table: identifier
T0\$	Symbol table: type of identifier V: variable A: array C: constant P: procedure F: function Y: parameter
T1()	Symbol table: level
T2()	Symbol table: value (constant) or displacement (variable) or address (proc or func)
T3()	Symbol table: array size (array) or number of parameter (proc or func)
X	Value to be pushed or popped
X\$	Next character to be read by the scanner
Y\$	String to be pushed or popped
W0\$	Table for reserved words

Table 2: Important variables used in the p-compiler.

Listing 2: Sample Pascal program with compiled p-code. The number at the beginning of each source line is the offset of the corresponding p-code from the base address.

To further improve service to our customers we have installed a toll-free WATS line in our Peterborough, New Hampshire office.

If you would like to order a subscription to BYTE, or if you have a question related to a BYTE subscription, you are invited to call*

BYTE's New Toll-free Subscriber W.A.T.S. Line

(800) 258-5485

We thank you and look forward to serving you.

(800)258-5485 between 8:00 AM and 4:30 PM Eastern Time. (Friday 8 AM - Noon).
*Calls from continental U.S. only.

9178

tions whose codes take up space. The second executable code of the block increments the stack pointer (INT). This allocates space for the triplet (static link, dynamic link and return address) plus any variables declared. The number of spaces for the variables is already known from the declaration portion of the procedure block. The variable D0 is used to keep track of the space to be allocated at the activation of the block.

Note that no space is allocated for constants. If a constant is referenced, a load literal (LIT) instruction is generated instead of a load (LOD) instruction. Also note that the procedure or function parameters and the function return value do not reserve any space in the procedure or function block called. Space is reserved before the call is made. Therefore, these values have negative displacement from the base address of the called procedure or function.

When a call is made to a function, the space for function return value is allocated by incrementing the stack pointer (line 2980 in listing 1) (this step is skipped for a procedure call). The parameter expression is then evaluated (line 4250), putting the resultant value on the stack. Thus, space is allocated for each parameter and initialized with the value of the parameter expression. Upon return from a procedure, the stack pointer is decremented by an amount equal to the space allocated

Powerful Software

with Extended Documentation offered by



**PRS—
THE PROGRAM OF THE MONTH CORPORATION
UNVEILS COMPREHENSIVE CONCEPT
IN SOFTWARE PRESENTATION**

UNIQUE DOCUMENTATION

Unique documentation gives you clear, complete and instructive text in a graphically appealing manual. This documentation doesn't only provide step by step "how to" but also is geared to help you to understand hardware-software interactions, and to promote further applications.

POWERFUL CODE

Whether it be for games, applications (home and business), or sophisticated programming tools and monitors, PRS permeates the design of its unique code with "human engineering." And you'll appreciate the delicate balance between machine-human dialogue and resident program-space in memory.

BEAUTIFUL CASSETTE-FOLDER

PRS packages your manual and cassette in an elegant and durable gold-stamped folder.

AN ARRAY OF PROGRAMS ARE AT YOUR FINGERTIPS

PRS presently offers two S-100 compatible program packages: "MICROFILE," a DATA FILE MANAGEMENT

program, and "DDS II," the famous DYNAMIC DEBUGGING SYSTEM. Also, an Extensive Function Plotter (A2FP) is available for the Apple II. New programs will be released at regular intervals.

YOU'LL DISCOVER EXTENSIVE PROGRAM CAPABILITIES

With "MICROFILE," a new DATA FILE MANAGEMENT program, you can:

- Manage any list of items
- Edit information already on file
- Sort items alphanumerically upwards or downwards
- Search by primary and/or secondary keys (labels)
- List and print selected or all items
- Total sums of columns
- Justify right or left margins of each column
- Save and retrieve data with mass storage media

PROGRAM APPLICATION EXPANDS YOUR COMPUTER USAGE

For example, "MICROFILE" manages: Home inventory • Listing of musical tapes • Calendar of activities • Vacation itineraries • Checks by categories • Home-upkeep tickler files • Family historical dates • Health records.

PRS SUPPORTS YOUR MAJOR BRANDS

APPLE, PET, SOL, SORCERER, TRS-80, and other systems with Z-80, 8080 and 6502 processors.

VISIT YOUR NEAREST DEALER TODAY

Let him demonstrate the excellence of PRS programs.



Or write for the name of a dealer in your area to:

PRS—THE PROGRAM OF THE MONTH CORPORATION
257 Central Park West, New York, N.Y. 10024

New Product Releases From

PRS THE PROGRAM OF THE MONTH CORPORATION

257 CENTRAL PARK WEST
NEW YORK, N.Y. 10024

Gentlemen:

☐ Please place my name on your priority mailing list to receive your descriptive advance releases off all new programs developed by -PRS- at regular intervals.

☐ Please send me a list of dealers in my area.

Name _____

Corporation _____

Address _____

City _____ State _____ Zip _____

REFERENCE: 9B8

KEYBOARD: fully professional. Full 128 ASCII upper & lower case characters with 79 keys including a 16 key numeric pad.

GRAPHICS: 64 pre-defined graphic chars. and 64 user defined chars. alternately all 128 graphic chars. may be user defined. Resolution 240 x 512 points, cursor control, and 64 chars. by 30 lines.

MEMORY: 4K byte power-on monitor, 8k byte user RAM, and 8k byte PROM external cartridge with Microsoft BASIC standard. Cartridges allow you to change operating systems & languages



PS-80

without any modification to the standard hardware by simply inserting a PROM cartridge in a side slot.

I/O: serial RS232 300/1200 baud port. 8 bit parallel port, dual cassette recorder port at 300/1200 baud.

EXPANSION: up to 32 k RAM on board. I/O to S-100 8 slot extension box for additional memory and any other S-100 peripheral boards.

PRICE: \$895.00 (does not include CRT or cassette.) Order by C.O.D.

**EDUCATIONAL AND CLUB DISCOUNTS AVAILABLE
PERSONAL CONSULTANT AND DEALER INQUIRIES INVITED**

For complete information write to: **PERSONAL SYSTEMS CONSULTING** P.O. Box 20286 El Cajon, California 92021

Ad Design, Joanne De Vore, Kwik Kopy Printing #215

(714) 443-5353

Pascal source	p-codes
$x+10*y[5]$	LOD X LIT 10 LIT 5 LODX Y OPR * OPR +
$a:=exp;$	(exp) STO A
if exp then stm1 else stm2;	(exp) JPC 0,1b1 JMP 1b2 (stm2)
for i:=exp1 to exp2 do stm;	1b1 1b2 ... (exp1) STO I (exp2) 1b1 OPR CPY LOD I OPR >= JPC 0,1b2 (stm) LOD I OPR INC STO I JMP 1b1 INT -1
while exp do stm;	1b2 1b1 (exp) JPC 0,1b2 (stm) JMP 1b1
case exp of c1b1,c1b2:stm1; c1b3 :stm2; else :stm3 end;	1b2 ... (exp) OPR CPY LIT c1b1 OPR = JPC 1,1b1 OPR CPY LIT c1b2 OPR = JPC 0,1b2 (stm1) 1b1 JMP 1b4 1b2 OPR CPY LIT c1b3 OPR = JPC 0,1b3 (stm2) JMP 1b4 1b3 (stm3) JMP 1b4 INT -1
repeat stm until exp;	1b4 1b1 (stm) (exp) JPC 0,1b1 INT 1
$i:=funca(exp1,exp2);$	(exp1) (exp2) CAL funca INT -2

for the parameters, getting back to the state before the procedure call. Upon returning from a function call, the stack pointer is also decremented by the same amount, but since a space has been allocated before the function call, the function return value is now on top of the stack, ready for further processing. This simple scheme works very efficiently and should lower the overhead usually associated with procedure or subroutine calls.

Listing 2 gives an output from the compiler for a Pascal program that prints out the maximum of four numbers. There are of course better ways of writing the program, but it does illustrate some ideas of the compiler discussed so far.

There is no optimization of the p-codes produced. Limited optimization can be done on the local level, and some optimization is actually done in the p-code to machine code translator. The problem of producing efficient codes is a difficult one, and is not addressed properly in our project. Given the simplicity of the p-machine and p-code, the p-compiler is efficient. But whether the combination of p-compiler and translator produces efficient 8080 code is uncertain.

This completes our discussion of the p-compiler. In part 3 (see November 1978 BYTE), we give a detailed discussion of a translator for converting the p-code into executable 8080 machine code. ■

REFERENCES

1. Wirth, N, "The Programming Language Pascal," *Acta Informatica*, 1, pages 35 thru 63, 1971.
2. Jensen, K, and Wirth, N, *Pascal: User Manual and Report* (second edition) Springer Verlag, New York, 1974.
3. Wirth, N, *Algorithms + Data Structures = Programs*, Chapter 5, "Language Structures and Compilers," Prentice-Hall, Englewood Cliffs NJ, 1976.

Table 3: Code generation for various Pascal constructs. For readability, the p-codes are given in assembly form. The italic identifiers in the Pascal statements are nonterminals that can be substituted by any valid expansion. The codes for these quantities are represented by parenthesized identifiers.

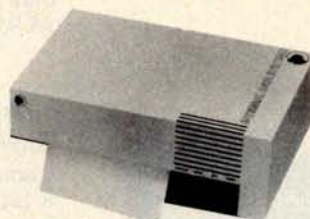
Integral Data Systems Printer

low cost, professional performance

Meet the IP-125. Ideal where you need a space-saving hard copy printer for your office. Micro-processor controlled, uses 8½" roll or fan-fold paper. Instantaneous print rate to 100 cps; sustained speed of 50 cps. Just 24 lbs.

- upper, lower case • 7 x 7 dot matrix
- RS232 serial interface • 256 char. multiple line buffer • tractor feed option \$150

\$749
reg. \$799



Hazeltine 1500

value packed—every feature is standard!

The high-quality basic terminal with extra standard features you can't find on most CRTs. Plus the features you expect, like 24 x 80 character display, auxiliary serial port, 10-key numeric pad. At this low price, you can order two.

- Standard & reverse video • Cursor addressing & sensing
- Upper, lower case • 7 x 10 dot matrix

\$1095
assld.
(reg. \$1225)



\$1895
reg. \$2495

LA 180 DECprinter with Serial Interface

immediate delivery on the field-proven performer

180 cps has never been so affordable. For a limited time, MicroWorld lowers the price of Digital's versatile medium speed printer. Reliable technology and an extensive array of human engineering features make the LA 180 the smart choice for local or remote business applications.

- 180 cps, 7 x 9 dot matrix
- tractor feed with switchable forms length control
- upper/lower case & compressed print, stand



\$1705
reg. \$1895

Texas Instruments Impact Printer

don't wait 240 days from TI — call MicroWorld for immediate delivery.

TI's new 810 multi-copy impact printer. Prints up to 440 lines per minute because of its unique look-ahead bi-directional feature, controlled by an on-board microprocessor.

- 150 cps, 110 to 9600 baud switchable
- includes tractor feed
- RS232 serial interface

MICROWORLD™

1425 W. 12th Pl. • Tempe, AZ 85281
Toll-free order line

1-800-528-1418

MicroWorld (formerly Byte Shop Mail Order) is a division of The Phoenix Group, Inc. Call or write for all your computer needs.

all prices plus shpg. & hdlg.

New Micro Shopper Guide Vol. IV \$5.00 (Includes \$1.05 postage)

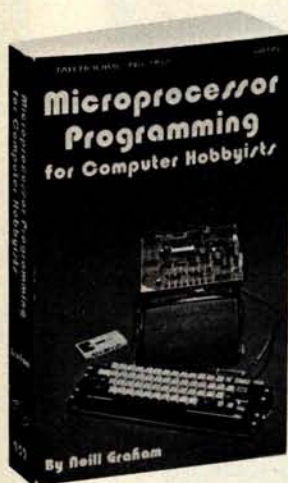
Cable MICROAGE

See us at the West Coast Computer Faire (Los Angeles), Biz Comp (Atlanta), Midwest Personal Computing Show (Chicago)

Circle 226 on inquiry card.

Book Reviews

**Microprocessor Programming
for Computer Hobbyists**
by Neil Graham
Tab Books (number 952)
Blue Ridge Summit PA 17214
\$8.95



Microprocessor Programming for Computer Hobbyists is an intermediate programming text intended for users of any 8 bit word computer. The focus is on systems programming and data structures rather than on applications programming. In order to make the discussion machine independent, all the examples are presented in a high level systems programming language which is a superset of PL/M.

There are six parts to the book. The first introduces numbers systems and the second introduces the high level language which is used throughout the rest of the book. The third discusses techniques for programming various types of arithmetic such as multiple precision, floating point, etc. The fourth section introduces data structures and treats programming techniques for arrays, stacks, strings, chains, trees and graphs. The fifth part discusses techniques for searching with various structures; and the last part discusses sorting algorithms.

The book provides a good introduction and a reference to a number of programming techniques which are not dealt with in introductory programming texts. Most subjects discussed in *Microprocessor Programming for Computer Hobbyists* do not appear in the average BASIC or assembler text. Because the examples are given in a concise, high level language, they are easy to follow no matter what computer you have.

There are also several shortcomings to the book. First, I indicated that the examples are written in a superset of PL/M. I would have preferred the use of standard PL/M, since I have access to a PL/M cross compiler. Those who do not know PL/M will probably not suffer from this confusion. For the benefit of such readers, the book promises to show you how to translate between its high level language and your machine code, but this is hardly mentioned at all outside of the introduction.

All in all, this is a very good reference book. My only real quibble is that it uses a nonstandard high level language, and does not deliver all that it promises in the way of transferring this to a hobbyist computer.

John A Lehman
716 Hutchins #2
Ann Arbor MI 48103

1 will get you 7

NOW, A TOTAL BUSINESS SOFTWARE PACKAGE OF SEVEN PROGRAMS ON ONE FLOPPY DISC MAKES IT A SNAP.

Our TBS software package has been in use for over a year now without a single failure thereby earning the privilege of joining our national product line. Written in a practical manner for the businessman who needs a total accounting system rather than bits and pieces. The Total Business System differs from other business soft-

ware offerings in that it is a Complete package, fully interactive, with automatic updating for all files. Available on floppy disk under Microsoft Disk Basic on CP/M the package requires a minimum of 24K of free memory with 256K of disk memory. We've taken the hard work out of business software for micro computers!

INCLUDES

Payables	Payroll	Fixed Assets	Financial Reports
Receivables	Inventory	Check Register	Etc.

Requires licensing agreement—Dealer discounts available.



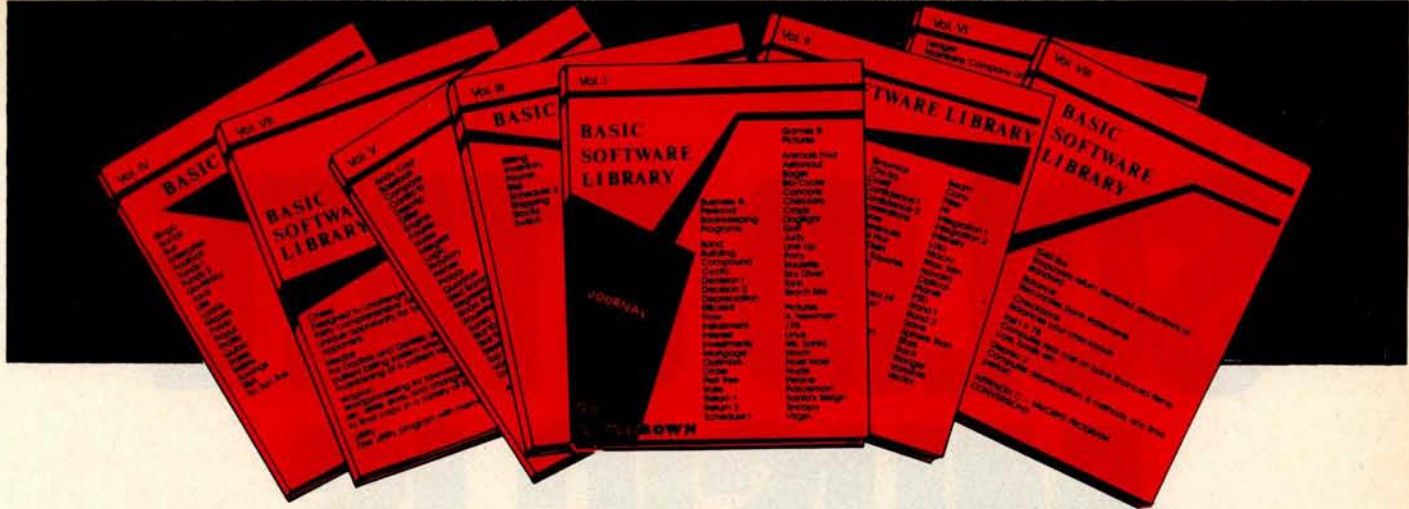
SCIENTIFIC RESEARCH

P.O. Box 490099-B

Key Biscayne, FL 33149

Phone orders call 800-327-6543

Information — (305) 361-1153



COMPUTER SOFTWARE

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

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

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

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

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

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

Vol. I	Vol. II	Vol. III	Vol. IV	Vol. V	Vol. VI	Vol. VII	Vol. VIII
Business & Personal Bookkeeping Programs	Games & Pictures	Binomial	Beam	Bingo	Ledger	Chess	1040-Tax
Bond Building Compound Cyclic	Animals Four	Chi-Sq.	Conv. Filter	Bonds	Maintains Company accounts and generates financial reports. Includes routines for: Payr, Inv, Dept, A/R, A/P.	Medbil	Balance
Decision 1	Astronaut	Confidence 1	Fit	Bull	Designed to challenge the average player fairly comprehensive. Great fun for all, offers a unique opportunity for beginners in need of an opponent.	Wdproc	Checkbook
Decision 2	Bio Cycle	Confidence 2	Integration 1	Enterprise	For Doctors and Dentists alike, a complete patient billing system which also permits the maintaining of a patient history record.	Utility	Inst 1 o 78
Depreciation	Bagel	Correlations	Integration 2	Football	Wordprocessing for lawyers, publishers, writers, etc. Write, store, and change from rough draft to final copy in a variety of formats.	Vol. VIII	Deprec 2
Efficient	Cannons	Curve	Intensity	Funds 1	Disk utility program with memory testing.	1040-Tax	APPENDIX C — FAVORITE PROGRAM CONVERSIONS
Flow	Checkers	Differences	Lola	Funds 2		Balance	
Installment	Craps	Dual Plot	Macro	Go-Moku		Checkbook	
Interest	Dogfight	Exp-Distri	Max. Min.	Jack		Inst 1 o 78	
Investments	Golf	Least Squares	Navald	Life		Deprec 2	
Mortgage	Judy	Paired	Optical	Loans			
Optimize	Line Up	Platpts	Planet	Mazes			
Order	Pony	Polynomial Fit	PSD	Poker			
Perf Tree	Roulette	Regression	Rand 1	Popul			
Rate	Sky Diver	Stat 1	Rand 2	Profits			
Return 1	Tank	Stat 2	Solve	Quibc			
Return 2	Teach Me	T-Distribution	Sphere Trian	Rates			
Schedule 1	Pictures	Unpaired	Stars	Rettie			
	A. Newman	Variance 1	Track	Savings			
	J.F.K.	Variance 2	Triangle	SBA			
	Unus	XY	Variable	Tic-Tac-Toe			
	Ms. Santa	APPENDIX A	Vector				
	Nixon						
	Noel Noel						
	Nude						
	Peace						
	Polliceman						
	Santa's Sleigh						
	Snoopy						
	Virgin						

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

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

Add \$1.50 per volume handling, all domestic shipments sent U.P.S. except APO and PO. Box which go parcel post. Foreign orders add \$8.00/volume for air shipment and make payable in U.S. dollars only.



SCIENTIFIC RESEARCH

P.O. Box 490099-B

Key Biscayne, FL 33149

Phone orders call 800-327-6543

Information — (305) 361-1153

SOLID STATE MUSIC IS MISLEADING!

We won't mislead you any longer. Solid State Music—the name is misleading because we're so much more than just music synthesizer boards. We offer the widest line of S-100 boards in the industry. Memory boards for RAM, ROM, and EPROM. Video interface and I/O boards, extender and mother boards, prototyping and vector jump boards, a new CPU board, and, of course, music boards. So we're changing our name to SSM.*

You've been enjoying the pleasures of our company for over four years now. Few competitors can say as much. In fact, Solid State Music was building quality boards when the first S-100 bus left the Altair® station.

As SSM,* we will continue to offer boards that pro-

vide quality, flexibility, and good design. Boards that represent value. Not the least expensive. Not the most expensive. Simply the best combination of price and quality available. That's SSM.*

Solid State Music has been known for service. Fast delivery, ready customer support, and a strong product warranty. Our name is changing. Our tradition of service is not. Orders still shipped from stock. A one year warranty on assembled and tested boards, 90 days on kits. And our people are still on hand, still glad to answer your questions.

Check out the Blue Boards of Happiness when you're after Solid State Music quality, reliability, and flexibility, backed by the friendly support of the oldest S-100 board manufacturer in the marketplace. If you liked us as Solid State Music, you'll love us as SSM.*



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

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

What Have You Found?

I would like to express my opinion about Mr O'Reilly's letter advocating the discovery and use of undefined op codes ("Instruction Search," May 1978 BYTE, page 153). Let me state what I think could be the reasons for the existence of undocumented op codes in a microprocessor instruction set:

- The op code was implemented unsuccessfully and under certain circumstances does not work correctly. The manufacturer was unable to justify correcting the problem, and chose to omit the instruction from the documentation.
- The instruction is an accident, an artifact of the specific implementation. It will work on some devices, but perhaps not on devices from a second source or even from another production run from the same vendor.
- The documentation of the instruction was accidentally left out. In this case, the vendor should have already issued corrections to the documentation, and you have not in fact disclosed any new information.
- The device you tested was defective. The feature does not work for anybody else.

Now I'm not out to criticize you for discovering new things about your processor; I'm just out to warn you that if the feature you think you have discovered is not acknowledged and supported by your vendor, you are taking a chance if you expect it to function correctly and to continue to be a feature in future versions of the processor.

If you refer to *The Mythical Man-Month* by Fred Brooks, you will find a revealing discussion of the consequences of the extra op codes on the IBM 7090. Brooks makes a very strong case for the significance of the "architecture specification" of a system, which states clearly what is to be expected of a piece of hardware, and equally clearly specifies those situations in which the results of an operation are "undefined." Briefly, the outcome of undefined operations is left up to the implementers, and may be chosen by them as they see fit. Cost, convenience and plain luck have much to do with the eventual results. ■



THE BLUE BOARD OF HAPPINESS

It's the new CB-1
CPU board from SSM.

It's blue. And it's loaded.
(That's why it's happy.)
Loaded with so many features.
Just add an I/O board and
you've got a computer.

Loaded starts with 256 bytes of on-board RAM. Add 2K of optional on-board 2708 EPROMs. Then add a power-on/reset jump circuit, and the availability of MWRITE, allowing use without a front panel.

And then there's a parallel input port with status. And enough DIP switching to make you dizzy. DIP controlled addressing of PROM in 2K blocks—of vector jump in 2K increments—of RAM in 256 byte increments—of input port for addresses 0 to 31 in decimal.

Like all SSM boards, the S-100 compatible CB-1 includes gold-plated edge connectors and TI low-profile sockets. And SSM support and warranty. Yet, even as loaded as our CB-1 is, the price won't leave you breathless. Only \$144.95. And an introductory offer at only \$129.95 makes it even happier. (Offer expires November 30, 1978.)

Available direct from SSM, or at over 100 retail locations.

Video and teletype monitor programs are available on EPROM for only \$34.95 with the purchase of any SSM kit.



SSM manufactures a full line of S-100 boards. How full? Too full for this ad. Just check the ad across the page.



2116 Walsh Avenue
Santa Clara, CA 95050
(408) 246 2707

Testing Memory in BASIC

I hate to toggle in a program through the front panel of my computer. Yet every time I finish a new memory board I have to do this to a machine language memory test program. I therefore resolved to write a memory test program in BASIC which could be loaded with an 8 K interpreter in 8 K of proven memory. The BASIC program in listing 1 is the result.

The program is written in MITS 8 K version 4.0 BASIC and uses multiple statement lines with statements delimited by a colon (:). In addition to the normal functions of most BASICs, the program requires

PEEK and POKE with arguments between 0 and 32767. In addition, the program needs the following BASIC primitives which may not exist on every system:

```
CLEAR 80
INPUT".prompt."
IF...OR...OR...THEN
INT
GOSUB
LEN
RIGHT$
STR$
```

Russell E Adams
3008 Mosby St
Alexandria VA 22305

```
LIST
0 REM          ** BASIC MEMORY TEST REV.5 **
1 REM          COPYRIGHT 1977 R.E. ADAMS
25 CLEAR 80
30 INPUT"START WITH BEGINNING OF PAGE";A
35 IF A<2 OR A>7 OR A<>INT(A) THEN PRINT"ERROR":GOTO30
40 INPUT"END WITH END OF PAGE";B
45 IF B<>INT(B) OR B<A OR B>7 THEN PRINT"ERROR":GOTO40
50 A=4096*A:B=4096*(B+1)-1
55 PRINT:PRINT"TEST PATTERN #1 LOADING":PRINT
60 P1=85:P2=170:GOSUB 300
70 R=8:X=A:GOSUB 500:AS=NS
75 X=B:GOSUB 500:BS=NS
80 PRINT:PRINT"MEMORY TEST #1 FROM ";AS;" TO ";BS;" OCTAL"
85 PRINT:PRINT"ADDRESS","DATA","SHOULD BE"
90 GOSUB 350
95 PRINT:PRINT"TEST PATTERN #2 LOADING":PRINT
100 P1=170:P2=85:GOSUB 300
110 PRINT:PRINT"MEMORY TEST #2 FROM ";AS;" TO ";BS;" OCTAL"
115 PRINT:PRINT"ADDRESS","DATA","SHOULD BE"
120 GOSUB 350
125 PRINT:PRINT"TEST COMPLETED"
130 END
300 FOR I=A TO B-1 STEP 2
305 POKE I,P1:POKE I+1,P2
315 NEXT:RETURN
350 D=P1:FOR I=A TO B-1 STEP 2
352 Z=PEEK(I):IF Z<>D THEN GOSUB 365
353 NEXT I
354 D=P2:FOR I=A+1 TO B STEP 2
355 Z=PEEK(I):IF Z<>D THEN GOSUB 365
360 NEXT I:IF F=0 THEN PRINT"NO BAD BITS DETECTED"
363 F=0:RETURN
365 F=1:R=8:X=1:GOSUB 500:BAS=NS
370 R=2:X=2:GOSUB 500:DS=NS
375 X=0:GOSUB 500
390 IF LEN(DS)<>8 THEN DS="0"+DS:GOTO390
395 IF LEN(NS)<>8 THEN NS="0"+NS:GOTO395
410 PRINTBAS,DS,NS
415 RETURN
500 NS=""
505 K=INT(X/R):L=X-R*K
510 NS=RIGHT$(STR$(L),1)+NS
515 IF K<>0 THEN X=K:GOTO505
520 RETURN
OK
```

Listing 1: A BASIC memory test program. The memory to be tested is first loaded with the alternating patterns "01010101" and "10101010" in the even and odd memory locations, respectively. After testing all the locations, a second pattern (the logical inverse of the first) is loaded and tested. If any bit is influencing the state of an adjacent bit, the bad bit will be detected.

The program has two parts: lines 25 to 130 contain the main program, while lines 300 to 520 contain four subroutines. Subroutine 300 loads a test pattern into memory; subroutine 350 reads back the data in memory and compares it to what the data should be; subroutine 365 prints out the bad address and the data; and subroutine 500 converts a base ten number into a base R number.

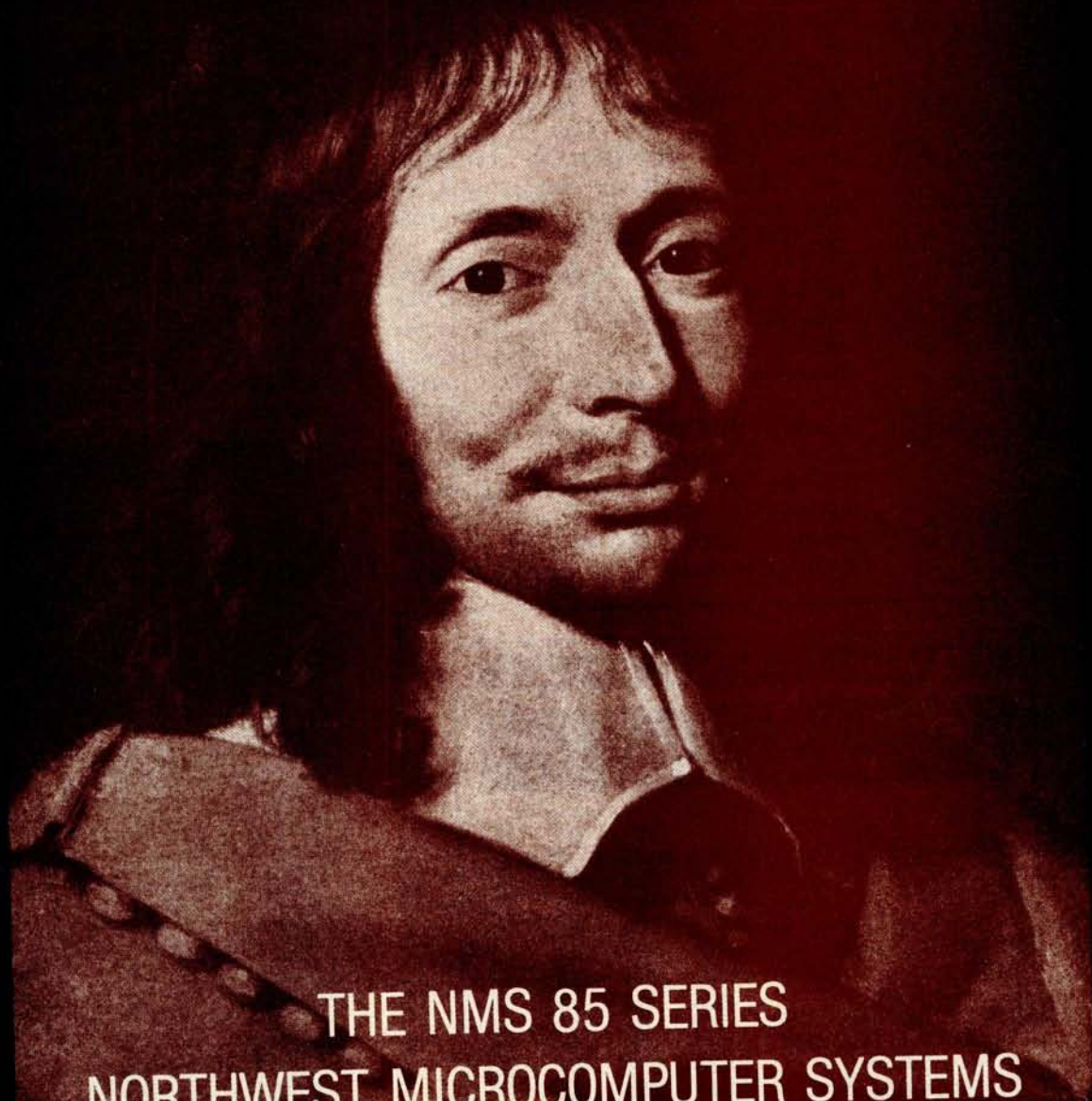
The memory under test is subjected to two test patterns. The memory is first loaded with the alternating pattern 0101-0101, 10101010, the first byte being placed in all the even addresses and the second being placed in all the odd addresses. After reading and comparing the first pattern, the second pattern is loaded. The second pattern consists of 10101010 loaded in all the even addresses and 01010101 in all the odd addresses. This alternating pattern is used so that if a bit is influencing the state of another adjacent bit, the bad bit will be detected (the pattern assumes that adjacent addresses are physically wired up as in the memory parts specifications).

The BASIC interpreter must be limited to the lowest 8 K of memory. In MITS 8 K you answer the initial dialog MEMORY SIZE? with 8191. Also the trigonometric functions must be deleted. The program asks which pages of memory are under test. The first 4 K of memory is defined as page 0 and the last 4 K of memory is defined as page 15. The memory under test must be addressed between page 2 and 7, inclusive. This is sufficient space to test six 4 K boards, three 8 K boards, or one 16 K board.

The program takes about two minutes

Blaise Pascal

1623 - 1662



THE NMS 85 SERIES NORTHWEST MICROCOMPUTER SYSTEMS

CLASSIC OEM DEVELOPMENT TOOLS

85/P - \$7,495

- 8085, 3MHz, 54K User/10K System Memory
- 1.2 Mb Dual Density Floppies, 4ms Step, DMA
- Keyboard, RS232 Ports, Pascal, BASICs, Assembler

OPTIONS

- Fast Floating Point APU, 5MHz Timers, Ports, Modem, Clock
- COBOL, FORTRAN, Sort, Decimal, Graphics

VINTAGE TURNKEY BUSINESS SYSTEMS

- Accounts Receivable: Billing, Aging, Full Forms Data Entry
- Word Processing: Screen Edit, Search, Justification, Page Numbering, Headings, etc.
- Client Information Management
- General Ledger
- Fuel Dispensing and Accounting

©UCSD

121 EAST ELEVENTH, EUGENE, OREGON 97401 (503) 485-0626

to test 4 K of memory. A sample printout is shown in listing 2. The program first asks the questions START WITH BEGINNING OF PAGE? and END WITH END OF PAGE?. These questions are answered with the appropriate page numbers of the memory under test. The program then prints TEST PATTERN #1 LOADING and starts loading the memory with the first test pattern. Next, the two lines MEMORY TEST #1 FROM TO OCTAL and the headings ADDRESS, DATA, and SHOULD BE are printed. The program then reads back the data in the memory and compares it to what the data should be. If the data does not compare, the address in octal is printed under the heading ADDRESS, the data in the memory address is printed in binary under the heading DATA and the data that should have been in the address is printed in binary under the heading SHOULD BE. The bits of the two bytes which do not compare

indicate that they are defective. If no bad locations are detected, NO BAD BITS DETECTED is printed. The program then prints TEST PATTERN #2 LOADING and repeats basically the same above described display only for test #2.

This program should not only detect inoperative memory but also "slow" memory, "forgetful" memory and "bleeding" memory. Just type in the program and save it on tape; then the next time you have a new memory board to test, no more toggling!■

Listing 2: A sample run of the memory test program.

```

RUN
START WITH BEGINNING OF PAGE? 6
END WITH END OF PAGE? 6

TEST PATTERN #1 LOADING

MEMORY TEST #1 FROM 60000 TO 67777 OCTAL

ADDRESS      DATA      SHOULD BE
NO BAD BITS DETECTED

TEST PATTERN #2 LOADING

MEMORY TEST #2 FROM 60000 TO 67777 OCTAL

ADDRESS      DATA      SHOULD BE
NO BAD BITS DETECTED

TEST COMPLETED
OK
RUN
START WITH BEGINNING OF PAGE? 7
END WITH END OF PAGE? 7

TEST PATTERN #1 LOADING

MEMORY TEST #1 FROM 70000 TO 77777 OCTAL

ADDRESS      DATA      SHOULD BE
70000        11111111    01010101
70002        11111111    01010101
70004        11111111    01010101
70006        11111111    01010101
70010        11111111    01010101
70012        11111111    01010101
70014        11111111    01010101
70016        11111111    01010101
70020        11111111    01010101
70022        11111111    01010101

TEST PATTERN #2 LOADING

MEMORY TEST #2 FROM 70000 TO 77777 OCTAL

ADDRESS      DATA      SHOULD BE
70000        11111111    10101010
70002        11111111    10101010
70004        11111111    10101010
70006        11111111    10101010
70010        11111111    10101010
70012        11111111    10101010
70014        11111111    10101010
70016        11111111    10101010

```

TERMINALS FROM TRANSNET

PURCHASE 12-24 MONTH FULL OWNERSHIP PLAN 36 MONTH LEASE PLAN

DESCRIPTION	PURCHASE PRICE	PER MONTH		
		12 MOS	24 MOS	36 MOS
DECwriter II	\$1,495	\$145	\$ 75	\$ 52
DECwriter III	2,695	257	137	95
DECprinter I	1,795	172	92	63
VT52 DECscope	1,695	162	85	59
VT100 DECscope	1,695	162	85	59
VT55 DECgraphic CRT	2,395	229	122	84
ADM 3A CRT	875	84	45	30
HAZELTINE 1400 CRT ..	845	81	43	30
HAZELTINE 1500 CRT ..	1,195	115	61	42
TI 745 Portable	1,875	175	94	65
TI 765 Bubble Mem.	2,995	285	152	99
TI 810 RO Printer	1,895	181	97	66
TI 820 KSR Terminal ..	2,395	229	122	84
Data Products 2230 ...	7,900	725	395	275
QUME, Ltr. Qual. KSR ..	3,195	306	163	112
QUME, Ltr. Qual. RO ..	2,795	268	143	98
DATAMATE Mini floppy	1,750	167	89	61

FULL OWNERSHIP AFTER 12 OR 24 MONTHS
10% PURCHASE OPTION AFTER 36 MONTHS

ACCESSORIES AND PERIPHERAL EQUIPMENT

ACOUSTIC COUPLERS • MODEMS • THERMAL PAPER
RIBBONS • INTERFACE MODULES • FLOPPY DISK UNITS

PROMPT DELIVERY • EFFICIENT SERVICE



TRANSNET CORPORATION
2005 ROUTE 22, UNION, N.J. 07083
201-688-7800



**There's a BYTE BOOK
in your future...**

... And the future

BYTE Publications, Inc. is proud to announce the creation of its new Book Division, which publishes books of interest to computer people. Readers will find a wide range of topics published as BYTE Books, including new material as well as collections of reprints of the best BYTE magazine articles. Users of small computers will find PAPER-BYTE™ Books to be complete descriptions of useful system software including detailed user documentation, source listings where possible, and the PAPERBYTE™ bar code representation of executable code.

To keep the cost reasonable and available to the greatest number of readers, the books will be paperback editions in the 8-1/2 x 11" format. You may purchase the initial selections directly from BYTE via mail order or from your favorite computer store or book distributor.

PROGRAMMING TECHNIQUES is a new series of **BYTE BOOKS** concerned with the art and science of computer programming. It is a collection of the best articles from BYTE magazine and new material collected just for this series. The book provides the personal computer user with background information to write and maintain programs effectively.

The first book in the Programming Technique series is entitled **PROGRAM DESIGN**. It discusses in detail the theory of program design. The purpose of the book is to provide the personal computer user with the techniques needed to design efficient, effective, maintainable programs. Included is information concerning structured program design, modular programming techniques, program logic design, and examples of some of the more common traps the casual as well as the experienced programmer may fall into. In addition, details on various aspects of the actual program functions, such as hashed tables and binary tree processing, are included.

ISBN 0-931718-12-0
Editor: Blaise W. Liffick
Pages: 96
Price: \$6.00
Publication: Fall 1978

In **SIMULATION**, the second book of the series, are articles dealing with various aspects of specific types of simulation. Both theoretical and practical applications are included. Particularly stressed is simulation of motion, including wave motion and flying objects. The realm of artificial intelligence is explored, along with simulating robot motion with the microcomputer. Finally, tips on how to simulate electronic circuits on the computer are detailed.

ISBN 0-931718-13-9
Editor: Blaise W. Liffick
Pages: approx. 80
Price: \$6.00
Publication: Fall 1978

The third book is **NUMBERS IN THEORY AND PRACTICE**. This book includes information of immense value to both the novice and the experienced personal computerist. The mechanics of the binary system are discussed, including division and multiplication, as well as the places to look for numerical error in programs. Floating point numbers, what they are and how to use them, are covered. There are also sections on numerical methods (functions, approximations, statistics), Boolean math, and several different approaches on how to obtain random numbers.

ISBN 0-931718-14-7
Editor: Blaise W. Liffick
Pages: approx. 100
Price: \$6.00
Publication: Fall 1978

The fourth book so far scheduled in this series is called **BITS AND PIECES**. The articles collected for this book are mostly unrelated and do not neatly fit into the topics of the previous three books, but still have a lot to do with programming techniques. Areas such as multiprogramming and interactive computing with the personal computer are discussed, as well as stacks, sorting, Polish notation, and program optimization. This is by far the most general book of the series.

ISBN 0-931718-15-5
Editor: Blaise W. Liffick
Pages: approx. 100
Price: \$6.00
Publication: Fall 1978

is right now!

RA6800ML: AN M6800 RELOCATABLE MACRO ASSEMBLER is a two pass assembler for the Motorola 6800 microprocessor. It is designed to run on a minimum system of 16 K bytes of memory, a system console (such as a Teletype terminal), a system monitor (such as Motorola MIKBUG read only memory program or the ICOM Floppy Disk Operating System), and some form of mass file storage (dual cassette recorders or a floppy disk).

The Assembler can produce a program listing, a sorted Symbol Table listing and relocatable object code. The object code is loaded and linked with other assembled modules using the **Linking Loader LINK68**. (Refer to **PAPERBYTE™** publication **LINK68: AN M6800 LINKING LOADER** for details.)

There is a complete description of the 6800 Assembly language and its components, including outlines of the instruction and address formats, pseudo instructions and macro facilities. Each major routine of the Assembler is described in detail, complete with flow charts and a cross reference showing all calling and called-by routines, pointers, flags, and temporary variables.

In addition, details on interfacing and using the Assembler, error messages generated by the Assembler, the Assembler and sample IO driver source code listings, and **PAPERBYTE™** bar code representation of the Assembler's relocatable object file are all included.

This book provides the necessary background for coding programs in the 6800 assembly language, and for understanding the innermost operations of the Assembler.

ISBN 0-931718-10-4
Author: Jack E. Hemenway
Pages: approx. 120
Price: \$25.00
Publication: Fall 1978

LINK68: AN M6800 LINKING LOADER is a one pass linking loader which allows separately translated relocatable object modules to be loaded and linked together to form a single executable load module, and to relocate modules in memory. It produces a load map and a load module in Motorola MIKBUG loader format. The linking Loader requires 2 K bytes of memory, a system console (such as a Teletype terminal), a system monitor (for instance, Motorola MIKBUG read only memory program or the ICOM Floppy Disk Operating System), and some form of mass file storage (dual cassette recorders or a floppy disk).

It was the express purpose of the authors of this book to provide everything necessary for the user to easily learn about the system. In addition to the source code and **PAPERBYTE™** bar code listings, there is a detailed description of the major routines of the Linking Loader, including flow charts. While implementing the system, the user has an opportunity to learn about the nature of linking loader design as well as simply acquiring a useful software tool.

ISBN 0-931718-09-0
Authors: Robert D. Grappel
& Jack E. Hemenway
Pages: 48
Price: \$8.00
Publication: Summer 1978

TRACER: A 6800 DEBUGGING PROGRAM is for the programmer looking for good debugging software. TRACER features single step execution using dynamic break points, register examination and modification, and memory examination and modification. This book includes a reprint of "Jack and the Machine Debug" (from the December 1977 issue of BYTE magazine), Tracer program notes, complete assembly and source listing in 6800 assembly language, object program listing, and machine readable **PAPER-BYTE™** bar codes for the object code.

ISBN 0-931718-02-3
Authors: Robert D. Grappel &
Jack E. Hemenway
Pages: 24
Price: \$6.00
Available now



TINY ASSEMBLER 6800, Version 3.1 is an enhancement of Jack Emmerichs' successful Tiny Assembler. The original version (3.0) was described first in the April and May 1977 issues of BYTE magazine, and later in the **PAPERBYTE™** book **TINY ASSEMBLER 6800 Version 3.0**. In September 1977, BYTE magazine published an article entitled, "Expanding The Tiny Assembler". This provided a detailed description of the enhancements incorporated into Version 3.1, such as the addition of a "begin" statement, a "virtual symbol table", and a larger subset of the Motorola 6800 assembly language.

All the above articles, plus an updated version of the user's guide, the source, object and **PAPERBYTE™** bar code formats of both Version 3.0 and 3.1 make this book the most complete documentation possible for Jack Emmerichs' Tiny Assembler.

ISBN 0-931718-08-2
Author: Jack Emmerichs
Pages: 80
Price: **\$9.00**
Publication: Summer 1978

SUPERWUMPUS is an exciting computer game incorporating the original structure of the WUMPUS game along with added features to make it even more fascinating. The original game was described in the book **What To Do After You Hit Return**, published by the People's Computer Company. Programmed in both 6800 assembly language and BASIC, **SUPERWUMPUS** is not only addictively fun, but also provides a splendid tutorial on setting up unusual data structures (the tunnel and cave system of **SUPERWUMPUS** forms a dodecahedron). This is a **PAPERBYTE™** book.

ISBN 0-931718-03-1
Author: Jack Emmerichs
Pages: 56
Price: **\$6.00**
Publication: Summer 1978

MONDEB: AN ADVANCED M6800 MONITOR-DEBUGGER has all the general features of Motorola's MIKBUG monitor as well as numerous other capabilities. Ease of use was a prime design consideration. The other goal was to achieve minimum memory requirements while retaining maximum versatility. The result is an extremely versatile program. The size of the entire **MONDEB** is less than 3 K.

Some of the command capabilities of **MONDEB** include displaying and setting the contents of registers, setting interrupts for debugging, testing a programmable memory range for bad memory locations, changing the display and input base of numbers, displaying the contents of memory, searching for a specified string, copying a range of bytes from one location in memory to another, and defining the location to which control will transfer upon receipt of an interrupt. This is a **PAPERBYTE™** book.

ISBN 0-931718-06-6
Author: Don Peters
Pages: approx. 72
Price: **\$5.00**
Publication: Summer 1978

BAR CODE LOADER. The purpose of this pamphlet is to present the decoding algorithm which was designed by Ken Budnick of Micro-Scan Associates at the request of BYTE Publications, Inc., for the **PAPERBYTE™** bar code representation of executable code. The text of this pamphlet was written by Ken, and contains the general algorithm description in flow chart form plus detailed assemblies of program code for 6800, 6502 and 8080 processors. Individuals with computers based on these processors can use the software directly. Individuals with other processors can use the provided functional specifications and detail examples to create equivalent programs.

ISBN 0-931718-01-5
Author: Ken Budnick
Pages: 32
Price: **\$2.00**
Available now

BYTE BOOKS Division • 70 Main Street • Peterborough, New Hampshire 03458

Name _____ Title _____ Company _____
Street _____ City _____ State/Province _____ Code _____

☐ Check enclosed in the amount of \$ _____
☐ Bill Visa ☐ Bill Master Charge Card number _____ Expiration Date _____

Please send the books I have checked.

- ☐ Program Design \$6.00
- ☐ Simulation \$6.00
- ☐ Numbers in Theory & Practice \$6.00
- ☐ Bits & Pieces \$6.00
- ☐ RA6800ML \$25.00
- ☐ Link68 \$8.00

- ☐ Tracer \$6.00
- ☐ Tiny Assembler (3.1) \$9.00
- ☐ SUPERWUMPUS \$6.00
- ☐ Mondeb \$5.00
- ☐ Bar Code Loader \$2.00

Add 50¢ per book to cover postage and handling

BYTE BOOKS, BYTE BOOKS logo, and PAPERBYTE are trademarks of BYTE Publications, Inc.

Please allow 6-8 weeks for processing your order.

Technical Forum

F D Sodamann
2603 N Greenwood
Pueblo CO 81003

In Defense of Analog?

I am an avid and enthusiastic supporter of the personal computing hobby and of BYTE. (At present I am building a full 6502-based OSI machine which pleases me very much.) But I am an old timer in electronics and think that all the fantastic digital devices which have been developed over the last few years have convinced people that general purpose analog computers belong in museums.

I feel there are a couple of things we digital hackers ought to consider:

1. Computing is computing. Setting up an analog machine to solve a differential equation is as satisfying as writing an elegant software program and, given some proper peripheral equipment, the results can be useful and aesthetically pleasing.
2. In some areas, analog machines can do a better job more easily; compare re-wiring an analog machine to writing a Runge-Kutta program or performing a slow digital computation when a less precise but real time analog computation will do).
3. The present CA3XXX series of op amps should be able to increase the accuracy of an analog machine by several orders of magnitude, especially when using a good analog/digital design for a digital readout.

Surely among your readers there are people who think as I do; I'd like to contact such people and find out the following things:

1. Does any manufacturer produce printed circuit boards or kits to build a reasonably powerful machine — say 4 or 5 integrators?
2. Does anyone have an old general purpose machine which could be updated? Is it for sale? ■

Program faster, debug easier now

Flowchartrix™, a unique flowchart development tool from Stirling/Bekdorf, saves you time, space, and money, no matter what language you work with. Whether you program professionally or just for fun. The 78F2 Flowchartrix™ helps your thoughts move in logical steps, and lets you retrace logic easily when debugging.

When you use "top-down" programming methods, you can use the 78F2 to lay out your original logic concept blocks. Then by following the plan you lay out in words at the concept stage, you can write a finely detailed flowchart quite smoothly. Then it's easy to write actual code based on the flowchart.

54% more logic cells than other flowchart forms, so you get far more of your program on each page. Each Flowchartrix has a full 77 logic cells, not just 50. This not only saves paper, but also makes your finished flowcharts easier to understand. By seeing up to 27 extra steps of your program on each page, you comprehend program flow more clearly. That's important while writing the flowchart, more important when you write actual code. It's also extremely helpful when you debug, and indispensable when you come back months or years later to modify your original work. 78F2's higher matrix count makes your flowcharts quicker to debug because there are fewer pages to search for errors. Fewer pages also save you money and storage space.

Unique matrix can show your loops AS loops. The Flowchartrix 7 x 11 matrix gives you plenty of room to write loops laid out as sort of a squared circle. This makes loops and subroutines easier to recognize, because their form is readily apparent at a glance. Since they're easier to find, and may even be completed on a single page, they're also simpler to debug or modify.

Every matrix cell has a specific label to help you track branch points. Now it's far easier to follow your program from page to page, point to point. When you write program documentation, having a separate reference point for each cell makes your program much easier to describe clearly.

With Flowchartrix, you don't need a shape template to draw remarkably regular logic symbols. Guides for the most-used logic symbols are right in each matrix cell. They help you draw most standard flowchart symbols entirely free-hand. This saves all the time you'd otherwise spend hunting a shape template and positioning it to draw every symbol. Your train of thought need no longer be interrupted by template tedium. With 78F2, your pencil can fly as fast as you can write, without interruption. When a flash of insight strikes, now you can keep your pen on paper, flowing rapidly from one step to the next without a break.

78F2 is surface-engineered to take both pen and pencil without blotching. The tough 22# base stock is the same brilliant white opaque material used in our 78C1 Combination Coding/CRT Layout forms. Pure enough to use with magnetic ink scanners, heavy enough to withstand vigorous erasure, every Flowchartrix gives you crisp, sharp, characters and symbols. It takes ink without spreading, and accepts soft pencil lead with good contrast.

Order your supply today. Ask your local computer store for Stirling/Bekdorf™ 78F2 Flowchartrix™. To enjoy the world's most advanced program development aids most, use the entire Stirling/Bekdorf system: 78F2 Flowchartrix (for concept planning and flowcharting), 78C1 Combination Coding/CRT Layout forms (for coding and display planning in BASIC, OPUS, and other line-number languages), and 78P4 Print-Out Design Sheets (to design report printouts for easy coding). Our programming tools work together as a complete system to save time and reduce errors during every stage of program development, from concept to completion. Try them for yourself today. If your store is out-of-stock, use the coupon below to get yourself a supply on the way now.

YES! Please rush the programming aids indicated below:

78F2 Flowchartrix™	78C1 Coding/CRT Combination
<input type="checkbox"/> two 50-sht. pads: \$7.90 + \$2.85 shpg.	<input type="checkbox"/> two 50-sht. pads: \$6.35 + \$1.95 shpg.
<input type="checkbox"/> ten 50-sht. pads: \$34.35 + \$6.45 shpg.	<input type="checkbox"/> ten 50-sht. pads: \$26.85 + \$3.35 shpg.

78P4 Print Out Designer

☐ one 50-sht. pad: \$7.45 + \$3.15 shpg. ☐ five 50-sht. pads: \$32.10 + \$6.75 shpg.
Texas residents please add 5.5% sales tax to base price

Enclosed is my check for \$ _____
Charge to: ☐ Master Charge ☐ Visa exp. date _____
Card # _____ Signature _____
Dealer inquiries welcome

Name _____
Address _____ Phone _____
City _____ State _____ Zip _____

We ship UPS so P.O. Box address must give phone number.

Stirling/Bekdorf™

b10 4407 Parkwood □ San Antonio, TX 78218 □ (512) 824-5643

HOW TO BEAT THE SYSTEM WITH SYNCHRO-SOUND

High-performance, low cost complete Microcomputer Business Systems (plus Software)
at EXTRA savings only Synchro-Sound can offer!

SYSTEM No. 1

DIGITAL SYSTEMS DSC-2 Z-80 COMPUTER SYSTEM

32K RAM, 4 RS-232 serial interfaces,
16 bits of parallel I/O. Double density
floppy disk, Shugart dual-drive.

Regular price \$4995.00

CENTRONICS 700 PRINTER With RS-232 Interface

60 characters per second, 132 col-
umn line, tractor feed.

Regular price \$1720.00

HAZELTINE 1500 VIDEO TERMINAL

80 character lines, 24 line page, line
and page editing. Separate numeric
keypad.

Regular price \$1149.00
\$7864.00

THE COMPLETE SYSTEM
ONLY **\$7495.00**
SAVE \$369.00!

SYSTEM No. 2

IMSAI VDP 80 DATA PROCESSING COMPUTER SYSTEM

32K RAM, expandable to 196K.
Parallel and serial I/O. Megabyte
mass storage, alphanumeric in-
telligent keyboard.

Regular Price \$6995.00

OKIDATA 22 PRINTER With RS-232 Interface

Tractor feed, 132 column, 125 lpm,
upper and lower case. 12 different
fonts on command.

Regular price \$2888.00
\$9883.00

THE COMPLETE SYSTEM
ONLY **\$9445.00**
SAVE \$438.00!

SYSTEM No. 3

CROMEMCO SYSTEM 3 Z-80 COMPUTER SYSTEM

32K RAM, dual disk drive, RS-232 In-
terface. S-100 bus.

Regular price \$5990.00

MODEL 3703 LINE PRINTER

180 characters per second, print line
width 132 cols., bi-directional print-
ing.

Regular price \$2995.00

CRT TERMINAL MODEL 3100

80 characters per line, 24 lines, up to
19,200 baud, upper and lower case.

Regular price \$1595.00
\$10,580.00

THE COMPLETE SYSTEM
ONLY **\$10,095.00**
SAVE \$485.00!

SOFT- WARE

Three software packages* that enable
you to profitably make full use of your
Microcomputer Business System

ACCOUNTS RECEIVABLE PACKAGE Creates transaction file
of charges, credits and payments. Batch mode for monthly
statements and aged schedules.
Operators manual and disk, single copy **\$500.00**

INVENTORY PACKAGE Maintains current listing of stock
items, master inventory listing with price and cost data.
Operators manual and disk, single copy **\$500.00**

**ORDER-ENTRY PACKAGE (Requires Accounts Receivable
and/or Inventory Package)** Links Accounts Receivable and
Inventory packages into one coherent, easy-to-use, time-
saving system.
Operators manual and disk, single copy **\$500.00**

**Buy any of our
3 MICROCOMPUTER SYSTEMS
and any combination of these
3 SOFTWARE PACKAGES ARE YOURS FOR
HALF PRICE!**

*Require 48K Memory and Microsoft Basic

Terminal and Printer substitutions may be made
on any of the above Systems

CUSTOMIZED HARDWARE SYSTEMS
ARE AVAILABLE

Complete modern servicing and consulting
facilities on premises



SYNCHRO-SOUND ENTERPRISES, INC.
The Computer People

193-25 Jamaica Avenue,
Jamaica, New York 11423

212/468-7067
Hours 9-4 daily
and Saturday

TWX: 710-582-5886

Visit our new showroom
Working units on display

Dept BSY

BankAmericard • Master Charge

THERE'S A NEW ADDITION TO THE HAZELTINE FAMILY...AND SYNCHRO-SOUND'S GOT IT!



THE ALL-NEW
HIGH-PERFORMANCE LOW COST

HAZELTINE 1400 VIDEO TERMINAL

All 128 ASCII Codes • 64 Displayable Characters • High Resolution 5 X 7 Dot Matrix • Cursor Addressing and Sensing EIA Interface • Rates up to 9600 Baud • Self Test

\$27.51 per month*
\$799.00 complete

HAZELTINE 1500 VIDEO TERMINAL



- Reverse video
- 24 X 80 display
- Programmable brightness levels
- RS232 and current loop...and much more

\$39.57
per month*
\$1149.00 complete
995.00 kit

HAZELTINE MODULAR 1 EDIT INTELLIGENT TERMINAL



- 1920 character display
- 8 different video levels
- Full editing capability
- Removable keyboard...and much more

\$57.14
per month*
\$1659.00 complete



SYNCHRO-SOUND

ENTERPRISES, INC.

The Computer People
193-25 Jamaica Avenue, Jamaica, New York 11423
212/468-7067 TWX 710-582-5886
West Coast: 5810 Commerce Blvd.
Rohnert Park, CA. 94928 • 707/544-2865

Dept. HB

Hours 9-4 Daily
and Saturday

BankAmericard

Visit our new showroom
Working units on display
Master Charge

*36 month lease
Maintenance additional
OEM pricing available

Multi Variable Task

software
system

FAMOS™

MULTI-TASKING DOS

- Multi user file security
- Automatic file & data integrity
- Device independent file system
- Multi-sessioning/spooling
- 20+ terminals supported

MVT-BASIC™

MULTI-USER COMPILER

- Powerful string, file I/O
- Error Trapping
- Basic and machine language program calls
- Library function
- Random, Sequential, ISAM file support

MVT-WORDFLOW™

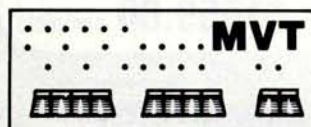
MULTI-USER WORD PROCESSING PROGRAM

- Search/replace
- "Cutting & pasting" scratch pad
- Simultaneous multi-file editing
- Automatic Field insertion
- Supports all RS232 terminals



MVT-ASMZ™ MACRO Z80/8080 ASSEMBLER

- Relocating
- Nested Macro calls & definitions
- Cross references
- Debug package
- Library facilities



MICROCOMPUTER SYSTEMS INC.
9241 Reseda Blvd., Suite 203
Northridge, CA 91324
Phone: (213) 349-9076

Programming Quickies

Formatting

Dollars

and

Cents

Les Palenik
25 Silversprings Blvd
Suite 512
Scarborough Ontario
M1V 1M9 CANADA

Most of the BASIC interpreters available on the microcomputer market today do not provide the PRINT USING option. I have written a formatting subroutine that will perform some of the PRINT USING functions for monetary output:

- Round the monetary amount to the nearest cent.
- Convert the numeric value to a character string and check the digits after the decimal point. If the last one or both digits are missing, insert zeroes.
- Insert a dollar sign in front of the converted amount. If the amount is less than 1, insert a 0 in front of the decimal point.
- Supply the length of the amount.

Before calling the subroutine, we have to pass the dollar figure to be processed to the variable X1. The converted figure is passed back in the variable X\$. The length of the formatted amount is passed back in X3.

The routine in listing 1 has been written in the Commodore PET-2001 version of Microsoft BASIC. Modifications may be required for other BASIC interpreters. The remarks can be deleted for faster execution and memory savings.

I use this subroutine in most of my programs. I place it rather high in the program (line numbers 3000 thru 3099) so I can always use the same line numbers.■

```

10 INPUT A
20 X1=A:GOSUB 3000
30 PRINT TAB(20-X3);X$
40 GOTO 10
3000 REM *****
3001 REM THIS SUBROUTINE WILL FORMAT
3002 REM DOLLARS AND CENTS
3003 REM *****
3004 REM ROUND THE AMOUNT
3005 X1=INT(X1*100+.5)/100
3010 X0$="":X$=""
3020 IF X1=0 GOTO 3030
3025 IF X1<1 THEN X0$="0"
3030 X1$=STR$(X1)
3035 X2=LEN(X1$)
3040 X2=X2-1
3041 REM DELETE SPACE IN FRONT
3042 REM OF THE FIRST DIGIT
3045 X1$=MID$(X1$,2,X2)
3050 FOR I=1 TO X2
3055 X2$=MID$(X1$,I,1)
3060 X3=I
3065 IF X2$="." GOTO 3085
3070 NEXT I
3075 X$="".00"
3080 GOTO 3090
3085 IF X3=(X2-1) THEN X$="0"
3086 REM CREATE THE FINAL STRING
3090 X$="X0$+X1$+X2$
3091 REM FIND THE STRING LENGTH
3095 X3=LEN(X$)
3099 RETURN

```

RUN

12	\$2.00
12.2	\$2.20
12.22	\$2.22
12.222	\$2.22
1222	\$222.00
175.756	\$75.76

Listing 1: BASIC program for formatting dollars and cents in BASIC interpreters that do not have the PRINT USING function. Also shown is a sample run of the program.

ARTEC CRAFTSMANSHIP HAS CREATED

The First Truly Silent Motherboard

Noise in your bus lines means errors in your programs. The Artec shielded Motherboard totally eliminates noise.

At 4MHz, the Artec shielded Motherboard is free from spurious noise. No ringing in your bus lines. No errors in your programs.

This Motherboard offers you engineering and craftsmanship never before available in the small computer field. Outstanding as either a replacement for your present Motherboard or as the heart of a new system. Consider these features:

- 1/8th inch thick—more than twice as thick as most Motherboards.
- Totally shielded—all holes plated through; full bus terminations.
- Fits easily into any standard chassis.
- Masterite edge connectors—the finest quality connectors available.
- Reflowed solder circuitry.
- No soldering required.
- Designed for the S-100 bus.

The Motherboard price is: \$150(KIT)
\$190(ASSEMBLED)

Five years of experience in every card

For five years, Artec has worked hard to develop a complete line of custom, prototype and off-the-shelf printed circuit boards. And in five years of tough industrial use, Artec boards have proven themselves among the most reliable boards available anywhere.

NEW! DEC® and Heath Compatible LSI Boards

The new Artec WW11 lets you adapt or add onto your DEC LSI-11 or Heathkit LSI mini-computer. Can accommodate 14 and 16 pin DIPs plus all necessary passive components.

FULL CARD \$75
(10.45" x 8.4")

HALF CARD \$35
(5.225" x 8.4")



® Trademark of Digital Equipment Corporation

Order today!

Put an Artec board to work for you. Use your Mastercharge or Visa. Or just send along a money order. We can accept only U.S. currency. Please include \$3 handling on all orders. California residents add 6% sales tax.

Please send me: (include quantity)

____ Shielded Motherboard ____ Full WW11 Card ____ Half WW11 Card

☐ I've enclosed a money order for \$ _____

☐ Mastercharge ☐ Visa (number) _____ (exp. date) _____

Name _____

Address _____

City _____ State _____ Zip _____

Calif. Res. add 6% sales tax. Encl. \$3 handling. 10% discount for students and computer club members. (Please enclose name of club or school)

ARTEC ELECTRONICS, INC.

Artec Electronics, Inc. • 605 Old County Rd. • San Carlos, CA 94070
(415) 592-2740

PAM/8:

A New Approach to Front Panel Design

Gordon Letwin
Heath Company
Benton Harbor MI 49022

Since the first personal computers appeared about three years ago, the field has been growing and advancing at an ever increasing rate. The variety and complexity of products increases even while the cost decreases. Indeed, the field has evolved so rapidly that it has gone through two generations (using the term somewhat loosely) in those three years. The first generation machines were typified by the first 8800 system sold by MITS, a bare bones machine festooned with switches and lights. It took a fair amount of technical know how to build one of these to get it operational. Before long, however, a new generation of machines was available. These, such as the SwTPC 6800, were usually cheaper and simpler to build, using fewer but more powerful integrated circuits.

And in July 1977, the Heath Company announced its two versions of the home computer idea, the H8 and H11 systems. I write as one of the persons who took part in the design of the H8's front panel firmware, an 8080 program called "PAM/8" which shows how software and hardware are often intimately related.

Microprocessor Front Panels

The ideal front panel for a microcomputer should allow its user total control and access to the processor's workings. A good panel system should allow an instantaneous display of the processor's states, register contents, memory contents, and other operating flags. An operator should be able to force a new state, register value, or memory value upon the processor with ease at any time without otherwise interfering with the executing program. In other words, it should be possible to examine any memory location or any register at any time without disturbing the program.

Ten years ago the implementation of such a front panel was obvious. The processor was built up from components such as integrated circuits, and the flags and registers were directly available on the circuit cards. In the remainder of this article, I will refer to this type of machine as a *discrete processor*, although it may be built out of high level integrated circuits. To build a suitable front panel for such a discrete processor, it is merely necessary to run a wire to a front panel indicator. Likewise, special logic can be built to allow flags and registers to be set from the front panel switches, usually when the machine is in a halted condition. Readers may have had experience with some of these minicomputer systems, such as the CDC 1700 or the IBM 1130 and 1620. This design works reasonably well, but the binary format is inconvenient and the cost of the front panel hardware and logic can be prohibitive for use in a personal computing system.

The situation was considerably changed with the advent of microprocessors. Now, for the first time, a full-fledged computer is within the financial reach of the general public. Unfortunately, the very development which brought this exciting possibility also brought problems. With a 1 integrated circuit microprocessor, the processor flags and register contents were no longer available for a front panel system, being buried out of reach of any possible hardware hookups. A typical microprocessor integrated circuit only has 40 connection pins (or pinouts). These are partly taken up with power supply and clocking signals, as well as the data and address buses. The remaining pins are allocated to receiving and providing signals to interface the processor to the rest of the computer system. As a result, there is no direct way to determine the contents of the processor's registers.

Jim-pak[®]

electronic components

One-Stop Component Center

AUTHORIZED DEALERS

ALABAMA

Crowell
Huntsville
Mobile
ALASKA
Anchorage
ARIZONA
Flagstaff
Fountain Hills
Tempe
Sierra Vista
Yuma

CALIFORNIA

Bellflower
Berkeley
Brea
Cypress
El Monte
Fontana
Fullerton
Glendale
Lake Tahoe, South
Lancaster
Long Beach
Mission Viejo
Modesto
Modesto
Monterey
Oceanside
Palmdale
Palo Alto
Pasadena
Riverside
Sacramento
Sacramento
San Bernardino
San Carlos
San Diego
San Fernando
San Francisco
San Jose
San Luis Obispo
San Rafael
Santa Barbara
Santa Cruz
Santa Maria
Santa Monica
Sunnyvale
Torrance
Vallejo
Van Nuys
Ventura
Walnut Creek
Westminster
Whittier
Whittier

COLORADO

Aurora
Denver
Steamboat Springs

CONNECTICUT

Bridgeport

FLORIDA

Ft. Lauderdale
Gainesville
Lakeland
Orlando
Pensacola
Tampa
Tampa

GEORGIA

Atlanta
Hawaii

HAWAII

Aiea

HONOLULU

IDAHOO

Boise

ILLINOIS

Carbondale
Evanston
Evanston
Granite City
Groveland
Mount Prospect

INDIANA

Niles
Oak Park
Peoria
Rockford
Schaumburg

INDIANA

East Chicago
Hammond

IOWA

Clinton
Davenport
Des Moines
Indianola

KANSAS

Kansas City

Tucker Bros.
Industrial Electronic Supply
Lafayette Radio Electronics

Electronics Corp. of Alaska

Jim's Audio & Stereo Repair
P & C Communications
Computerworld Inc.
B & S Electronics
Yuma Electronics

Earl's Hobby Shop
Al Lasher Electronics
Century Electronics
SCR Electronics
Kimball & Stark
Fontana Electronics
Orvac Electronics Inc.
Eagle Electronics
CalPine Electronics
Consumer Electronics
Scott Radio Supply Inc.
Tower Electronics Corp.

Computer Magic
Pacific Radio
Zackit

Electronic Center

Radio Shack A.S.C. Palmdale

Zack Electronics

Dow Radio Inc.

Computer Center

Heathkit Electronic Center

The Radio Place

Zackit

Inland Computer & Electronics

J & H Outlet Store

Radio Shack A.S.C. Mira Mesa

Radio-Tronics Inc.

San Fernando Electronics

Zack Electronics

Zenith Distributing Corp.

Quement Electronics

Mid-State Electronic Supply

Electronics Plus

Lombard Electronics

Santa Cruz Electronics

Caps Electronics

Mission Control

Sunnyvale Electronics

SE Electronics

Thrifty Electronics Supply

Lombard's Electronics Inc.

Byte Shop of Walnut Creek

JK Electronics

D & S Electronics

Whittier Electronics Co.

Com Co Electronics

Mt. Coin Distributing Co.

Norm's TV & Electronics

Bridgeport Computer

Computers For You

Lafayette Radio

Lakeland Specialty Electronics

Altai: Computer Center

Grice Electronics Inc.

AMF Radio

Microcomputer Systems

Atlanta Computer Mart

Delcoms Hawaii

Integrated Circuit Supply

Custom Electronics

A-Gem Supply Inc.

Audiotronics

Lafayette Radio

Itty Bitty Machine Co.

Tri-State Electronic Corp.

Computer Systems Center

Moyer Electronics

Tri-State Electronic Corp.

Computer Land

Electronics Inc.

Warren Radio Co.

Imperial Computer Systems

Data Domain

Acro Electronics Corp.

Quantum Computer Works

Bridge Elec. Computer Center

Computer Store of Davenport

Radio Trade Supply Co.

Electronix Limited

Electronic Surplus Sales

KANSAS (Continued)

Manhattan

Wichita

KENTUCKY

Lexington

LOUISIANA

Baton Rouge

Baton Rouge

New Orleans

MARYLAND

Baltimore

Baltimore

La Vale

Rockville

Silver Spring

Towson

Towson

MASSACHUSETTS

Medford

North Adams

Waltham

Worcester

MICHIGAN

Ann Arbor

Flint

Grand Rapids

Lansing

Midland

Mt. Clemens

Muskegon

Communications Specialties Ltd.

Amateur Radio Equipment Company

Radio-Electronic Equipment Co.

Davis Electronics Supply Co.

Menard Electronics Inc.

Wm. B. Allen Supply Co.

Computers Unlimited

Computer Workshop of Baltimore

Everything Electronic

J & M Electronics

Computer Workshop

Computers Etc.

Baynesville Electronic Inc.

Computers Etc.

Tufts Electronics

Electronics Supply Center

Computer Mart Inc.

RM Electronics Inc.

Airway Electronic Communications

Hobby Electronic Center

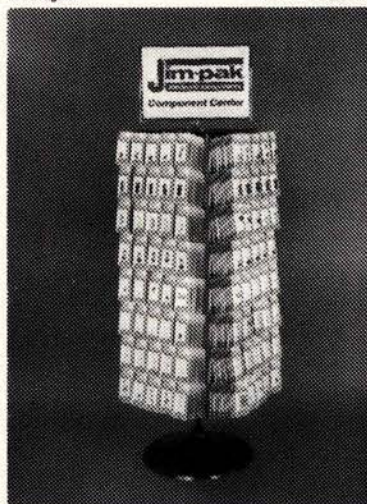
Micro Computer World

Fulton Radio Supply Co.

Computronix Corp.

The Computer Store

H.R. Electronics



MINNESOTA

Duluth

Eagan

Hopkins

St. Paul

MISSOURI

El Dorado Springs

Florissant

Parkville

MONTANA

Billings

Bozeman

Great Falls

NEBRASKA

Lincoln

Lincoln

North Platte

Omaha

Omaha

NEVADA

Las Vegas

NEW JERSEY

Bayville

Bricktown

Cherry Hill

Hoboken

Paterson

Pompton Lake

Ramsey

NEW YORK

Albany

Kingston

New York

Rensselaer

Rochester

Troy

Utica

Northwest Radio of Duluth

Computer Room Inc.

Heathkit Electronic Center

Heathkit Electronic Center

Beckman Electronics

Computer Country

Computer Workshop of Kansas City

Conley Radio Supply

Electronic Service & Distributing

Art's Electronics

Altair Computer Center

Scott Electronic Supply Inc.

Scott Radio Supply Corp.

Heathkit Electronic Center

Omaha Computer Store

Century 23

A.R.S. Communications Services

Radio Shack Associate Store

The Computer Emporium

Hoboken Computer Works

All-tronics

Computer Corner of New Jersey

Typetronic Computer Store

Fort Orange Electronics

Greylock Electronics

Computer Mart of New York

Com-Tech Electronics

2001 Microsystems

Trojan Electronics

Am-Com Electronics

NEW YORK (Continued)

White Plains

Williamsburg

NORTH CAROLINA

Durham

Greensboro

Raleigh

NORTH DAKOTA

Fargo

OHIO

Bucyrus

Cincinnati

Columbus

Dayton

Reynoldsburg

OKLAHOMA

Guymon

Oklahoma City

Tulsa

OREGON

Albany

Beaverton

Coos Bay

Medford

Ontario

Portland

Salem

PENNSYLVANIA

Drexel Hill

Erie

Hershey

Murrysville

Phoenixville

Pittsburgh

Wilkesbarre

York

RHODE ISLAND

Cranston

Pawtucket

SOUTH CAROLINA

North Charleston

TENNESSEE

Chattanooga

Clarksville

Cookeville

Knoxville

Memphis

Memphis

Nashville

Oak Ridge

TEXAS

Amarillo

Dallas

Houston

Houston

San Antonio

UTAH

Provo

Salt Lake City

VIRGINIA

Alexandria

Alexandria

Charlottesville

Hampton

Richmond

Roanoke

Springfield

Virginia Beach

WASHINGTON

Kennewick

Previous Front Panel Systems

Attempts to solve this fundamental problem of control over the microprocessor have been responsible for the major differences between competing machines. The first widely available machine, the MITS 8800, used a direct approach to front panel design: it simply had LED readouts for each pinout on the microprocessor chip and a bank of switches hooked across the data and address busses. Some additional logic was incorporated to control the running state of the microprocessor and to allow memory locations to be read to and written from via the front panel. This scheme is a straightforward adaptation of traditional panel design; unfortunately, there wasn't a great deal of correspondence between the useful items a programmer might want and the data available on the processor pinouts.

The difficulties of using such a panel system are by now nearly legendary: it is very awkward and time consuming to get information in and out of the processor. For example, to simply determine the contents of a register, it is necessary to stop the processor, write a small program to store the register in a memory location, key it in to some unused portion of memory, run it, read the stored value from memory, and then restore control to the interrupted program. Needless to say, this is a tedious process with many opportunities for error.

The problems with this approach no doubt influenced the designers of the second generation machines. They used a different approach wherein a console terminal was used in conjunction with a monitor program (usually in read only memory) to provide the equivalent of front panel service. With such a system, a programmer could display desired information such as memory or register contents directly in octal or hexadecimal. This represented a great step forward: entry speed was increased, and the clerical task of encoding and decoding binary values was eliminated. Another great benefit of this system was that most of the monitors incorporated a bootstrap loader so that the loader did not have to be keyed in each time.

This technique has been rapidly gaining popularity at the expense of the lights and switches system, for obvious reasons. Several companies are offering such monitors encoded in read only memory boards to allow users to convert their old systems. However, this new technique still has a few disadvantages: it requires a console terminal, which adds considerably to the system cost,

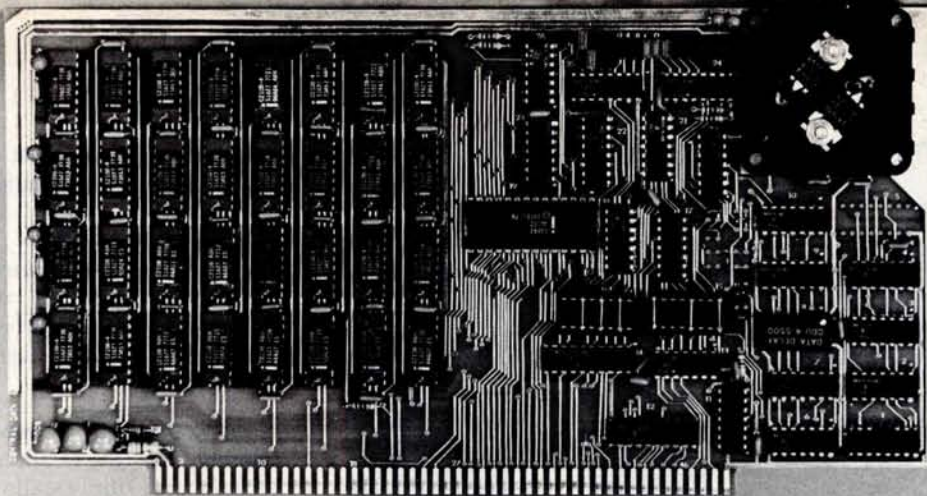
and once a user program has started execution the services of the monitor system are no longer available.

PAM/8 Design Goals

It was mentioned above that the front panel system is the area in which many of the differences between computer systems are found; this holds true for the Heath H8 system as well. The H8 employs a new concept in microprocessor front panels: it uses a unique combination of software and hardware to allow the emulation of a complete real time front panel system which I believe to be superior in performance to even the discrete minicomputer panel systems.

When the H8 project began, Heath engineers studied the requirements for a good front panel system closely and drew up a list of the major features to be satisfied. There were nine major requirements of a good front panel:

- The front panel system must present and accept data in a convenient octal format. Encoding and decoding binary is a job more suited to a computer than a human being.
- The front panel system must incorporate facilities to load and dump memory to and from an external device such as a cassette interface. A nearly foolproof error detection scheme must be used so that mysterious errors will not be introduced by bad loads.
- The front panel system must allow memory and register contents to be conveniently displayed and changed. In addition, data display has to be in real time. That is, if the front panel is displaying the contents of a register and the running program changes those contents, the change should be immediately visible on the panel.
- The front panel system must be capable of execution control. That is, the programmer should be able to step through a program one instruction at a time, and be able to set breakpoints within his code.
- The front panel system must provide facilities for inputting and outputting to IO ports.
- The front panel system must be easy to use, and (as much as possible) should reduce the opportunity for operator error. Whenever a front panel operation is performed, the programmer must be informed of the operation's success or failure.



We Start With A Price That's Hard To Beat.

But We Don't Stop There.

Central Data Corporation has combined the benefits of new technology and high-volume company sales to bring you a RAM board with more features and product options for less money.

Lower Prices

More Memory Capability

To begin with, we've reduced the price of our 16K RAM board by \$40 to \$249. At \$425—a price reduction of \$50—our 32K board costs less, too. Plus, we now offer a full 48K memory board for \$599. These boards are expandable to 64K at a price of \$185 per 16K package. Or you can start right out with a full 64K board for \$775.

Improved Board Design

We've also added improvements to the board design at no extra cost to you.

- **Deselectable in 2K increments.** Our deselect feature enables you to switch off any 2K to avoid overlap with your existing memory.
- **Fully socketed memory.** This feature enables you to expand the memory board yourself.
- **Plug selectable addressing.** Now you can re-address without soldering

Other Standard Features

- Power-saving dynamic board with on-board invisible refresh
- One-year guarantee on parts and labor
- S-100 and Z-80 compatible

Specifications

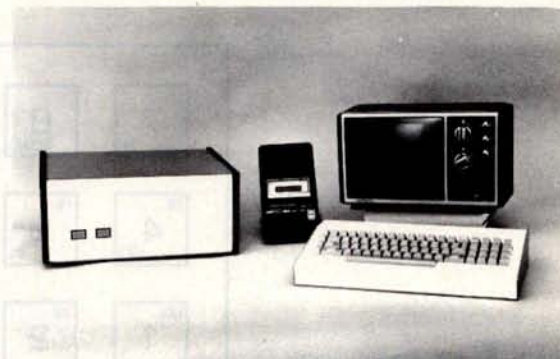
Storage Capacity	16K, 32K, 48K, or 64K
Addressing	16K boundaries
Max. Input Load	One LS TTL load
Output Buffering	On all data lines
Access Time	450ns
Cycle Time	480ns
Wait States Generated	None
Maximum DMA Rate	1 Mhz

Circle 45 on inquiry card.

Power Consumption

+ 16	150ma
+ 8	300ma
- 16	20ma

Other Products From Central Data



Central Data also offers, fully-assembled and in kits, a range of other computer products including (pictured above) our 2650 microprocessor, software packages, TV/Monitor, ASCII keyboard, and (not pictured) floppy disk system, to name just a few.

For More Information To Place an Order

We welcome any questions you have about our RAM boards or other products. To place an order, or for more information contact:

Central Data Corporation

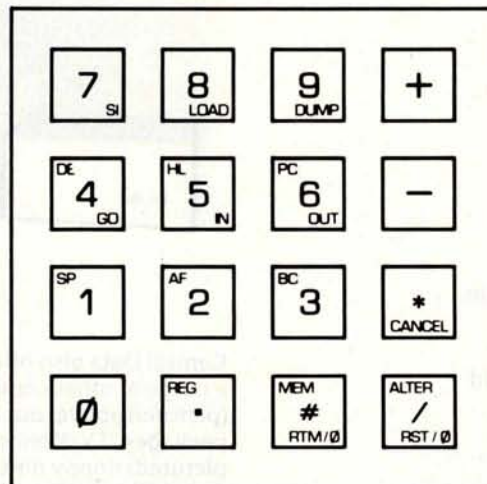
P.O. Box 2484, Station A
Champaign, IL 61820
Ph. (217) 359-8010

Place orders prepaid or COD. Delivery is stock to 30 days with shipping and handling prepaid in Continental United States. Please include phone as well as name and address.



Photo 1: Front panel of the Heath H8 computer. At left are nine 7 segment LED displays and four single LED lamps; at right is the 16 key keypad. The front panel is controlled by a novel firmware panel monitor (PAM/8) made up of both hardware and software elements.

Photo 2: H8 16 key keypad, the sole input source for the panel monitor (PAM/8). The keypad is used to enter commands and data. Some keys have more than one function, but the monitor provides an indication of which meaning will be taken for these keys.



- The front panel system must be transparent. In other words, it must emulate a hardware panel system so that no changes are necessary to any program to allow it to be run under the PAM/8 (Panel Monitor) system. Likewise, the front panel firmware must present a light processor load to the system so that program execution proceeds at a normal pace.
- The front panel system must be versatile. No system can be all things to all people. Some sophisticated users may have special requirements;

the system must be designed to allow the sophisticated user to circumvent part or all of the system.

- The front panel system must be inexpensive. Advanced design techniques must be used to keep the cost of the panel system at or below the cost of current front panel systems.

Undoubtedly, this was a formidable list. Happily, though, Heath was able to report success with the creation of the PAM/8, the panel monitor for the H8 computer.

PAM/8 Description

The front panel of the H8 computer is shown in photo 1. Three features are immediately obvious: a 16 key keypad, nine 7 segment LED displays, and four single LED lamps.

The 16 key keypad (see photo 2) is the sole input device to the PAM/8 system. It is used for commands for PAM/8, to enter data into memory and registers, and as a bank of sense switches. Some keys have more than one function; however, no confusion results because PAM/8 provides a clear indication at all times of which meaning will be taken for such keys.

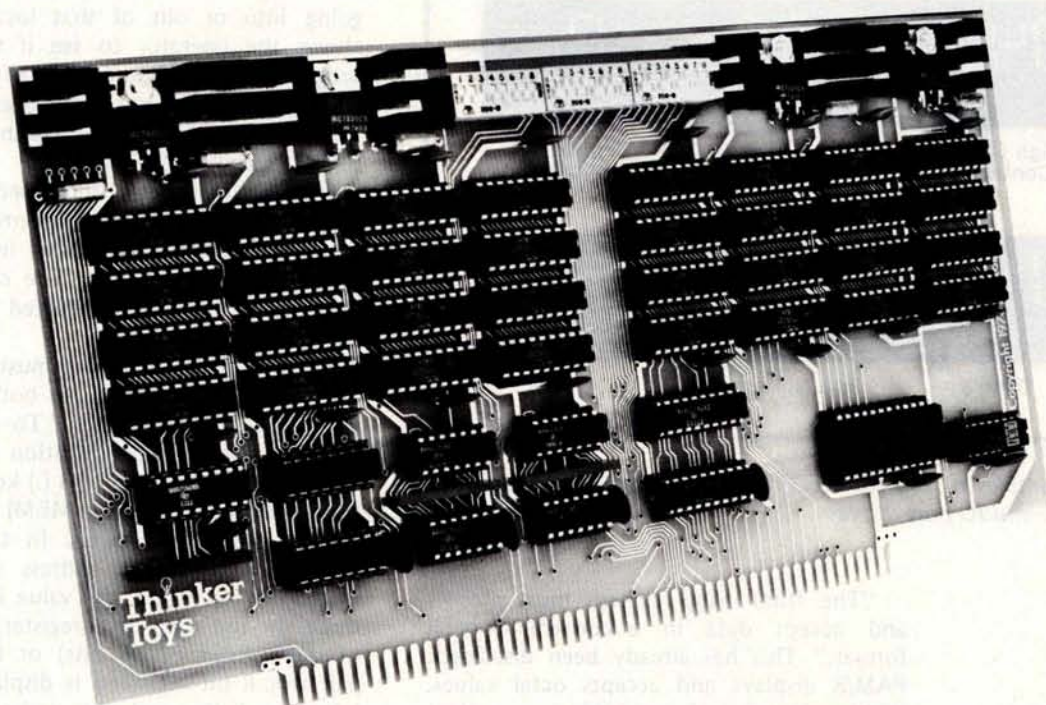
The second visible feature is the group of nine 7 segment LED displays. These are used to display addresses, data, and register names. 16 bit values are displayed in "split octal" notation. Each byte is represented as three octal digits; therefore, a 16 bit value is simply presented as two such byte groups together. Thus, in split octal notation, $377 + 001 = 001\ 000$.

The third visible feature consists of four LED lamps (see photo 3). Three of these lamps display true hardware conditions: power on (PWR), processor running (RUN), and interrupts enabled (IE). In fact, these are the only hardware indicators in the PAM/8 system. All other displays, indicators, and keypads are under firmware control. The remaining LED, MTR, is lit when the computer is in monitor mode. Monitor mode means that the user program is not running, and the keypad is available for PAM/8 commands. When the user program is running, PAM/8 ignores most keypad commands so that the user program can use it as an input (sense switch) device.

The best way to describe the operation of the PAM/8 monitor is to go through the list of design goals again, describing how it fulfills each objective. In the process, I will touch upon some other pieces of PAM/8 hardware not visible on the front panel.

SuperRam™

16K STATIC FOR \$299



Introducing SuperRam™ 16K static memory, the one that's leaping tall price barriers at a single bound. It saves you about \$100 on the usual cost of a big 16K memory for your S-100 system.

SuperRam™ 16K is the latest in cost-efficient memory designs by George Morrow, designer of the best-selling ECONORAM* memories.

SuperRam™ 16K is configured as four independent 4K blocks, each separately addressable and write-protectable. Designed to meet the proposed IEEE Standard for the S-100 bus (see IEEE Computer, 5/78), all signals are fully buffered—including address and data lines. And Morrow's design uses just 11 chips to keep the board uncrowded and trouble-free.

SuperRam™ 16K comes as an easily assembled kit, with solder mask and parts legend.

Ask for the SuperRam™ 16K memory kit at your local computer shop. Or if unavailable locally, call your BankAmericard/Visa or Master Charge order to 415-524-5317, 10-4 Pacific Time. Or send check or money order to Thinker Toys™, 1201 10th St., Berkeley, CA 94710. Add \$3 for handling; Cal. res. add tax.

*ECONORAM is a trademark of Godbout Electronics

A product of Morrow's Micro-Stuff for

**Thinker
Toys™** 1201 10th Street
Berkeley, CA 94710

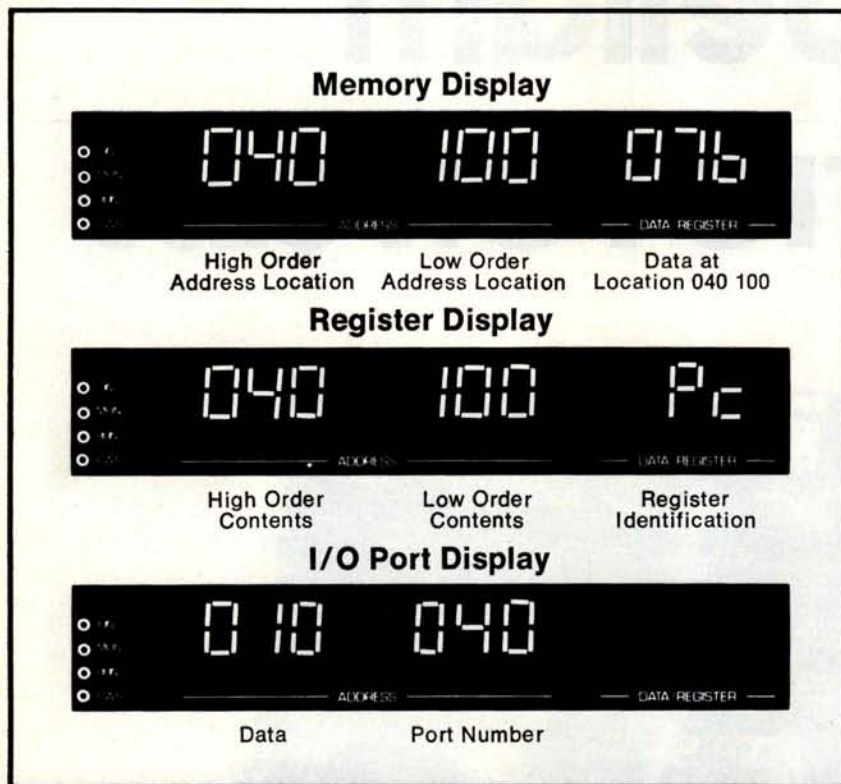


Photo 3: Three examples of the H8 LED readout format for memory display, register display and IO port display.

"The front panel system must present and accept data in a convenient octal format." This has already been discussed: PAM/8 displays and accepts octal values. 16 bit values are represented in a convenient byte octal notation.

"The front panel must incorporate facilities to both load and dump memory." The 8 and 9 keys are used for loading and dumping memory. In order to dump a block of memory to an output device (usually magnetic or paper tape), one must supply PAM/8 with the starting dump address, the ending dump address, and the entry point address. When the DUMP key is struck, PAM/8 writes a formatted record containing the memory contents. The dump record produced contains the starting address, the entry point address, and the memory data. The record is followed with a 16 bit cyclic redundancy check (CRC-16).

To reload a memory dump tape, place the tape in the transport (cassette or paper tape) and strike the LOAD (8) key. PAM-8 will read the tape and discard any information until the *beginning of record* sequence is found. The load operation then begins. When the load is complete, the computed CRC-16 is compared to the one on the tape.

If the load is correct, PAM/8 gives a single beep. Since the program counter (PC) register was loaded with the entry point address, striking the GO key will begin execution. If the load is incorrect, PAM/8 displays the error code 001 (CRC error) and repeatedly beeps the horn. Pressing CANCEL (*) silences the horn.

During the load and dump operations, the six leftmost LEDs display the address being loaded or dumped, while the three remaining LEDs display the data value going into or out of that location. This allows the operator to see if the load is progressing, and gives an idea of how much is left. The H8 cassette system runs at 1200 bps, allowing the loading of 8 K BASIC in about 60 seconds.

The CRC-16 check value used in PAM/8 is nearly foolproof: single bit errors, double bit errors, and error bursts of less than 16 bits are always detected. The chance of a larger error escaping undetected is less than 0.0002%.

"The front panel system must be capable of displaying and altering both memory and registers conveniently." To display the contents of a memory location or register, strike the MEM (#) or REG (.) key followed by a 6 digit address (for MEM) or a 1 key register select (for REG). In the case of memory display, the address will appear in the left six digits, the value in the right three. In the case of a register, the value of the register (if 16 bits) or the register pair (for 8 bit registers) is displayed in the left six digits, and the register name(s) is displayed in the right two digits. See photo 3 for examples.

To change the contents of a register or memory location, first display the old contents as described above. Next strike the ALTER (/) key. You can then alter the register or location by entering six (or three) octal digits. As each 3 digit group is entered, the PAM/8 monitor provides a beep in acknowledgement. In the case of memory alteration, the memory address is automatically incremented by one. This allows you to enter a series of memory locations by entering a steady stream of values.

When the altering is complete, restriking the ALTER key clears the alter mode and restores the 0 through 7 keys to their usual function.

It is important to note that the register and memory displays are real time: if the contents of that register or location change, the display will immediately show the new value. Thus, to watch the PC register in a

ECONORAM™: THE PLUG-IN-ANYWHERE MEMORY.

... And that's not by accident, but by design. Econoram is the memory that works with IMSAI, Altair/Pertec, Cromemco, Sol, North Star Horizon, Polymorphic, Vector Graphic, and other S-100 buss systems, thanks to **static** design that eliminates dynamic timing problems, conservative engineering, full buffering, high speed/low power parts, and intelligent mechanical design. Even better, though, we don't just design our boards to work... we design them to keep on working.

But, you don't have to take our word for it. Ask the dealers who carry Econoram because they want satisfied customers and no callbacks. Ask the system assemblers who, no matter what their choice of mainframe, use Econoram memory boards exclusively. Ask the professional users who specify Econoram for critical computer applications such as accounting and record-keeping. Ask the people who never get to take

advantage of our 1 year warranty on parts. Ask the independent survey from Image Resource, "1978 Profile of Computer Store Customers" (mentioned with permission), which named Godbout as one of the biggest suppliers of peripherals in the business. Better yet, ask an Econoram owner.

The following memories are available in 3 forms: **Unkit** (all sockets and bypass caps wave-soldered in place, user simply solders in a few other parts and inserts ICs); **assembled** and **tested**; or qualified under the **CSC** (Certified Systems Components) program. This program offers a board that is assembled, tested, guaranteed to run at 4 MHz, and burned in for 200 hours. If the board fails within a year of invoice date, we immediately exchange (not repair) the board upon notification from the customer.

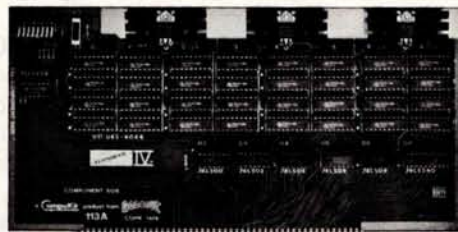
16K ECONORAM IV™

\$279 (unkit)

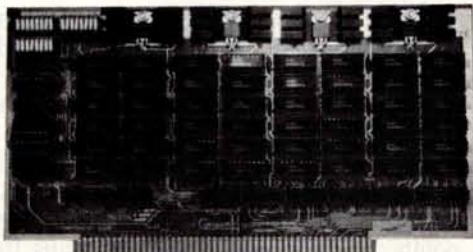
Assembled price \$314, CSC \$414.

We've been shipping these since May, and we've shipped a lot of them. Why? Current consumption under 2000 mA (usually way under). Fast operation. Manual write protect switches for 4K blocks. Can be used with or without phantom line. And, all the regular features of an Econoram. If you want a big block of memory, at a fair price, that will work with any system... here it is.

Our current best-seller:



Our top of the line:



24K ECONORAM VII™

\$445 (unkit)

Assembled price \$485, CSC \$605.

Current under 2000 mA, fast operation, and our other usual features. Additionally, Econoram VII is configured as two 4K blocks (addressable on 4K boundaries) and two 8K blocks (addressable on 8K boundaries), with independent write protect switches for each block. If you want full feature, dense memory, this is the board for your system.

OTHER S-100 BUSS PRODUCTS

10/11 SLOT MOTHERBOARD \$90

in kit form, with all edge connectors wave-soldered in place (which really takes the tedium out of building a motherboard!). Large power and ground traces, extensively bypassed. Includes active termination circuitry for reliable data transfer (see "Active Terminator Board" below).

18 SLOT MOTHERBOARD \$124

in kit form, with all edge connectors wave-soldered in place. Same as above, but with 18 slots.



ACTIVE TERMINATOR BOARD \$29.50,

kit form. Active termination promotes reliable and accurate data transfer by minimizing the ringing, crosstalk, overshoot, noise, and other gremlins that can occur with unterminated lines. Saves considerable energy compared to passive termination systems, thereby putting less strain on your power supply and keeping heat out of your mainframe. This is the board that tamed the S-100 buss... put one in a motherboard slot, and watch the glitches go away from your buss.



IF YOU SPEAK TRS-80, THEN READ THIS.

We introduced our TRS-80 Conversion Kit so that anybody could upgrade their 4K machine to a 16K machine. But apparently, that's not all our kit can do (which might explain why it's selling so well). One user wrote to say that our conversion chip set not only works in the mainframe, but also works with the memory expansion module offered by Radio Shack... and that he is currently running 32K of memory in his TRS-80. Some dealers have mentioned using these chips to expand Apples also.

No matter what you use it for, our conversion kit comes with eight uPD416 16K RAMs, DIP shunts, and full instructions. We back up our parts with a 1 year warranty.

Single kit price is \$190, or take advantage of our "Memory Expansion Special": 3 kits for \$

SAY HELLO TO A COMPUKIT™ TODAY.

Many dealers carry CompuKit products from Godbout. Our previous dealer list (see last month's issue of this magazine) was current as of May 1, 1978; we've added quite a few since then... call us for referral to the dealer nearest you.

GODBOUT

BILL GODBOUT ELECTRONICS
BOX 2355, OAKLAND AIRPORT, CA 94614

TERMS: VISA®/MASTERCARD® orders: Call our 24 hour answering service at (415) 562-0636. COD orders OK with street address for UPS. Californians add tax. Thank you very much for your business.

running program, merely select it for display and type GO. Should you now decide to watch the contents of a memory byte, press RTM/0 (# and 0 simultaneously) to halt the program, select the memory location, then press GO to resume execution from where it halted.

"The front panel system must be capable of execution control." PAM/8 provides five types of execution control:

- Run
- Halt
- Jump
- Breakpoints
- Single Instruction

Pressing the GO key starts a program running at the current value of the PC register. The desired start address can be entered into the program counter beforehand. To stop a running program, press RTM (return to monitor, keys 0 and # simultaneously). Execution of the program will immediately halt, and the MTR light will come on. The operator can now examine registers and memory locations and may alter them if desired. Pressing GO causes execution to resume where it left off. To jump the processor to a section of code, press RTM, alter the PC register and press GO.

When a HLT instruction is encountered by a user program, the PAM/8 gives a single alarm beep and execution of the user program is halted. The PC register points to the byte following the HLT operation. Pressing GO causes execution to resume following the HLT opcode. The user can make use of breakpoints to debug programs by assembling or patching in HLT operations.

PAM/8 also includes a single instruction facility. Each time the SI key is struck, the instruction pointed to by the program counter is executed and the user program is immediately halted. This works for all 8080A instructions except DI (disable interrupts) including jumps, subroutine calls, and other control-transfer instructions. Holding down the SI key causes the execution of an instruction every 400 ms. It is especially instructive to display a register and use the SI key to execute instructions one by one while watching the effect these instructions have on the registers being displayed.

"The front panel system must provide facilities for communicating with IO ports." To communicate with an IO port, use the MEM key to enter the 3 digit data value and the 3 digit port address as a 6 digit memory address. Striking the OUT key causes the data value to be output to the

port. Striking the IN key causes the value read from the port to be displayed in the leftmost three digits.

"The front panel system must be easy to use and should reduce the possibility for error." In order to increase convenience and minimize operator errors, PAM/8 is designed to maximize the bandwidth of the operator-machine communication channel. Thus, PAM/8 communicates in three different ways: by the digit displays, by the alarm horn, and by the display decimal points. The use of the digit displays in communication is obvious. Many panel operations, such as entering addresses and values, cause the display to change. For instance, when altering memory, the value of each key struck is shown in the displays. The front panel horn actually serves three purposes:

- Verify keystrokes.
- Provide information (such as the beep when entering byte values).
- Provide alarm indications (such as a CRC error when loading).

The PAM/8 uses the digit decimal points independently of the values on the digits themselves. As can be seen from photo 1, some keys have multiple uses. PAM/8 uses the decimal points to indicate which use of the key is currently *active*. When the REG or the MEM key is struck, PAM/8 expects an address (or register number). The decimal points are lit continuously, indicating that the address must be entered and that the keys 0 through 7 will be taken as address values. When the ALTER key is struck, PAM/8 displays a rotating pattern on the decimal points, indicating that a value must be entered, and the keys 0 through 7 will be taken as data values.

"The front panel system must be transparent." In operation, PAM/8 is totally transparent to a task program; ie: the program need not take any notice of the presence of the PAM/8 system; any existing 8080A program can run on the H8 without change (assuming it is ORGed correctly, and the IO is compatible). Since PAM/8 is implemented partially in system software, it does require processor service for operation. Normally, PAM/8 uses about 15 percent of the processor's capacity, leaving 85 percent for task programs. Most programs are compute bound for very short periods of time, and this presents no difficulties. Programs which must run at full speed can set a flag bit in the PAM/8 programmable memory area to turn off the front panel, which then gives the task program 100 percent of the

Radio Shack's personal computer system? This ad just might make you a believer.

**You can't beat
the 4K system at
\$599**



TRS-80 "Breakthru"

- TRS-80 microcomputer
- 12" video display
- Professional keyboard
- Power supply
- Cassette tape recorder
- 4K RAM, Level-I BASIC
- 232-page manual
- 2 game cassettes

**...or the step-up
16K system at
\$899**



TRS-80 "Sweet 16"

- Above, except includes 16K RAM

**...or the fast
4K/printer system at
\$1198**



TRS-80 "Educator"

- Above, except includes 4K RAM and screen printer

**...or the Level-II
16K/printer/disk
system at
\$2385**



TRS-80 "Professional"

- Above, except includes 16K RAM, disk drive, expansion interface, and Level-II BASIC

**So how are you gonna beat the system that
does this much for this little? No way!**

**...The amazing new
32K/Level-II/2-disk/
line printer system at
\$3874**



TRS-80 "Business"

- Above, except includes 32K RAM, line printer, and two disk drives

Get details and order now at Radio Shack stores and dealers in the USA, Canada, UK, Australia, Belgium, Holland, France, Japan.
Write Radio Shack, Division of Tandy Corporation, Dept. C-097, 1400 One Tandy Center, Fort Worth, Texas 76102. Ask for Catalog TRS-80.

Radio Shack®
The biggest name in little computers™

processor's capacity. The task program can then reenale PAM/8 when it desires.

"The front panel system must be versatile." Although a user program need not communicate directly with PAM/8, such communication is possible. In general, there is a set of special control bytes in the PAM/8's programmable memory area which can be used to control system operation. For example, a user program can cause PAM/8 to display any arbitrary segment pattern on the LED displays. Likewise, the user program can cause PAM/8 to stop refreshing the displays so that the program can refresh them itself. In general, it is possible to totally *close down* PAM/8 operations and to have a user program take them over, thus totally replacing the PAM/8 monitor with a homebrew system. Of course, user programs can make use of the PAM/8 utility subroutines to communicate with the tape system, read the keypad (with audio feedback and auto repeat), sound the horn, and so forth.

"The front panel system must be inexpensive." PAM/8 provides powerful features at a low cost due to its firmware design. The read only memory software handles display decoding and refreshing, keypad debouncing, and all high level functions. The necessary hardware consists of the keys, the LED displays, and a few SSI and MSI logic gates. In general, the PAM/8 design costs less than a good toggle switch and lamp panel.

How It Works

As mentioned above, PAM/8 is a firmware system, meaning that its functions are implemented by a closely integrated combination of hardware and software. The hardware resides on the front panel circuit board itself, and the software resides in a 1 K read only memory on the processor board. This read only memory contains a program which does most of the work for the PAM/8 system. Actual hardware was used only when the function could not be implemented by the program.

The central concept in the PAM/8 system is its built-in clock interrupt. When the system is powered on (or master cleared) PAM/8 sends a command to the panel control port requesting an interrupt every 2 ms. This interrupt interval is derived from the system's crystal clock and is therefore called the clock interrupt. The presence of this interrupt allows PAM/8 to perform two processes, or tasks, *simultaneously*. Of course, they are not actually performed simultaneously, since the com-

puter has only one processor, but to a being as slow as a human the operations appear simultaneous.

This division of the work load between two independent tasks, the task time and the interrupt time processes gives PAM/8 its power. For the sake of clarity, the functions of these two tasks will be discussed separately and it will be assumed that they are truly simultaneous.

Interrupt Time

The interrupt time task is always running (unless shut off by the user program) and has three main jobs:

- Process display refreshing and updating.
- Maintain system clock.
- Allow user program clock servicing.

The most important job of the interrupt time process is to refresh the front panel displays. The displays are not latched and decoded; the display hardware consists of a 4 bit digit select field and an 8 bit pattern select field. Every interrupt cycle (2 ms), a segment pattern and digit number are output by the code. The digits are refreshed round robin so that each digit is lit every 18 ms (nine digits at 2 ms each). This gives an overall refresh rate of 55 times a second, which is sufficient to eliminate flicker. The segment patterns being refreshed are obtained from a 9 byte programmable memory area. Each 8 bit byte contains the pattern for a digit (seven segments, one decimal point). Every 32 clock interrupts, or about 16 times a second, the 9 byte pattern being displayed is updated. The PAM/8 monitor examines flag locations to determine which memory location or register is being displayed and decodes its value into nine bytes of display bar code. If a register is being displayed, the program finds its value on the stack where it was pushed when the clock interrupt occurred. It should be noted that both of these processes, refreshing and updating, may be controlled by a user program. There is a bit for each function allocated in a PAM/8 control byte; setting the bit causes the function to be discontinued. Most programs which make use of this feature turn off display updating, but they leave display refreshing turned on. Then the program can display any arbitrary pattern by simply placing segment bar patterns into the 9 byte area in memory.

The second main job performed by the interrupt time task is the maintenance of the system clock. The PAM/8 monitor



Introducing the personal computer you've waited for. The Exidy Sorcerer.

I didn't buy my personal computer until I found the one that had all the features I was looking for.

The Exidy Sorcerer does everything I wanted to do and a few things I never dreamed of.

It isn't magic. Exidy started with the best features of other computers, added some tricks of their own, and put it all together with more flexibility than ever before available. Presto! My reasons for waiting just disappeared.

I wanted pre-packaged programs. Software on inexpensive cassette tapes for the Sorcerer is available from Exidy and many other software makers.

I wanted user programmability. The Sorcerer's unique plug-in ROM PAC™ Cartridges contain programming languages such as Standard (Altair 8k*) BASIC, Assembler and Editor (so I can develop system software), operating systems such as DOS (so I can also use FORTRAN and COBOL) and applications packages such as Word Processor.

* Altair is a trademark of Pertec Computer Corp.

I wanted graphics, and the Sorcerer is super. Its 256 character set—more than any other personal computer—includes 128 graphic symbols that I can define.

I wanted high resolution video. With 122,880 points in a 512 x 240 format, I get the most detailed illustrations.

I wanted to display more information. The Sorcerer displays 1920 characters in 30 lines of 64 characters—equal to a double-spaced typed page.

I wanted a full, professional keyboard. The Sorcerer's 79-key data processing keyboard provides designated graphics, the complete ASCII character set in upper and lower case, and a 16-key numeric pad.

I wanted memory. The 12k of ROM holds a Power-On Monitor and Standard BASIC; the 8k of RAM is internally expandable to 32k.

I wanted expandability. Serial and parallel I/Os are built in, and the optional 6-slot S-100 expansion unit lets

my system grow.

I wanted a computer that's easy enough for children to use. I just connect my Sorcerer to a video display and a cassette tape recorder, and if I have any questions the easy-to-understand Operation and BASIC Programming manuals have the answers.

I wanted to buy from an experienced manufacturer. In five years Exidy has become the third largest producer of microprocessor-based video arcade games.

I wanted to spend less than a thousand bucks. (This is where Exidy does a little magic.) My Sorcerer cost me \$895!

Now, what are **you** waiting for?

Call Exidy for the name of your nearest dealer. (408) 736-2110. Or write Exidy, 969 W. Maude Ave., Sunnyvale, CA, 94086.

Exidy
inc.

maintains a 16 bit count of the clock interrupts received. Since this count is updated during the clock interrupts, it appears to task time programs that the location "magically" increments itself. Many programs, including the task time portion of PAM/8, make use of this counter.

The third major job of the interrupt time task is the handling of user clock processing. Normally, PAM/8 returns directly from the clock interrupt so that the operation will be transparent to the user program. However, a user program can set a bit in a PAM/8 control byte requesting that a user subroutine be called during every clock interrupt. This allows the user to also write task time and interrupt time systems, as well as giving multitasking capability.

Task Time Task

While all this clock interrupt processing is taking place, the H8 is also running a *task time* program. Task time refers to the "problem solving" program which runs when interrupts are not being serviced. Under the PAM/8 system, the task time

program may be the user program itself, or it may be the PAM/8 command processing program.

When the system is initialized after power up, the task program is the PAM/8 command processor, which continually reads the keypad for operator commands. Keypad debouncing, key strike verification (beeps) and auto repeat on the keypad are all time dependent functions; PAM/8 makes use of the system clock to implement them. When a command is recognized, it is executed immediately. Having the interrupt time task running simultaneously with the command loop greatly simplifies command processing. For example, pressing the + key (when displaying memory) is supposed to cause the next location to be displayed. All the command processor needs to do is to increment the "address being displayed" word in memory. Sometime during the next 32 clock interrupts the interrupt task will decode this new address and its contents, causing the new address and value to be "magically" displayed (after a maximum wait of 1/6 of a second). In a similar manner, the routines to handle the LOAD and DUMP functions merely update the address being displayed word after every byte is loaded or dumped; the interrupt time task sees to it that the address being loaded is continuously displayed on the panel LEDs.

After reading this discussion, you can probably guess how the GO command is implemented: the PAM/8 monitor merely restores the user registers from the stack. The PC register is restored last, which causes execution to begin at the specified location. The interrupt time task proceeds as before, decoding and displaying the selected memory or register contents. Should the location or register be altered by the running program, the front panel will very quickly (typically in 32 ms) show the change.

HLT and Return to Monitor

So far, we've seen that the interrupt time and task time processes don't intermingle; each keeps to its own. The processing of the HLT instruction and the RTM (return to monitor) command are exceptions to this principle. When a HLT instruction is encountered the processor waits with the program counter pointing to the next byte. When the next clock interrupt comes along, the interrupt processing code takes a look at the preceding instruction; if it is a HLT, the code passes control directly to the PAM/8 task time command loop, never

P.E.T.™ PRODUCTS

SOFTWARE/ACCESSORIES/HARDWARE

Memory Expansion!!! 31,743 Bytes Free! **NEECO** now has internal memory Expansion Boards Available for your PET! 16K, 24K and 32K Memory Configurations. Call or write **NEECO** and ask for our "Free" Software and Hardware Directory. Power up to 32K Bytes! Call **NEECO** for more info.

Software-NEECO has too many programs to list them all here! Call or write and ask for our "Free" Directory! **Software Authors! **NEECO** offers 25% Royalties on Pet programs with nationwide distribution! Call **NEECO** for additional information on our 25% Royalty Program.

PET & Peripherals-NEECO offers fast (off the shelf?) delivery schedules for the **Pet Computer** and **Peripheral 2020 Printer**. **NEECO** also offers excellent personal & Warranty service!!! Interested in a **Pet**? Call and request our **P.E.T. Info Pak**. Feel free to call and ask questions.

The Music Box Music Composer and sound effects generator allows you to compose and hear music on your **Pet**! Program & Hardware allows you to display notes, hear the notes, save pages of music on tape for later playback or modification! The **Music Box** actually displays the notes as a song or tune is played! Allows you to add sound effects to your own **Pet** Programs. Endless Possibilities! All Cassette Software, plug-in Hardware, and **Music Box** instructions for only \$49.95! **Music Box** Fits right inside your **Pet**! No assembly required! **Music Box** even plays random tunes!

NEECO Dust Cover Protect your **Pet**! Cover your **Pet's** delicate circuitry and keyboard from dust that can, over time, cause intermittent chip failures! Heavy, clear Plastic **Dust Cover** shows off your **Pet** while protecting it from dust, spills, and those inevitable "Unwanted Sticky fingers"! Manufactured to last as long as your **Pet**!—only \$17.95

VISA OR MC Phone orders Accepted—(4% Surcharge on Hardware)

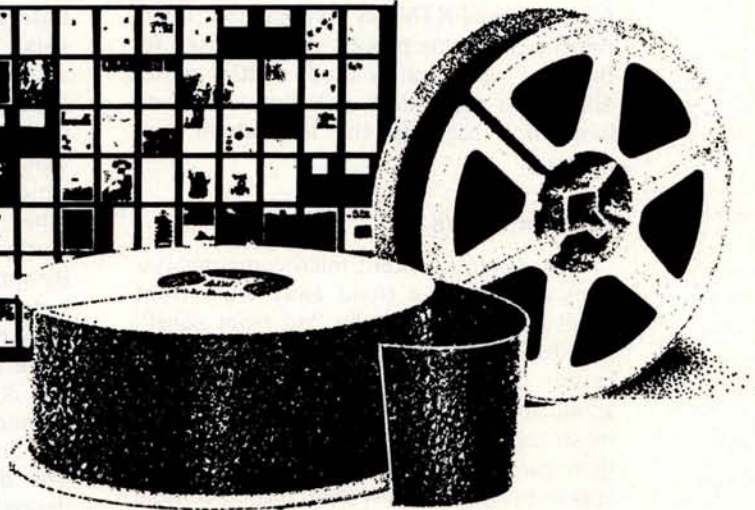
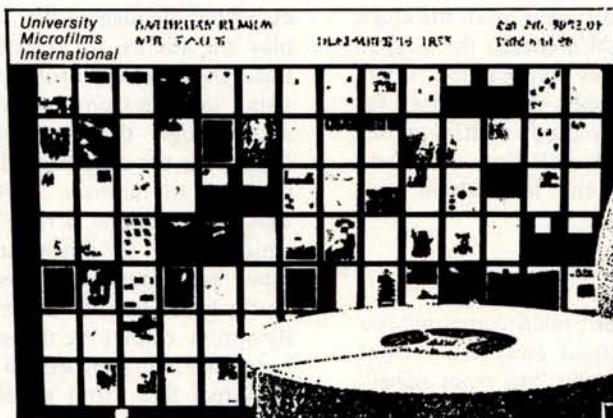
NEW ENGLAND ELECTRONICS CO.

248 Bridge Street
Springfield, Mass.

Area Code (413)
739-9626

Authorized PET Sales & Service
"Guaranteed Delivery"
Schedules for all of our
PET Customers. Call
for our PET Package.

BYTE^{T.M.} is available in microform



Please send me additional information.

Name _____

Institution _____

Street _____

City _____

State _____ Zip _____

University Microfilms International

300 North Zeeb Road
Dept. P.R.
Ann Arbor, MI 48106
U.S.A.

18 Bedford Row
Dept. P.R.
London, WC1R 4EJ
England

returning to the user program. Naturally, a little bit of cleaning up is performed to smooth over the abrupt transition from interrupt time to task time. This feature allows the use of the HLT instruction as a breakpoint and also provides transparent support of the HLT operation. When a program halts, the front panel comes alive, and user program execution stops. Striking the GO key causes execution to resume following the HLT instruction.

The RTM command is a key command executed by pressing the 0 and # keys simultaneously. This command serves the purpose of the RUN/HALT switch on hardware front panels: striking RTM causes execution of the user program to cease, and it causes the front panel to become active. The RTM command is implemented by a joint hardware and software effort: on a hardware level, the pressing of the two keys causes a clock interrupt to be requested immediately, without waiting through the 2 ms interval. On the software level, the clock interrupt code in PAM/8 checks the keypad for the special RTM key combination. If it is present, the same process that was used for the HLT operation is used: control passes directly to the PAM/8 task time command loop, not back to the interrupted user program.

Using the PAM/8

The design of recent microcomputer systems has shown a trend away from front panel designs toward the "no front panel" monitor. This is being done for a very good reason: a terminal monitor based on programmable memory or read only memory is much easier to use and is more powerful than hardware front panels. This fact also applies to the PAM/8 system: a good console oriented monitor and debugger, such as Heath's HBUG, is much more convenient for debugging programs. This is not to say that PAM/8 does not perform an indispensable task, as I will try to show in the following real life examples.

A typical experience in the life of a computer experimenter is the debugging of some peripheral interface. I've spent many a long hour slaving over a processor, trying to make some new device or interface talk to my computer. A favorite technique I use for this is to enter a 2 statement program into memory:

```
L1      IN      <port number>
        JMP     L1
```

This program simply inputs from the port assigned to the recalcitrant device into the accumulator, then loops back to do it again and again. Then all I do is set the PC register to the L1 address, punch up the accumulator for display, and press GO. The value read from the port will be continuously displayed in the A register, even while I adjust the hardware. By watching the panel displays, I can instantly see any results of my labors, such as, "if I ground this line, will that bit come on?"

Another important use for PAM/8 is as an aid to debugging software. Often I find myself debugging a complex piece of software that maintains various state flags in memory. For example, a command completion subroutine, which examines characters as they are entered for valid syntax, is a state dependent program. As each character is entered, the program sets flag bits indicating various things such as "two alphabetic characters entered," or "have just seen a blank," etc. When debugging this code, I simply display the address (or register) containing the state flags on the front panel. Then, as I strike test keys one by one, I can immediately judge the program's reaction by examining the state flags. This technique can be used to monitor working programs as well. For example, I have a loader program which I use to download programs from other computers. It keeps the address currently being loaded in the HL register pair. By simply displaying this register pair, I can watch the load progress (or fail!).

A real time front panel can be used for more than just debugging. The presence of the displays and keypad provides another channel of communication with the processor, independent of the console terminal. The displays can be used to indicate any desired status, and the keypad can be used as a bank of "sense switches," even while the console is being used by the program. For example, the BASIC interpreter supports commands to control the displays and read the keypad.

Conclusions

The PAM/8 front panel system provides an inexpensive and effective "firmware front panel" which emulates a complete hardware front panel. Its design combines the capabilities of a true hardware panel with the flexibility of firmware and ultimately provides the user with a greater communications bandwidth to a personal computer. ■

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

The AJ 841 I/O Terminal. Now with RS 232 interface. Now available from dealers.

Demand for our AJ 841 I/O computer terminal has been great. And now that we've finally added RS 232 interface, it will get even greater. So while you can still order it direct from us, now you can also buy it from dealers around the country.

The AJ 841 features:

- Choice of Serial RS 232 or parallel interface
- ASCII code
- 14.9 cps printout
- High quality Selectric printing
- Reliable, heavy-duty Selectric mechanism
- Off-line use as typewriter
- Documentation included
- 30-day warranty — parts and labor
- Mail order shipments to AJ office or direct to you.
- EBCD keyboard.

Warranty and service available from your local AJ dealer — or from AJ offices in:

Atlanta/Boston/Chicago/Cincinnati/
Cleveland/Columbus/Dallas/
Detroit/Hackensack/Houston/
Los Angeles/New York/Philadelphia/
San Jose/Washington, D.C.

Full warranty information
available on request.

Order with coupon—or from your local AJ dealer

For location of your nearest AJ dealer
call toll-free: 800/538-9721.
(Calif. residents call 408/263-8520)



**ANDERSON
JACOBSON**

HOW TO ORDER DIRECT FROM AJ

1. Make cashier's check or money order payable to Anderson Jacobson, Inc. and mail to:
Anderson Jacobson, Inc.
PERSONAL COMPUTER TERMINAL
521 Charcot Avenue
San Jose, CA 95131
2. You will be notified when your unit is ready for shipment. Allow six to eight weeks for delivery.
3. Shipments direct to you require a collect freight charge (FOB San Jose) plus \$25 for a special shipping carton; no tax necessary outside California. Shipments to nearest AJ office include freight in the \$35 handling charge and require applicable sales tax at pick-up location.
4. For warranty or repair service, return unit to local dealer or to designated AJ service location.

Available only in U.S.

Circle 10 on inquiry card.

CLIP AND MAIL WITH ORDER

Select interface: ☐ RS 232 @\$1195 or ☐ Parallel @ \$1095

- ☐ Ship direct to me (freight collect, FOB San Jose, plus \$25 carton, and California sales tax if applicable)
- ☐ Ship to AJ office (applicable sales tax plus \$35 shipping/handling)

Number of units	_____	\$	_____
Sales tax	_____	\$	_____
\$35 shipping/handling or \$25 carton	_____	\$	_____
TOTAL	_____	\$	_____

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

PHONE () _____

First Steps in Computer Chess Programming

Kathe and Dan Spracklen
10832 Macouba Pl
San Diego CA 92124

The fascination of chess gains a new dimension with microcomputer chess. No longer are the struggles confined to giant machines. With the advent of the Chess Mate, Chess Challenger, Boris, and Compu-chess, as well as some custom software packages, the day of microcomputer chess has dawned. Writing a program to play chess on a small system is no small matter, though. Consider just for a start the challenge of meaningfully representing the board and its pieces in computer memory: there are 64 squares, 32 pieces, 6 piece types and 2 piece colors. Since the machine is a microcomputer, storage requirements must be kept to a minimum. Next comes the job of moving the pieces. Only when these first problems of piece representation and move generation have been solved can the chess programmer go on to consider strategy.

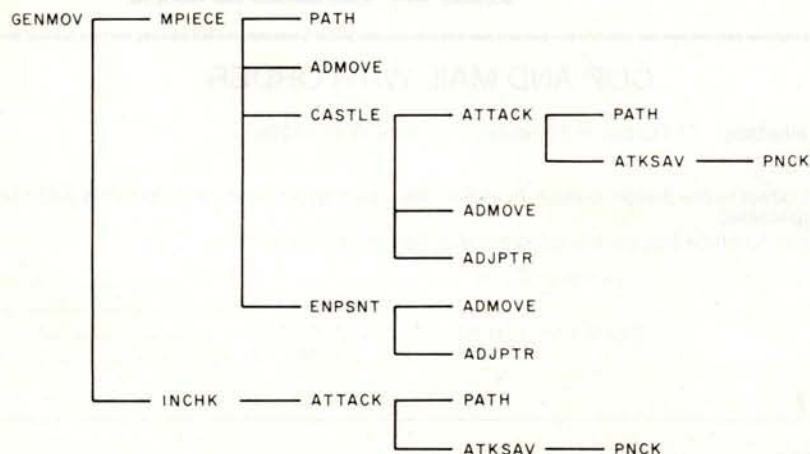


Figure 1: Block structure of the move generation routine of Sargon, the authors' chess playing program written for Z-80 assembler language.

Sargon, a chess playing program we developed for Z-80 machines, solves the representation problem through the use of a board array. Move generation is accomplished through a network of routines diagrammed in figure 1. The functions of the routines are as follows:

GENMOV	Generate move routine. Generates the move set for all of the pieces of a given color.
MPIECE	Piece mover routine. Generates the move set for a given piece.
INCHK	Check routine. Determines whether or not the King is in check.
PATH	Path routine. Generates a single possible move for a given piece along its current path of motion.
ADMOVE	Admove routine. Adds a move to the move list.
CASTLE	Castle routine. Determines whether castling is legal and adds it to the move list if it is.
ENPSNT	En passant routine. Tests for an en passant pawn capture and adds it to the move lists if it is legal.
ATTACK	Attack routine. Finds all the attackers on a given square.
ADJPTR	Adjust move list pointer. Links around the second move in a double move (ie: castle or en passant pawn capture).
ATKSAV	Attack save routine. Saves attacking piece value in the attack list and increments the attack count for that color piece.
PNCK	Pin check routine. Checks to see if an attacking piece is in the pinned piece list.

Several of the routines involved are multi-purpose routines. Their involvement in move generation is incidental to a main function elsewhere in the move selection logic. The key routines in move generation are MPIECE, PATH, CASTLE and ENPSNT. Of these,



Still Clean . . . Still Wild . . . Still the Land of Great Opportunity: **MINNESOTA.**

Professional careers need room to grow. The challenges, the excitement, and the high-technology products of Honeywell's Avionics Division are like the breath of fresh air to engineering professionals.

We are currently working on projects as diverse as radar altimeters and laser gyros for commercial flight and space applications, flight traffic control, air data computers, and microwave component systems design. We have the business to keep you growing!

Our quality work environment is a function of our general quality of life in Minnesota. Bring your appetite for good living with you when you come, because we've got it all: theatre, professional and amateur sports, art treasures, hunting, fishing, parks, educational opportunities, and much more. We think of Minnesota, the "Land of 10,000 Lakes," as offering the uncrowded, friendly atmosphere of a small community with the advantages of a major metropolitan area.

We have immediate needs for BSEE Engineers in the Following Areas:

Design Engineers
Production Engineers
Engineers
Reliability Engineers

Computer Application Engineers
Field Support Engineers
Component Application Engineers
Technical Writers

If you share our high-technology, growth-oriented attitudes and meet our professional requirements, we can offer you a highly competitive compensation and benefits package. Please send comprehensive resume with salary requirements to:

John Buck - Employee Relations Manager

AVIONICS DIVISION

2600 Ridgway Parkway
MN17-1507
Minneapolis, MN 55413

HONEYWELL is an Equal Opportunity Employer Actively Seeking Applicants Under Its Affirmative Action Program

Honeywell

(a)										(b)									
110	111	112	113	114	115	116	117	118	119	6E	6F	70	71	72	73	74	75	76	77
100	101	102	103	104	105	106	107	108	109	64	65	66	67	68	69	6A	6B	6C	6D
90	91	92	93	94	95	96	97	98	99	5A	5B	5C	5D	5E	5F	60	61	62	63
80	81	82	83	84	85	86	87	88	89	50	51	52	53	54	55	56	57	58	59
70	71	72	73	74	75	76	77	78	79	46	47	48	49	4A	4B	4C	4D	4E	4F
60	61	62	63	64	65	66	67	68	69	3C	3D	3E	3F	40	41	42	43	44	45
50	51	52	53	54	55	56	57	58	59	32	33	34	35	36	37	38	39	3A	3B
40	41	42	43	44	45	46	47	48	49	28	29	2A	2B	2C	2D	2E	2F	30	31
30	31	32	33	34	35	36	37	38	39	1E	1F	20	21	22	23	24	25	26	27
20	21	22	23	24	25	26	27	28	29	14	15	16	17	18	19	1A	1B	1C	1D
10	11	12	13	14	15	16	17	18	19	A	B	C	D	E	F	10	11	12	13
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9

Figure 2: Decimal (a) and hexadecimal (b) representations of the chessboard used in the Sargon program. Each square of the board is represented by a single byte in memory. Border squares are assigned a flag value of hexadecimal FF. The use of the border simplifies move generation, since it becomes easy to determine when a piece moves off the board.

MPiece and PATH will be discussed here. The routines will be described in a language independent narrative. The Z-80 assembler code in which they are implemented will also be presented and exhaustively commented.

The Board in Memory

The chessboard in memory is an array of 120 bytes that can be visualized as in figure 2. Each square of the board is represented in memory by a single byte. Border bytes are assigned a flag value of hexadecimal FF. The border simplifies move generation, since it becomes easy to determine when a piece moves off the board.

The Pieces in Memory

Each piece is represented in memory by one byte of data. The meaning and function of the bits are as follows:

- Bit 7 — color of the piece.
1 — Black
0 — White
- Bit 6 — not used.
- Bit 5 — not used.
- Bit 4 — castle flag for Kings only.
Set if the King has
castled.
- Bit 3 — moved flag.
Set if the piece has
moved.
- Bits 2-0 — Piece type.
1 Pawn
2 Knight
3 Bishop
4 Rook
5 Queen
6 King

The pieces in play occupy squares of the

board. If a board square is empty, it has the value 00. Thus the board set up for play would be as shown in figure 3.

Piece Mover Data Base

In order to generate moves for the pieces on the board, data must be maintained to describe the possibilities for each piece. This is accomplished through the use of three tables. Values for the tables are given in table 1.

DIRECT	Direction Table. Used to determine the direction of movement of each piece.
DPOINT	Direction Table Pointer. Used to determine where to begin in the direction table for any given piece.
DCOUNT	Direction Table Counter. Used to determine the number of directions of movement for any given piece.

FF	FF	FF	FF	FF	FF	FF	FF	FF	FF
FF	FF	FF	FF	FF	FF	FF	FF	FF	FF
FF	84	82	83	85	86	83	82	84	FF
FF	81	81	81	81	81	81	81	81	FF
FF	00	00	00	00	00	00	00	00	FF
FF	00	00	00	00	00	00	00	00	FF
FF	00	00	00	00	00	00	00	00	FF
FF	00	00	00	00	00	00	00	00	FF
FF	01	01	01	01	01	01	01	01	FF
FF	04	02	03	05	06	03	02	04	FF
FF	FF	FF	FF	FF	FF	FF	FF	FF	FF
FF	FF	FF	FF	FF	FF	FF	FF	FF	FF

Figure 3: Representation of the pieces on their home squares. Pieces are identified by means of unique byte values.

About the Authors

Dan and Kathe Spracklen are the creators of Sargon, the microcomputer chess program that won the microcomputer chess tournament at the 1978 West Coast Computer Faire. Dan Spracklen is a 13 year programming veteran. His experience ranges from scientific simulation programs to real time commercial applications. He is currently a senior applications analyst for Sperry-Univac. Kathe Spracklen is a graduate student in computer science at San Diego State University. An experienced tournament player, Kathe provided the chess background for Sargon.

Listing 1: The Sargon move generation routine, written in Z-80 assembly language.

```

;*****
;EQUATES
;*****
PAWN      = 1
KNIGHT    = 2
BISHOP    = 3
ROOK      = 4
QUEEN     = 5
KING      = 6
WHITE     = 0
BLACK     = 80H
BPAWN     = BLACK+PAWN
;*****
;TABLES SECTION
;*****
START:

        .LOC   START+80H
TBASE   =      START+100H

;*****
;DIRECT - DIRECTION TABLE
;*****
DIRECT  =      .-TBASE

        .BYTE +09,+11,-11,-09
        .BYTE +10,-10,+01,-01
        .BYTE -21,-12,+08,+19
        .BYTE +21,+12,-08,-19
        .BYTE +10,+10,+11,+09

        .BYTE -10,-10,-11,-09
;*****
;DPOINT-DIRECTION TABLE POINTER
;*****
DPOINT  =      .-TBASE
        .BYTE 20,16,8,0,4,0,0
;*****
;DCOUNT-DIRECTION TABLE COUNTER
;*****
DCOUNT  =      .-TBASE
        .BYTE 4,4,8,4,4,8,8

;*****
;BOARD - BOARD ARRAY
;*****
BOARD   =      .-TBASE
BOARDA  .BLKB 120
;*****
;TABLE INDICES SECTION
;*****
        .LOC   START+0
M1:     .WORD  TBASE
M2:     .WORD  TBASE
M3:     .WORD  TBASE
M4:     .WORD  TBASE
T1:     .WORD  TBASE
T2:     .WORD  TBASE
T3:     .WORD  TBASE

;*****
;VARIABLES SECTION
;*****
P1:     .BYTE 0
P2:     .BYTE 0
P3:     .BYTE 0
;*****
;PIECE MOVER ROUTINE
;*****
MPIECE: XRA    M

ANI     87H

CPI     BPAWN

```

Equate statements supply symbolic equivalents for the piece types and colors.

Start is the first address in Sargon and should lie on an even 256 byte page boundary.

Indexing in the Z-80 makes use of an address, contained in either the IX or IY index registers, plus a displacement. The displacement is a signed number +127 to -128. Thus a 256 byte area of memory centered on the index address is accessible. For this reason TBASE is placed in the middle of the tables section.

The value of "." is the current program counter. Direct is now the displacement of the direction table from the table base. So if the value of TBASE is loaded in the IY index register, "DIRECT(Y)" will reference the first element in the direction table.

Diagonal directions used for Bishop, Queen, and King.
Rank and file directions used for Rook, Queen, and King.
Knight move directions.

White pawn directions including two forward moves and two diagonal moves for captures.
Black pawn directions.

Displacement from table base.

Starting point in direction table. In the order BP, WP, N, B, R, Q, K.

Number of directions to use from table. In the same order as DPOINT.

The board array consists of 120 bytes in memory.

Uses the area of memory between START and START+80H. These indices are used to index into the various tables. Since TBASE is on an even boundary, its address is of the form XX00, where XX depends on the load address. The table address needed for a particular routine is formed by storing a one byte value in the 00 portion. Since addresses are stored in memory with the low order byte first, XX00 would be stored as 00XX. Then changing the 00 portion is simply a matter of storing a one byte value in the index.

Working storage area to hold the contents of the board array for a given square.

Gets the piece to be moved into register A. In GENMOV, the routine which calls MPIECE, the piece value in register A, had been exclusive ORed with COLOR, the color of the piece to determine whether or not to call MPIECE. Another exclusive OR restores the piece.
This clears all the flag bits and leaves just piece type and color.
Is it a Black pawn?

Listing 1, continued (Listing 1 is concluded on page 95):

```
MP2:  JRNZ  MP2
      DCR  A
      ANI  7
      STA  T1
```

```
      LIYD  T1
      MOV  B,DCOUNT(Y)
```

```
      MOV  A,DPOINT(Y)
MP5:  STA  INDX2
      LIYD  INDX2
      MOV  C,DIRECT(Y)
      LDA  M1
```

```
MP10: STA  M2
      CALL PATH
      CPI  2
      JRNZ  MP15
      ANA  A
      EXAF
```

```
      LDA  T1
      CPI  PAWN+1
      JRC  MP20
```

```
      CALL ADMOVE
      EXAF
      JRNZ  MP15
```

```
      LDA  T1
      CPI  KING
      JRZ  MP15
      CPI  BISHOP
      JRNZ  MP10
```

```
MP15: INX  Y
      DJNZ  MP5
```

```
      LDA  T1
      CPI  KING
      CZ  CASTLE
      RET
```

*****PAWN LOGIC*****

```
MP20: MOV  A,B
      CPI  3
      JRC  MP35
      JRZ  MP30
```

```
      EXAF
      JRNZ  MP15
```

```
      LDA  M2
      CPI  91
```

```
      JRNZ  MP25
      CPI  29
```

```
MP25: JRNZ  MP26
      LXI  H,P2
      SET  5,M
```

No-Skip.

Decrement, making piece type a 0 for a Black pawn.

Clears color bit and leaves just the piece type.

This is the first step in forming the index into DPOINT and DCOUNT. T1 contains the value of TBASE (XX00) stored in low-high order (00XX). After storing the piece type (0-6) in T1, it contains the address of TBASE + TYPE.

This operation loads the entire TBASE + TYPE address into the IY index register.

DCOUNT is the displacement from TBASE to the start of the direction count table. So DCOUNT + TBASE is the starting address of the direction count table. Then DCOUNT(Y) is:

DCOUNT + CONTENTS IY Register

= DCOUNT + TBASE + TYPE (0-6)

= START OF TABLE + TYPE (0-6)

This move instruction pulls the direction count for the given piece type and places it in register B.

Similarly, this instruction pulls the direction table pointer for the given piece type and places it in register A.

The direction table pointer will be used to index into the direction table.

Gets the direction and places it in register C.

Gets the "from" position which was stored in M1 in GENMOV.

Save in M2 to form the address of the current position.

Generate a single move in the given direction.

Did the moving piece encounter a piece of the same color, or is new position off the board?

Jump if yes to either question. No move to add to move list. Ready for new direction.

Was the square moved to empty?

Save the answer to this question by swapping flag register for alternate flag register.

Get type of moving piece.

Is it a pawn?

If so, jump to special pawn handling logic. PAWN+1 is equal to the number 2. A White pawn would be of type 1 while a Black pawn would have type set to 0. In either case the carry flag would be set upon a comparison to a value of 2. Valid move, so add it to the move list.

Restore the answer to the empty square question.

If it is not empty, go get ready for next direction. No further moves are possible in this direction.

Get piece type. Some pieces may only make one move in a given direction.

The King is such a piece. Is this piece a King?

If so, go get ready for a new direction.

Compare piece type to a Bishop.

If piece type is bishop or greater (ie: Bishop, Rook, or Queen) go make another move in this same direction.

Increment direction index for next direction in the direction table.

Decrement the direction count (in register B). If count is not yet 0, go back and repeat this process for the new direction. Otherwise all of the directions have been considered.

Fetch piece type again.

Is it a King?

If so, call castle to add it to the move list if legal.

Return to GENMOV.

Get the number of move directions left to consider. If this is the first direction, register A=4.

Are there three directions left to look at?

A carry on this compare indicates a diagonal move. If so, branch to diagonal logic.

Equality on this compare indicates a forward move of two squares.

Branch to check for legality.

Otherwise this is a forward move of one square. Restore the answer to the empty square question.

If the square is not empty, this is not a valid move. Go check the next direction.

Get the "to" position of the move.

Is it on the last rank and therefore a promotion of a White pawn?

If so, go set promotion flag.

Otherwise, is it on the first rank and therefore a promotion of a Black pawn?

If no, skip setting flag.

Load the address of the promotion flag.

Set the flag (bit 5 of P2).

Buy 1 unit from us at the 99 unit price!
In Stock for Immediate Delivery!

Intercolor 8070 Series 1

Small Business System
from Intelligent Systems Corp.®



The complete system, only - \$6,999⁹⁹ retail

8-Color Display Screen

6 Months Standard Warranty

- 19" Color Display w/keyboard
- 8080A Central Processor
- 16K Ram Memory (Expandable)
- 15K ROM Memory
- Dual 8" floppy disk drives (591K bytes)
- 110 CPS bi-directional printer
- Business BASIC
- Payroll programs for up to 500 employees
- Manuals - 6 Months Warranty

OEM's and Dealers

Phone Toll Free for your Special Prices

1-800-633-7566

In Alabama, Phone 205/793-1522

Digital Marketing

P. O. Drawer 159 ■ Dothan, Alabama 36302

"The Intercolor Distributors"

3 Reasons To Always Choose Computer Enterprises:

1. Quality Merchandise
2. Lowest Prices
3. NEW! No-Risk Guarantee

Take A Look At Our Latest Line Of Products From MICROPOLIS™

ALL ASSEMBLED:

	Credit Card Price	Cash Discount Price
METAFLOPPY DISK SUBSYSTEMS FOR THE S-100 BUS.		
1053 Mod II Two-disk system with 630,000 bytes (formatted)	1,774	1,706
1043 Mod II One-disk system with 315,000 bytes (formatted)	1,072	1,031

METAFLOPPY ADD-ON STORAGE MODULES

1023 Mod II One-disk 315,000 byte add-on storage module with enclosure and power supply. Requires daisy chain cable.	604	581
----------------------------------------------------------------------------------------------------------------------	-----	-----

MACROFLOPPY DISK SUBSYSTEMS FOR THE S-100 BUS.

1042 Mod I One-disk system with 143,000 bytes (formatted)	744	716
-----------------------------------------------------------	-----	-----

MACROFLOPPY ADD-ON STORAGE MODULES

1022 Mod I One-disk 143,000 byte add-on storage module with enclosure and power supply. Requires daisy chain cable.	510	491
---------------------------------------------------------------------------------------------------------------------	-----	-----

DISKETTES

1081-05 Package of 5 Micropolis diskettes (5-1/4") for use with both Mod I and Mod II drives.	33	32
-----------------------------------------------------------------------------------------------	----	----

DAISY CHAIN CABLES AND ACCESSORIES

1083-02 Daisy chain interface cable B, with 3 connectors for use with 2 storage modules attached to controller.	33	32
-----------------------------------------------------------------------------------------------------------------	----	----

1083-04 Daisy chain interface cable D, with 5 connectors for use with 4 storage modules attached to controller.	61	59
-----------------------------------------------------------------------------------------------------------------	----	----

NO-RISK GUARANTEE

- * Cancellation With No Obligation If WE Don't Deliver In 90 Days
- * Full Satisfaction Or You May Return Product
- * Plus All Manufacturers' Factory Guarantees

Shipping charges: \$10 per CPU on larger units; \$1.50 per kit. \$2.00 min. per order.

Delivery is stock to 30 days on most items. Shipment is immediate for payment by cashier's check, money order or charge card. Allow 3 weeks for personal checks to clear. N.Y. State residents add approp. sales tax. Availability, prices and specs may change without notice.

computer enterprises™

Operating Hours:
M-W 10-5 E.S.T.
TH-F 10-9 E.S.T.
Closed Sat. & Sun.

P. O. Box 71 Fayetteville, N.Y. 13066

Phone (315) 637-6208 Today!

The subroutines in Sargon that handle the actual move generation rely heavily on the indexing capabilities of the Z-80 microprocessor. For this purpose several sets of indices are maintained to access elements of the tables. The piece mover routines depend especially on the following groups of indices.

M1-M4	Working indices used to index into the board array.
T1-T3	Working indices used to index into direction count, direction value, and piece value tables.
INDX1	General working indices.
INDX2	Used for various purposes.

Variables and constants used in the routines PATH and MPIECE include:

PAWN	= 1	(Identification of the
KNIGHT	= 2	piece types is made
BISHOP	= 3	through use of
ROOK	= 4	equate statements.
QUEEN	= 5	Numbers are hexa-
KING	= 6	decimal.)
WHITE	= 0	
BLACK	= 80	
BPAWN	= Black + pawn	
P1-P3	= Working area to hold the contents of the board array for a given square.	

DPOINT

(a)

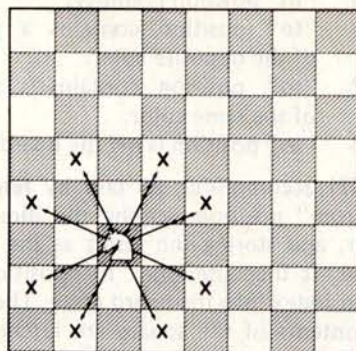
0	+09	+11	-11	-09
4	+10	-10	+01	-01
8	-21	-12	+08	+19
12	+21	+12	-08	-19
16	+10	+10	+11	+09
20	-10	-10	-11	-09

(b)

Piece Type	DPOINT	DCOUNT
Black Pawn	20	4
White Pawn	16	4
Knight	8	8
Bishop	0	4
Rook	4	4
Queen	0	8
King	0	8

Table 1: Direction table (a) and direction table pointer and counter (b). In order to generate moves for the chess pieces, data describing the possibilities for each piece is kept in table 1a. Table 1b shows the direction table pointer, which tells where to start in the table for a given piece, and the direction table counter, which determines the number of directions of movement for a given piece.

KNIGHT BEGINS AT WHITE'S QB3
DECIMAL BOARD ARRAY INDEX = 43



Direction Table Values	Direction Calculation	New Board Array Index	Resulting Square
-21	43 - 21	22	QN1
-12	43 - 12	31	QR2
+08	43 + 08	51	QR4
+19	43 + 19	62	QN5
+21	43 + 21	64	Q5
+12	43 + 12	55	K4
-08	43 - 08	35	K2
-19	43 - 19	24	Q1

Figure 4: Generating all the possible Knight moves from the Queen Bishop 3 (QB3) square. The Knight is piece type 2 (see text) and has a DPOINT (direction table pointer) value of 8 and a DCOUNT (direction table counter) value of 8 also. So in generating the Knight's moves, DIRECT+8 will be the starting point in the direction table, and 8 values will be used: -21, -12, +08, +19, +21, +12, -08 and -19. The Knight starts at White's QB3 square, which is square 43 (see figure 2a, decimal representation). Thus the first possible Knight move is $43 - 21 = 22$ (QN1), and so on.

Sample Move Generation

Suppose a Knight occupies the QB3 square. A Knight is piece type 2 and has a DPOINT of 8 and a DCOUNT of 8 (see table 1b). So in generating the Knight's moves, DIRECT + 8 will be the starting point in the direction table and 8 values will be used. Those values are -21, -12, +08, +19, +21, +12, -08, and -19. The Knight starts at White's QB3, which is square 43 (see figure 2a, decimal representation). Thus the first possible Knight move is $43 - 21 = 22$. Now 22 is QN1, so the first Knight move returns the Knight to its starting square. Figure 4 summarizes all possible Knight moves from QB3.

Move Generation— The Algorithms Explained

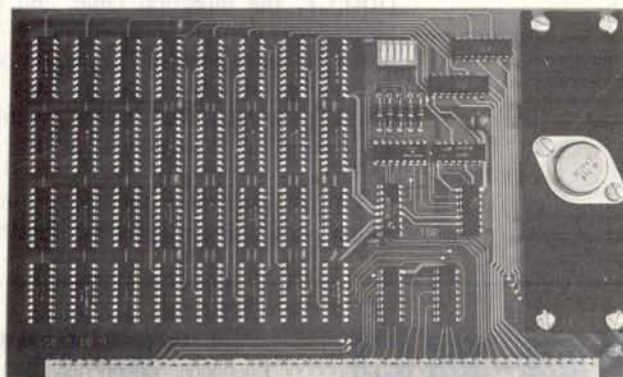
Move generation is controlled by GEN-MOV, which scans the board array and calls MPIECE for each piece encountered.



**PUT THIS IN YOUR PIPE
AND "SMOKE" IT:
\$150 less
for the best!**

SMOKE SIGNAL BROADCASTING'S M-16A STATIC MEMORY SYSTEM

IS NOW BEING OFFERED AT A NEW
LOW PRICE OF \$379.00 — \$150.00 LOWER
THAN EVER BEFORE!



FEATURES:

- SWTPC 6800 Plug Compatible
- STATIC — No refresh required
- Allows SWTPC 6800 expansion to 48K
- Low Power
- Uses Single +8 Volt Supply

The M-16A STATIC random access memory system, with a total storage capacity of 16834 words of 8 bits each, is switch selectable to any 4K starting address, and a hardware write protect switch is also included. The system's storage elements are 4K by 1 STATIC memory chips which store 4 times as much in only 12% more space than the low power 2102's. Typical access time is fast enough to work with a 6800 based computer operating at 2 MHz and all systems are factory tested at 2 MHz.

Send for FREE NEW
Computer Products Catalog
includes our complete line of 6800
Super Software products.

SMOKE SIGNAL BROADCASTING



6304 Yucca/Hollywood, CA 90028
(213) 462-5652

Then MPIECE, the piece mover routine, generates all possible legal moves for that piece (moves that place the King in check are eliminated later in the program). The piece is brought in from memory. It is a one byte data value, as previously discussed, which contains piece type, flags and color. The flags are deleted from the piece before checking for type. Basic piece types are indicated by values from 1 to 6. Except for pawns, White and Black pieces move alike. So a special case is needed for the Black pawn. If the given piece is a Black pawn, the piece type is decremented, making it type 0.

The type of the piece, now one from 0 to 6, is used as an index into the DCOUNT, direction table count, and DPOINT, direction table pointer arrays. The values for the given piece are fetched. The direction table pointer is then used as an index into DIRECT, the direction table, and the first move direction is fetched. The "from" position of the piece is the square on which the piece currently stands. This "from" board index and the direction table value are passed as parameters to the routine PATH.

PATH generates the move indicated and returns a flag which describes the status

of the "to" position of the piece. Flag values are:

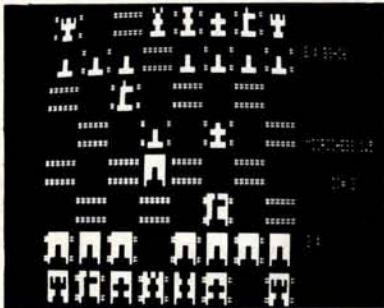
- 0 "to" position is empty.
- 1 "to" position contains a piece of the opposite color.
- 2 "to" position contains a piece of the same color.
- 3 "to" position is off the board.

PATH accomplishes its task by fetching the "from" position, adding the direction counter, and storing the result as the "to" position. It then uses the "to" position to form an index into the board array. The current contents of the square are fetched. If the square contains hexadecimal FF, it is off the board. The off board flag is set and control is returned to MPIECE.

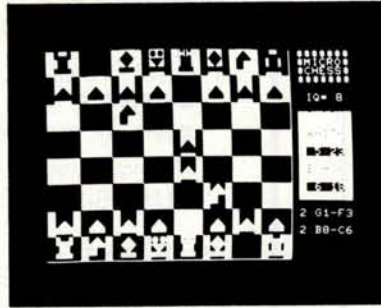
If the square is on the board, the contents of the square are saved in memory location P2. The color and flag bits are then cleared and the remaining piece type is saved in T2. If the square is empty, control is returned to MPIECE with the flag value still set to 0. Otherwise the color of the piece on the "to" square is compared with that of the moving piece. The appropriate flag is set to indicate whether or not the pieces are of the same color, and control is returned to MPIECE.

Upon return from PATH, piece mover

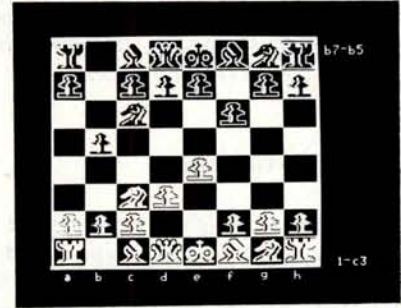
TRS-80



PET



APPLE



PLAY CHESS WITH YOUR COMPUTER!

MICROCHESS is the culmination of two years of chessplaying program development by **Peter Jennings**, author of the famous 1K byte chess program for the KIM-1. MICROCHESS 2.0 for 8K PETs and 16K APPLES, in 6502 machine language, offers 8 levels of play to suit everyone from the beginner learning chess to the serious player. It examines positions as many as 6 moves ahead, and includes a chess clock for tournament play. MICROCHESS 1.5 for **BRIDGE CHALLENGER** by **George Duisman** for 8K PETs, Level II 16K TRS-80s, and 16K APPLES: You and the dummy play 4 person Contract Bridge against the computer. The program will deal hands at random or according to your criterion for high card points. You can review tricks, swap sides or replay hands when the cards are known. No longer do you need 4 people to play! **\$14.95**

ORDERS: Check, money order or VISA/Master Charge accepted; programs and cassettes guaranteed. If you have questions, please call us at **617-783-0694**. If you know what you want and have your VISA/MC card ready, you can **DIAL TOLL FREE 1-800-325-6400**

4K TRS-80s, in Z-80 machine language, offers 3 levels of play (both Level I and Level II versions are included and can be loaded on any TRS-80 without TBUG). MICROCHESS checks every move for legality and displays the current position on a graphic chessboard. You can play White or Black, set up and play from special board positions, or even watch the computer play against itself! Available now at a special introductory price of only **\$19.95**

STIMULATING SIMULATIONS by **Dr. C.W. Engel** for 8K PETs, 4K Level I and II TRS-80s, and APPLES with Applesoft II: Ten original simulation games such as Forest Fire, Lost Treasure, Gone Fishing and Diamond Thief, progressing from elementary to quite complex with most suitable for schoolchildren. Includes a 64 page book giving flowcharts, listings and suggested modifications ... **\$14.95** (24 hours, 7 days; in Missouri, dial 1-800-342-6600). Or you can mail your order to the address below. Personal Software™ products are now **AVAILABLE NATIONWIDE FROM COMPUTER STORES**. Look for the Personal Software™ display in your local store!

P.O. Box 136-B10

Personal Software™

Cambridge, MA 02138

checks to see if the square is occupied by a piece of the same color or is off the board. If so, this cannot be a legal move, so a check for further moves must follow a new direction. Otherwise a check is made to see if the square is empty. The answer is saved. A check is made to see if the piece being moved is a pawn. If so, control is passed to the special pawn logic. Otherwise the move generated must be added to the move list. **ADMOVE** is called for the job. After the move has been added to the move list,

the answer to the empty square question is recovered. If the square is empty and the piece is a Bishop, Rook, or Queen, it is possible to continue moving in the same direction. In this case control passes back to the call to **PATH** for another move in that direction. Kings and Knights may make only one move in a given direction.

When the time comes to consider a new direction of movement for the piece, the index into the direction table is incremented. **DCOUNT**, the number of directions to con-

Listing 1, continued:

```
MP26:  CALL    ADMOVE
       INX     Y
       DCR     B
       LXI     H,P1
       BIT     3,M

       JRZ     MP10
       JMP     MP15

;*****MOVE OF 2 SQUARES*****
MP30:  EXAF
       JRNZ    MP15

MP31:  CALL    ADMOVE
       JMP     MP15
;*****DIAGONAL MOVE*****
MP35:  EXAF
       JRZ     MP36

       LDA     M2
       CPI     91

       JRNC    MP37
       CPI     29

       JRNC    MP31
       LXI     H,P2
       SET     5,M
       JMPR    MP31

;*****DIAGONAL SQUARE EMPTY *****
MP36:  CALL    ENPSNT

       JMP     MP15
;*****
;PATH ROUTINE
;*****
PATH:  LXI     H,M2

       MOV     A,M
       ADD     C

       MOV     M,A
       LIXD    M2
       MOV     A,BOARD(X)
       CPI     0FFH
       JRZ     PA2
       STA     P2
       ANI     7
       STA     T2
       RZ

       LDA     P2
       LXI     H,P1
       XRA     M
       BIT     7,A

       JRZ     PA1
       MVI     A,1
       RET

;*****SAME COLOR*****
       MVI     A,2
       RET

;*****OFF BOARD*****
       MVI     A,3
       RET
```

Add this move to the move list.
Increment direction index for two square move direction.
Decrement the direction count.
Load the address where the piece was saved.
Check the flag in the piece which tells whether it has moved before.
If the pawn has never moved, go generate a second forward move. (The pawn can move two squares on the first move.)
Otherwise go get new direction, skipping second forward move.

Restore the answer to the empty square question.
If the square is not empty, this is not a valid move. Go check the next direction.
Otherwise add this move to the move list.
Go check the next direction.

Restore the answer to the empty square question.
If the square is empty, it is not a normal pawn capture.
Go try en passant.
Get the "to" position of the move.
If the board index is 91 or greater, this is the last rank and a White pawn promotion.
If so, go set promote flag.
Otherwise, if the board index is less than 29, this is the first rank and a Black pawn promotion.
If not, just go add the move to the move list.
Load the address of the promotion flag.
Set the flag (bit 5 of P2), and go add the move to the move list.

Check for possible en passant capture and add it to the move list if legal.
Go check the next direction.

Get the address of the location where the "from" position was stored.
Get the "from" position from that memory location.
Add in the direction from the direction table, giving the "to" position.
Use "to" position to form an index into the board array.
Load the board index.
Get the contents of the board at the "to" square.
Is the "to" position off the board?
If so, go set off-board flag.
Save contents of the board at "to" square.
Isolate piece type.
Save piece type.
Return if the square is empty. The flag value is returned in the A register and it is already 0.
Get piece again.
Load the address of the moving piece.
Compare the pieces.
Check to see if the colors match. If so, after the exclusive OR the color bit will be 0.
If they match, go set match flag.
Otherwise, set different color flag and return.

Set same color flag and return.

Set off-board flag and return.

sider, is decremented. When DCOUNT reaches zero, all the moves for the piece have been generated. If the piece involved is the King, a call to castle will add any

legal castling moves. Then control is returned to GENMOV.

All that remains is to discuss the special pawn logic. Pawns are peculiar in that they capture diagonally, but move straight ahead. They also have the option of moving one or two squares forward on their first move. Furthermore, if they reach the eighth and final rank, they may be promoted to another piece. Sargon always promotes its own pawns to Queens. A flag in variable P2 indicates pawn promotion.

The pawn logic in MPIECE first checks to see if the direction of movement is along a diagonal. If so, the square must be occu-

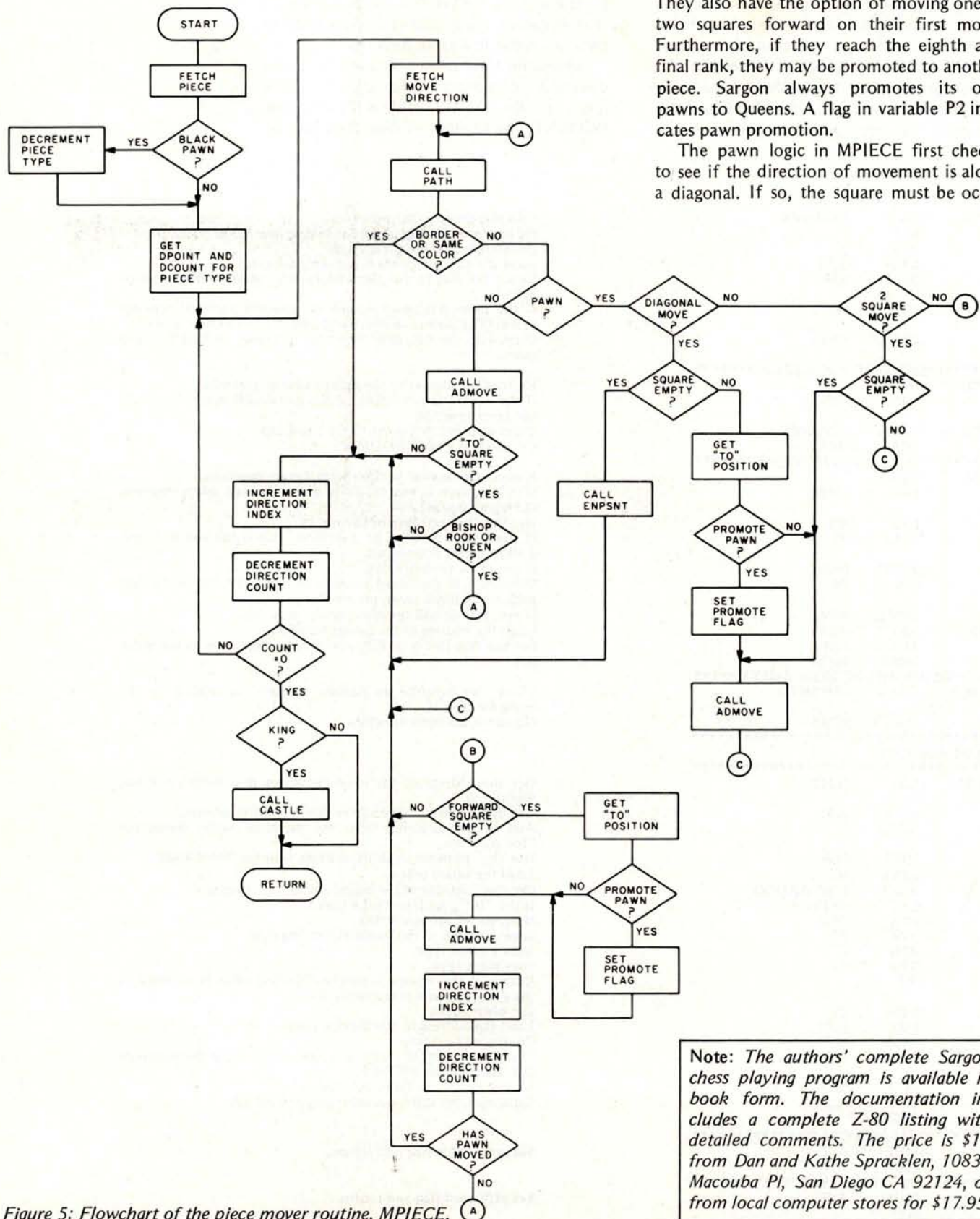


Figure 5: Flowchart of the piece mover routine, MPIECE.

Note: The authors' complete Sargon chess playing program is available in book form. The documentation includes a complete Z-80 listing with detailed comments. The price is \$15 from Dan and Kathe Spracklen, 10832 Macouba Pl, San Diego CA 92124, or from local computer stores for \$17.95.

pied by an enemy piece. It may also be possible to move to the eighth rank in capturing, so pawn promotion must be considered here as well. Another type of diagonal pawn move is the *en passant* capture. It must be considered by a call to ENPSNT. Finally it is time to consider a new direction, as is done for the other piece types.

If, however, the direction of movement is forward, the "to" square must be empty. Pawn promotion must be checked for on forward moves. If the piece has never moved before, another move in the same direction is a possibility. Otherwise it is time to consider a new direction. Figures 5 and 6 are flowcharts of MPIECE and PATH, respectively.

The Other Move Generation Routines

The move generation driver is GENMOV, the generate move routine. The basic function of GENMOV is to generate the move set for all pieces of a given color. It scans the board checking for a piece of the same color and calls MPIECE, the piece mover routine.

CASTLE and ENPSNT are also key routines in move generation. CASTLE checks the legality of both King side and Queen side castling. It adds them to the move list if legal. Basic checks must include:

Has King moved?
Is King in check?
Has Rook moved?
Are the intervening squares empty?
Are any squares that the King passes through under attack?

ENPSNT checks for any *en passant* pawn captures and adds them to the move list if legal. The tests must include:

On the fifth rank?
Was previous move the first move for the enemy pawn?
Is the enemy pawn on an adjacent file?

INCK, the check routine, performs the function of determining whether or not the King is in check. The basic method used is to scan outward from the King looking for attackers, by calling ATTACK.

The attack routine finds all attackers on a given square by scanning outward from the square until one of the following occurs:

A piece is found that attacks this square.
A piece is found that doesn't attack this square.
The edge of the board is reached.

Circle 383 on inquiry card.

\$1195



+



U.S. ROBOTICS SERIES-300 MODEMS

300 BAUD
103/113 COMPATIBLE
ACOUSTIC/HARDWARE VERSIONS
ORIGINATE/ANSWER VERSIONS

TELETYPE MODEL 43

10 OR 30 CHAR/SEC
132 COLUMNS
UPPER/LOWER CASE

U.S. Robotics now combines the price/performance leader in 300 Baud Modems with the price/performance leader in hardcopy terminals to bring you teleprinter capability at incredible package prices.

USR-310 Originate Acoustic Coupler + Teletype Model 43 KSR = \$1195
USR-330 Originate/Auto-Answer FCC Certified Modem + Teletype Model 43 KSR = \$1365
USR-320 Auto-Answer FCC Certified Modem + Teletype Model 43 RO = \$1215

Stand alone modems and teletype available:

Teletype 43 KSR with RS232C \$1095
USR-310 Originate Acoustic Coupler (Operates with any standard telephone) \$139

	Direct ¹	Telco ²
	Connect	DAA
	Style	Style
USR-330 Originate/Auto-Answer Modem	\$324	\$185
USR-320 Auto-Answer Modem	\$299	\$160

(¹F.C.C. Certified Package. Connection to phone lines via standard extension phone jack.)
(²Connection to phone lines via CBS-1001F DAA which can be leased from phone company for approximately \$5.00/mo. plus installation fee.)

Interfaces for stand alone modems:

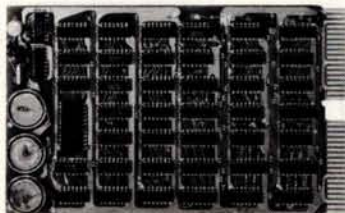
USR-310 — RS232C only
USR-320 and USR-330 — RS232C and 20 ma.
(Specify with order. If both interfaces are required, add \$10 to unit price.)

All products include a 90 day warranty and optional annual maintenance package. Add 1% shipping and handling in the continental U.S.
Illinois residents add 5% Sales Tax.

U.S. ROBOTICS, INC.

2440 N. Lincoln/Chicago, IL 60614/(312) 528-9045

LSI-11 TIME



It's **TIME** you brought your LSI-11 up to **DATE**. **TIME** and **DATE**, two important parameters in the computer world, are available to your LSI-11 on one **DUAL SIZE BOARD**. When requested, the TCU-50D will present you with the date (month and day), time (hour and minutes), and seconds. Turn your computer off and forget about the time — your battery supported TCU-50D won't, not for 3 months anyway. The correct date and time will be there when you power up.

The TCU-50D is shipped preset to your local time, but can be set to any time you want by a simple software routine.

AT \$295

YOU CAN'T AFFORD TO IGNORE TIME

Time is only one way we can help you upgrade your LSI-11 or PDP-11 system. We'd also like to tell you about the others. So contact Digital Pathways if you're into -11's. **We are too.**



DIGITAL PATHWAYS INC.

4151 Middlefield Road • Palo Alto,
California 94306 • Telephone (415) 493-5544

Note: Next month the authors discuss their Sargon Exchange Evaluator.

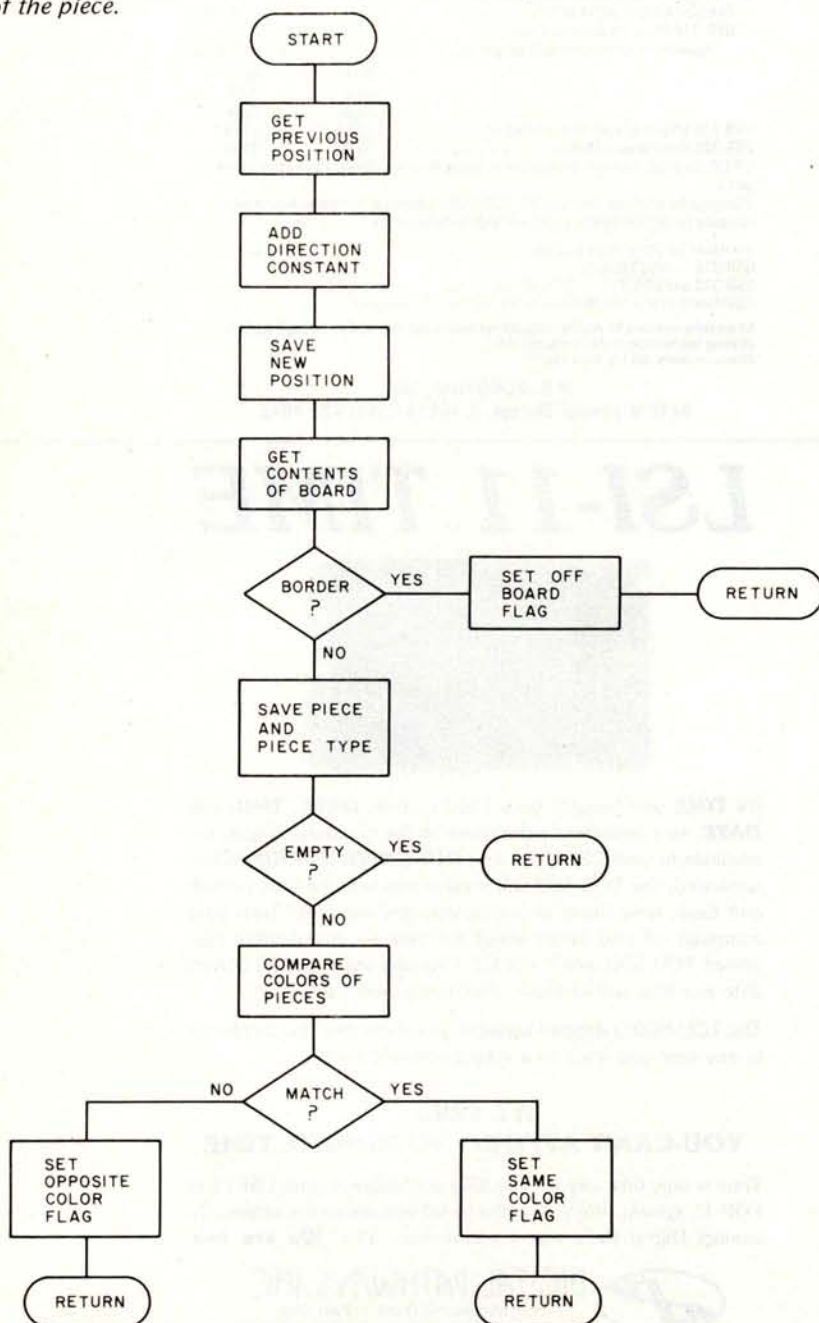
In the case where this routine is called by CASTLE or INCHK, the routine is terminated as soon as an attacker of the opposite color is encountered.

ADMOVE adds a move to the move list. The move list is a linked list. Each move in the move list is stored in a 6 byte area. The meaning of each byte is as follows:

- 0&1 MLPTR — Move list pointer. A pointer to the next move in the move list. Used to facilitate sorting the list.
- 2 MLFRP — Move list from position. The board position from which the piece is moving.

- 3 MLTOP — Move list to position. The board position to which the piece is moving.
- 4 MLFLG — Move list flags.
- 5 MLVAL — Move list value. Contains the score assigned to the move in evaluation.

Figure 6: Flowchart of the PATH routine, which performs the actual move of the piece.



It is hoped that this introductory discussion will assist potential chess programmers in getting started. With the essentials of move generation out of the way, the fun part of evaluation can begin. ■

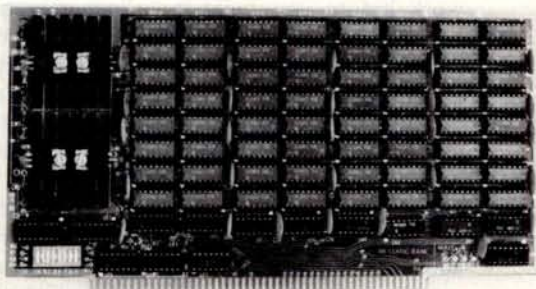
BIBLIOGRAPHY

In writing Sargon, it was our original intention to put together the first version without any research into the attempts made by others. In this respect Sargon is a unique creation. After competing in the Second West Coast Computer Faire, we began to investigate some of the literature. This bibliography presents some of the references we found most helpful, together with our evaluations.

1. Michie, Donald, *On Machine Intelligence*, Edinburg University Press, 1974.
Michie's book provides an excellent treatment of exchange evaluation. He uses the concept of an exchange polynomial for accurately determining the outcome of battles engaged on the board. The basic approach we used in XCHNG, the Sargon exchange evaluator, turned out to be surprisingly similar. Sargon's approach, however, is far less computationally complex. We highly recommend this reference to anyone planning to write a chess program without look-ahead.
2. Samuel, A L, "Some Studies in Machine Learning Using the Game of Checkers. 11-Recent Progress," *IBM Journal*, November 1967. Samuel provides a complete though sometimes difficult treatment of alpha-beta pruning. One of the few articles we encountered before writing Sargon, Samuel's article is the basis for the tree search used in the Sargon program.
3. Fine, Reubin, *Ideas Behind the Chess Openings*, David McKay, New York, 1943.
Fine's book makes a great starting point for anyone contemplating the addition of an opening book. Although Fine does not present enough lines of play for a complete book, it does provide a good orientation to other references.
4. Chernev, Irving, *Practical Chess Endings*, Dover Publications, New York, 1961.
Perhaps the greatest weakness we've seen in microcomputer chess programs is the play of the endgame. Chernev's book presents a marvelously readable introduction to this phase of the game.
5. Kmoch, Hans, *Pawn Power in Chess*, D McKay Company, New York, 1959.
Alas, too many microcomputer chess programs shoot out pawns like photon torpedoes. Kmoch provides an excellent introduction to what constitutes good pawn structure.

? Wondering which memory is best for you?

base 2 offers the following products to the S-100 market at the industry's lowest prices:



8K Static Memory Board

This 8K board is available in two versions. The 8KS-B operates at 450ns for use with 8080 and 8080A microprocessor systems and Z-80 systems operating at 2MHz. The 8KS-Z operates at 250ns and is suitable for use with Z-80 systems operating at 4MHz. Both kits feature factory fresh 2102's (low power on 8KS-B) and includes sockets for all IC's. Support logic is low power Schottky to minimize power consumption. Address and data lines are fully buffered and 4K bank addressing is DIP switch selectable. Memory Protect/Unprotect, selectable wait states and battery backup are also designed into the board. Circuit boards are solder masked and silk-screened for ease of construction. These kits are the best memory value on the market! Available from stock . . .

8KS-B \$125 (assembled and tested add \$25.00)

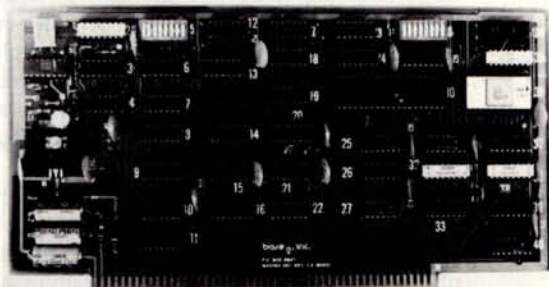
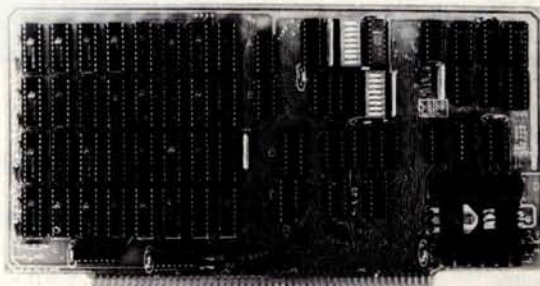
8KS-Z \$145 (assembled and tested add \$25.00)

16K Static Memory Board

Base 2 can now offer the same price/performance in a 16K static RAM as in its popular 8K RAM. This kit includes 8K bank addressing with 4K boundary address setting on DIP switches. This low power unit provides on-board bank selection for unlimited expansion . . . No MUX board required. Using highest quality boards and components we expect this kit to be one of the most popular units on the market. Available in two speed ranges, the 16KS-B operates at 450ns while the 16KS-Z operates at 250ns.

16KS-B \$285 (assembled and tested add \$25.00)

16KS-Z \$325 (assembled and tested add \$25.00)

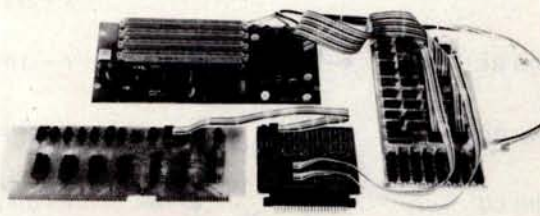


Z-80 CPU Board

Our Z-80 card is also offered in two speed ranges. The CPZ-1 operates at 2MHz and the CPZ-2 operates at 4MHz. These cards offer the maximum in versatility at unbelievably low cost. A socket is included on the board for a 2708 EPROM which is addressable to any 4K boundary above 32K. The power-on jump feature can be selected to address any 4K boundary above 32K or the on-board 2708. An On-board run-stop flip-flop and optional generation of Memory Write allows the board to run with or without a front panel. The board can be selected to run in either the 8080 mode, to take advantage of existing software, or in the Z-80 mode for maximum efficiency. For use in existing systems, a wait state may be added to the M1 cycle, Memory request cycle, on-board ROM cycle, input cycle and output cycle. DMA grant tri-states all signals from the processor board. All this and more on top quality PC boards, fully socketed with fresh IC's. **CPZ-1 \$110 CPZ-2 \$125**

S-100 for Digital Group Systems

This kit offers, at long last, the ability to take advantage of S-100 products within your existing Digital Group mainframe. Once installed, up to four S-100 boards can be used in addition to the existing boards in the D.G. system. The system includes an "intelligent" mother board, ribbon cables to link existing D.G. CPU to the DGS-100 board and a power wiring harness. The DGS-100 is designed to fit in the 5-3/4" x 12" empty area in the standard D.G. cabinet. It may seem expensive but there's a lot here! End your frustration! **DGS-100 \$295**



base 2. inc.

Send for more details on these products. Get on our mailing list for information on more soon to be announced products at factory-direct prices from BASE 2. Why pay more when you can get the best at these prices???

P.O. Box 3548 • Fullerton, Calif. 92634

(714) 992-4344

CA residents add 6% tax

MC/BAC accepted • FOB — U.S. destination

Linear Circuit Analysis

Leonard H Anderson
10048 Lanark St
Sun Valley CA 91352

Editor's Note:

Readers wishing to obtain more details about the electrical concepts discussed in this article will find a concise treatment of complex impedance and related topics in The Radio Amateur's Handbook published by the American Radio Relay League, Newington CT 06111. For a good programmed learning introduction to electricity and DC circuits, see Basic Electricity and DC Circuits by Oliva and Dale, published by Texas Instruments Inc, POB 5012, Dallas TX 75222.

R = entered resistance in ohms.
L = entered inductance in henries.
C = entered capacitance in farads.
I = entered current in amperes.
F = solution frequency in hertz.

Branch Type	Plus Node	Minus Node	Calculation of Admittance
Resistor			$Y = (1/R) + j0$
Capacitor			$Y = 0 + j(2\pi FC)$
Inductor			$Y = 0 - j[1/(2\pi FL)]$
Series RL			$Y = R/(R^2 + X^2) - j[X/(R^2 + X^2)]$ $X = 2\pi FL$
Series RC			$Y = R/(R^2 + X^2) + j[X/(R^2 + X^2)]$ $X = 1/(2\pi FC)$
Series LC			$Y = 0 + j[X/(1 - 2\pi FLX)]$ $X = 2\pi FC$
Parallel RL			$Y = (1/R) - j[1/(2\pi FL)]$
Parallel RC			$Y = (1/R) + j(2\pi FC)$
Parallel LC			$Y = 0 + j[(2\pi FC) - (1/2\pi FL)]$
Current generator			$Y = I + j0$
Current generator with θ			$Y = I \cos(\theta) + j[I \sin(\theta)]$

Table 1: Admittance calculations for simple branches. On both of the generators the direction of electron flow is shown by the arrow.

Circuit analysis programs are valuable tools that can tell you how a circuit will work before you build it — "paper breadboards" in effect that don't require any component purchases, expensive equipment or debugging time spent on the bench. Analysis programs fall into two general categories: frequency domain and time domain. Presented here are the fundamentals of a frequency domain *linear* analysis program. In practice, linear analysis means that no active devices are operated at saturation or cutoff. Frequency domain tells us what circuits do at different frequencies, a type of analysis well-suited to model amplifiers, filters and operational amplifier circuits operating over any desired frequency range. You can make voltage and impedance readings at any point in the circuit without experiencing the loading problems that can occur with conventional equipment.

Because of the variations in small computer systems, primarily in memory, no specific language is given. All of the necessary flowcharts are presented along with necessary mathematical operations. You will need the four basic floating point functions plus array handling (single dimension arrays are acceptable, but two-dimensional arrays are preferred) and at least arctangent and logarithmic functions.

Matrix operations are done but you don't need BASIC MAT functions; the matrix is fully explained later. Using charts and explanations, you can write the program in any form from assembler to BASIC and higher languages. Assembler will work faster since this is a "number crunching" program. The main constraints are memory and the ability to hold many arrays in main memory.

Modeling the Circuit

Each component of a circuit with two connections is called a *branch*. Connection points are called *nodes*. Several branches can be connected to the same node. Signal sources are also branches; these have specific requirements in node descriptions and are covered later.

Table 1 shows the basic branch types with only two nodes. The complex number

Introducing the **NEW STATE-OF-THE-ART LEADER...**

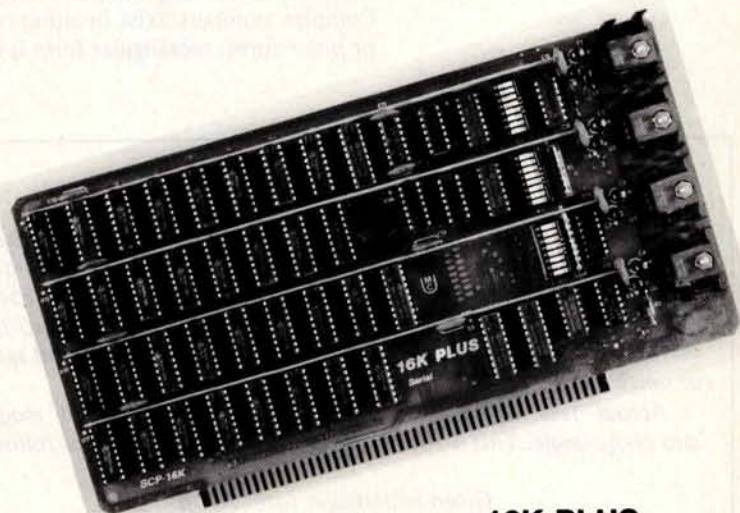
16K PLUS

**HIGH RELIABILITY
MEMORY BOARD
FOR THE S-100 BUS**

**IDEAL FOR CROMEMCO
64K DISC SYSTEMS**

*Fully meets proposed
IEEE Standard*

*Specially designed for the new high speed
disc systems using DMA and Time Sharing*



16K PLUS

- **Bank Select**

This feature allows running up to 512K of RAM and multiple users on your system. It is fully compatible with Cromemco software, using output port 40H.

- **Parallel Addressing Feature**

You may choose to locate blocks of RAM at more than one address simultaneously. This feature is ideal for mixing North Star software, which begins at 2000H, with other software beginning at 0000H. With parallel addressing you can locate blocks of RAM in the lowest 8K and at some higher address at the same time.

- **High Reliability**

Reliability begins at Seattle Computer Products with proper design. All inputs to the board have Schmitt triggers which provide superior noise immunity. Next, we select only first quality components for assembly. To catch infant mortality, we test all boards following assembly, fully burn them in, and then retest at full operating speed. Rigorous quality control is used throughout the manufacturing process.

- **Fully Static TMS 4044**

These Texas Instruments 4K by 1 fully static memory chips require no critical clocks or refresh. They allow a straight-forward, clean design ensuring S-100 bus DMA compatibility.

**250 nsec. chips — \$445
450 nsec. chips — \$410**

The 16K PLUS board is offered fully assembled and tested only.

Guaranteed: USA customers — parts and labor guaranteed for one full year. You may return undamaged board within ten days for a full refund (factory orders only — dealer return policy may vary). Foreign and kit purchasers — parts only guaranteed; no return privilege.

Check with your local computer dealer

If our board is not in his stock, he can get one in three to five days.

Factory Orders — You may phone for VISA, MC, COD orders. (\$3 handling charge for COD orders only) Purchase orders accepted from recognized institutions. Personal checks OK but must clear prior to shipment. Shipped prepaid with cross-country orders sent by air. Shipping — normally 48-72 hours. Washington residents add 5.4% tax. Spec. sheet, warranty statement sent upon request.

Standard S-100 Memory

Our standard 16K RAM boards using the TMS 4044 have been reduced in price. This is the same board sold worldwide to satisfied customers since January.

	ASM	KIT
250 nsec. chips	\$345	\$320
450 nsec. chips	\$310	\$285



Seattle Computer Products, Inc.

1114 Industry Drive, Seattle, WA. 98188
(206) 255-0750

admittance value is also given; the program is required to calculate the admittance as part of analysis.

Review of Complex Numbers

If you are unfamiliar with complex number notation or admittance, some review is necessary before beginning any programming. Complex numbers exist in either *rectangular* or *polar* form; rectangular form is used here.

Complex Number Arithmetic

The rules for rectangular form arithmetic are shown in the table below. Note that division and inversion have equal value denominators for both real and imaginary parts. Finding the denominator first in the division routine will increase computational speed. Note also that inverting $(C + jD)$ is equal to dividing $(A + jB)$ by $(C + jD)$ and setting A at unity and B at zero.

Actual test equipment such as oscilloscopes present magnitude and phase angle. This is the polar form, and conversion is as follows:

Given rectangular form $A + jB$,
 magnitude = $MAGN = A + B$ and
 phase angle = $PHA = (B/A)$.

Conversion from polar to rectangular form is:

Given polar form $MAGN$ at angle PHA ,
 real part = $MAGN \times \cosine(PHA)$ and
 imaginary part = $MAGN \times \sin(PHA)$.

Trigonometric functions in the language will determine whether angles are in radians or degrees. Most are in radians. The conversion factor from radians to degrees is:

$$\text{Degrees} = 57.29577951 \times \text{radians.}$$

Given Complex Numbers of $(A + jB)$ and $(C + jD)$

Addition:

$$(A + jB) + (C + jD) = (A + C) + j(B + D)$$

Subtraction:

$$(A + jB) - (C + jD) = (A - C) + j(B - D)$$

Multiplication:

$$(A + jB) \times (C + jD) = (AC - BD) + j(AD + BC)$$

Division:

$$\frac{(A + jB)}{(C + jD)} = \left[\frac{AC + BD}{C^2 + D^2} \right] - j \left[\frac{AD - BC}{C^2 + D^2} \right]$$

Inversion:

$$\frac{1}{(C + jD)} = \left[\frac{C}{C^2 + D^2} \right] - j \left[\frac{D}{C^2 + D^2} \right]$$

Summary of complex arithmetic used for analysis.

This requires two floating point numbers for every complex number. The lefthand number is called the *real* component and the righthand number, separated by the j , is called the *imaginary* component. Don't let the imaginary term fool you — it is very real. The naming comes from mathematical notation. [Note that electronics applications use j instead of the mathematical symbol i to avoid confusion with the symbol for current ... BWL]

Admittance is the reverse of impedance. You may be more familiar with impedance and the notation:

$$Z = R + jX$$

with X being *reactance*, either positive or negative. Admittance is:

$$Y = G + jB$$

with G being *conductance* and B *susceptance*, either positive or negative. The relationship $Y = 1/Z$ is true but there are special rules governing complex number mathematics. These rules are summarized in the text box on complex number arithmetic.

The circuit to be analyzed is converted into a model for the computer by copying each component as a branch. Each branch has two node numbers corresponding to connections in the circuit. All nodes above ground must have sequential numbering, beginning with 1, but the node numbers may be in arbitrary positions. A ground node is signified by 0.

A complete set of branch descriptions comprises a circuit list. The circuit list we use requires three integer values and two floating point values to completely define a node. The three integer values are for the connections to other nodes and for indicating what number node we are presently at. The two floating point values define the complex admittance of the branch. To be useful, the minimum number of branches available should be at least 20.

You will notice that signal sources are currents and not voltages. This and use of admittances are deliberate in the solution of a node voltage. Consideration of node voltage solutions is important for our analysis.

Fundamental Circuit Matrix

A simple resistor network is shown in figure 1. This circuit can be analyzed quickly using pencil and paper, but will serve to show the mechanism of solutions. Keeping this circuit in mind, inspect the general

EEs

What's GE's Mobile Radio Products Department doing in a computer magazine?

Hoping to arouse your curiosity for one thing. It's not universally known that our two-way radio systems, now in use throughout the world, increasingly use microprocessing systems for control and data transmission.

Hoping to interest you in investigating a career future with General Electric for another. Our stable, growing business provides many opportunities to pursue new areas of interest and to develop professionally.

We have openings for EEs with experience in RF hardware design and control/signaling hardware and software, to work in the total spectrum of land mobile communications technology . . . including small signal and power RF circuits, custom monolithic ICs, thick-film hybrid circuit design and process technology, frequency synthesis and the application of microprocessors to land mobile communications, to name a few.

The best candidates are aggressive, free-thinking . . . who can hold their own in a technical discussion and work best in a team environment that encourages testing new concepts and approaches. Engineers who enjoy designing equipment to help people solve communications needs.

We have top-notch lab facilities, interesting assignments, and some of the brightest minds in the business. We can also provide choice living in a progressive community, or among the beautiful rolling hills of our nearby countryside.

Curious to know more about these opportunities? Send your resume with earnings history to Dept. 31-K, Professional Relations, General Electric, Mountain View Rd., Lynchburg, Va. 24502.

GENERAL  ELECTRIC

An equal opportunity employer, M/F

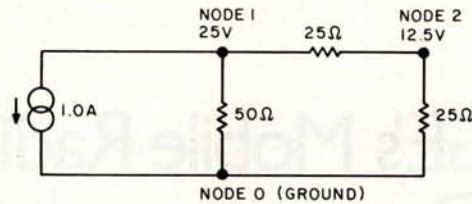


Figure 1: Simple resistive network with a current generator. The direction of the electron flow from the generator is indicated by an arrow. Note that nodes are numbered sequentially.

Matrix Representation									
$Y_{1,1}$	$Y_{1,2}$	$Y_{1,3}$	$Y_{1,4}$	\dots	$Y_{1,N}$	E_1		I_1	
$Y_{2,1}$	$Y_{2,2}$	$Y_{2,3}$	$Y_{2,4}$	\dots	$Y_{2,N}$	E_2		I_2	
$Y_{3,1}$	$Y_{3,2}$	$Y_{3,3}$	$Y_{3,4}$	\dots	$Y_{3,N}$	E_3	=	I_3	
$Y_{4,1}$	$Y_{4,2}$	$Y_{4,3}$	$Y_{4,4}$	\dots	$Y_{4,N}$	E_4		I_4	
\vdots	\vdots	\vdots	\vdots	\dots	\vdots	\vdots		\vdots	
$Y_{N,1}$	$Y_{N,2}$	$Y_{N,3}$	$Y_{N,4}$	\dots	$Y_{N,N}$	E_N		I_N	
Simultaneous Equations									
$Y_{1,1}E_1 + Y_{1,2}E_2 + Y_{1,3}E_3 + Y_{1,4}E_4 + \dots Y_{1,N}E_N = I_1$									
$Y_{2,1}E_1 + Y_{2,2}E_2 + Y_{2,3}E_3 + Y_{2,4}E_4 + \dots Y_{2,N}E_N = I_2$									
$Y_{3,1}E_1 + Y_{3,2}E_2 + Y_{3,3}E_3 + Y_{3,4}E_4 + \dots Y_{3,N}E_N = I_3$									
$Y_{4,1}E_1 + Y_{4,2}E_2 + Y_{4,3}E_3 + Y_{4,4}E_4 + \dots Y_{4,N}E_N = I_4$									
\vdots									
$Y_{N,1}E_1 + Y_{N,2}E_2 + Y_{N,3}E_3 + Y_{N,4}E_4 + \dots Y_{N,N}E_N = I_N$									

Figure 2: Matrix and simultaneous representations of any circuit. In the figure, and also in the text, the following conventions hold:

Y := circuit branch admittance

E := circuit node voltage

I := circuit node current

The circuit branch admittance is determined by the node description.

Matrix Array Subscripts			
Branch Type	Row	Column	Enter into Array by
Passive	Plus node	Plus node	Addition
	Plus node	Minus node	Subtraction
	Minus node	Minus node	Addition
	Minus node	Plus node	Subtraction
Generator	Plus node	NMAX + 1	Addition
	Minus node	NMAX + 1	Subtraction

Table 2: Matrix insertion subscript rules for branches. Any row and column node combination that contains a zero will not enter the matrix. NMAX is the maximum node number in the circuit. Remember that the nodes must be numbered sequentially.

matrix and simultaneous equations given in figure 2.

The mathematical matrix form and the simultaneous equations form are identical. Mechanizing the solution will require parts of both forms. Admittance subscripts will depend on node numbers (in the branch list) and follow certain rules depending on type. Those rules are given in table 2.

The simple example, expressed in the general equations of figure 2 is:

$$Y_{1,1} E_1 + Y_{1,2} E_2 = I_1 \quad (1)$$

$$Y_{2,1} E_1 + Y_{2,2} E_2 = I_2 \quad (2)$$

The conductance of 50 ohms is 0.02 mho, 25 ohms is 0.04 mho. [The mho is a unit of conductance, the inverse of the ohm. The mho is also called the siemens . . . CM] Using only the real parts of admittance and following the rules of table 2 yields the numeric forms:

$$0.06 E_1 - 0.04 E_2 = 1.0 \quad (1A)$$

$$-0.04 E_1 + 0.08 E_2 = 0 \quad (2A)$$

Solving for E_2 can be done by multiplying equation (1A) by 2/3 and adding the product to equation (2A) to give:

$$0.05333 E_2 = 0.66667$$

$$E_2 = 12.5$$

Substitution of E_2 into equation (1A) gives:

$$0.06 E_1 - 0.50 = 1.0$$

$$E_1 = 1.50/0.06$$

$$E_1 = 25$$

The preceding straightforward mathematics becomes impractical for models with many nodes. Note that the subscript rules of table 2 are different than the example just given. A slightly different matrix arrangement is actually used.

Fundamental Properties of Matrices

Mechanization of the solutions requires a matrix in two dimensions having N rows and N+1 columns, N being the highest node number in the model. The first subscript is the row, and the second is the column position. The rightmost column is used only for signal sources.

Figure 3 shows the example represented

TARBELL SOFTWARE

Extensive & Inexpensive.

TARBELL CASSETTE BASIC only \$36.00

Most features of ALTAIR* Extended BASIC are included PLUS these added features:

- Assignment of I/O
- Alphanumeric line labels
- Unlimited length of strings
- Unlimited length of variable names
- Procedures with independent variables
- Number system 10 digits BCD integer or floating point

Included are commands unique to TARBELL CASSETTE BASIC which provide capabilities to:

- Initialize I/O channel
- Assign a physical device to a logical device
- Drop an I/O channel previously assigned
- Save the BASIC interpreter and monitor or I/O routines on cassette
- Cause programs to be appended onto programs already in memory
- Call a procedure and pass variables on the list
- Cause interpreter to enter edit mode using 15 single character edit commands.

Tarbelle BASIC occupies 18K of RAM. Source is available on cassette, CP/M** Disk, and printout—all at reasonable prices. Price for TARBELL CASSETTE BASIC and complete documentation: \$36.00.

CP/M Disk Operating System

The I/O section of this software has been modified to operate with the TARBELL Floppy Disk Interface in 24K bytes of memory. Five commands permit listing of directory, typing contents of an ASCII file, renaming a file, erasing a file from disk, and saving memory on disk. Fourteen programs are included which are invoked like commands. Six source files are included for transferring between TARBELL Cassette and disk, cold-start loading, Basic I/O system with drivers, and reformatting crashed diskettes. Documentation includes a listing of BIOS and instructions to patch CBIOS for your system. Price is \$100 on CP/M diskette with documentation. (CP/M is a product of Digital Research).

CP/M 1.4 Update Package

A TARBELL Update Package for those now using CP/M 1.3 is now available on diskette. The Update Package adds new commands and the ability to access four disk drives, as well as 2 new CP/M manuals, TARBELL CP/M User's Guide and a new BIOS listing. Price: \$50.00.

SPOOLER

This 8080 program will save many hours of computing time. It intercepts all output to the list device, spools the output to a high-speed disk file, and directs the spooled data to a low-speed printer during unused cycle time while the CPU waits for transfer of data to and from the console. System throughput is greatly increased with the aid of SPOOLER. Output is never lost due to insufficient memory allocation. Fully compatible with the CP/M file system, SPOOLER permits parallel processing without hardware interrupt, and with minimal impact on other processes. Price: \$50.00 (Copyright KLH Systems.)

BASIC-E Compiler

Designed to work with CP/M Disk Operating System this software requires a total of 20K bytes of memory. Included are 26 compiler error messages and 23 run-time error messages. Disk files may be read, written or updated by using both sequential and random access. Included are blocked and unblocked files. Price for compiler and run-time monitor on diskette is \$10.00. Manual is available separately for \$5.00. (Public domain software by Gordon E. Eubanks, Jr.).

CBASIC Programming System

Upward compatible from BASIC-E, CBASIC is similar but expanded to include several business oriented facilities, allowing decimal computations to 14 digits of precision, data formatting and PRINT USING statements. Statements allow access to disk files and disk file maintenance. Strings of characters may be read from the console to permit correct input line format to be checked before reading data. General programming features include variable names up to 31 characters, optional line numbers, dynamic debugging tracers, and optional data output to printer. CBASIC on diskette and manual priced at \$100. (Copyright Software Systems.)

EMPL-an 8080 APL

Especially suited to educational applications, EMPL is an adaptation of APL, using the ASCII character set. This 8K version occupies the first 5376 bytes of memory and operates in two modes. The Execution Mode permits all instructions to be executed immediately. The Definition Mode permits the user to enter functions. EMPL on Tarbell Cassette with manual is \$15.00. (Copyright 1977 Erik Mueller).

Tarbelle
Electronics

*ALTAIR is a trademark/tradename of MITS, Inc.

**CP/M is a trademark/tradename of Digital Research.

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

$M_{1,1}$	$M_{1,2}$	$M_{1,3}$
$M_{2,1}$	$M_{2,2}$	$M_{2,3}$

INITIAL

.06	-.04	1.0
-.04	.08	0

D	0	0
N	↓	↓

FORWARD SOLUTION

.06	-.04	1.0
-.04	.05333	.66667

	N	
	D	0

BACK SOLUTION

.06	-.04	1.5
-.04	.05333	.66667

D_1		N_1
	D_2	N_2

LOCATION OF SOLUTION NUMERIC VALUES

.06		1.5
	.05333	.66667

$$\text{Multiplication factor} = \left(\frac{M_{1,2}}{M_{2,2}} \right) = -0.75$$

$$\text{New } M_{1,3} = M_{1,3} - (\text{MULT.FACT} \times M_{2,3}) = 1.50$$

Final node voltage solutions are indicated by numbered subscript Ns and Ds, where the subscript stands for the node of solution.

We have used a slightly different number handling scheme and have arrived at the same solution. This technique can be expanded to larger arrays in order to provide an algorithm that solves all node voltages. It should be noted that solutions provide node voltages with reference to circuit ground; modeling techniques allow finding the voltages between nodes.

$M(K,J)$ in the optional section. A 0 numerator will have no effect on inner loop variables, so a bypass could occur on 0s. (Remember to check both the real and imaginary parts of 0.) Many circuits will have only about one half array positions nonzero, so this test will help running time.

A similar test can be made by bypassing the inner loop if $M(J,I)$ is equal to 0. This helps reduce running time on large node circuit models; at 20 nodes or less, the help is arbitrary. All such tests take time, so it is worthwhile to perform these tests outside the inner loop since the inner loop iterates the most.

It is interesting to note where the node voltage solution numerators and denominators are located. Numerators are always in the righthand or generator column. De-

nomimators are always in the main diagonal from upper left to lower right. Row position is equal to node of solution. Highest node numerators and denominators are always found; back solution is required only for nodes less than the highest node. The back solution algorithm is called the *Gaussian elimination* or *Gauss-Jordan* method of solution.

Complete Frequency Solution

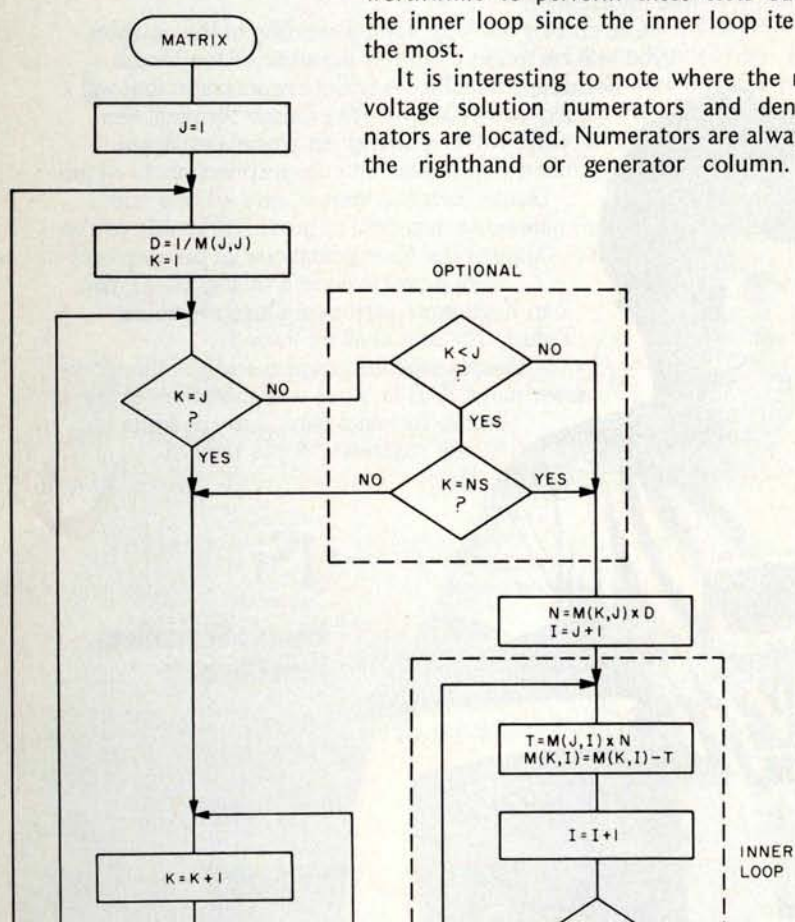
The flowchart shown in figure 6 is the ANALYSIS routine. This routine assumes that the admittance of each branch, Y , is already calculated. Before the matrix branch values can be calculated, the entire matrix is set to 0. Zeroing the matrix will allow simple addition and subtraction in the matrix fill section.

Variable W is the frequency in radians per second. Variable $W1$ is the negative inverse of W . These simplify admittance calculations. An often used constant is 2π which should be stored as a single variable. Variable F is the solution frequency.

Variable Y is the calculated complex admittance for passive branches but is the stored value of current for generators. Variable M is the two-dimensional complex matrix array used in figure 3, and variable S is the solution matrix, which is capable of storing complex values. Variable L is the subscript value for array S .

Most of the flowchart involves an examination of each branch, calculation of the admittance, and addition or subtraction of that value into the matrix. Positioning tests seem to be rather complex, but they do follow the rules of table 2. The flowchart and table 2 can be expanded to fit a special branch type.

Current flow of a generator branch is determined by node number entry order. This will be illustrated further under modeling techniques. A constant value



Totally Integrated, Entirely Self-Contained

THE PETTM PERSONAL COMPUTER



With technology so advanced,
Concept so remarkable,
Operation so utterly simple,
Cost so incredibly low.

The PET has given rise to a brand new era...
The Age of the Personal Computer

**HIGH SPEED PRINTER
ACCESSORY**

Immediate Delivery

FEATURING AN IEEE-488 BUS

THE PET has become the standard for the personal computer industry. Consumer and business publications have lauded its discovery. POPULAR SCIENCE and PLAYBOY have given special tribute to the "mind-boggling" PET.

IN A LEAGUE WITH IBM, HP AND WANG MINICOMPUTERS

THE PET is a minicomputer and should not be confused with game products that hook up to household T.V.'s. What sets it apart from other computers is price. While others cost from \$11,000 to \$20,000 and more, THE PET, with similar power, costs only \$795.00.

Features an IEEE-488 Bus - like HP's mini and full size computers. This standard data and control channel permits direct connection to many peripherals. Over 120 pieces of compatible equipment such as counters, timers, spectrum analyzers, digital voltmeters and printer plotters, from HP, Philips, Fluke, and Tectronix, etc., are currently available.

ROM Magazine, January 1978, writes, "THE PET comes out of the box, plugs into the wall, and is ready to use." It is equipped with a CRT video display with reverse and blink features, an alpha-numeric keyboard with complete graphics and a built-in standard cassette tape deck.

THE PET has 8K bytes of RAM (user memory). Optional equipment permits expansion to 32K. And, it has 14K bytes of ROM (program memory).

THE PET COMMUNICATES IN BASIC. THE EASIEST COMPUTER LANGUAGE

If THE PET wants you to press a key, it will flash, "Press such and such", on the display. You speak back to it through its full size 73-key keyboard.

EXTENSIVE CHARACTER ORIENTED GRAPHICS

The unit features a 9-inch, high resolution, 1000 character CRT. Characters are arranged 40 columns by 25 lines on an 8 x 8 matrix for superb graphics.

WHAT IS THE PET REALLY FOR?

It is the single most important teaching device for any computer related subject. It will entertain the most sophisticated data application, or the simplest inquiry/response assignment. **IN THE LAB** it handles instrumentation, process monitoring, and more. A number of Fortune 500 companies have already made it an integral part of their lab and general office system.

TECHNICAL SPECIFICATIONS

MEMORY

Random Access Memory (user memory); 8K internal, expandable to 32K bytes

Read Only Memory (operating system resident in the computer); 14K bytes
8K-BASIC interpreter program, 4K-Operating system, 1K-Diagnostic routine

VIDEO DISPLAY UNIT

9" enclosed, black & white, high resolution CRT
1000 character display, arranged 40 columns by 25 lines
8 x 8 dot matrix for characters and continuous graphics
Automatic scrolling from bottom of screen
Winking cursor with full motion control
Reverse field on all characters

64 standard ASCII characters; 64 graphic characters

KEYBOARD

9 1/2" wide x 3" deep; 73 keys

All 64 ASCII characters available without shift.

Calculator style numeric key pad

All 64 graphic and reverse field characters accessible from keyboard (with shift)

Screen Control: Clear and erase

Editing: Character insertion and deletion

CASSETTE STORAGE

Fast Commodore designed redundant-recording scheme, assuring reliable data recovery

As a **BUSINESS TOOL** it will; Maintain ledgers. Keep payroll records. Create P & L's. Control inventory. Store and analyze sales data. Draw bar graphs. Issue invoices. Hook up to on-line computer system. **AT-HOME** it will; Compute state and federal tax returns. Make heat and insulation analyses. Keep Christmas lists. Keep checkbook and finances up to date. A variety of games, from Blackjack to Galaxy, is currently available.



Bar Graphs



Amortization Chart



Black Jack



Teaching Trigonometry

HIGH SPEED PET PRINTER

This powerful word processor prints hardcopies, invoices, computer correspondence. **Faster than an IBM Selectric.** THE PET Printer delivers 60 characters per second at a sustained rate - with upper and lower case capability. Characters are one-eighth inch tall and are printed in a 7 x 8 dot matrix. The printer uses a standard 8 1/2" wide paper roll. And, it is only \$695.00.

PERIPHERAL SECOND CASSETTE

This optional component expands storage and increases flexibility. Only \$99.95.

MILES OF SOFTWARE

Many programs are available now, including, "BASIC BASIC" which shows how to write a program. You can develop your own programs to meet personal requirements.

Cassette drive modified by Commodore for much higher reliability of recording and record retention
High noise immunity, error detection, and correction
Uses standard audio cassette tapes
Tape files, named

OPERATING SYSTEM

Supports multiple languages (BASIC resident)
Machine language accessibility
File management in operating system
Cursor control, reverse field, and graphics under simple BASIC control

Cassette file management from BASIC
True random number generation or pseudo random sequence

INPUT/OUTPUT

All other I/O supported through IEEE-488 instrument interface for peripherals

I/O automatically managed by operating system software

Single character I/O with GET command

Easy screen line-edit capability

Flexible I/O structure for BASIC expansion with peripherals

BASIC INTERPRETER

8K BASIC; 20% faster than most other 8K BASICS

Upward expansion from BASIC language

Strings, integers, multiple dimension arrays

10 significant digits; floating point

Direct memory access: PEEK and POKE commands

DIMENSIONS

16" wide; 18 1/2" deep; 14" high. Weight: 44 lbs.

GAME PROGRAMS ARE \$9.95 EACH:

- ☐ Black Jack ☐ Draw Poker ☐ Galaxy Games
- ☐ Space Flight ☐ Target Bong. Off-The-Wall
- ☐ Lunar Lander, Wumpus, Rotat, Tic-Tac-Toe
- ☐ Osoro, Reverse ☐ Spacetrek ☐ Kingdom

PROGRAMS AT \$14.95 EACH:

- ☐ Mortgage Analysis
- ☐ Diet Planner and Biorhythm
- ☐ Basic Basic-by Lodewyck and James

PROGRAMS AT \$24.95 EACH:

- ☐ Basic Investment Analysis-loans, annuities, return on regular and irregular sequences of payments, calendar calculations
- ☐ Stock Portfolio Recordkeeping and Analysis-keeps track of buys, sells, and dividends. Calculates current value, rates of return
- ☐ Checkbook Recordkeeping and Analysis-keeps track of checks and deposits. Analyzes expenses by date and type

PROGRAMS AT \$29.95 EACH:

- ☐ Basic Math Package-matrix addition, multiplication, determinants and inverses to 16 x 16, solution of simultaneous linear equations, vector and plane geometry calculations, integration by trapezoidal, Simpson's rule or Gaussian quadrature, differentiation
- ☐ Basic Statistics Package-mean, median, variance, standard deviation, skewness, kurtosis, frequency distribution, linear regression, T-tests, correlation analyses

FREE ORIENTATION PACKAGE

Your PET comes complete with two programs and an easy-to-follow instruction manual. By working through the routines you will quickly discover how easy it is to gain command of your personal computer.

SERVICE WORLDWIDE

Because your PET is self-contained and compact, professional factory service is never far away. If major service is required, the unit can simply be returned by UPS to an authorized Commodore PET clinic.

To order your PET send check or money order for \$795.00 plus \$20.00 for shipping and insurance. To order the PET Printer, add \$695.00 plus \$12.00 for shipping and insurance. The Second Cassette is \$99.95. No shipping and insurance charges are required when ordering a second cassette or programs with your PET. Credit card orders are invited to call our toll free number below. Orders will be accepted on our TELEX, No. 25-5268.

Use THE PET for 30 days with no obligation. If, for any reason, you are not satisfied, return it for a prompt and courteous refund.

ORDER DIRECT

CREDIT CARD ORDERS CALL TOLL FREE

800-323-2272

ILLINOIS RESIDENTS CALL: 312-595-0461

TELEX ORDERS: 25-5268

Order your PET, Printer Accessory, Second Cassette and Programs from Contemporary Marketing at:

**790 MAPLE LANE DEPT. BT-9
BENSENVILLE, ILLINOIS 60106**

Contemporary
Marketing Inc.

©CMI 1978/85

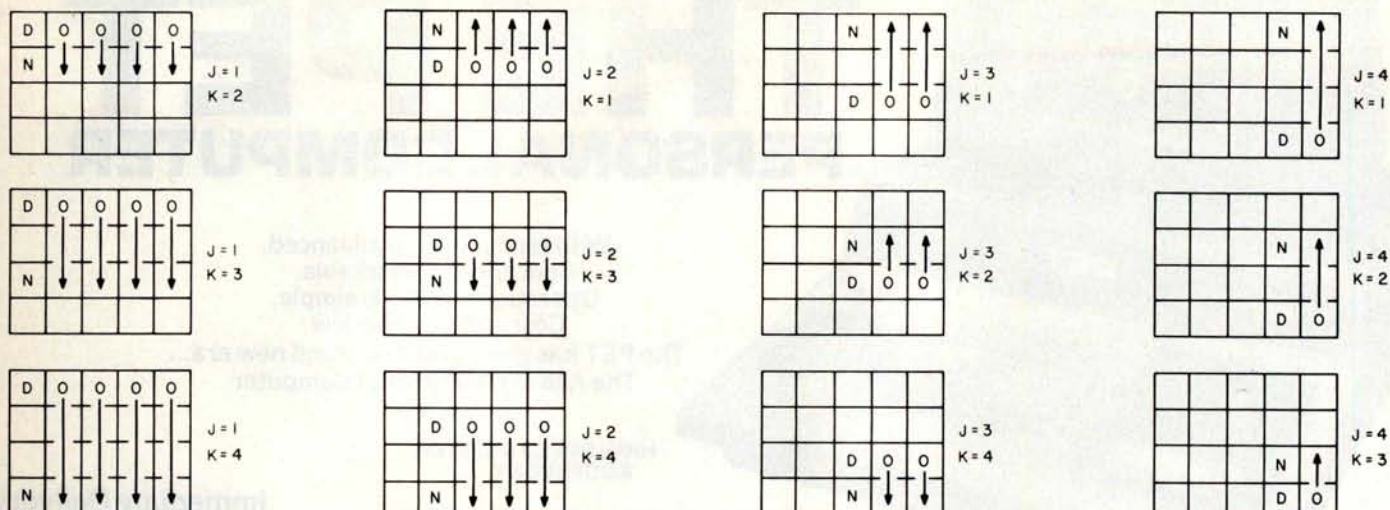


Figure 5: Sequential solution for all nodes of a 4 node circuit. This solution is the type that would take place if the optional section of figure 4 were deleted.

Branch Types and Passive Calculations

Small systems need simple rules, so it is probably easier to identify branch types in storage by integer numbers. One is sufficient. The number of different types should be considered in terms of calculation code and analysis needs.

Multicomponent branch types are strongly recommended since they reduce the number of nodes required in a model. Multicomponent branches are given in table 3 in terms of ohms, farads and henries stored in the branch list. List array storage posi-

tions should be considered in regard to the calculations.

Radian frequency, W , and its inverse negative, $W1$, are from the single frequency analysis routine. All of the parallel combinations are calculated as impedances first and then inverted. Series combinations should require less coding if calculated as impedances first; this can be seen by comparing table 3 with the complex values given in table 1.

Direct admittance calculations may be slightly faster for series combinations. The choice is determined by the amount of memory, possibly by external memory control. All analysis matrices should be in main memory when ANALYSIS is called.

Passive Branch Values at DC

Direct current (DC) analysis can be considered as analysis at 0 Hz. Resistances remain the same but capacitors have 0 susceptance. Their susceptance (imaginary part) is effectively bypassed. Single inductors should have their susceptance value replaced by a low resistance, say a hundredth of an ohm (100 mhos susceptance), to avoid calculating difficulties. In actuality, inductors have finite resistance at DC.

Series combinations can be bypassed for certain types. A series resistor-capacitor (RC) or inductor-capacitor (LC) branch will have 0 admittance. In a series RL branch calculation, the susceptance calculation can be omitted and only the conductance calculation performed. Parallel combinations are also modified. A parallel RC branch requires only the conductance calculation. Parallel RL or LC branches would have the nominal

Branch Value Storage		
Type	V1 (First Floating Point Variable)	V2 (Second Floating Point Variable)
Parallel RL	R	L
Parallel RC	R	C
Parallel LC	L	C
Series RL	R	L
Series RC	R	C
Series CL	C	L
Admittance Value Calculation		
Type	YR (Real Part)	YI (Imaginary Part)
Parallel RL	$1/V1$	$W1/V2$
Parallel RC	$1/V1$	$W \times V2$
Parallel LC	0	$W \times V2 + (W1/V1)$
Series RL	V1	$W \times V2$
Series RC	V1	$W1/V2$
Series CL	0	$W \times V2 + (W1/V1)$

Table 3: Calculations showing how a multicomponent branch admittance calculation is performed. The three series calculations (RL, RC, CL) are actually impedance calculations since they are so much easier to perform. To obtain the admittance, perform the complex inversion $Y = 1/(R+jX)$.

BUY FROM THE BIGGEST

NCE/CompuMart

1250 North Main Street, Department BYA8
P.O. Box 8610 Ann Arbor, Michigan 48107

PET IN STOCK NOW \$795

- Only \$795
- Fantastic graphics
- High-speed 6502 processor
- Easy to use Extended BASIC
- Built-in Tape, TV and I/O

NCE/CompuMart Inc. sells more PET 2001 computers than any other store. Our supplies of this popular microcomputer have now been increased so that we can offer immediate delivery so you don't have to wait for this versatile machine.

Unequaled Features

The PET's high-resolution character graphics allow you to draw pictures, simulate experiments, enhance data, etc. The University of Michigan is utilizing this feature to simulate test tubes and solutions at equilibrium. Others are using it to display the i-Ching or funny faces for the kids. PET BASIC allows editing lines to keep you from having to type entire lines over to make corrections — a great time saver. File storage on tape cassette is highly valuable for information retrieval applications and the 10-digit precision makes sure that your calculations are accurate.

More and more people are buying the PET every day and when you see how easy it is to learn to use, you'll know why. Programs and accessory peripherals are now available for your PET right now. No matter where you go, you won't find a more capable computer for \$795.



THE PET CONNECTION

PET with 8K user memory **\$795.00**
Second Cassette drive **\$99.95**
RS-232 Printer Adapter — assembled board **\$98.50**
With power supply, case & DB25 **\$169.00**
Beeper — PET controlled beep **\$19.95**

Video Buffer — add a conventional monitor **\$19.95**
BETSI — PET to S-100 I/O Motherboard Kit **\$105.00**
Assembled **\$160.00**

READER/PUNCH

NEW ASCII INTERFACES for Reader/Punch



8 LEVEL PAPER TAPE/READER PUNCH

NEW in original box **\$295.00**
USED (90 day warranty) **\$175.00**
Documentation Package **\$15.00**

30 Day delivery on interfaces
Boards & Cables
Parallel RS232 Serial **\$220**
Board, Cables, Power Supply **\$490**
Parallel **\$615**
Board, Cables, Power Supply **\$575**
Serial **\$780**

KIM-1

The original fully expandable single board computer

Assembled

\$179

with power supply

\$209

EXPAND YOUR KIM SYSTEM

KIMSI

KIM to S-100 Board

\$125

Assembled

\$169

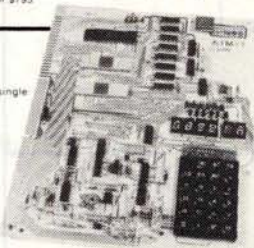
Connector set

\$15

KIM4

Expansion board

\$119



KIM ENCLOSURE

8K VISIBLE MEMORY FOR KIM

Assembled **\$289**

CASSETTE RECORDER (SANYO) **\$55**

connector set Cat. No. KIM-KXR-RCDR3 **\$12**

MICRO TECH. POWER SUPPLY

Assembled **\$29.95**

MICRO TECHNOLOGY K-1000

Fully assembled and tested, enclosed in a Bakelite box. Outputs are -5VDC at 1.2A, -12VDC at 100mA, -7.5VDC at 750mA, -16VDC at 250mA. Power your KIM and additional memory too!

Assembled

\$23.50

Give your KIM a professional appearance. No alterations required, sturdy, Kiyex 100, Black

EXIDY SORCERER

- Z-80 Processor
- Full-size ASCII keyboard
- User definable characters
- Up to 32K on-board RAM
- Interchangeable ROM PACs
- 30 x 64 display
- Resident 4K Monitor ROM
- Dual Cassette I/O
- Serial and Parallel I/O
- Complete Operators Manual
- Only \$895

State-of-the-art technology makes these features available at a fantastic price. You simply add a monitor and tape decks to complete the system. Control key enables you to use it as a terminal. Later ROM PACs will give you Z-80 Assembly Language, APL, PILOT, Word Processing and a DOS PAC for FORTRAN and COBOL. What a system for only \$895!

Autocomputer



Reduce Fuel costs — monitor your engines performance in real time **\$129.50**

The AUTOCOMP mounts in or on your dash, and by pushbutton control provides LED readouts of the following driving functions: Instantaneous MPG, Average MPG, Fuel Used, Distance Traveled, and Correct Time.

AUTOCOMP can be installed on most American and Japanese make autos and vans except those with fuel injection and is NOT recommended for European imports.

Rockwell

AIM65

- Fully assembled, tested, and warranted
- Addressing to 65K bytes (1K RAM on board)
- Includes onboard
- Powerful 4K ROM Debug/Monitor
- Supports for additional 4K RAM 18K ROM
- 25 Col. ASCII Thermal printer (90 lines/min.)
- Full size (54 key) alphanumeric keyboard
- 25 char ASCII alphanumeric display
- Application Conn. for TTY, 2 cassette, 2 8 bit I/O ports
- Expansion Conn. (try our KIMSI S-100 board)
- Both connectors totally KIM-1 compatible
- Easy Power connections

Options — 4K ROM Assembler/Test Editor **\$375**
8K Basic ROM



CompuColor II

NEW!

Disk-based Model 3

\$1,495

• Beautiful color graphics

• 16K ROM with Extended Disk BASIC

• Editing and file control commands

• 8K Graphics, 4K User RAM

• Integral Mini-floppy holds 51.2K bytes

• RS-232 Asynch. I/O

• Full-size keyboard

• Popular 8080 micro-processor

• Variety of pre-programmed diskettes available

TC-71 SELECTRIC TERMINALS

Based upon the heavy duty selectric mechanism, RS232C, PTT code. See catalog for details and easy interfacing information. Specify table top or version with its own desk.

Refurbished **\$695**
Cleaned & working **\$495**
AS IS **\$339**
Documentation **\$30**

SALE ASCII INTERFACE FOR TC-71 **\$159**
30 day delivery Normally \$199 NOW \$159
Acoustic Coupler for use with ASCII TC-71



SALE!

Table-top Datel/Selectric Terminals

- High quality printing
- Interchangeable typebars
- Local, remote or wall data section
- Computer controllable terminal functions
- Remote integration of terminal status
- Interrupt and reverse scan
- Low noise level
- Portability
- Size 21" wide x 21" deep x 8" high
- Power input 115 Volt, 60 Hz
- Interface RS232C (BCD code)



NEW!

from \$395

DOCUMENTATION **\$45**
AS IS **\$295**
WORKING **\$395**
REFURBISHED **\$895**

Single board VIDEO TERMINAL

16 Ln x 64 chr display, 128 printable characters, software UART (ASCII or Baudot), 3 serial interfaces - cassette I/O, true composite video, ASCII keyboard (parallel input) TTL compatible, easy power connection

Assembled & tested **NOW \$187**

GRI ASCII KEYBOARD



53 keys in standard ASR-33 layout. Kit **\$59.95**
Assembled **\$71.95**
Enclosure **\$14.95**

• 28 Double-function keys including up to 12 "Special" functions
• Easy to view 8 digit hex led display
• KIM-1 hardware compatible
• 6502 based system
• 4K byte ROM resident monitor and operating system
• 1K byte of 2114 static RAM
• 16 pin direct system video for immediate expansion to 4K bytes
• Enhanced software

VIM-1

From Synertek

\$269.00

PIKE-VERTER

\$9.95

The original video to R.F. converter. Converts any good T.V. to a video monitor.

Surface area: 8 1/2 x 11 inches
Plot Area: 7 x 10 inches
200 or 100 increments per inch, 240 steps per second at 81 inch or 480 steps per second at 800. 6A RS-232C (Serial), 6-Line, TTL (Parallel) **\$1.085**

MATROX VIDEO RAMS S-100

ALT-2480 24Ln x 80Chr display **\$295**
ALT-256 256 x 256 dot display **\$395**

INTEGRAL DATA IP-125 IMPACT PRINTER

\$799

RS232C or parallel interface, full upper & lower case ASCII, 8 1/2 paper, baud rates to 1200, 80 columns, built-in self-test.

NOW only \$749 when purchased with COMPUCOLOR II, PET, VIM, KIM OR AIM

SALE!

TI PROGRAMMER

Hexadecimal, octal, decimal calculator/converter.

Reg. \$59.95 **NOW \$53.95**

SALE!

Hexadecimal, octal, decimal calculator/converter.

Reg. \$59.95 **NOW \$53.95**

SALE!

Hexadecimal, octal, decimal calculator/converter.

Reg. \$59.95 **NOW \$53.95**

SALE!

Hexadecimal, octal, decimal calculator/converter.

Reg. \$59.95 **NOW \$53.95**

SALE!

Hexadecimal, octal, decimal calculator/converter.

Reg. \$59.95 **NOW \$53.95**

SALE!

Hexadecimal, octal, decimal calculator/converter.

Reg. \$59.95 **NOW \$53.95**

SALE!

Hexadecimal, octal, decimal calculator/converter.

Reg. \$59.95 **NOW \$53.95**

Books

DESCRIPTION PRICE

Telephone Accessories You Can Build **4.95**

The First Book of KIM (New Edition) **9.00**

Basic BASIC: An Introduction **7.95**

Advanced BASIC: Application and Solutions **8.95**

Home Computers: A Beginners Guide **6.95**

THE ADAM OSBORNE SERIES:

An Introduction to Microcomputers V. 0 **7.50**

An Introduction to Microcomputers V. 1 **7.50**

An Introduction to Microcomputers V. 2 **15.00**

8080 Prog. for Logic Design **7.50**

6800 Prog. for Logic Design **6.95**

Some Common BASIC Programs **7.50**

WORKBOOKS FOR PET 2001

Descriptive text with many exercises and sample programs

Getting Started with Your PET **4.00**

PET String and Array Handling **3.95**

PET Graphics **4.95**

PET Cassette I/O **4.95**

Miscellaneous PET Features **3.95**

PET LITERATURE PACKAGE

A collection of three valuable publications relating to the PET 2001

CPET2 The PAPER PET User Notes 5.00

10 DAY RETURN PRIVILEGE

- 90 day limited warranty
- Newest, most exciting products in personal computing
- Outstanding values
- All items fully assembled and tested unless otherwise stated.
- Send for our catalog for more detailed product information.

1-800
521
1534

• Michigan residents add 4% sales tax. • Foreign orders add 10% additional handling (U.S. funds only). • P.O.s accepted from D&B rated companies. • Toll FREE phones open from 8:30 AM — 7:00 PM EST. • Open accounts invited — call for credit application. • All orders add 4% shipping & handling. • Same day shipment on prepaid and

credit card orders, except as noted. • Sorry — NO C.O.D.s • All prices subject to change without notice. • Write for giant FREE catalog. • Handling charge of \$1.50 for orders under \$10.00. • In the Ann Arbor area? Retail store open 11:00 AM — 7:00 PM Tuesday-Friday 10:00 AM — 5:00 PM Saturdays.

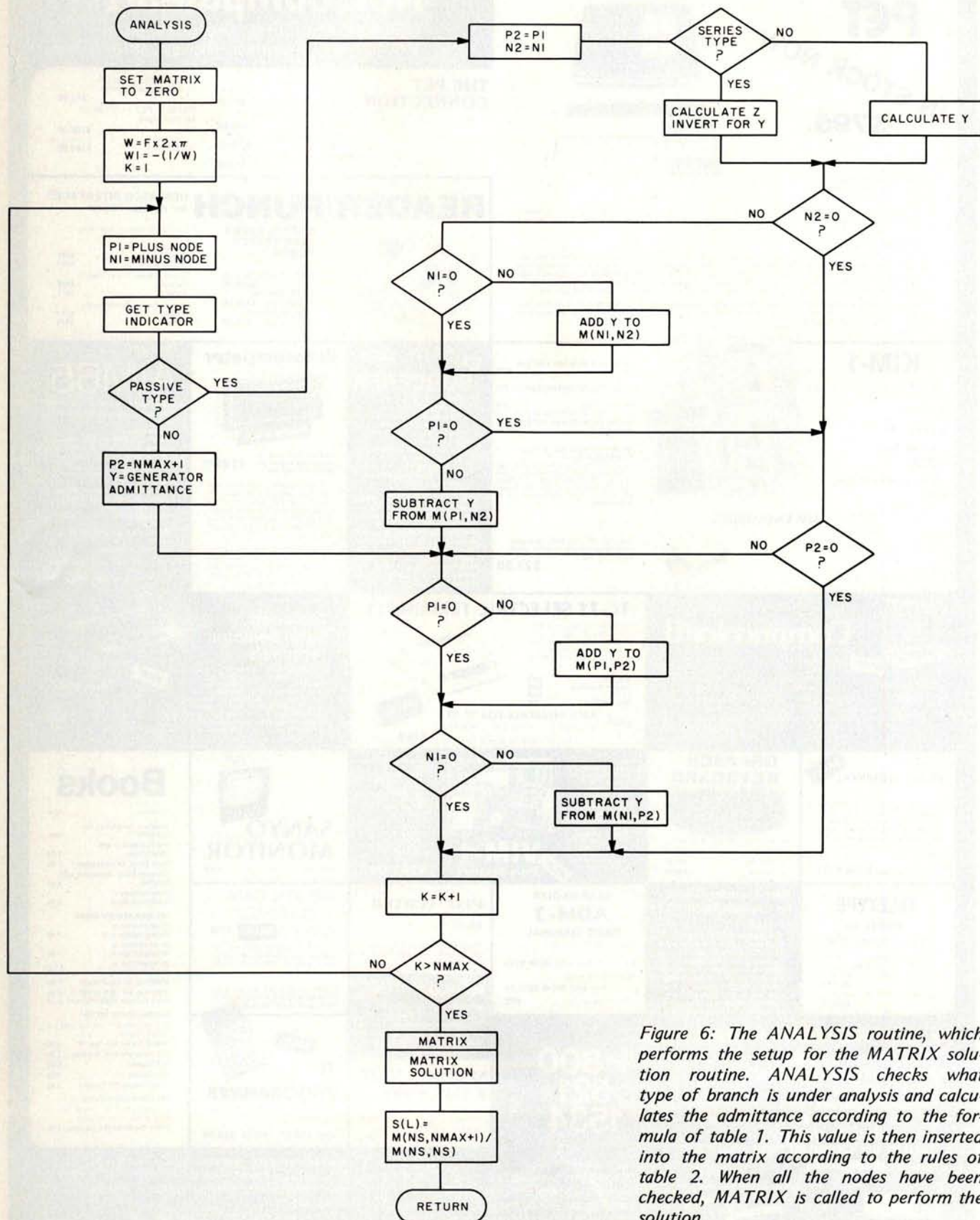


Figure 6: The ANALYSIS routine, which performs the setup for the MATRIX solution routine. ANALYSIS checks what type of branch is under analysis and calculates the admittance according to the formula of table 1. This value is then inserted into the matrix according to the rules of table 2. When all the nodes have been checked, MATRIX is called to perform the solution.

the electric pencil II™

• 1978 Michael Shrayer

The Electric Pencil II is a Character Oriented Word Processing System. This means that text is entered as a string of continuous characters and is manipulated as such. This allows the user enormous freedom and ease in the movement and handling of text. Since line endings are never delineated, any number of characters, words, lines or paragraphs may be inserted or deleted anywhere in the text. The entirety of the text shifts and opens up or closes as needed in full view of the user. The typing of carriage returns as well as word hyphenation is not required since lines of text are formatted automatically.

When text is printed, The Electric Pencil II automatically inserts carriage returns where they are needed. Numerous combinations of line length, page length, line spacing and page spacing allow for any form to be handled. Character spacing, **BOLD FACE**, multicolumn as well as bidirectional printing are included in the Diablo versions. Right justification gives right-hand margins that are even. Pages may be numbered as well as titled. This entire page (excepting the large titles and logo) was printed by the Diablo version of The Electric Pencil II in one pass.

Now on CP/M

The Electric Pencil II is also compatible with lmsal's **IMDOS**, **HELIOS** versions **SSH** and **DSH** are now ready. The **NEC** print package is now available. A utility program that converts **PENCIL** to **CP/M** to **PENCIL** files is ready. **"CONVERT"** is only \$35.00.

NEW FEATURES: * **CP/M**, **IMDOS** and **HELIOS** Compatible * Supports Four Disk Drives * Dynamic Print Formatting * **DIABLO** as well as **NEC** printer packages * Multicolumn Printing * Print Value Chaining * Page-at-a-time Scrolling * New Bidirectional Multispeed Scrolling Controls * New Subsystem with Print Value Scoreboard * Automatic Word and Record Number Tally * Cassette backup for additional storage * Full Margin Control * End-of-Page Control * Non-Printing Text Commenting * Line and Paragraph Indentation * Centering * Underlining * **BOLD FACE** *

W I D E S C R E E N V I D E O ! ! !

Available to lmsal VIO video users for a huge 80x24 character screen. These versions put almost twice as many characters on the screen !!!

HAVE WE GOT A VERSION FOR YOU ?

The Electric Pencil II operates with any 8080/Z80 based microcomputer that supports a CP/M disk system and uses a lmsal VIO, Processor Technology VDM-1, Polymorphic VTI, Solid State Music VB-1B or any similar memory mapped video interface. **REX** versions now available. Specify when using CP/M that has been modified for Micropolis or North Star disk systems as follows: For North Star add suffix A to version number, for Micropolis add suffix B to version number, e.g. **SS-11A**, **DV-11B**.

Vers	Video	Printer	Price
SS-11	SOL	TTY or similar	\$225.
SP-11	VTI	TTY or similar	\$225.
SV-11	VDM	TTY or similar	\$225.
SR-11	REX	TTY or similar	\$250.
SI-11	VIO	TTY or similar	\$250.
DS-11	SOL	Diablo 1610/20	\$275.
DP-11	VTI	Diablo 1610/20	\$275.
DV-11	VDM	Diablo 1610/20	\$275.
DR-11	REX	Diablo 1610/20	\$300.
DI-11	VIO	Diablo 1610/20	\$300.
NS-11	SOL	NEC Spinwriter	\$275.
NP-11	VTI	NEC Spinwriter	\$275.
NV-11	VDM	NEC Spinwriter	\$275.
NR-11	REX	NEC Spinwriter	\$300.
NI-11	VIO	NEC Spinwriter	\$300.
SSH	SOL	Helios/TTY	\$250.
DSH	SOL	Helios/Diablo	\$300.

UPGRADING POLICY: Any version of The Electric Pencil may be upgraded at any time by simply returning the original disk or cassette and the price difference between versions plus \$15.00 to MSS. Accept only original media at time of purchase.



MICHAEL SHRAYER SOFTWARE, INC.
1253 Vista Superba Drive
Glendale, CA 91205
(213) 956-1593

Electric Pencil I is still available for non CP/M users:

Vers	Video	Printer	Cassette	Disk Drive	Price
SS	SOL	TTY or similar	CUTS	---	\$100.
SP	VTI	TTY or similar	Tarbell	---	\$100.
SV	VDM	TTY or similar	Tarbell	---	\$100.
SSN	SOL	TTY or similar	CUTS	North Star	\$125.
SPN	VTI	TTY or similar	Tarbell	North Star	\$125.
SVN	VDM	TTY or similar	Tarbell	North Star	\$125.
DS	SOL	Diablo 1610/20	CUTS	---	\$150.
DP	VTI	Diablo 1610/20	Tarbell	---	\$150.
DV	VDM	Diablo 1610/20	Tarbell	---	\$150.
DSN	SOL	Diablo 1610/20	CUTS	North Star	\$175.
DPN	VTI	Diablo 1610/20	Tarbell	North Star	\$175.
DVN	VDM	Diablo 1610/20	Tarbell	North Star	\$175.

Demand a demo from your dealer!

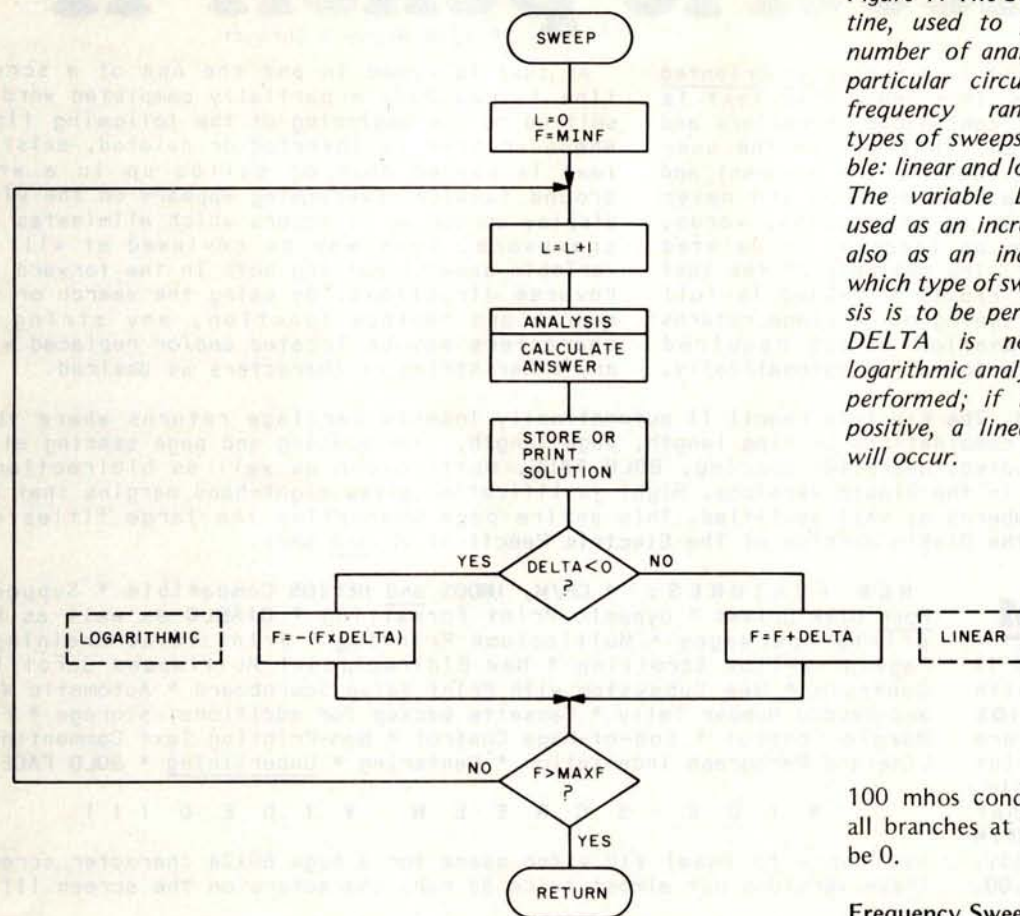


Figure 7: The SWEEP routine, used to perform a number of analyses on a particular circuit over a frequency range. Two types of sweeps are possible: linear and logarithmic. The variable DELTA is used as an increment and also as an indicator of which type of sweep analysis is to be performed. If DELTA is negative, a logarithmic analysis will be performed; if DELTA is positive, a linear analysis will occur.

100 mhos conductance specified above. In all branches at 0 Hz the susceptance would be 0.

Frequency Sweeping

For this analysis, minimum and maximum analysis frequencies must be specified plus an increment. Most solutions over a narrow range will have a small increment but it is often useful to have a logarithmic frequency sweep with wide bandwidths. The main program should have a command point to which all major routines return. Frequency range can be selected at this command point with a minimum (MINF), a maximum (MAXF) and an increment (DELTA).

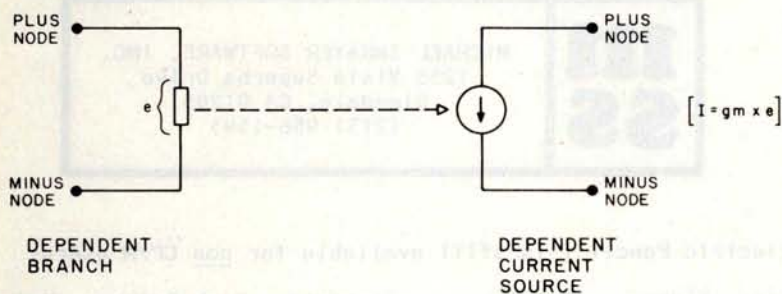
A choice between linear and logarithmic sweep can be done by simply checking for a negative or positive DELTA. A positive DELTA is the incremental change for a linear sweep, and a negative DELTA can be the frequency interval multiplier. The multiplier can be precalculated for the number of frequencies per decade:

$$\text{DELTA} = -(\text{EXP}(2.302585/\text{NFD}))$$

which reduces to

$$\text{DELTA} = -10^{(1/\text{NFD})}$$

where NFD is the number of frequencies per decade and EXP is a function to raise e (the base for the natural logarithms which is approximately 2.71828) to the power of the following argument. For example, twenty



Matrix Array Subscripts		
Row	Column	Enter into Array by
Plus node	Dependent branch minus node	Addition
Plus node	Dependent branch plus node	Subtraction
Minus node	Dependent branch plus node	Addition
Minus node	Dependent branch minus node	Subtraction

Table 4: Turning a dependent branch into a dependent current source. The source is entered into the matrix by the stated rules. Remember that any row and column combination with a zero node will not enter the matrix.

frequencies per decade would have a DELTA equal to -1.122018 .

Figure 7 is the flowchart for a frequency sweep analysis routine. The option of storing results or printing them directly depends on the operating system and memory. Subscript L is used only for solution matrix purposes.

There is a caution to be observed with solution storage: the number of frequencies to be analyzed must not exceed the storage matrix size. Other storage matrices may be written over if no check on the total number of frequencies analyzed is made. This is a very easy error to make.

Branch Switching

Implementing this function is useful for circuit modeling. In effect it allows you to disconnect or reconnect a branch from analysis and yet retain it in the branch list. It is the same as removing or replacing a component in a breadboard. If removed, it is still on the bench and can be installed later.

There are two easy ways to implement switching. Since we are using a numeric value to designate the branch type, we can define a positive value as a connected branch and a negative value as an open branch. Another method is to devote one byte per branch with a numeric value of +1 if con-

nected and 0 or -1 if open. Another test can be inserted in the ANALYSIS routine of figure 6, just before the *passive type?* test. An open condition would bypass any calculations and go on to the next branch.

Dependent Current Sources

This branch type, not mentioned before, enables a model to duplicate transistors or operational amplifiers. It is a current source dependent on the voltage across another branch and is specified by a gain factor called *transconductance*. The symbology and matrix entry rules are given in table 4.

Transconductance is specified in mhos and is equal to the current divided by the voltage. Branch value entry is the transconductance, and admittance calculation for solution takes this as the stored value for the real part with an imaginary part of 0. You can think of transconductance as a *current gain* factor. A transconductance of 0.1 with a dependent branch voltage of 24 V produces a dependent source current of 2.4 A. A transconductance of 1.0 gives 24 A.

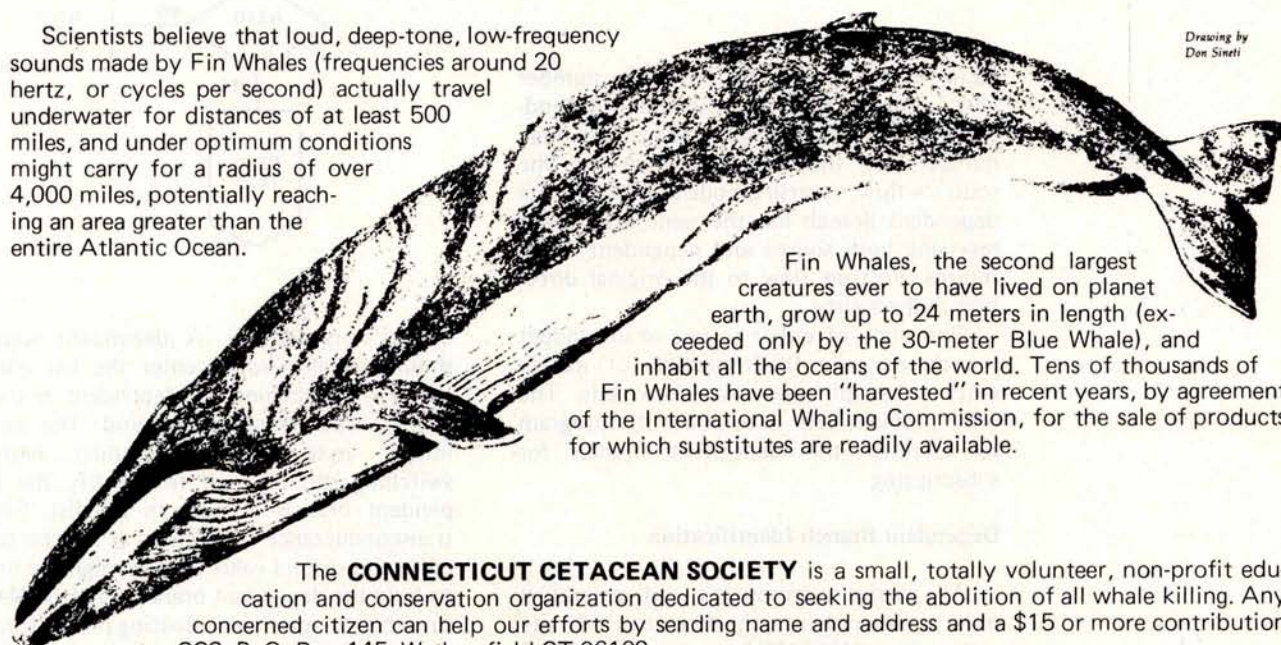
You do not have to be concerned about the dependent branch voltage. The matrix entry and solution will determine the current from the specified transconductance. The *direction* of electron flow is another

SAVE THE WHALE

The Fin Whale is the world's greatest long-distance communicator.

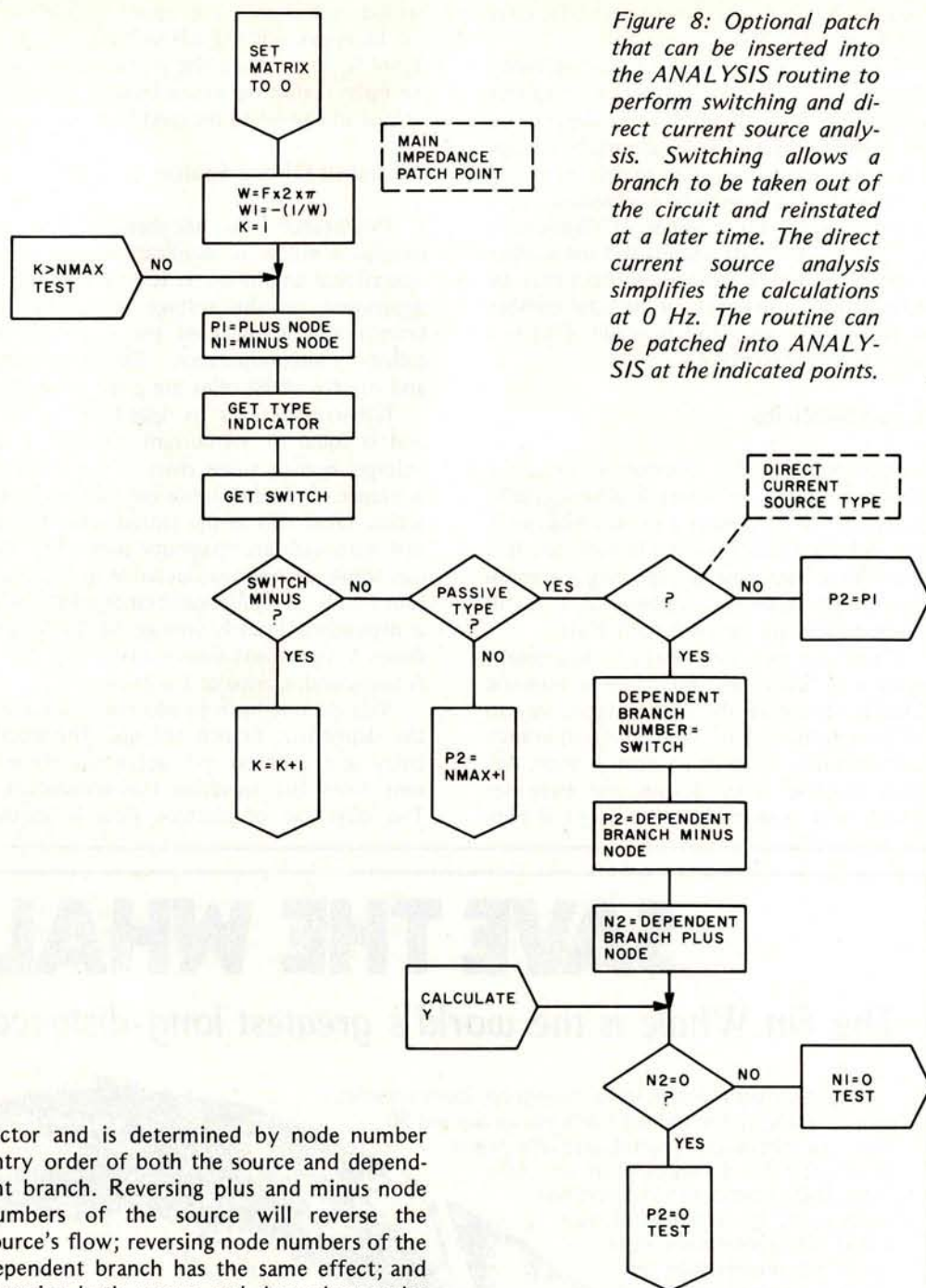
Scientists believe that loud, deep-tone, low-frequency sounds made by Fin Whales (frequencies around 20 hertz, or cycles per second) actually travel underwater for distances of at least 500 miles, and under optimum conditions might carry for a radius of over 4,000 miles, potentially reaching an area greater than the entire Atlantic Ocean.

*Drawing by
Don Sinetti*



Fin Whales, the second largest creatures ever to have lived on planet earth, grow up to 24 meters in length (exceeded only by the 30-meter Blue Whale), and inhabit all the oceans of the world. Tens of thousands of Fin Whales have been "harvested" in recent years, by agreement of the International Whaling Commission, for the sale of products for which substitutes are readily available.

The **CONNECTICUT CETACEAN SOCIETY** is a small, totally volunteer, non-profit education and conservation organization dedicated to seeking the abolition of all whale killing. Any concerned citizen can help our efforts by sending name and address and a \$15 or more contribution to: CCS, P. O. Box 145, Wethersfield CT 06109.



factor and is determined by node number entry order of both the source and dependent branch. Reversing plus and minus node numbers of the source will reverse the source's flow; reversing node numbers of the dependent branch has the same effect; and reversing both source and dependent nodes returns electron flow to the original direction in the source.

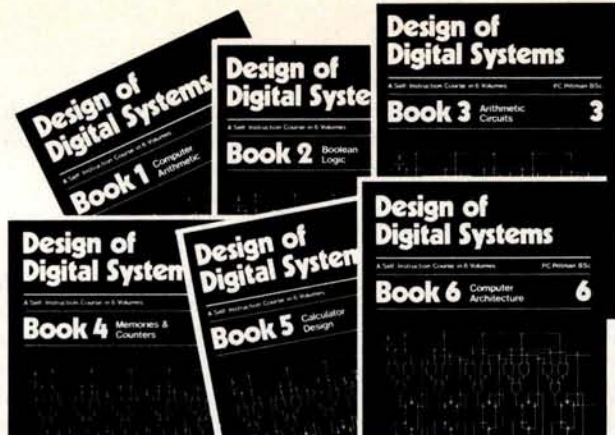
One node of either source or dependent branch may be 0. Inspection of matrix entry subscript rules will show this. The only problem left is to allow the program to identify the dependent branch for subscripting.

Dependent Branch Identification

All passive components and generators may be entered into the branch list in any order. The ANALYSIS routine of figure 6 scans the entire list in order to fill the

matrix for solution. A dependent source should be allowed to enter the list either ahead of or behind its dependent branch.

Two options come to mind. The extra integer byte mentioned under branch switching can be used to identify the dependent branch number in the list. Since transconductance is specified as the real part only, the second value storage might be used to hold the dependent branch number. Make sure that the particular floating point storage method that you are using will not change the value of the integer slightly. If there is



Design of Digital Systems - six volumes

The products of digital electronics technology will play an important role in your future. Calculators, digital watches and TV games are already commonplace. Now, microprocessors are generating a whole new range of products. Personal computers will be in widespread use very soon. Your TV, telephone and computer will combine to change your children's education, your job—your entire way of life.

WRITTEN BY EXPERTS

These courses were written by experts in electronics and learning systems so that you could teach yourself the theory and application of digital logic. Learning by self-instruction has the advantages of being faster and more thorough than classroom learning. You work at your own pace and respond by answering questions on each new piece of information before proceeding.

After completing these courses you will have broadened your career prospects as well as your understanding of the rapidly changing technological world around you.

The courses are designed as much for the professional engineer as for the amateur enthusiast. You'll learn about microprocessing as well as personal computing—not to mention all the other aspects of digital electronics design.

ADVANCED COURSE DESIGN OF DIGITAL SYSTEMS

Design of Digital Systems is written for the engineer and serious hobbyist who wants to learn more about digital electronics. Its six large-format volumes—each 11¼" x 8¼"—are packed with information, diagrams and questions designed to lead you step by step through number systems and Boolean algebra to memories, counters and simple arithmetic circuits, and finally to a complete understanding of the design and operation of microprocessors and computers.

CONTENTS

The contents of Design of Digital Systems include:

Book 1: Octal, hexadecimal and binary number systems; representation of negative numbers; complementary systems; binary multiplication and division.

Book 2: OR and AND functions; logic gates; NOT, exclusive-OR, NAND, NOR and exclusive-NOR functions; multiple input gates; truth tables; DeMorgan's Laws; canonical forms; logic conventions; Karnaugh mapping; three-state and wired logic.

Also available at leading computer stores:

Erie Computer Co., 1253 West 8th St., Erie, PA.
Computer Mart of Royal Oak, 1800 W 14 Mile Rd., Royal Oak, MI.
The Madison Computer Store, 1863 Monroe St., Madison, WI.
Personal Computer Corp., Lancaster Ave & Rt. 52, Frazer, PA.
Computer Shoppe, 3225 Danny Pk., Metairie, LA.
Computer Corner, 200 Hamilton Ave., White Plains, NY.
Imperial Computer Systems, Inc., 2105 23rd Ave., Rockford, IL.
Home Computer Center, 6101 Yonge St., Willowdale, Ontario, Canada
and many others. Ask your dealer

Book 3: Half adders and full adders; subtractors; serial and parallel adders; processors and arithmetic logic units (ALUs); multiplication and division systems.

Book 4: Flip-flops; shift registers; asynchronous counters; ring, Johnson and exclusive-OR feedback counter; random access memories (RAMs); read-only memories (ROMs).

Book 5: Structure of calculators; keyboard encoding; decoding display data; register systems; control unit; program ROM; address decoding; instruction sets; instruction decoding; control program structure.

Book 6: Central processing unit (CPU); memory organization; character representation; program storage; address modes; input/output systems; program interrupts; interrupt priorities; programming; assemblers; executive programs, operating systems, and time-sharing.

BASIC COURSE



Digital Computer Logic & Electronics

CONTENTS

Digital Computer Logic and Electronics is designed for the beginner. No mathematical knowledge other than simple arithmetic is assumed, though you should have an aptitude for logical thought. It consists of 4 volumes—each 11½" x 8¼"—and serves as an introduction to the subject of digital electronics.

Contents include: Binary, octal and decimal number systems; conversion between number systems; AND, OR, NOR and NAND gates and inverters; Boolean algebra and truth tables; DeMorgan's Laws; design of logical circuits using NOR gates; R-S and J-K flip-flops; binary counters, shift registers and half-adders.

Personal Computers & Microprocessing

Here are two inexpensive programmed learning courses designed to keep you up-to-date in digital electronics.

NO RISK GUARANTEE

There's absolutely no risk to you. If you're not completely satisfied with your courses, simply return them to GFN within 30 days. We'll send you a prompt, full refund, **Plus return postage.**

TAX DEDUCTIBLE

In most cases, the full cost of GFN's courses can be a tax deductible expense.

HOW TO ORDER

To order by credit card, call GFN's toll-free number — **(800)331-1000**; or send your check or money order (payable to GFN Industries, Inc.) to the address below.

Prices include overseas surface mail postage. **Air Mail:** additional costs (10 volumes), \$10. Or write for exact quote.

Write for educational discounts, quantity discounts and dealer costs.

LOW PRICES — SAVE \$5

We ship promptly from stock. There are **no extras**—we pay all shipping costs; we even pay your sales tax where required. And if you order both courses, you save \$5. Order at no obligation today.

FREE OFFER

When you order both courses, we'll also send you a copy of **The Algorithm Writer's Guide** — a **\$5.95** value — **free** of charge, and yours to keep even if you decide to return the other volumes.

Design of Digital Systems \$19.95
- 6 volumes

Digital Computer Logic \$14.95
& Electronics - 4 volumes

Both courses - 10 volumes \$29.90



GFN Industries, Inc.
Suite 400-C
888 Seventh Ave.
New York
N.Y. 10019

Call TOLL-FREE (800) 331-1000
(orders only) 7 days — 24 hours

any doubt about whether your floating point to integer conversions are totally accurate, use the extra integer per branch for both switching and dependent branch identity. A dependent source can be switched by signing the extra integer. This method will be assumed for all further discussion.

Entering branch data in the list requires an extra entry for dependent sources to identify the dependent branch. The ability to print out a branch list should also include printing the dependent branch number.

Modification of the ANALYSIS routine to handle dependent current sources is shown in figure 8. This modification also

includes the switch function with the extra integer SW acting as the switch and identifier of dependent branch list number.

Impedance Analysis

All analysis procedures have so far given only voltage solutions. The last analysis we will consider is readily determined by disregarding all generators, placing a value of unity in the proper generator column position and then solving the matrix as before.

This may seem too simple. To understand it, consider once again the circuit of figure 1 and the position of solution numerators and denominators. Denominators always lie in the main diagonal and numerators always lie in the generator column. Impedance analysis will have only one generator column entry since all other generator branches automatically bypass any entry into the matrix.

A unity current is simply $(1.0 + j0)$, 1 A with no phase shift. This is the condition of figure 1 if an impedance is desired at node 1. The resistance of the total figure 1 circuit looking into node 1 is simply 25 ohms. In the model all generators are pure current sources; that is, they have no admittance themselves and can therefore be disregarded.

Addition of impedance analysis is shown in figure 9, a modification of figure 8. A flag variable must be held in the main program to identify analysis type. It is considered to be on for impedance and off for voltage analysis. It can be logical, integer or a single bit, but must be available if both types are desired.

Implementing impedance analysis requires a solution at only one node. It is best to use the optional tests in the flowchart of figure 4 and have all solutions at only one node. Direct printouts of impedance will be in rectangular form but the polar form can also be printed at the same time by using temporary variables and form conversion. Both forms are useful in studying analysis. ■

REFERENCES

1. Huelsman, Lawrence P, *Basic Circuit Theory with Digital Computations*, Prentice-Hall, Englewood Cliffs NJ, 1972. Contains a great number of FORTRAN routines along with good basic circuit theory in both frequency and time domain.
2. Cornet, Wendell H Jr, and Battocletti, Frank E, *Electronic Circuits by System and Computer Analysis*, McGraw-Hill, New York, 1975. Again, FORTRAN oriented, but contains complete source code for Ohio State's linear and transient analysis programs.

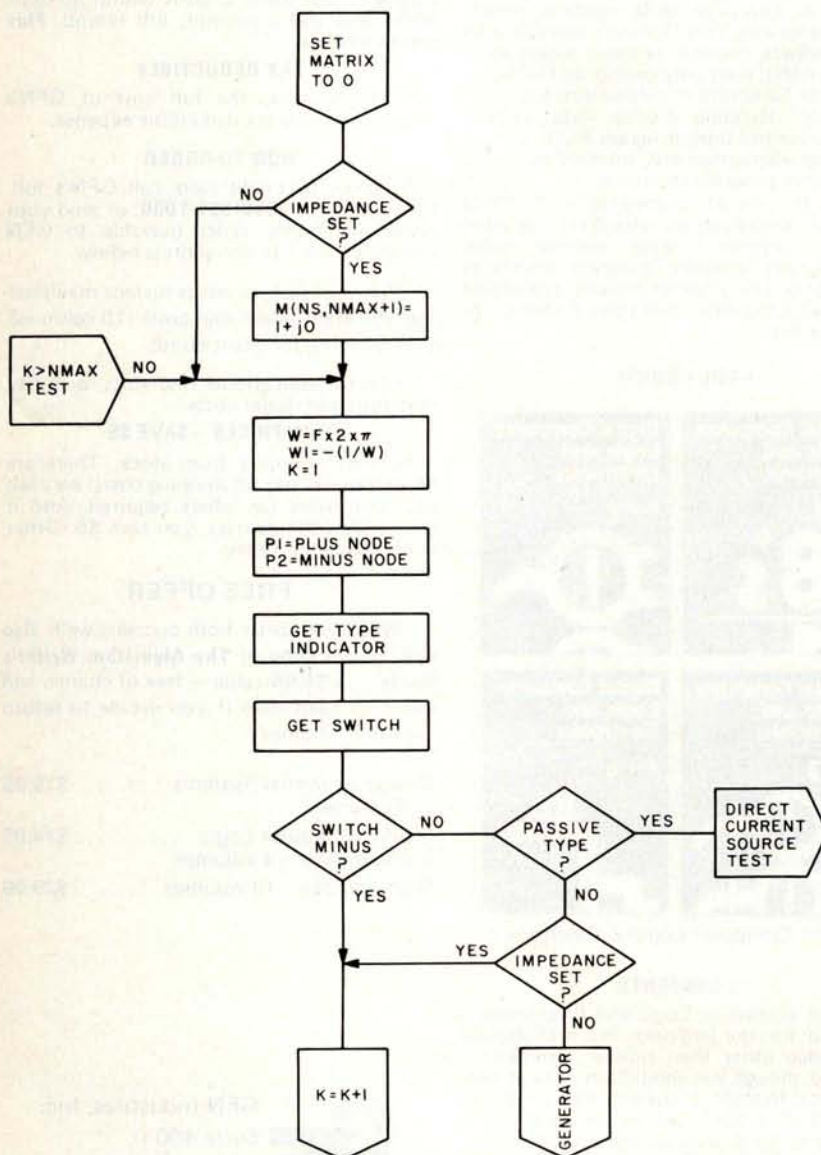


Figure 9: A patch that can be made to figure 8 to further increase the calculating power of the program. This patch will allow the solution of the matrix with impedance entries. It can be added to figure 8 at the instructions indicated.

Software that's tried and true.

Text Editing System

This is the most complete and versatile editor available for the 6800 or 8080 micro. The system is line and content oriented for speed and efficiency; and features such commands as block move and copy, append and overlay, as well as string manipulators. The 6800 version requires 5K beginning at 0 hex, the 8080 needs 6K starting at 1000 hex. Both should have additional file space as required.

SL68-24	6800 Text Editing System	\$23.50
SL68-24C	w/cassette	30.45
SL68-24P	w/paper tape	31.50
SL68-24D	w/SWTP Mini Disc	31.50
SL68-24F	w/SWTP DMAF Disc	50.00
SL80-10	8080 Text Editing System	\$28.50
SL80-10P	w/paper tape	37.50
SL80-10F	with CP/M Disc	40.00

Mnemonic Assembler

An ideal addition to the Text Editing System, together they form a complete program development center. It is one of the most versatile assemblers available, and allows for easy adaptation to most systems. The Assembler is many times faster than other resident assemblers. Requires approximately 5.5K plus file and symbol table space.

SL68-26	6800 Mnemonic Assembler	\$23.50
SL68-26C	w/cassette	30.45
SL68-26P	w/paper tape	31.50
SL68-26D	w/SWTP Mini Disc	31.50
SL68-26F	w/SWTP DMAF Disc	50.00
SL80-12	8080 Mnemonic Assembler	\$25.00
SL80-12P	w/paper tape	34.00
SL80-12F	with CP/M Disc	40.00

Relocator

Self-prompting, easy to use program relocates object code in RAM or from tape. Complete instructions included for making the TSC Editor and Assembler or Editor and Text Processor co-resident. (As sold they reside in the same area.) Just over 1K in length.

SL68-28	6800 Relocator	\$ 8.00
SL68-28C	w/cassette	14.95
SL80-13	8080 Relocator	\$ 8.00
SL80-13P	w/paper tape	13.00

Text Processing System

A compliment to the Editor, the Processor supports over 50 commands for left, right, or center justification, titling, paging, and general text out-put formatting. A loop command is available for repeated formatting jobs such as form letters. Also included are capabilities for macro definition to build special formatting commands. The program requires about 8K of memory and previously edited text.

SL68-29	6800 Text Processor	\$32.00
SL68-29C	w/cassette	38.95
SL68-29P	w/paper tape	40.00
SL68-29D	w/SWTP Mini Disc	40.00
SL68-29F	w/SWTP DMAF Disc	75.00
SL80-11	8080 Text Processor	\$32.00
SL80-11P	w/paper tape	41.00
SL80-11F	with CP/M Disc	50.00

TSC Space Voyage™

This assembly language version of the popular Star Trek game requires little RAM, runs very fast and has all the features. The program gives you a choice of a short game that takes 20 to 30 minutes, or a long one that takes over an hour to finish. Runs in 4K.

SL68-5	6800 Space Voyage™	\$12.00
SL68-5C	w/cassette	18.95
SL68-5P	w/paper tape	19.00
SL80-9	8080 Space Voyage™	\$12.00
SL80-9P	w/paper tape	19.00

All software includes a fully commented source listing.

Orders should include check or money order. Add 3% for postage, and for orders under \$10 please add \$1 for handling. Send 25¢ for a complete software catalog.

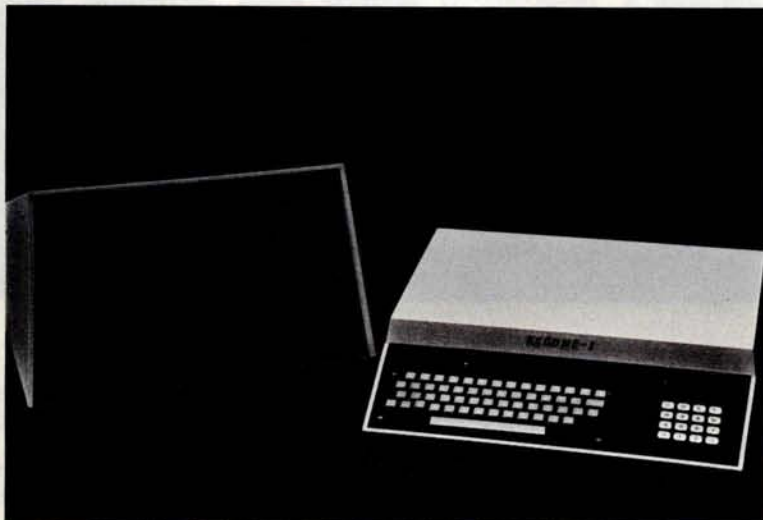


**Technical Systems
Consultants, Inc.**

Box 2574 W. Lafayette, IN 47906

Specialists in Software & Hardware for Industry & the Hobbyist

**Now! A computer course and a
computer kit featuring 8K RAM
all for one unbeatable price!**



Video monitor optional.

RECOMP - I

Factory-tested RCA 1802 CPU.

8K RAM.

ASCII and hexadecimal keyboards.

RF modulator for T.V. interface.

Tape cassette recorder interface.

A big, three-amp power supply.

Full color graphics capability.

**Integer BASIC, Machine Language, and
Assembly Language built right in.**

Twenty ready-to-play computer games.

A handsome, functional plastic case.

... and much, much more!

That's right —

**A powerful personal
computer system**

— PLUS —

**A complete home study
course in computers**

**All for \$460 ...
less than you'd expect
to pay for peripherals
alone!**

Now you can have a flexible, easy-to-assemble computer kit PLUS a comprehensive course in computers — all for one incredibly low price. RCA's engineering know-how and Reston's publishing excellence make it all possible.

Because you learn by doing, you'll quickly become an expert in computer programming and operation ... even if you've had no experience with computers before!

In just a few hours of pleasurable kit building, you can assemble a versatile computer system that offers features found in units costing many times more. Check our features and compare!

**UNLIMITED
EXPANDABILITY!**

The RECOMP-I is designed to keep up with the latest advances in computer technology. It'll never become outdated because you can expand it easily whenever you want to — the possibilities are endless. Call

Much more for your money — professional performance at kit price!

us or write for details on these currently available options:

- * Memory expansion to 64K RAM.
- * 9-inch video monitor.
- * A fast, high-quality printer.

And there's a lot more to come! But best of all, you won't have to send RECOMP-I back to us for expansion. You can install all the optional circuit boards and peripherals yourself, in your own home. Just make the necessary interconnections and your computer will be ready to go.

RECOMP-I: FOR HOME, OFFICE, OR WHEREVER

Part of the fun of owning a personal computer is finding unique applications for it. Here are just a few ways you can take advantage of this computer's amazing versatility:

EDUCATION: Solve math and science problems with ease. Use it as a tutor on most any subject. It's a valuable study aid for any student from grammar school to medical school.

HOUSEHOLD: Organize, index, and store data on household finances. Calculate your income tax, record lists, balance your checkbook, and more!

BUSINESS: Program RECOMP-I to handle general accounting, inventory, patient/client records, just about any routine office chore — all with a minimum of time and effort. It's the perfect work aid for the busy professional.

NO NEED TO PAY UP TO \$1,000 FOR A COMPUTER COURSE

As incredible as it may seem, you get a complete course in computers along with our RECOMP-I kit. Whether you're a complete novice or an experienced computer professional, this is the course for you. It's a complete guide to all phases of computer construction, programming, and operation. This all-inclusive course contains:

Complete assembly instructions. They guide you every step of the way. Just follow the directions provided for easy, flawless assembly, even if you've never built a kit before! There's just no room for error because the assembly manual explains each procedure clearly and completely. (If you should get into trouble, however, write us and we'll bail you out!)

An introduction to digital electronics. You'll learn all the basic principles of computer operation. The course covers the essentials to give you a working knowledge of the latest in microprocessor technology. You don't need a degree in computer science to understand how computers work. This course explains it all in easy-to-understand language.

Simplified programming methods. You'll be amazed at how easy computer programming can be. With this crash course in programming techniques, you'll gain the basic skills you need to write and implement accurate programs. In no time flat, you'll be giving your RECOMP-I commands in three of the most widely-used computer languages.



NO-RISK TRIAL OFFER

Order your RECOMP-I today. Send us your check or money order — or use your Visa/BankAmericard or Master Charge if you wish. We'll ship your kit to you just as soon as we receive your order. Remember, the full price of \$460 includes all shipping and handling charges.

RECOMP-I comes to you on a 15-day trial basis. If you're not completely satisfied, just return it, in its original condition, within the trial period. You'll receive a full refund. What's more, the parts carry a one-year warranty. Your investment's protected — you can't go wrong!

Let our RECOMP-I kit and computer course introduce you to the world of the personal computer. You'll discover for yourself how useful, and how much fun, a home computer can be.

One more thing. If you have any questions or problems regarding the RECOMP-I, just write to us or call our toll-free number. We'll be glad to hear from you!

RESTON PUBLISHING CO.



A Prentice-Hall Company
11480 Sunset Hills Road
Reston, Virginia 22090

- ☐ Send me my RECOMP-I computer kit and course for \$460. (Price includes shipping, handling, and insurance fee) If I'm not completely satisfied I can return the kit, in its original condition, within 15 days for a full refund.

- ☐ Send me just the RECOMP home computer course manual for \$29.95. (Assembled RECOMPs are available. Write for info)

Pay by check or money order, or use your bank card. By mail, send your payment to: RESTON PUBLISHING COMPANY, 11480 Sunset Hills Road, Reston, Virginia 22090

For IMMEDIATE service, dial your bank card orders toll free! Just call 800-336-0338

☐ Visa/BankAmericard No. _____

☐ Master Charge No. _____

Interbank No. _____ Expiration date _____

☐ Check or M.O. enclosed.

NAME _____ Signature _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

Please add your state's sales tax where applicable. Dept. BM

1							1
1							1
1							1
1							1
1							1
1							1
1							1
1							1

(a)

1	1						1
1	1						1
1	1						1
1	1						1
2	1	1	1				
2	Q	2	1	1	1	1	1
2	2	1					
Q	2	1	2	1	1	1	1

(b)

2	1	1	1	1	1	1	1
2	2	1	1	2	1	1	1
1	2	2	2	2	1	1	1
3	2	Q	4	3	2	2	1
3	4	3	4	Q	2	1	1
3	Q	4	3	4	2	1	1
3	3	4	Q	2	2	2	1
Q	3	3	3	3	1	2	2

(c)

Figure 1: The author's algorithm for solving the eight Queens problem, in which eight Queens are to be placed on a chessboard so that no Queen attacks any other Queen. (In chess, the Queen can capture any piece that is in direct line with it horizontally, vertically, or diagonally.) The method consists of placing the first Queen on the lower lefthand corner square. Markers are placed on all squares that the Queen can attack (a). Moving one column to the right, another Queen is placed on the first empty square from the bottom. Markers are again placed (b). The process is repeated. Eventually, either the problem will be solved or there will be no more spaces for one or more Queens; (c) illustrates the latter situation where corrective action is taken by altering details of the trial solution.

Solving the Eight Queens Problem

Terry Smith
9 Hillard Pl
Weston, Ontario
CANADA M9R 2N1

The eight Queens problem is a chess related puzzle, the object of which is to place eight chess Queens on an 8 by 8 chessboard in such a way that no Queen can take another. [For the benefit of nonchessplaying readers, the Queen can capture any piece that is in direct line with it horizontally, vertically or diagonally. No detailed knowledge of chess is required in order to understand the rest of this article. . . .CM] 8 is the maximum number that is not obviously impossible, since 9 would force one Queen to be in at least one other Queen's row or column. I will explain how I solved this problem using a computer, since a look into the mind of a problem solver from start to finish might help you with your own problems.

The First Method

The first method I tried was to place the Queens at random on the board and

check the board for a proper position. There are $64!/56!$ or 1.7846289×10^{14} such permutations. I would never have thought about this except that I grossly overestimated the speed of the IBM 370 (the machine on which I was working). Even 370s have their limits, I was to discover. If the 370 evaluated 10,000 positions per second, it would have taken 565 years to find all the answers, and then only if I could have written a program that would create all the permutations one after another with no duplications. This is very difficult. I tried writing one and failed. If you can actually do this, I'd like to see it.

The Second Method

I then divided the board into eight columns and placed one Queen at random in each column and realized that with one Queen in each column, I could represent any permutation with an 8 digit number, each digit representing the position of one Queen in its column. Since no two Queens could have the same column position (for example, if the leftmost Queen was at 1 or the bottom, obviously no other Queen could also be at the bottom), what I needed was a list of permutations of all numbers from 1 to 8. With this method I would have to check only the diagonals; much of the work would already have been done. This also reduced my problem to $8!$ or 40,320

About the Author

Terry Smith is 21 years old, has studied data processing at Humber College in Rexdale, Ontario CANADA, and is a mathematics oriented computer hobbyist. He works as a computer programmer and is saving to buy a computer of his own on which to develop programs.

Is personal computing worth it?

**We want your answers at the NCC '79
Personal Computing Festival.
New York City, June 4-7**

Has personal computing been worthwhile for you? Every aspect of this fast-growing field is being questioned...from the effort to generalize a subroutine to the cost of the latest hardware. What are your views?

Some key questions about personal computing need answers. How is personal computing enriching our lives and those of our families and associates? What is its potential? What are we getting for our investments in this field? Is it worth the time, effort, cost...even the criticism?

JOIN THE PERSONAL COMPUTING FESTIVAL

You can answer these and other questions by participating in the Personal Computing Festival of the 1979 National Computer Conference, the

most comprehensive computer show on earth.

Here's how you can participate:

- Present a paper
- Give a talk
- Organize a panel
- Deliver a tutorial
- Demonstrate your application and equipment

The deadline for receipt of letters of intent to participate is February 1, 1979. Accepted papers will be published in the 1979 NCC *Personal Computing Proceedings*. Honors and prizes will be awarded for the best papers and application demonstrations.

For more details, fill in and return this coupon.



NCC '79

Personal Computing Festival
c/o American Federation of Information
Processing Societies, Inc.
210 Summit Avenue, Montvale, New Jersey 07645
201/391-9810

Send me more details on:

- ☐ Participating in a Personal Computing Festival session.
- ☐ Demonstrating my personal computing application.
- ☐ Keeping me up-to-date on the Personal Computing Festival.
- ☐ Exhibiting my company's products and services at the Personal Computing Festival.

Name _____
Company _____
Street _____
City _____ State _____ Zip _____

BT


```

10 DIM A(8,8),AS(10),F(8)
11 FOR T=1 TO 10
12 READ AS(T)
13 NEXT T
14 DATA "0","1","2","3","4","5","6","7","8","9"
20 C=0
30 C=C+1
40 IF C=9 THEN 250
50 FOR E=1 TO 8
60 IF A(C,E)=0 THEN 89
70 NEXT E
80 GOTO 330
89 F(C)=E
90 A(C,E)=-1
91 D=1
92 GOSUB 100
93 GOTO 30
100 FOR X=-1 TO 1
110 FOR Y=-1 TO 1
120 IF X*Y+X+Y=0 THEN 220
130 FOR Z=1 TO 8
140 A=C+Y*Z
150 B=E+X*Z
160 IF A>8 THEN 220
170 IF A<1 THEN 220
180 IF B>8 THEN 220
190 IF B<1 THEN 220
200 A(A,B)=A(A,B)+D
210 NEXT Z
220 NEXT Y
230 NEXT X
240 RETURN
250 FOR X=8 TO 1 STEP -1
260 FOR Y=1 TO 8
270 IF A(Y,X)=-1 THEN 290
280 PRINT AS(A(Y,X)+1);
281 GOTO 300
290 PRINT "Q";
300 NEXT Y
310 PRINT
320 NEXT X
321 PRINT
330 REM NO SPACES, NOW WHAT?
340 C=C-1
350 A(C,F(C))=0
360 E=F(C)
380 D=-1
390 GOSUB 100
391 IF E=8 THEN 340
400 FOR X=E+1 TO 8
410 IF A(C,X)=0 THEN 440
420 NEXT X
430 GOTO 340
440 A(C,X)=-1
441 F(C)=X
450 D=1
451 E=X
460 GOSUB 100
470 GOTO 30
480 END

```

Listing 1: A BASIC program for solving the eight Queens problem.

positions to search, a far cry from 1.7846289×10^{14} or even 8^8 . But a program to create all these numbers? Much later I discussed this with some friends whom I consider to be software experts. They shook their heads saying, "This is a difficult task." They were right, for as it turned out, I had to give up. An easy solution just wasn't going to work.

Final Method

A determined human, after trying permutations and finding the problem is not trivial, would get a set of pawns to represent Queens and, using pennies for markers,

attempt to find a solution by placing a Pawn (to represent each Queen) on a chessboard and a penny on each square that comes under that Queen's influence. By inspection (s)he would determine where to put subsequent Queens. A methodical procedure would be as follows (I have shown in parentheses the line in the program which is relative to the step in the manual solution):

Place a Queen in the lower lefthand corner of the board (line 90) and then, on all the squares that would come under that Queen's influence, place one penny (GOSUB 100, D=1). Then moving one column to the right (line 30), place a Queen on the first empty square from the bottom. This entails having to move up two squares. Place a penny on each square (even the ones already marked) in this Queen's domain. You'll see why in a minute. Continue moving right and repeating this algorithm until you hit a column that is all pennies (line 80). You use a lot of pennies here. If you run off the righthand edge of the board (line 40) you have solved the problem. However, you probably won't find one the first time. Three columns from the end you will have to stop, having run out of spaces. Now you remove the latest Queen (line 350) and then remove one penny from each of its dominion squares (line 380, GOSUB 100 D=-1). This is why you placed pennies on already covered squares because if you didn't, you wouldn't know if the penny there was the subject Queen's or not. Continuing from the subject Queen's square (line 400) look up the column for a new blank spot (line 410) to place a new Queen and continue. If there are none or if your last Queen was at the top of the board (I check for the top first, line 391), move back one column (line 340 again). Remove that Queen and remove her pennies, and check for blanks above, etc. If you are trying this by hand by now you will have noticed how slow and messy it is. It was only the feelings of frustration from the manual simulation that kept me moving on this seemingly hopeless computer simulation.

The final program started off at half its present length and I spent three days repairing it by adding one line after another as it failed time and again. I added line 391 to eliminate a subscript error.

I was beginning to get worried because the program was twice its original size and I was no longer capable of understanding it at a glance. I typed RUN for the 100th time and waited for the next error. My method of repair depended on my being able to comprehend the program. I added several GOTOs and I knew I couldn't keep it up much longer.

Everything you've ever wanted to know about microcomputers in ONE complete book for only \$10.95

Over 400 pages. Full 8½" x 11" size.



The ultimate book about microcomputers. Written by experts ... SCELBI and BYTE. Over 400 pages. A collector's item, featuring The Basics from the first 16 issues of BYTE and SCELBI's classic library of books. Your microcomputer bookshelf is incomplete without this priceless edition.

You can't buy information organized like this anywhere. This is the book that everyone who is into microcomputers needs for reference, for ideas, for clues to problem solving. It is a truly authoritative text, featuring easy-to-read, easy-to-understand articles by more than 50 recognized professional authors, who know and love microcomputers from the ground up. Logical and complete, it features many glossaries, and is illuminated with profuse illustrations and photographs.

The Scelbi/BYTE Primer is divided into four logical sections, that take you from point "0" through building and programming your own computer... step-by-step-by-step.

What can you do with a microcomputer? Checkbook balancing. Recipe converting and food inventory. Heating and air conditioning control. Home and business security and management. Playing the ponies. Analysis of the stock market. Maintaining massive data banks. Self-instruction. Toys and games. Small business accounting and inventory. And lots, lots more.

How does a microcomputer do it? Lots of "how to" theory. Introducing you to microcomputer operation. 6800, 6502, Z80 CPU chip capabilities. RAM and ROM memories. Addressing methods.

THE SCELBI/BYTE PRIMER

Over 400 pages. Selected articles from BYTE and SCELBI books. Profusely illustrated. Many photographs. \$10.95, plus \$1 shipping and handling.

How to control peripherals. Transmission of information to and from computers. Magnetic recording devices for bulk storage. Analog to digital conversion. How a computer can talk. Other I/O techniques. And more.

Order your copy today!

SCELBI COMPUTER CONSULTING INC.

Post Office Box 133 PP STN
Dept. B
Milford, CT 06460

BITS

25 Route 101 West
P.O. Box 428
Peterborough, NH 03458
1-800-258-5477

Prices shown for North American customers. Master Charge. Postal and bank Money Orders preferred. Personal checks delay shipping up to 4 weeks. Pricing, specifications, availability subject to change without notice.

All about building a microcomputer system. Over 12 complete construction articles. Flip-flops. LED devices. Recycling used ICs. Modular construction. Making your own p.c. boards. Prototype board construction. Make your own logic probes. Construction plans for 6800 and Z80 computers. Building plans for I/Os — TV and CRT displays, cassette interfaces, etc. Mathematics functions. ROM programmer. Plus much, much more.

How to program a microcomputer. Programming for the beginner. Assembling programs by hand. Monitoring programs. Number conversions. Game of Hexpawn. Design your own assembler. Lots more.

And that's only the beginning! Others have spent millions acquiring the type of microcomputer information found within the 400 pages of **The Scelbi/BYTE Primer**. But, it costs you only \$10.95, plus \$1 for postage and handling, complete! You know the quality of Scelbi and BYTE. This is your assurance of excellence throughout this **MUST** text. Order your copy today! And, get one for a friend!

the Mullen CB-1 Controller Board: now only \$88

People have used our original model CB-0 Controller Board for controlling audio systems, model railroads, time lapse photography, and dozens of other applications requiring intelligent, computer-controlled switching.

Our improved model CB-1 has all the features of its predecessor: 8 relays that respond to an 8 bit word for control purposes, 8 opto-isolators that accept input data for handshaking or further control purposes, full 5-100 buss compatibility, address selection switch, quality components and board, and so on.

But . . . the limited use (and expensive!) flat cable connector has been replaced with new connectors; these allow you to use pairs of wires of mixed gauges and lengths as needed. Also, a self-test feature is built on the board itself, and a new output design allows replacement of the relays with opto-isolators.

The best part is that you don't pay a penny more for these new features. In fact, compared to the CB-0 price, you pay 2,900 pennies less.

Available at computer stores nation-wide, or by direct mail (mail orders shipped postpaid in USA; Californians and sales tax).

MULLEN COMPUTER BOARDS
BOX 6214, HAYWARD, CA 94545

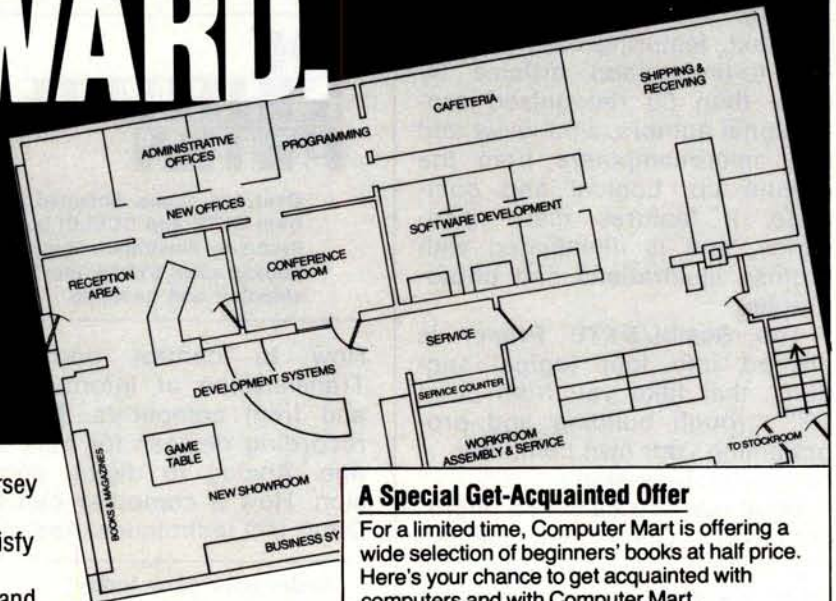
Suddenly to my amazement, the printer started to hammer out the solutions as fast as it could! I peeled off the paper to check the first one by hand and it was right! I include the final program exactly as it was written, a blow to the cause of structured programming and a glorious victory for dumb luck. If you want to try it, go ahead, but be forewarned that only on the Humber College VM370-135 CMS system was the solution instant. On a Heathkit H8 it took 20 minutes for the first solution and 5 minutes for the next. There are 92 solutions of which 23 are discrete. So beware! I feel this is the most efficient algorithm possible. (Using brute force to generate and file all those 40,320 8-digit numbers, and having the computer run through them probably qualifies for the epithet "inefficient.")

The eight Queens problem was a challenge, and the pleasure of beating it was tremendous. I feel the approach described here demonstrates a good heuristic for general problem solving, which is: don't check all the other situations in search of a solution, but custom design your own situation to match your specifications. I think now I'll see if I can place eight Maharajahs (a piece combining the Queen and Knight moves) on a board. Excelsior! ■

OUR REWARD. YOUR PROOF.

This new expansion of our facilities in New Jersey is our reward for successfully serving our customers. It is also your proof that we can satisfy you. Our continued growth is the result of our policy that we don't sell it if we can't run it — and keep it running. And we have more experience with small computer hardware and software than any other computer store in the East.

So if satisfaction is important to you, come get acquainted with us — all 30 of us — at Computer Mart of New Jersey or Computer Mart of Pennsylvania.



A Special Get-Acquainted Offer

For a limited time, Computer Mart is offering a wide selection of beginners' books at half price. Here's your chance to get acquainted with computers and with Computer Mart.



The Microcomputer
People.™

Computer Mart of New Jersey

501 Route 27, Iselin, NJ 08830 • 201-283-0600
Tue.-Sat. 10:00-6:00 • Tue. & Thur. til 9:00

Computer Mart of Pennsylvania

550 DeKalb Pike, King of Prussia, PA 19406 • 215-265-2580
Tue.-Thur. 11:00-9:00 • Fri. & Sat. 10:00-6:00

14

Microcomputer Problem Solving Using PASCAL by Kenneth L Bowles. This book is designed both for introductory courses in computer problem solving at the freshman and sophomore college level, and for individual self-study. Graphics is stressed in this version of the book, in many cases borrowing from the "Turtle Graphics" approach originated by Seymour Papert of MIT. A complete single-user software system based on PASCAL has been developed at the University of California at San Diego, where the author is a professor in the Department of Applied Physics and Information Science. This system embodies extensions to the standard PASCAL which include the necessary functions and procedures for handling graphics and strings. 563 pp. \$9.80.

An Introduction to Programming and Problem Solving With PASCAL by G M Schneider, S Weingart, and D Perlman. This book has three major goals:

- (1) To introduce *all* aspects of the programming and problem solving process, including problem specification and organization, algorithms, coding, debugging, testing, documentation, and maintenance.
- (2) To teach good programming style and how to produce a high quality finished product. This is brought out in numerous style examples throughout the text.
- (3) To teach the syntax of the PASCAL programming language.

PASCAL is used as a vehicle to teach various aspects of programming techniques. \$12.95.

PASCAL User Manual and Report (Second Edition) by K Jensen and N Wirth consists of two parts: the User Manual and the Revised Report. The Manual is directed to those who have some familiarity with computer programming and who wish to get acquainted with the PASCAL language. It is mainly tutorial and includes many helpful examples to demonstrate the various features of the language. The Report is a concise reference for both programmers and implementors. It defines Standard PASCAL, which constitutes a common base between various implementations of the language. \$6.90.

Programming in PASCAL by Peter Grogono. This book is an excellent introduction to one of the fastest growing programming languages. The text is arranged as a tutorial containing both examples and exercises to increase reader proficiency in PASCAL. Besides sections on procedures and files, there is a chapter on dynamic data structures such as trees and linked lists. These concepts are put to use in an example bus service simulation. Other examples range from the Tower of Hanoi problem to circumscribing a circle about a triangle. **Programming in PASCAL** is sure to hold the reader's interest. 359 pp. \$9.95.

Speaking of PASCAL . . .

The Design of Well-structured and Correct Programs by S Alagic and M A Arbib. This book represents ten years of research in top-down program design and verification of program correctness, and demonstrates how these techniques can be used in day-to-day programming with PASCAL. An explanation of control and data structures and many examples of programs and proof development are provided. As a programming text, this book contains an introduction to the language, provides algorithms which operate on sophisticated data structures, and offers the full axiomatic definition of PASCAL in terms of proof rules. To use this book, no particular mathematical background is necessary beyond the basic idea of a mathematical proof, although an introductory course in programming is required. 292 pp. \$12.80.



BITS inc
Books to erase the impossible

POB 428, 25 Route 101 West
Peterborough NH, 03458

DIAL YOUR BANK CARD ORDERS ON OUR TOLL-FREE HOT LINE: 1-800-258-5477.

Name _____

Address _____

City _____ State _____ Zip _____

Signature _____

My check enclosed:

Check # : _____

Amount: _____

My card # : _____

Expires: _____

Total

Number of books _____

Postage \$.75/book or
\$1.00 outside U.S. _____

Grand Total _____



Prices subject to change without notice.

Dealer Inquiries Invited.

You may photocopy this page.



HOW TO REPAIR VIDEO GAMES by Robert Goodman.

□ A 270-page service/repair manual containing information on products sold by manufacturers of electronic home video games and pinball machines. Each chapter of the manual is devoted to an individual manufacturer's equipment. Some manufacturers covered are equipment manufacturers while others produce game chips only. The three game chip manufacturers are General Instrument, Texas Instrument and National Semiconductor, while equipment manufacturers include Magnavox, Atari, Radio Shack, RCA and Midway. \$7.95.

STANDARD DICTIONARY OF COMPUTERS AND INFORMATION PROCESSING 2nd Edition by Martin H Weik.

□ This is a very complete, fully cross-referenced dictionary. It goes a step farther in that it includes full explanations, practical examples, many pertinent illustrations, and supplementary information for over 12,500 hardware and software terms. It cross-references the terms to other closely related concepts, and appended to each definition, as the need arises, are explanations, tutorial information, examples, usage areas, and cross-references for further clarification of concepts and meanings. 390 pp. \$16.95 hardcover.

SEMICONDUCTOR CIRCUIT ELEMENTS by T D Towers & S Libes.

□ In recent years there has been a bewildering proliferation in the kinds of semiconductor devices available not only for functions once fulfilled by the vacuum tube but also for new applications. This compact text provides a comprehensive survey of this vast array of devices. The author discusses the principle of operation for each device and all the relevant information, including alternative symbols, types of encapsulations, with sketches, ratings and characteristics, numbering systems, and common "workhorse" types. An essential book for anyone involved in the design or construction of electronic equipment — home experimenter, technician or design engineer. 309 pp. \$6.95.

AN INTRODUCTION TO PERSONAL AND BUSINESS COMPUTING by Rodney Zaks.

□ This text is designed for both the novice and the user seeking to expand his/her knowledge in the microcomputer field. A comprehensive introduction to concepts, peripherals, and techniques, this book serves well as an educational text. 245 pp. Only \$6.95.

THE MIND APPLIANCE: HOME COMPUTER APPLICATIONS by T G Lewis.

□ If you are looking for household uses for your microcomputer, you need this book. Mr. Lewis finds uses for the computer in every room of the house. Dozens of BASIC programs will help your computer dial the telephone, plan menus, balance checkbooks, and perform filing. After using this practical and adventurous text you will never again have to search for an answer when a friend asks, "But what do you do with it?" 138 pp. \$6.95.

BASIC AND THE PERSONAL COMPUTER by Thomas A Dwyer and Margot Critchfield.

□ A fascinating book covering many areas of interest to the personal computer user. After giving an in-depth course in BASIC, which can be covered in 8 hours, the book discusses microcomputer hardware, graphics, word processing, sorting, simulation and data structures. This is an easy to read text that is useful for the beginner and informative for the advanced user. 438 pp. \$12.95.

THE LITTLE BOOK OF BASIC STYLE by John M Nevison.

□ BASIC is a fairly easy language to learn, but becoming proficient in its use requires a lot of practice. This book teaches you how to write programs you can read. It does not teach you how to program in BASIC; rather, it helps you to write well-planned programs. This is done by developing 19 rules that can reduce the time necessary to turn out legible and correct programs. By using the techniques developed in this instructive text, you will produce clearer and more easily read programs. 151 pp. \$5.95.

BITS™

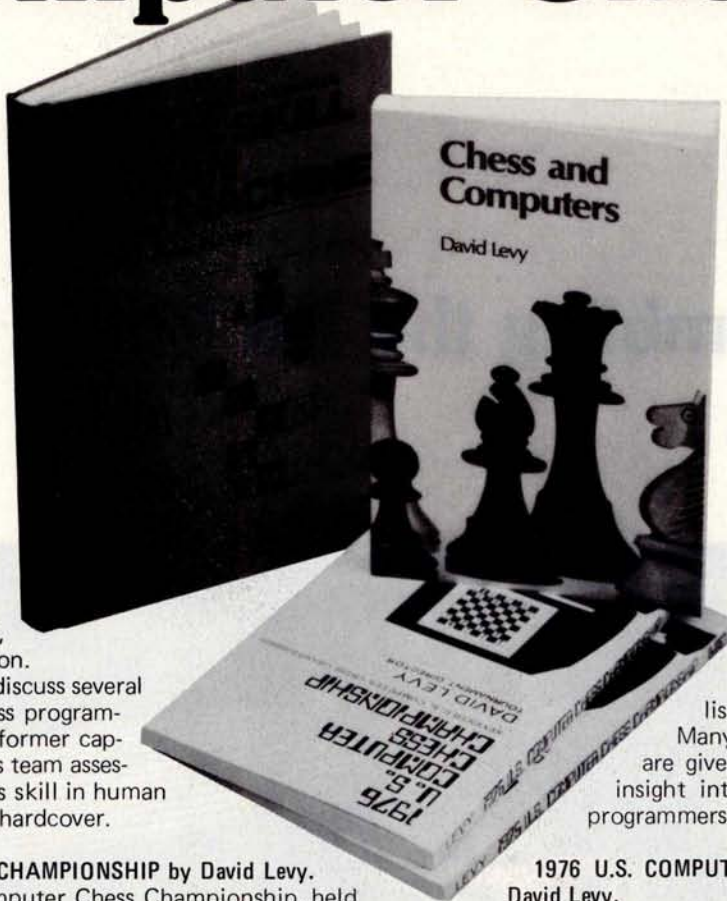
POB 428, 25 Route 101 West
Peterborough NH, 03458

New Selections

Computer Chess

CHESS SKILL IN MAN AND MACHINE edited by Peter W Frey.

□ A game of endless variations, chess has challenged our skill for centuries. This book surveys our current understanding of human chess skill and covers the subtleties of coaxing a machine to play chess. The initial chapter and appendix present a brief history of the computer chess tournaments. The next two chapters describe the essentials of how humans and computers play chess. The fourth chapter provides a detailed description of the Northwestern Chess Program, currently the national champion. The following three chapters discuss several alternative approaches to chess programming. In the final chapter, a former captain of the U.S. Olympic chess team assesses the present status of chess skill in human and machine. 217 pp. \$14.80 hardcover.



CHESS AND COMPUTERS by David Levy.

□ If you enjoy playing chess, then you will thoroughly enjoy this book, which is loaded with chess games played by computers. The first chapter describes the earliest chess "machine," the famous Automaton chess player that toured Europe and America. There is a detailed account of Torres y Quevedo's invention that played the ending of King and Rook against King. There is also a description of how computers play chess, including an account of early Soviet attempts at chess programming that contains much information hitherto unpublished outside the Soviet Union. Many examples of computer play are given, which provide an excellent insight into the problems facing chess programmers. 145 pp. \$8.95.

1975 U.S. COMPUTER CHESS CHAMPIONSHIP by David Levy.

□ The sixth annual U.S. Computer Chess Championship, held in October 1975, was a tournament in which twelve computer programs competed against each other. This book includes a detailed analysis and description of all the games, presented by David Levy, the tournament director. 86 pp. \$5.95.

1976 U.S. COMPUTER CHESS CHAMPIONSHIP by David Levy.

□ This book includes a detailed analysis and description of all the tournament games played at the seventh annual U.S. Chess Championship held in October 1976. 90 pp. \$5.95.

A New Book on PASCAL!

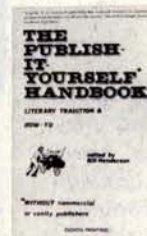
A CONCURRENT PASCAL COMPILER FOR MINICOMPUTERS by Alfred C Hartmann.

□ This is a paper describing a seven-pass compiler for the Concurrent Pascal programming language. It includes details about the pass structure, lexical analysis, syntax analysis, code assembly and implementation of the compiler. Concurrent Pascal is an abstract programming language for computer operating systems. The language extends sequential Pascal with the monitor concept for structured concurrent programming. Compilation of Concurrent Pascal on a minicomputer is done by dividing the compiler into seven sequential passes. The passes, written in sequential Pascal, generate virtual code that can be interpreted on any 16 bit computer. 119 pp. \$8.00.



THE PUBLISH-IT-YOURSELF HANDBOOK: LITERARY TRADITION & HOW-TO edited by Bill Henderson.

□ This excellent self-published book offers the potential author-publisher the insights of 26 contributors who have sold up to hundreds of thousands of copies of their works. Although this book is aimed primarily at the literary rather than the technical world, through tradition, testimony and suggestion it will tell you how to publish it yourself, book, magazine, or journal. Almost every kind of publication is discussed. A how-to section offers practical tips, and a bibliography of 70 books about related subjects is included. 364 pages of fascinating reading, only \$5.



Self-publishing?

For your convenience in ordering, please use these pages plus the order form on page 127. You may photocopy these pages.

Terry T Steeden
40 Waseca Av
Tonka Bay MN 55331

Assembling the H9 Video Terminal

Photo 1: The most exciting part follows the construction of a good portion of the chassis, power supply, high voltage circuits and the character generators: the terminal is fired up for the first time, and the pleasant aura of success is evident in the display. The deflection yoke has yet to be aligned to produce horizontal rows of characters, but just the fact that characters appear at all is exciting.

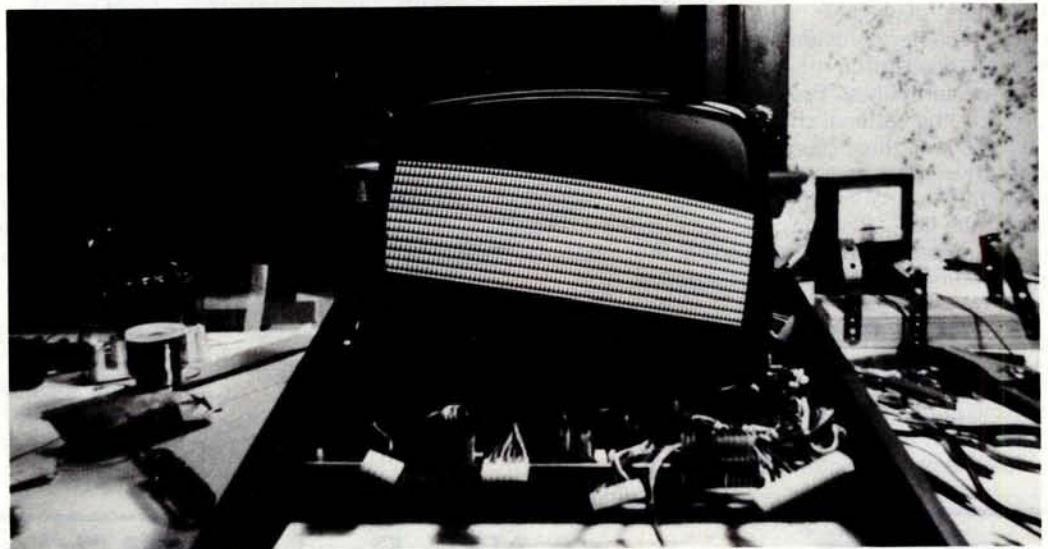
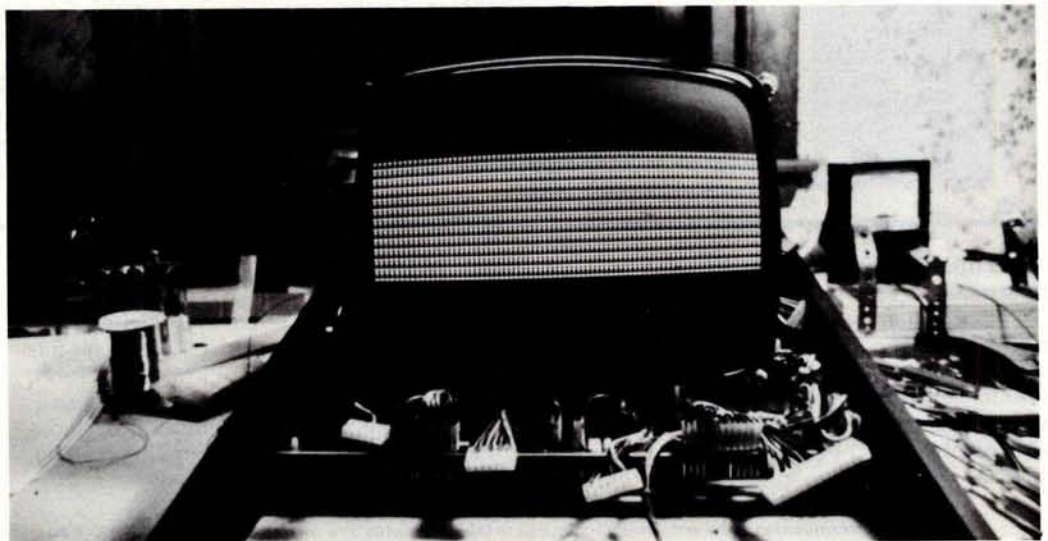


Photo 2: Several steps later in the manual, the deflection yoke has been carefully twisted around the neck of the cathode ray tube to produce horizontal rows of null ("?") characters.



I have just completed one of the more satisfying electronic experiences in my life. I think a lot of the feeling is a result of everything working the first time. Everyone should have such an experience at least once every ten years. More often is preferable, but Murphy's Law usually prevents it. I have just finished assembling the Heathkit Model H9 video terminal.

At first I thought that everything worked the first time because of my great skill as an assembler. However, as a long time Heathkit builder (automotive testers, amateur radio equipment, and now microprocessor equipment), I have sensed something better about this kit and its construction manual. While they appear in the familiar and efficient format of past Heathkits, there is something which made them easier to follow, and therefore helped contribute to the "works the first time" result. First, the printed circuit boards are clearly and legibly marked. Double and triple referencing of all components by manufacturer's part number, Heathkit part number, and reference designation made part location much easier, faster, and more accurate. The only place where something might go wrong is in the placement of integrated circuits and diodes (correct placement of pin 1 and band). Second, each printed circuit board is electrically checked as soon as it is completed. It is much easier to check each board as it is completed (there are six printed circuit boards to build) than to troubleshoot the entire finished unit. Each check assures that the board is functioning in a go or no go sort of way. Generally, you can be assured the unit is working up to the point of inserting the last printed circuit board. If something does not work, you can assume it was the last board added. This cuts down troubleshooting time. Resistance checks at each board completion (before applying power) further assure that you will not do severe

damage to a board because of shorts or integrated circuits installed backwards.

The entire building procedure took me about 18 hours [*but reports from other builders, such as yours truly, indicate that it can take as long as 40 hours. . .CH*]. Sometimes you just get hooked and can't quit. This also contributes to the little mistakes which cause things not to work the first time. As Heathkit advises, if you get tired, quit and go rest. I might mention that this is the prime reason previous Heathkits, which I assembled, did not work. At 2 AM diodes and integrated circuits can go in backwards very easily and wires can get soldered to the wrong places.

The chassis took about two and a half hours to set up. A lot of mechanical as-

Notes on Construction of the Heathkit H9 Terminal. . .

This series of pictures illustrates several aspects of the construction of the Heathkit H9 terminal. The pictures begin about midway through the construction of the kit, and are presented in the order of assembly of the kit per the manual.


Accutrack II


8" & 5 1/4" Diskettes & Word Processing Magnetic Cards

Ready shipment

Accutrack II offers delivery on premium quality 8" and 5 1/4" diskettes and mag cards. Accutrack II is designed for virtually any data or word processing system. Each is certified to meet the highest quality standards, is competitively priced and backed by Kybe's 18 years of magnetic storage experience. You can count on Kybe for quality, support and fast delivery. Dealer inquiries invited.

Call toll free:
800 225-8715





KYBE
KYBE CORPORATION
132 Calvary Street, Waltham, Mass. 02154
Tel. (617) 899-0012; Telex 94-0179
Offices & representatives worldwide

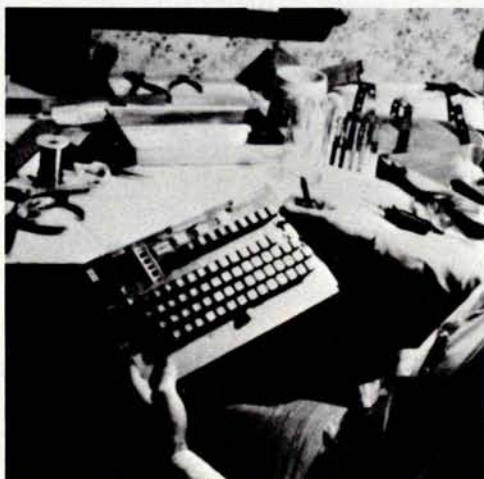
Photo 3: One of the most tedious tasks when assembling the H9 is manually checking each switch of the keyboard. Here, two metal cake pans are used as input (background) and output (foreground) of the process of checking each switch with an ohmmeter.



Photo 4: After soldering the switches to the keyboard printed circuit board, each switch must be individually tagged with a preprinted self-sticking key identification. The key identification fits into a recessed flat area on the upper side of the keytop.



Photo 5: Eventually all the keys are marked properly and the completed keyboard is ready for installation.



sembly, as opposed to electrical assembly, is required. I hardly used my soldering iron, except to make the occasional small cable assembly. The major cable assemblies are already assembled and supplied in the kit. I thought I would never run out of plugs to put into the chassis, and interconnect. There seemed to be a lot of them. All are necessary to support and interconnect the seven printed circuit boards, and to interface to the outside world.

The power supply circuit card was the first electrical assembly. It went very fast, half an hour, and after resistance checks, it fired up and regulated beautifully. The tests at this point check the regulators on the circuit card, and also check the power wiring on the chassis.

The character generator circuit card was also quickly assembled. The testing at this point was a resistance check, and voltage measurement after power on. The video circuit card must be completed before you can be assured that the character generator board is working. The video circuit card took just a little longer, but then it was just a little bigger.

The next part of the assembly was one of the most enjoyable (enjoyable only if it works; remember Murphy). Even though less than half of the circuit cards were assembled and installed, there were enough to fire the terminal up to see how it worked. The cathode ray tube was installed, more mechanical work. Not too hard, but a little time consuming, as well it should be. It is not wise to be careless with a cathode ray tube. It can implode and must be handled carefully, as noted in the manual. Temporary jumpers, supplied with the kit, are used to set up the character generator and video cards. If all is going well, when you turn the power switch to on, twelve rows of 80 "?" characters with underlines appear magically on the screen (see photo 1 and photo 2). I couldn't believe it when it worked just as the manual said. It was 3:30 AM and I went to bed a very happy person.

Next day started with the keyboard circuit card. This was the most time consuming board to assemble, with lots of pushbuttons to test and install (see photo 3, photo 4 and photo 5). There were also a large number of jumpers to install. I would almost pay a few dollars more for a double sided printed circuit board rather than put in all those jumpers. The pushbuttons have a much better feel to them than what I had expected. My wife contributed significantly by inserting the logos onto the top of each key. The keyboard resistance check was made and power applied. Behold, I could make



Your BASIC Needs Are Filled By HAYDEN Books!

Basic BASIC, **Game Playing with BASIC**, and **The BASIC Workbook** are just three of Hayden's top-notch BASIC language books. Our line runs the gamut of BASIC books: the beginner's beginner (**BASIC From the Ground Up**; **Basic BASIC**); the advanced applications book (**Advanced BASIC**); the game playing guide (**Game Playing with BASIC**); the problem-solving guides (**The BASIC Workbook**; **Discovering BASIC**); and the style guide for advanced programmers (**BASIC With Style**).

These books succeed in teaching BASIC because they present the perfect balance between theory and practice. All the guides are chock full of programs that illustrate the techniques. All the explanations are fairly general so that they cover a variety of computer systems using BASIC.

Their simple approach puts principles to work — so you can get to work in BASIC quickly and with desired results.

So, whatever your BASIC needs are, HAYDEN has the answer.

HAYDEN — The Best in BASIC!
15-Day Money-back Guarantee!

Hayden Book Company, Inc.
50 Essex Street
Rochelle Park, NJ 07662

ORDER FORM

Please send me the book(s) checked on that time. I will send payment, plus postage, or return the book(s) and owe nothing. On all prepaid orders, publisher pays postage. Residents of N.J., F.I.A., and CA must add sales tax. Prices are subject to change without notice. Offer good in U.S.A. and Canada only.

- | | | |
|---------------------------------|---------------------------------|----------|
| <input type="checkbox"/> 5106-9 | Basic BASIC (p) | \$8.95 |
| <input type="checkbox"/> 5107-7 | Basic BASIC (cl) | 9.95 |
| <input type="checkbox"/> 5104-2 | The BASIC Workbook | 5.50 |
| <input type="checkbox"/> 5109-3 | Game Playing with BASIC | 6.95 |
| <input type="checkbox"/> 5855-1 | Advanced BASIC (p) | 7.95 |
| <input type="checkbox"/> 5856-X | Discovering BASIC (cl) | 8.95 |
| <input type="checkbox"/> 5783-0 | BASIC From the Ground Up | 6.85 |
| <input type="checkbox"/> 5760-1 | BASIC With Style | 8.95 |
| <input type="checkbox"/> 5115-8 | | 6.95 (t) |
- Name _____
Title _____
Company _____
Address _____
City/State/Zip _____

Send to: **HAYDEN BOOK COMPANY, INC.**
50 Essex Street, Rochelle Park, NJ 07662
78-074





Photo 6: After installation of the keyboard, another live test of the display is performed, this time using the keyboard to vary the content of the display.

letters and numbers appear on the screen (photo 6).

The memory and counter circuit card was next, the board with the most integrated circuit sockets to solder in. As in all sub-modules of a Heathkit, the assembly process begins with a parts tally (see photos 7a and 7b). It takes a while. However, look at the positive side; I personally would rather solder in sockets than try to remove even one soldered in integrated circuit. Sockets for each and every integrated circuit on every board are supplied.

The final board to be assembled is the IO circuit card. It does not take too long to build, but the most impressive thing here is the schematic. Working professionally with microprocessor systems, one of the biggest problems I've run across is interfacing. Heathkit has designed one of the most flexible IO cards I have ever seen. Serial RS-232, TTL, and 20 mA loop are all jumper selectable. Parallel IO is also included.

The timing and processing unit circuit card is preassembled, tested, and calibrated by Heathkit. It is simply plugged in. The final adjustments are easily accomplished. A good VOM or VTVM is all that is required through the whole procedure, with ranges of 10, 100 and 1000 ohms for resistance measurements.

One final electrical note: there have been reports of blown Darlington transistors

because of insufficient current limiting. While this fix was not in the manual when I assembled the H9, the friendly guys at the local Heathkit store provided both the information and the components to effect it. Readers with H9 kits should check to make sure that this fix is present.

Reflecting on the H9 design, I found two things I do not like. 12 rows of data does not seem sufficient. Anyone writing software and needing to see more than the last 11 statements will feel limited. This is offset a bit by the short form mode which creates four columns with 12 rows and 20 characters. Now 48 statements, rather than 12, can be displayed at once if they are all less than 20 characters long. The second thing I found disconcerting was that the characters displayed on the video screen were slightly blurred on the left and right edges of the picture. After playing with the adjusting magnets, and other adjusting controls, this was minimized. It is barely noticeable through the front protective screen.

Other controls include page or scroll selection, independent cursor controls, erase page, erase to end of line, automatic line carry over selection (automatic return to next line after 80 characters), controls for timeshare (half or full duplex, transmit page, break). Serial and parallel interfaces, adjustable to rates between 110 and 9600 bps, are very flexible and functional. Un-



Photo 7a: A good practice when assembling complicated kits is built into the Heathkit manuals: a parts check off. In this photograph, the parts for the "RAM and counter circuit board" have been unpacked from the paper bags, with loose parts placed in the baking pan at the left.

fortunately, few of the standard ASCII formatting commands are decoded: if you want to clear the screen from your computer, 12 line feeds in a row is about the only way to do it, in spite of the fact that an equivalent key is available.

After searching for several months, I was very pleased to find an 80 character per line terminal with so many functions. I saw units that cost 50 to 70 percent

more which did not have the features of the H9. The documentation is equal or better than past Heathkits. Physically, it looks professional and is clean and neat. It would be hard to find a unit so flexible for the investment. I use mine with a modem for timesharing as well as using it as a terminal for my home micro-processor system. And what's more, it worked the first time.■



Photo 7b: As the parts are checked off against the parts list, they are moved from the pan at the left into the pan at the right, and arranged in order for access later during assembly. In this photo, the circuit board for the new module and a conductive foam pad with the integrated circuit parts are both placed at the back of the two pans.

Maze

Robert J Bishop
1143 W Badillo #E
Covina CA 91722

Here is an interesting novelty program that you can leave running on your video display whenever you are planning to have guests over to see your computer. The program automatically generates and displays a different maze about once a minute on an Apple I computer. Each maze is 11 squares high and 19 squares wide, and has only one path through it. The size, 11 by 19, was chosen so that a display with 24 lines of 40 characters each would just fill the screen.

Basically, here's how the program works. The entrance and exit points are randomly chosen first. Next, a random walk is performed from both of these points until the two paths cross. This determines the one, and only one, way through what will become the maze. As each "cell" is visited via these random walks, the location of the cell is placed in a *queue*. A queue is simply a list of items in which all insertions are made at one end, and all accesses are made from the other end, ie: it's a first in-first out (FIFO) list. When either of the walks runs out of places to go (gets stuck in a corner, or gets boxed-in), it goes back to the queue and restarts from the node indicated by the next item in the queue. This restarting process continues until the queue becomes empty, at which point the maze is complete. The resulting maze is then displayed, and the whole process starts over again.

The program is written in Apple BASIC and requires less than 2 K bytes of memory; an additional two pages (512 bytes) are required for the queue and grid array. Along with the BASIC interpreter the whole thing easily fits in 8 K bytes. In order to conserve space, the grid array and the queue are accessed via PEEK and POKE functions. The queue, indicated by the variable Q in the program, is located starting at decimal location 768; the grid array G starts at decimal location 1024. These values are set in line 100 of the program. Each of these

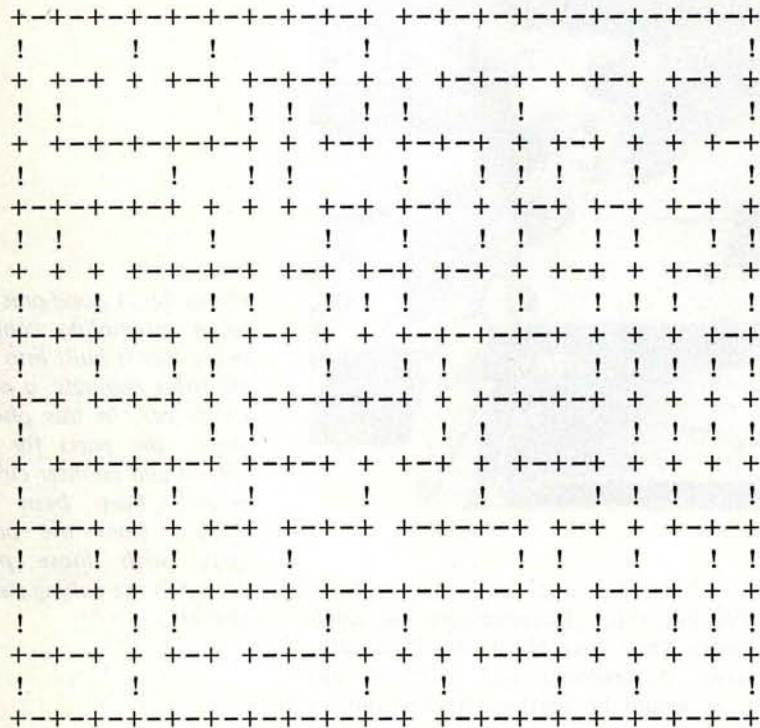
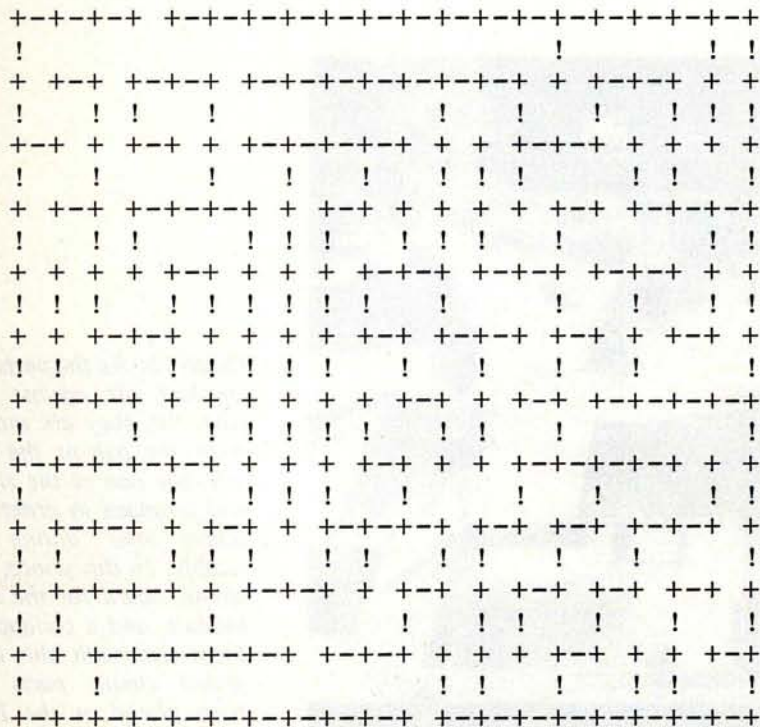


Figure 1: Two typical mazes as generated by the program of listing 1. A series of these will entertain you for hours and furnish you with another response to that age old question, "What do you do with it?"



Osborne & Associates announces two new books. . .

AN INTRODUCTION TO MICROCOMPUTERS: VOLUME 2 - SOME REAL MICROPROCESSORS VOLUME 3 - SOME REAL SUPPORT DEVICES

There are hundreds of microprocessor books on the market today, but there's nothing like *Volumes 2 and 3*. These books provide the only detailed descriptions of real products from an independent source.

NEW MICROPROCESSORS

Volume 2 describes individual microprocessors and support devices commonly used only with the parent microprocessor. The new edition represents a massive expansion of our previous *Volume 2*; among other new material it includes the first detailed description of the Intel 8086 16-bit microprocessor.

NEW SUPPORT DEVICES

Volume 3 describes support devices that can be used with any microprocessor. The majority of this book is new material; in particular it has one of the most comprehensive discussions of memory devices ever printed.

Between *Volumes 2 and 3*, every microprocessor and most support devices available today are described — in detail, and from an independent source.

NEW UPDATES

Because of the tremendous amount of material that *Volumes 2 and 3* must cover, these books have been written to be updated on a regular bimonthly schedule. Six update sections for each of the two volumes may be purchased on a yearly subscription basis. Each update will describe new products, or products not covered in the original volumes; updates also provide additional information for products already included, and errata pages for previous text.

NEW FORMAT

For your convenience, *Volumes 2 and 3* are printed in loose leaf form and may be purchased with or without a binder.

The 1978 edition of *Volume 2* and the new *Volume 3* of *AN INTRODUCTION TO MICROCOMPUTERS* will be available at the end of September. To order these or other Osborne & Associates publications, check the appropriate boxes below.

	PRICE	QTY	AMT
14-4 Volume 2 — Some Real Microprocessors 1978 Edition — With Binder	\$20.00		
15-2 Without Binder	\$15.00		
16-0 Binder alone	\$ 5.00		
17-9 Volume 3 — Some Real Support Devices With Binder	\$20.00		
18-7 Without Binder	\$15.00		
19-5 Binder alone	\$ 5.00		
Volume 2 and 3 Updates (Subscription to six issues of each series)	\$40.00		
Volume 2 Updates only (six issues)	\$25.00		
Volume 3 Updates only (six issues)	\$25.00		
• 6 1/2%, SF Bay Area residents only • 6%, California residents outside SF Bay Area • Payment in advance must be enclosed for purchases of up to \$70.00. Invoicing for purchases of \$70.00 or more in the U.S.A. available upon approval of your account. All foreign orders must be prepaid in U.S. dollars drawn on a U.S. bank.			TOTAL Sales Tax (Calif. residents only) Shipping Charges TOTAL AMOUNT ENCLOSED

OSBORNE & ASSOCIATES, INC. (415) 548-2805
P.O. Box 2036 DEPT. 113 TWX 910-366-7277
Berkeley, California 94702 U.S.A.

NAME _____
ADDRESS _____
CITY _____
STATE _____ ZIP _____ PHONE _____

SHIPPING CHARGES: Shipping for large orders to be arranged.

UPDATE SUBSCRIPTIONS:
☐ All foreign orders \$4.00 per 6-issue subscription for airmail
☐ No extra charge in the U.S. - 4th Class Mail ONLY.

BOOKS:
☐ All foreign orders, \$3.00 per book, for air shipment
☐ 4th class \$0.35 per book (allow 3-4 weeks within USA, not applicable to discounted orders)
☐ \$0.75 per book, UPS (allow 10 days) in the U.S.
☐ \$1.50 per book, special rush shipment by air in the U.S.

Please send information on:
☐ Other O&A publications
☐ Becoming an O&A dealer
☐ School discounts
☐ List of foreign distributors
☐ More information on Volumes 2 and 3

arrays requires one 256 byte page of memory.

If you have a random access display (if your hardware lets you change displayed characters without having to regenerate the complete display), you might want to modify the program to become an interactive game. After the maze is displayed, let players try to move some type of cursor through it before a set time limit is reached.■

Listing 1: An Apple I BASIC listing of the maze program. This program should be easy to convert to any BASIC language which uses PEEK and POKE functions.

```
10 DIM A(3), B(3), C(3), E(4), N(2)
20 E(1)=1:E(2)=2:E(3)=4:E(4)=8
100 Q=768:G=1024:R=-1:F=-1:M=0:L=2
120 FOR K=1 TO 209: POKE G+K-1,0: NEXT K
140 N(1)=3+ RND (7):N(2)=205- RND(7)
160 POKE G+N(1),2: POKE G+N(2),24
180 P=N(1): GOSUB 1000: P=N(2): GOSUB 1000
200 L=3-L: P=N(L)
250 GOSUB 3000: IF P<0 THEN 350
300 GOSUB 1000: GOTO 400
350 GOSUB 2000: IF P<0 THEN 500
400 N(L)=P: GOTO 200
500 FOR K=1 TO 24: PRINT : NEXT K
510 FOR K=1 TO 11
520 FOR L=1 TO 19
540 T= PEEK (G+19*(K-1)+L-1)/2
```

```
560 O$= " ": IF T=2*(T/2) THEN O$= "- "
580 PRINT "+":O$:
600 NEXT L: PRINT "+ "
620 FOR L=1 TO 19
640 T= PEEK (G+19*(K-1)+L-1)/4
660 O$= " ": IF T=2*(T/2) THEN O$= "! "
680 PRINT O$: " ":
700 NEXT L: PRINT "! "
720 NEXT K
740 P= PEEK (Q+1): T=P-19*(P/19)
760 FOR K=1 TO T:PRINT "+-": NEXT K:PRINT "+ "
780 FOR K=T+2 TO 19: PRINT "+-": NEXT K:PRINT "+ "
800 GOTO 100
1000 R=R+1: POKE Q+R,P: RETURN
```

```
2000 F=F+1: P=-1: IF F<=R THEN P= PEEK (Q+F): RETURN
3000 K=0
3100 T=P+1: IF T/19#P/19 THEN 3200
```

```
3150 S=1: GOSUB 4000
3200 T=P-19: IF T<0 THEN 3300
3250 S=2: GOSUB 4000
3300 T=P-1: IF T/19#P/19 THEN 3400
```

```
3325 IF T<0 THEN 3400
3350 S=3: GOSUB 4000
3400 T=P+19: IF T>=209 THEN 3500
```

```
3450 S=4: GOSUB 4000
3500 IF K#0 THEN 3600: P=-1: RETURN
```

```
3600 K=1+ RND (K):T=C(K)
3610 IF PEEK (G+T) #0 THEN M=1
3620 IF M=0 THEN B(K)=B(K)+16*(PEEK (G+P)/16)
3630 POKE G+P, PEEK (G+P)+A(K)
3640 POKE G+T, PEEK (G+T)+B(K)
3650 P=T: RETURN
4000 IF PEEK (G+T)=0 THEN 4300
4050 IF M#0 THEN RETURN
4100 IF PEEK (G+P)/16= PEEK (G+T)/16 THEN RETURN
4300 K=K+1: C(K)=T: A(K)=E(S)
4400 S=S+2-4*((S+1)/4): B(K)=E(S)
4500 RETURN
```

TURTLES

Small home robots
controllable by **your** computer.

Needs 8 bits in, 4 bits out TTL compatible parallel port.
Attachable to any computer via parallel interface (not included).

Terrapin™ Turtles can:

- 'walk' (on 2" radius wheels)
- 'talk' (via 2-tone speaker)
- 'blink' (with lights as eyes)
- draw (with solenoid-controlled pen)
- 'feel' (using 3½" radius dome as touch sensor)

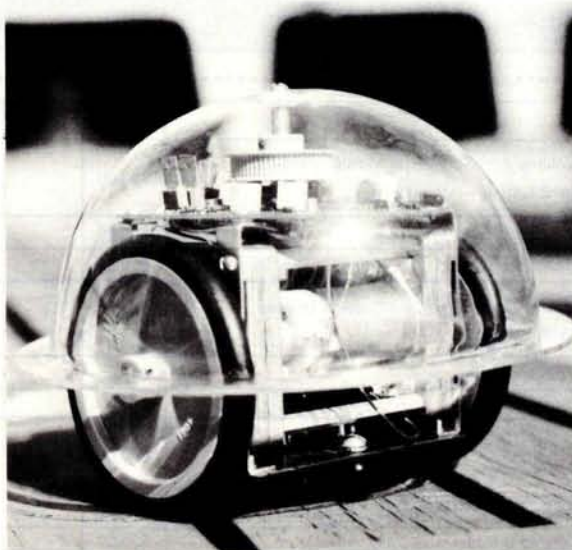
Use your **Turtle** to map rooms, solve mazes, dance, explore Artificial Intelligence, teach geometry or programming.

A unique peripheral to keep you "in touch" with your computer.

Computer not included (Batteries not needed).

Kit \$300 Assembled \$500

S-100 Bus Interface \$40 • Shipping \$5
Mass. residents add 5% sales tax
Limited delivery from stock • Brochures available



Terrapin, Inc.



33 Edinborough Street, 6th Floor
Boston, MA 02111
(617) 482-1033

EDP books you can't afford to be without

MICROCOMPUTER-BASED DESIGN

by J. Peatman

491/380 Pub. Pr., \$24.50 Club Pr., \$17.50

COMPUTER ARCHITECTURE

by C. C. Foster

770/794 Pub. Pr., \$17.95 Club Pr., \$13.95

THE 8080A BUGBOOK—MICROCOMPUTER INTERFACING AND PROGRAMMING

by P. R. Rony, D. G. Larsen & J. A. Titus

783/845 Pub. Pr., \$9.95 Club Pr., \$8.45

MINICOMPUTER SYSTEMS

Organization and Programming

by R. H. Eckhouse, Jr.

768/641 Pub. Pr., \$18.95 Club Pr., \$13.95

MICROPROCESSOR PROGRAMMING FOR COMPUTER HOBBYISTS

by N. Graham

783/56X Pub. Pr., \$12.95 Club Pr., \$10.95

FUNDAMENTALS OF DATA STRUCTURES

by E. Horowitz & S. Sahni

770/522 Pub. Pr., \$17.95 Club Pr., \$14.95

CHESS AND COMPUTERS

by D. Levy

785/252 Pub. Pr., \$12.95 Club Pr., \$10.50

TOP-DOWN STRUCTURED PROGRAMMING TECHNIQUES

by C. L. McGowan & J. R. Kelly

769/052 Pub. Pr., \$15.95 Club Pr., \$13.50

COMPUTER DATA STRUCTURES

by J. L. Pfaltz

497/435 Pub. Pr., \$19.50 Club Pr., \$14.60

AUTOMATIC DATA PROCESSING HANDBOOK

by The Diebold Group, Inc.

168/075 Pub. Pr., \$34.95 Club Pr., \$23.75

STRUCTURED COBOL

by A. S. Philippakis & L. J. Kazmier

497/974 Pub. Pr., \$12.95 Club Pr., \$9.70

GETTING INVOLVED WITH YOUR OWN COMPUTER

A Guide for Beginners

by L. Solomon & S. Veit

771/952 Pub. Pr., \$9.95 Club Pr., \$8.35

MICROPROCESSOR/MICROPROGRAMMING HANDBOOK

by B. Ward

768/749 Pub. Pr., \$9.95 Club Pr., \$8.45

DATA BASE DESIGN

by G. Wiederhold

701/30X Pub. Pr., \$21.50 Club Pr., \$15.95



any two
of these great
professional books
for only **\$2.95**
values up to
\$59.45

Introductory offer to new members of the Computer Professionals' Book Club

Two special bonus books come to you for \$2.95 with your first club selection

THIS professional club is designed to meet your day-to-day on-the-job needs by providing practical books in your field on a regular basis at below publisher prices. If you're missing out on important technical literature—if today's high cost of reading curbs the growth of your library—here's the solution to your problem.

The Computer Professionals' Book Club was organized for you, to provide an economical reading program that cannot fail to be of value. Administered by the McGraw-Hill Book Company, all books are chosen by qualified editors and consultants. Their understanding of the standards and values of the literature in your field guarantees the appropriateness of the selections.

How the Club operates: Every month you receive free of charge *The Computer Professionals' Book Club Bulletin*. This announces and describes the Club's featured book of the month as well as alternate selections available at special members' prices. If you want to examine the Club's feature of the month, you do nothing. If you prefer one of the alternate selections—or if you want no book at all—you notify the club by returning the card enclosed with each *Bulletin*.

As a Club Member, you agree only to the purchase of four books (including your first selection) over a two-year period. Considering the many books published annually, there will surely be at least four you would want to own anyway. By joining the club, you save both money and the trouble of searching for the best books.



VALUES UP TO \$59.45 WITH MAJOR DISCOUNTS ON ALL OTHER CLUB SELECTIONS. Your bonus books come with the first selection, and you may choose both of them from the books described in this special introductory offer.

EXTRA SAVINGS: Remit in full with your order, plus any local and state tax, and McGraw-Hill will pay all regular postage and handling charges.

NO RISK GUARANTEE:

If not completely satisfied return selections for full refund and membership cancellation.

MAIL THIS COUPON TODAY

COMPUTER PROFESSIONALS' Book Club P.O. Box 582 Princeton Road, Hightstown, New Jersey 08520

Please enroll me as a member and send me the three books indicated. I am to receive the two bonus books at the introductory price of \$2.95 plus my first selection, plus tax, postage, and handling. If not completely satisfied, I may return the books within 10 days and request that my membership be cancelled. If I keep the books, I agree to take a minimum of three additional books during the next two years at special Club prices (guaranteed 15% discount, often more). I will receive the Club Bulletin 13 times a year. If I want to examine the featured selection, I need take no action. It will be shipped automatically. If, however, I want an alternate selection—or no book at all—I simply notify the Club by returning the convenient card always enclosed. I will always have a minimum of 10 days in which to return the card and you will credit my account fully, including postage, if this is not the case. Membership in the club is continuous but cancellable by me at any time after the four-book purchase requirement has been filled. This order subject to acceptance by McGraw-Hill. Orders from outside the continental U.S. must be prepaid. Company, business, or institutional tax exemption status is not applicable to purchases made through individual Club memberships. All prices subject to change without notice. Offer good for new mem-

bers only. Postage and handling charges are added to all shipments. Members are billed when books arrive.

Write Code # of 1st bonus book selection here

Write Code # of 2nd bonus book selection here

Write Code # of 1st book selection here

NAME _____

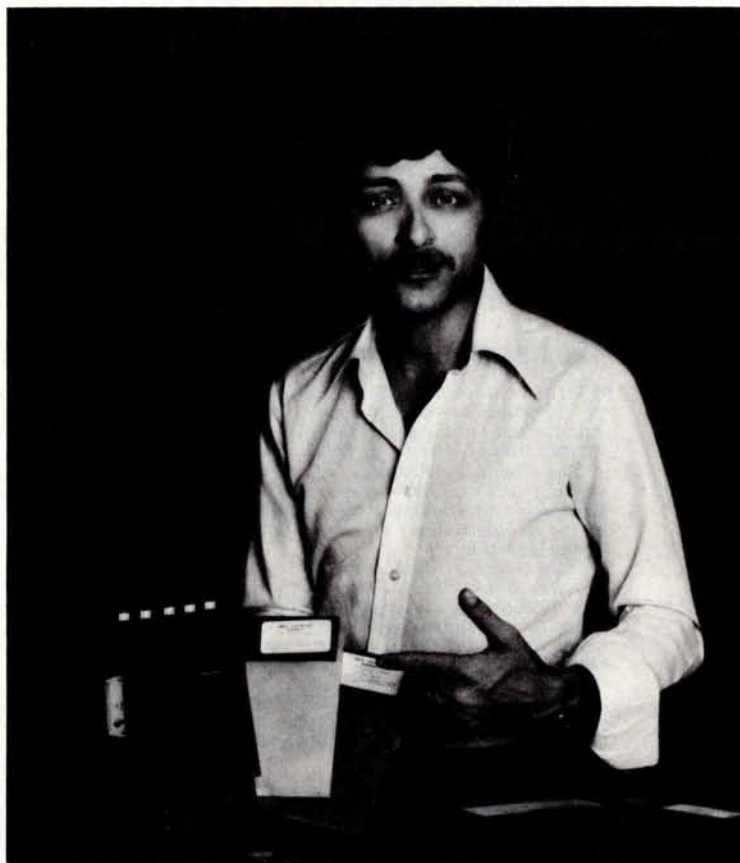
ADDRESS _____

CITY _____

STATE _____ ZIP _____

P39300

Can you upgrade to 16-bits on a tight budget?



Of course!

Let me introduce you to the 16-bit world of Alpha Micro. Consider *all* the advantages of upgrading your present 8-bit system with the first fully integrated concept of hardware and software. A concept that provides all the features of a 16-bit minicomputer, yet retains all the flexibility, peripheral options, and low cost of S-100 bus systems.

Now you can have much of the sophistication that was previously restricted to only the mini's... Multi-User, Multi-Tasking, Time-Sharing, Memory Management, Disk-File Management, and yes, Peripheral Independence.

Come on, Join Alpha Micro's 16-bit world... You can do it on an 8-bit budget. Five subsystems let you expand your 8-bit

system capability as your needs, and your budget, allow:

AM-100 16-bit CPU. Two board S-100 bus compatible microprocessor set, complete with software—a year and a half field proven reliability.

AM-200 Floppy Disk Controller. S-100 bus compatible supports PerSci 277 and Wangco 87 disk drives.

AM-300 Six Port Serial I/O. S-100 bus compatible provides six fully programmable RS-232 ports.

AM-400 Hard Disk Subsystem. S-100 bus compatible interface and CALCOMP Trident series drives (25, 50, 80, 200 and 300 megabyte configurations).

AM-500 Hard Disk Subsystem. S-100 bus compatible formatter-controller and

CDC Hawk 10 megabyte hard disk drive.

All Alpha Micro systems are fully software supported including the new completely integrated, minicomputer class accounting system which consists of several hundred programs.

For more information see your local Alpha Micro dealer or write or call.



17881 Sky Park North
Irvine, California 92714
(714) 957-1404

Programming Quickies



See the exciting 16-bit world of Alpha Micro at your local Alpha Micro dealer.

Converting North Star's Deletion Characters

I own a North Star floppy disk operating system and have patched in my own IO routines. I found that attempting to correct a single error by using the DEL (or RUB OUT) key doesn't work. Or if I try to cancel a complete line with the ESC key, nothing happens. The problem is that North Star's disk operating system uses the BASIC commands of the at symbol "@" for canceling a line and the back arrow (or underline) for correcting a single character. All my other programs, monitors, assemblers and so on use the ESC key to cancel a line and the DEL (RUB OUT) key for deleting the previously typed character.

The solution is fairly simple and is shown in listing 1. Since I had to write a set of IO routines anyway, I incorporated a section to look for ESC and DEL input. When either is found, the byte is changed to the corresponding value needed by the operating system. The extra 16 bytes will readily fit into the space allocated to the user.

Of course, the original correction characters, at sign and arrow, can still be used. ■

Alan R Miller
New Mexico Tech
Socorro NM 87801

```

294D DB00      CHIN:  IN  STAT  ; CHECK STATUS
294F E601      ANI  MASK  ; MASK FOR INPUT READY
2951 CA4D29    JZ   CHIN  ; LOOP UNTIL READY
2954 DB01      IN  DATA  ; GET DATA BYTE
2956 E67F      ANI  7FH   ; STRIP PARITY
2958 FE1B      CPI  1BH   ; ESC?
295A CA6329    JZ   CESC  ; DELETE LINE IF SO
295D FE7F      CPI  7FH   ; DEL?
295F CA6629    JZ   CDEL  ; DELETE CHARACTER IF SO
2962 C9        RET      ; OTHERWISE RETURN

2963 3E40      CESC:  MVI  A, "@" ; CHANGE ESC TO @
2965 C9        RET

2966 3E5F      CDEL:  MVI  A, 5FH ; CHANGE DEL TO BACK ARROW
2968 C9        RET
    
```

Listing 1: 8080 assembly language listing of the changes to the North Star disk operating system to allow usage of DEL and ESC key codes for deleting characters and lines.

ALABAMA
HUNTSVILLE
Computerland
(205) 539-1200

ALASKA
ANCHORAGE
Data Com
Systems, Inc.
(907) 344-4536

ARIZONA
PHOENIX
Byte Shop of
(602) 285-0065

TEMPLE
Byte Shop of
(602) 967-1421

TUCSON
Byte Shop of
(602) 327-4579

CALIFORNIA
BERKELEY
Byte Shop of
(415) 845-6368

CARSON
Shaw Brothers
(213) 770-3688

COSTA MESA
Orange County
Computer Center
(714) 448-0221

FRESNO
Electric Brain
(209) 227-8479

GLENDALE
Beaumarck
(213) 244-9348

LA JOLLA
Tech-Mart
(714) 459-2797

LAWNDALE
Byte Shop of
(213) 371-2421

MANHATTAN
BEACH
De Marco-Schatz
Computer Systems
(213) 545-4539

MISSION VIEJO
ComputerLand
(714) 770-0311

ORANGE
Computer Mart
(714) 633-2222

OXNARD
APR Systems
(805) 485-5498

Prodata Systems
(805) 483-1168

PALO ALTO
Byte Shop of
(415) 327-8080

PASADENA
Byte Shop of
(213) 684-3311

SAN DIEGO
Computer Center
(714) 292-6302

Computerland of
San Diego
(714) 560-9912

SAN LUIS OBISPO
Byte Shop of
(805) 543-9310

SAN RAFAEL
Byte Shop of
(415) 457-9311

Computer
Alternatives
(415) 459-1366

SANTA ANA
Advanced
Microcomputer
Products
(714) 558-6813

SANTA BARBARA
Byte Shop of
(805) 966-2638

SANTA MONICA
Mission Control
(213) 809-9337

The Computer Store
(213) 451-0713

SHERMAN OAKS
People's
Computer Co.
TARZANA
Tech Mart
(213) 344-0153

VAN NUYS
Computer
Components
(213) 344-0153

WESTMINSTER
Byte Shop of
(714) 894-9311

COLORADO
BOULDER
Byte Shop of
(303) 444-8550

DENVER
Byte Shop of
(303) 399-8995

Computer Hut
(Prime Radius)
(303) 573-4995

Mini Mini
Computer Co.
ENGLEWOOD
Mini Mini
Computer Co.
(303) 770-5005

CONNECTICUT
HAMDEN
JRV Computer Store
(203) 281-1453

FLORIDA
CORAL GABLES
Sunny Computer
Stores, Inc.
(305) 861-0042

FORT LAUDERDALE
Byte Shop of
(305) 561-2983

HIALEAH
Metronix
Computers, Inc.
(305) 885-4700

MIAMI
Byte Shop of
(305) 284-2983

HAWAII
HONOLULU
Pan Pacific
Computer
Company
(808) 737-5857

Small Computer
Systems
(808) 732-5246

IDAH0
BOISE
Capitol Office
Machines, Inc.
Computer Division
(208) 342-8585

ILLINOIS
CHAMPAIGN
Champaign
Computer Co.
(217) 586-4131

CICERO
Digital Research
(312) 856-3353

EVANSTON
Rty Birty
Machine Co.
(312) 328-8800

SCHAUMBURG
Data Domain of
(312) 397-8700

INDIANA
BLOOMINGTON
Data Domain
(812) 334-3607

INDIANAPOLIS
Data Domain
(317) 251-3139

Computers
Unlimited
(317) 849-6505

IOWA
WATERLOO
The Computer
Center
(319) 232-9504

KANSAS
OVERLAND PARK
Personal Computer
Center, Inc.
(913) 649-5942

KENTUCKY
LOUISVILLE
Memory
System Co.
(502) 895-4269

MARYLAND
ROCKVILLE
Computer Workshop
(301) 468-0455

MASSACHUSETTS
WALTHAM
Computer Mart
of Boston
(617) 899-4540

MICHIGAN
ANN ARBOR
Computer Store of
(313) 995-7616

ROYAL OAK
Computer Mart of
(313) 576-0900

MINNESOTA
MANKATO
North Kato Supply
(507) 825-5475

MINNEAPOLIS
Computer Depot
(612) 927-5601

MOOREHEAD
P.S. Inc.
(218) 233-6682

MISSOURI
BOLIVAR
Computer
Workshop
(816) 741-5055

MONTANA
BILLINGS
Big Sky Byte Shop
(406) 252-2299

NEBRASKA
OMAHA
Byte Shop of
(402) 339-7350

Omaha
Computer Store
(402) 592-3590

NEVADA
LAS VEGAS
Computer Systems
for Business, Inc.
(702) 873-7400

RENO
Byte Shop of
(702) 828-8080

NEW JERSEY
SELIN
Computer Mart of
(201) 283-0600

NEW YORK
NEW YORK
Computer Mart of
(212) 686-7923

NORTH CAROLINA
BOONE
Alpha Digital
Systems
(704) 264-7946

NEWELL
Digital Dynamics
(704) 374-1527

OHIO
CINCINNATI
Software Systems
Consulting Inc.
(513) 745-3111

CLEVELAND
Byte Shop of
(216) 333-3261

COLUMBUS
Midwestern Digital
Electronics
(614) 294-2991

OREGON
BEAVERTON
Byte Shop of
(503) 544-2686

EUGENE
Real Oregon
Computer Co.
(503) 484-0400

PORTLAND
Byte Shop of
(503) 223-3496

PENNSYLVANIA
BURGETTSBORO
Byte Shop of
(610) 398-0282

QUEBEC
Trois-Rivieres
Selle Inc.
819 373-2367

WANCOURVER
Byte Shop of
(604) 736-7221

Pacific Computer
Store, Ltd.
(604) 438-3282

Quil Computer
Systems
(604) 684-5082

WINNEPEG
Micro-Byte Ltd.
(204) 947-8289

ENGLAND
LONDON
Computer
Applications
Research
(01) 373-4834

SALFORD
MANCHESTER
Computer Design
Systems
(061) 468-0477

FRANCE
PARIS
Computer Boutique
310-085-047

EURO Computer
Shop Paris
(01) 468-0477

GERMANY
HOLSTEIN
Computer Systems
Computersystems
4103

73-93-4103 68-69
MUNICH
Datameg KG
(089) 460-4993

HOLLAND
Ronda
Telex 50463

HONG KONG
CAUSEWAY BAY
Telex
5-783-669

JAPAN
TOKYO
Nihon Terminal
Computer
Tokyo 170

SPAIN
BARCELONA
Informatica
(000) 235-7110

SWEDEN
BROMMA
Mentor, AB

SWITZERLAND
ZURICH
Comico, A.G.
(01) 242-2803

VENEZUELA
CARACAS
E.D.C. MEGA, C.A.
33-79-90

Circle 4 on inquiry card.

A Simpler Digital Cassette Tape Interface

To our department at Ohio University, "Saturation Recording's Not All That Hard" by David M Allen, page 34, January 1977 BYTE, was a sleeper until we happened to

Ralph W Burhans
Ohio University
E E Dept
Athens OH 45701



Photo 1: The author's tape recorder as modified for direct digital recording. IO switch is at bottom left; LEDs are at bottom right.

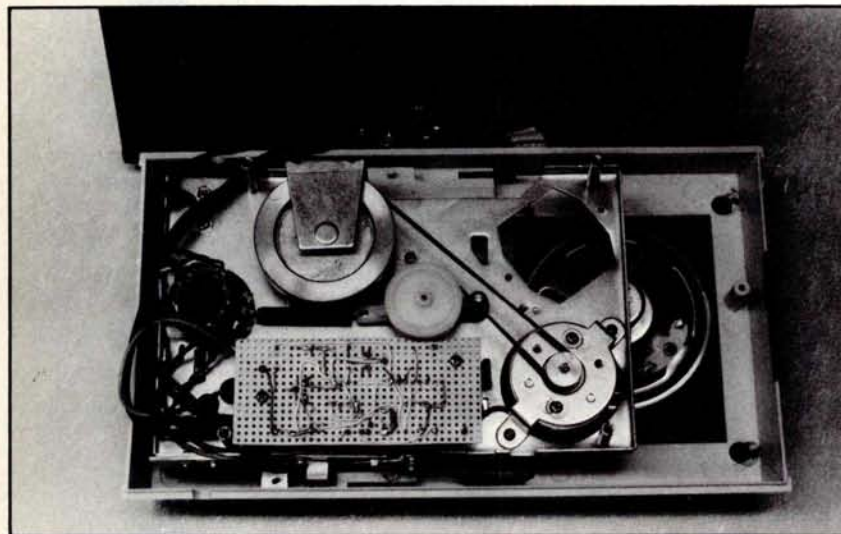


Photo 2: Interior view of digital cassette unit showing additional circuitry on perforated circuit board.

visit Abex Corporation here in Athens OH. While we were there, Dave Weeks showed us a direct digital interface which he was building from an old cassette deck. Bernie Hutchins in the *Electronotes Applications Note No 32*, March 25 1977, published a short item on the 555 used as a window comparator. Putting the two ideas together results in the interface of figure 1, where the 555 performs the function of upper and lower limit comparators with adjustable threshold along with a flip flop to recover the serial data stream. It even supplies an extra open collector output to drive a read indicator LED. A cassette deck by Western Auto was obtained at the local surplus store for \$10 and was modified by removing all the original audio electronics, but saving the wire motor control and power on and off switching features. An evening of bench tests indicated that the head would provide a 10 to 20 mV peak to peak output on direct saturation. Installation of a single Darlington transistor (SE4022) provided 40 db gain to bring the read level up to a volt or so, which fires the 555 comparators by pulling down the 555 control point threshold with an adjustable resistor to ground. That is about all there is to the unit except for a 4049 buffer inverter driver.

In our department, Larry Eichman fabricated a neat packaging of the system for a senior lab project. The recorder works fairly well over the range of 100 to 1200 bps. At 2400 bps, though, the tape recorder drive is somewhat erratic because of the motor speed drive mechanical on and off control. Some users of similar older tape machines have modified the drive motor by bending the regulator spring such that power is always applied to the motor with a regulated power source, rather than depend on the centrifugal rotating regulator mechanism. The same kind of machine has been used on a homebrew 8008 system, and Larry Eichman has used it with a COSMAC 1802 processor. Photos 1 and 2 illustrate the front panel controls and IO indicators, as well as the circuit board wiring for the electronics.

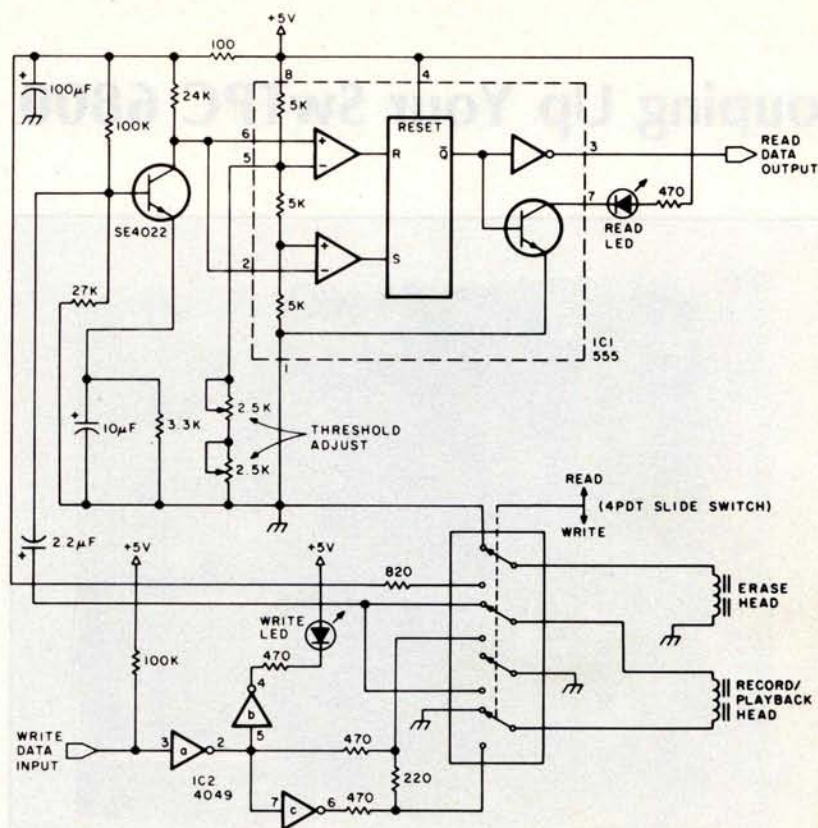
The older style rotary switching deck is not suited to more complex software start and stop controls, but it does provide a quick serial data IO system for those who are willing to cannibalize an existing audio cassette recorder. ■

IC Number	Type	+5 V	Ground
IC1	555	8	1
IC2	4049	8	1

Figure 1: Circuitry to modify a standard cassette recorder for direct digital recording. During the write process a DC current of approximately 1 V is passed through the record head, which saturates the tape. The polarity of the saturation recorded signal depends on the polarity of the DC current going through the head winding. During the read cycle, a voltage is induced in the head winding only when a transition between two oppositely polarized zones moves past the head. The 555 circuit (IC1) is used as a combination level detector and flip flop to recover the serial data.

REFERENCE

Electronotes Applications Note No 32, March 25, 1977. Available from Electronotes, 203 Snyder Hill Rd, Ithaca NY 14850.



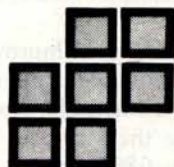
BASIC is BASIC is ...

And **BASIC** does what it should. But if you're ready to step up from **Beginner's All-purpose Symbolic Instruction Code**, look at **OPUS**, the high-level 8080/Z80 language from A.S.I. ... roots in **BASIC**, but designed for business applications. **OPUS** gives you the capabilities you need, like extended precision, string handling, and easy formatting. **OPUS/TWO** takes up where **OPUS/ONE** leaves off, allowing subroutines, overlays, and extended disc file management.

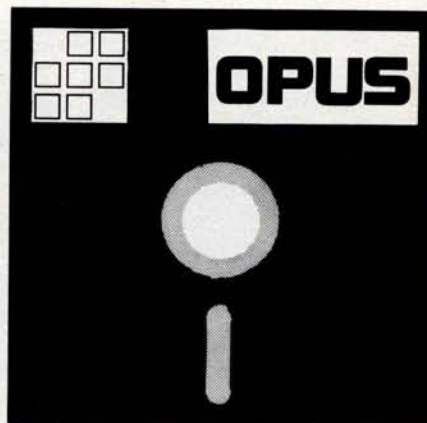
But we didn't stop there. **OPUS** programs and data are directly upward-compatible, all the way up through **TEMPOS**, A.S.I.'s multi-user, multi-tasking operating system.

Ask your dealer, or contact A.S.I. We'd like to tell you more.

OPUS/ONE	\$99.00	OPUS/TWO	\$195.00
S.O.S.	\$385.00	TEMPOS	\$785.00



ADMINISTRATIVE SYSTEMS, INC.
1642 S. Parker Road, Suite 300
Denver, Colorado 80231 (303) 755-9694



ORDER A MANUAL NOW and we'll apply the price toward your software purchase.

OPUS User's Manual	\$12.50
S.O.S. Manual Set (includes OPUS Manual)	\$20.00
TEMPOS Manual Set (includes OPUS Manual) ..	\$20.00

MASTER CHARGE and **VISA** accepted.

Add \$1.50 per manual (set) for shipping/handling in U.S.

Souping Up Your SwTPC 6800

Steve A Hughes
5831 Hillside Dr
Doraville GA 30340

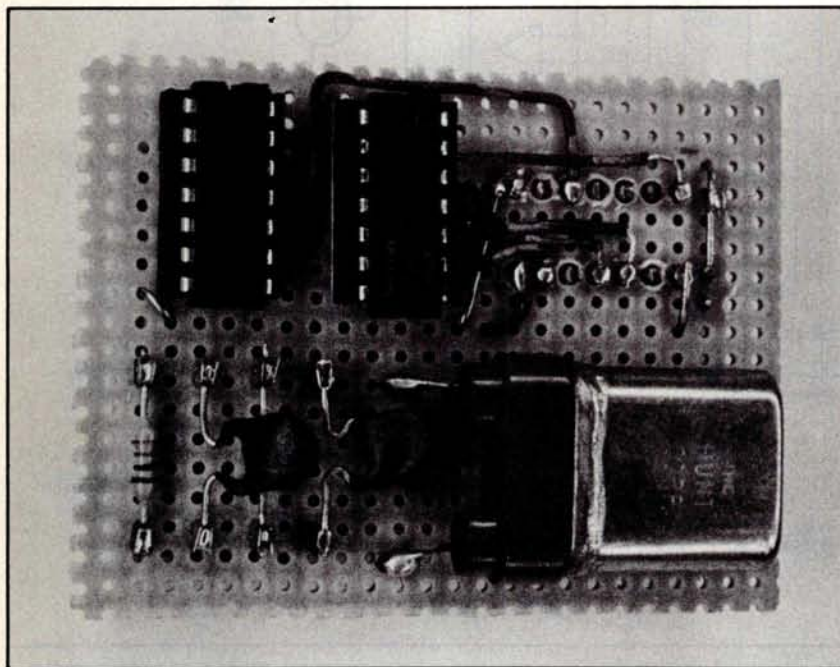


Photo 1a: Top view of the SwTPC 6800 processor clock speed modifier circuit.

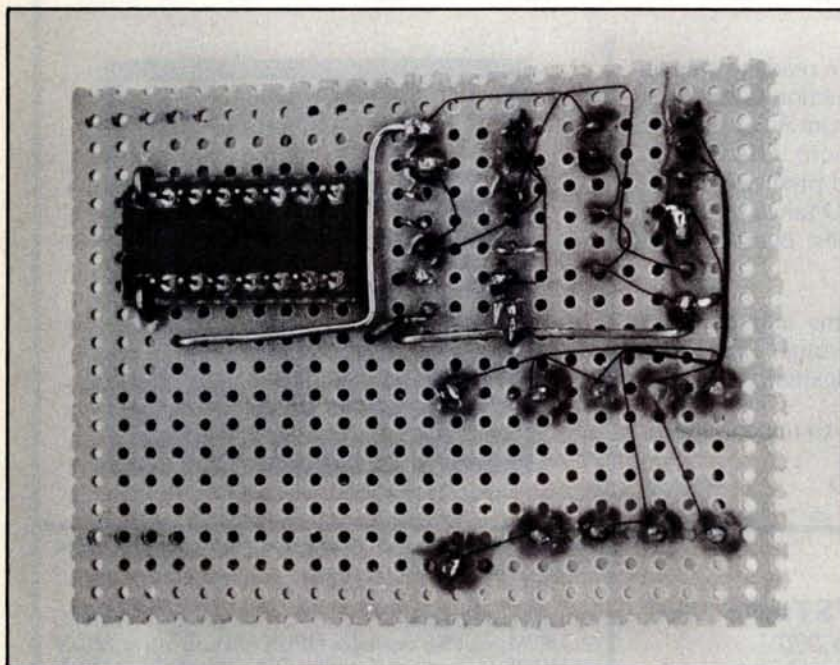


Photo 1b: Bottom view of the SwTPC 6800 processor clock speed modifier circuit.

One of the design economies in the SwTPC 6800 is the use of the same clock to set data transfer rate and to control processing speed. It avoids the need to build a separate processor clock and reduces the processing speed by only 10 percent. For most applications, this speed loss is unimportant, but it can become important if you are interested in heavily processor based activities such as process control or robotics. It is also inconvenient if you use timing loops frequently, since it is more difficult to calculate timing loops which are based on a slightly more than $1 \mu\text{s}$ period rather than on an even $1.0 \mu\text{s}$ period for the processor states. Therefore, I decided a little "souping up" was in order.

The 10 Percent Solution

The processing speed of the SwTPC 6800 is governed by the data rate generator clock, which is based on a 1.7971 MHz crystal timebase. A 7474 flip flop is used to divide the data rate generator timebase down to provide the processor clock with its $1.11 \mu\text{s}$ clock period. By replacing this 7474 with a socket into which you can plug a 2 MHz crystal oscillator, you can provide the desired 1 MHz signal source. This oscillator can be built cheaply and simply on a small piece of perforated circuit board (see photos 1a and 1b). It provides a separate source for the processor clock without interfering with the data rate generator or the action of the 7474.

Memories used with a 1 MHz processor must have access times of no more than 500 ns. This means that, although all factory supplied memories should run at the increased processor speed with no difficulty, other memories may not. For example, 2102-2s will *not* work reliably at the higher speed. To simplify confirming that your memories are fast enough, I've included a table of access times for the more commonly available types of 2102 memories (see table 1).

One advantage of making this improvement in your system is that you are no longer limited to one unchangeable clock speed. If you want to use the 1.5 MHz or 2.0 MHz versions of the 6800 processor, ACIA (Asynchronous Communications

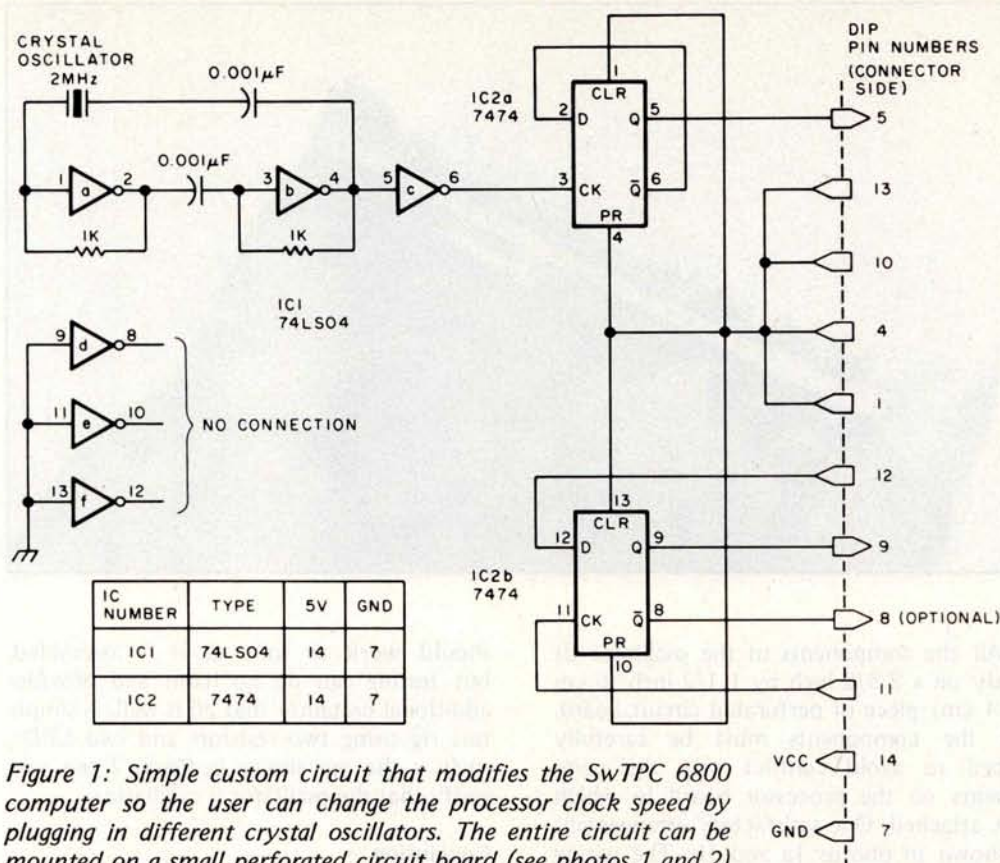


Figure 1: Simple custom circuit that modifies the SwTPC 6800 computer so the user can change the processor clock speed by plugging in different crystal oscillators. The entire circuit can be mounted on a small perforated circuit board (see photos 1 and 2) which plugs directly into the SwTPC 6800 board in place of the existing 7474 data rate generator timebase divider.

Memory Number	Access Time	Usable at 1 MHz?
2102	1000 ns	No
2102-1	500 ns	Yes
2102-2	650 ns	No
2102A	350 ns	Yes
2102A-2	250 ns	Yes
2102A-4	450 ns	Yes
2102A-6	650 ns	No
2102AL	350 ns	Yes
2102AL-2	250 ns	Yes
2102AL-4	450 ns	Yes

Table 1: Some commonly used memory integrated circuits (ICs) and their compatibility with a 1 MHz processor speed.

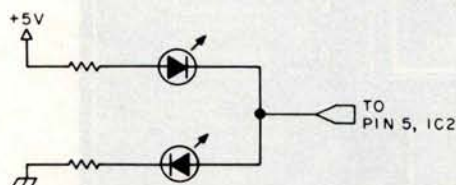


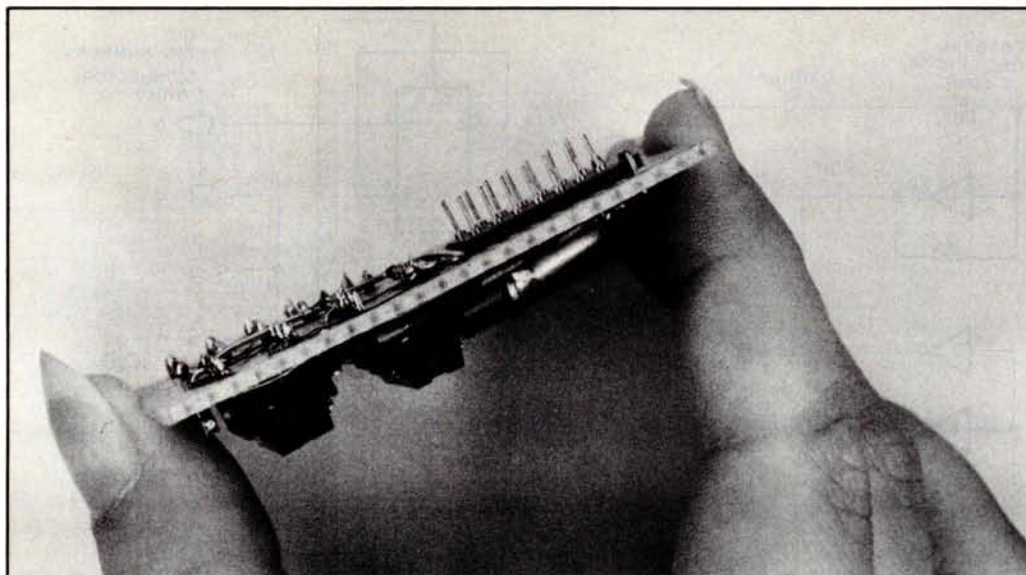
Figure 2: Simple test rig to verify that the oscillator circuit (shown in figure 1) is working. Both LEDs should light up when connected to pin 5 of IC2.

Interface Adapter), PIA (Peripheral Interface Adapter), and the like, which are currently available, you can adjust the timebase simply by replacing the 2.0 MHz crystal with one specified at 3.0 MHz (for a 1.5 MHz processor clock) or at 4.0 MHz (for a 2 MHz processor clock). Increasing the processor speed above 1 MHz will necessitate replacing (or adding a slow memory interface for) memories not suited to the increased speed, and replacing the MIKBUG read only memory (not currently available in higher speed versions). But for some applications the increased speed is undoubtedly worth the effort.

Building the Oscillator Card

The schematic shown in figure 1 indicates how the oscillator card works. This is one of the most common circuits of its type and was chosen for its simplicity. The parts as shown in photo 1a are mounted on top of the board and the connector (a 14-pin DIP [dual in line package] header) mounts underneath with its upper pins sticking through the top of the board. The reverse of the board is seen in photo 1b.

Photo 2: Side view of the clock modifier circuit, showing the pins of the dual in line connector (DIP) plug, enabling the experimenter to plug the entire board into the SwTPC board in place of the existing 7474 flip flop, which serves as the data rate generator timebase divider.



All the components of the oscillator fit nicely on a 2 3/8 inch by 1 1/2 inch (6 cm by 4 cm) piece of perforated circuit board, but the components must be carefully placed to avoid conflict with the components on the processor board to which it is attached. One satisfactory arrangement is shown in photos 1a and 1b. The wiring arrangement on the card is not critical so long as the wires are correctly connected to the connector pins. Capacitance values also are not critical. Any value from 0.001 μ F to 0.1 μ F will probably work. The entire board then plugs into the SwTPC 6800 board in place of the existing 7474 (see photo 2 for a side view of the DIP plug).

This is largely a foolproof card and

should work as soon as it is assembled, but testing can do no harm and provides additional certainty that all is well. A simple test rig using two resistors and two LEDs, such as the one shown in figure 2, lets you verify that the oscillator is oscillating.

Conclusion

The increased processor speed which results from this modification offers benefits in any heavily processor based application. The circuit shown on the card is also convenient as a 1 MHz source for any other development work you may be doing. As an inexpensive way to solve processor speed problems, it's hard to beat. ■

NEW
FROM XITEX

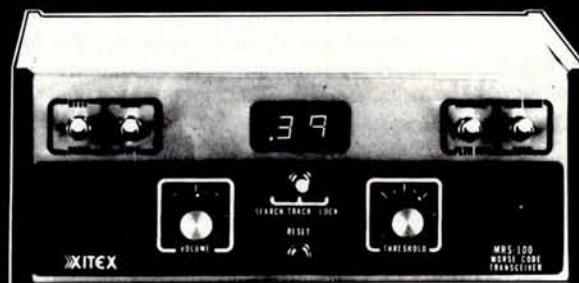
\$95 MORSE TRANSCIEVER

SEND:

- 1 to 150 WPM (set from terminal)
- 32 character FIFO buffer with editing
- Auto Space on word boundaries
- Grid/Cathode key output
- LED Readout for WPM and Buffer space remaining

SERIAL INTERFACE:

- ASCII (110, 300, 600, 1200) or Baudot (45, 50, 57, 74) compatible
- Simplex Hi V Loop or T-L electrical interface
- Interfaces directly with the XITEX® SCT-100 Video Terminal Board; Teletypes® Models 15, 28, 33, etc.; or the equivalent



MRS-100 CONFIGURATIONS:

- \$95 Partial Kit (includes Microcomputer components and circuit boards; less box and analog components)
- \$225 Complete Kit (includes box, power supply, and all other components)
- \$295 Assembled and tested unit (as shown)

Overseas Orders and dealer inquiries welcome

COPY:

- 1 to 150 WPM with Auto-Sync.
- Continuously computes and displays Copy WPM
- 80 HZ Bandpass filter
- Re-keyed Sidetone Osc. with on-board speaker
- Fully compensating to copy any 'fist style'

See your local dealer or contact XITEX® direct.

MC/Visa accepted

XITEX Corp.
P.O. Box 20887
Dallas, Texas 75220
(214) 386-3859

why the last BUSS is the best BUSS

It has the latest news for users (and prospective users) of Heath Co. computer products. It isn't company-controlled--BUSS can get new product information and tidbits about items being developed before the official announcement by Heath Co. But BUSS does more than that--BUSS also lets you in

on news of compatible hardware & software from other vendors. H8 and H11 users may save enough on these products to pay for a BUSS subscription several times over. And users of the ET-3400 Trainer aren't left out either. The first issue of BUSS came out more than a year ago in April of

1977. Every issue goes by first class mail and almost all orders for new subscriptions are filled within two days. Back issues go fast, but most of those for 1978 are still available. BUSS keeps getting better. So send for it:

12 ISSUES FOR \$ 6.80

THE INDEPENDENT NEWSLETTER OF HEATH CO. COMPUTERS 325 PENNSYLVANIA AVENUE, S.E. WASHINGTON, DC 20003

Continued from page 6

it had only the usual audio tape cassette interface for mass storage, and television for display purposes. (I have since ordered and received a floppy disk drive, which was plugged in and working within five minutes of setup.)

The immediate spur to writing this practical program was the need to analyze the editorial preferences section of the BYTE 1978 reader survey. This section, like the monthly BOMB analysis of articles in BYTE, gave a number of entries for which the respondent to the survey indicated a preference on a scale of 0 to 10. In the case of the survey, my goal was to find out what readers were interested in, so there was a list of 38 categories of interest to be rated 0 to 10. Each respondent's individual scale differs, but the idea here is to average the ratings of a large number of individuals and thus approximate an overall preference

ranking. In the case of the survey, 2457 people responded out of 5000 subscribers picked at random from our mailing list.

In our monthly BOMB analysis, the ratings are acquired by the time-honored method of tallying with strokes on paper in groups of five strokes. Thus when Wai Chiu Li takes a monthly break from his normal job of "final paste" preparation for BYTE in order to tally the BOMB cards on a large sheet of paper, he accumulates strokes, thus:

||||

In the survey analysis, with 2457 forms returned, our data processing contractor, Systemetrics, performed the keystroking of data and produced a report giving a count for each rating 0 to 10 in the 38 different categories of the preference survey.

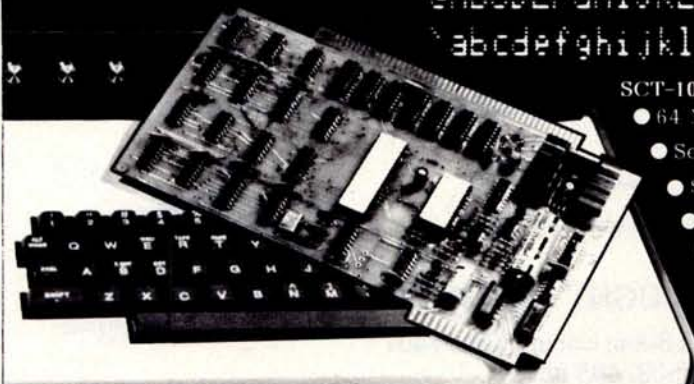
Articles Policy

BYTE Publications Inc 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 informal description of procedures and requirements, potential authors should send a self-addressed, stamped envelope to BYTE Authors' Guide, 70 Main St, Peterborough NH 03458.

Articles which are accepted are purchased with a rate of \$45 per published page, based on technical quality and suitability for the intended readership. As to articles appearing in BYTE magazine, 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. ■

\$95 Stand Alone Video Terminal

αΒΓΔΕΒϰμνσζϕτθρσ1234567890!@#%&'()*+,-./012456789:;<=>?
@ABCDEFGHIJKLMNPOQRSTUVWXYZ[\]^_
`abcdefghijklmnopqrstuvwxyz{|}~



SCT-100 FEATURES:

- 64 X 16 line format with 128 displayable characters
 - Serial ASCII or BAUDOT with multiple Baud rates
 - \$187 Assembled or \$157 Kit (Partial Kit \$95)
 - Full cursor control with scrolling and paging
 - On board power supply
 - Many additional features
- Call or write today. MC/VISA accepted

XITEX CORP. P.O. Box #20887

Dallas, Texas, 75220 • Phone (214) 386-3859
Overseas orders and dealer inquiries welcome

But this raw data is not the desired result. For the monthly BOMB analysis and for the survey analysis, I need a program which produces the following derived data from the input of ten counts (I exclude the 0 rating case) in n categories:

- Weighted sum total rating for each category.
- Mean and standard deviation over the field of ratings.
- Sorted rankings of each category by weight.
- Deviations for each category in units of one standard deviation.

The previous method of analyzing these results was to use a Commodore PR-100 programmable calculator, which has a mean and standard deviation calculation built into it. But this suffered from a number of awkward disadvantages. The procedure was essentially manual, with minimal automation through the use of the programmability of the calculator. The calculator has no way to enter enough data for the whole analysis, or to edit that data if a mistake is made, or to verify that data by examining details. Use of a calculator required an "expert" who knew the process, in order to accomplish the goal: calculation of mean, standard deviation,

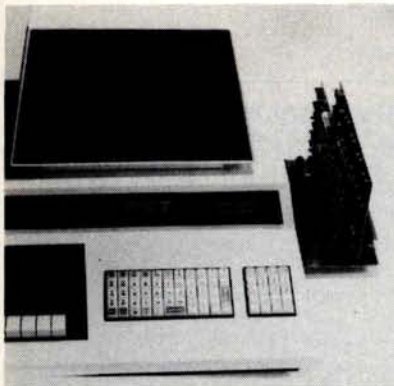
sorting of the categories by weight, and calculation of relative deviation from the mean for each category. With only 10 to 15 items I had put up with this procedure for a long time, but the prospect of 38 items and no way to verify the detail entries was not encouraging.

Thus I proceeded to create a program. Since the Apple II was the computer available to me in my office, I wrote the program using the Applesoft BASIC interpreter (Microsoft's product in Apple II clothing) as the high level language. It took me all of about five hours on July 11 1978 to go from the intention to a working BASIC program. If I had had the floppy disk accessory at the time, the result would have been even quicker since I would not have had to put up with the relative inconvenience of the audio tape mass storage system. Since this program was the first extensive one I have written in the Microsoft dialect of BASIC, I had to read the manuals as part of that process of creating the program. (Apple II's Applesoft interpreter is essentially identical to the Radio Shack Level II interpreter, the Commodore PET interpreter, and interpreters available for OSI and MITS Altair machines. All were written by Bill Gates and his associates at Microsoft Inc.) As many readers no doubt know, the language

From the people who brought you KIMSI —
Mr. Interface™ does it again with...

BETSI

The PET* to S-100 bus
Interface/Motherboard



Expand your PET as easily as S-100 users !

- Plugs directly into any PET, no cable fabrication or additional connectors required.
- Compatible with virtually all S-100 boards (including memory and I/O types).
- Does not slow the CPU or alter PET's operation in any way.
- Does not interfere with PET's IEEE or parallel user ports.
- Interface draws only 100ma at 8V.

And Betsi includes:

- On-board *Dynamic Memory Controller* for the S.D. Sales "Expando-ram" high density/low power memory board (expand PET's memory to the limit on a single S-100 card)!
- On-board sockets and decoding circuitry for 8K of PROM (add future PET firmware *without* purchasing an S-100 PROM card).

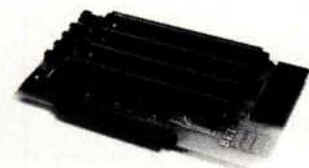
Now available from stock at a price that can't be beat (even just for memory expansion)!

BETSI Interface/Motherboard — Kit \$119, Assembled \$165

Expandoram 24K memory board — Kit \$364, Assembled \$414

See your local dealer or contact: **FORETHOUGHT PRODUCTS**

Coburg Box 8066; Coburg, OR 97401
(503) 485-8575



* PET is a Commodore product

was more than adequate to the task. Pascal it is not, but *any* high level language is better than no high level language.

So, with all the preparation carried out, and a program verified, I was able to analyze the 38 categories of preferences included in our survey, and proceed to begin analyzing BOMB results the same way.

Let's take a look first at what readers of BYTE found of interest based on our survey. The task presented to our survey participants was the following:

The following list contains a selection of topics drawn from computer science, mathematics, science and engineering. Please give your personal rating from 0 (no interest) to 10 (high interest). If a particular field within this list is your professional or occupational specialty, please record a check mark in the "Primary Interest" column to the left of the line. If you have already used a personally owned system for at least one nontrivial application in the field, please record a check mark in the "Have Implemented" column for that line.

The complete list of 38 topics is presented in table 1, ranked according to weighted total count, along with the actual weighted total counts and a fraction representing the number of standard deviations away from the mean of 38 categories. The mean weighted count total of the 38 categories was 8579.5, and the standard deviation calculated was 1977.9.

The top ranked category was rather nebulous: "applications to everyday life." Thus its 2.2 standard deviation rank may be less than significant. If the survey had asked for a ranking of "motherhood and apple pie" the result might have come out the same. I tend to think that the whole motivation for having a personal computer is to use it in everyday life, and it is always a great ego trip to have such an appraisal measure out at the top. Household automation with computers is one way to accomplish such a task, and is also a fitting subject for the experimenter. Personal data base design is a natural, ranging from the oft mentioned kitchen recipe file to the record collector's inventory to the maintenance of tax records. The latter of course overlaps on the application of personal computers to personal business.

In the experimenter's corner, there is a high interest in voice recognition by computers. But no pattern matching and recognition of sounds is possible without heavy emphasis on the art of programming, a topic which turned up as the sixth ranked item.

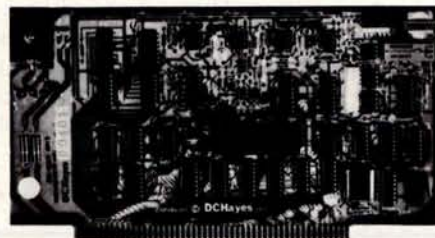
APPLE II TRS-80 & other CASSETTE TAPES FOR SALE

We promote, advertise and sell software for free lance computer specialists all over the United States.

Get the latest issue of our book full of programs by return mail.
Send \$1.00 to:

Programmers Software Exchange
2110 N. 2nd Street
Cabot, Arkansas 72023

modem / 'mo • dēm / [modulator + demodulator] *n* - *s* : a device for transmission of digital information via an analog channel such as a telephone circuit.



- Completely compatible with your IMSAI, ALTAIR*, SOL** or other S-100 microcomputers. Trademarks of *MITS, **Processor Technology
- Designed for use on the dial telephone or TWX networks, or 2-wire dedicated lines, meets all FCC regulations when used with a CBT coupler.
- All digital modulation and demodulation with on board crystal clock and precision filter mean that **NO ADJUSTMENTS ARE REQUIRED**
 - Bell 103 standard frequencies
 - Automated dial (pulsed) and answer
 - Originate and answer mode
 - 110 or 300 BPS speed select
 - Complete self test capability
 - Character length, stop bit, and parity
 - 90 day warranty and full documentation

D.C. Hayes Associates, Inc.

P.O. BOX 9884 ATLANTA, GEORGIA, 30319 (404) 455-7663

TRS-80 OWNERS, HAVE WE GOT SOFTWARE ON CASSETTES FOR YOU!!!!

AARDVARK / CAPTURE-hunt the ant with coordinates/capture an enemy spacecraft.....	(8-1)	\$13.95	WE ALSO PRODUCE CUSTOM SOFTWARE FOR BUSINESS OR SCIENTIFIC APPLICATIONS ... WE WILL EVALUATE YOUR REQUEST AND SEND YOU A QUOTE INDICATE IF YOU HAVE A LEVEL 1 OR A LEVEL 2 TRS-80
STARTREK-advanced version with verbal interaction between crew members.....	(8-2)	\$14.95	
ROULETTE / ONE ARM BANDIT-two of the famous casino games in full graphics.....	(8-3)	\$13.95	
PATTERNS / PINBALL-graphic demonstration programs, see what your computer can do.....	(8-4)	\$11.95	
ANNUITIES-value at maturity, payment amount, no. of payments, interest rate, schedule.....	(8-5)	\$10.95	
SPACESHIP / CANNON-land on venus/fight aggressive enemies.....	(8-6)	\$12.95	
DICE / HYPERBAGELS-play craps/guess the secret number using computer hints.....	(8-7)	\$14.95	
I CHING / BIORHYTHMS-ancient chinese method for telling the future/plot biorhythms....	(8-8)	\$13.95	
POKER-draw poker in full graphics, using standard casino house rules.....	(8-9)	\$10.95	
COMBUSTION / GROWTH-simulate hydrocarbon combustion/determine growth patterns.....	(8-10)	\$16.95	
RALLY-a super rally with 4 different cars and 5 different tracks.....	(8-11)	\$12.95	
NIM / HEXAPAWN-play nim with counters/heuristic hexapawn, both in full graphics.....	(8-12)	\$19.95	
TAYLOR, P.O. BOX 1180, PLATTSBURGH, N.Y. 12901	(8-1) <input type="checkbox"/> (8-7) <input type="checkbox"/>	NAME.....	
check the programs with an X	(8-2) <input type="checkbox"/> (8-8) <input type="checkbox"/>	ADDRESS.....	
	(8-3) <input type="checkbox"/> (8-9) <input type="checkbox"/>	CITY.....STATE.....	
	(8-4) <input type="checkbox"/> (8-10) <input type="checkbox"/>	ZIP.....	
CASHIER CHECKS and MONEY ORDERS ... IMMEDIATE SHIPPING	(8-5) <input type="checkbox"/> (8-11) <input type="checkbox"/>	ADD \$1 for POSTAGE and HANDLING	
PERSONAL CHECKS ... PLEASE ALLOW 2 WEEKS FOR PROCESSING	(8-6) <input type="checkbox"/> (8-12) <input type="checkbox"/>	N.Y. RES. ADD STATE SALES TAX TOTAL\$ ____	

Once the "compleat" home computer experimenter has mastered the voice recognition and programming arts, what more natural test application than some of the neat logical games ranging from computer chess and the game of Go, on downward in complexity.

In the top ten, the last three items are perhaps a trio of related interests (which also are related to the other members of the top 10 set). Voice synthesis by computers complements voice recognition, yet is an easier task than voice recognition and perhaps less of a challenge as a result. The art of hardware design is required in any event for work in the more action oriented real time applications of computers such as voice experiments, household automation and control of mechanisms.

And of course, the general interest in robotics enters into the top 10 category in the form of computer control of mechanisms. Most of the challenging but little understood topics enter into the picture in the second ranked ten categories of the survey. Here we find graphics topics, the first entry of artificial intelligence topics into the ranking, etc.

A surprise (in view of this issue's chess theme) was the slightly negative rating of chess relative to the mean. The bottom ranked item (related to chess) is the artificial intelligence category of theorem proving. Also included in the bottom ten interest areas were other topics related to abstract artificial intelligence. What is surprising, though, is the fact that for people to be practically interested in robots, this relatively abstract theory of knowledge and its representation is absolutely essential. Perhaps we have here the indication of a need for some good tutorial articles about these quite essential fields—to say nothing of some practical demonstrations of concepts which can be exercised by the personal computer user.

In summary, the program worked out just fine for measuring the data of the survey. Although not covered in any great detail at this point, the BOMB analysis figures beginning in the September 1978 BYTE were created using this program. And now that I've completed the editorial and the floppy disk is working, I'll think of some other tasks for my intellectual servant to do. ■



SOROC IQ-120 \$795



T.I. 810 \$1695



TELETYPE 43 \$999



DIABLO 1620/3 \$2999

MICRO MAIL

MICRO MAIL

P.O. BOX 3297 • SANTA ANA, CA 92703 • (714) 731-4338

Send certified check (personal or company checks require two weeks to clear) including handling* and 6% tax, if a California resident

*Handling: Less than \$750, add 3%; \$750 to \$1999, add 2%; over \$1999, add 1%

Everything shipped freight collect in factory cartons with manufacturer's warranty.

H8 PROGRAMS

GAMES

Eleven computer games, including **Black-Jack**, **Hangman**, **23 Matches**, **Tic-Tac-Toe**, **Silly Sentence Maker**, **Poem Writer**, **Word Puzzle**, **Backtalker**, **Math Quiz**, **Caricature Printer**, and **Typing Speed Drill**. (Stock No. 101.1, Cassette, Requires Ext. B.H. Basic, Issue 10.01 or 10.02, \$10)

PERSONAL FINANCE

Includes two programs. **Personal Budget** provides a personal accounting system and helps reconcile your checkbook. **Interest** calculates simple interest, compound interest, and mortgage amortization schedules. (Stock No. 102.1, Cassette, Requires Ext. B.H. Basic, Issue 10.02, \$10)

COOK'S HELPER

Two programs to help the cook. **Menu** produces nutritious, within-calorie-limits menus. **Shopper** makes your trip to the grocery store more enjoyable by arranging your grocery list in the shelf order of your favorite store; prevents backtracking to look for missed items. (Stock No. 103.1, Cassette, Requires Ext. B.H. Basic, Issue 10.01 or 10.02, \$10)

MAILING LIST

Features programs for the creation, updating, sorting, and printing of mailing lists and labels. Highly flexible, with provision for coding each entry, sorting on any desired field, printing selectively by code, printing on various sizes and layouts of labels. (Stock No. 104.1, Cassette, Requires Ext. B.H. Basic, Issue 10.02, \$20)

MAILING LIST—DISK

This disk-based package contains features similar to those of the cassette version above, plus the addition of a feature that permits computerized printing of form letters to persons on the mailing list. (Stock No. 114.1, Diskette, Requires HDOS Basic, \$30)

All programs are recorded on cassette or diskette ready for use with your Heathkit H8 computer. Each package comes complete with program listings and user instructions. A discount of 10% is given if more than one item is ordered at once. Price includes shipping to U.S. destinations. Items are in stock for immediate shipment.

Ed-Pro Incorporated

6580 Buckhurst Trail
Atlanta, GA 30349

Please send the following:

Amount Enclosed

GAMES @ \$10	_____
PERSONAL FINANCE @ \$10	_____
COOK'S HELPER @ \$10	_____
MAILING LIST @ \$20	_____
MAILING LIST—DISK @ \$30	_____
TOTAL	_____
Less 10% Discount if Ordering Two or More Items	_____
AMOUNT ENCLOSED \$	_____

Name _____
Street Addr _____
City _____
State _____ ZIP _____

Circle 112 on inquiry card.

BYTE's Bugs

A Bug in the Scanner

A small bug crept into Steve Ciarcia's article, "Let Your Fingers Do the Talking: Add a Noncontact Touch Scanner to Your Video Display" (August 1978 BYTE, page 156). The Q output of IC20 in figure 2d (page 163) should be shown as pin 6, not pin 1. ■

BYTE's Bits

A Call for Papers: Reliable Software Conference

The IEEE's Technical Committee on Software Engineering is seeking papers on specifications of reliable software, to be presented at their conference in Cambridge MA, April 3 thru 5 1979.

Suggested topics include: the theory of, and experiences with, formal specification languages; disciplined specification methods; verification of the consistency and completeness of specifications; quality, adequacy, and usefulness of specifications; and future research directions.

Deadline for submitting papers is November 1, 1978. Contact Marvin Zelkowitz, Dept of Computer Science, University of Maryland, College Park MD 20742, (301) 454-4251. ■

Eighth World Computer Congress

The Eighth World Computer Congress (International Federation for Information Processing Congress 80) will be held jointly in Tokyo JAPAN from October 6 thru 9 1980 and in Melbourne AUSTRALIA from October 14 thru 17 1980. The Congress will be a gathering of computer scientists, managers, and administrators from all over the world. It will bring together both developers and users of information processing techniques and systems to share their knowledge and experience with colleagues from widely dispersed lands. The Eighth World Computer Congress will feature technical state-of-the-art developments in presentations on technology, equipment and applications, prepared by technical experts from approximately 35 countries. In addition, more than 100 international companies are expected to exhibit their products and services. In both Japan and Australia the Congress will also feature special events and entertainment. Write to Eighth World Computer Congress, Datapro Research Corp, 1805 Underwood Blvd, Delran NJ 08075. ■

LEARN TO PROGRAM MICROCOMPUTERS

And at an affordable price. The Modu-Learn™ home study course from Logical Services.

Now you can learn microcomputer programming in ten comprehensible lessons. At home. In your own time. At your own pace.

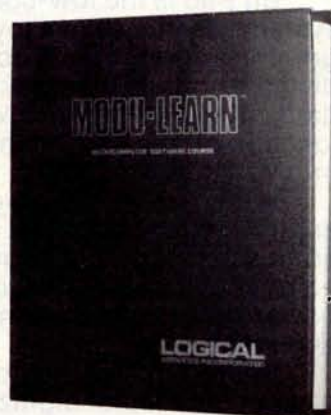
You learn to solve complex problems by breaking them down into easily programmed modules. Prepared by professional design engineers, the Modu-Learn™ course presents systematic software design techniques, structured program design, and practical examples from real 8080A micro-computer applications. All in a modular sequence of 10 lessons... more than 500 pages, bound into one practical notebook for easy reference.

You get diverse examples, problems, and solutions. With thorough background material on micro-computer architecture, hardware/software trade-offs, and useful reference tables. All for only \$49.95.

For \$49.95 you learn design techniques that make software work for you. Modu-Learn™ starts with the basics. Our problem-solution approach enables you to "graduate" as a programmer.

Circle the reader service number below to receive our free descriptive brochure and course outline.

Use your Master Charge or VISA card to order today. Call Pat at (408) 245-8855.



Circle 215 on inquiry card.

P.O. Box 60968
Sunnyvale, CA 94088
408-245-8855

LOGICAL SERVICES INCORPORATED

How to say low-cost data tablet/digitizer in two words.

Bit PadTM
Bit PadTM
Bit PadTM
Bit PadTM
Bit PadTM



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

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

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



Summagraphics[®]
corporation

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

Clubs and Newsletters

South African Computer Club

We have heard from the Transvaal Amateur Computer Club, a South African club founded in June 1977. They currently have 120 members and publish a monthly newsletter called *TAC²* which they would be pleased to exchange for newsletters from clubs based in the US. The club project is the design of a M6800 microcomputer that can be manufactured locally. This club meets every first Wednesday at 8 PM, Senate House, Witwatersrand University, Johannesburg SOUTH AFRICA.

Help Wanted

A group of computer enthusiasts from Singapore need some assistance in starting a computer club in that area. They are requesting advice from existing clubs about how to get a club started and would like suggestions about a meeting format. Additionally, they would welcome technical information in the form of manuals, brochures and catalogs from manufacturers. Write to Steven Goh, 3 Bristol Rd, Singapore 8 SINGAPORE.

Washington Area KIM Enthusiasts

Formed in January 1978, the Washington Area KIM Enthusiasts meet monthly at the McGraw-Hill Continuing Education Center in Washington DC. Meetings are scheduled for the third Wednesday of every month to discuss items of interest to KIM owners and users. To receive a copy of the current *WAKE* newsletter, send a stamped, self-addressed envelope to *WAKE*, c/o Ted Beach, 5112 Williamsburg Blvd, Arlington VA 22207, (703) 538-2303.

Attention: Xitan/TDL Owners

A user's group for owners of Xitan/TDL hardware and software has recently been formed. A bimonthly newsletter is available on a \$5 annual subscription basis, and its contents include application programs, hardware and software modifications, classified ads, technical articles and software exchange. For further information, write to Xitan User Group, c/o Bill Machrone, 121 N Av, Fanwood NJ 07023.

The New York Amateur Computer Club

The New York Amateur Computer Club meets on the second Thursday of every month at Bernard Baruch College, 17 Lexington Av (corner 23rd St), New York, room 903 at 7 PM. For further information, write The New York Amateur Computer Club, POB 106, Church St Station, New York NY 10007.

Monthly Newsletter Provides
Reader Services

The *Personal Computer News* is a monthly newsletter dedicated to a variety of reader services. PCN features a regular news column detailing developments in the microcomputer industry, product and software evaluations geared to the small businessman and hobbyist, a software exchange and "Trading Post" classified advertisement section. A software sources listing culls the latest offerings from the microcomputer media and an index to computer related articles cross reference features in computer magazines. The subscription rate is \$9 per year in the US. For more information, write to *Personal Computer News*, POB 425, Dayton OH 45419.

Digital Group User's Organization in Chicago

A Digital Group user's organization was formed in the Chicago area in February of this year to provide a forum for the exchange of ideas, software, fixes, etc, by owners of Digital Group computer systems. They meet on the last Tuesday of the month in the meeting room of Consumer Systems, 2107 Swift Rd, Oak Brook IL, at 7:30 PM. Membership dues are \$5 annually which includes a newsletter. The newsletter is currently running about four to six pages and contains news of activities of club members, announcements of Digital Group compatible hardware and software and articles and reviews by members of the club. Prospective members can write to The Digital Group of Chicago, c/o W L Colsher, 4328 Nutmeg Ln, Apt 111, Lisle IL 60532.

TCH IMP-16 Users Group

TIPS is a fairly new publication which focuses on the TCH IMP-16 system. To date, this newsletter has informed its readers of the status of the system including what is available and from whom, where parts of interest are available, basic knowledge about building the system and additional hardware details. Frederick Holmes, editor of *TIPS*, has also mentioned that the upcoming issues of the newsletter will be expanded to support SC/MP based systems. Subscriptions to *TIPS* numbers 5 thru 7 are available for \$1.50 and three SASE; back issues are \$.50 and 1 SASE for each issue desired. Write to Fred Holmes, 101 Brookhead CT, Mauldin SC 29662.

Utah Computer Association

The *μCa* is a monthly publication of the Utah Computer Association, an association dedicated to hobbyist interaction and public education about minicomputers and microcomputers. The club meets the second Thursday of each month at 7 PM in room 131, Murray High School, Salt Lake City UT. The membership fee is \$5. For more information about this club, call (801) 278-1907.■

HOBBYISTS! ENGINEERS! TECHNICIANS! STUDENTS!

Write and run machine language programs at home, display video graphics on your TV set and design microprocessor circuits—the very first night—even if you've never used a computer before!

ELF II featuring RCA COSMAC COMPUTER \$99.95

As featured in POPULAR ELECTRONICS

Shown with optional 4k Memory Board, GIANT BOARD™ & Kluge Board.



Stop reading about computers and get your hands on one! With ELF II and our new *Short Course* by Tom Pittman, you can master computers in no time at all! ELF II demonstrates all 91 commands an RCA 1802 can execute and the *Short Course* quickly teaches you how to use each of the 1802's capabilities.

ELF II's video output lets you display an alphanumeric readout or graphics on any TV screen or video monitor plus enjoy the latest video games, including an exciting new target/missile gun game that was specifically developed for ELF II.

But that's not all. Once you've mastered computer fundamentals, ELF II can give you POWER with add-ons that are among the most advanced found anywhere. No wonder IEEE chapters plus hundreds of universities and major corporations have chosen the ELF II to introduce their students and personnel to microprocessor computing!

Learn The Skill That May Soon Be Far More Important Than Your College Degree!

The ability to use a computer may soon be more important to your earning power than a college degree. Without a knowledge of computers, you are always at the mercy of others when it comes to solving highly complex business, engineering, industrial and scientific problems. People who understand computers can command MONEY and to get in on the action, you must learn computers. Otherwise you'll be left behind.

ELF II Is The F-A-S-T Way To Learn Computer Fundamentals!

Regardless of how minimal your computer background is now, you can learn to program a computer in almost no time at all. That's because Netronics has developed a special *Short Course on Microprocessor And Computer Programming* in non-technical language that leads you through every one of the RCA COSMAC 1802's capabilities so you'll understand everything ELF II can do...and how to get ELF II to do it!

All 91 commands that an 1802 can execute are explained to you, step-by-step. The text, written for Netronics by Tom Pittman, is a tremendous advance over every other programming book in print.

Keyed specifically to the ELF II, it's loaded with "hands on" illustrations. When you're finished, ELF II and the 1802 will no longer hold any mysteries to you.

In fact, not only will you be able to use a personal computer creatively, you'll also be able to read magazines such as *BYTE*, *INTERFACE*, *AGE*, *POPULAR ELECTRONICS* and *PERSONAL COMPUTING* and understand the articles.

If you work with large computers, ELF II and the *Short Course* will help you to understand what makes them tick.

A Dynamite Package For Just \$99.95!

With ELF II, you learn to use machine language—the fundamental language of all computers. Higher level languages such

as FORTRAN and BASIC must be translated into machine language before a computer can understand them. With ELF II you build a solid foundation in computers so you'll really know what you're doing, no matter how complicated things get.

Video output also makes ELF II unique among computers selling for such a low price. Attached to your TV set, ELF II becomes a fabulous home entertainment center. It's capable of providing endless hours of fun for both adults and children of all ages! ELF II can create graphics, alphanumeric displays and fantastic video games.

No additional hardware is required to connect ELF II to your TV's video input. If you prefer to connect ELF II to your antenna terminals instead, simply use a low cost RF modulator (to order one, see coupon below).

ELF II's 5-card expansion bus (connectors not included) allows you to expand ELF II as your needs for power grows. If you're an engineer or hobbyist, you can also use ELF II as a counter, alarm, lock, thermostat, timer or telephone dialer, or for countless other applications.

ELF II Explodes Into A Giant!

Thanks to ongoing work by RCA and Netronics, ELF II add-ons are among the most advanced anywhere. Plug in the *GIANT BOARD* and you can record and play back programs, edit and debug programs, communicate with remote devices and make things happen in the outside world. Add *Kluge Board* to get ELF II to solve special problems such as operating a more complex alarm system or controlling a printing press. Add *4k RAM* board and you can write longer programs, store more information and solve more sophisticated problems.

Expanded, ELF II is perfect for engineering, business, industrial, scientific and personal finance applications. No other small computer anywhere near ELF II's low price is backed by such an extensive research and development program.

The *ELF-BUG™ Monitor* is an extremely recent breakthrough that lets you debug programs with lightning speed because the key to debugging is to know what's inside the registers of the microprocessor and, instead of single stepping through your program, the *ELF-BUG™ Monitor*, utilizing break points, lets you display the entire contents of the registers on your TV screen at any point in your program. You find out immediately what's going on and can make any necessary changes. Programming is further simplified by displaying 24 bytes of RAM with full address, blinking cursor and auto scrolling. A must for serious programmers!

Netronics will soon be introducing the ELF II Color Graphics & Music System—more breakthroughs that ELF II owners will be the first to enjoy!

Now BASIC Makes Programming ELF II Even Easier!

Like all computers, ELF II understands only "machine language"—the language computers use to talk to each other. But, to make life easier for you, we've developed an ELF II *Tiny BASIC*. It talks to ELF II in machine language for you so that you can program ELF II with simple words that can be typed out on a keyboard such as PRINT, RUN and LOAD.

"Ask Now What Your Computer Can Do... But What Can It Do For YOU!"

Don't be trapped into buying a dinosaur simply because you can afford it and it's big. ELF II is more useful and more fun than "big name" computers that cost a lot more money.

With ELF II, you learn to write and run your own programs. You're never reduced to being a mere keypunch operator, working blindly with someone else's predeveloped software.

No matter what your specialty is, owning a computer which you really know how to use is sure to make you a leader. ELF II is the fastest way there is to get into computers. Order from the coupon below!

NOW AVAILABLE FOR ELF II—		SEND TODAY!	
<input type="checkbox"/> Tom Pittman's <i>Short Course On Microprocessor & Computer Programming</i> teaches you just about everything there is to know about ELF II or any RCA 1802 computer. Written in non-technical language, it's a learning breakthrough for engineers and laymen alike. \$5.00 postpaid!	<input type="checkbox"/> Deluxe metal cabinet for ASCII Keyboard, \$19.95 plus \$2.50 p&h.	<input type="checkbox"/> ELF II <i>Tiny BASIC</i> on cassette tape. Commands include SAVE, LOAD, +, -, *, /, (), 26 variables A-Z, LET, IF/THEN, INPUT, PRINT, GOTO, GOSUB, RETURN, END, REM, CLEAR, LIST, RUN, PLOT, PEEK, POKE. Comes fully documented and includes alphanumeric generator required to display alphanumeric characters directly on your TV screen without additional hardware. Also plays tick-tack-toe plus a drawing game that uses ELF II's hex keyboard as a joystick. 4k memory required. \$14.95 postpaid.	<input type="checkbox"/> Netronics R&D Ltd., Dept. 0000 333 Litchfield Road, Phone New Milford, CT 06776 (203) 354-9375
<input type="checkbox"/> Deluxe metal cabinet with plexiglas dust cover for ELF II, \$29.95 plus \$2.50 p&h.	<input type="checkbox"/> ELF II connects to the video input of your TV set. If you prefer to use your antenna terminals, order RF Modulator, \$8.95 postpaid.	<input type="checkbox"/> Tom Pittman's <i>Short Course on Tiny BASIC</i> for ELF II, \$5 postpaid.	<input type="checkbox"/> Yes! I want to run programs at home and have enclosed: <input type="checkbox"/> \$99.95 plus \$3 postage & handling for RCA COSMAC ELF II kit, <input type="checkbox"/> \$4.95 for power supply (required), <input type="checkbox"/> \$5 for RCA 1802 User's Manual, <input type="checkbox"/> \$5 for <i>Short Course on Microprocessor & Computer Programming</i> .
<input type="checkbox"/> GIANT BOARD™ kit with cassette I/O, RS 232-C/TTY I/O, 8-bit P I/O, decoders for 14 separate I/O instructions and a system monitor/editor, \$39.95 plus \$2 p&h.	<input type="checkbox"/> Kluge (Prototype) Board accepts up to 36 IC's. \$17.00 plus \$1 p&h.	<input type="checkbox"/> Expansion Power Supply (required when adding 4k RAM). \$34.95 plus \$2 p&h.	<input type="checkbox"/> I want mine wired and tested with power supply, RCA 1802 User's Manual and <i>Short Course</i> included for just \$149.95 plus \$3 p&h!
<input type="checkbox"/> 4k Static RAM kit. Addressable to any 4k page to 64k. \$89.95 plus \$3 p&h.	<input type="checkbox"/> Gold plated 86-pin connectors (one required for each plug-in board). \$5.70 postpaid.	<input type="checkbox"/> ELF-BUG™ Deluxe System Monitor on cassette tape. Allows displaying the contents of all registers on your TV at any point in your program. Also displays 24 bytes of memory with full addresses, blinking cursor and auto scrolling. A must for the serious programmer! \$14.95 postpaid.	<input type="checkbox"/> I am also enclosing payment (including postage & handling) for the items checked at the left.
<input type="checkbox"/> Professional ASCII Keyboard kit with 128 ASCII upper/lower case set, 96 printable characters, onboard regulator, parity, logic selection and choice of 4 handshaking signals to mate with almost any computer. \$64.95 plus \$2 p&h.		<input type="checkbox"/> Coming Soon: A-D, D-A Converter, Light Pen, Controller Board, Color Graphics & Music System...and more!	Total Enclosed (Conn. res. add tax) \$ <input type="checkbox"/> Check here if you are enclosing Money Order or Cashier's Check to expedite shipment.
		Call or write for wired prices!	USE YOUR <input type="checkbox"/> VISA <input type="checkbox"/> Master Charge (Interbank # _____)
			Account # _____ Exp. Date _____
			Signature _____
			PHONE ORDERS ACCEPTED (203) 354-9375
			Print Name _____
			Address _____
			City _____
			State _____ Zip _____
			DEALER INQUIRIES INVITED

Event Queue

October 5, Minicomputer and Microcomputer Seminar, Bluefield State College, Bluefield WV. This 1 day seminar and exhibition will feature business and engineering applications of minicomputers and microcomputers. The seminar will be conducted in the morning and afternoon and exhibits in the afternoon and evening. Contact Dr Alvin Hall, director of continuing education, Bluefield State College, Bluefield WV 24701, (304) 325-7102.

October 5-8, Midwest Personal Computing Show, Apparel Center's Expocenter, Chicago IL. More than 200 displays featuring the full spectrum of the latest personal computing developments are expected to be presented by manufacturers and distributors. The comprehensive program includes seminars, forums and practical application classes. Contact Midwest Personal Computing Exposition, ISCM, 222 W Adams St, Chicago IL 60606, (312) 263-4866.

October 9-13, Microcomputer Workshop, Carnegie-Mellon University, Pittsburgh PA. This intensive 5 day course is for individuals interested in applying microprocessor systems to a practical problem. Theory as well as practical experience will be emphasized in order to learn the capabilities and limitations of microcomputers and what it takes to apply them on the job. Contact Gerry Cohen, Post College Professional Education, Carnegie Institute of Technology, Carnegie-Mellon University, Schenley Park, Pittsburgh PA 15213, (412) 578-2207.

October 25-27, International Computer Retailers Conference, Chicago IL. The main purpose of this conference is to provide existing and future computer dealers with an in-depth look at the opportunities and pitfalls for developing sales and profits in computer retailing. For more information contact registration manager, Management Research

Associates, 60 East 42nd St, New York NY 10017, (212) 687-2560.

October 27-29, BizComp '78, Marriott Motor Hotel, Atlanta GA. BizComp '78 will highlight the small budget necessary for the independent business operator to be able to purchase an in-house computer system. All facets of the small business computer industry will be on display from the latest innovations in computers to business software and word processing, supplies and services. Contact Felsburg Associates Inc, 12203 Raritan Ln, POB 735, Bowie MD 20715, (301) 262-0305.

October 31-November 3, Tulsa Computer Conference, Skyline Sheraton East, Tulsa OK. Contact Tulsa Chapter Association for Systems Management, 4110 S 100 East Av, Suite 128, Tulsa OK 74145.

November 3-5, Third West Coast Computer Faire, Los Angeles Convention Center. This is a conference and exposition on personal computers for home, business and industry. For more details about this computer faire, write for a free copy of the Silicon Gulch Gazette. Contact Computer Faire, POB 1579, Palo Alto CA 94302, (415) 851-7075.

November 5-8, Computer Applications in Medical Care, Washington DC. This IEEE sponsored symposium on computer applications in medical care is designed to inform physicians and health care professionals about current and potential applications of computer technology to patient care; and to identify areas of future research and development that need to be addressed. Contact Abund O Wist, PhD, general chairman, Medical College of Virginia, (804) 770-4957.

November 6-8, Asilomar Conference on Circuits, Systems and Computers, Asilomar Hotel and Conference Grounds, Pacific Grove CA. This conference, sponsored by the IEEE Computer Society, will delve into areas such as circuit theory and design, communication and control systems, computer systems, computer aided design, etc. Contact Donald E Kirk, Electrical Engineering Dept, Naval Postgraduate School, Monterey CA 93940.

November 13-16, COMPSAC, The Palmer House, Chicago IL. The IEEE Computer Society's second international computer software and application conference. This conference will bring together computer practitioners, users and researchers to share their ideas, experiences and requirements for applications software, management techniques, and software development support, including automated techniques. Contact Wallace A Depp, executive director, Processor and Computer Software System Division, Bell Laboratories, Naperville IL 60540, (312) 690-2111.

HOLD IT! Anywhere you want it.

PanaVise tilts, turns, rotates. One quick turn of the control knob and you securely position your work exactly where you want it. Holds firmly but gently the most delicate electronic parts and P. C. boards.

Whether you're into building home electronics, trouble shooting, or professional servicing... you'll wonder how you got along without this modestly priced 'extra hand.'

Model 396 Wide Opening PanaVise shown. An ingenious variety of other interchangeable bases, holders and accessories also available. See your electronics distributor, or write for FREE brochure.

PANA VISE® Dept. CE1
5224 Chakemco St., South Gate, CA 90280



November 19-22, The 11th Annual Microprogramming Workshop, Asilomar Conference Ground, Pacific Grove CA. This workshop will provide a forum for the discussion and comparison of design techniques for firmware and for the supporting hardware. Informal interaction between groups working in similar research and application environments will highlight the topical session. For more information contact Dr Alice G Parker, Micro-11 program chairman, Dept Electrical Engineering, Carnegie-Mellon University, Pittsburgh PA 15213, (412) 578-2472.

November 27-December 1, Micro Programming Workshop, Lafayette IN. This 5 day hands-on advanced programming workshop is for individuals interested in developing skills required to plan, prepare, test and document 6800/6801 microprocessor applications software. Contact Jerilyn Williams, Wintek Corp, 902 N 9th St, Lafayette IN 47904.

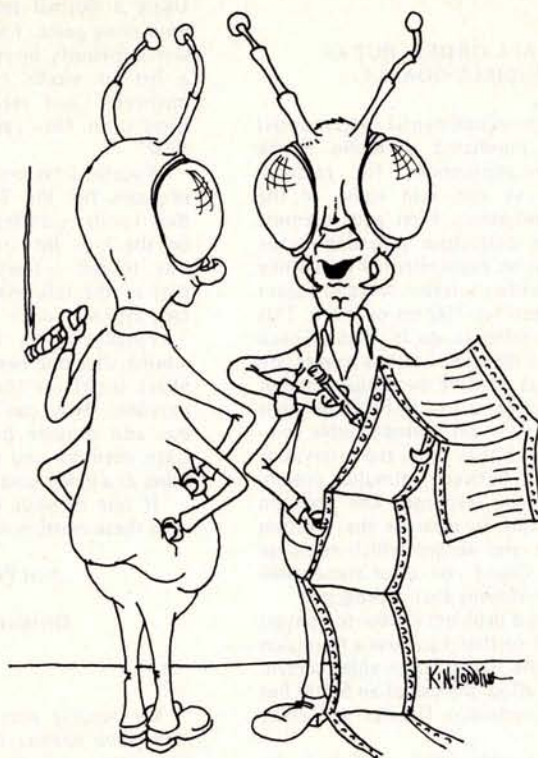
November 28-30, 9th Annual Canadian Computer Show, International Centre, Toronto CANADA. Products displayed at this show will include: computer and data processing equipment, supplies and services, including minicomputers, peripheral hardware and software, keypunch services, consulting and contract programming and timesharing. Contact Industrial Trade Shows of Canada, 36 Butterick Rd, Toronto Ontario M8W 3Z8, (416) 252-7791.

December 3-5, Ninth North American Computer Chess Championship, Sheraton Park Hotel, Washington DC. The 1978 annual meeting of the Association for Computing Machinery will be the site of this chess championship. This will be a 4 round Swiss style tournament with participants restricted to computers. Two rounds will be played on December 3 (1 PM and 7:30 PM), one on Monday (7:30 PM) and the last round on Tuesday (7:30 PM). Deadline for entries is October 20. Contact Prof M M Newborn, School of Computer Science, McGill University, Montreal Quebec H3A 2K6 CANADA.

December 12-14, Midcon/78, Dallas Convention Center, high technology electronics show and convention. Contact Electronic Conventions Inc, El Segundo CA, (800) 421-6816 (toll free).

December 13, Computer Networking Symposium. Sponsored by the IEEE Computer Society's Technical Committee on Computer Communications and the Institute for Computer Sciences and Technology of the National Bureau of Standards. This symposium will highlight papers of practical and research experiences concerning both computer and communication networks. Contact Dr George Cowan, Computer Sciences Corp, 6565 Arlington Blvd, Falls Church VA 22046. ■

Cartoon by
K N Lodding



"I think I found the human in your code."

Announcing . . .

SMALL BUSINESS COMPUTERS Magazine

The magazine for users and potential users of small business computer products and services

- The monthly magazine for businessmen in the process of purchasing or installing their first computers.
- The practical how-to publication written in non-technical language and stressing business applications for small computer systems. Each monthly issue includes:

FEATURE SURVEY REPORTS: Such as, *Software Packages for Small Business Applications*, *Small Manufacturing Systems*, *Inventory Control Systems*, *Microcomputer Business Applications*, and so on.

APPLICATION STORIES: Real-life examples of computer applications in the small business environment — capabilities, benefits, what to watch for, and much more of direct interest to the small businessman.

COMPUTER PROFILES • IDEAS AND INNOVATIONS • INFORMATIVE ADS

SPECIAL CHARTER SUBSCRIPTION
12 issues @ 50% off

Receive the next 12 issues of **Small Business Computer Magazine** for just \$9 . . . 50% off the cover price

Mail the coupon today to: **SMALL BUSINESS COMPUTERS Magazine**
33 Watchung Plaza • Montclair, NJ 07042

SMALL BUSINESS COMPUTERS Magazine • 33 Watchung Plaza • Montclair, NJ 07042

☐ YES. Enter my charter subscription at the 1/2 price cost of \$9 for 12 monthly issues.

☐ Check enclosed. ☐ Bill me.

Name _____

Organization _____

Address _____

City/State _____ Zip _____

A TALL ORDER, BUT IN PRINCIPLE DOABLE...

I am an experimental psychologist and have purchased a Radio Shack TRS-80 microprocessor for research purposes. I've run into some of the following problems. First and foremost I am having difficulties in setting up the following as an experiment. I would like to present either a letter, word or object on the screen for 100 ms or more. This is an easy thing to do in Radio Shack BASIC. The observer's task is to respond as quickly as possible by pushing one of two keys (either a 1 or 0) based on what was presented. I am having trouble computing the reaction time, the interval of time lapsing between stimulus presentation and the response. The program should be able to measure the reaction time in ms and record which response was made. Could you offer some assistance on developing such a program?

My second problem is how to convert my TRS-80 so that I can use a television instead of the Radio Shack video screen. This would allow the use of an S-100 bus and the Cromemco Dazzler for color video.

A third problem I've run into is the following: research-wise I am into work-

load measurement or dual task analysis. Using a normal television I've hooked up a pong game. I would like to present simultaneously by means of the TRS-80 a list of words for the observer to memorize and recall while the pong game is on. How can one go about doing this?

Fourth, I believe the cassette transfer program for the TRS-80 is limited in that I must transfer all the information on the tape into memory. Is there no way to run a search and only transfer part of the information on the cassette tape into memory?

Finally, I am interested in determining why one needs to buy the Radio Shack interfaces for memory expansion purposes. Why can't one buy an S-100 bus and mother board and additional static memory and accomplish the same thing at a lower cost?

If one of your readers can help me with these matters, please let me know.

Asst Prof Joseph Dalezman
New College of USF
Division of Natural Sciences
5700 Tamiami Tr
Sarasota FL 33580

We suggest that you get in touch with your nearest local computer club (see Clubs and Newsletters Directory, September 1978 BYTE, page 124).

TIMELY COMMENTS ON KIM

I just tried Robert Baker's KIMER (KIMER: A KIM-1 Timer, July 1978 BYTE, page 12). The clock operated but the calibration was not wide enough for my crystal.

Since the BIT instruction (line 0220) is used to test the timer status, the timer is not being used in the interrupt mode even though memory location 170F was loaded. The status of PB7 in this case has nothing to do with the timing. The major time delay is determined by the JSR SCANDS command which takes several milliseconds to perform. The timer status is tested on each return from SCANDS and so will always be some multiple of this time delay. The 1 ms calibration resolution cannot be obtained.

Here are a few ways the program could be fixed:

- The clock could be written as an interrupt routine. SCANDS would then be interrupted at any point in the subroutine.
- The number of JSR SCANDS commands could be counted in a loop which would be exited before the timer times out.
- The calibration could be reduced to EF or F0 and a longer fine adjustment used.

There have been several programs in the KIM-1 User Notes which illustrate the use of the timer. My version of a clock using the interrupt mode was printed in the March 1977 User Notes and also in *The First Book of KIM*. When using the program in the latter publication, go by the detailed listing since line 036A is incorrectly printed in the HEX DUMP.

I hope this is of help.

Charles H Parsons
80 Longview Rd
Monroe CT 06468

A SwTPC 6800 FIX

Here is a problem with the SwTPC 6800 and a fix that I haven't seen published before:

You can't reset the 6800 from a wait-for-interrupt state!

On the SwTPC MP-A board, the reset signal is transmitted to the MCM6800 chip via a DM8098 hexadecimal inverting three state buffer that is disabled when the processor enters a hold condition, as occurs after the execution of a WAI (3E hexadecimal) instruction. Once the 6800 is in the wait state, the reset signal generated by pushing the front panel reset button is stopped at the 8098 and never gets to the 6800 chip. A hardware fix is to break the traces to pins 2 and 3 of the 8098 (labeled IC15 on the SwTPC schematic and parts layout) and reroute the signal through a new, permanently enabled 8098. This

S-100 BUS COMPATIBLE. The EMM 1104 single card plug-in memory has been field tested and proven in a variety of systems including the Poly 88, IMSAI, MITS, COMPAL-80, TLD and CREMENCO. 16K BYTES ON A CARD. Convenient plug-in card, fully burned-in, tested and guaranteed by one of the industry's largest memory suppliers. NMOS STATIC RAM. The 4K static RAMs have been proven in applications ranging from single chip memories to IBM 370 add-on systems. They are fast, reliable, and no refresh cycle is required.

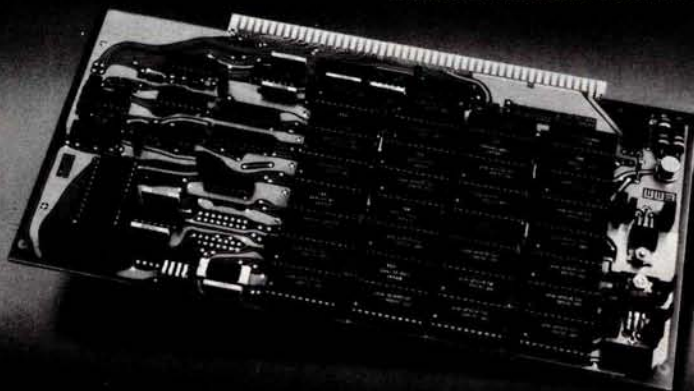
See your dealer, or contact us for complete information.

EMM

S-100 Bus Compatible Memory

16K bytes on a card

NMOS static RAM



Commercial Memory Products, a Division of Electronic Memories & Magnetics Corp.
12621 Chadron Avenue • Hawthorne, California 90250 • Telephone (213) 644-9881

permits the reset signal to reach the 6800 and you can then recall your 6800 from the "never-never land" it inhabits after performing a WAI.

I hope this will help anyone who's been annoyed by his SwTPC not responding to reset on mysterious occasions. I don't know if SwTPC fixed this on their new MP-A/2 board or not.

William R Hamblen
946 Evans Rd
Nashville TN 37204

PERSONAL COMPUTER COMMUNICATIONS NETWORK

I was certainly surprised by the degree of negativity expressed by Donald Newcomb, commenting on my article ("Personal Computers in a Communications Network," February 1978 BYTE, page 80) in the July 1978 BYTE. Perhaps some comment is in order.

First, I certainly do not wish to characterize a distributed communications network as anything less than highly complex. However, I do believe that in principle these complexities can be solved with a combination of sophisticated software and straightforward hardware. What makes a problem like this particularly difficult is that it is not isolated in the same way that the development of a language processor or operating system can be isolated. The first step in the creation of complicated software interfacing to a myriad of systems has to be communication in generalities. In that spirit I welcome Mr Newcomb's comments.

A second large point is made by Mr Newcomb that such a scheme runs contrary to the sensible regulation of the radio spectrum. Again, I acknowledge the difficulties, but I would like to mention that Dr John deMercado, head of Canada's Telecommunication Regulatory Service (analogous to the FCC) and an early developer of ARPA, characterized my article as "forward thinking" and has solicited my further opinions. Perhaps regulatory agencies are not quite as committed to maintaining the status quo as Mr Newcomb assumes.

On the specific question of "Why not use the phone?", I believe there are several responses. First, I agree that the phone system is fine for well-defined transfers between two individuals. But, there is a strong possibility that "Ma Bell" will soon begin charging data communications automatically at a different rate. Further, and this is the primary point of the article, new types of network activities will evolve if the environment is open-ended.

Finally, it is simply not true that unsupervised transmitters are rarely approved by the FCC; there are hundreds, if not several thousand, VHF and UHF repeaters operating in the amateur bands on a 24 hour basis with only periodic maintenance. When the FCC modified its regulations for commercial broadcasters to allow oper-

ation over a remote control link by nontechnical personnel, a clear statement was made that the Commission felt that the technology had progressed to the point that broadcasters should no longer be burdened by unnecessary rules. Yes, it was still possible that there might be situations where an on site technician would save the day, but the FCC seemed willing to take the risk in that case. I would prefer to think positively about the matter and hope that the FCC will view networks as another case where the benefit can outweigh the risk.

I am not certain that the network structure I have discussed is workable, but I do know that it can never work without a beginning. I am slowly working toward such a beginning, and I hope that others will as well.

Jeff Steinwedel
715 Reseda Dr, Apt 2
Sunnyvale CA 94087

PERSONAL COMPUTERS REQUIRE INSURANCE, TOO...

In shopping around for insurance on my house (renewal due in August), I discovered that none of three large insurance firms in this area would cover—specifically—a personal computer

of any significant value. None of the three would add any rider or offer any separate insurance coverage. The general consensus was that personal computers were considered no more than "hi-fi" equipment.

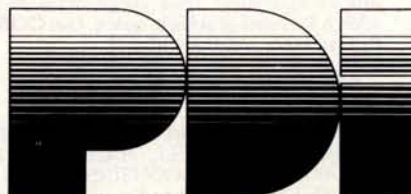
The specific area of insurance on a personal computer does not affect me yet since I am just starting to collect the components for a fairly large system. Medium to large microcomputer systems can run from \$3 K to \$8 K, the price of a new or nearly new auto.

Auto insurance is commonplace and there is a good reason for it. Only part of such insurance is devoted to the auto itself. Home insurance covers only part of personal property within a dwelling and is generally covered as half the amount of the dwelling itself. With the increase in overall prices, replacement of personal property will probably not cover a system of \$3 K or greater. This is especially true in a household having expensive relatives such as children.

Perhaps some reader might comment on insurance for such expensive devices?

Leonard H Anderson
10048 Lanark St
Sun Valley CA 91352

Where there is demand, the marketplace is sure to follow. Here is a niche for some enterprising underwriter.



TURN YOUR COMPUTER INTO A TEACHING MACHINE

The staff at Program Design did not learn about educational technology from a book—we wrote the book! We have been innovators in such teaching materials as programmed instruction and multimedia presentations. We also belong to that minority in education who actually test materials to see that people can learn from them.

Now Program Design brings this experience to the personal computer field. PDI is developing a line of educational and game programs for the whole family—from preschool child to adults.

Program Design educational software uses the computer's full teaching potential in exciting and effective ways. Programs are simple to use and memory efficient, and most important... they teach!

TAPES NOW AVAILABLE FOR THE TRS-80, PET, APPLE II

SAMPLE OUR SOFTWARE FOR \$2.00. Send us \$2.00, your name, address, and type of computer, and we'll send you a tape for your computer with actual samples of our programs.

Or circle our number on the reply card for a printed catalog.

Department 200 PROGRAM DESIGN, INC. 11 IDAR COURT GREENWICH, CONN 06830

REGIONAL BASIC CONTEST NOTES

Thank you for the nice article in the July 1978 issue of BYTE about the regional BASIC contest. I would like to make a couple corrections. First, Scott Parker is really Scott Porter, and the second man was Newton B White Jr of St Louis MO. Mark Grundler, the advisor, was unable to make the trip.

If the truth must be known, it was Newton, and not Porter, who led the team. He spent the weekend teaching BASIC to Scott, a situation which was a major handicap to the team's effort. I am happy to report that next year Grinnell will be able to field a team of four BASIC programmers.

White and Porter were members of Grinnell's FORTRAN team, which took second in this year's Midwest Regional FORTRAN contest and competed in the national FORTRAN contest. The other two members of the team were Bruce Albrecht and Steve McKelvey. Both Albrecht and McKelvey had strong performances to help the Grinnell team to a second place in its first outing. An interesting side note: at the FORTRAN regional, Porter taught White how to program in batch FORTRAN. Porter was a batch FORTRAN programmer and White was an interactive BASIC (redundant, but anything for a parallel construction) programmer, and both had the

faults of each style. This last summer White was working in some batch environments and, likewise, Porter is working mostly with interactive BASIC.

Since Grinnell is a liberal arts college without an applied math or computer science major, it was necessary to go looking among the other majors for programmers. The makeup of the team was a math/philosophy double major, a physics major, and a chemistry/math major. The blend of that group's problem solving ability was its major asset.

Scott Porter
Office of Computer Services
Grinnell College
Grinnell IA 50112

SOME ACES NEED ENGINEERING

After reading your magazine avidly for a couple of years we felt we could write to you and request the assistance of you and your readers. First a few words about our aims: the Awareness, Consciousness and Energy Studies Group (ACES Group) is devoted to the scientific study of the various manifestations and attributes of consciousness. Today the "consciousness explosion" is well under way and more and more people are practicing some sort of technique to bring about an expansion of their

awareness. Success becomes apparent through the subjective experience of joy and well-being. However, our society has long been indoctrinated with the need to provide objective proofs of every experience. We reasoned, as other groups have done, that an increase in awareness or a change in one's state of consciousness should have some corresponding effect on the body's physiology and therefore be physically detectable. Research during the last eight years shows that this is indeed the case. Stress is apparently the biggest hindrance to increased awareness. A reduction in stress shows itself in such ways as an increase in galvanic skin resistance (GSR), normalization of the blood pressure and increased alpha activity of the brain (to mention but a few). In order to study the effectiveness of different methods of reducing stress the ACES Group has developed its own equipment. Continuous monitoring of EEG, GSR, heart rate and body temperature is possible.

The outputs from our present monitoring equipment are eight analogue voltages which we wish to sample at not less than 100 times per second. This information should then be passed to our microprocessors for storage and analysis. For this purpose we have purchased two processors, one being the Digital Group Z-80 and the other the OSI Challenger; both have VDUs, four digital tape drives and in excess of 20 K memory.

Our main problem is interfacing the analogue monitoring equipment to our processors. Perhaps some of your readers with experience in analog to digital conversion could offer us some helpful suggestions. We welcome contact with anyone (professional or hobbyist) who has experience of biomedical monitoring systems and we are constantly on the lookout for methods of increasing the speed of computation. Another problem we have not yet resolved is that of designing a simple but accurate noninvasive method of monitoring blood pressure for use in a nonlab environment. Ideas, anybody?

Thank you for a most informative and interesting journal.

Graham Else, Ian Wales
ACES Group
Koenigsberger Straße 10
6107 Reinheim/Odenwald 1
WEST GERMANY

9900 DOWN UNDER

Living as we do on the other side of the world from where it is all happening on the microcomputer scene, we depend very heavily upon what we can read in the pages of BYTE and the other magazines. We can hardly tell you with what avid interest each issue of BYTE is perused (we get it shipped out to us airmail in order to get it as early as possible). Keep up the good work.

We ourselves use TMS-9900 based equipment, so every mention of this rare but wonderful beastie in your pages

JOIN THE COSMIC QUEST!

• Subscribe now to **COSMIC SEARCH** and share the provocative articles and latest news about mankind's most exciting venture, the search for intelligent life in space. Get **COSMIC SEARCH** starting with its first issue, out December 1.

• **COSMIC SEARCH** is for everyone who has ever wondered about life in the universe.

• Featured in the first issues of **COSMIC SEARCH** are articles by RONALD BRACEWELL, JOCELYN BELL BURNELL, ARTHUR C. CLARKE, NORMAN COUSINS, FRANK D. DRAKE, CARL SAGAN, WALTER SULLIVAN and many other world-famous persons.

• Will communication be by radio, gravity waves or neutrino beams? Are there cosmic languages? Will long transmission times make us cosmic archeologists? These and many other questions are discussed in **COSMIC SEARCH** in a popular, authoritative manner.

• Exclusive interviews with noted researchers, book reviews and an extensive book list for further reading are regular special features of **COSMIC SEARCH**.

• **COSMIC SEARCH** award papers on SETI topics by students and others under 30 will add new talent.

• **COSMIC SEARCH** is published 6 times per year. First issue January 1979. Out Dec. 1, 1978.

COSMIC SEARCH, Radio Observatory, P.O. Box 293, Delaware, Ohio 43015 Tel. 614-363-1597

Single copies \$2.50 (\$15 a year). Subscription rate: \$12 for 1 year, \$22 for 2 years.

SPECIAL PRE-PUBLICATION rate \$10 for 1 year, \$18 for 2 years

SPECIAL PREPAID PRE-PUBLICATION rate \$8 for 1 year, \$15 for 2 years

Enter my subscription to **COSMIC SEARCH**, Box 293, Delaware, Ohio 43015
At special pre-publication rate: \$10 for 1 year ☐ \$18 for 2 years ☐ and bill me later.
At special PREPAID pre-publication rate: \$8 for 1 year ☐ \$15 for 2 years ☐
☐ Check or Money Order enclosed ☐ MASTERCARD ☐ VISA (BankAmericard)

Account # _____ MC Interbank # _____ Exp. date _____

Name _____

Address _____

City _____ State _____ Zip _____

1976/1977

Cover Price *
plus postage
and handling**BYTE****Back Issues for sale**

The following issues available:

'76	'77	'78
July	March	January
August	May	February
October	June	March
November	July	April
December	August	May
	September	June
	October	July
	November	August
	December	September

* Cover price for all issues thru August 1977 is \$1.50 plus \$.25 postage and handling (\$3.50 total foreign). September '77 thru current '78 issues are \$2.00 plus \$.50 postage and handling (\$4.00 total foreign).

Send requests with payment to: **BYTE Magazine**
70 Main Street
Peterborough, NH 03458
Attn: Back Issues

THE INCREDIBLE LEARNING MACHINE

WHATSIT™

(Wow! How'd All That Stuff get In There?)

- She's a Conversational Query System!
- She's an Indexing/Filing System!
- She's a 'Data Base Manager' for your Microcomputer!

"One of the first software products of the
New Computer Age..."

—Ted Nelson, author of
Computer Lib/Dream Machines

Mail to: **Information Unlimited**
331 W. 75th Place, Suite 2-1
Merrillville, Indiana 46410
219- 769-9280

- ☐ Model CP-1 for C-Basic (requires 40K RAM) \$125
- ☐ Model NS3 for North Star Basic (requires 24K RAM) \$75
- ☐ WHATSIT Manual \$25
- ☐ Quantity discount schedule for Dealers.
- ☐ More information (I'm running _____ disc BASIC
on a _____ computer)



A CREATION OF
COMPUTER HEADWARE™

NEW SOFTWARE AVAILABLE FOR

NORTH STAR ★ COMPUTERS

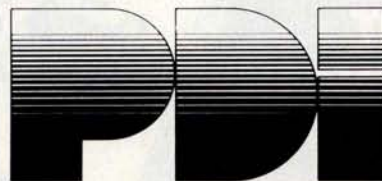
The following software is now being offered for use on
the North Star disk systems and Horizon Computers.

	From \$145
CP/M™ FDOS and Utilities	\$400
Microsoft FORTRAN-80	\$625
Microsoft COBOL-80	\$300
Microsoft Disk Extended BASIC	\$99
Xitan SUPER BASIC (A3)	\$159
Xitan DISK BASIC (A3+)	\$69
Xitan Z-TEL Text Editor (A3, A3+)	N/A
Xitan Text Output Processor (A3, A3+)	\$69
Xitan Macro ASSEMBLER (A3, A3+)	\$89
Xitan Z-BUG (A3+)	\$69
Xitan LINKER (A3+)	\$249
Xitan Package A3 (as keyed above)	\$409
Xitan Package A3+ (as keyed above)	\$349
Xitan Fortran IV	\$95
CBASIC Compiler/Interpreter BASIC	\$100
MAC Macro Assembler	\$85
SID Symbolic Instruction Debugger	\$85
TEX Text Formatter	\$30
BASIC-E Compiler/Interpreter BASIC	\$750
Accounts Receivable	\$79
NAD Name & Address Processor	\$95
QSORT Disk File Sort/Merge Utility	

Available from computer stores nationwide or order
direct from:

LIFEBOAT ASSOCIATES

164 W. 83rd Street
New York, N.Y. 10024
(212) 580-0082



PROGRAMS FOR KIDS

Educational and fun. Developed by educational designers.
Teach essential skills in an exciting new way.

PRESCHOOL IQ BUILDER—Helps 3-to-6-year-olds develop
vital intellectual skills needed to do well in school.
7 programs + Guide TRS-80 Levels I & II, PET, Apple II

MEMORY BUILDER: CONCENTRATION—Educational
games to help children 6 and up improve memory.
3 games + Guide Apple II & PET.

STORY BUILDER/WORD MASTER—games that teach
grammar and vocabulary to children 9 and up.
4 games + Guide TRS-80 Level II, PET, Apple II

GRAPH BUILDER—teaches children 10 and up to read
graphs. Includes games.
11 programs + Guide TRS-80 Levels I & II

Each title \$9.50 plus \$100 shipping
VISA & Master Charge accepted (include number, exp. date,
MC include digits above name)

Department 80
Program Design, Inc., 11 Idar Court, Greenwich, Conn. 06830

evokes a heightened response of interest.

I would like to get in touch with users of 9900-based systems in the States so we can exchange notes, ideas, etc.

B Ward Powers
IMPACT Ltd
POB 177
Petersham NSW 2049
AUSTRALIA

A FEW NOTES FROM A CANADIAN READER

1. Items move faster through our mail system if you include the postal code. This is that funny series of letters and numbers that appear above, after the province. My postal code is V6S 1B2.

Note that the format is letter, number, letter, *space*, number, letter, number. Although this may not be quite as simple as your ZIP code, it does mean that a letter addressed:

Andrew Bates,
Canada V6S 1B2

will be delivered to me. The postal code pinpoints the side of the street in a residential block or even the floor of a building in a business district. How's that for precision!

Software writers take note: we Canadians need at *least* six characters for the postal code and four characters for the province (state). And if you are going to check the ZIP for all numbers, please put the check in a subroutine so we can replace it with a suitable check

for our postal code.

2. WATS lines do not cross international borders (at least that is what the telephone operator told me). This means that we people in Canada can't phone you for free like everyone else in the United States can. How about letting your people accept collect phone calls from Canada, only so we can use A G Bell's famous invention, instead of having to spend hours slugging away at the typewriter and then waiting for what is an erratic mail service on both sides of the border?

3. Another small request for software writers who are mailing things to Canada: if your package costs \$75 and is distributed on North Star diskette, for instance, please mark the customs declaration as:

DISKETTE \$6
PRINTED MATTER \$69

If you mark the price as \$75, we end up paying duty on the *diskette* as though it cost \$75. Printed matter comes across the border duty free and there is no duty on an item of less than \$10 value.

Andrew Bates
3261 W 18th Av
Vancouver BC
CANADA V6S 1B2

EROM CONFUSION: THE 2716

Elaborating on David Marke's letter (July 1978 BYTE, page 11), it seems to me that Intel bears the blame for the 2716 single voltage versus 3 voltage supply EROM confusion.

Intel gave their new generation 16 K part an old generation number. They have essentially acknowledged the confusion by introducing the 2758, a 1 K by 8 EROM like the 2708, but single

I suggest we use the Texas Instruments part number, 2516, when referring to either the TI part or the Intel 2716.

Al Anway
Poly Micro Systems Inc
2616 Lansing Dr SW
Roanoke VA 24015

IN SEARCH OF SPEED

There are some things that retard communication between people having no contradictory interests, eg: vendor and customer. Vendor has something to sell. Customer finds something to purchase.

One of these retarding things is a slow answer to a request. Surface mail for Sweden travels the distance from the United States in six weeks. Air mail, the same distance, arrives within a week.

So please, if at all possible, use air mail for overseas requests.

Hans Nordström
Tingvallavägen 7F
S-195 00 Märsta
SWEDEN

WHAT WE KNOW ABOUT COMPUTERS COULD SAVE YOU MONEY

- Finally, an objective look at the top 24 micro systems sold throughout the world!
- Honest pros and cons of each system, plus a straightforward look at the micro computer industry as it relates to you!
- Written in plain English for the layman. If you are considering the purchase of a personal computer, this book will save you money!

SAMPLE CONTENTS

- Don't Get Hung up on the Chips • Now, about the hardware • What? No software! • Helpful suggestions before spending money

READ UP ON COMPUTERS BEFORE YOU
PUT YOUR MONEY DOWN!

ONLY \$4.50 PER VOLUME

TELEPHONE TOLL FREE:

800-327-6543—

or send this coupon!

SCIENTIFIC RESEARCH
P.O. Box 490099 B Key Biscayne, Florida 33149
Please send me (quantity) _____ books I am enclosing \$4.50
per book plus \$1.00 postage and handling charge.
Master Charge or Visa _____ Account No _____
Expiration Date _____
NAME _____ ADDRESS _____ CITY _____ STATE _____ ZIP _____

ONLY
\$4.50
PER VOLUME

NEW SOFTWARE AVAILABLE FOR **MICROPOLIS™**

The following software is now being offered for use on the Micropolis MetaFloppy and MacroFloppy disk systems.

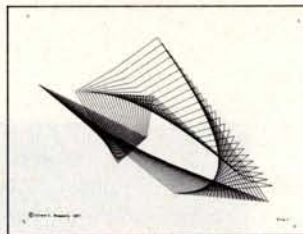
	From \$145
CP/M™ FDOS and Utilities	\$400
Microsoft FORTRAN-80	\$625
Microsoft COBOL-80	\$300
Microsoft Disk Extended BASIC	\$99
Xitan SUPER BASIC (A3)	\$159
Xitan DISK BASIC (A3+)	\$69
Xitan Z-TEL Text Editor (A3, A3+)	N/A
Xitan Text Output Processor (A3, A3+)	\$69
Xitan Macro ASSEMBLER (A3, A3+)	\$89
Xitan Z-BUG (A3+)	\$69
Xitan LINKER (A3+)	\$249
Xitan Package A3 (as keyed above)	\$409
Xitan Package A3+ (as keyed above)	\$349
Xitan Fortran IV	\$1,250
Xitan DATA BASE MANAGEMENT SYSTEM	\$95
CBASIC Compiler/Interpreter BASIC	\$100
MAC Macro Assembler	\$85
SID Symbolic Instruction Debugger	\$85
TEX Text Formatter	\$30
BASIC-E Compiler/Interpreter BASIC	\$995
General Ledger	\$750
Accounts Receivable	\$79
NAD Name & Address Processor	\$95
QSORT Disk File Sort/Merge Utility	

Available from computer stores nationwide or order direct from:

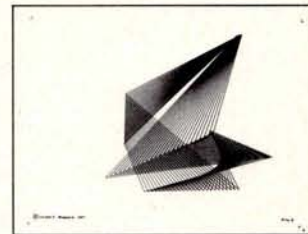
LIFEBOAT ASSOCIATES

164 W. 83rd Street
New York, N.Y. 10024
(212) 580-0082

Art-by-Computer™ is here!



File 1



File 3

Black-on-white, 9 3/4H by 12 3/4W reproductions of computer generated designs. See Jan 78 Byte or phone or write for a brochure. Set of 12: \$20.00; singles \$2.00 each. Minimum order: 2 prints. Orders less than \$10.00 and all orders from outside continental U.S. add \$2.00 postage and handling. Payment must be in U.S. dollars. California residents add 6% sales tax. Send check or money order to:

Leland C. Sheppard
PO Box 60051, Dept. B
Sunnyvale, California 94086.

Also available at selected retail outlets.

© LCS, 1978.

ATTENTION SWTPC DISC SYSTEM USERS

All Ed Smith's **M6800 SOFTWARE TOOLS**

are now available in mini-FLEX format as well as Smoke Signal Broadcasting format. See July BYTE for diskette media prices. Disc users specify SSB OR SWTPCO.

● **M6800 RELOCATING ASSEMBLER AND LINKING LOADER** software for rapid program development and debugging. Some of its features are RELOCATABLE CODE—FULL ALPHABETIZED CROSS REFERENCE LISTING—BOTH GLOBAL AND LOCAL LABELS—LISTING OF EXECUTION TIME—RELATIVE BRANCH TARGET ADDRESS—ES-8 CHARACTER LABELS—CORESIDENT EDITOR—ENGLISH ERROR MESSAGES—80 COLUMN LISTING USING PR-40—etc.

M68AS . . . cassette \$50.00
M68AS-D . . . minifloppy \$55.95

● **M6800 RELOCATABLE DISASSEMBLER AND SEGMENTED SOURCE TEXT GENERATOR.** This software tool enables you to modify and adapt those large sized object programs and re-assemble them on your system without requiring enormous memory. This program will produce segmented source text files with all the external linkage information required for re-assembly using the above Relocating Assembler.

M68RS . . . cassette \$35.00
M68RS-D . . . minifloppy \$40.95

● **M68ASPK** Above two programs on single diskette \$85.00

● The above two programs are furnished in relocatable formatted code with instruction manuals and commented assembly listings. The loader is also supplied in standard MIKBUG format on cassette or as a binary file on disc to initially load the linking loader at any desired address.

● The linking loader is also available in EPROM on two 2708's for \$45.00. Specify desired address and version, i.e. cassette, FLEX or SSB.

8-M-I-T-H-B-U-G

FIRMWARE from Ed Smith's SOFTWARE WORKS

● A 2k Monitor Disassembler-Trace Debugging Tool in EPROM. Use as stand-alone monitor or as an adjunct to your Smartbug or Swtbug. Requires ACIA as control port. Provides all the monitor commands (23) you could ever ask for, plus the convenience of a mnemonic disassembler and single stepping disassembler trace display. Interactive use of single or dual breakpoint with trace pickup at breakpoint, plus many new monitor functions and sub-routines, makes this a super tool you will love to work with. Uses location \$F800 to \$FFFF. Furnished on two 2708's or one 2716. Includes Manual and commented assembly listing. Specify ACIA location and present monitor in order to keep \$A000 RAM compatibility.

SMITHBUG ON 2708's \$60.00
SMITHBUG ON 2716 \$70.00

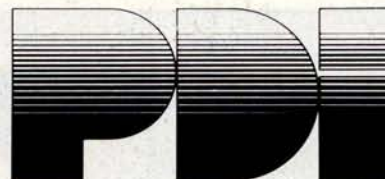
● Get under Ed Smith's Software RUG (Relocating assembler Users Group). All RUG members will have use of a building software support library in relocatable format. Upcoming items are a Floating Point package and a Trig package.

● Order direct by check. Specify system configuration if other than SwtPco. California residents add 6% sales tax.

Ed Smith's **SOFTWARE WORKS**

P.O. Box 339, Redondo Beach, CA 90277, (213) 373-3350

Circle 324 on inquiry card.



HAVING TROUBLE LEARNING BASIC?

STEP BY STEP is an interactive computer course in BASIC that's easy even for beginners. Program Design has developed a logical, structured approach that really works. At the end of STEP BY STEP, you'll be writing programs using all important BASIC commands.

AVAILABLE FOR TRS-80 LEVELS I & II, PET, AND APPLE II

STEP BY STEP:

- presents material in small steps
- provides guided programming practice in each lesson
- tests your progress after each lesson
- teaches actual program writing, not just terms
- is suitable for anyone from junior high up, regardless of math background

10 lessons with quizzes, plus final test 3 cassettes
80 page Workbook \$29.95 plus \$1.00 shipping

VISA & Master Charge accepted (include number, exp. date, MC include digits above name)

Department 400
Program Design, Inc., 11 Idar Court, Greenwich, Conn. 06830

Circle 307 on inquiry card.

In the March 1977 BYTE, page 130, we announced a bar code reader contest in which readers were asked to decode a page of Paperbyte™ bar code copy using a reading technique of their own design. Winning points for originality was this entry by Campbell Farnell and Glen Seeds. While the method described here is not the intended method of reading the codes, it shows what is perhaps the world's least expensive drum read only memory as a serendipitous side-light to printing software on paper.

A Novel Bar Code Reader

Campbell Farnell and Glen Seeds
RR #1
Seeley's Bay, Ontario
CANADA K0H 2N0

Technical Description

Our Paperbyte™ bar code reader consists of three parts: (1) an old turntable set at 33 RPM on which sits the page to be read, attached to a 48 ounce juice can; (2) a read head with light source which is attached to a parallelogram assembly to allow the head to be moved up and down while remaining level; (3) an interface that brings the output of the phototransistor in the read head up to a 5 V digital level.

The Turntable and Juice Can

A juice can with one end removed supports the page while the turntable (a junked one obtained for free) rotates the page. For purposes of this contest we simply taped the page to the can. However, for everyday use some sort of clip-on system would be reasonable. Even four small magnets should work to hold the paper on the can. Centering the juice can on the turntable was no problem since the plastic record mat on the turntable platter has a series of raised concentric circles on it. On turntables lacking this feature it is an easy matter to draw a circle on a piece of cardboard placed on the turntable to indicate the proper position. In use, we found that the can did not tend to wander as the turntable went around.

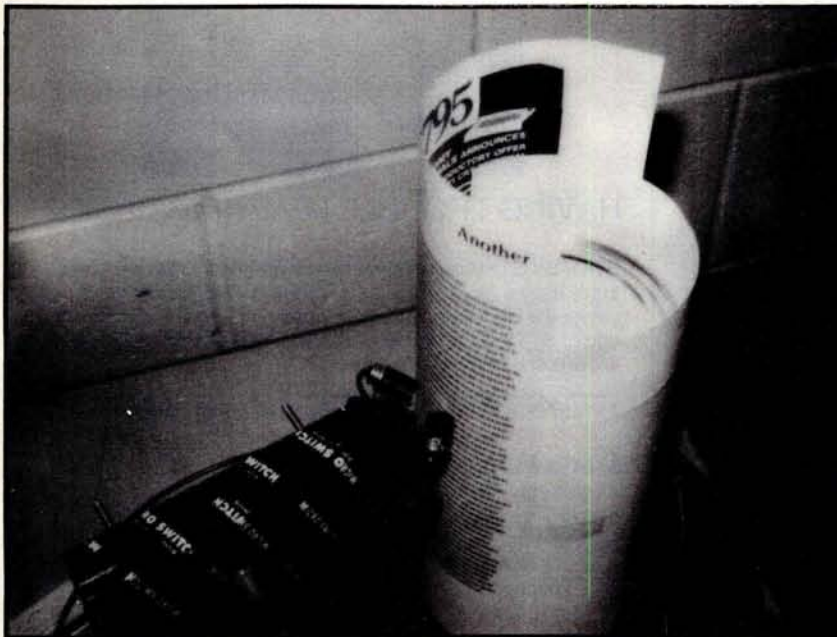


Photo 1: The authors' bar code reader entry. The page of bar code is shown taped to a fruit juice can sitting on a phonograph turntable. The reading arm, shown at bottom left, features two small lamps and a focusing lens. Light reflected from the rotating bar code energizes a phototransistor at the other end of the reading arm. The signal is then translated into binary voltage levels and sent to the computer's input port.

BLABBERWA
 CKYww Twas brilliant
 and the slimy toads
 wDid go and gander i
 n the wave:wALL mist
 y were the bluish gr
 oves. wAnd the mole r
 uns outraged.ww"Bewa
 re the Blabberwack,
 my son! wThe words th
 at bite, the barbs t
 hat catch! wBeware th
 e mynah bird, and sh
 unwThe frivolous Ben
 dersnitch! "wwHe took
 his vicious words i
 n hand:wLong time th
 e slanderous foe he
 sought--wSo remained
 he by the titling t
 ree, wAnd stood awhile
 e in thought. wwAnd,
 as in malign thought
 he stood, wThe Blabb
 erwack, with eyes of
 flame, wCame whistli
 ng through the state
 ly wood, wAnd bluffed
 as it came! wwOne, t
 wo!, One, two! And t
 hrough and throughwT
 he vicious blade wen
 t crushing--crash! wHe
 left it dead, and w
 ith its headwHe went
 galloping back. ww"A
 nd hast thou slain t
 he Blabberwack? wCome
 to my arms, my boun
 cing boy! wO fabulous
 day! Hoorah! Hooray
 !"wHe chortled in hi
 s joy. ww Twas brilli
 ant and the slimy to
 adswDid go and gande
 r in the wave:wAll m
 isty were the bluish
 groves. wAnd the mol
 e runs outraged.w

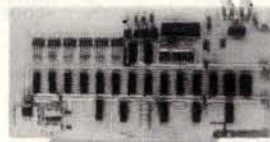
Listing 1: Walter Banks' "Blabberwacky." The output was produced on a printer that does not respond to ASCII control characters, so the line feeds were printed as lower case ws.

The Read Head

The read head consists of a 2N5777 phototransistor, a lens and two penlight bulbs. These items were mounted on a block of wood. The lens we used was a 25 mm lens from an 8 mm movie projector, but any lens of similar focal length can be used because color rendition and edge focus are of no concern. The phototransistor was mounted on its side rather than vertically so that the lens effect of the T092 package would tend to pick up more of one particular bar rather than picking up adjacent bars. It was also covered with black tape on all sides but the front, to exclude stray light.



FREE 10 DAY TRIAL* New and Unusual Sounds For Your Computer



*If after using the unit you don't agree with our claims merely return the system postage pre-paid and insured, and we will promptly refund your purchase price.

\$149⁹⁵

The Microsounder is an S-100 compatible sound generating card that can be programmed in BASIC or assembly language. Three to five lines of code generates such sounds as: organ music, sirens, phasers, shotguns, explosions, trains, bird calls, helicopters, race cars, airplanes, machine guns, barking dogs, and many thousands more.

Now you can hear the sounds of phasers and photon torpedos in Star Trek. Practice Morse code recognition, create your own unique sounds and songs, or use the Microsounder for a signaling device. Only a few minutes of time is needed to patch the sound code into existing programs.

The Microsounder is assembled and tested, and comes complete with sample code, two game programs, and a utility program for creating almost any sound. Send your orders (Master Charge, Visa, cashier's or personal check to:

BOOTSTRAP ENTERPRISES INC.

100 North Central Exprwy.,
 Richardson, TX 75080
 (214) 238-9262



Name _____
 Address _____
 City _____ State _____ Zip _____
 Add \$4.95 for Postage & Handling
☐ Check or Money Order Enclosed Exp. Date _____
☐ VISA # _____
☐ MASTERCHARGE # _____

Specials!!

Specials!!

	LIST PRICE	Special PRICE
Problem Solver 16 K Static Ram (A & T) at 250 nsec	\$ 499.00	\$ 349.30
Micropolis Model 1053 Mod II Dual Disk System (A & T)	\$1895.00	\$1610.75
Meca Dual Drive Cassette System (A & T)	\$ 845.00	\$ 699.00
Solid State Music Video Interface Kit (A & T)	\$ 149.95	\$ 119.95

PRICES QUOTED INCLUDE 10% CASH DISCOUNT!

Exclusive Dealer for Meca in
 New Jersey - New York - Connecticut - Delaware!

COMPUTER LAB OF NEW JERSEY

141 Route 46
 Budd Lake, NJ 07828
 (201) 691-1984

ALL PRODUCTS 10% OFF LIST! PLUS 5% ADDITIONAL FOR CASH!

Mail and phone orders accepted, subject to available quantities. Prices and specifications subject to change without notice. Shipping charges extra. NJ residents add 5% sales tax. Master Charge and BankAmericard/VISA accepted.

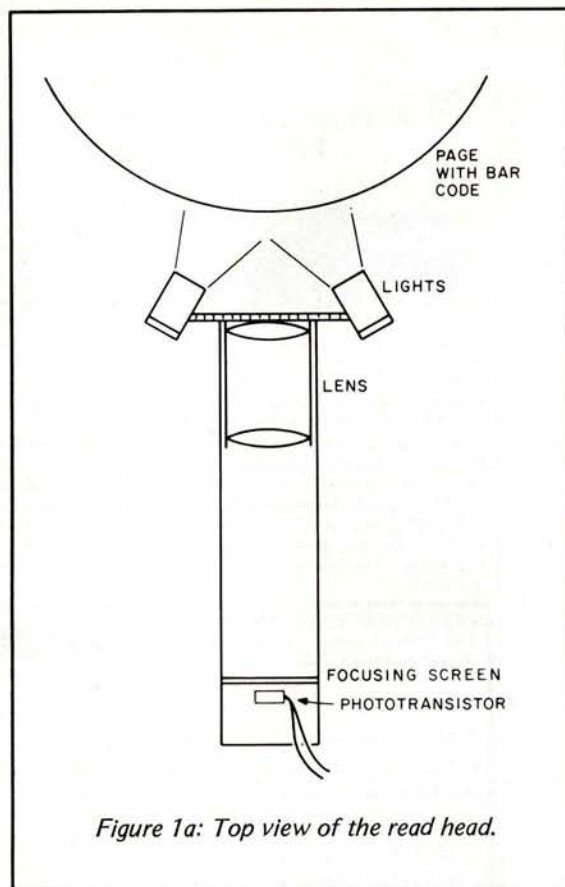


Figure 1a: Top view of the read head.

The phototransistor was mounted peeking through some translucent tape which served as a focusing screen. The entire assembly was covered on the top and sides with a cardboard hood to exclude ambient light. The block of wood on which the read head was assembled was attached to two strips of wood, which were in turn attached

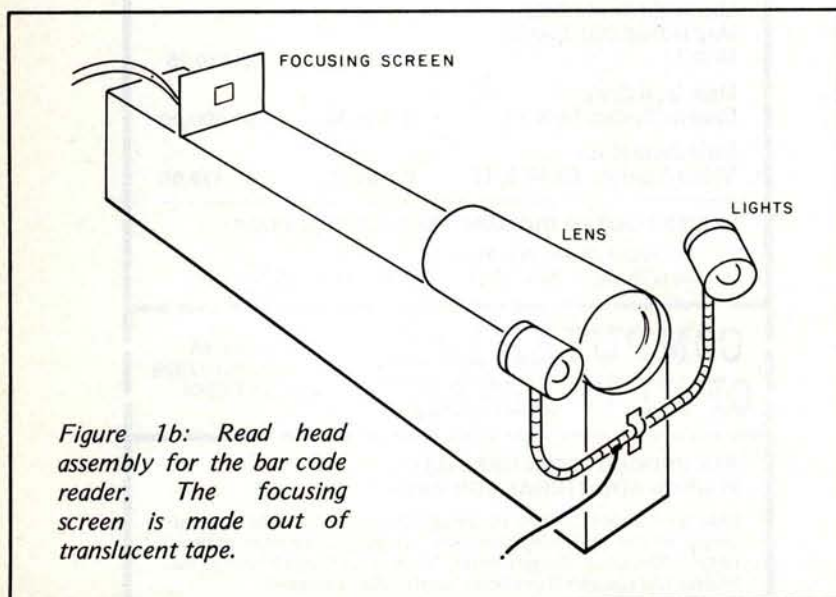


Figure 1b: Read head assembly for the bar code reader. The focusing screen is made out of translucent tape.

to a base. This allows us to move the read head up and down while keeping it level.

The system was focused by moving the the base plate back and forth. A pair of type 222 prefocused penlite bulbs were mounted on either side of the lens and angled toward the bar being read. These bulbs are rated at 2.25 V; when wired in series they ran fine from the +5 V used for the logic, and drew 250 mA. A strip of ordinary black tape was wrapped around each bulb to prevent stray light from reaching the lens.

The Interface

The interface consists of a 500 k trimpot and a 74C04 CMOS hex inverter, as shown in figure 2a. Since the input port on our computer accepts CMOS logic, no further buffering was required. In order to drive standard TTL logic, the remaining CMOS inverters can be used or a transistor and two resistors (see figure 2b). This interface owes its simplicity to the high gain of the 2N5777 and the very high input impedance of the CMOS chip.

Calibration and Use

The calibration and use of this system are simple. Once physically assembled, the read head is moved close to the page to be read and is adjusted to bring the page into focus on the screen. This requires some experimenting at first. The phototransistor is positioned about 3 inches behind the lens, which provides a magnification of about 2. To adjust the sensitivity, focus the head and then, with the turntable turned off, turn the platter until the read head faces plain white paper. Observe the voltage at the collector of the phototransistor at point A in figure 2a. With a lot of light from the white paper on the phototransistor, and the potentiometer set to its highest value, this point is pulled low by the transistor. The potentiometer is adjusted until it just pulls the line high and then it is backed off just enough to let the line go low. This completes the sensitivity adjustment. While spinning the turntable by hand, you can watch the output of the transistor alternate. In our case we had a voltage swing of about 4 V at point A.

In order to actually read the lines, the output of the CMOS interface is hooked to a single bit of an input port on the computer. The computer then waits for a line to start, times the light and the dark times, and decides if the bit is a one or a zero. The computer program itself is straightforward, if somewhat long-winded. The computer we used is an MCM/800 manufactured by Micro Computer Machines, Kingston, Ontario. The processor is a discrete bipolar affair that has

the same instruction set as the 8008, with a few enhancements.

Notes and Conclusions

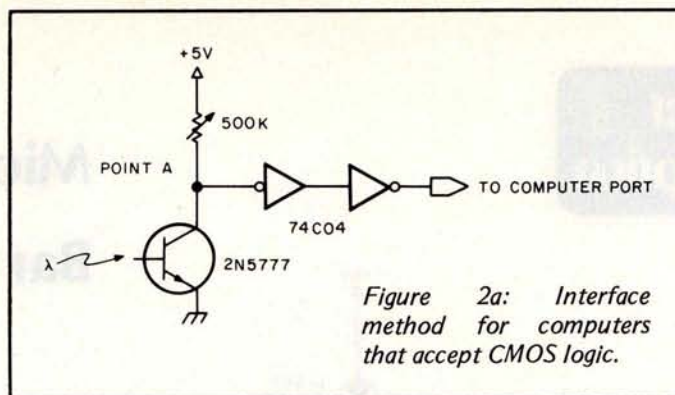
Because this reader was produced and documented within a period of 48 hours, we did not have time to go through many revisions. From our experiences we gained a considerable amount of information that could be applied to the development of an improved reader.

When we set out to build the reader, we assumed that the mechanical portion would be easy and that most difficulties would be with the electronics. This was not the case. Although the entire electronic portion of our reader turned out to be extremely simple, (it cost under four dollars), it performed flawlessly. We have had no difficulties with it and we do not suggest any modifications. In one test performed while checking the reader, we read a single line 255 times without glitches.

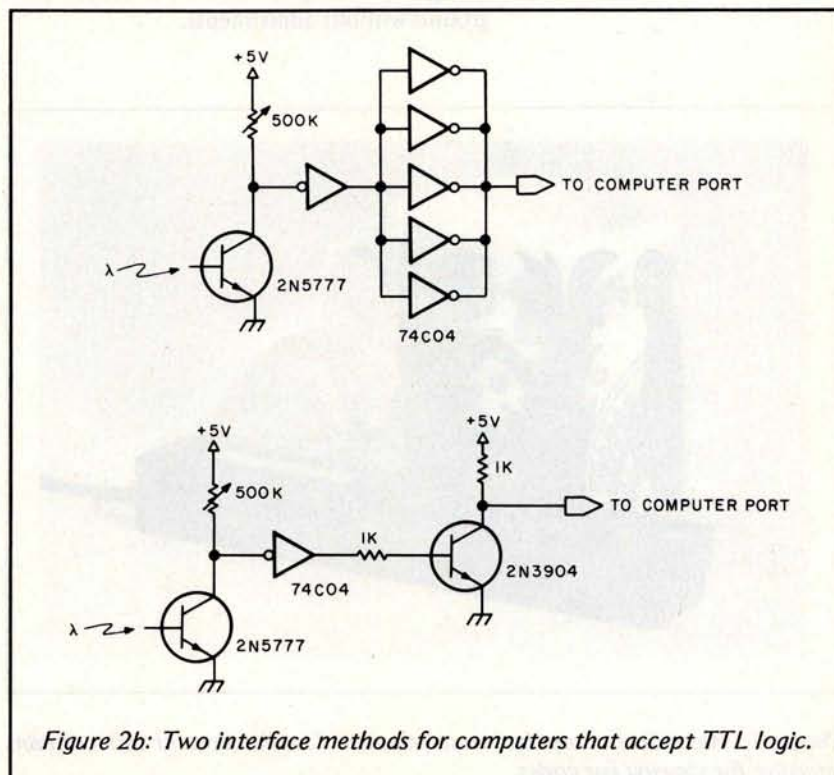
The mechanical portions of the reader, however, could stand some improvements. Our most serious problem was keeping the read head focused on the page. The juice can was not perfectly round, particularly at the end with the top removed, and minor variations tended to put things out of focus at one end or the other of the line. The can had to be centered exactly on the turntable or similar problems would arise. Anyone seriously considering this approach might use a full unopened juice can, remove the turntable spindle and glue the can (after careful centering) to the turntable.

Probably the weakest link in the design is the head support mechanism, which we do not recommend. Given some sort of reasonably round support for the page, it would be nice to have the head permanently mounted on a slide arrangement so it could be focused once and then slid back and forth in front of the page being read. If you standardize on a fixed spacing for the lines, it would be possible to add a detent mechanism so that the head would stop only in the middle of lines. It would be reasonably easy to add some automatic method of advancing the head.

We feel we should also mention something that we discovered in the course of testing our reader. It applies to bar code readers of our type and to wands as well. As Keith Regli points out in his article "Software for Reading Bar Codes" (December 1976 BYTE, page 18), readers will tend to read light and dark areas of equal width as being somewhat different. Our reader was no exception, and in fact the amount of bias shifted from one part of the line to



another as the focus changed a bit. This caused quite a bit of jitter in the light time to dark time ratios, which are, in theory, what is used to separate 1s from 0s. However, we also observed something that is of considerable use: while the light to dark ratio jittered a lot on our reader, the timing of a full bit (light time plus dark time) was very stable. This suggests an improved software decoding routine in which you can compare the total time (light plus dark) for the current bit with the total time of the previous bit. Since you know if the previous bit is a 1 or 0, you can determine what this next bit is by appropriate comparison. This automatically compensates for the jitter in the light to dark ratio introduced by the reader, and also allows tracking on wands where the time will tend to wander a lot. ■



Micro-Scan Corp Bar Code Scanner

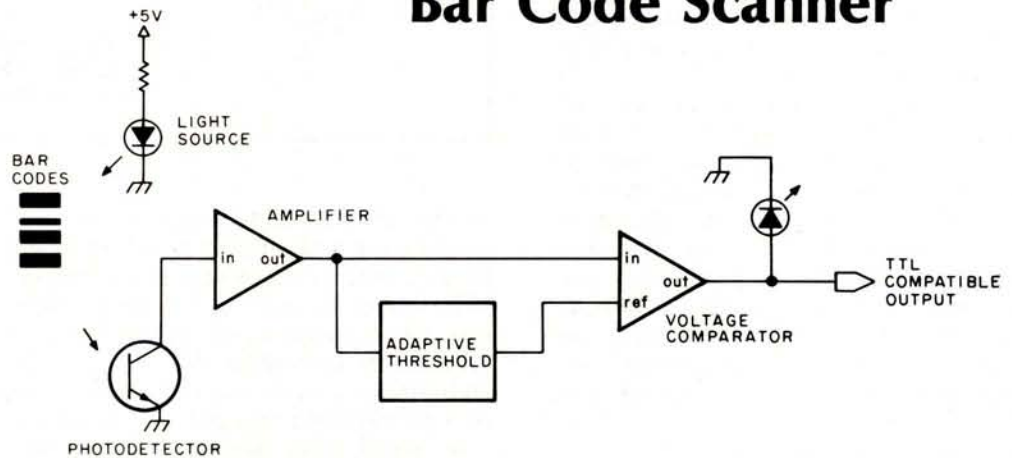


Figure 1: Functional diagram of the BCS-1 hand held bar code scanner.

Frederick L Merkwitz
Micro-Scan Corp
POB 705
Natick MA 01760

The Data-Scan bar code scanner is designed for reading bar codes such as those presented in BYTE. The scanner can read degraded bar codes (such as Xeroxed patterns) as well as black bars on a gray background or gray bars on a white background without adjustments.

Functionally, the scanner specifications include: a scanning rate of 10 to 40 inches (25.4 to 101 cm) per second, power supply requirements of +12 V at 50 mA, and a transistor-transistor logic (TTL) compatible output in the form of a serial bit stream suitable for application to an input port.

The scanner consists of a light source, a phototransistor and the signal conditioning circuitry shown in figure 1. The light source, an infrared light emitting diode (LED), illuminates the surface of the paper through an aperture slightly smaller than the area of a unit width bar. Viewing this same surface area through the aperture is a phototransistor. The transmitted and reflected light either passes directly through the aperture or travels through a bifurcated fiber optic cable as described in my article, "Signal Processing for Optical Bar Code Scanning," December 1976 BYTE, page 77.

As reflected light impinges on the photo surface of the detector, a light induced current of several hundred nanoamperes flows into the collector. This minute current is amplified, converted to a voltage, and applied to one input of the voltage comparator. Simultaneously, the average of the peak to peak output voltage is applied to the reference input of the comparator. Those voltages in excess of the reference voltage (corresponding to the white areas between the bars) cause the output of the comparator



Photo 1: Micro-Scan Corp bar code scanner. Circular area at left contains aperture for viewing bar codes.

to conduct, resulting in a logic zero at the interface input. Those voltages below the reference (corresponding to black bars) cause the comparator output to turn off, resulting in a logic one at the interface input. The process of using the average of the peak to peak voltage as the reference input to the comparator is known as adaptive thresholding.

As the line of bar coded data is scanned, a string of 1s and 0s is serially applied to the IO interface. At this point the software loader is continually inputting the value of the parallel interface and testing a specific bit for 1s and 0s. To optimize the human engineering aspects of the scanner, an LED is turned on every time a bar is detected. Also available, as an option, is a beeper to signal the operator when a line of bar codes is scanned successfully.

I mentioned earlier that the transmitted and reflected light passes either through the aperture directly or first through a fiber optics cable. These variations represent a number of scanner models I have designed and developed for sale. For further information on the bar code scanner write to Micro-Scan Corp, POB 705, Natick MA 01760.■

**COMING TO ATLANTA IN
OCTOBER...**

BizComp '78



October 27-29
Marriott Motor Hotel, Atlanta, Georgia



•Crowds.Exposure.Sales.

Atlanta, The Computer City Of The South...

BizComp '78, The Reason For Being There!

Plan To Exhibit: Reserve Space Now!

BizComp '78 will highlight the relatively small budget necessary for the independent business operator to be able to purchase an in-house computer system. All facets of the small business computer industry will be on display from the latest innovations in computers to business software and word processing, supplies and services. BizComp '78 will also emphasize to the small businessman the simplicity and dependability of microcomputer systems.

Plan To Attend: Daily Seminars!

At the door registration will be \$4.00 per day. Register now for \$2.00 per day. Pre-registration offer expires October 20th. When ordering your tickets, please make certain to indicate dates you will be attending and number of tickets per day. All tickets are color coded. All early registrants will receive a special copy of the Expo seminar schedule. Tickets will be mailed immediately upon receipt of your check. Please make checks out to Felsburg Associates, Inc.

Circle 27 on inquiry card.

**For Complete
Details Write
Or Call Today!**

Felsburg Associates, Inc.
12203 Raritan Lane—P.O. Box 735
Bowie, Maryland 20715
(301) 262-0305

Seventeen Years Producing Quality Expositions

AJA

SOFTWARE

P. O. BOX 2528 • ORANGE, CA. 92669

(714) 774-1270

BASIC SOFTWARE
NORTH STAR TRS-80 APPLE

NORTH STAR BASIC on diskette, ready to run. North Star Tutorial I, Tutorial II, Tutorial III (Release 4) teaches North Star Basic, Word Processing, Accts. Payable, Accts. Receivable, Payroll, General Ledger, Medical/Prof. Accts., Rec. Billing, Inventory, Sales Analysis, Computer Chess, Mailing Labels, Personnel System, MANY MORE AVAILABLE. EACH INDIVIDUAL SYSTEM \$35.00

TOTALLY INTEGRATED SYSTEM (A/R, A/P, GEN. LEDGER, PAY, LETTER GENERATOR, BUS. STATISTICS) in Binder Complete Doc. \$150.00
Checkbook Bal., Budget Planner, Golf Handicapper, Game Disk, X-RATED Story Generator. MORE AVAILABLE. EACH INDIVIDUAL SYSTEM \$25.00

IQ TEST, MEMORY Diagnostic, Pers. Finance, Bus. Statistics, Crypto Encoder, Sign Maker, Menu Planner \$150.00 EACH

SINGLE or DUAL DRIVE, 8K Free Memory Required.

TRS-80 on cassette (Level 1). Numerous Games, Examples, STARTREK, WUM-PUS, MORE only \$3.95 EACH
BASIC TUTORIAL (Learn Basic Programming) \$9.95
STOCK MARKET ANALYSIS \$9.95
MANY MORE.

APPLE on Cassette. Many Games, Examples, WORLDPOWER, STARTREK, BOWLING, BINGO \$5.95 EACH
BASIC TUTORIAL (Learn Basic) \$9.95
STOCK MARKET ANALYSIS \$9.95
BUDGET PLAN \$5.95
APPLE DISK BUSINESS SYSTEMS, A/R, A/P, etc. ONLY \$35.00 PER SYSTEM

Order by Phone (714) 774-1270, UPS COD, or Mail Order Today.

Over 1000 Systems Sold, Order Now
SOFTWARE BOOKS SAME PRICE FOR ALL SYSTEMS

Software

- Games • **CRAPS** (Las Vegas style) \$6.00
- **MULTIPLE LUNAR LANDER** \$8.00
- **SLOT MACHINE** \$6.00
- **GAME PACKAGE:** Russian Roulette, Mad Scientist, and ABM \$8.00
- Graphics • **PICTURE MAKER** with AMP'L ANNY \$12.00
- **GRAPHICS PACKAGE I:** Laser Beam, Space Shuttle, and Blast Off \$10.00
- **GRAPHICS PACKAGE II:** Rain in Greece, Flea, Textwriter, Random Walk \$10.00
- Scientific • **FOURIER FIT:** Does curve fitting \$15.00
- Systems • **RANDOM NUMBER GENERATOR TEST** \$5.00
- **HEX MEMORY LOADER** \$10.00
- **MEMORY DUMP PROGRAM** \$10.00
- **MEMORY SEARCH** \$5.00

All Programs Written in **BASIC**
Complete Easy to Read Documentation
Programs Completely Tested

SOFTWARE RECORDS

P.O. BOX 8401-B
UNIVERSAL CITY, CA 91608
(cal residents add 6% sales tax)

Figure 1: White to play. This example illustrates some of the basic problems of strategy and tactics that must be evaluated by any chess playing computer in a typical position. The computer (White) must evaluate a variety of possibilities: two good first moves for White include 1 R-B7 and 1 BxN ch. 1 R-B7 threatens BxB. Therefore Black must either exchange Bishops or gain time by the counterattack 1...B-K4. If 1...BxB, White must complete the exchange by playing 2 RxB or 2 BxN ch, and so on. The position is analyzed in detail in the game tree shown in figure 2.

A Computer Chess Tutorial

Norman D Whaland
430 E 9th St, Apt #15
New York NY 10009

On February 20 1977, the Minnesota Open chess tournament was won by a computer program, Northwestern University's Chess 4.5. This was a far better result than any program had previously achieved, considering that all the other entrants in the tournament were human beings. An improved version, Chess 4.6, went on to wrest the world computer chess championship from the Soviet program KAISSA (see "The Second World Computer Chess Championships" by Peter Jennings, January 1978 BYTE, page 108). Professional chess players are beginning to worry about the competition from machines. They would seem to have little to fear at the moment, however. The consensus is that Chess 4.5's tactical skill is impressive but its strategy is weak.

Against such competition, what can a personal computer experimenter expect to accomplish? Perhaps a great deal. There have been few new ideas in computer chess since Claude Shannon (see references) outlined the basic principles in a paper published in 1950. (The superiority of Chess 4.6 is due

primarily to faster hardware.) Experimenters can participate in the search for the conceptual breakthroughs that will be needed before computer programs can be a match for the best human players. With that thought in mind, this article deals with the questions: What is a good structure for a chess program? What are the major functions that it must perform? In what directions can we seek innovations?

The Game Tree

To get a notion of what a chess program must do, let's look at a position from an actual game (see figure 1). First we must grasp the important features of the position. White has an extra pawn, a passed pawn far from Black's King. Black's mobility is very limited: neither the Knight nor the Rook can move. Black's Bishop is attacking White's Rook and, indirectly, the Bishop behind it. Of less importance, because of Black's lack of mobility, is the fact that two of White's pawns are unguarded. White's task is to save

GLOSSARY

Analysis: the calculation of variations in order to assess a position or find the best move.

Backward pawn: a pawn that lags behind the pawns on the adjoining files. When the opponent has no pawn on the file, a backward pawn is usually a serious weakness.

Development: the process of initially moving the pieces from their original squares.

Diagonal: a diagonal row of squares on the chessboard.

File: a vertical row of squares on the chessboard.

Material: the chess pieces considered as assets. A pawn is traditionally considered to have a material value of one unit. Programs often use smaller units to avoid using fractions for positional advantages.

Minor piece: a Knight or a Bishop.

Passed pawn: a pawn not hindered by enemy pawns on its file or on adjoining files.

Piece: a chess piece other than a pawn.

Positional advantage: any advantage other than an advantage in material.

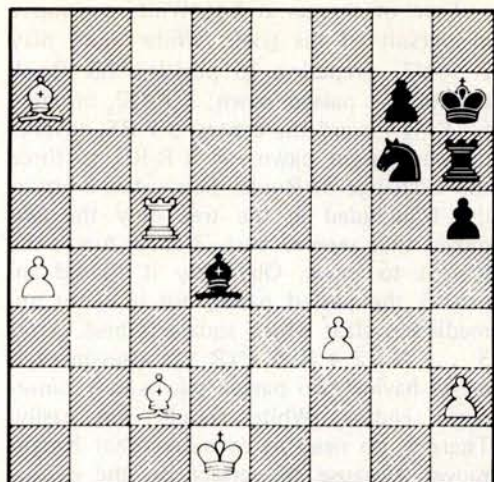
Rank: a horizontal row of squares.

Strategy: that aspect of chess concerned with long-range planning.

Tactics: that aspect of chess concerned with move-by-move changes in the position. Tactics include the methods for winning material and advancing strategic plans.

Variation: a sequence of moves considered as one of several from a given starting position.

BLACK



WHITE

his Rook and to profit from Black's lack of mobility. White should win if he can find satisfactory solutions to these problems.

Next we calculate variations — sequences of moves that we would visualize in an actual game before deciding on a move to play. We will follow a systematic procedure that will serve as a first approximation to a computer program. We construct a tree whose nodes represent positions and whose edges represent moves. The variations are the paths from the root to the leaves. Initially, the tree will consist of one node representing the given position. We expand the tree as follows:

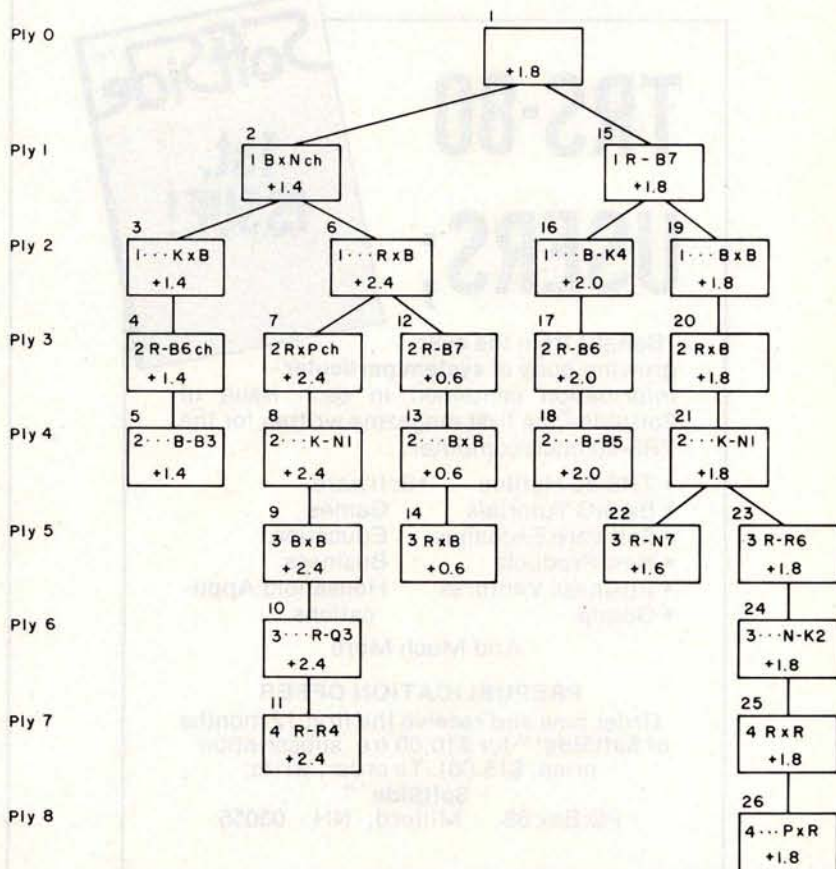
Expansion — Choose a leaf that has not been marked as final. (If one cannot be found, the expansion phase is ended.) Either mark it as final or select a set of legal moves in the position represented by the node. To the leaf attach *sons* representing the positions reached by the moves. Repeat from the beginning.

This procedure might yield the tree shown in figure 2. The size of the tree has been limited somewhat for illustrative purposes. Some of the variations I considered and rejected are not included. Most programs generate much larger trees since it is hard to build into a program the chess knowledge needed for rigorous selection of moves. The length of paths in the tree is expressed in *plies* (*half-moves*). A move consists of a play by one player and a response by the other; a ply is a move by one player alone. Because the term *move* can be confusing (the chess literature speaks of looking three *moves* ahead for example, but are two or three moves by the opponent meant to be included?), in discussions of chess program-


ming one speaks more precisely of a 5 or 6 ply look ahead.

In the expansion procedure, no rule was given for deciding whether to expand a node or for selecting the moves. To gain insight into the way human players make these choices, let us consider the variation that runs down the right side of the tree. In the initial position, Black threatens ... BxR. White can either make a counterthreat or move his Rook to guard the Bishop. Thus the possible moves include 1 BxN ch, 1 R-B7, and 1 R-R5. I rejected the last alternative because the Rook would have less mobility on R5 and it seemed unimportant to keep it on the fifth rank. 1 R-B7 threatens BxB and moving the Bishop to another diagonal allows B-K3, attacking Black's Rook. Therefore, Black must either exchange bishops or gain time by the counter-attack 1 ... B-K4. If 1 ... BxB, White must complete the exchange by playing 2 RxB or 2 BxN ch. The latter move was omitted because the reply 2 ... RxB leads to the position at node 13 (see figure 2), already seen to be unsatisfactory for White. After 2 RxB White threatens R-R6 followed by the exchange of all the pieces and the triumphant advance of the Queen's Rook pawn (QRP). Black must play 2 ... K-N1 or 2 ... K-R1. The square closer to the center was chosen on general principles.


Figure 2: A game tree developed from the position in figure 1. Each node represents a position; the root, the initial position. The move leading to the position is written in the top of the box, the evaluation of the position in the bottom. The number above the box identifies the node. A node's ply number is its distance from the root.



ATTENTION COMMODORE PET* OWNERS



S-100 MPA
(MEMORY + PERIPHERALS ADAPTER)
(FORMERLY THE PET'S 100)



AN S-100 BUS ADAPTER FOR THE COMMODORE PET*

- PLUGS INTO ANY S-100 BUS MAINFRAME
- CONNECTS TO PET VIA RIBBON CABLE (PROVIDED)
- FULL S-100 BUS EMULATION
- USE DMA DEVICES LIKE CROMEMCO DAZZLER™
- EXPAND THE PET'S MEMORY & I/O
- MEETS PROPOSED IEEE S-100 BUS SPECS
- EASY TO ASSEMBLE—SOLDER MASK, LEGEND & SOCKETS
- \$199.95 KIT, \$279.95 ASSM. & TESTED + 5.00 SHIPPING.

The S-100 MPA was the FIRST and is still the BEST S-100 Bus Adapter on the market. This well thought out board actually meets the proposed IEEE specifications for the S-100 Bus which insures compatibility for the widest range of S-100 Bus peripherals. Now you can easily expand your PET's memory and I/O capabilities.

THE S-100 MPA CAN ALSO BE A STAND ALONE 6502 CPU BOARD FOR THE S-100 BUS

With the addition of a 6502 chip and a few other components, the S-100 MPA becomes a stand-alone CPU board for the S-100 Bus—the only one to offer such complete compatibility. Just order the Stand-Alone Option Kit for an additional \$49.95.

OTHER HUH ELECTRONICS ACCESSORIES FOR YOUR COMMODORE PET*


The BEEPER—Automatically beeps when cassette LOADS and SAVES are completed. Also can beep under program control. Just \$24.95 + 2.00 shipping. Fully assembled and tested.

The PETUNIA—Music Board that is actually an 8-bit DAC. Our software makes it play up to four notes at once. Software included. External amp and speaker required. Just \$29.95 + 2.00 shipping and handling. Fully assembled and tested.

The VIDEO—BUFFER—Allows use of a standard monitor or TV with the PET. Great for classroom or remote viewing. Designed so that M&R Enterprises SURRMOD II plugs right on allowing use of Standard TV's. Just \$29.95 + 2.00 shipping and handling. With SURRMOD II for standard TV's—\$59.95 + 2.00 shipping and handling. Assembled and tested.

The COMBO—A Petunia and a Video Buffer all on one board. You save \$10.00!! \$49.95 + 2.00 shipping and handling—with SURRMOD II—\$79.95 + 2.00 shipping and handling.

ALL HUH ELECTRONICS PRODUCTS ARE AVAILABLE FROM STOCK FROM LEADING COMPUTER STORES OR FACTORY DIRECT. CALL OR WRITE FOR MORE INFORMATION.




1429 MAPLE STREET
SAN MATEO, CA 94402
(415) 573-7359

COMING SOON: TRS-80 to S-100 Bus Adapter!!!
See us at the 3rd. West Coast Computer Faire, LA
—Booth #311
DEALER INQUIRIES INVITED

*PET IS A TRADEMARK OF COMMODORE BUSINESS MACHINES

TRS-80 USERS;



Benefit from the ever growing body of **system particular** information contained in each issue of **SoftSide™** the first magazine written for the TRS-80 microcomputer.

- TRS-80 Hotline
- BASIC Tutorials
- Software Exchange
- New Products
- Business Ventures
- Gossip

- Software Games
- Education
- Business
- Household Appli-
cations

And Much More

PREPUBLICATION OFFER

Order now and receive the first 12 months of **SoftSide™** for \$10.00 (re. subscription price, \$15.00). To order, write:

SoftSide™
PO Box 68 Milford, NH 03055

Free of threats at last, White can move in pursuit of his goals. White could play 3 R-N7, preparing to position his Rook behind the passed pawn; 3 K-Q2, bringing his King toward the center; 3 P-R5, advancing the passed pawn; or 3 R-R6, to force the exchange of Rooks. Somewhat arbitrarily, I included in the tree only the two moves that seemed best. 3 R-R6 forces the Knight to move. Obviously it should approach the passed pawn, but it is not immediately clear which square is best. After 3 ... N-K2 4 RxR PxR the assessment is clear: having two passed pawns in a minor-piece ending, White should win easily. There is no need to consider other Knight moves, because the effect on the evaluation of the position would be too small to affect White's choice of move in the initial position.

From this brief discussion we can see some of the factors that determine the selection of moves. When there is a definite threat, it is necessary either to answer the threat directly or to make a counter-threat. Otherwise you must decide which goals are most important and choose the moves that best advance these goals. When two moves have similar effects, not much is learned by including both in the tree, particularly at a deep level.

We can also see some of the reasons for terminating a node (that is, choosing not to expand it). In this example, a node is terminated when the position can be evaluated sufficiently well or when the previous move was not forcing and the side to move has no forcing move that accomplishes anything. At node 14, for example, it is already clear that White doesn't have a won position, and it follows that one of his moves must have been a mistake. Thus we can evaluate the position sufficiently well (but not accurately: further analysis would lower the estimated evaluation given in the figure). At node 5 White has the forcing move 3 B-K3, but after 3 ... R-R1 his position hasn't improved. We consider these moves but don't add them to the tree, because the resulting position is merely compared with the position at node 5, not evaluated.

Once the tree is complete, the next step is to evaluate the terminal positions:

Evaluation — Label each leaf with the value of the position from the point of view of the player whose turn it is to move in the *initial* position. Positive values mean the player has the advantage; negative values mean the player's opponent does. A value of ± 1 means an advantage

barely enough to win; a value of ± 2 means an easy win (see figure 2).

In the present example, material, mobility and pawn structure were the most important factors in making the evaluation. In a middle game position, King safety would also be taken into consideration.

The final step is a completely mechanical procedure called the *minimax* algorithm, which is guaranteed to choose the best move provided the evaluations are accurate and that the best move at each node is included in the tree.

Backup — Select an unevaluated node, all of whose sons have been evaluated. If the node is at even ply, label it with the maximum of the sons' values; at odd ply, choose the minimum. Repeat from the beginning until all of the nodes have been evaluated. Then choose the move leading to the ply-1 node with the greatest value.

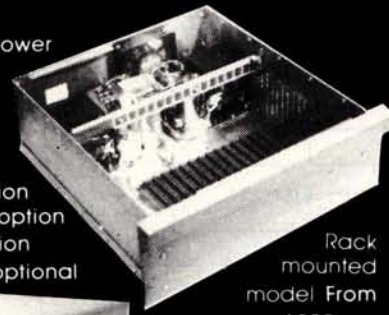
This method of assigning evaluations to non-terminal nodes is based on the assumption that each player always makes the best move. The minimax algorithm will *not* always choose the move that affords the best winning chances against a weak opponent.

Our 3 part procedure for generating a game tree is somewhat unnatural. For one thing, a person analyzing a position would return to the expansion phase if the moves originally selected didn't work out as well as expected. Also, the evaluation phase reflects the human assessment process poorly. No provision is made for recording degree of confidence in the evaluation. Human players make relatively coarse absolute evaluations: they judge which of two similar positions is better, but do not attempt to assign slightly different values to them.

In chess programs, expansion, evaluation and backup are carried out simultaneously. One reason is that time can be saved by using backed-up values to demonstrate that some nodes need not be expanded at all. For example, the variation 1 BxN ch RxB 2 RxP ch gives White a great advantage; we say that 2 RxP ch refutes 1... RxB. Once one refutation is found, it is pointless to look for another: 2 R-B7 need not be considered if not considered already. What does this mean in terms of the minimax algorithm? Once node 3 has been assigned the value +1.4, we know that the value of the minimizing node 2 will not be any greater. Similarly, once node 7 has the value +2.4, we know that the value of the maximizing node 6 will not be any less. Therefore the minimax algorithm will not choose the value of node 6, and it

\$100 MAINFRAME \$200 \$100 MAINFRAME \$200

- NOT A KIT
- 8v@ 15A, $\pm 16v@ 3A$ power
- Rack mountable
- 15 slot motherboard
- Card cage
- Fan, line cord, fuse, switch, EMI filter
- Desk top version option
- 8v@ 30A, $\pm 16v@ 10A$ option
- voltage monitor option
- 100 pin connectors optional



Rack
mounted
model From
\$200



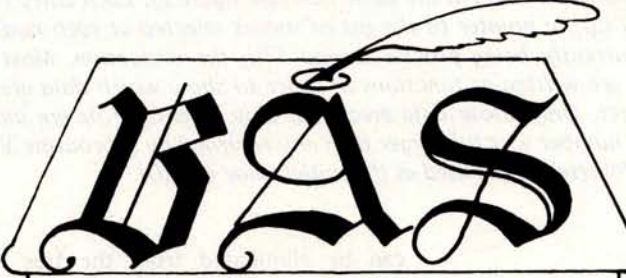
Desk
top model
From \$235

Write or call for a copy of our
detailed brochure which includes
our application note
BUILDING CHEAP COMPUTERS.

INTEGRAND

8474 Ave 296 • Visalia, CA 93277 • (209) 733-9288

We accept BankAmericard/Visa and Master Charge



BAS

BUSINESS APPLICATION SOFTWARE

***. ACCOUNTS**

- *. RECEIVABLE
- *. File Maintenance
- *. Sale & Cash Journals
- *. Customer Lists
- *. Mailing Labels
- *. Aged Trial Balance
- *. Monthly Statements
- *. Transaction Listings
- *. Customer Inquiry

- *. PAYABLE
- *. File Maintenance
- *. Purchases Journals
- *. Vendor Lists
- *. Mailing Labels
- *. Payables Ageing
- *. Automatic Checks
- *. Check Register
- *. Vendor Inquiry

BUSINESS APPLICATION SOFTWARE
 Division of ELP Development Co., Inc.
 16755 Littlefield Lane, Los Gatos, CA 95030

ITEM	A/R	A/P	Both
General Information	\$ 3.00 <input type="checkbox"/>	\$ 3.00 <input type="checkbox"/>	\$ 5.00 <input type="checkbox"/>
System Manual	7.00 <input type="checkbox"/>	6.00 <input type="checkbox"/>	11.00 <input type="checkbox"/>
Program Listings	58.00 <input type="checkbox"/>	51.00 <input type="checkbox"/>	93.00 <input type="checkbox"/>
Programs on Disk*	89.00 <input type="checkbox"/>	81.00 <input type="checkbox"/>	140.00 <input type="checkbox"/>

*CP/M™; CBASIC™ Source & Object Code
 Single Density ☐ Dual Density ☐

Name

Address

City State Zip

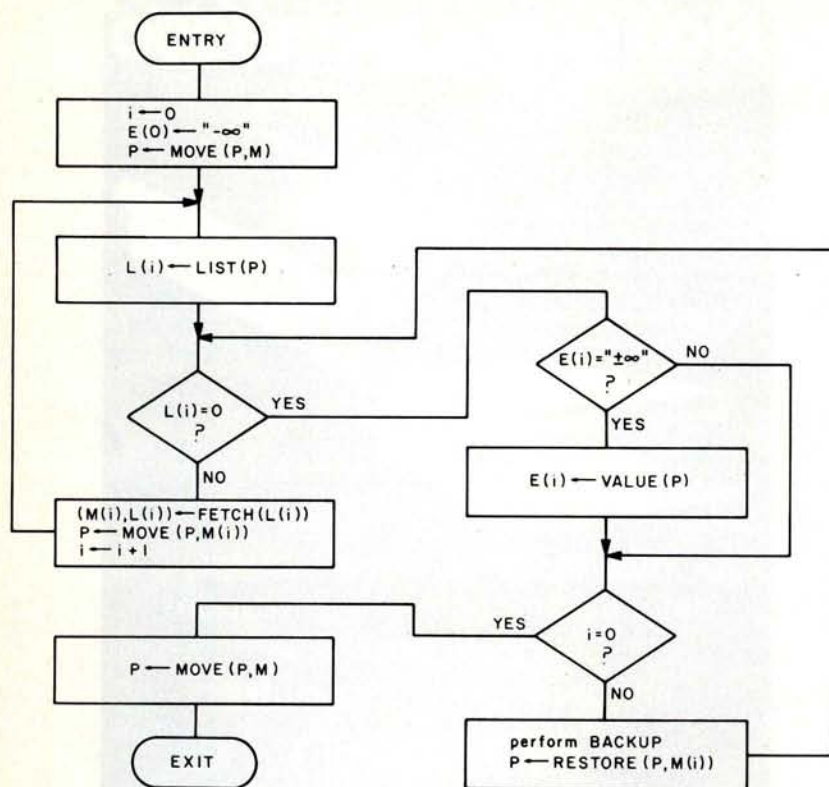


Figure 3: A routine to choose a move. A ply table (so called because it is indexed by the ply number, i) is used to choose moves. (A ply is a move on the part of one player; two plies equal one chess move.) The entries in the ply table correspond to nodes in the game tree (see figure 2). Each entry contains three fields: $L(i)$, a pointer to the list of moves selected at each node; $M(i)$, the move currently being processed; and $E(i)$, the evaluation. Most of the subroutines are written as functions in order to show which data areas they use and affect. Only those data areas that play a central role are indicated. ∞ refers to a number which is larger than any returned by subroutine VALUE. Its additive inverse, $-\infty$, is used as the initial value of $E(0)$.

can be eliminated from the tree without expanding node 12. Although in this example only one branch can be eliminated in this way, it is an important method for limiting the size of the "bushier" trees generated by chess programs.

We have seen that there are three major aspects of chess reasoning that need to be analyzed to create a chess program: selection, termination and evaluation. The handling of these functions by existing programs is only a crude approximation to the human reasoning process. It has proven particularly difficult to limit the number of moves considered at each node without inadvertently eliminating the best move. Consequently, Chess 4.6 uses no selection or termination at a depth of less than six plies, and generates trees with hundreds of thousands of nodes. Even those programs that exercise some selection generate, in most cases, trees too large to store in programmable memory. Fortunately our procedure

can be reformulated so as to require only a small part of the tree to be retained in memory at any time.

The Depth-First Minimax Procedure

A tree can be traversed systematically by the following procedure:

Start at the root — At each step, move to the leftmost unmarked son and mark it. If there is no unmarked son, move to the father. If there is no father, stop. (The terms *son*, *father* and *brother* are analogous to those in a family tree.)

The depth-first minimax procedure traverses the game tree in this way, simultaneously doing the expansion, evaluation and backup. Storage is required only for one path from root to leaf and for the brothers of the nodes on the path.

Figure 3 shows one way to organize the procedure. The processing is centered on the *ply table*, so named because it is indexed by the ply number i . The entries in the ply table correspond to nodes in the game tree. Each entry contains three fields: $L(i)$, a pointer to the list of moves selected at the node; $M(i)$, the move currently being processed; and $E(i)$, the evaluation. The data area P contains the board position. As the tree is traversed, P is modified to show the position at the current node. At the start of the routine, the position is as it was presented to the opponent. The routine applies the move in location M to the position, chooses its move, stores it in M , and applies it to the position.

The subroutines named in figure 3 are discussed briefly here and in greater detail in the following sections. MOVE applies a move to the board representation P . It may also update auxiliary information describing the position. RESTORE simply reverses the changes made by MOVE. LIST generates the list of selected moves and places a pointer to the list in $L(i)$. If the list is empty, $L(i)$ is set equal to zero. FETCH moves the first move on the list to $M(i)$ and advances the pointer $L(i)$ to the next move. VALUE places the evaluation of a terminal position in $E(i)$. BACKUP moves the evaluations $E(i)$ up the table in accordance with the minimax rules.

Programs that generate a large tree generally use a depth-first search and have an overall structure similar to that shown in figure 3. The inflexibility of the depth-first search is a significant disadvantage, though. For example, suppose that shallow analysis of the first ply-1 move casts doubt on its

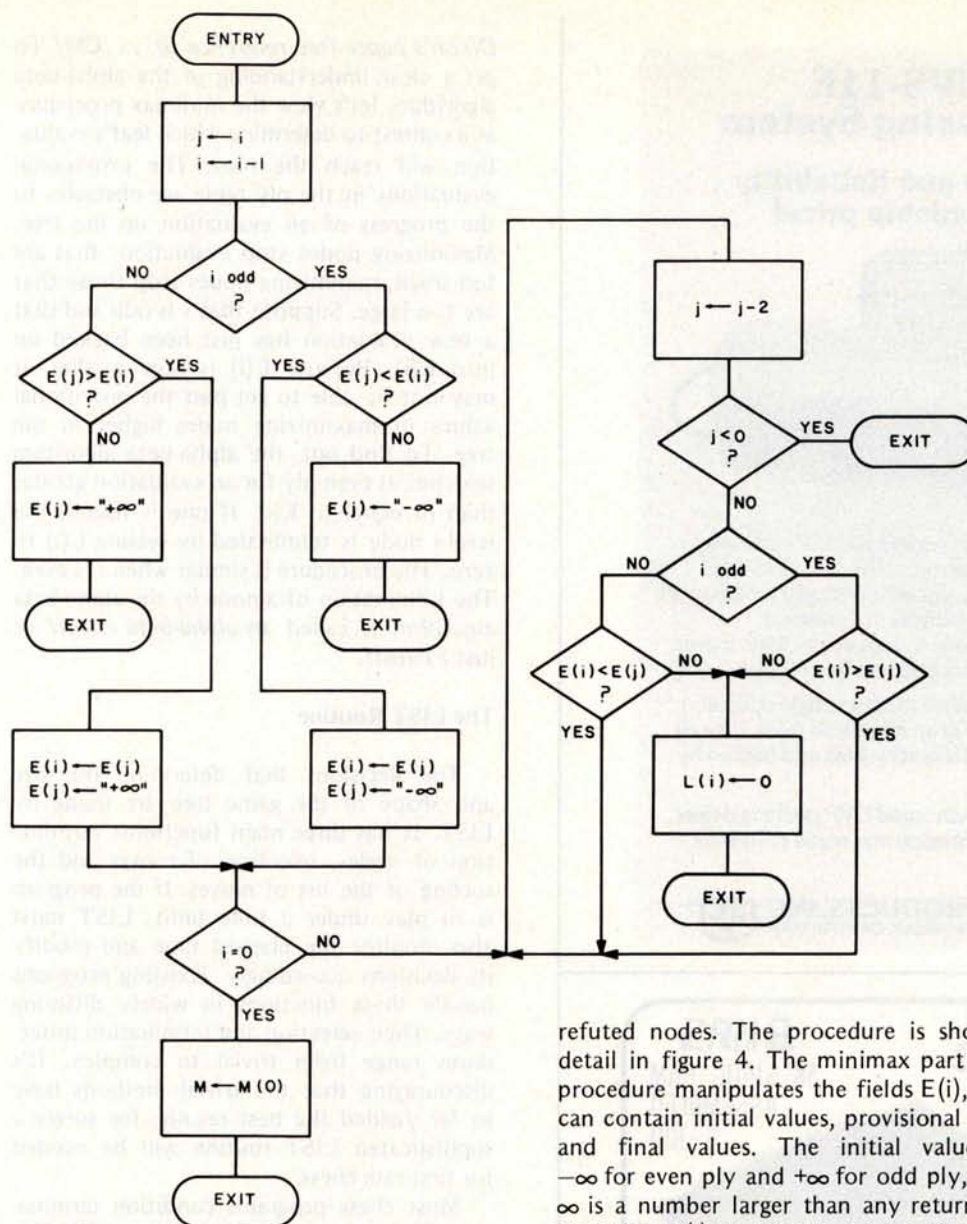


Figure 4: The BACKUP routine. The lefthand side of the flowchart depicts the minimax algorithm, a method which is guaranteed to choose the best move provided that the evaluations of the nodes in the game tree are accurate and that the best move at each node is included in the tree. The right side of the flowchart illustrates the alpha-beta algorithm, used to "prune" refuted nodes — that is, nodes which are known to represent inferior positions. Trimming the tree in this way reduces the amount of information that must be stored in memory and speeds up the evaluation process (see text).

value. Time might be saved by proceeding at once to the other moves and returning to the first move only if they seem no better. But in a depth-first search, the decision to terminate a variation cannot be changed on the basis of later information. Consequently, programs that generate small trees usually maintain the entire tree in programmable memory. Then it is possible to skip around in the tree, expanding those nodes that look most promising. Although such programs aren't structured like depth-first programs, they perform many of the same functions, and so the following discussion of the sub-routines partially applies to them.

The BACKUP Routine

The movement of values up the tree is controlled by BACKUP, which also prunes

refuted nodes. The procedure is shown in detail in figure 4. The minimax part of the procedure manipulates the fields $E(i)$, which can contain initial values, provisional values, and final values. The initial values are $-\infty$ for even ply and $+\infty$ for odd ply, where ∞ is a number larger than any returned by VALUE. $E(i)$ is always set to the initial value when the table entry is not being used. The values produced by VALUE are final values. Whenever a final value $E(i)$ appears in the ply table, BACKUP compares it with the value $E(i-1)$. $E(i)$ replaces $E(i-1)$ if i is even and $E(i-1)$ is greater than $E(i)$ or if i is odd and $E(i-1)$ is less than $E(i)$. $E(i-1)$ then contains a provisional value. A provisional value becomes final when the move list at its ply becomes empty. Whenever $E(1)$ replaces $E(0)$, $M(0)$ is saved in M . As a result, M ultimately contains the first move in the list $L(0)$ that produces a maximum final value in $E(1)$.

The Alpha-Beta Algorithm

The elimination of refuted moves from the tree is accomplished by a procedure called the *alpha-beta* algorithm. [The *alpha-beta* algorithm is discussed in *Slagle and*

New UVS-11E EPROM Erasing System

**Performance and Reliability
at an affordable price!**



Now available . . . the newest member of UVP's growing family of quality EPROM Erasing Lamps. The UVS-11E Short Wave UV Lamp was designed specifically for the small systems user and computer hobbyist. It's compact, easy-to-use, and will erase up to 4 chips at one time. It even features a special safety interlock system for complete safety.

This is the first UV erasing system to offer simple operation and foolproof safety features at an affordable price. Like all UVP products, the UVS-11E is quality-built and backed by 45 years of UV technology.

Order now from your local authorized UVP stocking dealer. Or write today for more information and name of nearest dealer.

ULTRA-VIOLET PRODUCTS, INC. 
5100 Walnut Grove Avenue, San Gabriel, CA 91778 U.S.A.

Dixon's paper (see reference 6). . . CM/ To get a clear understanding of the alpha-beta algorithm, let's view the minimax procedure as a contest to determine which leaf's evaluation will reach the root. The provisional evaluations in the ply table are obstacles to the progress of an evaluation up the tree. Maximizing nodes stop evaluations that are too small; minimizing nodes stop those that are too large. Suppose that i is odd and that a new evaluation has just been backed up into $E(i)$. Because $E(i)$ is now smaller, it may not be able to get past the provisional values in maximizing nodes higher in the tree. To find out, the alpha-beta algorithm searches at even ply for an evaluation greater than or equal to $E(i)$. If one is found, the level- i node is terminated by setting $L(i)$ to zero. The procedure is similar when i is even. The termination of a node by the alpha-beta algorithm is called an *alpha-beta cutoff* or just a *cutoff*.

The LIST Routine

The decisions that determine the size and shape of the game tree are made by LIST. It has three main functions: termination of nodes, selection of moves and the sorting of the list of moves. If the program is to play under a time limit, LIST must also monitor the elapsed time and modify its decisions accordingly. Existing programs handle these functions in widely differing ways. Their selection and termination procedures range from trivial to complex. It's discouraging that the trivial methods have so far yielded the best results, for surely a sophisticated LIST routine will be needed for first-rate chess.

Most chess programs condition termination primarily on depth and the availability of certain types of forcing moves. The simplest method would be to terminate always at some fixed depth. Then VALUE would have to give special handling to positions with an exchange in progress, lest material be reckoned incorrectly. Consequently, many programs use two depth limits. Beyond the first limit are selected only certain forcing moves, typically checks and captures. Termination occurs, of course, when there are none. At the second depth limit termination always occurs.

Other criteria for termination have been tried. The Ostrich program (developed on a Data General Supernova minicomputer at McGill University in Montreal, Canada) terminates variations in which material is sacrificed and not recovered within three plies. Several people have suggested that termination should occur only if the position can be accurately evaluated. The

Pacific
DIGITAL 

**RELIABILITY
QUALITY
DEPENDABILITY**

**ADDRESSING
PROTECT
BUFFERING
LOW POWER
WAIT STATES
QUALITY
GUARANTEE
DELIVERY
PHANTOM
TESTING**

SPECIAL

(714) 992-5540
2555 E. CHAPMAN AVE.
SUITE 604
FULLERTON, CA 92631

INTRODUCTORY
PRICE
ASSEMBLED / TESTED

450 ns \$14995
250 ns \$18995
CALIFORNIA RESIDENTS ADD 6% TAX

Pacific
DIGITAL 

8KRS
8K STATIC RAM
ASSEMBLED
S-100



TWO INDEPENDENT 4K BLOCKS SELECTED BY PLUGGABLE JUMPERS AT BOARD EDGE

ON-BOARD SWITCH WRITE PROTECTS/UNPROTECTS ALL 8K OR EACH 4K BLOCK CAN BE PROTECTED VIA FRONT PANEL

ALL S-100 BUS LINES ARE FULLY BUFFERED ONE LS-TTL LOAD PER LINE

21L02 RAMS - THE 8KRS TYPICALLY REQUIRES 1.5 AMPS AT 8 VOLTS - 4 ON-BOARD 5 VOLT REGULATORS

Q, 1, OR 2 WAIT STATES MAY BE SELECTED VIA A PLUGGABLE JUMPER

THE BOARD IS GLASS EPOXY WITH SILK SCREEN LEGEND, FULL SOLDER MASKS ON BOTH SIDES, FLOW SOLDERING, GOLD CONTACTS

IF NOT SATISFIED RETURN THE UNDAMAGED 8KRS WITHIN 10 DAYS FOR FULL REFUND - ALSO 90 DAY LIMITED WARRANTY

STOCK TO 30 DAYS - CALL BETWEEN 8:30 AND 5:00 TO RESERVE YOUR 8KRS OR FOR MORE INFORMATION

MEMORY DISABLE IS IMPLEMENTED VIA PHANTOM (PIN 67)

COMPLETE TESTING NOT ONLY OF ALL MEMORY CELLS BUT ALSO OF ALL SUPPORT CIRCUITRY AND OPTIONS

Newell-Shaw-Simon program used this philosophy. When the entire tree is maintained in programmable memory, termination decisions as such need not be made at all. For example, the program COKO expands those nodes that promise the greatest yield of information, no leaf being permanently excluded from consideration.

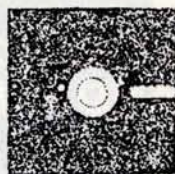
For selection and sorting, LIST might assign to each legal move a plausibility rating designed to indicate the probability that the move will prove best. Many programs don't explicitly assign a rating; nevertheless, it is convenient to imagine that their decisions are based on an implicit rating. Selection and sorting can then be done as follows: select all moves with ratings greater than some threshold. If too few moves are selected, add highest-rated moves to make up the minimum number. (The threshold and number of moves might depend on depth.) Sort the selected moves by rating.

For sorting, the requirements on the rating procedure are not stringent. It suffices that moves good enough to cause cutoffs often appear early in the list. Occasional inaccurate ratings will merely increase the processing time, not cause a blunder. The number of cutoffs can be markedly increased by simply assigning high ratings to a few easily defined categories of moves: captures, checks, moves by attacked pieces, etc. Another simple rating method is to assign a high rating to moves that have proven to be good in other parts of the tree. For example, the "killer" heuristic assigns to a refutation found at one node a high rating at its brother nodes. This heuristic works well in positions containing threats, because all moves that ignore the threat can be refuted by the same reply.

For selection, the plausibility rating must be more accurate. A best move markedly better than the second best move must only rarely receive a rating low enough to cause its rejection. Simple criteria that are adequate for sorting are bound to fail. The rating must be based on all of the move's important effects, which can in turn be determined only by elaborately tracing the relationships of the pieces. For this reason, programs that use selection generally maintain a tactical description of the position. In the program we are considering, it is the responsibility of the MOVE routine to keep such information current.

The VALUE Routine

The evaluation is usually computed as a sum of numerical scores, each representing one aspect of the position. Chess programmers tend to include only those aspects that



CP/M™ LOW-COST MICROCOMPUTER SOFTWARE

CP/M™ OPERATING SYSTEM:

- Includes Editor, Assembler, Debugger and Utilities.
- For 8080, Z80, or Intel MDS.
- For IBM-compatible floppy discs.
- **\$100**-Diskette and Documentation.
- **\$25**-Documentation (Set of 6 manuals) only.

MAC™ MACRO ASSEMBLER:

- Compatible with new Intel macro standard.
- Complete guide to macro applications.
- **\$90**-Diskette and Manual.

SID™ SYMBOLIC DEBUGGER:

- Symbolic memory reference.
- Built-in assembler/disassembler.
- **\$75**-Diskette and Manual.

TEX™ TEXT FORMATTER:

- Powerful text formatting capabilities.
- Text prepared using CP/M Editor.
- **\$75** Diskette and Manual.



DIGITAL RESEARCH

P.O. Box 579 • Pacific Grove, California 93950
(408) 649-3896



The SSI Microcomputer Software Guide

Thousands of programs available on disk, cassette, paper tape; in books, listings, and magazines, complete with source addresses. If you have access to a microcomputer the SSI Guide is a must!

\$ 7.95 postpaid U.S.

A Companion to Uiterwyk's Interpreters by Dave Gardner

Over 70 memory addresses mapped in MSI and SWTPC 6800 Basics, plus 30 custom assembled alterations. Included is an implied GOTO routine, FOR-NEXT-THEN loops plus much more. Learn about Basic not in theory, but by application.

\$ 9.95 postpaid U.S.



4327 East Grove Street / Phoenix, Arizona 85040

ENCLOSE CHECK OR MONEY ORDER

FOREIGN ORDERS ADD \$ 2.00 PER ITEM

POSTAGE PAYABLE IN U.S. FUNDS

Distributed to dealers by MICROMEDIA MARKETING

NOW! LOW PRICED EIA RS-232 CABLES IN STANDARD LENGTHS



*Just \$15 plus
50¢ per foot.*

IDS now supplies quality cables with male to male, male to female, or female to female connectors in 5, 10, 15, 20, 25, 30, 40 & 50 foot lengths. No minimum

order necessary. Just phone or mail in your orders. Special cable configurations also available. Immediate delivery from stock.



ON GSA SCHEDULE

Seven Wellington Rd., Lincoln, R.I. 02865
Tel: (401) 333-6200 TWX: 710-381-0285
Export: EMEC, Box 1285, Hallandale, Florida 33009

**INTERNATIONAL
DATA
SCIENCES, INC.**



BET, YOU DIDN'T KNOW!

OAE's new **PP-2708/16** PROM Programmer is the *only* programmer with all these features:

- Converts a PROM memory socket to a table top programmer: No complex interfacing to wire—just plug it into a 2708 memory socket*
- A short subroutine sends data over the address lines to program the PROM
- Programs 2 PROMS for less than the cost of a personality module. (2708s and TMS 2716s)
- Connect 2 or more in parallel — super for production programming
- Complete with DC to DC switching inverter and 10

turn cermet trimmers (for precision pulse width and amplitude alignment)

- All packaged in a handsome aluminum case

PP-2708/16 .. A & T \$295.

PP-2716 (Programs Intel's 2716) A & T \$295.

OAE

Oliver Advanced Engineering, Inc.
676 West Wilson Avenue
Glendale, Calif. 91203
(213) 240-0080

*Pat's Pending

are easiest to program. Unfortunately they are not always the most important ones. The traditional chess literature is more explicit about evaluation than about selection and termination. The books in the bibliography are particularly helpful.

The evaluation of a position depends mainly on material, mobility and vulnerability. The calculation of material is straightforward, although experts disagree about the exact values of the men. Chess 4.6 uses the values: P=100, N=325, B=350, R=500 and Q=900. Like most programs, it adjusts the material score to encourage the exchange of pieces when ahead in material. The values of the pieces vary with the strategic character of the position: Rooks are better when the opponent has weak pawns, Knights are better in blocked positions, and so on. Such considerations are important, but I know of no program that takes them into account.

The assessment of mobility is more difficult. Counting the legal moves of each man is easy but inadequate. It is necessary also to take into account the exclusion of men from squares controlled by the opponent and the immobilization of men by defensive functions, such as the shielding or guarding of a man or important square. Detecting these factors is complicated and may involve tracing the relationships between several men.

Under vulnerability we have to consider unguarded pieces, the safety of the King, weaknesses in the pawn structure and pieces exposed to attack by less valuable men. Pawn weaknesses are easy to detect, and most programs take them into account. Measuring danger to the King is more complicated, but it is easy to detect some of the relevant features, such as disturbances of the King's pawn cover or the absence of friendly minor pieces nearby. Detecting unguarded and exposed pieces seems to be relatively simple, but oddly it is often neglected.

The MOVE Routine

Because of the rapid expansion of the game tree with depth, most of the processing time is spent in selecting and evaluating the terminal positions. It is therefore desirable for MOVE to maintain, along with the current position, information helpful to the LIST and VALUE routines. For example, it is more efficient for MOVE to keep track of changes in the material score than for VALUE to scan the board to do the same thing. Also, some programs maintain lists of the locations of each side's men to facilitate the generation of moves.

We have seen that sophisticated LIST

and VALUE routines would have to detect relationships between the men. Since each move changes only some of the relationships, it is more efficient to compute them in MOVE than to compute them all from scratch in LIST and VALUE. In general, the features needed for selection are the same as those needed for evaluation. For example, a backward pawn affects the evaluation and also suggests moves for both sides. The possessor of the pawn will try to advance it or protect it, while his opponent will try to prevent its advance and win it. Likewise any advantage suggests moves to maintain and exploit it; any disadvantage, moves to eliminate or mitigate it.

Levels of Skill

The United States Chess Federation rates its members at eight levels of skill based on performance in tournaments. In descending order they are Senior Master, Master, Expert and Classes A through E. From time to time computer programs have played in rated tournaments. Until recently their performance has been in the Class C or Class D range. Against this background the strong showing of Chess 4.5 startled everyone. At the conclusion of the Minnesota Open its rating had risen to Expert. It is still too early to assess its true strength, however. Although it is strong tactically, its grasp of strategy is well below the Expert level. The weak showing of Class A players against Chess 4.5 was caused largely by their unfortunate tendency to get into tactically complex positions, thereby playing into the computer's strength. The program may not be so successful once people learn how to play against it.

The sudden improvement in Chess 4.5 coincided with its transfer to a faster machine, enabling it to search two plies deeper in most positions. This supports the belief that chess skill depends mainly on the number of moves one can see ahead. It's difficult to give a precise equivalence between depth of search and level of skill, though. The following rule of thumb is, I think, close enough to the truth to give some idea of the design requirements for strong programs. Let a search depth of four plies correspond to Class C, and assume that each additional two plies yields an increase of one level of skill. Thus, play at the Expert level would require a 10 ply search.

The Exponential Explosion

The depth of search is limited by the increase in the size of the game tree with depth. Suppose that B moves are selected

CPAids CPAids CPAids CPAids

THE PROGRAMS FOR PROFESSIONALS!

Microcomputer software developed by a CPA with an M.S. in Accounting
Orders being accepted now for:

TAX PROGRAM: includes federal and state; used successfully this past tax season on hundreds of returns

PAYROLL PROGRAM: includes federal, state and city withholdings — prepares payroll register — even prints the checks!

GENERAL LEDGER PROGRAM: includes inventory, accounts receivable, accounts payable, budget report, mailing labels and financial statements, trial balance and general journal listing.

Runs in 16 K memory-North Star basic. Also available for Cromemco Systems Three and Vector M/Z-Micropolus.

Call or write

CPAids

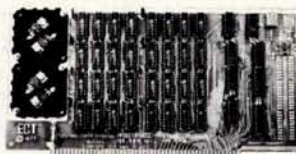
today for more information

about these programs and our many others that are available. We will even custom program for your individual needs. Let us show you how to increase the efficiency and volume of your business or practice.

CALL: [216] 678-9015

Located at 1640 Franklin Ave., Kent, Ohio 44240
(in the Trans-Ohio Building) A division of COMPUTER TAX SERVICE

DEALER INQUIRIES WELCOME

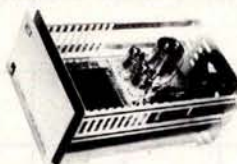


16K RAM FULLY STATIC KIT \$350

10 SLOT MAINFRAME
TT-10...KIT \$325

10 SLOT TABLE TOP
MICROCOMPUTERS
TT-8080...KIT \$440

SYSTEM WITH 16K & I/O
TT-8080-S...KIT \$1050

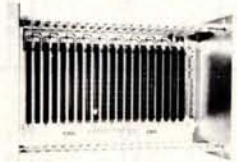


CARD CAGE &
MOTHER BOARD
ECT-100...KIT \$100

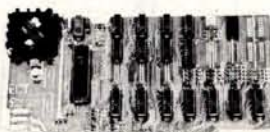
CCMB-10...KIT \$75

WITH CONNECTORS
& GUIDES
ECT-100-F...KIT \$200

CCMB-10-F...KIT \$125



CPU'S, MEMORY
MOTHER BOARDS
PROTOTYPING BOARDS
EXTENDER CARDS
POWER SUPPLIES



SHIPPING EXTRA

DEALER INQUIRIES INVITED

ELECTRONIC CONTROL TECHNOLOGY

FACTORY ADDRESS:
763 RAMSEY AVENUE
HILLSIDE, N. J. 07205

MAILING ADDRESS:
P. O. BOX 6
UNION, N. J. 07083

(201) 686-8080

Search Depth	Number of Terminal Nodes
2	59
3	929
4	1,800
5	27,900
6	54,000
7	837,000

Table 1: Tree size as a function of search depth (D), assuming exhaustive search and the maximum possible number of alpha-beta cutoffs. The branching factor (B) is assumed to be 30. The number of terminal nodes is $2B^{D/2}-1$ when D is even and $B^{(D+1)/2}+B^{(D-1)/2}-1$ when D is odd.

at each node. This number is called the *branching factor* or *fanout*. If D represents the depth of search, the tree has B^D leaves; the tree grows exponentially with depth. A typical position might have 30 legal moves, and if no selection is exercised, the tree will have 27,000 leaves at a depth of three plies. This is probably already too large a tree to examine with a microcomputer in a reasonable time. We have not, however, yet taken alpha-beta pruning into consideration.

The effectiveness of the alpha-beta algorithm depends on how well the move list is sorted. The greatest possible reduction in tree size is achieved when the best move is always first on the list. Table 1 shows the tree size under this condition, assuming a branching factor of 30. Clearly, exhaustive search beyond six plies is impossible for a small computer. To play

Branching Factor	Depth of Search	Tactical Skill
31.6	4	Class C
15.8	5	Class B
10.0	6	
7.2	7	
5.6	8	Class A
4.6	9	Expert
4.0	10	
3.5	11	
3.2	12	Master
2.9	13	
2.7	14	
2.5	15	

Table 2: Depth of search (D) and tactical skill as a function of the branching factor (B). It is assumed that the alpha-beta algorithm reduces the effective branching factor to $B^{2/3}$ and that 10,000 terminal nodes can be processed. These assumptions yield the formula $B=10^{6/D}$.

strong chess a microcomputer will have to use selection. The question is: how much?

To derive a relationship between the branching factor and the depth of search, we have to make some assumptions. Let us assume that we must limit the size of the tree to 10,000 leaves, and that the alpha-beta algorithm reduces the effective branching factor from B to $B^{2/3}$. Then table 2 gives the desired relationship. Although much guesswork went into this table, it seems safe to conclude that an Expert-level program must be very fast or very selective.

The TECH Program

How simple can a program be and still play reasonable chess? The TECH program was developed in order to answer that question. It would be a good model to follow if you want to have a running program in the shortest possible time. Despite its simplicity, or perhaps because of it, TECH placed higher in computer chess tournaments than some of the more complicated programs. It is good enough to defeat only inexperienced human players, but that is true of most programs. For the newcomer to chess programming, the design of a TECH type program would be a good way to gain experience.

TECH considers all moves to a fixed depth, beyond which it considers only captures. The evaluation of terminal positions is based only on material. Hence there is no need for a VALUE routine; the evaluation is computed on the run whenever captures occur. When the program has an advantage of two pawns or more, it reduces the value of its own pieces slightly so that exchanges are favored. TECH sorts moves for two purposes: to increase the frequency of alpha-beta cutoffs, and to bring factors other than material to bear on the choice of a move. At ply 2 and lower, captures are considered first and the killer heuristic is used. The positions at ply 1 are assigned a rating that includes such factors as the number of legal moves, the advancement of the center pawns, and the proximity of the pieces to the center, to the enemy King, and to passed pawns. The program expands the ply-1 nodes in descending order of the rating, which thus breaks ties in the backed-up evaluation.

Because TECH does very little processing at each node, it is able to generate a relatively large tree. Cutoffs are frequent; basing the evaluation only on material ensures that the alpha-beta comparison will often give an equal result. The ply 1 rating procedure could be made more elaborate

without slowing down the program noticeably. It would be interesting to see how much the program's play could be improved in this way.

New Directions

Chess programming is still a young field. There are many ideas that have never been tried or never been developed sufficiently to determine their value. Experimentation by computer enthusiasts could play a major role in developing the innovations that will be needed for a Master-level chess program. Some of the less successful chess programs use ideas worth further consideration. Papers describing some of these programs are listed in the bibliography. Additional ideas can be found by comparing the behavior of programs and human players.

Some Ideas for the Future

Chess games between computers are often dull because the programs don't follow any plan. They pursue general goals such as development and control of the center, but don't formulate goals specifically appropriate for the position at hand. Goals are represented in the evaluation and rating procedures. Setting a specific goal is accomplished by making changes in these procedures. For example, the general goal of center control might be implemented in part by a term in the evaluation polynomial for the number of pieces bearing on the center. A routine for setting specific goals might add a term for the number of pieces bearing on a center square that the routine had determined to be particularly important.

Here are some of the types of specific goals that occur frequently:

- Get control of a key square.
- Attack an area of the board where the opponent is weak.
- Free an immobile piece.
- Save an attacked man.
- Maneuver a particular piece to a square where it will have a strong influence.

It should be fairly easy to determine how to modify the evaluation and rating procedures in such a way as to set these goals. However, it might be difficult to devise a procedure for choosing the specific goals.

Most chess programs spend almost all of their time considering silly moves. There are two main types of silly moves: moves irrelevant to the important goals of the position, and sacrifices that gain nothing

Circle 142 on inquiry card.

Special Offer

Insurance
Information
Files

Games

LP-100F
\$99.00

Information
Retrieval

How to Build and
Interface Your Own
Light Pen
\$9.95

Patent
Search

LP-100F
Light Pen Kit
\$69.95

Controls

Medical
Information
Files

Supplies Limited • Prepaid Orders Only Accepted
Offer Limited to U.S.

LIGHT PEN

FOR INTERFACING DIRECTLY TO YOUR CRT

FULLER ENGINEERING & MANUFACTURING

149 SAN LAZARO AVE.
SUNNYVALE, CALIFORNIA 94086 • (408) 245-5701

Why Pay More?

Why pay for more printer than you need? Our series 40 printers offer more features for less bucks than any other commercial quality printer on the market today. A complete stand-alone 40 column impact dot matrix printer with a 64 character ASCII set. Includes power supply, casework and interface electronics. Single quantity price for the parallel ASCII interface model is \$425. Serial RS232/current loop interface models start at \$575. OEM discounts available.

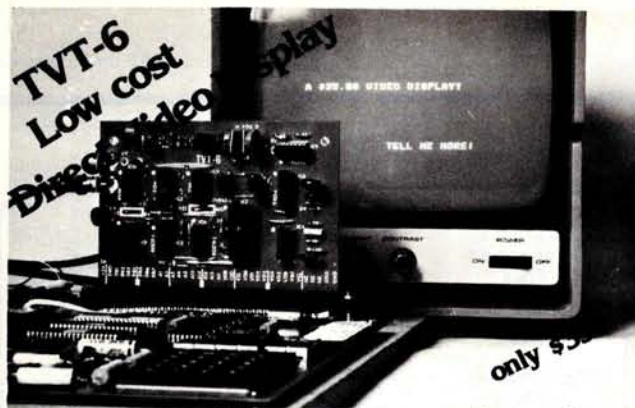
For more information write to:

MPI 2099 West
2200 South, Salt
Lake City, Utah
84119 or call (801)
973-6053.



Circle 265 on inquiry card.

October 1978 © BYTE Publications Inc 179



Don Lancaster's ingenious design provides software controllable options including:

- Scrolling • Full performance cursor
- Over 2K on-screen characters with only 3MHz bandwidth
- Variety of line/character formats including 16/32, 16/64 even 32/64
- User selectable line lengths

TELL ME MORE! () Send instruction manual for the TVT-6 Kit with full operational details. \$1 enclosed.

() SEND FREE CATALOG

Name: _____

PAIA

ELECTRONICS, INC.

Address: _____

City: _____ State: _____ Zip: _____

DEPT. 10-B, 1020 W. WILSHIRE BLVD., OKLAHOMA CITY, OK 73116

TRS-80 COMPATIBLE PERIPHERALS

- *CENTRONICS 779 LINE PRINTER
(Same one that Radio Shack uses) \$999
- *779 WITH TRACTOR FEED OPTION (Highly recommended) \$1179
- *PI MICROPRINTER (A low-cost alternative to the impacts) \$399

All the above printers are supplied with a special cable that allows a direct connection to the Centronics parallel line printer port on your Expansion Interface Unit.

The printers are warranted for 90 days. Call Centronics nationwide field service for repair at 800-258-1952. They usually respond to a service call within four hours.

- *SHUGART SA400 MINI-DISKS COMPLETE WITH POWER SUPPLY AND CASE
(Again the same one Radio Shack uses). BUY TWO UNITS AND GET CABLE FREE \$399

- *16 K RAM EXPANSION KITS (8 CHIPS)
Upgrade your 4 K's or add to your Expansion Interface Unit \$99

TRS-80 SOFTWARE ON COMPATIBLE CASSETTES OR DISKETTES

- DATA-SET CONTROL PACKAGE - BY JOHN DeMITA 4K \$8
This subroutine provides TRS-80 Level I BASIC with File OPEN, READ, WRITE, and CLOSE Functions. Also included are two utility programs and full documentation.
- INVENTORY CONTROL PROGRAM - BY JERRY HICKS 4K \$35
Allows the small business to upgrade its present inventory system and provide timely reports to the management. 6 programs with documentation (4K).
- HOROSCOPE CASTING BY COMPUTER - BY D. L. PITMAN \$10
A fantastic program with graphics. Also available for Level II with output formatted for printer.
- PERSONAL FINANCE PACKAGE - BY JOHN DeMITA (3 Programs) \$15
- MORTGAGE CALCULATIONS AND MATH TEST - BY JOHN DeMITA \$5 each
- LEVEL I RELOCATED IN LEVEL II RAM (16K REQUIRED) \$15
Run your non-convertible Level I programs or make Level I compatible tapes in your L II machine.
- *DISASSEMBLED LEVEL II LISTING WITH COMMENTS \$30
- QUIC - BY ALVIN FILES (3-D Tic-Tac-Toe with graphics - Level II only) \$5
- CHECK RECONCILIATION PROGRAM - BY CLARENCE STINSON \$5
- APARTMENT ANALYSIS - BY DICK MICHELS \$4

Send for free catalog for complete program listing. A few sample games follow:
STAR TREK (8K), FLIGHT SIMULATOR (4K), FOOTBALL (8K) \$5 each

ADD \$2 FOR PROGRAMS ON CASSETTE, \$5 FOR DISKETTE
(Includes Shipping and Handling)

Colorado residents add 6% sales tax.

SOFTWARE ROYALTY PLANS
& PET PROGRAMS ALSO AVAILABLE



APPARAT, INCORPORATED
6000 E. Evans Av, Bldg 2
Denver, CO 80222
303/ 758-7275

CU COMPUTER
INTERFACE
TECHNOLOGY
AFFILIATE

that could be worth the cost. To safely reject irrelevant moves, the program must avoid overlooking important goals, lest it reject a vital move and blunder. Because of the difficulty of writing a comprehensive goal setting routine, it is not surprising that highly selective programs haven't performed well. Nevertheless, it is only a matter of time until enough chess knowledge is formalized to permit accurate selection. In the meantime, it might be possible to devise an algorithm that would reliably identify at least some of the silly moves.

Chess programs usually compare moves or positions by assigning numbers to them and then comparing the numbers. This method precludes certain possibilities of reliably rejecting moves. Suppose we have an algorithm that, given two similar positions, lists all of the important differences between them, together with limits on the effect each difference could have on the evaluation. It is then sometimes possible to determine which position is better, even though it might not be possible to evaluate either position reliably. We saw an example of this in the analysis of figure 1, where 2... K-N1 appeared to be clearly better than 2... K-R1. The position-comparing algorithm could be used for selection and for a variant of an alpha-beta pruning. We meet with a familiar difficulty, however: the algorithm would have to incorporate comprehensive knowledge in order to avoid overlooking important differences.

To summarize, a program to play Master-level chess might contain algorithms to

- Find the important features of the position.
- Determine the relevant goals and rate their importance.
- Compare two similar positions to determine whether one is clearly better than the other.
- Select a list of reasonable moves in a given position.

Each algorithm would use the results of the previous ones in the list. The program would contain much chess knowledge, which would best be represented in a form both compact and easily alterable.

Prerequisites

How good a chess player do you have to be to tackle some of these problems? Most people need only a basic understanding of chess strategy and the ability to find simple combinations. Far more important than chess knowledge is the ability to teach what you know to a very dull, nonhuman pupil.

You will have to be able to state explicitly the reasons for the choices you make while analyzing a chess position. It's not as easy as it sounds. Above all, it's important to keep in mind that writing a chess program is a big project. A methodical approach, using structured programming and careful documentation, is absolutely essential.

Concluding Remarks

In this article I have tried to cover the basic ideas of chess programming and indicate some new directions for experimentation. I hope that many of you will be stimulated to get involved in this growing field of research. ■

BIBLIOGRAPHY

1. Frey, Peter W, editor, *Chess Skill in Man and Machine*, Springer-Verlag, New York, 1977. Contains an introduction to computer chess, a description of Chess 4.5 and much thought provoking material.
2. Gillogly, J J, "The Technology Chess Program," *Artificial Intelligence*, volume 3, pages 145 thru 163, 1972. A simple program using exhaustive search.
3. Horowitz, I A, and Mott-Smith, Geoffrey, *Point Count Chess*, David McKay, New York, 1970. An informal system for evaluating positions numerically.
4. Kozdrowicki, Edward W, and Cooper, Dennis W, "COKO III: The Cooper-Koz Chess Program," *Communications of the ACM*, volume 16, pages 411 thru 427, July 1973. A program that uses a small game tree.
5. Newborn, Monroe, *Computer Chess*, Academic Press, New York, 1975. Contains brief descriptions of some of the older programs, many games and a detailed description of the author's program, Ostrich.
6. Newell, A, Shaw, J C, and Simon, H A, "Chess Playing Programs and the Problem of Complexity," *Computers and Thought* (Feigenbaum, E, and Feldman, J, editors), McGraw-Hill, New York, 1963, pages 39 thru 70. A program that uses a small game tree.
7. Shannon, Claude E, "Programming a Computer for Playing Chess," *Philosophical Magazine*, volume 41, pages 256 thru 275, March 1950. The start of it all, and still a good introduction to the subject.
8. Slagle, James R, and Dixon, John K, "Experiments with Some Programs that Search Game Trees," *Journal of the ACM*, volume 16, pages 189 thru 207, April 1969. Contains the results of some experiments with the alpha-beta algorithm and a proof of the formulas used for table 1 in this article.
9. Tarrasch, Siegbert, *The Game of Chess*, David McKay, New York, 1976. Contains a good summary of the principles of the opening and a systematic survey of middle game tactics.

cañada

systems, inc.

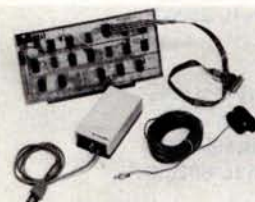
Boards DO Something

If your system needs to know what time it is, our CL2400 is the board for you. The present time in hours, minutes, and seconds is always available for input, and is continuously updated by the highly accurate 60 Hz power line frequency. Need periodic interrupts? The CL2400 can do that, too, at any of 6 rates. Reference manual with BASIC and assembly language software examples included.



CL2400 Real Time Clock
\$98 / Kit \$135 / Assembled

If your system needs on/off control of lights, motors, appliances, etc., our PC3200 System components are for you. Control boards allow one I/O port to control 32 (PC3232) or 16 (PC3216) external Power Control Units, such as the PC3202 which controls 120 VAC loads to 400 Watts. Optically isolated, low voltage, current-limited control lines are standard in this growing product line.



PC3200
Power Control System
PC3232 \$299/Kit \$360/Asm.
PC3216 \$189/Kit \$240/Asm.
PC3203 \$39.50/Kit \$ 52/Asm.

P.O. Box 516
La Canada, CA 91011
(213) 790-7957

(formerly comptek)

INNOTRONICS



COME
NEAR MY
FLOPPY
AND I'LL
BITE YOUR
LEG OFF
!!!!

IF QUALITY IS FOREMOST IN YOUR REQUIREMENTS
WE ARE PROUD TO OFFER THE HIGHEST QUALITY
DISKETTE DRIVE FOR THE FAIREST PRICE

NEW MODEL 410, 8 INCH FLOPPY DISK DRIVES \$495
TWO DRIVE SUB-SYSTEMS (less controller) \$1555

INNOTRONICS CORPORATION DEPT D
BROOKS ROAD
LINCOLN, MASSACHUSETTS 01773
Tel. (617) 259-0600

Creating a Chess Player

Peter W Frey
Department of Psychology
Northwestern University
Evanston IL 60201

Larry R Atkin
Health Information Services
542 Michigan Av
Evanston IL 60202

An Essay on Human

and Computer Chess Skill

In a recent *Time* essay (see references) Robert Jastrow, director of NASA's Goddard Institute for Space Studies, predicted that history is about to witness the birth of a new intelligence, a form superior to humanity's. The pitiful human brain has "a wiring defect" that causes it to "freeze up" when faced with "several streams of information simultaneously." Jastrow suggests that "the human form is not likely to be the standard form for intelligent life" in the cosmos. Even on our own small planet, a new day is near at hand: "In the 1990s, . . . the compactness and reasoning power of an intelligence built out of silicon will begin to match that of the human brain."

We have always been fascinated by the idea of a machine that is capable of rational thought. Jastrow is neither the first nor the last person who is betting on rapid improvements in machine intelligence. His expectation that computers will rival humanity within 15 years seems optimistic to anyone who has watched half-a-dozen excited technicians flutter about for several hours trying to bring a crashed system back to life. This prophecy seems even more fanciful to those who have attempted to program machines to cope with pattern recognition, language translation or a complex game such as chess.

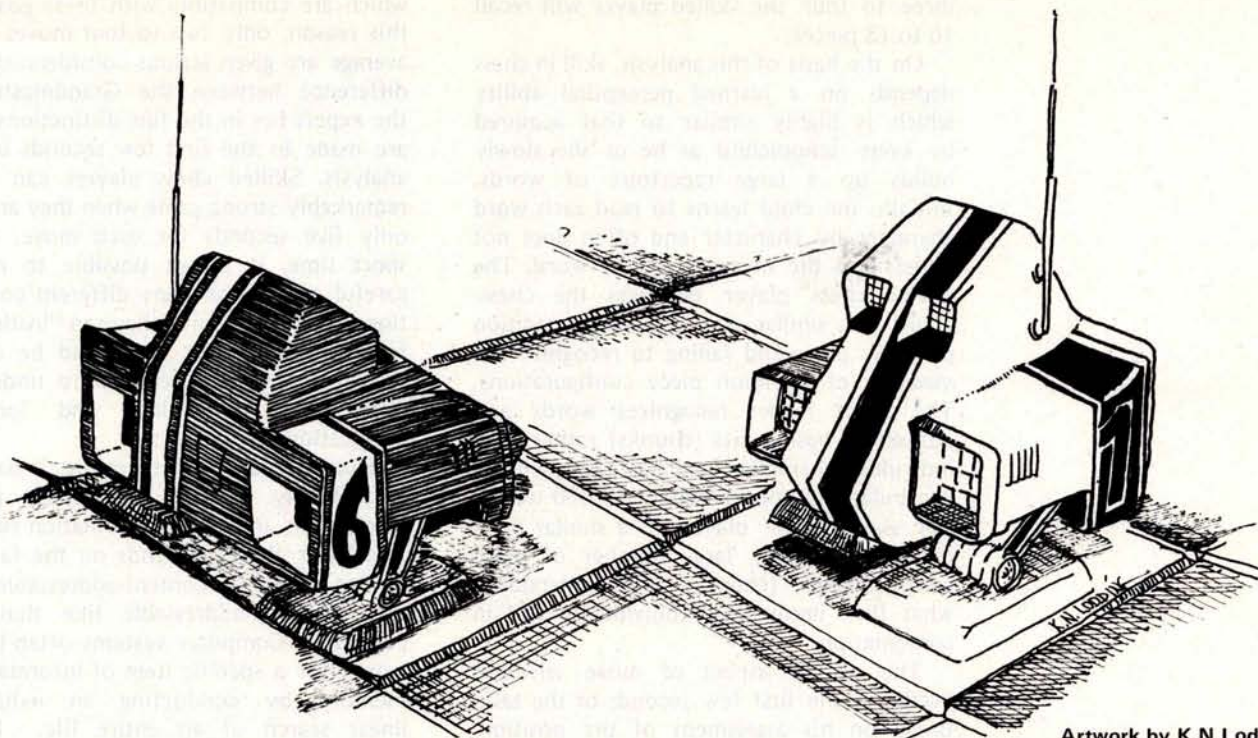
The chess environment, in fact, provides a particularly good example of the difficult problems which still need to be solved before silicon intelligence can become a reality. More than 20 years ago, Herbert Simon, a recognized expert in the field of artificial intelligence, predicted that within a decade, the world's chess champion would be a computer. This prognostication has not come to pass. Why was an informed scientist

like Simon so wrong in his assessment of computer capabilities? A major factor is that computer scientists have often failed to appreciate the level of knowledge which is required to play master-level chess. They have also commonly underestimated the tremendous information-processing capacity of the human brain. Even though chess is a game of logic in which all legal moves can be precisely specified and in which nothing is left to chance, several centuries of intensive analysis have not exhausted the perennial challenge and novelty of the game. Psychologists have been actively studying the human brain for several decades and have discovered a fascinating mystery wrapped within an enigma. The more we learn about the brain, the more we are aware of our lamentable state of ignorance.

The Mind of the Chess Player

At a general level of knowledge, we have several provocative insights on the nature and structure of human chess skill. We know, for example, that the skilled chess player does not examine hundreds of possible continuations before selecting a move. We also know that superior chess players are not formidable "thinking machines" but in fact display a normal range of intelligence scores. Strong chess players, as a group, do not even appear to have special retention abilities such as having "photographic" memories. In most respects, top-flight chess players have the same intellectual capacities as the rest of the population and, in the technical details of move selection, seem to engage in the same type of information processing that is observed in much weaker players.

Peter Frey is currently at the Cresap Laboratory of Neuroscience and Behavior at Northwestern University. He is editor of Chess Skill in Man and Machine. Larry Atkin is co-author of Chess 4.6, presently the world champion computer chess program.



Artwork by K N Lodding.

Our knowledge in these matters is based on the early work of Binet in France and that of de Groot in Holland and on more recent investigations by other scientists in the USSR and the United States. In the late nineteenth century, Binet was surprised to discover that masters did not have a vivid image of the board when playing blindfolded chess. Instead, they seemed to remember positions in abstract terms such as by specific relations among pieces. Interviews with masters clearly indicated that a photographic memory was not a prerequisite for being able to play many simultaneous games of blindfolded chess. In the 1930s and 1940s, de Groot worked with a number of strong chess players (from Grandmasters to strong club players) and had them verbalize their thought processes while selecting a move in a complicated position. His research indicated that the Grandmasters' general approach was highly similar to that of weaker players. They analyzed a similar number of moves (about four) from the initial position, a similar number of total moves (about 35), made a similar number of fresh starts (about six), and calculated combinations to the same maximal depth (about seven plies or half-moves, where a move is defined as a play by one side and a response by the other). The only clear measurable difference was that the Grandmasters invariably chose the strongest move while the weaker players did not. Thus de Groot concluded that Grandmasters play better chess because they

pick better moves. Unfortunately, this conclusion is not very informative since it is obviously circular. The fact that de Groot's extensive study did not uncover any prominent differences in the move-selection strategies used by strong and average players implies that the analysis procedure itself is not the critical factor which determines chess skill.

An important clue to the difference between skilled and unskilled players was discovered by de Groot when he displayed an unfamiliar chess position to his subjects for a few seconds and then asked them to recall the position from memory. He found that masters recalled almost all the pieces while club players remembered only about half of them. Recent work in this country by Chase and Simon at Carnegie-Mellon University has indicated that novice players recall only about a third of the pieces. Chase and Simon also added an important control procedure. They demonstrated that the differences in recall ability completely disappear if the pieces are positioned randomly. This outcome indicates that the superior memory of the chess master is chess-specific and not a general trait.

Simon and Gilmartin have proposed that skilled chess players learn to recognize a large number of piece combinations as perceptual chunks and perform well in the recall task because they remember four or five chunks rather than four or five pieces like the novice. If the average chunk size is

De Groot's "law" of chess is that Grandmasters play better chess simply because they pick better moves.

three to four, the skilled player will recall 16 to 18 pieces.

On the basis of this analysis, skill in chess depends on a learned perceptual ability which is highly similar to that acquired by every schoolchild as he or she slowly builds up a large repertoire of words. Initially the child learns to read each word character by character and often does not understand the meaning of the word. The novice chess player perceives the chessboard in a similar way, assessing a position piece by piece and failing to recognize the *meaning* of common piece configurations. The adult reader recognizes words and phrases as basic units (chunks) rather than individual characters and has a recognition vocabulary of approximately 50,000 words. The skilled chess player, in a similar vein, recognizes a very large number of piece configurations (chunks) and understands what they imply both individually and in combination.

The critical aspect of move selection occurs in the first few seconds of the task. Based on his assessment of the position, the skilled player immediately recognizes appropriate long-term and short-term goals and has a good feel for the specific moves

which are compatible with these goals. For this reason, only two to four moves on the average are given serious consideration. The difference between the Grandmaster and the expert lies in the fine distinctions which are made in the first few seconds of their analysis. Skilled chess players can play a remarkably strong game when they are given only five seconds for each move. In this short time, it is not possible to make a careful analysis of many different continuations. The player must have an "instinctive" feel for the correct move and be able to recognize key features and to understand both their immediate and long-term implications.

Human chess skill, therefore, is based on two highly refined capacities, pattern recognition and rapid information retrieval. The latter ability depends on the fact that human memory is content-addressable rather than location-addressable like that of a computer. Computer systems often have to search for a specific item of information in memory by conducting an exhaustive, linear search of an entire file. Human memory however is organized in an amazingly complex fashion such that most of us can easily recall a specific fact on the basis of a completely novel retrieval cue. For example, name a flower that rhymes with *nose*. In this case, your quick response demonstrates that words are grouped together on the basis of their phonetic similarity (ie: sound). Your ability to quickly recall words which are similar in meaning to the word *fat* (such as obese, chubby, rotund, flabby, plump and stout) demonstrates that human memory is also organized by semantic similarity (ie: meaning). When a person is given a retrieval cue which does not elicit an immediate response, he or she can usually find the correct information after a brief search of related ideas or concepts. This facility contrasts sharply with the extremely limited linear searches which are generally conducted with large computer based storage systems. Even sophisticated computer retrieval strategies which arrange the data base in multilinked lists with elaborate tree structures presently lack the large system efficiency displayed by their biological counterparts.

Pattern recognition and rapid information retrieval are not only key capacities for chess, but are also essential for a wide range of important human problem solving skills. Whether your field is medicine, engineering, plumbing or computer programming, you would be a complete failure at your job without these essential abilities. Jastrow's claim that machine intelligence will soon equal man's intelligence seems to

ESSENTIAL

Good Software is Essential for an Efficient Business. Now, the finest in software at a price you can afford. We are definitely the affordables!

PROGRAMS CURRENTLY AVAILABLE:

INVENTORY PROGRAM PACKAGE

- Inventory Addition
- Update
- Search
- Analysis (Current month)
- Analysis (Year to date)
- Vendor File

Also generates 7 additional user reports and much, much more.

— Cost \$175.00 —

MAILING LIST PROGRAM

*Print formatting in 80 or 132 columns.

— Cost \$20.00 —

The above programs are designed to run under the following:

- | | |
|------------------|-------------------------------------------------------|
| *CP/M in CBASIC | } also IMSAI IMDOS
in Debbi (Source code included) |
| *CP/M in BASIC E | |
| ICOM FDOS-III | |

8" Disk IBM 3740 Format.

EXTENSIVE CONTRACTORS ESTIMATING PROGRAM

Literature available upon receipt of your letterhead

Currently Under Development:

- Billing
- Payroll
- General ledger

Specializing in custom software for the AM-100**

Datafac System Inc. Eastern Division
2440 W. Catalpa, Chicago, Ill. 60625

*CP/M is a Trademark of Digital Research Corp.

**AM-100 is a Trademark of Alpha Microsystems.

overlook the important points made in BYTE by Ernest Kent (see references). Kent emphasizes the fact that biological information processors have a vastly different architecture than their silicon imitations. In fact, he suggests that our lack of success in building a thinking machine stems from our attempts "to make a wrench do a screwdriver's job." Our modern high-speed computers were designed to do important tasks which men are not very good at, such as complex mathematical calculations.

The human brain evolved, in contrast, on its ability to identify important environmental events and to quickly recognize their significance. Natural selection has never placed much emphasis on our ability to multiply or our ability to compute the inverse of a matrix. Kent also reminds us that organic evolution worked with a very different kind of hardware than that which is available to the modern computer engineer. Biological information processors have an incredibly slow cycle time, less than 100 operations per second. The basic unit, the neuron, operates in milliseconds rather than in nanoseconds. The brain, however, makes up in quantity and in structural complexity what it lacks in speed. Computers, on the other hand, have many fewer components and a much simpler gating architecture, but are orders of magnitude faster.

It may be that present machine hardware configurations are simply inappropriate for efficient pattern recognition or semantic recall. An analysis of the history of computer chess is instructive. Although there have been numerous advocates for chess programs which imitate human playing methods, only a few have been attempted, and none of these have played reasonable chess. The earliest paper on machine chess, written by Claude Shannon in 1950 (see references), proposed a mechanical algorithm which was not modeled on human chess play. Shannon suggested a workable procedure for representing the board and piece locations, specified simple mathematical algorithms for generating the legal moves of each piece and gave an example of a straightforward technique for evaluating a position (see *Chess Skill in Man and Machine*, chapter 3). The key feature of Shannon's proposal was the adoption of the *minimax* technique as described by von Neuman and Morgenstern in 1944. The basic idea of the minimax technique is to assume that the player whose turn it is to play will always choose the move which minimizes his opponent's maximum potential gain. Hence, the name minimax.

GRAPHICS STOCK ANALYSIS NAVIGATION ASTRONOMY NUMBER THEORY GAMES



Users of computers and programmable calculators enjoy this magazine! The articles are of interest to hobbyists and professionals. The programs are accompanied by explanations written in clear, logical language. Our authors are people who own and use machines like yours!

"The Recreational Programmer" is issued bi-monthly. It is available by subscription only for twelve dollars per year (domestic), or fifteen dollars per year (foreign).

Subscriptions and articles may be sent to:

THE RECREATIONAL PROGRAMMER
BOX 2571
KALAMAZOO MICHIGAN 49003

EXCELLENT CHOICE!

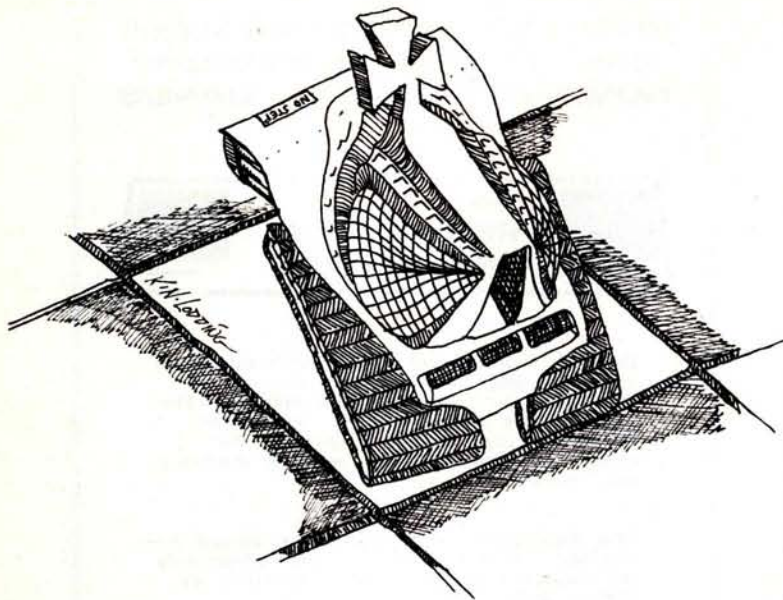
The experienced 2114 4K static RAM



From EMM — the industry's largest supplier of 4K static RAMs — a 2114 with a year and a half of delivery behind it. Not a new part. Just a new pin-out of a proven part. 1K x 4 organization. 5V only. Standard 18-pin DIP. It draws only 300 mw, has all the speed you need for microprocessor applications.

EMM SEMI, INC.

A division of Electronic Memories & Magnetics Corporation
3883 North 28th Avenue, Phoenix, Arizona 85017 (602) 263-0202



The Type B Strategy

One of the difficulties of this approach is that a complete analysis of all possible continuations (type A strategy) very rapidly leads to an overwhelming number of potential positions. The look-ahead tree grows at an exponential rate and with an average, according to de Groot, of 38 legal moves at each position, a search involving three moves (three half-moves for each player) produces over 3 billion (38^6) terminal positions. You may recall that de Groot's research indicated that human players regularly searched a tree to seven plies and sometimes much deeper. Because of this, Shannon concluded that it would not be possible for the machine to consider all possible legal continuations at each *node* of the game tree. Instead, he proposed a type B strategy in which only reasonable (ie: plausible) moves are pursued at each branching point. If the program considered only five continuations at each node instead of all 38, a 6 ply look-ahead would involve only 15,625 (5^6) terminal positions.

The attractiveness of the type B approach seems overwhelming when the number of terminal positions increases exponentially with depth. The fact that skilled human players explore only a limited number of continuations at each choice point is additional evidence which favors the adoption of this strategy. It is not surprising, therefore, that most programmers have used Shannon's type B strategy in designing a chess program.

Sometimes our understanding of the real world, however, is not always as accurate as we presume. In selecting a type B

strategy in preference to a type A strategy, the programmer does not necessarily simplify the problem. This approach was competently implemented in 1967 by Greenblatt at MIT. His program played reasonable, and at that time, fairly impressive chess. The major design problem in a selective search is the possibility that the look-ahead process will exclude a key move at a low level in the game tree. The failure to consider an important move can lead to a very serious miscalculation. A chess game can be lost by a single weak move. For this reason, it is of critical importance that a necessary move not be missed. The type B programs place a critical dependence on the accuracy of their plausible move generator. Chess is an extremely complex game and in many situations a move which at a superficial level seems unlikely, is, in fact, the best one. Grandmasters find these moves while lesser players, including machines, fail to see them. For a decade, several dozen individuals have tried to create a plausible move generator that is superior to Greenblatt's. The evidence is fairly clear, however, that type B programs have improved very little since 1967.

As strange as it may seem, recent progress in computer chess has come by abandoning the type B strategy. Shannon's logical analysis was made in a "stone-age" hardware environment and without knowledge of several important algorithms. Today, the type A strategy is not as ridiculous as it seemed in 1950. In addition, very few individuals anticipated the immense difficulty involved in constructing a competent plausible move generator. To become a chess master, a man has to study chess intensively (20 hrs or more a week) for at least 5 years. During this time he acquires an immense amount of detailed knowledge about the game of chess. Subtle features of a particular position are recognized immediately and suggest both short-term and long-term goals as well as specific moves. This kind of knowledge is sufficiently abstract that most players find it impossible to verbalize the relevant thought processes. The one factor which stands out clearly, however, is that the chess master has acquired a tremendous library of factual information which can be retrieved quickly and applied in apparently novel situations. No chess program has been able to duplicate this facility and, without it, the creation of a workable plausible move generator is next to impossible.

When a type A strategy is employed, however, this problem can be bypassed. By making all the moves *plausible*, the program never overlooks a subtle but important one. In fact, by reverting to a brute force search

The superior memory of the chess master is chess-specific and not a general trait.

of all possible continuations, the program often finds interesting combinations that are commonly missed even by strong human players. It seems ironic that the brute force approach (full width searching) produces many more brilliant moves than the smart approach (selective searching). This important discovery was made independently by Slate and Atkin at Northwestern (the authors of the current world champion chess program, Chess 4.6) and by the Russian KAISSA team.

Minimax and the Alpha-Beta Algorithm

Slate and Atkin's work has demonstrated that a full width search can be conducted considerably more efficiently than anyone had previously suspected (including Slate and Atkin; see references). There are a number of important developments which are responsible for this reassessment. The most important discovery was made in the late 1950s by Newell, Shaw and Simon as well as by Samuels. Because of the basic logic underlying a minimax search, it is not necessary to search the entire look-ahead tree before selecting the best move. Consider a simple 2 ply search (one move for you and one for your opponent). First you examine one of your possible moves and the 38 or so terminal positions which result from each of your opponent's legal replies. You select the one reply which is best, according to your evaluation function, for your opponent (ie: the one which minimizes your own maximum potential gain). Next, you consider a second move for yourself and the 38 or so replies that your opponent can make to this move. In considering these moves, you discover that the third reply you examine would give your opponent a better outcome than his best reply to your first candidate. Immediately you realize that it is a complete waste of time for you to analyze any more of his replies to your second candidate. Since you are already guaranteed a worse position after the second move than after the first, it is reasonable to reject the second one and turn to your third candidate. This decision eliminates the need for evaluating 35 of the potential replies to your second candidate. A very tidy savings.

Historically, the score for the best move so far for White has been designated as α and the score for the best move so far for Black has been called β . Thus the name alpha-beta (α - β) algorithm. When the tree is both wide and deep, this algorithm can reduce the number of terminal nodes to a small fraction of the number which would be examined by a complete minimax search. The beauty of this procedure is that it always produces the same result as the full minimax search.

An important factor in determining the efficiency of the alpha-beta algorithm is the order in which the moves are examined. If White's best moves and Black's best replies are considered first at each choice point, the search of the uniform game tree of height h (number of plies deep) and width d (number of successors at each node) will involve approximately $2 \cdot d^{h/2}$ terminal positions instead of d^h (see references, Knuth and Moore). The potential magnitude of this saving can be appreciated by considering our previous example with a 6 ply search: 38^6 is more than 3 billion while 2×38^3 is about 110,000. Shannon might have given more consideration to the type A strategy if he had been aware of the alpha-beta algorithm and some of the other technical improvements which were to follow.

General Strategy

To maximize the benefit of the alpha-beta procedure, it is necessary to devise an efficient strategy for generating the moves at each node in an order which is likely to produce a cut-off, such that searching can be terminated at that node. There are several general heuristics which have proven their value time and time again. One is extremely simple and powerful: try capturing moves first. Because a full width search includes many ridiculous moves, a reply which involves a capture will often remove a piece which was "stupidly" placed *en prise* (ie: attacked and insufficiently defended).

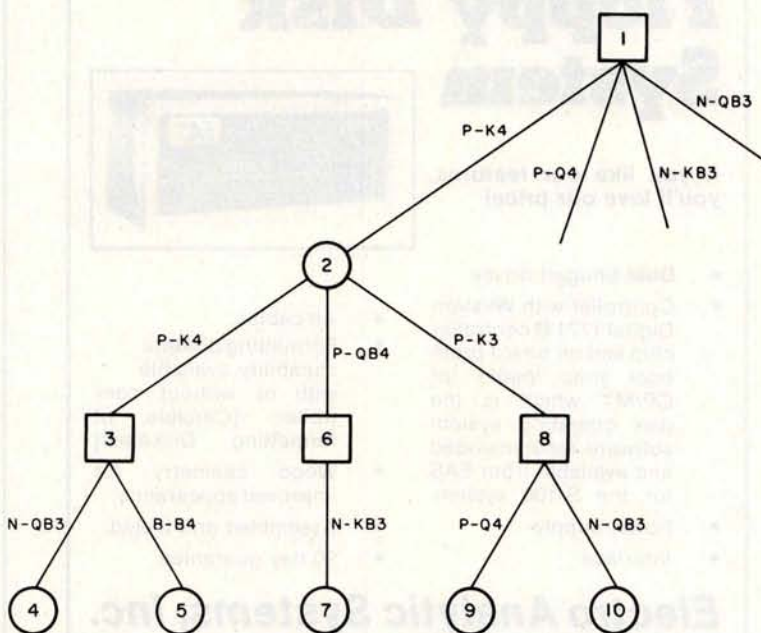


Figure 1: Portion of a game tree for the opening game in chess. Square nodes indicate that White is to play; round nodes that Black is to play. Techniques such as alpha-beta pruning and minimax strategy are used to optimize the use of trees like this.

CATCH THE S-100, INC. BUS



LIST PRICE	SPECIAL CASH PRICE
1,990 ⁰⁰	1,690 ⁰⁰
89 ⁹⁵	74 ⁹⁵
699 ⁰⁰	569 ⁹⁵

Cromemco Z-2D Kit w/4MHZ Z-80 Processor, 30A Power Supply, 21 Slot Mother Board, Disc Con- troller, One Disk Drive, 16K Memory Kit	1,990 ⁰⁰	1,690 ⁰⁰
Percom Cassette Interface Kit C1-812	89 ⁹⁵	74 ⁹⁵
IMSAI 8080 Kit	699 ⁰⁰	569 ⁹⁵

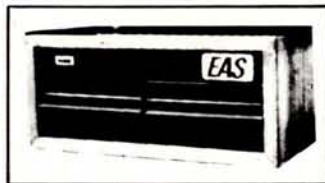
**Call For Our Prices on
Cromemco, IMSAI, Vector Graphic,
North Star, Sanyo, Hazeltine, IMC
Plus Most Other Major Lines.**

Subject to Available Quantities.
Prices Quoted Include Cash Discounts.
Shipping & Insurance Extra.

Bus....**S-100, inc.**
Address...**7 White Place**
Clark, N.J. 07066
Interface...**201-382-1318**

The EAS Floppy Disk System

**If you like our features,
you'll love our price!**



- Dual Shugart drives.
- Controller with Western Digital 1771 B controller chip and on board prom boot strap loader for CP/M™ which is the disk operating system software recommended and available from EAS for the S-100 system.
- Power supply.
- Interface.
- All cables.
- Formatting diskette capability, available with or without controller. [Capable of formatting Diskettes]
- Wood cabinetry for improved appearance.
- Assembled and tested.
- 90 day guarantee.

Electro Analytic Systems, Inc.



P. O. Box 102
Ledgewood, New Jersey 07852
Phone: (201) 584-8284

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

Captures also have the beneficial effect of reducing the number of potential offspring. An additional important characteristic of a capturing move is that it will generally have to be examined sooner or later in order to insure the quiescence of the terminal position. Because of this, every capture that is examined early generally reduces the amount of work which will have to be done later. In practice, investigators have reported a speed-up in search time of as much as 2 to 1 by simply putting all the captures at the beginning of the move list.

In addition to captures, there is another class of moves which is also effective for producing cut-offs. These are called *killers* because they are moves which have produced cut-offs in the immediate past and have been specifically remembered for that reason. A short list of killers is maintained by the program and whenever the legal capturing moves fail to produce a cut-off, each of the killers (if legal in the given position) is then examined. This *killer heuristic* is quite effective in producing a move order which enhances the probability of a quick cut-off.

The general features of the alpha-beta algorithm and its important servants, the capture and killer heuristics, were reasonably well-known late in the 1960s. In recent years, several important refinements have been added to this list. One of the most important is the staged or iterative alpha-beta search. For example, instead of conducting a 5 ply search all at once the search is done in stages, first a 2 ply search, then a 3 ply search, then a 4 ply search, and finally a 5 ply search. Superficially this might appear to be wasteful since the staged search requires the full 5 ply search eventually anyway. This is not at all the case. As each search is completed, the principal variation (best moves for each side at each depth) is used as the base for the next (1 ply deeper) search. The 3 ply search therefore starts with a move at ply 1 and a reply at ply 2 which has already been proven to be reasonable (from the machine's limited perspective). The 4 ply search starts with reasonable moves at its first three plies. The 5 ply search has the benefit of reasonable moves at its first four plies. Because the efficiency of the alpha-beta algorithm is tremendously sensitive to move ordering, the spill-over in information from one iteration to the next has a surprisingly powerful effect. A single 1 stage 5 ply search might require 120 seconds of processor time. The last segment of the staged 5 ply search might require only half as much time (ie: 60). Since each iteration requires about five times as much processor time as its predecessor (the exponential char-

acter of the look-ahead tree is diminished somewhat by the alpha-beta algorithm), the staged 4 ply search would take about 12 seconds, the staged 3 ply search about 3 seconds, and the 2 ply search about 1 second. The total time for the iterative search would be approximately 76 seconds ($1 + 3 + 12 + 60$) rather than 120 seconds.

An added benefit of the iterative search, and, incidentally, the reason for its discovery in the first place, is that it provides a useful mechanism for time control. In tournaments, a move must be calculated within a fixed time limit such as 90 to 120 seconds. If one decides to do a 5 ply search in a single stage, it is possible to find oneself tied up in calculation after 120 seconds with no idea of how much more time will be needed to complete the search, and without a move to make until the search is completed. In some complex situations the search might take as long as 10 minutes — a disaster for time control. An iterative search allows one to predict the probable duration of the next iteration and to make a decision whether it is cost effective to initiate the next one. If this decision is a go and the search, for some reason, fails to terminate in the anticipated time, the machine can abort and play the move selected by the last iteration. This provides relatively neat and tidy time control. The iterative search was first mentioned by Scott in 1969 and was apparently discovered independently several years later by Jim Gillogly at Carnegie-Mellon, by Slate and Atkin at Northwestern and by the Russian KAISSA team.

Refinements to the Type A Strategy

Several other refinements have also made the type A strategy more manageable. One of the time intensive activities involved in tree searching is move generation. This can be minimized by generating only one move at a time and seeing if it produces a cut-off before generating the next move. If a cut-off occurs and the node is abandoned, one can avoid generating a large number of potential moves. With the n-best approach, it is customary to generate all moves at each node and then invest time attempting to decide which ones are worthy of further consideration. Thus the smaller tree, obtained by selective searching, has to be partially paid for by an additional time investment in plausibility analysis.

Another time-intensive activity in the tree search is the repeated use of the evaluation function. Since many thousands of terminal nodes have to be evaluated in each move selection, any refinement that reduces the work of the evaluation function will pay rich dividends. There are three important

P.E.T. Food

NOURISH YOUR HUNGRY P.E.T. WITH SELECTIONS FROM CREATIVE SOFTWARE'S EXTENSIVE MENU!

DUAL JOYSTICK INTERFACE: This Creative Software interface allows you to plug in two Atari-type joysticks (not included) with no modification to the P.E.T. Comes with two games and complete programming instructions..... **\$35.00**

JOYSTICKS: for above interface, price each..... **\$12.50**

BREAKOUT: Written in BASIC for the P.E.T., this program uses either keyboard input or any Creative Software joystick (single or dual). You get ten balls to knock out three double layers of bricks..... **\$10.00**

LIFE: (By S. Bartonsmith) Possibly the finest personal computer version of LIFE currently available, this program uses machine language routines to display up to four new generations per second. User-definable initial configuration, complete screen wraparound, and introducing two original additions—"posts" and "holes." **\$20.00**

TRAP and CRAPS (Joystick or keyboard input)..... **\$10.00**

HURKLE and ONE-QUEEN (Joystick or keyboard input)..... **\$10.00**

HOUSEHOLD FINANCE Parts I and II **\$15.00**

ORDERS: Send check, money order, or VISA/Mastercharge (include expiration date) and add the following shipping charges: 1-2 programs (or dual joystick interface)- 1.50. 3-4 programs- 2.00. 5 or more programs- 2.50. Extra joysticks, each- 1.50. California residents add 6% sales tax.

INFORMATION: More information on these and many other currently available programs are available on a free flyer. Write directly to Creative Software for a complete list.

Creative Software

P.O. BOX 4030, MOUNTAIN VIEW, CA 94040



You've got a Computer Terminal on your desk.

With your push-button dial telephones and our P1-5 Data Concentrator, you've got a comprehensive interactive system to front-end your computer. The P1-5 will answer up to 16 simultaneous callers and record their key entries on to dual floppy diskettes, which eliminates the key punching process.

The P1-5 Data Concentrator offers:

- User designated field duplication
- Modulo 10 checks on user designated fields
- Audio response to callers
- Blank fill to the next field with the "****" key
- 3740 diskette compatibility along with automatic Time and Date recording
- Battery backup power supply.
- Low monthly cost averaging \$300
- Optional 360/370 multiplexor channel interface for P1-5
- Optional CRT/Keyboard terminals for \$17/month

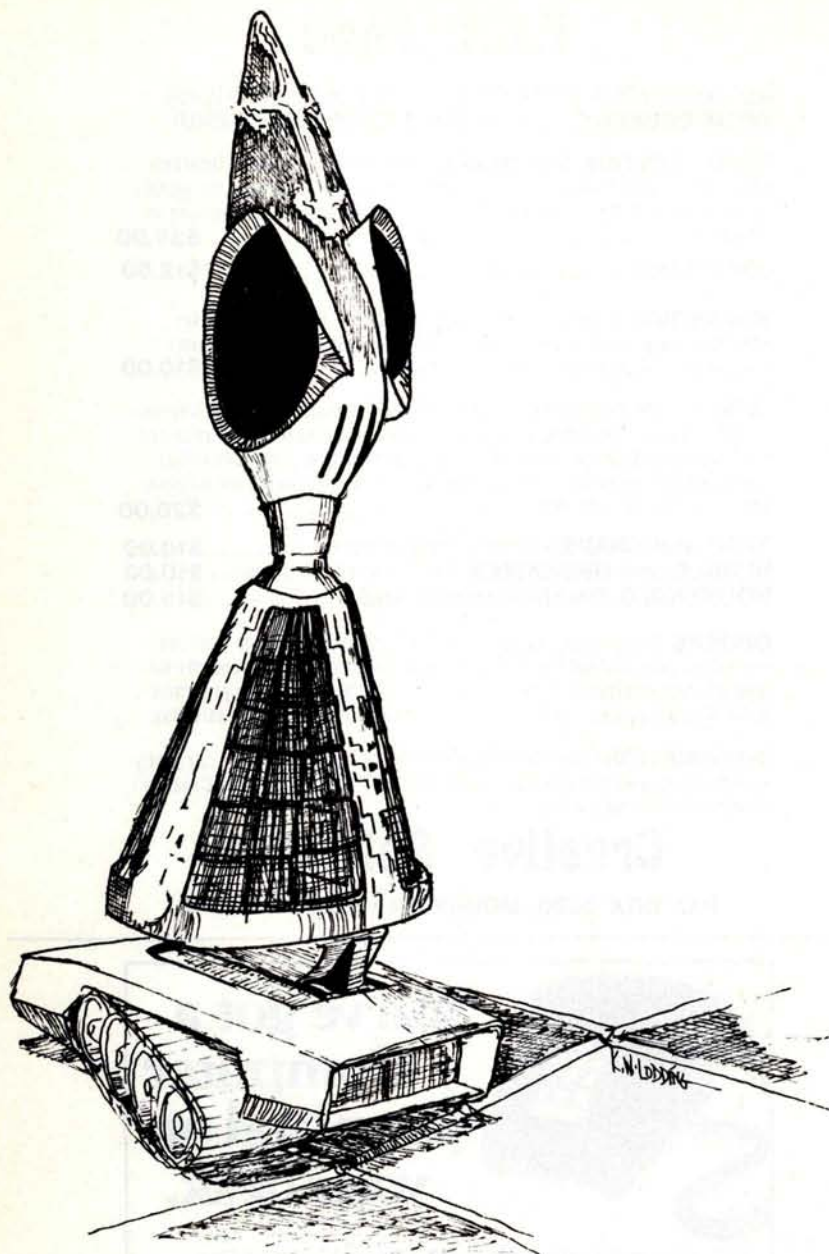
The P1-5 has almost unlimited applications including General Ledger, Payroll, Time and Attendance Reporting, Production Reporting, Receivables Control, Inquiries and many other uses.

Call us today and we'll tell you how the P1-5 Data Concentrator can help you get in 'touch' with your employees and customers.



PHONE 1

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



techniques which fall in this category. One of these is called *incremental updating*. In order to make an evaluation of a node, it is necessary to have certain key facts available, such as which squares are attacked by each piece, which pieces are present, etc. This information can be newly calculated at each terminal node or can be incrementally maintained by updating the appropriate tables as the tree is generated during the search. This latter procedure is more complex to program but tremendously more efficient in terms of computing time because neighboring terminal positions are highly similar. They usually differ in respect to only a single piece, and therefore the updating procedure requires about 10 percent of the computations that would be ex-

pected if the evaluation data base were recalculated from scratch for each evaluation.

A second refinement in this category is the use of serial organization in the evaluation function. In order to assess the relative merit of a chess position, most programs place heavy emphasis on the material balance (ie: the relative number of pieces for each side). This tradition is founded on the idea that winning or losing is strongly correlated with being ahead or behind in material. An additional rationale is that this information is readily available and easily updated.

In most programs material factors are so dominant that the other evaluation terms, such as mobility, pawn structure, King safety, area control, etc, taken together almost never account for more than two pawns. Because of this, it makes sense to compute the material balance factor first and then determine if the result is within two pawns of the target value. If not, there is no need to assess the other factors, because the final decision will be independent of their value.

This simple idea encourages one to organize the evaluation function in strict serial order such that influential (heavily weighted) terms are analyzed first and the result examined to see if a decision is possible based on this initial information. If not, the next most influential term(s) are examined and another determination is made. This process is repeated until an escape condition occurs or until all terms have been examined. In most cases, the evaluation will be terminated long before the list of potential terms has been exhausted. This technical refinement can save a significant amount of time.

A third procedure for speeding the evaluation process is to remember past evaluations. For instance, one should avoid re-assessing the same position two or more times. In chess, there are many pathways by which one can reach identical positions. In a 3 ply sequence in which the middle move remains constant, for example, the first and third moves can be interchanged and the resulting position will be the same. Transpositions such as this occur frequently in the end game where the King may have literally hundreds of 4 move pathways that end on the same square. Rooks, Bishops and Queens also have a special facility for reaching a particular destination square in multiple moves rather than in one or two.

A full width search (ie: type A strategy) greatly accentuates this foolishness. By creating a large table of past positions which have been already evaluated, and using a hashing procedure to check if the present position is in the table, the programmer can completely eliminate a portion of the eval-

uation effort. In most middle game positions, this technique will produce a 10 to 50 percent saving. In certain end game positions, however, the transposition table can eliminate more than 80 percent of the evaluation effort. This idea seems to have been implemented first by Greenblatt in 1967.

An extension of this idea is to use the table to store likely moves as well as evaluations. By remembering a move which previously produced a cut-off, the table can facilitate move ordering decisions. In addition, the use of the same reply at a familiar position may have the added benefit of increasing the number of transpositions which will be encountered at later nodes. Additional details on the use of a transposition table are discussed in chapter 4 of *Chess Skill in Man and Machine*.

One of the most difficult challenges for a chess program is the end game. A machine which calculates a move for each position has difficulty competing with humans who "know" the correct move on the basis of their own or someone else's past experience. There are a huge number of end game situations in which a specific and highly technical strategy is required. Strong chess players study these intricacies at great length and use this knowledge at the chessboard to avoid unnecessary calculations. For example, a King and a pawn against a lone King is a win in some positions, and a draw otherwise. The same is true for a King and two pawns against a King and a pawn. If a Rook or minor piece is added to each side, the situation changes dramatically. Unfortunately our present day programs are oblivious to these subtleties. For this reason they can find the correct move only by engaging in prodigious calculations. Their human counterpart, on the other hand, "knows" the correct move after a cursory glance at the position.

Newborn (see references) has introduced a useful technique for reducing this knowledge gap. The main idea is to categorize familiar end game positions as wins or draws. Many games end with a King and a pawn fighting a lone King. Skilled players usually terminate the contest before it runs its inevitable course because the outcome is not in doubt. Newborn has shown that it is feasible, taking advantage of the symmetries of the chessboard, to make a bit map that indicates either a win (1) or a draw (0) for each potential square on which the lone King might reside for each of the potential locations of the opposing King and pawn. This knowledge can be encoded in approximately 300 bit boards of 64 bits each (see chapter 5 of *Chess Skill in Man and Machine*).

Although a tremendous amount of work and chess knowledge is required to complete this task, the end result is well worth the effort. When a position involving two Kings and a pawn is encountered anywhere in the look-ahead tree, it can be immediately scored with 100 percent accuracy as a win or a draw. This extends the look-ahead horizon of the program by as much as 12 to 15 plies for these specific situations, and eliminates all the tree searching effort which would normally be required. Furthermore, it permits accurate evaluations at the end points of a deep search, which allows the program to select a continuation which leads to a favorable end game. If this approach were extended to a wider range of situations, the machine's present knowledge deficit with respect to the end game would be greatly reduced.

These programming refinements, together with rapid hardware advances, have made the Shannon type A strategy feasible if not particularly elegant. For this reason it is possible to program a machine to play a game of chess which is free of gross blunders and which sometimes even contains an innovative move or two. Although this approach is clearly not a final solution, it does provide a solid base which can be used as a reliable starting point for future developments.■

REFERENCES

Charness, N, "Human Chess Skill," *Chess Skill in Man and Machine*, Frey, P W (editor), New York, Springer-Verlag, 1977.

Frey, P W, "An Introduction to Computer Chess," *Chess Skill in Man and Machine*, Frey, P W (editor), New York, Springer-Verlag, 1977.

Jastrow, R, "Toward an Intelligence Beyond Man's," *Time*, February 20 1978, page 59.

Kent, Ernest W, "The Brains of Men and Machines" (4 part series): January 1978 BYTE, page 11; February 1978 BYTE, page 84; May 1978 BYTE, page 74; and April 1978 BYTE, page 66.

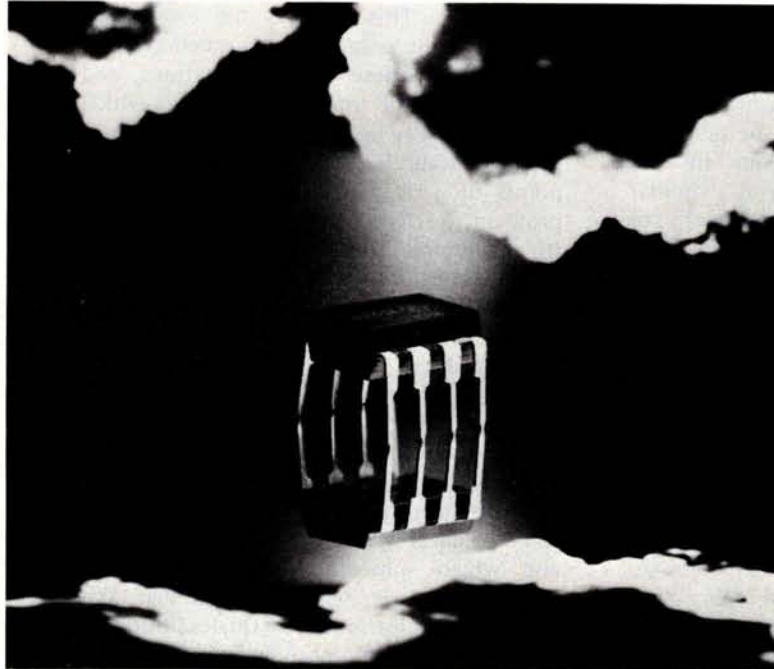
Knuth, D E and Moore, R, "An Analysis of Alpha-Beta Pruning," *Artificial Intelligence*, volume 6, 1975, pages 293 thru 326.

Newborn, M, "PEASANT: An Endgame Program for Kings and Pawns," *Chess Skill in Man and Machine*, Frey, P W (editor), New York, Springer-Verlag, 1977.

Shannon, C E, "Programming a Computer For Playing Chess," *Philosophical Magazine*, volume 41, 1950, pages 256 thru 275.

Slate, D J and Atkin, L R, "CHESS 4.5 - The Northwestern University Chess Program," *Chess Skill in Man and Machine*, Frey, P W (editor), New York, Springer-Verlag, 1977.

THE BEST FOR BOTH WORLDS



**FACTORY PRIME ELECTRONIC EQUIPMENT
FOR BOTH THE DISCERNING HOBBYIST AND
THE PROFESSIONAL**

THE NEW HOBBY WORLD CATALOG

Your source for factory prime, professional quality equipment (no surplus). Computers, add-on boards, IC's, sockets, resistors, supplies, tools, test equipment, books, and more. Shop your buy list at Hobby World. You'll find what you want, and at a solid savings. For example, look at this month's specials.

16K MEMORY ADD-ON FOR APPLE OR TRS-80.

Hobby World price is only **\$145.00** (specify when ordering).

16K STATIC RAM.

S-100 Bus kit uses 2114 memories. Phantom and bank switching capability.

Hobby World Price: KIT **\$300.00**, BOARD ONLY, **\$30.00**

S-100 WIRE WRAP BOARD.

Over 3600 holes, for super versatility. Provisions for 4 regulators. Double sided, plate-through. All S-100 pins labelled for number and signal.

The PT-1. Hobby World Price: Only **\$30.00**

Send me a catalog!

Name

Address

City State

Hobby World
19355 Business Center Dr #6
Northridge, CA 91324

TELEPHONE ORDERS
Inside Calif: 213 886-9200
Outside Calif: 800 423-5387



What's New?

A Chess Playing Program for the TRS-80 Microcomputer



Microchess 1.5 for the Radio Shack TRS-80 microcomputer has been announced by Personal Software in conjunction with Peter Jennings of MicroWare Ltd. Microchess is a 4 K byte Z-80 machine language chess playing program described in "Microchess 1.5 versus Dark Horse," March 1978 BYTE, page 166. The program has three separate levels of play designed for beginners, intermediate players and experienced players.

The program is available in both Level I and II BASIC versions for the TRS-80. Standard algebraic notation is used to describe the moves to the computer. Every move is verified for legality

to prevent user error, and a simple command allows temporary numbering of the squares to assist in move entry. The chessboard is displayed using the graphics mode available on the TRS-80.

Microchess 1.5 is being offered at a temporary introductory price of \$19.95. Microchess 1.0 was described in What's New, February 1978 BYTE, page 200. Contact Personal Software, POB 136, Cambridge MA 02138. If you have questions on Microchess call (617) 783-0694. For Visa and MasterCard credit card orders dial toll-free (800) 325-6400; in MO dial (800) 342-6600.■

Circle 587 on inquiry card.

Open Item Billing System for Small Business Use

According to a release from Structured Systems Group Inc, 5615 Kales Av, Oakland CA 94618, accounts receivable can now be processed on your 8080 or Z-80 based CP/M microcomputer system.

The general ledger compatible accounts receivable system is a full open item billing system for small businesses. The programs are designed for use by business oriented professionals who need reliable and simple

operations. The system is documented with a 120 page reference manual that orients the first time user and provides depth for the experienced hand.

The accounts receivable system is priced at \$750 and features itemized statements, two aged trial balance reports, late charges, reminder letters, recurring receivables, sales reports and more.■

Circle 588 on inquiry card.

Match Your Chess Skills with Boris



Boris is a recently developed chess computer that can flash messages to its opponent such as *Illegal move*, *Congratulations*, *Stalemate*, and *I expected that*. It is designed for all levels of ability from the beginner to the master player.

The electronic position programming permits the player to set up any board position desired. This programming flexibility is designed to allow advanced players to set up board situations and practice specific strategies. Also, beginners can use the feature to remove pieces at any time during a game for handicapping. Boris displays each rank electronically so the player always knows where the pieces are.

Boris will play either black or white or even play itself. If a player is unsure of what move to make, Boris is programmed to suggest the best possible move. When Boris gets his opponent into a corner, you can change places with it and see how it battles its way out of its own trap.

All the classic chess moves are in the computer's programs, such as castling, capturing en passant and queening, and Boris will solve all mate-in-two problems. Players will not get the same game twice since the computer is programmed for random play.

Boris costs \$299.95 in a solid walnut case along with a compact chess board plus a set of pieces. Contact Chafitz Inc, 1055 First St, Rockville MD 20850.■

Circle 589 on inquiry card.

Palo Alto Tiny BASIC Extended for North Star

California Software has made available Palo Alto Tiny BASIC Extended (PATB) for use with the North Star DOS. According to the firm, all save and load functions are available for disk storage and loading of programs. Programs are said to be automatically sized, typed and saved without leaving PATB, even the disk directory can be accessed while still in PATB. The extended version of the software allows string handling along with other advancements. Although originally designed as a memory saving interpreter, it provides an alternative language of North Star users at an affordable price. The product is available on diskette for \$30 (plus 6% sales tax for California residents), including user's manual. Contact California Software, POB 275, El Cerrito CA 94530. ■

Circle 605 on inquiry card.

Software for North Star Disk Systems

The following software programs have been announced for the North Star Micro-disk System: Maillist is a general purpose mailing label program. It is said to be capable of producing formatted lists for tractor fed or Xerox type labels. Maillist will also sort lists for any field, name, address, city, state or zip. DOS In-Out Driver Version 4.0 is designed to set up mapped memory video boards with its driver located at C700H and a terminal at port 1. Register is a flexible cash register and inventory control program which records transactions, writes sales receipts and flags items which fall below prespecified reorder quantities. Prices are \$39.95 for Maillist, \$12.95 for In-Out Driver, and \$299.95 for Register. Contact Alpha Data Systems, POB 267, Santa Barbara CA 93102. ■

Circle 606 on inquiry card.

Air Conditioner Selection Program in North Star BASIC

An Air Conditioner Selection Program (ACSP) written in North Star BASIC has been developed by HSC Computer Services Ltd, POB 43, Brooklyn NY 11236. The package allows the calculation of the necessary capacity of an air conditioner in BTUs per hour, taking into account the heat gain through windows, walls, ceiling, floor, electrical equipment, number of people in room and heat loss through doors and arches. The program applies a correction factor depending on locality in the United States. Also available are North Star error messages and their meaning.

Price of the ACSP package on diskette with a user manual is \$19.95, and the North Star Error Message Summary is \$5. ■

Circle 609 on inquiry card.

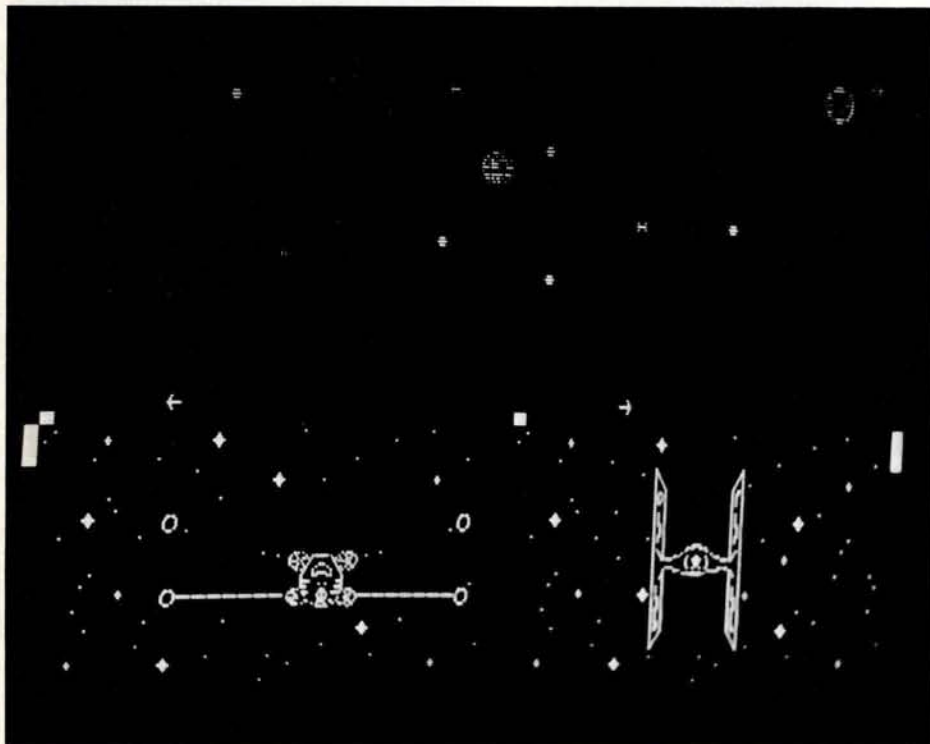
SOLOS Tied to North Star DOS and BASIC

Microcomputer Resources Inc has announced a software package which is said to tie the North Star disk operating system (DOS) and North Star BASIC to the SOLOS IO routines and allow the use of the CUTS tape IO port for archive storage of data. The tape routines are accessed as IO devices. The cursor control keys on the SOL are interfaced to BASIC, allowing most edits in the line editor without the use of control keys. The package is said to allow the user to list the directory of a disk while in BASIC. Documentation for the software is included on the disk.

The package sells for \$10 for the diskette and program, and a \$2 shipping and handling charge. Contact Microcomputer Resources Inc, 3000 Medical Park Dr, Suite 107, Tampa FL 33612. ■

Circle 610 on inquiry card.

Star Wars Simulation Now Available



The Star Wars simulation game, an adaptation of the end of the movie battle against the Death Star, is a real time simulation. Under player control, ships move in three dimensions to create a realistic simulation of actual space flight. Objects increase in size as the ships approach and diminish as they pass. Weapons, deflector screens, and a directional control joystick are implemented in each ship. Ships of the rebel forces must pass through Imperial defenses and Tie-fighters to enter a channel

on the Death Star.

The game requires the high density graphic display provided by Objective Design's programmable character generator. Written in 14 K bytes of 8080 assembly language, the program code is offered on Tarbell and CUTS tape. Game rules and instructions for assembling the required ship control boxes are included in the total price of \$7.50. The game is available from Objective Design Inc, POB 20325, Tallahassee FL 32304. ■

Circle 607 on inquiry card.

PDP-8 Simulator for 8080

The Simul8tor is said to be a complete PDP-8 simulator for the 8080. Simul8tor enables 8080 owners to utilize the thousands of PDP-8 programs available both commercially and through the Digital Equipment Corporation User's Society (DECUS). DECUS software such as ALGOL, BASIC, FOCAL, SNOBOL, FORTRAN, LISP, assemblers, editors, debuggers, floating point, etc, is readily available. The simulator is available in two formats: Intel paper tape and Intel Tarbell cassette. It comes complete with a user's manual, PDP-8 programming tutorial, PDP-8 loader, DECUS library information, and a source listing of its IO routines for users who wish to modify them. Prices are: one to three, \$20 each; four to ten, \$18 each; and 11 and up \$15 each. Discounts may be applied to any format combination. Add \$3 for each cassette ordered. Contact The Amide Corp, POB 600, Sag Harbor NY 11963. ■

Circle 608 on inquiry card.

Electrolabs

PO Box 6721 Stanford, CA 94305

415-321-5601

★ TI Sockets 1 cent per pin. All low profile solder tail 8 pin - 40 pin.

The "Pro" fully encoded ASCII Keyboard by Cherry. Auto REPEAT feature, 5 special function keys. 300mA/5V. (Shown as mounted in "The Case", Below) \$119.00, 3/99.00, 10+/89.00

USED SYLVANIA The Dumb Terminal for Smart People 12" MONITORS

You Fix: \$24.95
Working: \$69.95
Cold Chassis, 25lbs.

80X24 with full 128 char. ASCII UC+LC font with all control characters displayed. 300-19,200 baud RS232. 2nd font addressable from keyboard in you-program-it 2708 for APL, Graphics sets, etc. Plug in monitor I/O connector, 110VAC and you are ready. INCLUDES: "The Case", Cherry Kbd. A used monitor, ESAT 200A, all options except vector addressable cursor and modem. Bulletproof design and construction. Normally \$675.00 What you always wanted your ADM3 to be:
SYSTEM "A" \$649.00 10/\$599.00



"The Case" Beautiful and sturdy anodized aluminum case in deep black designed to contain the ESAT 200A, and with a bezel cut out for the Cherry "Pro" keyboard. (installed as shown above) Choose deep brown, light yellow, or crimson to accent or color code your installation. The only choice for hard-use institutional and educational applications. \$69.00, 10/ 59.00



THE FANTASTIC!

MEMOREX FIVE-FIFTY



MINIDISKETTES (5.25") 1-9 10-24 25+
10, 16 or Soft Sector \$4.79 4.50 4.25

STANDARD (8") DISKETTES
Hard or Soft Sector \$5.99 4.99 4.50

CASSETTES
R-300 Certified Phillips Type \$5.25 4.99 4.35
I-150 Certified for audio decks \$4.60 4.30 3.90
(*Kansas City' & SWTP formats)

★ NEW! 32 K, S-100 Universal Static Store. Accepts 2114 RAMs or 70 ns, 3625 PROMs paging up to 8 Mby. Board only with manual and paging software \$69.00. 32 Kby RAM 450 ns \$679.00, 250 ns \$789.00. We have software application notes for multi-task multi-user applications utilizing paging feature.

Shipping and Handling: Surface: \$0.40/lb. Air: \$0.75/lb., 1.00 minimum
Cal. Tax: 6.5% Insurance: \$0.50 per \$100.00

P.O. Box 4430X Santa Clara, CA 95054

For will call only: (408) 988-1640
2322 Walsh Ave.

Quest

ELECTRONICS

Same day shipment. First line parts only. Factory tested. Guaranteed money back. Quality IC's and other components at factory prices.

INTEGRATED CIRCUITS

MICROPROCESSOR

6800	19.50
6800A with data	8.95
280	18.95
8212	2.90
8214	8.00
8216	2.90
8224	2.90
8228	5.35
8251	9.25
8253	10.00
8255	9.25
CDP1802CD	19.95
CDP1802D	25.00
CDP1861	12.95
6820	9.95
6850	12.95
6802	18.50

5800	19.
8080A with data	8.
280	18.
8212	2.
8214	8.
8216	2.
8224	5.
8228	5.
8251	9.
8253	10.
8255	9.
CDP1802CD	19.
CDP1802D	25.
CDP1861	12.
6820	9.
6850	12.
6502	18.
PROM	
1702A	3.
N82523	2.
N825123	3.
N825126	3.
N825129	3.
N825131	3.
N825136	8.
N825137	8.
2708	12.
DM8577	2.
8223	2.
2716T1	22.

IC SOCKETS	Solder Tin	Low Profile
PIN 1 UP	PIN 1 UP	PIN 1 UP
8	15	24
14	18	28
16	20	36
18	22	40
22	30	61
3 level wire wrap gold.		
14 pin .25	16 pin .27	
2 level 14 pin ww .20		

CONNECTORS	44 pin edge	2.00
	100 pin edge	4.50
	100 pin edge WW	5.25

MOS/MEMORY RAM	2101-1	3.95
	2102-1	1.28
	2102AL-4	1.60
	21F02	1.85
	2104A-4	4.95
	2107B	4.95
	2111-1	4.95
	2112-2	3.95
	2114	8.50
	4116	24.95
	2513B	6.30
	21L02-1	1.49
	53 key kit	\$55.00
	56 key kit	\$62.00
	MM5262	40
	MM5280	3.00

MM5320	9.95
MM5330	5.94
PD411D-3	4.00
PD411D-4	5.00
PS101	13.95
4200A	12.95
82S25	2.90
91L02A	1.75
HD0165-5	6.95
MM57100	4.50
GIAY38500-1	9.95
MM6571A	9.95
9368	3.50

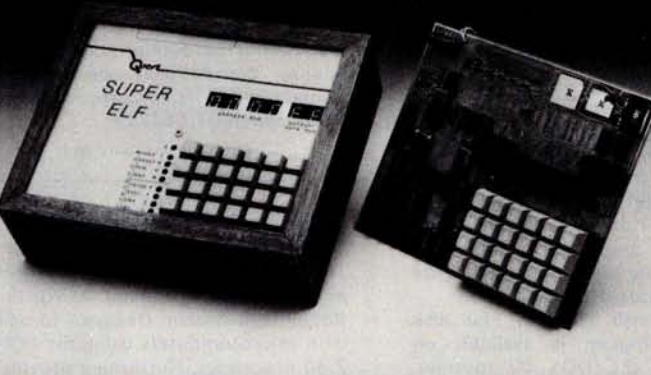
INTERFACE	8125	3.20
	8126	1.69
	8128	2.75
	8197	1.69
	8198	1.69
	8095	.85
	8096	.85
	8097	.85
	8098	.85
ASCII KEYBOARDS		
	53 key kit	\$55.00
	56 key kit	\$62.00
Enclosure		\$14.95

CRYSTALS	4.50	2.0100 MHz	1.95
1 MHz	4.50	2.097152 MHz	4.50
2 MHz	4.25	2.4576 MHz	4.50
4 MHz	4.25	3.2768 MHz	4.50
5 MHz	4.25	3.9688 MHz	4.50
10 MHz	3.90	5.185 MHz	4.50
18 MHz	3.90	5.7143 MHz	4.50
20 MHz	3.90	6.5536 MHz	4.50
32 MHz	4.00	14.31818 MHz	4.25
32768 Hz	4.00	18.432 MHz	4.50
1.8432 MHz	4.00	18.432 MHz	4.50
3.5795 MHz	1.20	22.1184 MHz	4.50

30 MHz Frequency Counter Kit	\$47.75
Prescaler Kit to 350 MHz	\$19.95

COMPUTER BOARD KITS	
8K RAM Board Kit	\$134.95
4K EPROM Kit	114.95
I/O Board Kit	44.50
Extender Board w/connector	12.50
Video Interface board kit	125.00
16K EPROM board kit w/o PROMS	74.50
16K Static RAM board kit	395.00
North Star Floppy Disk Kit	\$665.00
Additional Drive Kit	415.00

Paratronics 100A Logic Analyzer Kit	\$199.00
Model 10 Trigger Expander Kit	\$229.00
Model 150 Bus Grabber Kit	\$369.00



New Cosmac Super "ELF"

RCA CMOS expandable to 64K microcomputer w/HEX keypad input and video output for graphics. Just turn on and start loading your program using the resident monitor on ROM. Pushbutton selection of all four CPU modes. LED indicators of current CPU mode and four CPU states. Single step op. for program debug. Built in pwr. supply, 12.00 per yr.

4K Elf Expansion Board Kit with Cassette I/F \$79.95

Available on board options: 1K super ROM monitor \$19.95. Parallel I/O port \$7.95. RS232 I/F \$3.50. TTY 20 ma I/F \$1.95. S-100 Memory I/F \$4.50. Need 4K Expansion Board Kit for all above options. Power Supply Kit ± 5 +12V 5 amp \$24.95.

Tiny Basic for ANY 1802 System

Cassette \$10.00
on ROM Monitor \$38.00 Super Elf owners take 30% off.

256 Bytes of RAM, audio amp. & spkr. Detailed assy. man. w/PC board & all parts fully socketed. Comp. Kit \$108.95. High address display option 8.95; Low address display option 9.95; Custom hardware cab.; drilled front panel 19.75; Nicad Battery Backup Kit w/all parts 4.95; Fully wired & tested in cabinet without options 151.70; 1802 software club. 10-12 pg. monthly publication

Object code listing or paper tape with manual \$5.50

Auto Clock Kit \$15.95

DC clock with 4-.50" displays. Uses National MA-1012 module with alarm option. Includes light dimmer, crystal timebase PC boards. Fully regulated, comp. instr. Add \$3.95 for beautiful dark gray case. Best value

60 Hz Crystal Time Base Kit

All parts and instructions \$4.40.

'78 IC Update Master Manual \$30.00

1978 IC Update Master Manual \$30.00 Complete IC data selector 2175 pg. Master reference guide. Over 42,000 cross references. Free update service through 1978. Domestic postage \$3.50. Foreign \$6.00.

Video Modulator Kit \$8.95

Convert your TV set into a high quality monitor without affecting normal usage. Complete kit with full instructions.

RCA CosmacVIP Kit \$275.00

Video computer with games and graphics.

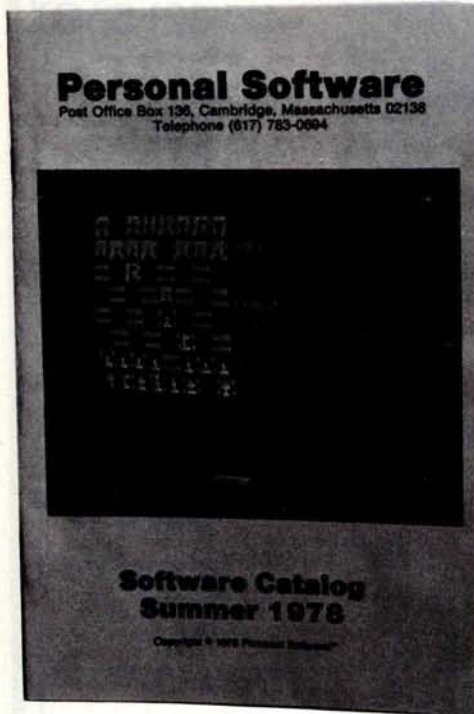
Sinclair 3 1/2 Digit Multimeter \$59.95

Batt. oper. 1mV and .1NA resolution. Resistance to 20 meg. 1% accuracy. Small, portable, completely assem. in case. 1 yr. guarantee.

PROM Eraser

Ultraviolet, assembled \$49.95

TERMS: \$5.00 min. order U.S. Funds. Calif residents add 6% tax. BankAmericard and Master Charge accepted. Shipping charges will be added on charge cards. FREE: Send for your copy of our NEW 1978 QUEST CATALOG. Include 28¢ stamp.



Personal Software Catalog Offers Large Selection of Software Packages

This new catalog is filled with software ranging from entertainment and self-education to personal finance, home information management and a variety of hobbies. A sampling of some of the software available includes: Stimulating Simulations, a set of ten games that simulate a situation that may be realistic or fanciful; Microchess, which enables the user to play chess against a TRS-80 computer; assembler in BASIC to make it possible to write programs in assembly language for the 6502 processor and have them translated to machine language for direct execution on the PET; and a word processing package available for PET owners who would like to compose and edit letters, articles and manuscripts at the computer and obtain corrected output at high speed. For a catalog containing these and other software packages, PET and TRS-80 owners should write to Personal Software, POB 136, Cambridge MA 02138, giving their serial numbers, memory size, and describing their most wanted software products. ■

Circle 642 on inquiry card.

Software Publication

A publication called *The Software Exchange* has been announced by its publisher Alan Bartholomew. Intended as a sort of "want ad" publication devoted to software produced by individuals, the plan is to put out six issues per year at a \$5 per year subscription fee. For further details contact *The Software Exchange*, POB 55056, Valencia CA 91355. ■

Circle 646 on inquiry card.

Attention Readers, and Vendors. . .

Where Do New Product 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 neat new whiz-bang gizmo or save the world software package is of interest to the personal computing experimenters and homebrewers who read BYTE, we print the information in some form. We openly solicit such information 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.

Computer Chess Program Available in Assembly Language

Software Specialists, POB 845, Norco CA 91760, have announced a computer chess program for 8080 and Z-80 based microcomputers. This assembly language program conforms to all rules and conventions including castling, en passant captures, and promotion of pawns. The entire program, including input/output (IO) routines, will run in 8 K bytes of programmable memory.

The user can select one of two board sizes for display. . . large for 24 by 80 inch videos, or small for television typewriters and Teletypes. A level of difficulty between 2 and 5 is selected, with level 3 playing an average game. Both the user's and the computer's moves are displayed in standard chess notation.

For users with a North Star disk system, the program is available on disk and uses the DOS IO routines. The program is also available on paper tape with a 256 byte block reserved for the user's IO routines. Instructions are provided for loading the program and patching the IO routines.

The program is available in either form for \$35. A deluxe version which allows presetting of the board to any playing situation is available on North Star disk only for \$50. The standard starting addresses are 2A00H for disk and 0000H for paper tape. Other starting addresses are available on request at no extra charge. ■

Circle 647 on inquiry card.

Assembler for Microprogramming of Bit Slice Microprocessors

The Signetics Micro Assembler is a software package designed to be used for the complete microprogramming cycle including defining microinstructions, writing and assembling programs, and generating paper tape output for read only memory programming. The assembler permits flexible editing for debugging and program alterations through iterated loops, updates, and replacements, and includes a built-in test program to check system accuracy.

The assembler is written in ANSI FORTRAN IV and can be run on any 16 or 32 bit computer with FORTRAN capability.

The microassembly language provides direct support for the 3002 and 2901-1 bipolar processors and the 8X02 Control Store Sequencer. Through the inclusion of explicit definitions, similar support can be obtained for the 3001 Microprogram Control Unit, as well as other bipolar processing elements and sequences.

The Micro Assembler is available in source form on 9 track tape for \$775. Contact Signetics Corp, POB 9052, 811 E Arques Av, Sunnyvale CA 94086. ■

Circle 643 on inquiry card.

System Monitor for 8085 Microprocessor

The Micro Mate-85 is a hardware connected system monitor for the 8085 processor. When operating in conjunction with a terminal or video display, provides a means of examining and modifying memory locations and microprocessor registers at any point in an operating program through the implementation of addressable traps. The operating program may be started stopped at any location, or the program may be stepped one location at a time. The monitor provides a means of loading or punching a paper tape of memory data for microprocessor systems not containing conventional peripheral IO. Contact Spectrogram Corp, 385 State St, North Haven CT 06473. ■

Circle 644 on inquiry card.

Timeshare Disk BASIC System for North Star

A timeshare disk BASIC system is now available for users of the North Star floppy disk system. Designed to operate with microcomputers using the 8080 or Z-80 processors, Northshare provides up to four independent users with selectable memory partitions and buffered terminal outputs.

Minimum memory requirements for operation are 24 K bytes. There are no special hardware requirements other than additional terminals and IO ports to support the multiple users.

System includes one diskette with release 3 of North Star BASIC and DOS with Northshare supervisor and documentation package. Price is \$48 from the Byte Shop of Westminster, 14300 Beach Blvd, Westminster CA 92683. ■

Circle 645 on inquiry card.

PLACE ORDERS TOLL FREE: 800/262-1710 inside California
800/421-5809 all other states

MICROPROCESSORS

F8	16.95
Z80	20.00
Z80 A	25.00
I802	17.95
2550	19.95
AM2901	20.00
6502	11.95
6800	16.95
6802	24.95
8008-1	12.95
8035	20.00
8080 A	9.95
8085	23.00
8748	60.00
TMS9900	50.00

8080 A

SUPPORT DEVICES

8212	3.90
8214	4.60
8216	2.75
8224	4.00
8224-4	9.95
8226	2.75
8228	6.40
8238	6.40
8251	7.50
8253	20.00
8255	6.35
8257	19.95
8259	19.95
8275	75.00
8279	18.50

6800 SUPPORT

6810P	4.00
68B10P	6.00
6820P	6.50
6821P	6.50
6828P	11.25
6834P	16.95
6850P	8.75
6852P	11.00
6860P	9.00
6862P	12.00
6871P	28.00
6875P	8.75
6880	2.50

CHARACTER GEN.

13 U/L	6.75
513 (5v) U/C	9.75
2513 (5v) L/C	10.95
6571	10.95
6571A	10.95
6574	13.25

DYNAMIC RAMS

16D (200ns)	16.00
16 (200ns)	16.00
04/4096	4.00
07B4	3.95
MS4027	4.00
MS4050	4.00
MS4060	4.50
4096	4.00
MMS270	4.50

PROMS

1702A	5.00
2516 (5v)	38.00
27 08	9.00
2716 (TI)	24.95
2716 (INTEL)	38.00
2758	23.25

STATIC RAMS

	1-63	64 up
21L02 (45 (450ns)	1.50	1.18
21L02 (250ns)	1.75	1.50
410D	10.00	8.50
2101-1	2.95	2.50
2102	1.25	.90
2111-1	3.25	2.65
2112-1	2.75	2.35
2114 (300ns)	10.00	8.25
2114 (450ns)	9.00	7.69
2125L	7.69	6.60
TMS4044 (250ns)	9.95	8.00
TMS4044 (450ns)	8.95	7.40
4200A	10.00	8.60
TMS4045 (250ns)	10.50	9.00
TMS4045 (450ns)	9.00	8.00

FLOPPY DISC CHIPS

1771B-01	39.95
----------	-------

KEYBOARD ENCODERS

AY-5-2376	13.75
AY-5-3600	13.75



EXPANDO-32 KIT

Uses 4115 (8Kx1) Dynamic RAMs, It can be expanded in 8K increments up to 32K

8K	\$179.00
16K	\$255.00
24K	\$325.00
32K	\$399.00

EXPANDO-64 KIT

Uses 4116 (16Kx1) Dynamic RAMs, It can be expanded in 16K increments up to 64K

16K	\$260.00
32K	\$579.00
48K	\$757.00
64K	\$925.00

JADE 8080A

KIT	\$100.00
A+T	\$149.95
BARE BOARD	\$30.00

JADE Z80

with PROVISIONS for ONBOARD 2708 and POWER ON JUMP

(2MHZ)	\$135.00 ea.
Assembled & Tested	\$185.00 ea.
(4MHZ)	\$149.95 ea.
Assembled & Tested	\$199.95 ea.
Bare Board	\$35.00 ea.

JADE VIDEO INTERFACE KIT

KIT	\$117.95
Assembled & Tested	\$159.95

S-100 Bus compatible
32 or 64 Characters per line - 16 lines
Graphics (128 x 48 matrix)
Parallel & composite video
On board low-power memory
Powerful software included for cursor, home, EOL, Scroll Graphics/Character, Upper case, lower case and Greek.
Black-on-white & White-on-black.

SHUGART 801R

8" FLOPPY DISC DRIVE



MODEL 801R Shugart Disc with Cabinet

Includes Cabinet, Disc Drive, Power Supply, Cable, Fan & Data Cable. Has AC line filter.
Cabinet size 10" H x 10" W x 16" D
MODEL DM 2700-S \$750.00

FLOPPY DISC INTERFACE

JADE Floppy Disc (Tarbell Board) KIT	\$175.00 ea.
S.D. Computer Products Versa Floppy Kit	\$159.00 ea.
Assembled & Tested	\$189.00 ea.

STATIC RAM BOARDS ASSEMBLED & TESTED

8K	
Ram 8 (250ns)	\$169.95
Ram 8B (450ns)	\$139.95
250ns KIT Mem-1	\$149.95
450ns KIT Mem-1	\$125.00
BARE BOARD	\$25.00

16K Uses 2114 (lo pwr.)	
Ram 16 (250ns)	\$375.00
Ram 16B (450ns)	\$325.00
MEM-2 Kit (250ns)	\$285.00
32K Assembled & Tested by SEALS ELECTRONICS	
JG-32 (250ns)	\$795.00
JG-32B (450ns)	\$725.00
250ns KIT	\$575.00

6800 Adapter - adapts Mem-1 8K board to Motorola MEK 6800D2 evaluation kit \$12.95

TU-1

Convert T.V set to Video Monitor
KIT... \$8.95

PROBLEM SOLVER SYSTEMS, INC.

16K STATIC BOARD with memory management can be used with Alpha Micro or Cromenco Systems.

ASSEMBLED & TESTED

RAM 65(250ns)	\$390.00
RAM 65B (450ns)	\$350.00

HITACHI

VIDEO MONITORS - BLACK & WHITE



VM-129

12" Solid-State Video Monitor 700 lines horizontal resolution. Includes black level clamping, DC restoration circuit (switchable), Ext sync provision (Optional) \$370

VM-909

9" Solid-State Video Monitor 500 lines horizontal resolution line lock sync High voltage 10KV \$215



apple II

One of the best "Total Package" home and business computers on the market. "Basic" in ROM, Color Graphics, Floating Point Basic Package, etc.

16K version only \$1,095.00

4116 [16Kx1-200NS] MEMORY EXPANSION KIT

Dynamic Ram Chip can be used for expanding Apple II Memory or the TRS-80 (200ns)

8 for \$128.00

CONTAINS INSTRUCTIONS
Call for quote on larger quantities

JADE PARALLEL/SERIAL INTERFACE KIT

KIT	\$124.95
Assembled & Tested	\$174.95

- * S-100
- * 2 Serial interfaces with RS232 interfaces or 1 Kansas City cassette interface.
- * Serial interfaces are crystal controlled
- * Selectable baud rates.
- * Cassette works up to 1200 baud.
- * 1 parallel port.

JADE

Computer Products

4901 W. Rosecrans,
Department B
Hawthorne, Ca. 90250

Freight Charge \$2.00 less than 10-lbs.

Cash, Check, Money Order or Credit Card

6% sales tax on all parts delivered in California

Discounts available at OEM quantities.

The Piggy is coming!



Cards Welcome

A New Appliance Computer from Pertec



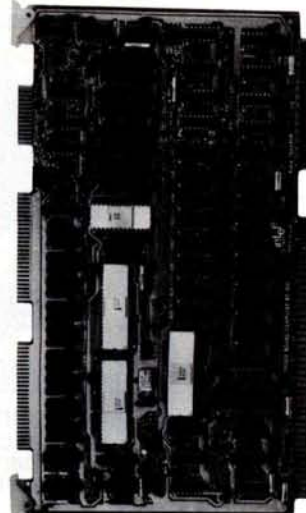
Sometimes a few surprises happen. A recent case in point is the appearance of a new computer from Pertec Computer Corp's Microsystems Division (iCOM and MITS). This new computer, called Attaché, is a surprise because it fits the functional definition of the "appliance" computer: it can be purchased off-the-shelf in a ready to use condition. The base price of \$1449 gets an assembled and tested computer, to which (at extra cost) one must add a BASIC interpreter on a read only memory board for the internal S-100 bus.

The Attaché comes with a full ASCII keyboard, upper and lower case. It has a 10 slot board capability, LED indicators for on and off status, a reset switch which returns to the programmable read only memory monitor, a monitor PROM

that controls operation of the computer from the keyboard, and a 75 Ω video output jack. The video output provides 16 lines of 64 characters and a choice of black on white or white on black display. The system includes forced air conditioning over the vertically mounted cards and a power supply which provides 10 V at 10 A (regulated to 5 V on boards), with preregulated +18 V and -18 V, each rated at 2 A. A 1 K volatile memory region and extra sockets for programmable read only memories are standard. The basic configuration includes keyboard, processor board, video board, and turnkey monitor board. Contact Pertec Computer Corp, Microsystems Division, 21111 Erwin St, Woodland Hills CA 91367. ■

Circle 596 on inquiry card.

Intel Introduces Improved Single Board Computer



The iSBC 80/10A Single Board Computer, an enhanced version of the iSBC 80/10, has been introduced by Intel. The 80/10A gives the user up to twice the read only memory capability presently available on the 80/10, for the same price. The 80/10A sells for \$495 and includes the Intel 8080A central processor, system clock, 1 K bytes of programmable memory, up to 8 K bytes of nonvolatile read only memory and both parallel and serial IO. The unit is available from Intel Corp, 3065 Bowers Av, Santa Clara CA 95051. ■

Circle 597 on inquiry card.

ITHACA AUDIO

THE OEM MARKETPLACE

Ithaca Audio Boards

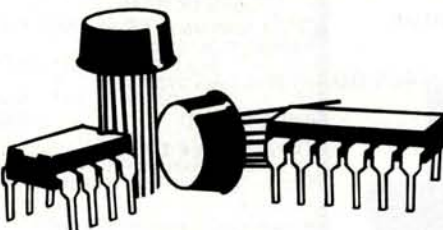
Are fully S-100 compatible, featuring gold edge connectors and plated-through holes. All boards (except the ProtoBoard) have fully buffered data and address lines, DIP switch addressing, solder mask and parts legend.

Z-80 CPU Board Most powerful 8 bit central processor available. Featuring power-on-jump, provision for on-board 2708. Accepts most 8080 software. **\$35.00**

8K Static RAM Board High speed static memory at the lowest cost per bit. Includes memory protect/unprotect and selectable wait states. **\$25.00**

2708/2716 EPROM Board Indispensable for storing dedicated programs and often used software. Accepts up to 16K of 2708's or 32K of 2716's. **\$25.00**

ProtoBoard Universal wire-wrap board for developing custom circuitry. Accepts any size DIP socket. **\$25.00**



RAM!

32K for \$319.00

Ithaca Audio is now stocking the Mostek 4115 for S.D.'s Expandoram. Buy their basic kit, 24K of add-on RAM from us and SAVE.

S.D. SALES Expandoram Kit w. 8K	\$151.00
Ithaca Audio 24 4115's @ \$7.00 ea.	168.00
TOTAL	\$319.00
S.D. SALES Expandoram Kit w. 32K	\$475.00
YOU SAVE	\$156.00

Quality Components

ZILOG Z-80	\$19.00
ZILOG Z-80A	23.00
Intel 2708	11.00
FAIRCHILD 2102 LHPC	1.60
FAIRCHILD 2102 LIPC	1.35

IMSAI 8080 Kit with 22 Slot M.B.

\$560.00

plus \$10.00 shipping.

HOW TO ORDER

Send check or money order, include \$2.00 shipping per order. N.Y.S. Residents include tax.

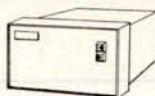
For technical assistance call or write to:

ITHACA AUDIO

P.O. Box 91
Ithaca, New York 14850
Phone: 607/273-3271



TAPE DRIVES

MODEMS AND
PHONE COUPLERS

SELECTRIC TERMINALS



**NO RISK! 7 DAY
APPROVAL ON ALL
MAIL-ORDERS. FULL
REFUND ON RETURNS.**



MODEMS: High-quality Bell 103 & Bell 202 styles by VADIC Corp. in an attractive desk-top case. EIA std RS-232 connectors permit choice of phone access via acoustic coupler, manual Data Access Arrangement or Auto-Answer DAA (sold separately.) Fully assembled & tested; up to 3,000 mile range over unconditioned phone lines.

Bell 103:

0-300 Baud, full-duplex, asynchronous serial data transmission; includes Auto-Answer.

Prices:

Standard Features	\$149.95
VADIC PCB only w/ interface instructions	\$ 89.95
Acoustic Coupler	\$ 29.95
DAA Kit (private line only)	\$ 14.95

Bell 202:

0-1200 Baud rate, half-duplex operation over 2-wire lines; 0-1800 Baud full-duplex over 4-wire conditioned lines. Reverse Channel included.

Standard Features	\$219.95
Standard Features, with Auto-Answer	\$249.95
VADIC PCB only, with interface instructions, with Reverse Channel, Manual DAA	\$149.95
with Reverse Channel, Auto Answer	\$179.95

CONVERT IBM OFFICE SELECTRIC to I/O Typewriter: solenoids, switches, wire harness, magnet driver PCB with instructions #8080 Interface Diag. \$150.00

FORMS TRACTORS, Moore Variable-width "Form-A-Line"

for 15" Carriage IBM SELECTRICS \$ 50.00

for DIABLO HYTYPE I PRINTERS \$ 90.00

AMPEX MODEL TMX TAPE DRIVES: Ideal for microcomputerist who wants backup mass storage or access to IBM-type systems via standardized 2400 series 1/2" mag tape.

Specs: 9-track, NRZ1 standard, 800 BPI, 12"/sec., 1200 ft. reels (11 megabyte capacity.) Drive is like new & comes with 8-bit CPU controller diagram (requires only 11 I/C's) & MCPU interface instructions.

Prices: Drive & Documentation	\$750.00
Controller & cable for MCPU, assembled & tested	\$200.00
Hi-speed search option: controller moves drive at 72"/sec	\$ 50.00
Software listing to read std IBM tapes, translate to ASC II	\$ 50.00

SELECTRIC I/O TERMINALS (by GTE/Information Systems). Both ASC II & IBM code versions with microcomputer interface software & hardware (single EIA std RS-232 connector.) Cassette drive models permit up to 2400 baud data transfer rate as well as off-line data storage, use as memory typewriter, & use as data entry device for office personnel familiar with Selectric Typewriters but not computers. Wide-carriage; interchangeable type spheres; optional built-in modem. All units cleaned, adjusted & warranted.

Model 5541	\$695.00
Model 5550 (corres. code, built-in cassette drive)	\$1195.00
Model 5560 (ASC II code, built-in cassette drive)	\$1295.00

IBM SELECTRIC APL TYPE SPHERES (Specify EBCDIC or Correspondence Code). new \$15.00

Call or write for details, quantity discounts, and our CATALOG. See recent issues of BYTE for a list of other products and prices (including tape drives, power supplies, form tractors, paper tape readers, video monitors, ASC II encoded keyboards, Selectric & Diablo Terminals, etc.)

90 day warranty against defects in material or workmanship on all used equipment. Full documentation

PACIFIC OFFICE SYSTEMS, INC.

2600 El Camino Real, Suite 502

Palo Alto, Calif. 94306

(415) 321-3866

included PLUS interface instructions where indicated. Availability subject to prior sale. Prices may change without notice.

All orders shipped from stock. No back orders, no substitutions. All equipment is shipped insured FOB Palo Alto within 14 days after check clears or COD order is received. M/C & VISA accepted.

★ YOUR BEST BUY IN WIRE WRAP SUPPLIES ★

PRECUT WIRE

WHY BUY WIRE ON ROLLS?

PRECUT & STRIPPED WIRE IS:

- **Fast** - No more cutting & stripping by hand
- **Reliable** - Good, clean, uniform strip
- **Economical** - Cheaper than using bulk wire

Precut Wire

100 pcs of 3" at \$82 + 3 1/4"/ft. 50 ft roll at \$199 = 44"/ft.
100 pcs of 6" at 1 06 + 24"/ft. 100 ft. roll at 2 95 = 36"/ft.
Wire Kit 1 at \$6 95 = 2 1/2"/ft.

Bulk Wire

100 pcs of 3" at \$82 + 3 1/4"/ft. 50 ft roll at \$199 = 44"/ft.
100 pcs of 6" at 1 06 + 24"/ft. 100 ft. roll at 2 95 = 36"/ft.
Wire Kit 1 at \$6 95 = 2 1/2"/ft.

* 30 Kynar stripped 1" on each end. Lengths are overall. Colors: Red, Blue, Green, Yellow, Black, Orange, White. Wire packaged in plastic bags. Add 25¢/length for tubes.

	100	500	1000	5000
2 1/2 in	78	240	430/K	3.88/K
3 in	82	260	471/K	4.22/K
3 1/2 in	86	280	512/K	4.55/K
4 in	90	300	552/K	4.88/K
4 1/2 in	94	321	593/K	5.21/K
5 in	98	342	634/K	5.52/K
5 1/2 in	102	365	675/K	5.85/K
6 in	106	385	716/K	6.19/K
6 1/2 in	110	405	757/K	6.52/K
7 in	114	425	798/K	6.85/K
7 1/2 in	118	445	839/K	7.18/K
8 in	122	465	880/K	7.53/K
8 1/2 in	126	485	921/K	7.84/K
9 in	130	505	962/K	8.17/K
9 1/2 in	134	525	1003/K	8.50/K
10 in	138	545	1044/K	8.83/K
Add. inches	10	41	82/K	66/K

WIRE KITS

#1 \$6.95

#2 \$19.95

250 3" 100 4 1/2"	250 2 1/2" 250 4 1/2"	250 6"
250 3 1/2" 100 5"	300 3" 250 5" 100 6 1/2"	
100 4" 100 6"	500 3 1/2" 100 5 1/2" 100 7"	
	500 4" 1 250 ft. Roll Bulk	

Choose One Color or Assortment

SOLDERLESS BREADBOARDS

2.2" x 6.5"

SK 10 \$16.50

INCLUDING:
Over 100 pieces of precut wire in assorted lengths — free!
Choose 1 color: Red, Black, Blue, Yellow, Green, White, Orange Or Assortment.

**INTERCONNECT CABLES**

Ribbon cable connectors for connecting boards to front panels, or board to board

SINGLE ENDED**DOUBLE ENDED**

	14 pin	16 pin	24 pin	14 pin	16 pin	24 pin
6"	1.24	1.34	2.05	2.24	2.45	3.37
12"	1.33	1.44	2.24	2.33	2.55	3.92
24"	1.52	1.65	2.63	2.52	2.76	4.31
48"	1.91	2.06	3.40	2.91	3.17	5.08

WIRE WRAP TOOLS

\$34.95

With Free Wire Kit 1 (\$6.95 Value)

HOBBY WRAP

Model BW 630

Batteries & Charger

\$11.00

WSU 30 Hand Wrap-Unwrap Strip Tool

6.25

WSU 30M, for Modified Wrap

7.25

BT 30 Extra Bit

2.95

**WIRE WRAP SOCKETS**

	1-9	10-24	25-99	100-249	250-999	1K-5K
8 pin	.35	.33	.31	.29	.25	.23
14 pin	.35	.33	.31	.29	.28	.27
16 pin	.37	.35	.33	.31	.30	.29
18 pin	.60	.55	.45	.43	.40	.37
20 pin	.84	.78	.71	.63	.59	.54
22 pin	.90	.85	.82	.78	.70	.60
24 pin	.91	.84	.78	.68	.64	.59
25 pin strip	1.25	1.05	.95	.80	.70	.65
28 pin	.95	.89	.84	.80	.76	.74
40 pin	1.50	1.40	1.30	1.20	1.05	.90

Gold 3-Level Closed Entry Design.

* End & Side Stackable.

All prices include Gold.

2 Level Sockets Also Available.

EDGE CARD CONNECTOR

SALE!

44 Pin	Solder Tail	\$1.75	\$15/10
100 Pin	Solder Tail	3.50	\$30/10
100 Pin	Wire Wrap	3.50	\$30/10

All connectors include Gold.

PAGE DIGITAL ELECTRONICS

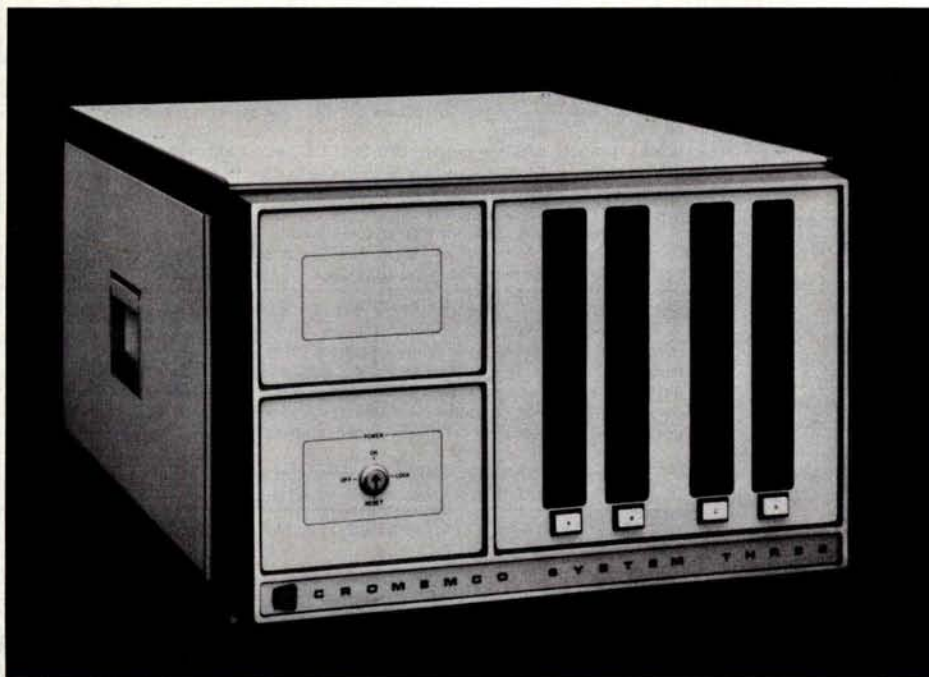
Ordering Information:

- Orders under \$25 and COD's, add \$2
- All others, shipped Ppd in U.S. via UPS
- For Blue Label (Air) or 1st Class, add \$1
- We accept Visa & Mastercard
- Most orders shipped same day

135 E. Chestnut Street 5
Monrovia, California 91016
Phone (213) 357-5005

Dealer Inquiries Invited

Cromemco Features a Z-80 Based Microcomputer



Cromemco's System Three is ideal for a wide range of professional work in almost any field. It consists of a 4 MHz

Z-80 based microcomputer, 32 K bytes of programmable memory (two 16 K byte cards) expandable to 512 K bytes,

an RS-232 interface, a parallel printer interface, a video terminal with line editing and block mode transfer capabilities, and a fast line printer with 132 columns.

System Three is available with a number of options including a programmable read only memory programmer for development work, an additional dual disk drive and additional memory. With the optional second disk drive, System Three provides a megabyte of disk storage.

It has several provisions for protection of disks including software control for ejection of disks if desired, a key switch that will disable the disk eject buttons when in the LOCK position and motor driven disk loading and unloading.

Currently available software includes a FORTRAN IV compiler, a 16 K byte Z-80 BASIC, and a Z-80 macroassembler and linking loader. All software is available on standard, IBM format, soft sector diskettes.

The System Three mainframe is available for \$5990. The additional video is available in two models for either \$1595 or with expanded capabilities including line editing and block mode transfer for \$1995. The additional line printer is also available in two models including a 180 character per second model for \$2995 and a 60 character per second model for \$1495. For more information, contact Cromemco Inc, 280 Bernardo Av, Mountain View CA 94040.■

Circle 601 on inquiry card.

Compucolor Introduces Series of Color Home Computer Systems



The Compucolor II is a personal computer system available in five models,

with its own 8 color, 13 inch (33.02 cm) diagonal display, a typewriter-like keyboard with 3 key rollover, 8080A processor, 4 K bytes to 16 K bytes memory (depending on the model), and a built-in minidisk drive mass storage device. The Compucolor II utilizes BASIC 8001, a conversational programming language with English-type statements and familiar mathematical notations.

Games like Star Trek, Blackjack, Chess, Checkers, Othello, and educational games for youngsters are available on diskettes. In addition, there are programs available for checkbook balancing and income tax compilation.

Prices for the Compucolor II range from \$795 to \$1995. Further information can be obtained from Compucolor Corp, POB 569, Norcross GA 30091.■

Circle 602 on inquiry card.

New Microcomputer Based on TI TMS 9900



The SS-16, a 16 bit microcomputer based on the Texas Instruments TMS 9900, has been introduced by Technico Inc, 9130 Red Branch Rd, Columbia MD 21045. System memory is expandable up to 64 K bytes, and the unit is available with dual floppy or minifloppy disks. Expansion cards provide up to six RS-232 and 20 mA current loop interfaces. Also available are a 64 color video board and a 128 bit parallel input and output board, a complete editor, assembler, linking loader and BASIC. European 220 V, 50 Hz models are also available.■

Circle 603 on inquiry card.

S-100 Microcomputer Price Reduction

Quay Corp, POB 386, Freehold NJ 07728, has announced that its Q80A1, Z-80 based, S-100 compatible microcomputer has been reduced in price. The Q80A1, formerly priced at \$550, is now available, factory assembled and tested for \$350. The unit includes 1 K byte

static programmable memory, 1 K byte programmable read only memory resident monitor, on board programmable read only memory programmer, keyboard interface and serial (RS232C/TTY) input and output (IO).

Quay has also package priced the

Q80A1, the Q80SMB (8 K byte static memory board) and the Q-TBPE-80 (Palo Alto Tiny BASIC-extended) to sell for \$495.■

Circle 604 on inquiry card.

California Digital

Post Office Box 3097 B • Torrance, California 90503

CLARE-PENDAR General Instrument Corp. KEYBOARD ASCII ENCODED



63
KEY \$64.95



This is a one time purchase of NEW Surplus keyboards, recently acquired from the Telecommunications Division of the Singer Corporation. The keyboard features 128 ASCII characters in a 63 key format. MOS encoder circuitry "N" key rollover, lighted shift lock, control, escape and repeat functions. Sloped pannel and positive feel switches, makes this professional quality keyboard an excellent buy at only \$64.95. Limited Quantities.

S-100 Mother Board

Quiet
Buss™

\$2995

18 slot
IMSAI



HEXADECIMAL KEYBOARD

Maxi-Switch hexadecimal keyboards are designed for microcomputer systems that require 4-bit output in standard hex code.

Each assembly consists of 16 hermetically sealed reed switches and TTL "one shot" debounce circuitry.

Patented low friction acetal resin plungers are credited for the smooth operation and long life of this premium keyboard.

Requires single +5 volt supply.



TELETYPE MODEL 43

New from Teletype, the Model 43 is capable of printing 132 ASCII characters per line. Send and receive data at 10 or 30 char. per second. Keyboard generates all 128 ASCII code combinations. RS-232 interface, same as the popular Model 33. Data sheet sent upon request. Manufacturer suggested price \$1377.00.

IMMEDIATE DELIVERY \$1219

TTL model with NOVATION brand Acoustic Modem. \$1419



DIGITAL ALARM CLOCK

Completely Assembled \$1995



Walnut-grained decorator clock features large 7" LED display which is driven by the new National MM5385 alarm clock chip. Preset 24-hour alarm function allows you to awaken at the same time each morning without resetting. Upon reaching the wake-up time, the clock's loudspeaker emits a gentle tone. Touch the snooze button and doze off for an additional 9 minutes of sleep. Clock also functions as a ten-minute elapse timer. "Alarm Set" indicator, AM-PM display.

CONNECTORS



your choice
DB25P
male plug & hood
or
DB25S female
\$395

Qty. fe. male hd.
10 3.45 2.45 1.15
25 3.15 2.25 1.05
100 2.85 1.90 .95
500 2.25 1.60 .85
1K 1.97 1.37 .75

Edge Connectors



GOLD
100 PIN
IMSAI/ALTAIR

Imesai solder .125x.250 \$4.95 3/\$10.00
Imesai w/w .125centos \$4.95 3/\$13.00
Altair solder tail .140 row \$5.95 3/\$15.00
SPECIALS
22/44 Kim eyelet .156" \$1.95 3/\$5.00
25/50 solder tab .156" \$1.95 3/\$2.00
36/72 wide post w/w .156" \$1.95 3/\$5.00



UNIVAC
KEYBOARD

The famous Sperry Univac 1710 Hollerith keyboard assembly is now available from California Industrial for only \$24.88. The ideal computer input device for accountants and mathematicians. The numeric keys are placed on the lower three rows to resemble a ten key adding machine. This format shows one handed numeric data entry. Original cost was \$185. Used but guaranteed in excellent condition. Complete with documentation.

FROM ATARI COLOR TELEVISION R.F. MODULATOR



SPECIAL APPLE II 16K MEMORY

COLOR • GRAPHICS • SOUND
\$1024
Mfg. Sug. Retail... \$1195

\$498
10 for \$45.

Scotch® CASSETTES

Certified Digital
Won't drop a BIT!



DISKETTES
8inch Soft (IBM)
8inch 32 sector
Mini Soft sec.
Mini 10 sector
Mini 16 sector

\$550
CALIFORNIA
INDUSTRIAL
is an
Authorized
Dealer of
Scotch Brand
Data Products

JOYSTICK \$4.50



450ns
\$995
8K UV Erasable
MEMORY

LED DIGITAL
Darkroom
Timer • Kit
As featured in the August 78 issue
of POPULAR ELECTRONICS.
Time 1 second to 10 hours
\$34.95 information
upon request.

S-100 PROTOTYPE BOARD
\$1998
Maximum design versatility along with standard address decoding and buffering for S100 systems. Room for 32 uncommitted 16 pin IC's. 5 bus buffer & decoder chips. 1 OR address select switch, a 5 volt regulator and more. VW100-Wire wrap breadboard, similar to the GP100. Allows wire wrap of all sizes of sockets in any combination. An extra regulator position for multiple voltage applications.

2102
LOW POWER
450 NS
\$119
SUPER BUY!

MEMORY
7496 1.99
7497 3.99
74100 1.15
74107 3.99
74109 3.99
74110 1.75
74111 1.99
74112 1.75
74113 1.99
74114 1.99
74115 1.99
74116 1.99
74117 1.99
74118 1.99
74119 1.99
74120 1.99
74121 1.99
74122 1.99
74123 1.99
74124 1.99
74125 1.99
74126 1.99
74127 1.99
74128 1.99
74129 1.99
74130 1.99
74131 1.99
74132 1.99
74133 1.99
74134 1.99
74135 1.99
74136 1.99
74137 1.99
74138 1.99
74139 1.99
74140 1.99
74141 1.99
74142 1.99
74143 1.99
74144 1.99
74145 1.99
74146 1.99
74147 1.99
74148 1.99
74149 1.99
74150 1.99
74151 1.99
74152 1.99
74153 1.99
74154 1.99
74155 1.99
74156 1.99
74157 1.99
74158 1.99
74159 1.99
74160 1.99
74161 1.99

SPECIAL SPECIAL SPECIAL
Only 10,000 Available
NE555H
Leads fan out to fit
Mini-DIP socket.
3 for \$98
25 for \$7.00 • 100 \$19.50

Digital Cassette Drive COMPUTER CONTROLLED



\$7950
This precision I/O assembly features remote software controlled search capabilities. Two independent capstan drive motors allow the computer to control direction and speed of the transport. The assembly consists of a Raymond cassette transport, chassis, motherboard and three edge cards: read/write, capstan drive & control card. Current replacement valued at over \$700.00. Schematics and complete documentation included. USED, but in excellent condition.



Thumbwheel
switch
Ten position
BCD
\$139 ea.
10 50
31.19 .89
CAPACITORS



MINIATURE
SWITCHES
your choice
10 50 100 1k
\$98 \$88.81 .73 .66
SPDT Miniature Toggles
7101 C&K ON-NONE-ON
7107 J&H ON-OFF (mt. ON)
7108 CK ON-(moment. ON)
Rocker 1BT DPDT
Rotary 3P-4-Pos.
Rotary 3P-6-Pos.
Push B (N.O.) \$39ea. 4/\$1

California Digital Inc.

NAME CHANGE

Since the inception of our organization in 1968, we have strived to offer our customers the highest quality electronic and industrial products at competitively low prices. In the past several years our focus has narrowed to primarily computer and digital related products. Appropriately the name CALIFORNIA DIGITAL evolved.

All of us at California Digital want to thank you for your continued patronage.

UART
AY 5-1013A
\$4.98

SPECIAL
GENERAL INSTRUMENT ASCII Keyboard Encoder
AY 5-3600 Prime but house marked only \$4.95

7400	13	7442	39	350N	95
7401	19	7443	39	351CN	95
7402	19	7444	1.29	370H	1.29
7403	19	7445	1.29	370N	1.29
7404	19	7446	1.29	373N	1.29
7405	19	7447	1.29	377N	1.29
7406	19	7448	1.29	380N	1.29
7407	19	7449	1.29	381N	1.29
7408	19	7450	1.29	NE555V	1.29
7409	19	7451	1.29	NE555H	1.29
7410	19	7452	1.29	NE565H	1.29
7411	19	7453	1.29	NE565N	1.29
7412	19	7454	1.29	NE566N	1.29
7413	19	7455	1.29	NE566V	1.29
7414	19	7456	1.29	NE567N	1.29
7415	19	7457	1.29	NE567V	1.29
7416	19	7458	1.29	NE568N	1.29
7417	19	7459	1.29	NE568V	1.29
7418	19	7460	1.29	NE569N	1.29
7419	19	7461	1.29	NE569V	1.29
7420	19	7462	1.29	NE570N	1.29
7421	19	7463	1.29	NE570V	1.29
7422	19	7464	1.29	NE571N	1.29
7423	19	7465	1.29	NE571V	1.29
7424	19	7466	1.29	NE572N	1.29
7425	19	7467	1.29	NE572V	1.29
7426	19	7468	1.29	NE573N	1.29
7427	19	7469	1.29	NE573V	1.29
7428	19	7470	1.29	NE574N	1.29
7429	19	7471	1.29	NE574V	1.29
7430	19	7472	1.29	NE575N	1.29
7431	19	7473	1.29	NE575V	1.29
7432	19	7474	1.29	NE576N	1.29
7433	19	7475	1.29	NE576V	1.29
7434	19	7476	1.29	NE577N	1.29
7435	19	7477	1.29	NE577V	1.29
7436	19	7478	1.29	NE578N	1.29
7437	19	7479	1.29	NE578V	1.29
7438	19	7480	1.29	NE579N	1.29
7439	19	7481	1.29	NE579V	1.29
7440	19	7482	1.29	NE580N	1.29
		7483	1.29	NE580V	1.29
		7484	1.29	NE581N	1.29
		7485	1.29	NE581V	1.29

50
Conductor
RIBBON WIRE
TWISTED PAIR
\$69

Power Adapter
6vdc, 140mA \$1.39
7vdc, 1.4 A. 5.50
9vdc, 15mA. 1.19
10 vdc, 300mA. 1.95

Page Wire Wrap Kits
precut & stripped
KIT No.1 \$6.95
900 Assorted Lengths
KIT No.2 \$19.95
2800 Assorted Lengths
250' Bulk Wire

.1 disc \$12.09 .07
.01 disc .06 .05 .04

DIP Switch
\$149 10 25 100 1k
specify for 8 pos.

Transistors
ea. 10 50 100
2N2222A .20 .18 .16 .15
2N3055 .69 .65 .59 .55
MJ3055 .79 .75 .69 .65
2N3772 .15 .14 .13 .12
2N3904 .15 .11 .09 .07
2N3906 .15 .11 .09 .07

Output:
12v.ct. 175mA.
TRANSFORMER
\$98

9 foot
Heavy
duty grounded
power cord and mating
chassis connectors.
\$149

TRIMMER
POTENTIOMETERS
2K 5K 10K 50K
5 for \$98

DISCOUNT
Wire Wrap Center

Diodes
ea. 10 25 100
1N4002 100v. .08 .06 .05
1N4005 600v. .10 .08 .07
1N4148 signal .07 .05 .04

LED's
jumbo red ea. 10 25 100
\$15.13 .11 .09

PANASONIC
\$98
Nicaid
"A"
450mA.

IC SOCKETS
wire wrap low profile
pin ea. 25 50 ea. 25 50
8 17: 16 15
14 37: 36 35 18 17 16
16 38 37 36 19 18 17
24 99 93 85 36 35 34
40 169 155 139 63 60 58

KYNAR WIRE
500 1,000 11,000
\$.95 \$15. \$105.
\$545

(213) 679-9001

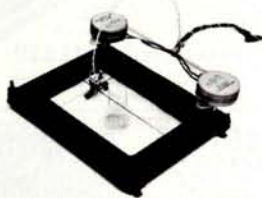
All merchandise sold by California Industrial is premium grade.
Orders are shipped the same day received.
PLEASE INCLUDE \$1.00 SHIPPING ON ORDERS UNDER \$15.00
California residents add 6% sales tax + Money Back Guarantee.
Sorry, no COD's • Foreign orders add 10%
Credit cards accepted, \$20 minimum



Circle 39 on inquiry card.

DIGITAL PLOTTER

FEATURING THE IEEE 488 BUSS
THE RS 232 SERIAL DATA INPUT
INTERFACE OPTIONS
OR DIRECT FROM ANY TTL PORT



BASIC AND MACHINE LISTING
SOFTWARE FURNISHED

KIT IS \$ 195

ASSEMBLED - TESTED \$ 249,

WRITE FOR DETAILS TO
X-Y ENTERPRISES P.O. BOX 796
HUNTSVILLE ALA. 35804

Circle 397 on inquiry card.

SURPLUS ELECTRONICS

ASCII



ASCII

IBM SELECTRIC[®]
BASED I/O TERMINAL
WITH ASCII CONVERSION
INSTALLED \$695.00

- Tape Drives • Cable
- Cassette Drives • Wire
- Power Supplies 12V15A, 12V25A, 5V35A Others, • Displays
- Cabinets • XFMRs • Heat Sinks • Printers • Components

Many other items

Write for free catalogue
WORLDWIDE ELECT. INC.
10 FLAGSTONE DRIVE
HUDSON, N.H. 03051

Phone orders accepted using VISA
or MC. Toll Free 1-800-258-1036
In N.H. 603-885-3705

Circle 395 on inquiry card.

MICRO-VERTER

A SPECIAL COLOR MODULATOR FOR APPLE II USERS!!
UHF Version. Operates above channel 14. Eliminates worms!

Operates above the switching harmonics of the computer, thereby yielding a cleaner, worm-free picture. Tunable over a minimum of 4 channels. Interfaces directly with the Apple II as well as most other micros. Comes with video cable and RF output stub coupler. Two-toned cow type decorator cabinet. Size: 5.5cm x 8.5cm x 11.5cm. Power: +5V. Current approx. 1 ma. Self-powered with 4 penicill batteries. Operating life in excess of 1000 hours or near shelf-life of batteries. Excellent stability. Precise frequency adjustment. No assembly required except for installation of batteries, not supplied. MODEL MVX-500.

AVAILABLE FROM YOUR LOCAL COMPUTER DEALER or direct from ATV RESEARCH. COST including shipping anywhere in USA and Canada — \$35.00.

"PIKE-PLEXER" An IC type video-to-RF modulator includes FM sound sub-carrier, color subcarrier and separate R-Y and B-Y inputs. Designed around the LM-1889 chip. A designer's dream with full data sheets. Model PX-P-4500. Kit form. \$24.50 postpaid.

"PIKE-VERTER" The original computer video-to-RF interface module. Kit form: \$8.50 Model PXV-2A

PHONE OR WRITE TODAY. DIAL 402-367-3771.

12-B Broadway ATV Research Dakota City, Nebr. 68731

Circle 22 on inquiry card.

CANADIANS

Announcing

HAMILTON LOGIC SYSTEMS

Specializing in logic devices, microprocessors, memories, TTL, Cmos, etc.

Send for your catalogue

Box 7

STONEY CREEK
ONTARIO L8G 3X7

Circle 157 on inquiry card.



The "EXTERMINATOR" by VAMP

All New Dual Function Board:
Serves as an extender card & also terminates S-100 bus. Eliminates crosstalk, overshoots & noise which can scramble data. Occupies only a single slot. Fully fused.

VTE-100 "Exterminator" \$49.95
Extender Card only -
with connector \$21.95
Add \$2 Shipping
6% Calif. Sales Tax.

VAMP Inc.
Box 29315
Los Angeles, Calif. 90029

Circle 386 on inquiry card.

NEW SURPLUS PRINTER

Okidata — CP 110 — Friction Feed
Un-Used, in O.E.M. Factory Cartons.

- 5x7 Impact Dot Matrix
- 80 Char/Line
- 64 Char ASCII
- 110 Char/Sec.
- 66 Lines/Min.
- Accepts 8 1/2" Roll paper



Includes — Power Supply, Built in Selftest, Parallel Interface, Line Buffer and Cables. Housed in a three piece plastic cabinet with all control electronics. Retail for over \$1,100

Our Price: 1 ea. \$650 10 up \$600 ea.
Operating Manual Included.

Service Manual \$20 Supplies Limited

Shipped Freight Collect. Send Check or M.O.
Sorry No Warranty Available at these Prices

INTERNATIONAL ELECTRONICS
EQUIPMENT CORP.

P.O. Box 522542, Miami, Florida 33152

Circle 177 on inquiry card.

PCE ELECTRONICS

S-100 KITS

16/4+1 EPROM/RAM BOARD KIT \$130⁰⁰

8K STATIC RAM KIT \$130⁰⁰

11 SLOT MOTHER BOARD with sockets \$80⁰⁰

48K DYNAMIC RAM KIT \$631⁰⁰

VERSAFLOPPY DISK CONTROLLER \$155⁰⁰

All kits are complete with
sockets and documentation.

prices subject to change

There is much more, including complete systems; for more information, write for our flyer.

PCE Electronics
4782 Dewey Drive
Fair Oaks Ca. 95628

- master charge • 5% for shipping, excess refunded
- visa •
- phone orders • calif residents add 6% sales tax (916)966-2208
- COD requires • all products 50% Deposit guaranteed

Circle 288 on inquiry card.

New!

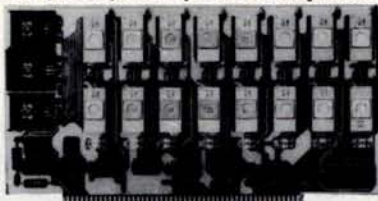
16K E-PROM CARD

IMAGINE HAVING 16K OF SOFTWARE ON LINE AT ALL TIME!

S-100 (Imsai/Altair) Buss Compatible!

KIT FEATURES:

1. Double sided PC board with solder mask and silk screen and gold plated contact fingers.
 2. Selectable wait states.
 3. All address lines & data lines buffered!
 4. All sockets included.
 5. On card regulators.
- KIT INCLUDES ALL PARTS AND SOCKETS (except 2708's). Add \$25. for assembled and tested.



PRICE CUT!

\$57.50 kit

SPECIAL OFFER:

WAS \$69.95

Our 2708's (450NS) are \$8.95 when purchased with above kit.

Fully Static!

KIT FEATURES:

1. Doubled sided PC Board with solder mask and silk screen layout. Gold plated contact fingers.
2. All sockets included.
3. Fully buffered on all address and data lines.
4. Phantom is jumper selectable to pin 67.
5. FOUR 7805 regulators are provided on card.

ADD
\$20 FOR
250NS

8K LOW POWER RAM KIT \$149.00

S-100 (Imsai/Altair) Buss Compatible!

2 KITS FOR \$279



USES 21L02 RAM'S!

Fully Assembled & Burned In
\$179.00

Blank PC Board w/ Documentation
\$29.95

Low Profile Socket Set 13.50

Support IC's (TTL & Regulators)
\$9.75

Bypass CAP's (Disc & Tantalums)
\$4.50

MOTOROLA QUAD OP - AMP
MC 3401. PIN FOR PIN SUB.
FOR POPULAR LM 3900.

3 FOR \$1

ALARM CLOCK CHIP
N.S. MM5375AA. Six Digits.
With full Data. **New!**
\$2.49 each

FULL WAVE BRIDGE
4 AMP. 200 PIV.
69¢ 10 FOR \$5.75

NOT ASSOCIATED WITH DIGITAL
RESEARCH OF CALIFORNIA, THE
SUPPLIERS OF CPM SOFTWARE.

MOTOROLA 7805R VOLTAGE REGULATOR
Same as standard 7805 except 750 MA output.
TO-220. 5VDC output.
44¢ each or 10 for \$3.95

450 NS! 2708 EPROMS
Now full speed! Prime new units from a major U.S. Mfg. 450 N.S.
Access time. 1K x 8. Equiv. to 4-1702 A's in one package.
~~\$15.75 ea.~~ **\$9.95** ~~4 FOR \$50.00~~
PRICE CUT

SALE! 16K DYNAMIC RAM CHIP

16K X 1 Bits. 16 Pin Package. Same as MOSTEK 4116-4. 250 NS access. 410 NS cycle time. Our best price yet for this state of the art RAM. 32K and 64K RAM boards using this chip are readily available. These are new, fully guaranteed devices by a major mfg.

VERY LIMITED STOCK!

\$17.95 EACH

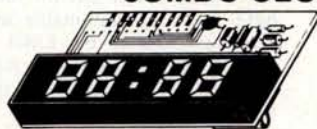
8 FOR \$129

4K STATIC RAM'S
2114. The new industry standard. Arranged as 1K x4. Equivalent to 4-21 L02's in 1 package! 18 pin DIP. 2 chips give 1Kx8.
2/\$19 8 FOR 69.95

OPCOA LED READOUT
SLA-1. Common Anode.
.33 inch character size.
The original high efficiency LED display. 75¢ ea.
4 FOR \$2.50

Z-80 PROGRAMMING MANUAL
By MOSTEK, or ZILOG. The most detailed explanation ever on the working of the Z-80 CPU CHIPS. At least one full page on each of the 158 Z-80 instructions. A MUST reference manual for any user of the Z-80. 300 pages. Just off the press.
\$12.95

NATIONAL SEMICONDUCTOR JUMBO CLOCK MODULE



ASSEMBLED! NOT A KIT!

ZULU VERSION!
We have a limited number of the 24 HR Real time version of this module in stock
#MA1008D — \$9.95

\$6.95

2 FOR \$13

(AC XFMR \$1.95)

PERFECT FOR USE WITH A TIMEBASE.

COMPARE AT UP TO TWICE OUR PRICE!

MANUFACTURER'S CLOSEOUT!

MA1008A
BRAND NEW!

- FEATURES
- FOUR JUMBO 1/2 INCH LED DISPLAYS
 - 12 HR REAL TIME FORMAT
 - 24 HR ALARM SIGNAL OUTPUT
 - 50 OR 60 HZ OPERATION
 - LED BRIGHTNESS CONTROL
 - POWER FAILURE INDICATOR
 - SLEEP & SNOOZE TIMERS
 - DIRECT LED DRIVE (LOW RFI)
 - COMES WITH FULL DATA

SALE!
1N4148 DIODES. SILICON.
Same as 1N914. New, factory prime, Full Leads.
100 FOR \$2
1000 FOR \$17.50

New! REAL TIME
Computer Clock Chip
N.S. MM5313. Features BOTH 7 segment and BCD outputs. 28 Pin DIP. \$4.95 with Data



MICRO-MINI TOGGLE SWITCH

SPDT. By RAYTHEON. MADE IN USA! WITH HDWR.

99¢ EACH

6 FOR \$5

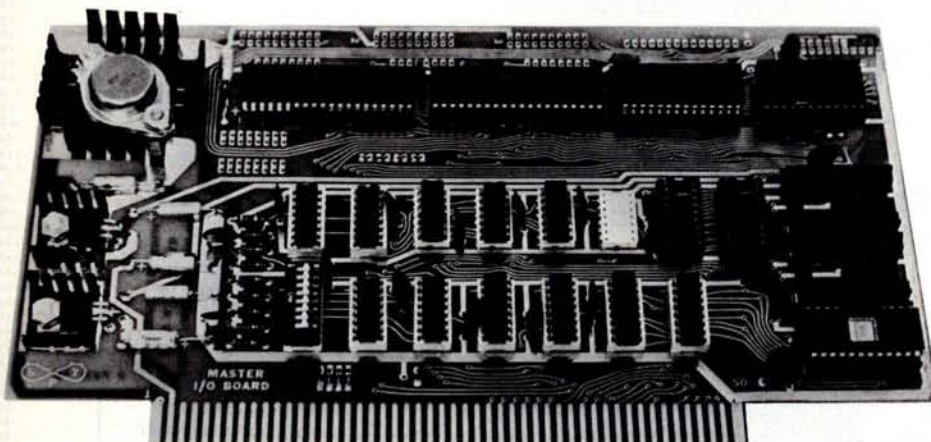
Digital Research Corporation

(OF TEXAS)

P. O. BOX 401247Y GARLAND, TEXAS 75040 • (214) 271-2461

TERMS: Add 30¢ postage, we pay balance. Orders under \$15 add 75¢ handling. No C.O.D. We accept Visa, MasterCard, and American Express cards. Tex. Res. add 5% Tax. Foreign orders (except Canada) add 20% P & H. 90 Day Money Back Guarantee on all items.

S-100 IO Read Only Memory Board



The Master IO contains enough read only memory and IO to allow a 2 board S-100 system and can be used to emulate the Intel SBC IO functions. This board can replace a real time clock, a fre-

quency and period counter, programmable read only memory and programmable memory, and parallel and serial IO cards.

Besides 1 K bytes programmable

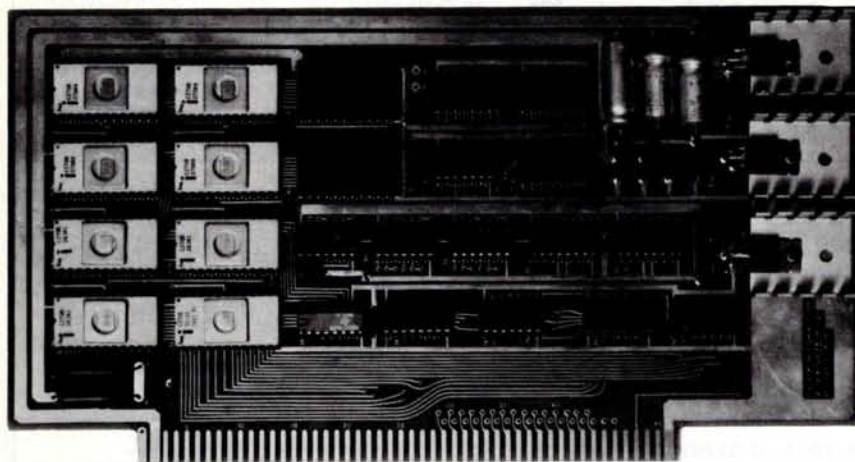
memory and 3 K read only memory, the board has the following peripheral chips: two 8255s which can be programmed to be input ports, output ports, handshaking ports and a bidirectional data port. One of the ports on each chip can use bit and reset commands. Each 8255 has a total of 24 possible IO lines. One 8253 has three 16 bit counters and timers in each chip. Each counter and timer can be programmed to be a binary counter or a binary coded decimal counter, a programmable one shot, a digital delay, a pulse wave rate generator (divide by N), a square wave rate generator, a software triggered strobe and a hardware triggered strobe.

The 8251 universal synchronous and asynchronous transceiver can be programmed for various clock division ratios. All the usual UART functions are available plus synchronous serial IO to 56 bps. One of the 8253 counters is dedicated to the USART (8251). This allows complete software programmability of bps rates. Over 60,000 bps data rates are available.

For further information, write to Space Time Productions, 2053 N Sheffield, Chicago IL 60614. ■

Circle 549 on inquiry card.

S-100 PROM Board



This programmable read only memory (PROM) board for the S-100 bus can

be used with eight 2708 type E read only memories with provisions for using

2716s or the pin compatible 8316 memories. This provides for a total storage capacity of 12 K bytes.

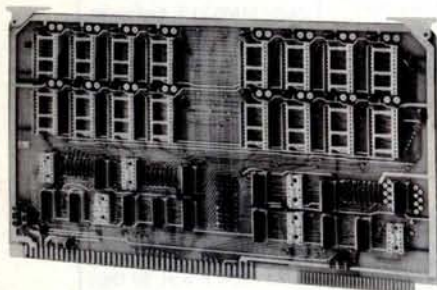
While the board is prejumped for the use of the programmable read only memories as a continuous block of memory, the address decoding scheme provides for using any programmable read only memory anywhere within the memory map. This addressing scheme provides monitors at both the low and high order end of the memory map.

The memory ready line is pulled low when slower memories are utilized. Three spare 16 pin pads are provided on board for user electronics.

The board is available in kit form, fully socketed at \$59.95; assembled and fully tested versions are also available at \$109.95. Bare boards can also be obtained. For further information contact Mini Micro Mart, 1618 James St, Syracuse NY 13203. ■

Circle 550 on inquiry card.

Memory Board Compatible with SBC 80 Multibus



This 32 K byte programmable read only memory board is compatible with

Intel's SBC 80 Multibus. The PROM-32 accepts 16 2716 erasable read only memories. All integrated circuits are socketed. Base addresses fall on 16 K byte boundaries and are jumper selectable. Any number of 2 K byte memory address blocks may be deselected by jumper removal. Memory access time is 475 ns maximum. The board uses 5 V at 0.38 A typical, and 0.72 A maximum fully loaded. The board is priced at \$195 in unit quantity and can be obtained from Electronic Solutions Inc, 7969 Engineer Rd, San Diego CA 92111. ■

Circle 553 on inquiry card.

EMM Cuts Prices on 2 K Static Memory

A major price cut on the 3539 2 K byte static programmable memory has been announced by EMM Semi Inc, 3883 N 28th Av, Phoenix AZ 85107. In quantities of 500, the price has been cut from \$7.80 to \$4.05.

The 3539 is a byte organized 256 by 8 static programmable memory comprising a small memory on an integrated circuit. It replaces the older 256 by 4 programmable memories (2101 and 2111) for many small memory applications, since only one component is required instead of two. For more information, contact EMM Semi Inc. ■

Circle 554 on inquiry card.

For free catalog including parts lists and schematics, send a self-addressed stamped envelope.

APPLE II SERIAL I/O INTERFACE *

Part no. 2

Baud rate is continuously adjustable from 0 to 30,000 • Plugs into any peripheral connector • Low current drain. RS-232 input and output • On board switch selectable 5 to 8 data bits, 1 or 2 stop bits, and parity or no parity either odd or even • Jumper selectable address • SOFTWARE • Input and Output routine from monitor or BASIC to teletype or other serial printer. • Program for using an Apple II for a video or an intelligent terminal. Also can output in correspondence code to interface with some selectrics. Board only — \$15.00; with parts — \$42.00; assembled and tested — \$62.00.



T.V. TYPEWRITER

Part no. 106

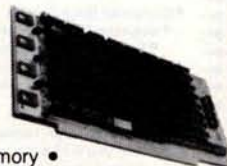
• Stand alone TVT • 32 char/line, 16 lines, modifications for 64 char/line included • Parallel ASCII (TTL) input • Video output • 1K on board memory • Output for computer controlled cursor • Auto scroll • Non-destructive cursor • Cursor inputs: up, down, left, right, home, EOL, EOS • Scroll up, down • Requires +5 volts at 1.5 amps, and -12 volts at 30 mA • All 7400, TTL chips • Char. gen. 2513 • Upper case only • Board only \$39.00; with parts \$145.00



8K STATIC RAM

Part no. 300

• 8K Altair bus memory • Uses 2102 Static memory chips • Memory protect • Gold contacts • Wait states • On board regulator • S-100 bus compatible • Vector input option • TRI state buffered • Board only \$22.50; with parts \$160.00



RF MODULATOR *

Part no. 107

• Converts video to AM modulated RF, Channels 2 or 3. So powerful almost no tuning is required. On board regulated power supply makes this extremely stable. Rated very highly in Doctor Dobbs' Journal. Recommended by Apple. • Power required is 12 volts AC C.T., or +5 volts DC • Board \$7.60; with parts \$13.50



MODEM *

Part no. 109

• Type 103 • Full or half duplex • Works up to 300 baud • Originate or Answer • No coils, only low cost components • TTL input and output-serial • Connect 8 ohm speaker and crystal mic. directly to board • Uses XR FSK demodulator • Requires +5 volts • Board \$7.60; with parts \$27.50



DC POWER SUPPLY *

Part no. 6085

• Board supplies a regulated +5 volts at 3 amps, +12, -12, and -5 volts at 1 amp. • Power required is 8 volts AC at 3 amps, and 24 volts AC C.T. at 1.5 amps. • Board only \$12.50; with parts excluding transformers \$42.50



TAPE INTERFACE *

Part no. 111

• Play and record Kansas City Standard tapes • Converts a low cost tape recorder to a digital recorder • Works up to 1200 baud • Digital in and out are TTL-serial • Output of board connects to mic. in of recorder • Earphone of recorder connects to input on board • No coils • Requires +5 volts, low power drain • Board \$7.60; with parts \$27.50



UART & BAUD RATE GENERATOR *

Part no. 101

• Converts serial to parallel and parallel to serial • Low cost on board baud rate generator • Baud rates: 110, 150, 300, 600, 1200, and 2400 • Low power drain +5 volts and -12 volts required • TTL compatible • All characters contain a start bit, 5 to 8 data bits, 1 or 2 stop bits, and either odd or even parity. • All connections go to a 44 pin gold plated edge connector • Board only \$12.00; with parts \$35.00 with connector add \$3.00



RS 232/TTL * INTERFACE

Part no. 232

• Converts TTL to RS-232, and converts RS-232 to TTL • Two separate circuits • Requires -12 and +12 volts • All connections go to a 10 pin gold plated edge connector • Board only \$4.50; with parts \$7.00 with connector add \$2.00



ELECTRONIC SYSTEMS

Dept. B,

P.O. Box 21638, San Jose, CA. USA 95151

To Order:

Mention part number and description. For parts kits add "A" to part number. In USA, shipping paid for orders accompanied by check, money order, or Master Charge, BankAmericard, or VISA number, expiration date and signature. Shipping charges added to C.O.D. orders. California residents add 6.5% for tax. Outside USA add 10% for air mail postage, no C.O.D.'s. Checks and money orders must be payable in US dollars. Parts kits include sockets for all ICs, components, and circuit board. Documentation is included with all products. All items are in stock, and will be shipped the day order is received via first class mail. Prices are in US dollars. No open accounts. To eliminate tariff in Canada boxes are marked "Computer Parts". Dealer inquiries invited. 24 Hour Order Line: (408) 226-4064



* Circuits designed by John Bell

**IT'S A GREAT BIG COMPUTER WORLD
But You Only Need
THE COMPUTER CORNER**

- SOL — A New Dawn is Here!
- COMMODORE PET & KIM
- NORTHSTAR HORIZON
- IMSAI VDP-80
- Memories & I/O Boards
- Computer Book Service
- Magnetic Tapes & Disks
- Full Line of Magazines
- Brain Games & Puzzles
- Workshops & Club Information

Visit **THE COMPUTER CORNER** for all your computer needs. Stop in and browse — you'll like our personal service.

THE COMPUTER CORNER
White Plains Mall — Upper Level
200 Hamilton Avenue
White Plains, New York 10601
Tel: (914) WHY - DATA

Ample Parking
10-6 Daily & Saturday
10-9 Thursday

Circle 65 on inquiry card.

**couplers
connect: always**



The Datec 30 Originate Only and the Datec 32 Originate Answer acoustic couplers provide reliable Bell System 103/113 compatible Duplex or Half-Duplex, 300 bps data communication over conventional telephones.

Datec acoustic couplers are the only couplers on the market with **CRYSTAL CONTROL** for both the receiver and the transmitter.

The Datec 30 and Datec 32 acoustic couplers connect, time and time again.

datec inc
P.O. Box 839
Chapel Hill, North Carolina 27514
phone: (919) 967-5605

Circle 83 on inquiry card.

**FORT LAUDERDALE AREA
COMPUTER AGE**

**MICROCOMPUTERS & PERIPHERALS
for HOME, SCHOOL & BUSINESSES**

We specialize in computer systems and provide a full range of computer services. Applications software for business including word processing, payroll and accounts receivable.
More to come.

DEALERS FOR

Apple Computers	Extensys
Micromation	Soroc
Hazeltine	Centronics
DEC	North Star
Problem Solvers	and Others
Cromemco	

999 South State Road 7 (441)
Plantation, Florida 33317
305-791-8080

Circle 47 on inquiry card.

**COMPUTER MART
of NEW HAMPSHIRE, Inc.**

* SPECIALIZING IN BUSINESS
AND PERSONAL COMPUTERS *

Featuring:

**DATA GENERAL microNOVA®
XITAN GENERAL
APPLE II**

S-100 Bus Products
SOFTWARE currently available:
AR, GL, AP, Inv., Payroll,
Word Processing, and Dental
Office Manager.

170 Main Street
Nashua, NH 03060
603/883-2386

microNOVA® is a registered
trademark of Data General Corp.

Circle 73 on inquiry card.

We ship from stock

TELETYPE MODEL 43 \$985
with RS 232 \$1,085

HAZELTINE

1500	Kit	\$895
1500		\$1,045
1510		\$1,165
1400		\$ 775

We ship 24 hours after receipt of
certified check or money order.
\$10 shipping charge.

OWENS ASSOCIATES
147 NORWOOD AVENUE
STATEN ISLAND, NEW YORK 10304

(212) 448-6283 (212) 448-6298

We have no reader inquiry number. Please write or call.
DAY, EVENING, WEEKEND CALLS WELCOME!

Dynamic RAM Breakthrough
16K Bits For \$15.95

The best current prices and better than you can expect to
beat for quite some time:

MC4116L-20 PRIME MOTOROLA DYNAMIC RAM (16 pin,
200ns access, 375ns cycle time, 70C, ceramic package,
gold pins, fully guaranteed) \$15.95 per chip. These plug
directly into your TRS-80 or APPLE computer. Data
sheet included with your order. For more than 100 units
call for quantity pricing.

S-100 64K MEMORY BOARD KIT (for 16K to 64K of
above chips) manuals, and all components except memory
chips \$125.

S-100 CONNECTORS, (used in excellent condition, some
with wire wrap wire) 3 level wire wrap, Imsei Spacing,
\$2.95 ea. 10 for \$27.00, 30 for \$75.00.

CARD GUIDES Ward (but very nice) with retaining clips
\$30 a pair.

Minimum order \$10.00. Mailcharge and Visa accepted.
For questions and charge orders (no COD) call Phil Apley
or David Lounie at (617) 242-3350.

Please add \$1.00 for shipping and handling on all orders.

Remit to:
The Memory Coop
144 MIT Branch
Cambridge MA 02138

Due to the unpredictability of the electronics marketplace prices
are subject to change without notice.

Circle 221 on inquiry card.

KIM SOFTWARE
9K MICROSOFT BASIC

Includes:

- Over 55 Commands
- Full String Handling
- 9 Digit Precision
- Hypertape Built-In
- 70 Page Manual

**SPECIAL
INCLUDES "DATA/SAVE"**
(added commands to record
both programs and data!)

KIM CASSETTE & MANUAL
\$100.00 prepaid

MICRO-Z COMPANY
Box 2426
Rolling Hills, CA 90274

Circle 228 on inquiry card.

**LSI-11 AND 6800
64KB MEMORIES**

CI-1103 — 8K words to 32K words in a
single option slot. Plugs directly into LSI
11, LSI 11/2, H11 & PDP 1103. Address-
able in 2K increments up to 128K. 8K x 16
\$390.00. 32K x 16 \$995.00 qty. one.

CI-6800 — 16KB to 64KB on a single
board. Plugs directly into Motorola's
EXORcisor and compatible with the eval-
uation modules. Addressable in 4K in-
crements up to 64K. 16KB \$390.00.
64KB \$995.00.

CI-8080 — 16KB to 64KB on a single
board. Plugs directly into Intel's MDS
800 and SBC 80/10. Addressable in 2K
increments up to 64K. 16KB \$390.00.
64KB \$995.00.

Tested and burned-in. Full year warranty.

Chrislin Industries, Inc.
Computer Products Division
31312 Via Colinas • Westlake Village, CA 91361
213-991-2254

Circle 46 on inquiry card.

**From the wonderful
folks who brought
you iCOM-CP/M!**

MICROPOLIS-CP/M*

Computer Mart now brings CP/M software to
MICROPOLIS users, giving the MICROPOLIS
disc owner the full capacities of CP/M, while
retaining full access to Micropolis' operating
system. PLUS — Direct load and start CP/M

- Automatic program execution
- Dynamic disc space allocation
- Random access on all files
- HIGH speed disc read and write
- Full compatibility with all other CP/M systems

Call us!

Dealer inquiries invited.

Computer Mart of New Jersey
501 Route 27, Iselin, NJ 08830 • 201-283-0600
Tue.-Sat. 10:00-6:00 • Tue. & Thur. til 9:00

Computer Mart of Pennsylvania
550 DeKalb Pike, King of Prussia, PA 19406 • 215-265-2580
Tue.-Thur. 11:00-9:00 • Fri. & Sat. 10:00-6:00

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

Circle 74 on inquiry card.

**NEW
ANNOUNCING**

The EW-2001 A "Smart" VIDEO BOARD KIT At A "Dumb" Price!

A VIDEO BOARD + A MEMORY BOARD + AN I/O BOARD – ALL IN ONE!

- STATE OF THE ART TECHNOLOGY USING DEDICATED MICROPROCESSOR I.C.
- NUMBER OF I.C.s REDUCED BY 50% FOR HIGHER RELIABILITY ■ MASTER PIECE OF ENGINEERING ■ FULLY SOFTWARE CONTROLLED

\$199.95

Priced at ONLY Basic Software Included

SPECIAL FEATURES:

- S-100 bus compatible
- Parallel keyboard port
- On board 4K screen memory (optional)* relocatable to main computer memory
- Text editing capabilities (software optional)
- Scrolling: up and down through video memory
- Blinking characters
- Reversed video
- Provision for on board ROM
- CRT and video controls fully programmable (European TV)

- Programmable no. of scan lines
 - Underline blinking cursor
 - Cursor controls: up, down, left, right, home, carriage return
 - Composite video
- *Min. 2K required for operation of this board.

DISPLAY FEATURES:

- 128 displayable ASCII characters (upper and lower case alphanumeric, controls)
- 64 or 32 characters per line (jumper selectable)
- 32 or 16 lines (jumper selectable)
- Screen capacity 2048 or 512
- Character generation: 7 x 11 dot matrix

OPTIONS:

- Sockets \$10.00
- 2K Static Memory (with Sockets) \$45.00
- 4K Static Memory (with Sockets) \$90.00
- Complete unit, assembled and tested with 4K Memory \$335.00
- Basic software on ROM . \$20.00
- Text editor on ROM \$75.00

DEALER

INQUIRIES WELCOMED

8080 SUPPORT

8212	.....	\$3.00
8214	.....	7.95
8216	.....	3.50
8228	.....	5.95
8251	.....	7.95
8255	.....	8.50

8080A CPU
\$7.75

RAM-2114

1Kx4 450ns
\$8.00

**GROUNDING
A.C. CORDS**
6 Ft. — \$1.19

WIRE WRAP WIRE
KYNAR 28 AWG
\$2.95/100 Feet
Blue, Red, White

**Computer Grade
Capacitors**
5000 mfd 60VDC
\$1.50

EDGE CONNECTOR WIRE WRAP PINS

44 Pin \$1.25 — 72 Pin \$1.75 — 100 Pin (S-100) \$5.45

MISC. IC's	CMOS	LINEAR I.C.'s	Transistors & Diodes
DM8810 3/\$1	4011 6/\$1.00	LM320K-5 .99	2N3906 7/\$1
DM8210 \$2 ea.	4022 2/\$1.70	LM320-12 .99	2N4400 9/\$1
N8T15 \$1 ea.	4023 4/\$1.00	LM709N 11/\$1	2N4403 9/1
9024 2/\$1.50	4071 5/\$1.00	LM710H 6/\$1	2N2222A 4/\$1
93L08 \$1.50 ea.		LM711H 6/\$1	1N4003 12/\$1
93L09 2/\$1.50		LM741M 7/\$1	1N4005 10/\$1
93L24 \$1 ea.			1N4148 14/\$1
			SCR 400V 4A, TO220 \$.80

SHIPPING: Keyboard and Video Board: \$3.50; OTHERS 1.25

California residents add 6% sales tax

ELECTRONICS WAREHOUSE Inc.

1603 AVIATION BLVD.
REDONDO BEACH, CA. 90278
TEL. (213) 376-8005

WRITE FOR FREE CATALOG

Minimum Order: \$10



ASCII KEYBOARD KIT \$74.00



**Additional Improvements: Double Size Return Key
Control Characters Molded on Key Caps**

- Power: +5V 275mA
 - Upper and Lower Case
 - Full ASCII Set
 - 7 or 8 Bits Parallel Data
 - Optional Serial Output
 - Selectable Positive or Negative Strobe, and Strobe Pulse Width
 - 2 Key Roll-Over
 - 3 User DEfineable Keys
 - P.C. Board Size: 17-3/16" x 5"
- OPTIONS:**
- Metal Enclosure Painted Blue and White \$27.50
 - 18 Pin Edge Con. \$ 2.00
 - I.C. Sockets \$ 4.00
 - Serial Output Provision (Shift Register) \$ 2.00
 - Upper Case Lock Switch for Capital Letters and Nos. \$ 2.00
 - Assembled (on Sockets) and Tested \$90.00

APPLE II I/O BOARD KIT

Plugs Into Slot of Apple II Mother Board

18 Bit Parallel Output Port
(Expandable to 3 Ports)

1 Input Port

15mA Output Current Sink
or Source

Can be used for peripheral
equipment such as printers,
floppy discs, cassettes,
paper tapes, etc.

1 free software listing for
SWTP PR40 or IBM selectric

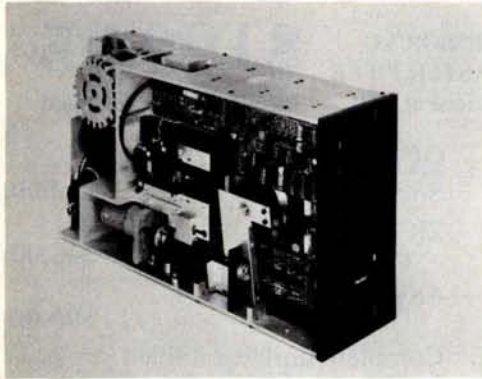
PRICE:

1 Input and 1 Output
Port for \$49.00

1 Input and 3 Output
Ports for \$64.00

Dealer Inquiries Invited

New 4 Headed Voice Coil Floppy



This 4 headed flexible disk drive stores up to 3.2 M bytes of data in the space required by a standard size floppy drive. The new PerSci Model 299 diskette drive interfaces to microcomputers using the 8080, 6800, or Z-80 processors, as well as minicomputers.

The Model 299 is a dual headed, dual diskette drive, reading and writing both sides of two 8 inch diskettes. Data can be encoded in single or double density in IBM compatible soft sector formats

or expanded hard and soft sector formats on IBM diskette I, II, IID or equivalent media. The drive will store up to 1 M byte of data in IBM type format, 1.6 M bytes unformatted single density and up to 3.2 M bytes in unformatted double density encoding.

PerSci's voice coil positioning system gives the PerSci drives an average seek time of 33 ms, five to seven times faster than stepper motor positioned drives. The speed and the capacity of the drive are achieved while maintaining industry standard data reliability figures of 1 in 10^9 soft errors and 1 in 10^{12} hard errors.

The Model 299 features electric auto-load and can be unloaded by remote, host software control. Optical write protect secures the file.

The PerSci 4 headed drive measures 4.38 by 8.72 by 15.4 inches (11.1 by 22.1 by 39.1 cm) so two drives can be mounted horizontally or four vertically in a 19 inch (48.3 cm) rack.

The price is \$1595 from PerSci Inc, 12210 Nebraska Av, W Los Angeles CA 90025. ■

Circle 525 on inquiry card.

A Low Cost Minifloppy System



Techtran's low cost minifloppy system, the 950 Microdisk, features over 200 K characters of storage. RS-232 or 20 MA current loop plug compatibility make the 950 a reasonable addition to timesharing and minicomputer or microcomputer based systems. The unit incorporates a Shugart drive and data can be recorded in either file or batch modes with the 950 automatically entering file names into the directory for total random access. Switch selectable data rates to 9600 bps supply fast on line or off line operations. A binary mode is an additional standard feature providing for code transparent applications.

The 950 is list priced at \$1395. Contact Techtran Industries Inc, 200 Commerce Dr, Rochester NY 14623, (716) 334-9640. ■

Circle 527 on inquiry card.

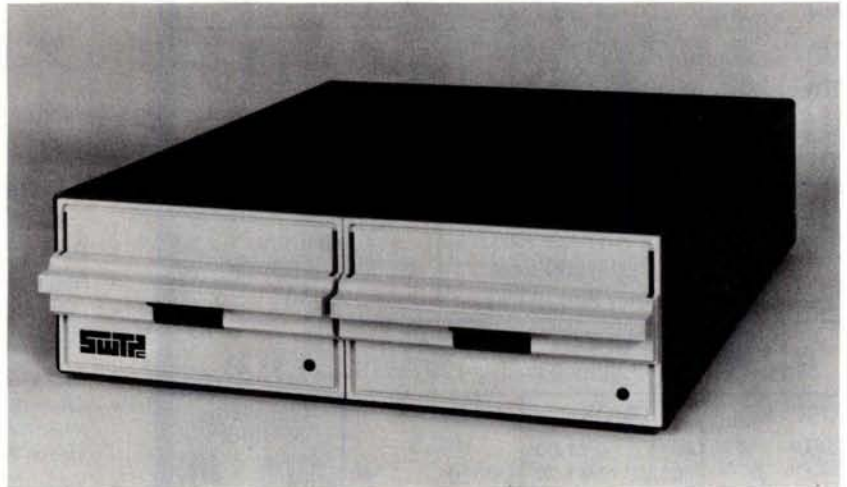
New Unbundled Floppy Disk Based Computer Systems



Two fully assembled unbundled floppy disk based computer systems have been announced by Ohio Scientific, 1333 S Chillicothe Rd, Aurora OH 44202. Both of these computer systems feature a 6502A processor, 16 K bytes of dynamic programmable memory and an 8 inch floppy disk drive and interface. Both systems have a full 8 slot backplane which will accommodate system expansion. The systems are available as C2-8SK which includes a standard RS-232 serial IO port for use with an external computer terminal and Model C2-8VS which includes a 32 by 64 (81.3 by 162.6 cm) character video display board and a keyboard. Only a video monitor is required to complete the system. Both systems come fully assembled with software and manuals but without cases or power supplies. The C2-8SK with serial interface is \$1590 and the C2-8VS with video interface is \$2090. ■

Circle 528 on inquiry card.

Floppy Disk System for SwTPC 6800



The Southwest Technical Products Corp DMAFI is a dual drive, single density, double sided 8 inch floppy disk system. The hardware consists of a SS-50 bus (SwTPC 6800) compatible direct memory access controller capable of handling up to four drives, two CalComp 143 M double density rated disk drives, 5 3/4 by 17 1/8 by 20 1/2 inch (14.5 by 43.5 by 52 cm) aluminum chassis, regulated power supply, drive motor control board, cooling fan, diskette and interfacing cables.

The supplied software includes a disk operating system. An 8 K byte BASIC

interpreter with disk file capability and string functions is also included with the system. Each diskette holds approximately 600 K bytes of data; with two drives there is over one megabyte of data online.

The system is available in assembled and kit form (the drives are fully assembled). The unit weighs approximately 45 lbs (20.4 kg) and sells for \$2095 assembled and \$2000 as a kit, plus postage. Contact Southwest Technical Products Corp, 219 W Rhapsody, San Antonio TX 78216. ■

Circle 526 on inquiry card.

DIODES/ZENERS				SOCKETS/BRIDGES				TRANSISTORS, LEDS, etc.			
1N914	100v	10mA	.05	8-pin	pcb	.20	ww	2N2222	NPN (2N2222 Plastic .10)		.15
1N4005	600v	1A	.08	14-pin	pcb	.20	ww	2N2907	PNP		.15
1N4007	1000v	1A	.15	16-pin	pcb	.20	ww	2N3906	PNP (Plastic - Unmarked)		.10
1N4148	75v	10mA	.05	18-pin	pcb	.25	ww	2N3904	NPN (Plastic - Unmarked)		.10
1N4733	5.1v	1 W Zener	.25	22-pin	pcb	.35	ww	2N3054	NPN		.35
1N753A	6.2v	500 mW Zener	.25	24-pin	pcb	.35	ww	2N3055	NPN 15A 60v		.50
1N758A	10v	"	.25	28-pin	pcb	.45	ww	T1P125	PNP Darlington		.95
1N759A	12v	"	.25	40-pin	pcb	.50	ww	LED Green, Red, Clear, Yellow			.15
1N5243	13v	"	.25	Molex pins	.01	To-3 Sockets	.25	D.L.747	7 seg 5/8" High com-anode		1.95
1N5244B	14v	"	.25	2 Amp Bridge		100-prv	.95	MAN72	7 seg com-anode (Red)		1.25
1N5245B	15v	"	.25	25 Amp Bridge		200-prv	1.95	MAN3610	7 seg com-anode (Orange)		1.25
								MAN82A	7 seg com-anode (Yellow)		1.25
								MAN74A	7 seg com-cathode (Red)		1.50
								FND359	7 seg com-cathode (Red)		1.25

C MOS				- T T L -							
4000	.15	7400	.10	7473	.25	74176	.85	74H72	.35	74S133	.40
4001	.15	7401	.15	7474	.30	74180	.55	74H101	.75	74S140	.55
4002	.20	7402	.15	7475	.35	74181	2.25	74H103	.55	74S151	.30
4004	3.95	7403	.15	7476	.40	74182	.75	74H106	.95	74S153	.35
4006	.95	7404	.10	7480	.55	74190	1.25			74S157	.75
4007	.20	7405	.25	7481	.75	74191	.95	74L00	.25	74S158	.30
4008	.75	7406	.25	7483	.75	74192	.75	74L02	.20	74S194	1.05
4009	.35	7407	.55	7485	.55	74193	.85	74L03	.25	74S257 (8123)	1.05
4010	.35	7408	.15	7486	.25	74194	.95	74L04	.30		
4011	.20	7409	.15	7489	1.05	74195	.95	74L10	.20	74LS00	.20
4012	.20	7410	.15	7490	.45	74196	.95	74L20	.35	74LS01	.20
4013	.40	7411	.25	7491	.70	74197	.95	74L30	.45	74LS02	.20
4014	.75	7412	.25	7492	.45	74198	1.45	74L47	1.95	74LS04	.20
4015	.75	7413	.25	7493	.35	74221	1.00	74L51	.45	74LS05	.25
4016	.35	7414	.75	7494	.75	74367	.75	74L55	.65	74LS08	.25
4017	.75	7416	.25	7495	.60			74L72	.45	74LS09	.25
4018	.75	7417	.40	7496	.80	75108A	.35	74L73	.40	74LS10	.25
4019	.35	7420	.15	74100	1.15	75491	.50	74L74	.45	74LS11	.25
4020	.85	7426	.25	74107	.25	75492	.50	74L75	.55	74LS20	.20
4021	.75	7427	.25	74121	.35			74L93	.55	74LS21	.25
4022	.75	7430	.15	74122	.55			74L123	.85	74LS22	.25
4023	.20	7432	.20	74123	.35	74H00	.15			74LS32	.25
4024	.75	7437	.20	74125	.45	74H01	.20	74S00	.35	74LS37	.25
4025	.20	7438	.20	74126	.35	74H04	.20	74S02	.35	74LS38	.35
4026	1.95	7440	.20	74132	.75	74H05	.20	74S03	.25	74LS40	.30
4027	.35	7441	1.15	74141	.90	74H08	.35	74S04	.25	74LS42	.65
4028	.75	7442	.45	74150	.85	74H10	.35	74S05	.35	74LS51	.35
4030	.35	7443	.45	74151	.65	74H11	.25	74S08	.35	74LS74	.35
4033	1.50	7444	.45	74153	.75	74H15	.45	74S10	.35	74LS86	.35
4034	2.45	7445	.65	74154	.95	74H20	.25	74S11	.35	74LS90	.55
4035	.75	7446	.70	74156	.70	74H21	.25	74S20	.25	74LS93	.55
4040	.75	7447	.70	74157	.65	74H22	.40	74S40	.20	74LS107	.40
4041	.69	7448	.50	74161	.55	74H30	.20	74S50	.20	74LS123	1.00
4042	.65	7450	.25	74163	.85	74H40	.25	74S51	.25	74LS151	.75
4043	.50	7451	.25	74164	.60	74H50	.25	74S64	.15	74LS153	.75
4044	.65	7453	.20	74165	1.10	74H51	.25	74S74	.35	74LS157	.75
4046	1.25	7454	.25	74166	1.25	74H52	.15	74S112	.60	74LS164	1.00
4049	.45	7460	.40	74175	.80	74H53J	.25	74S114	.65	74LS193	.95
4050	.45	7470	.45			74H55	.20			74LS367	.75
4066	.55	7472	.40							74LS368	.65

9000 SERIES				LINEARS, REGULATORS, etc.			
9301	.85	95H03	1.10	MCT2	.95	LM320T5	1.65
9309	.35	9601	.20	8038	3.95	LM320T12	1.65
9322	.65	9602	.45	LM201	.75	LM320T15	1.65
				LM301	.45	LM324N	1.25
				LM308 (Mini)	.95	LM339	.75
				LM309H	.65	7805 (340T5)	.95
				LM309K (340K-5)	.85	LM340T12	.95
				LM310	.85	LM340T15	.95
				LM311D (Mini)	.75	LM340T18	.95
				LM318 (Mini)	1.75	LM340T24	.95
				LM320K5(7905)	1.65	LM340K12	1.25
				LM320K12	1.65		

MICRO'S, RAMS, CPU'S, E-PROMS				SPECIAL DISCOUNTS			
74S188	3.00	8214	8.95	Total Order	Deduct		
1702A	4.50	8224	3.25	\$35 - \$99	10%		
MM5314	3.00	8228	6.00	\$100 - \$300	15%		
MM5316	3.50	8251	8.50	\$301 - \$1000	20%		
2102-1	1.45	8255	8.50				
2102L-1	1.75	8T13	1.50				
2114	9.50	8T23	1.50				
TR1602B	3.95	8T24	2.00				
TMS 4044	9.95	8T97	1.00				
		2107B-4	4.95				
8080	8.95	2708	9.50				
8212	2.95	280 PIO	8.50				

INTEGRATED CIRCUITS UNLIMITED

7889 Clairemont Mesa Boulevard, San Diego, California 92111
(714) 278-4394 (Calif. Res.)

All orders shipped prepaid
Open accounts invited

No minimum
COD orders accepted

Discounts available at OEM Quantities California Residents add 6% Sales Tax
All IC's Prime/Guaranteed. All orders shipped same day received.

24 Hour Toll Free Phone 1-800-854-2211

American Express / BankAmericard / Visa / MasterCard



ELPAC POWER SUPPLIES

Completely Assembled

SPECIFICATIONS:

105-125/210-250 Vac, 47-440 Hz Input:
Line Regulation $\pm 0.1\%$
Load Regulation $\pm 0.1\%$ no-load to rated-load
Output Ripple and Noise $\pm 0.1\%$ no-p.d.c to 10 MHz
Input/Output Isolation 35% rated current
Short Circuit Current 35% rated current

PART NO.	RATINGS			PRICE
	WATTS	VOLTS	AMPS	
SOLV15-5*	15	5	3	\$36.95
SOLV15-12*	15	12	1.5	36.95
SOLV30-5	30	5	6	59.95
SOLV30-12	30	12	3	59.95
OVP over voltage protection for SOLV30-5,-12				9.95
*SOLV15-5, 12 includes OVP installed				

SUP 'R' MOD II

UHF Channel 33 TV Interface Unit Kit



- Wide Band B/W or Color System
- Converts TV to Video Display for home computers, CCTV camera, Apple II, works with Cromeco Dazzler, SOL-20, IRS-80, Challenger, etc.
- MOD II is pretuned to Channel 33 (UHF)
- Includes coaxial cable and antenna transformer.

MOD II

\$29.95 Kit

CRYSTALS

THESE FREQUENCIES ONLY

PART NO.	FREQUENCY	CASE	PRICE
CY1A	1.000MHz	HC33	5.95
CY1.84	1.8432MHz	HC33	5.95
CY2A	2.000MHz	HC33	5.95
CY2.01	2.010MHz	HC33	1.95
CY2.50	2.500MHz	HC33	4.95
CY3.27	3.2768MHz	HC33	4.95
CY3.57	3.579545MHz	HC33	4.95
CY3A	4.000MHz	HC18	4.95
CY4.91	4.916MHz	HC18	4.95
CY7A	5.000MHz	HC18	4.95
CY5.18	5.185MHz	HC18	4.95
CY6.14	6.144MHz	HC18	4.95
CY6.40	6.400MHz	HC18	4.95
CY6.55	6.5536MHz	HC18	4.95
CY12A	10.000MHz	HC18	4.95
CY14A	14.31818MHz	HC18	4.95
CY19A	18.000MHz	HC18	4.95
CY18.43	18.432MHz	HC18	4.95
CY22A	20.000MHz	HC18	4.95
CY30A	32.000MHz	HC18	4.95

AUTO-TEL KITS

As Featured in August - Popular Electronics

An Electronic Warning Device For Temperature and Oil Failure



Size 2 1/2" x 2 1/2" x 7/8"

AUTOTEL — An audible alarm kit indicating potential engine damage. An audible signal (70 db pulsing) immediately forewarns a malfunction or failure. There is no sound during normal operation. Features CMOS circuitry. Complete kit with all components, hardware.

\$4.95/ea

1/16 VECTOR BOARD

Part No.	0.1" Hole Spacing	P Pattern	Price
		L W	1-9 10 up
PHENOLIC	64P44 062XXXP	4.50 6.50	1.72 1.54
	169P44 062XXXP	4.50 17.00	3.69 3.32
EPOXY	64P44 062WE	4.50 6.50	2.07 1.86
	169P44 062WE	4.50 17.00	2.56 2.31
GLASS	64P44 062WEC	4.50 6.50	5.04 4.53
	169P44 062WEC	4.50 17.00	9.23 8.76
EPOXY GLASS	169P44 062WEC1	4.50 17.00	6.80 6.12
COPPER CLAD			

CONNECTORS

25 Pin-D Subminiature

DB25P(as pictured)	PLUG	\$3.25
DB25S	SOCKET	4.95
DB51226-1	Cover for DB25 P or S	1.75

MOLEX CONNECTOR PINS

M-530-1	\$1.95/100 pins (minimum order)
	\$16.00/1000 pins

INSTRUMENT/CLOCK CASE
Injection molded unit. Complete with red bezel. 4 1/2" x 4" x 1-9/16".

\$3.49

MICROPROCESSOR COMPONENTS

P8085 CPU	\$29.95	COP 1802 CPU	\$19.95
8080A CPU	10.95	280 CPU	24.95
8212 8-Bit Input/Output	4.95	2850 MPU	26.50
8214 Priority Interrupt Control	7.95	MC6800 128 x 8 Static Ram	19.95
8216 Bi-Directional Bus Driver	4.95	MC6801 Paraph. Interface Adapter	7.95
8224 Clock Generator/Driver	5.95	MC6821 Paraph. Interface Adapter	11.50
8228 System Controller/Bus Driver	5.95	MC6830L 1024 x 8 Bit ROM	14.95
8251 Prog. Comm. Interface	9.95	MC6850 Asynchronous Comm. Adapter	14.95
8255 Prog. Periph. Interface	10.95		

RAM'S			PROMS		
1101	256 x 1 Static	\$ 1.49	1702A	2048 x 1	Famous \$ 5.95
1103	1024 x 1 Dynamic	.99	5203	2048 x 1	Famous 14.95
2101	256 x 4 Static	5.95	82523	32 x 8	Open C 5.00
2102	1024 x 1 Static	1.75	825115	4096 x 1	Bipolar 19.95
2107/5280	4096 x 1 Dynamic	4.95	825123	32 x 8	Tristate 5.00
2111	256 x 4 Static	6.95	745287	1024 x 1	Static 7.95
2112	256 x 4 Static	5.95	7452532	32 x 8	EPROM 99.95
2114	4K x 1 Static 450ns	9.95	2708	8K	EPROM 10.95
2114L	4K x 1 Static 450ns Low Power	10.95	2716 T.I.	16K	EPROM 29.95
2114-3	1K x 4 Static 300ns	10.95	2716 Intel (2515 T.I.)	16K	EPROM 59.95
74141-3	1K x 4 Static 300ns Low Power	11.95	6301-1	1024 x 1	Ti-Static Bipolar 3.49
7489	16 x 4 Static	1.75	6330-1	256 x 1	Open C Bipolar 2.95
8101	256 x 4 Static	5.95			
8111	256 x 4 Static	6.95			
8599	16 x 4 Static	3.49			
21102	1024 x 1 Static	2.95			
74200	256 x 1 Static	6.95			
74201	256 x 1 Static	2.95			
74202	256 x 1 Static	3.17			
ROM'S			SHIFT REGISTERS		
MM5013N	256 x 1 Dynamic	3.17	MM5013N	256 x 1 Dynamic	2.95
MM5016H	512 x 1 Dynamic	3.17	MM5016H	512 x 1 Dynamic	2.95
MM5017N	1024 x 1 Dynamic	3.17	MM5017N	1024 x 1 Dynamic	2.95
MM5020	2K x 1 Dynamic	3.17	MM5020	2K x 1 Dynamic	2.95
MM5027	4K x 1 Dynamic	3.17	MM5027	4K x 1 Dynamic	2.95
MM5042	8K x 1 Dynamic	3.17	MM5042	8K x 1 Dynamic	2.95
MM5044	16K x 1 Dynamic	3.17	MM5044	16K x 1 Dynamic	2.95
MM5046	32K x 1 Dynamic	3.17	MM5046	32K x 1 Dynamic	2.95
MM5048	64K x 1 Dynamic	3.17	MM5048	64K x 1 Dynamic	2.95
MM5050	128K x 1 Dynamic	3.17	MM5050	128K x 1 Dynamic	2.95
MM5052	256K x 1 Dynamic	3.17	MM5052	256K x 1 Dynamic	2.95
MM5054	512K x 1 Dynamic	3.17	MM5054	512K x 1 Dynamic	2.95
MM5056	1M x 1 Dynamic	3.17	MM5056	1M x 1 Dynamic	2.95
MM5058	2M x 1 Dynamic	3.17	MM5058	2M x 1 Dynamic	2.95
MM5060	4M x 1 Dynamic	3.17	MM5060	4M x 1 Dynamic	2.95
MM5062	8M x 1 Dynamic	3.17	MM5062	8M x 1 Dynamic	2.95
MM5064	16M x 1 Dynamic	3.17	MM5064	16M x 1 Dynamic	2.95
MM5066	32M x 1 Dynamic	3.17	MM5066	32M x 1 Dynamic	2.95
MM5068	64M x 1 Dynamic	3.17	MM5068	64M x 1 Dynamic	2.95
MM5070	128M x 1 Dynamic	3.17	MM5070	128M x 1 Dynamic	2.95
MM5072	256M x 1 Dynamic	3.17	MM5072	256M x 1 Dynamic	2.95
MM5074	512M x 1 Dynamic	3.17	MM5074	512M x 1 Dynamic	2.95
MM5076	1G x 1 Dynamic	3.17	MM5076	1G x 1 Dynamic	2.95
MM5078	2G x 1 Dynamic	3.17	MM5078	2G x 1 Dynamic	2.95
MM5080	4G x 1 Dynamic	3.17	MM5080	4G x 1 Dynamic	2.95
MM5082	8G x 1 Dynamic	3.17	MM5082	8G x 1 Dynamic	2.95
MM5084	16G x 1 Dynamic	3.17	MM5084	16G x 1 Dynamic	2.95
MM5086	32G x 1 Dynamic	3.17	MM5086	32G x 1 Dynamic	2.95
MM5088	64G x 1 Dynamic	3.17	MM5088	64G x 1 Dynamic	2.95
MM5090	128G x 1 Dynamic	3.17	MM5090	128G x 1 Dynamic	2.95
MM5092	256G x 1 Dynamic	3.17	MM5092	256G x 1 Dynamic	2.95
MM5094	512G x 1 Dynamic	3.17	MM5094	512G x 1 Dynamic	2.95
MM5096	1T x 1 Dynamic	3.17	MM5096	1T x 1 Dynamic	2.95
MM5098	2T x 1 Dynamic	3.17	MM5098	2T x 1 Dynamic	2.95
MM5100	4T x 1 Dynamic	3.17	MM5100	4T x 1 Dynamic	2.95
MM5102	8T x 1 Dynamic	3.17	MM5102	8T x 1 Dynamic	2.95
MM5104	16T x 1 Dynamic	3.17	MM5104	16T x 1 Dynamic	2.95
MM5106	32T x 1 Dynamic	3.17	MM5106	32T x 1 Dynamic	2.95
MM5108	64T x 1 Dynamic	3.17	MM5108	64T x 1 Dynamic	2.95
MM5110	128T x 1 Dynamic	3.17	MM5110	128T x 1 Dynamic	2.95
MM5112	256T x 1 Dynamic	3.17	MM5112	256T x 1 Dynamic	2.95
MM5114	512T x 1 Dynamic	3.17	MM5114	512T x 1 Dynamic	2.95
MM5116	1T x 1 Dynamic	3.17	MM5116	1T x 1 Dynamic	2.95
MM5118	2T x 1 Dynamic	3.17	MM5118	2T x 1 Dynamic	2.95
MM5120	4T x 1 Dynamic	3.17	MM5120	4T x 1 Dynamic	2.95
MM5122	8T x 1 Dynamic	3.17	MM5122	8T x 1 Dynamic	2.95
MM5124	16T x 1 Dynamic	3.17	MM5124	16T x 1 Dynamic	2.95
MM5126	32T x 1 Dynamic	3.17	MM5126	32T x 1 Dynamic	2.95
MM5128	64T x 1 Dynamic	3.17	MM5128	64T x 1 Dynamic	2.95
MM5130	128T x 1 Dynamic	3.17	MM5130	128T x 1 Dynamic	2.95
MM5132	256T x 1 Dynamic	3.17	MM5132	256T x 1 Dynamic	2.95
MM5134	512T x 1 Dynamic	3.17	MM5134	512T x 1 Dynamic	2.95
MM5136	1T x 1 Dynamic	3.17	MM5136	1T x 1 Dynamic	2.95
MM5138	2T x 1 Dynamic	3.17	MM5138	2T x 1 Dynamic	2.95
MM5140	4T x 1 Dynamic	3.17	MM5140	4T x 1 Dynamic	2.95
MM5142	8T x 1 Dynamic	3.17	MM5142	8T x 1 Dynamic	2.95
MM5144	16T x 1 Dynamic	3.17	MM5144	16T x 1 Dynamic	2.95
MM5146	32T x 1 Dynamic	3.17	MM5146	32T x 1 Dynamic	2.95
MM5148	64T x 1 Dynamic	3.17	MM5148	64T x 1 Dynamic	2.95
MM5150	128T x 1 Dynamic	3.17	MM5150	128T x 1 Dynamic	2.95
MM5152	256T x 1 Dynamic	3.17	MM5152	256T x 1 Dynamic	2.95
MM5154	512T x 1 Dynamic	3.17	MM5154	512T x 1 Dynamic	2.95
MM5156	1T x 1 Dynamic	3.17	MM5156	1T x 1 Dynamic	2.95
MM5158	2T x 1 Dynamic	3.17	MM5158	2T x 1 Dynamic	2.95
MM5160	4T x 1 Dynamic	3.17	MM5160	4T x 1 Dynamic	2.95
MM5162	8T x 1 Dynamic	3.17	MM5162	8T x 1 Dynamic	2.95
MM5164	16T x 1 Dynamic	3.17	MM5164	16T x 1 Dynamic	2.95
MM5166	32T x 1 Dynamic	3.17	MM5166	32T x 1 Dynamic	2.95
MM5168	64T x 1 Dynamic	3.17	MM5168	64T x 1 Dynamic	2.95
MM5170	128T x 1 Dynamic	3.17	MM5170	128T x 1 Dynamic	2.95
MM5172	256T x 1 Dynamic	3.17	MM5172	256T x 1 Dynamic	2.95
MM5174	512T x 1 Dynamic	3.17	MM5174	512T x 1 Dynamic	2.95
MM5176	1T x 1 Dynamic	3.17	MM5176	1T x 1 Dynamic	2.95
MM5178	2T x 1 Dynamic	3.17	MM5178	2T x 1 Dynamic	2.95
MM5180	4T x 1 Dynamic	3.17	MM5180	4T x 1 Dynamic	2.95
MM5182	8T x 1 Dynamic	3.17	MM5182	8T x 1 Dynamic	2.95
MM5184	16T x 1 Dynamic	3.17	MM5184	16T x 1 Dynamic	2.95
MM5186	32T x 1 Dynamic	3.17	MM5186	32T x 1 Dynamic	2.95
MM5188	64T x 1 Dynamic	3.17	MM5188	64T x 1 Dynamic	2.95
MM5190	128T x 1 Dynamic	3.17	MM5190	128T x 1 Dynamic	2.95
MM5192	256T x 1 Dynamic	3.17	MM5192	256T x 1 Dynamic	2.95
MM5194	512T x 1 Dynamic	3.17	MM5194	512T x 1 Dynamic	2.95
MM5196	1T x 1 Dynamic	3.17	MM5196	1T x 1 Dynamic	2.95
MM5198	2T x 1 Dynamic	3.17	MM5198	2T x 1 Dynamic	2.95
MM5200	4T x 1 Dynamic	3.17	MM5200	4T x 1 Dynamic	2.95
MM5202	8T x 1 Dynamic	3.17	MM5202	8T x 1 Dynamic	2.95
MM5204	16T x 1 Dynamic	3.17	MM5204	16T x 1 Dynamic	2.95
MM5206	32T x 1 Dynamic	3.17	MM5206	32T x 1 Dynamic	2.95
MM5208	64T x 1 Dynamic	3.17	MM5208	64T x 1 Dynamic	2.95
MM5210	128T x 1 Dynamic	3.17	MM5210	128T x 1 Dynamic	2.95
MM5212	256T x 1 Dynamic	3.17	MM5212	256T x 1 Dynamic	2.95
MM5214	512T x 1 Dynamic	3.17	MM5214	512T x 1 Dynamic	2.95
MM5216	1T x 1 Dynamic	3.17	MM5216	1T x 1 Dynamic	2.95
MM5218	2T x 1 Dynamic	3.17	MM5218	2T x 1 Dynamic	2.95
MM5220	4T x 1 Dynamic	3.17	MM5220	4T x 1 Dynamic	2.95
MM5222	8T x 1 Dynamic	3.17	MM5222	8T x 1 Dynamic	2.95
MM5224	16T x 1 Dynamic	3.17	MM5224	16T x 1 Dynamic	2.95
MM5226	32T x 1 Dynamic	3.17	MM5226	32T x 1 Dynamic	2.95
MM5228	64T x 1 Dynamic	3.17	MM5228	64T x 1 Dynamic	2.95
MM5230	128T x 1 Dynamic	3.17	MM5230	128T x 1 Dynamic	2.95
MM5232	256T x 1 Dynamic	3.17	MM5232	256T x 1 Dynamic	2.95
MM5234	512T x 1 Dynamic	3.17	MM5234	512T x 1 Dynamic	2.95
MM5236	1T x 1 Dynamic	3.17	MM5236	1T x 1 Dynamic	2.95
MM5238	2T x 1 Dynamic	3.17	MM5238	2T x 1 Dynamic	2.95
MM5240	4T x 1 Dynamic	3.17	MM5240	4T x 1 Dynamic	2.95
MM5242	8T x 1 Dynamic	3.17	MM5242	8T x 1 Dynamic	2.95
MM5244	16T x 1 Dynamic	3.17	MM5244	16T x 1 Dynamic	2.95
MM5246	32T x 1 Dynamic	3.17	MM5246	32T x 1 Dynamic	2.95
MM5248	64T x 1 Dynamic	3.17	MM5248	64T x 1 Dynamic	2.95
MM5250	128T x 1 Dynamic	3.17	MM5250	128T x 1 Dynamic	2.95
MM5252	256T x 1 Dynamic	3.17	MM5252	256T x 1 Dynamic	2.95
MM5254	512T x 1 Dynamic	3.17	MM5254	512T x 1 Dynamic	2.95
MM5256	1T x 1 Dynamic	3.17	MM5256	1T x 1 Dynamic	2.95
MM5258	2T x 1 Dynamic	3.17	MM5258	2T x 1 Dynamic	2.95
MM5260	4T x 1 Dynamic	3.17	MM5260	4T x 1 Dynamic	2.95
MM5262	8T x 1 Dynamic	3.17	MM5262	8T x 1 Dynamic	2.95
MM5264	16T x 1 Dynamic	3.17	MM5264	16T x 1 Dynamic	2.95
MM5266	32T x 1 Dynamic	3.17	MM5266	32T x 1 Dynamic	2.95
MM5268	64T x 1 Dynamic	3.17	MM5268	64T x 1 Dynamic	2.95
MM5270	128T x 1 Dynamic	3.17	MM5270	128T x 1 Dynamic	2.95
MM5272	256T x 1 Dynamic	3.17	MM5272	256T x 1 Dynamic	2.95
MM5274	512T x 1 Dynamic	3.17	MM5274	512T x 1 Dynamic	2.95
MM5276	1T x 1 Dynamic	3.17	MM5276	1T x 1 Dynamic	2.95
MM5278	2T x 1 Dynamic	3.17	MM5278	2T x 1 Dynamic	2.95
MM5280	4T x 1 Dynamic	3.17	MM5280	4T x 1 Dynamic	2.95
MM5282	8T x 1 Dynamic	3.17	MM5282	8T x 1 Dynamic	2.95
MM5284	16T x 1 Dynamic	3.17	MM5284	16T x 1 Dynamic	2.95
MM5286	32T x 1 Dynamic	3.17	MM5286	32T x 1 Dynamic	2.95
MM5288	64T x 1 Dynamic	3.17	MM5288	64T x 1 Dynamic	2.95
MM5290	128T x 1 Dynamic	3.17	MM5290	128T x 1 Dynamic	2.95
MM5292	256T x 1 Dynamic	3.17	MM5292	256T x 1 Dynamic	2.95
MM5294	512T x 1 Dynamic	3.17	MM5294	512T x 1 Dynamic	2.95
MM5296	1T x 1 Dynamic	3.17	MM5296	1T x 1 Dynamic	2.95
MM5298	2T x 1 Dynamic	3.17	MM5298	2T x 1 Dynamic	2.95
MM5300	4T x 1 Dynamic	3.17	MM5300	4T x 1 Dynamic	2.95
MM5302	8T x 1 Dynamic	3.17	MM5302	8T x 1 Dynamic	2.95
MM5304	16T x 1 Dynamic	3.17	MM5304	16T x 1 Dynamic	2.95
MM5306	32T x 1 Dynamic	3.17	MM5306	32T x 1 Dynamic	2.95
MM5308	64T x 1 Dynamic	3.17	MM5308	64T x 1 Dynamic	2.95
MM5310	128T x 1 Dynamic	3.17	MM5310	128T x 1 Dynamic	2.95
MM5312	256T x 1 Dynamic	3.17	MM5312	256T x 1 Dynamic	2.95
MM5314	512T x 1 Dynamic	3.17	MM5314	512T x 1 Dynamic	2.95
MM5316	1T x 1 Dynamic	3.17	MM5316	1T x 1 Dynamic	2.95
MM5318	2T x 1 Dynamic	3.17	MM5318	2T x 1 Dynamic	2.95
MM5320	4T x 1 Dynamic	3.17	MM5320	4T x 1 Dynamic	2.95
MM5322	8T x 1 Dynamic	3.17	MM5322	8T x 1 Dynamic	2.95
MM5324	16T x 1 Dynamic	3.17	MM5324	16T x 1 Dynamic	2.95
MM5326	32T x 1 Dynamic	3.17	MM5326	32T x 1 Dynamic	2.95
MM5328	64T x 1 Dynamic	3.17	MM5328	64T x 1 Dynamic	2.95
MM5330	128T x 1 Dynamic	3.17	MM5330	128T x 1 Dynamic	2.95
MM5332	256T x 1 Dynamic	3.17	MM5332	256T x 1 Dynamic	2.95
MM5334	512T x 1 Dynamic	3.17	MM5334	512T x 1 Dynamic	2.95
MM5336	1T x 1 Dynamic	3.17	MM5336	1T x 1 Dynamic	2.95
MM5338	2T x 1 Dynamic	3.17	MM5338	2T x 1 Dynamic	2.95
MM5340	4T x 1 Dynamic	3.17	MM5340	4T x 1 Dynamic	2.95
MM5342	8T x 1 Dynamic	3.17	MM5342	8T x 1 Dynamic	2.95
MM5344	16T x 1 Dynamic	3.17	MM5344	16T x 1 Dynamic	2.95
MM5346	32T x 1 Dynamic	3.17	MM5346	32T x 1 Dynamic	2.95
MM5348	64T x 1 Dynamic	3.17	MM5348	64T x 1 Dynamic	2.95
MM5350	128T x 1 Dynamic	3.17	MM5350	128T x 1 Dynamic	2.95
MM5352	256T x 1 Dynamic	3.17	MM5352	256T x 1 Dynamic	2.95
MM5354	512T x 1 Dynamic	3.17	MM5354	512T x 1 Dynamic	2.95
MM5356	1T x 1 Dynamic	3.17	MM5356	1T x 1 Dynamic	2.95
MM5358	2T x 1 Dynamic	3.17	MM5358	2T x 1 Dynamic	2.95
MM5360	4T x 1 Dynamic	3.17	MM5360	4T x 1 Dynamic	2.95
MM5362	8T x 1 Dynamic	3.17	MM5362	8T x 1 Dynamic	2.95
MM5364	16T x 1 Dynamic	3.17	MM5364	16T x 1 Dynamic	2.95
MM5366	32T x 1 Dynamic	3.17	MM5366	32T x 1 Dynamic	2.95
MM5368	64T x 1 Dynamic	3.17	MM5368	64T x 1 Dynamic	2.95
MM5370	128T x 1 Dynamic	3.1			

SPECIAL REQUESTED ITEMS

TELEPHONE KEYBOARD CHIPS	ICM CHIPS	NMOS READ ONLY MEMORIES	MISCELLANEOUS
AY-5-9100 \$14.95	ICM7045 \$24.95	MC6M571 \$13.50	11C90 \$19.95
AY-5-9200 14.95	ICM7205 19.95	MC6M574 13.50	MC6801P 11.95
AY-5-9500 4.95	ICM7207 7.50	MC6M575 13.50	MC1498L 4.95
AY-5-2316 14.95	ICM7208 19.95		MC1498L 5.75
HD0165 9.95	ICM7209 19.95		MC1498L 11.95
74C922 9.95			LD10110 \$25.00/set
			MC6801(74416) 7.50
			4N33 3.95



The Sinclair PDM35. A personal digital multimeter for only \$59.95

Now everyone can afford to own a digital multimeter

A digital multimeter used to mean an expensive, bulky piece of equipment. The Sinclair PDM35 changes that. It's got all the functions and features you want in a digital multimeter, yet it's neatly packaged in a rugged but light pocket-size case, ready to go anywhere.

Technical specification
DC Volts (4 ranges)
Range: 1 mV to 1000 V
Accuracy of reading 10% ± 1 count.
Note: 10 M Ω input impedance.
AC Volts (4 ranges)
Range: 1 V to 100 V
Accuracy of reading 10% ± 2 counts.
DC Current (4 ranges)
Range: 1 mA to 200 mA
Accuracy of reading 10% ± 1 count.
Note: Max resolution 0.1 nA.
Resistance (5 ranges)
Range: 1 Ω to 20 M Ω
Accuracy of reading 1% ± 1 count.
Note: Provides 5 function test ranges.
Dimensions: 6 in x 3 in x 1 1/2 in
Weight: 6 oz.
Power supply: 9V battery (batteries not included).
Note: AC adapter (not included).
Socket: Standard 4 mm for resistor plugs.
Options: AC adapter for 117 V 60 Hz power. DC-leak padded carrying wallet.

PART NO.	DESCRIPTION	PRICE
PDM35	Digital Multimeter (Completely Assembled)	\$59.95
PDM-AC	117 volt AC Adapter	6.95
PDM-DP	Deluxe padded carrying case	6.95

3 1/2-Digit Portable DMM



Model 2800	\$99.95
------------	---------

Comes with test leads, operating manual and spare fuse

100 MHz 8-Digit Counter

- 20 Hz to 100 MHz Range
- 6 LED Display
- Crystal-controlled timebase
- Full Automatic
- Portable — completely self-contained
- Size — 1.75" x 7.38" x 5.63"

MAX-100 \$134.95

ACCESSORIES FOR MAX 100:	Model 100 —
Mobile Charger/Eliminator	CLA \$3.95
Charger/Eliminator	CAI \$9.95

63-Key Unencoded KEYBOARDS

This is a 63-key, terminal keyboard newly manufactured by a large computer manufacturer. It is unencoded with SPST keys, unattached to any kind of PC board. A very solid molded plastic 13 x 4" base suits most applications. IN STOCK

\$29.95/each

19-key pad includes 1-10 keys, ABCDEF and 2 optional keys and a shift key. **\$10.95/each**

\$5.00 Minimum Order — U.S. Funds Only
California Residents — Add 6% Sales Tax

Spec Sheets — 25¢
1978 A Catalog Available — Send 41c stamp

Jameco ELECTRONICS
a division of JAMES ELECTRONICS of California

MAIL ORDER ELECTRONICS — WORLDWIDE
1021 HOWARD AVENUE, SAN CARLOS, CA 94070

Advertised Prices Good thru October

The Incredible "Pennywhistle 103"

\$139.95 Kit Only

The Pennywhistle 103 is capable of recording data to and from audio tape without critical speed requirements for the recorder and it is able to communicate directly with another modem and terminal for telephone "hacking" and communications for the deaf. In addition, it is free of critical adjustments and is built with non-precision, readily available parts.

Data Transmission Method	Frequency-Shift Keying, full-duplex (half-duplex selectable)
Maximum Data Rate	300 Baud
Data Format	Asynchronous Serial (return to mark level required between each character)
Receive Channel Frequencies	2025 Hz for space, 2225 Hz for mark
Transmit Channel Frequencies	Switch selectable: Low (normal) = 1070 space, 1270 mark; High = 1025 space, 2225 mark
Receive Sensitivity	46 dbm acoustically coupled
Transmit Level	15 dbm nominal. Adjustable from -8 dbm to +20 dbm
Receive Frequency Tolerance	Frequency reference automatically adjusts to allow for operation between 1800 Hz and 2400 Hz
Digital Data Interface	ELIA RS-232C or 20 mA current loop (receiver is optoisolated and non-polar)
Power Requirements	120 VAC, single phase, 10 Watts
Physical	All components mount on a single 5" by 9" printed circuit board. All components included.

Requires a VOM, Audio Oscillator, Frequency Counter and/or Oscilloscope to align

The Original the 3rd Hand \$9.95 each

*Leaves two hands free for working
*Clamps on edge of bench, table or work bench
*Position board on angle or flat position for soldering or clipping
*Sturdy, aluminum construction for hobbyist, manufacturer or school rooms

DIGITAL STOPWATCH

• Bright 6 Digit LED Display
• Times to 59 minutes 59 seconds
• Crystal Controlled Time Base
• Three Stopwatches in One (Times Single Event — Split & Taylor)
• Size 4.5" x 2.15" x .90" (4 1/2 ounces)
• Uses 3 Penrite Cells

Kit — \$39.95
Assembled — \$49.95
Heavy Duty Carry Case \$5.95

Stop Watch Chip Only (7205) \$19.95

3 1/2-DIGIT DPM KIT

• New Bipolar Unit
• Auto Zeroing
• 5" LED
• Auto Polarity
• Low Power
• Single IC Unit

Model KB500 DPM Kit \$49.00
Model KB503 5V Power Kit \$17.50

JE700 CLOCK

The JE700 is a low cost digital clock, but is a very high quality unit. The unit features a simulated walnut case with dimensions of 6" x 7" x 1". It utilizes a MAX7218 high brightness readout, and the MM5314 clock chip.

12 or 24 Hour
KIT ONLY \$16.95

JE803 PROBE

The Logic Probe is a unit which is for the most part indispensable in trouble shooting logic families. TTL, DTL, RTL, CMOS. It derives the power it needs to operate directly off of the circuit under test, drawing a scant 10 mA max. It uses a MAX3 readout to indicate any of the following states by these symbols: (H) 1 (LOW) 0 (PULSE) P. The Probe can detect high frequency pulses to 45 MHz. It can't be used in MOS levels or circuit damage will result.

\$9.95 Per Kit
printed circuit board

TPL 5V 1A Supply

This is a standard TTL power supply using the well known LM309H regulator IC to provide a solid 1 AMP of current at 5 volts. We try to make things easy for you by providing everything you need in one package, including the hardware for only

JE225 \$9.95 Per Kit

PROTO BOARDS

GATEWAY SPECIALTIES CORPORATION

PROTO BOARDS

PROTO BOARD 6

\$15.95

(6" long X 4" wide)

PB100 - 4.5" x 6"	\$ 19.95
PB101 - 5.8" x 4.5"	22.95
PB102 - 7" x 4.5"	26.95
PB103 - 9" x 6"	44.95
PB104 - 9.5" x 8"	54.95
PB203 - 9.75 x 6 1/2 x 2 1/4	75.00
PB203A - 9.75 x 6 1/2 x 2 1/4	124.95
(includes power supply)	

PROTO CLIPS

14 PIN	\$4.50
16 PIN	4.75
24 PIN	8.50
40 PIN	13.75

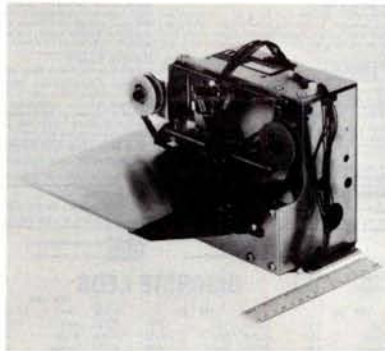
7400 TTL			
		SN7470N	29
		SN7471N	29
SN7400N	16	SN7472N	35
SN7401N	18	SN7473N	35
SN7402N	18	SN7474N	35
SN7403N	18	SN7475N	35
SN7404N	18	SN7476N	35
SN7405N	20	SN7477N	5.00
SN7406N	20	SN7478N	5.00
SN7407N	29	SN7479N	35
SN7408N	20	SN7480N	35
SN7409N	20	SN7481N	79
SN7410N	18	SN7482N	35
SN7411N	25	SN7483N	59
SN7412N	25	SN7484N	35
SN7413N	40	SN7485N	43
SN7414N	25	SN7486N	43
SN7415N	25	SN7487N	65
SN7416N	25	SN7488N	65
SN7417N	25	SN7489N	65
SN7418N	20	SN7490N	65
SN7419N	20	SN7491N	3.00
SN7420N	29	SN7492N	89
SN7421N	25	SN7493N	35
SN7422N	29	SN7494N	35
SN7423N	25	SN7495N	35
SN7424N	29	SN7496N	35
SN7425N	29	SN7497N	35
SN7426N	25	SN7498N	35
SN7427N	25	SN7499N	1.25
SN7428N	29	SN7500N	1.25
SN7429N	29	SN7501N	1.25
SN7430N	20	SN7502N	49
SN7431N	25	SN7503N	49
SN7432N	25	SN7504N	49
SN7433N	25	SN7505N	75
SN7434N	25	SN7506N	75
SN7435N	25	SN7507N	79
SN7436N	25	SN7508N	2.95
SN7437N	25	SN7509N	2.95
SN7438N	25	SN7510N	2.95
SN7439N	25	SN7511N	1.29
SN7440N	59	SN7512N	89
SN7441N	59	SN7513N	59
SN7442N	79	SN7514N	59
SN7443N	79	SN7515N	59
SN7444N	59	SN7516N	59
SN7445N	59	SN7517N	59
SN7446N	59	SN7518N	59
SN7447N	59	SN7519N	59
SN7448N	59	SN7520N	59
SN7449N	59	SN7521N	59
SN7450N	59	SN7522N	59
SN7451N	20	SN7523N	59
SN7452N	20	SN7524N	59
SN7453N	20	SN7525N	59
SN7454N	20	SN7526N	59
SN7455N	20	SN7527N	59
SN7456N	20	SN7528N	59
SN7457N	20	SN7529N	59
SN7458N	20	SN7530N	59
SN7459N	20	SN7531N	59
SN7460N	20	SN7532N	59
		SN7533N	59
		SN7534N	59
		SN7535N	59
		SN7536N	59
		SN7537N	59
		SN7538N	59
		SN7539N	59
		SN7540N	59
		SN7541N	59
		SN7542N	59
		SN7543N	59
		SN7544N	59
		SN7545N	59
		SN7546N	59
		SN7547N	59
		SN7548N	59
		SN7549N	59
		SN7550N	59
		SN7551N	59
		SN7552N	59
		SN7553N	59
		SN7554N	59
		SN7555N	59
		SN7556N	59
		SN7557N	59
		SN7558N	59
		SN7559N	59
		SN7560N	59
		SN7561N	59
		SN7562N	59
		SN7563N	59
		SN7564N	59
		SN7565N	59
		SN7566N	59
		SN7567N	59
		SN7568N	59
		SN7569N	59
		SN7570N	59
		SN7571N	59
		SN7572N	59
		SN7573N	59
		SN7574N	59
		SN7575N	59
		SN7576N	59
		SN7577N	59
		SN7578N	59
		SN7579N	59
		SN7580N	59
		SN7581N	59
		SN7582N	59
		SN7583N	59
		SN7584N	59
		SN7585N	59
		SN7586N	59
		SN7587N	59
		SN7588N	59
		SN7589N	59
		SN7590N	59
		SN7591N	59
		SN7592N	59
		SN7593N	59
		SN7594N	59
		SN7595N	59
		SN7596N	59
		SN7597N	59
		SN7598N	59
		SN7599N	59
		SN7600N	59
		SN7601N	59
		SN7602N	59
		SN7603N	59
		SN7604N	59
		SN7605N	59
		SN7606N	59
		SN7607N	59
		SN7608N	59
		SN7609N	59
		SN7610N	59
		SN7611N	59
		SN7612N	59
		SN7613N	59
		SN7614N	59
		SN7615N	59
		SN7616N	59
		SN7617N	59
		SN7618N	59
		SN7619N	59
		SN7620N	59
		SN7621N	59
		SN7622N	59
		SN7623N	59
		SN7624N	59
		SN7625N	59
		SN7626N	59
		SN7627N	59
		SN7628N	59
		SN7629N	59
		SN7630N	59
		SN7631N	59
		SN7632N	59
		SN7633N	59
		SN7634N	59
		SN7635N	59
		SN7636N	59
		SN7637N	59
		SN7638N	59
		SN7639N	59
		SN7640N	59
		SN7641N	59
		SN7642N	59
		SN7643N	59
		SN7644N	59
		SN7645N	59
		SN7646N	59
		SN7647N	59
		SN7648N	59
		SN7649N	59
		SN7650N	59
		SN7651N	59
		SN7652N	59
		SN7653N	59
		SN7654N	59
		SN7655N	59
		SN7656N	59
		SN7657N	59
		SN7658N	59
		SN7659N	59
		SN7660N	59
		SN7661N	59
		SN7662N	59
		SN7663N	59
		SN7664N	59
		SN7665N	59
		SN7666N	59
		SN7667N	59
		SN7668N	59
		SN7669N	59
		SN7670N	59
		SN7671N	59
		SN7672N	59
		SN7673N	59
		SN7674N	59
		SN7675N	59
		SN7676N	59
		SN7677N	59
		SN7678N	59
		SN7679N	59
		SN7680N	59
		SN7681N	59
		SN7682N	59
		SN7683N	59
		SN7684N	59
		SN7685N	59
		SN7686N	59
		SN7687N	59
		SN7688N	59
		SN7689N	59
		SN7690N	59
		SN7691N	59
		SN7692N	59
		SN7693N	59
		SN7694N	59
		SN7695N	59
		SN7696N	59
		SN7697N	59
		SN7698N	59
		SN7699N	59
		SN7700N	59
		SN7701N	59
		SN7702N	59
		SN7703N	59
		SN7704N	59
		SN7705N	59
		SN7706N	59
		SN7707N	59
		SN7708N	59
		SN7709N	59
		SN7710N	59
		SN7711N	59
		SN7712N	59
		SN7713N	59
		SN7714N	59
		SN7715N	59
		SN7716N	59
		SN7717N	59
		SN7718N	59
		SN7719N	59
		SN7720N	59
		SN7721N	59
		SN7722N	59
		SN7723N	59
		SN7724N	59
		SN7725N	59
		SN7726N	59
		SN7727N	59
		SN7728N	59
		SN7729N	59
		SN7730N	59
		SN7731N	59
		SN7732N	59
		SN7733N	59
		SN7734N	59
		SN7735N	59
		SN7736N	59
		SN7737N	59
		SN7738N	59
		SN7739N	59
		SN7740N	59
		SN7741N	59
		SN7742N	59
		SN7743N	59
		SN7744N	59
		SN7745N	59
		SN7746N	59
		SN7747N	59
		SN7748N	59
		SN7749N	59
		SN7750N	59
		SN7751N	59
		SN7752N	59
		SN7753N	59
		SN7754N	59
		SN7755N	59
		SN7756N	59
		SN7757N	59
		SN7758N	59
		SN7759N	59
		SN7760N	59
		SN7761N	59
		SN7762N	59
		SN7763N	59
		SN7764N	59
		SN7765N	59
		SN7766N	59
		SN7767N	59
		SN7768N	59
		SN7769N	59
		SN7770N	59
		SN7771N	59
		SN7772N	59
		SN7773N	59
		SN7774N	59
		SN7775N	59
		SN7776N	59
		SN7777N	59
		SN7778N	59
		SN7779N	59
		SN7780N	59
		SN7781N	59
		SN7782N	59
		SN7783N	59
		SN7784N	59
		SN7785N	59
		SN7786N	59
		SN7787N	59
		SN7788N	59
		SN7789N	59
		SN7790N	59
		SN7791N	59
		SN7792N	59
		SN7793N	59
		SN7794N	59
		SN7795N	59
		SN7796N	59
		SN7797N	59
		SN7798N	59
		SN7799N	59
		SN7800N	59
		SN7801N	59
		SN7802N	59
		SN7803N	59
		SN7804N	59
		SN7805N	59
		SN7806N	59
		SN7807N	59
		SN7808N	59
		SN7809N	59
		SN7810N	59
		SN7811N	59
		SN7812N	59
		SN7813N	59
		SN7814N	59
		SN7815N	59
		SN7816N	59
		SN7817N	59
		SN7818N	59
		SN7819N	59
		SN7820N	59
		SN7821N	59
		SN7822N	59
		SN7823N	59
		SN7824N	59
		SN7825N	59
		SN7826N	59
		SN7827N	59
		SN7828N	59
		SN7829N	59
		SN7830N	59
		SN7831N	59
		SN7832N	59
		SN7833N	59
		SN7834N	59
		SN7835N	59
		SN7836N	59
		SN7837N	59
		SN7838N	59
		SN7839N	59
		SN7840N	59
		SN7841N	59
		SN7842N	59
		SN7843N	59
		SN7844N	59
		SN7845N	59
		SN7846N	59
		SN7847N	59
		SN7848N	59
		SN7849N	59
		SN7850N	59
		SN7851N	59
		SN7852N	59
		SN7853N	59
		SN7854N	59
		SN7855N	59
		SN7856N	59
		SN7857N	59
		SN7858N	59
		SN7859N	59
		SN7860N	59

20% Discount 100 pcs combined order 25% - 1000 pcs combined order

C/MOS			
CD4000	23	CD4070	55
CD4001	23	CD4071	55
CD4002	23	CD4072	55
CD4003	119	CD4073	119
CD4004	25	CD4074	119
CD4005	49	CD4075	49
CD4006	49	CD4076	49
CD4007	49	CD4077	49
CD4008	119	CD4078	119
CD4009	125	CD4079	125
CD4010	89	CD4080	89
CD4011	89	CD4081	89
CD4012	89	CD4082	89
CD4013	139	CD4083	139
CD4014	139	CD4084	139
CD4015	119	CD4085	119
CD4016	49	CD4086	49
CD4017	119	CD4087	119
CD4018	99	CD4088	99
CD4019	49	CD4089	49
CD4020	119	CD4090	119
CD4021	139	CD4091	139
CD4022	119	CD4092	119
CD4023	23	CD4093	23
CD4024	79	CD4094	79
CD4025	23	CD4095	23
CD4026	25	CD4096	25
CD4027	69	CD4097	69

74C00	39	74C00	74C164	3	
74C02	55		74C173	2	
74C04	75	74C08	6.49	74C191	2
74C08	75	74C90	3.00	74C192	3
74C10	65	74C83	2.00	74C193	2
74C14	3.00	74C95	2.00	74C195	2
74C20	85	74C107	1.25	74C822	9
74C26	65	74C151	2.90	74C823	8
74C42	2.15	74C165	2.15	74C824	14
74C48	4.75	74C157	2.15	74C826	11
74C73	1.50	74C160	3.25	80C86	1
74C74	1.15	74C181	3.25	80C87	1

LRC Improved Series of Matrix Impact Printers

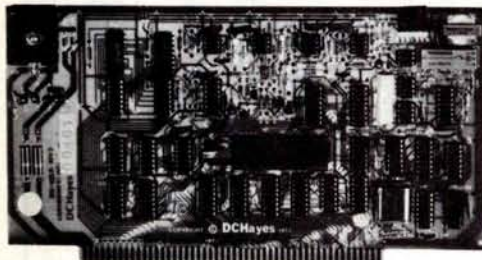


LRC Inc, Technical Research Park, Riverton WY 82501, has announced the availability of improved versions of its 7000 series matrix impact printers. Improvements include a new drive cam for the print head which is said to result in a uniform character width at the extreme ends of the print line as well as a decreased failure rate.

Available in ticket printer models as well as in roll paper models, all units have multiple copy capability with the print line capacity of 40 columns at 12 characters to the inch. Ticket printer versions are available in 22 column models. 1 line or 5 line document validation is optional on rollpaper models. Prices range from \$66.50 to \$282 depending upon model, options and quantity. ■

Circle 564 on inquiry card.

Data Communications Adapter



This 80-103A Data Communications Adapter has been developed to function as a S-100 bus compatible serial interface

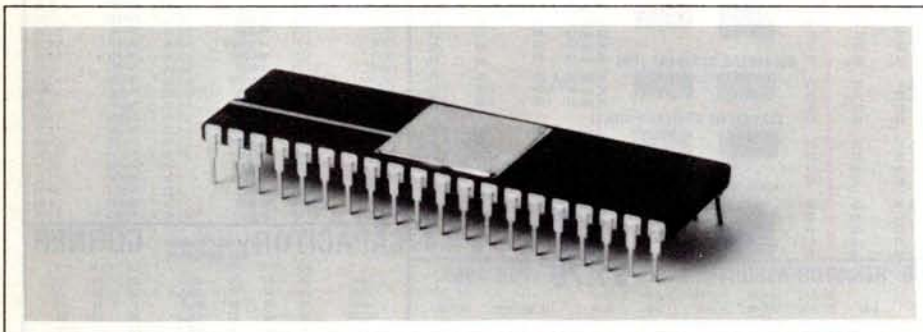
incorporating a fully programmable modem and Telco interface. These functions are usually accomplished by the use of two separate modules: a serial IO board and an external modem. The 80-103A combines these features on a single board.

A S-100 computer and a Telco 1001D data access arrangement (DAA) are all that is needed to control the adapter and interface to the telephone network.

The price of the 80-103A is \$279.95 from DC Hayes Associates Inc, POB 9884, Atlanta GA 30319. ■

Circle 565 on inquiry card.

New Programmable UART Interface



The COM6402, a programmable universal asynchronous transceiver (UART) with high clock frequencies, low power requirements and independent programming capabilities, has been introduced by Standard Microsystems Corp. Compatible with industry standard UARTs, the COM6402 is a pin for pin replacement for Harris HD-6402 and Intersil IM6402.

CMOS/LSI technology permits operator clock frequencies up to 3.2 MHz (200 k bps) while requiring only 10 mW of power. Duplex mode, bps rate, data word length, parity mode and number of stop bits are independently program-

mable through the use of external controls. There may be five, six, seven and eight data bits, odd, even or no parity, and one or two stop bits or 1.5 stop bits when utilizing a 5 bit code.

COM6402 is TTL compatible and requires only a single ± 5 V power supply. It is fully double buffered to eliminate the need for external timing and provides start bit verification to decrease error rate. Three state outputs are bus structure oriented.

For further information, contact Standard Microsystems Corp, 35 Marcus Blvd, Hauppauge NY 11787. ■

Circle 568 on inquiry card.

Pertec Announces Double Head, Double Density Microfloppy

The new FD250 Microfloppy disk drive stores up to 437.5 K bytes without operator intervention. Double density, hard or soft sectoring, and write protect are all standard features. The unit can write and read data on both sides of a diskette.

Measuring 3.25 inches by 5.75 by 8 inches (8.26 by 14.61 by 20.32 cm), the FD250 weighs 3.2 lbs (1.45 kg). Its seek time is 25 ms track-to-track, with head settling time of 10 ms (last track addressed) and a maximum head loading time of 35 ms.

The recommended recording mode is frequency modulation (FM) on single density and modified frequency modulation (MFM) on double density. Recording density (inside track) is 2768 to 5536 bpi, with 1750 K bits per disk (single density and unformatted) or 3500 K bits per disk (double density and unformatted).

The FD250 is priced at \$325 per unit for quantities of 100. For further information contact Pertec Computer Corp, Pertec Division, 9600 Irondale Av, Chatsworth CA 91311. ■

Circle 566 on inquiry card.

Put Your PET on the Bus

The PET-488 cable assembly makes the PET computer plug-compatible with any device using the IEEE 488 bus. The PET computer can become the controller for a variety of electronic test equipment and computer peripherals. The cable assembly plugs directly into the edge connector on back of the PET computer and has an IEEE-488 compatible connector on the other end. The cable meets all IEEE-488 specifications for shielding and crosstalk and is 18 inches (45 cm) long. The price of the PET-488 cable assembly is \$30 (California residents add 6% sales tax). Contact Pickles & Trout, POB 1206, Goleta CA 93017. ■

Circle 567 on inquiry card.



IT WILL TELL YOU WHERE TO GO -
CPU-1 8080A CPU BOARD WITH
8 LEVEL VECTOR INTERRUPT.

\$30. BARE \$185. KIT
\$220. ASSEMBLED AND TESTED

DEALER INQUIRIES INVITED

UNIVERSITY DISCOUNTS AVAILABLE

WMC inc. TM WAMECO INC.
3107 LANEVIEW DRIVE SAN JOSE CA. 95132

2708/2716 EPROM MEMORY BOARD

- * S-100 BUS
- * 1-32 KBYTES USING EITHER 2708 OR 2716 EPROMS
- * HIGH/LOW LIMIT ADDRESS RANGE SELECTION
- * MEMORY BANK SELECT OPTION
- * SOL TM COMPATIBLE MEMORY DISABLE
- * SELECTABLE WAIT STATES
- * FULLY BUFFERED INPUTS AND OUTPUTS
- * DOUBLE SOLDER MASK
- * SILK SCREENED PARTS LAYOUT
- * COMPLETE DOCUMENTATION

\$30. BARE

\$100. KIT (LESS EPROMS)

**TESTED AND ASSEMBLED \$130.
(LESS EPROMS)**

DEALER INQUIRIES INVITED

UNIVERSITY DISCOUNTS AVAILABLE

WMC inc. TM WAMECO INC. 3107 LANEVIEW DRIVE SAN JOSE CA 95132

RONDURE COMPANY

2522 BUTLER ST.
DALLAS, TEXAS 75235
214-630-4621

the computer room



SPECIAL SALE
\$875.00

**TESTED WITH
NEW
ASCII
ELECTRONICS**

ASCII Selectric with ASCII parallel electronics.
Immediate Delivery—Shipped from inventory.

ASCII SELECTRIC

Printer Mechanism: Heavy
duty input/output, Series
745.

Weight: 120 lbs. Dimen-
sions: 29"Hx35"Wx33"D.
Print Speed: (14.8 charac-
ters per second)

Platen: 15" wide, pin feed
or form feed device option-
al (132 print positions).

Parallel output only—15
characters per second ac-
cepts 7 bit ASCII parallel
w/strobe & prints on Selec-
tric. The unit still works as
a typewriter in off-line
mode.

DATL SELECTRIC (IBM Selectric Mechanism)



Specifications:

- Size: 21"Wx21"Dx8"H.
- Power Input 115 Volt
Hz
- Interface: RS232
- Weight: 54 lbs. (Shipping
weight 65 lbs.)
- 15" Carriage
- 15 CPS
- Correspondence code
- Half Duplex
- 132 Print Positions, 10
Pitch

Used — \$395

NOVATION DC3102A

Used
Working



\$150.00

RS232 Connection
300 Baud

TI 990/4
Single Board 16 Bit Micro
Computer
NEW \$250.00

USED MODEMS & COUPLERS
NOVATION TC102 (Acoustic) \$45.00
AJ 233 (Acoustic) \$25.00
CF 318 (Hard Wire) \$25.00

SHUGART MINI-FLOPPY DRIVE



NEW PRICE
\$325.00 ea.
Model SA-400



**FLAT PACK ACOUSTICAL
MODEM PICK-UP**
Useable with most modem
chips/kits
Used — \$17.50 (w/prints)

ORDERING INFORMATION:

We ship the same day we receive a certified check or money order.
Texas residents add 5% sales tax. Please call if you have a question.
Write for our CATALOG of many parts, terminals, printers, etc.
All items subject to availability. Your money returned if we are out
of stock.

SHIPPING INFORMATION:

Modems: \$2.00 each; 2 for \$4.00 UPS.
Large Items & Parts: Specify Freight or Air Freight Collect
Foreign Orders: Add appropriate freight or postage.
We now take Master Charge and Visa orders, Specify full number,
bank number and expiration date.

DUAL TRACE 15 MEGAHERTZ PORTABLE MINISCOPE

\$435.00



**MADE
IN THE
U.S.A.!**

**BATTERY
OPERATED!**

FEATURES

- Dual Trace- 2 channel: separate, chopped or alternate modes.
- 15 megahertz bandwidth.
- External and internal trigger.
- Time Base - 0.1 microseconds to 0.5 Sec/div - 21 settings.
- Battery or line operation.
- Automatic and line sync modes.
- Power consumption less than 15W.
- Vertical Gain - 0.01 to 50 volts/div - 12 settings.
- Weight is only 3 pounds.

From the originator of the Digital Voltmeter, Non-Linear Systems comes the MS-215 Miniscope. It is a fine electronic instrument with a great deal of measuring capability and excellent accuracy. Its design is modern, utilizing the latest in low-powered integrated circuits, and it is packaged into the smallest practical size. The instrument fits into many briefcases and tool boxes with room to spare.

Operating characteristics have been chosen so that the MS-215 will make all of the measurements needed in servicing most electronic equipment. It is field-portable so its use is not restricted to the bench.

SPECIFICATIONS:

Vertical Mode: CH1, CH2, CH1 & CH2 (Chopped) & CH1 & CH2 (Alt.)
The Following Specifications apply to each channel

Y Axis

Vertical Input: 10mV/div to 50V in 12 Calibrated ranges, as follows:
x1-10mV/div to 10V/div in four ranges, each continuously variable.
x2-20mV/div to 20mV/div in four ranges, each continuously variable.
x5-50mV/div to 50mV/div in four ranges, each continuously variable.
Accuracy is 3%.

Input Impedance: 1M ohm shunted by 50 pF.

Bandwidth: DC/DC to 15 Mhz ± 6 db (DC to 8 Mhz ± 3 db). AC, same as DC down to 3Hz.

Rise Time: Approximately 23 nS @ 1 division deflection.

Input Voltage: 250V maximum (DC and Peak AC).

Horizontal Mode: Internal Time Base or External Horizontal, switch selectable. In the XY mode, vertical input is through CH1 and horizontal input is through CH2.

Bandwidth: DC to 200 KHz (± 3 db).

Coupling: AC, DC or ground, switch selectable. Low frequency point on AC is 3 Hz.

Input Impedance: 1Meg ohm shunted by 50 pF.

Deflection Factor: 10mV/div to 50V/div in 12 calibrated ranges. The ranges can be calibrated with the CH2 gain control.

Input Voltage: 250V maximum (DC and Peak AC).

Time Base: 0.1 μ S/div to 0.5 Sec/div in 21 calibrated ranges, as follows:
x1, 0.1 μ S/div to 100 μ S/div. x2, 0.1 μ S/div to 200 μ S/div.
x5, 0.5 μ S/div to 500 μ S/div. x1, mS-0.1mS/div to 100 mS/div.
x2, mS-0.2mS/div to 200 mS/div. x5, mS-0.5mS/div to 500 mS/div.
all in four ranges, each continuously variable. (Range increments are 1, 1, 1, 10, 100.) With vernier in full clockwise position, calibrated time measurements are possible. Accuracy is 3%.

Triggering

Internal: Sweep triggered from internal trigger source (in the dual trace modes, the internal trigger source is CH1). Trigger source is internal calibrator frequency. To be used if there is no other trigger source available to synchronize the sweep.

External: Trigger is derived from line frequency when using the battery charger.

Slope: Controls function as for internal triggering (1 Megohm input impedance).

Coupling: Selects sync to positive- or negative- going waveform.

Sensitivity: AC Less than 1 div for internal trigger and less than 1 volt for external trigger.

Level: Trigger Level control permits continuous adjustment of trigger point in all modes except Auto.

Internal Calibrator: A square-wave signal of 1 volt p-p $\pm 5\%$ is provided. Frequency is approximately 1KHz.

Display

Graticule: 4x5 div, each division is 0.25 inch. Viewing area 1.1"Hx1.35"W.

CRT: Bluish-white phosphor, medium persistence. CRT uses low power filament for low battery drain. Instant on!

Power

On-Board Batteries: Three sealed, rechargeable lead acid "D" Cells.

Operating Time: Typically 4 hours.

Charging Time Scope Operating: Will run indefinitely but not reach full charge.

Non-operating: Sixteen hours.

External Power: Battery charger 115 vac (220 vac on request). 50-400Hz, less than 15 watts.

Dimensions: 3.1"Hx6.4"Wx8.0"D.

Weight: Three pounds.

Environment

Operating Temperature: 0° to 40°C.

Shock and Vibration: Designed to withstand normal shock and vibration encountered in commercial shipping and handling.

Accessories Furnished: Optional: Warranty:

Tilt stand, battery charger, 2 input cables, and 3 miniature banana plugs.
Leather carrying case and probes
One year parts and labor. Made in the U.S.A.

MS-215 with Rechargeable Batteries and Charger \$395.00

Leather Carrying Case

The leather case has 2 separate compartments. One to hold the scope, the other to hold the charger, probe, shoulder strap, etc. The case can be worn on the belt, or over the neck.

The snaps used on the case are "one way", thus accidental striking of the case against an object will not undo the snaps or let it be pulled off your belt.

41-140

\$45.00

Probes

10 to 1 probe with 10 megohm input.

Probe uses spring hook tip for sure connection. Compensation network is located at the connector rather than at the probe, so as to keep size and weight to a minimum.

41-141

\$27.00

Deluxe Combination Probe

Switchable 10to1/1to1 probe with an assortment of probe tips to suit any situation.

41-3495

\$36.00

MS-15 Single Trace version of MS-215

\$318.00

PRIORITY ONE ELECTRONICS®

4911B West Rosecrans, Hawthorne, CA 90250

Terms: VISA, MC, BAC, check, Money Order, C.O.D. U.S. Funds Only. CA residents add 6% sales tax. Minimum order \$10.00. Orders less than \$75.00 include 10% shipping and handling, excess refunded. Just in case please include your phone no. "Sorry, no over the counter sales"

Good thru NOV 1978

phone orders welcome (213) 973-4876

OEM and Institutional inquiries invited.

Send for our latest brochure.

SALE S-100 BUS EDGE CONNECTORS SALE

NLS MS-215 DUAL TRACE MINISCOPE \$435.00

LM3A 3 dig 1% DC \$134.00
LM3.5A 3 1/2 dig .5% DC \$158.50
LM40A 4 dig .1% DC \$209.00
LM4A 4 dig .03% DC \$250.00

- Rechargeable batteries and charger included
- Measures DC Volts, AC Volts, Ohms and Current
- Automatic polarity, decimal and overload indication
- Rechargeable batteries and charger
- Measures DC Volts, AC Volts, Ohms and Current
- Automatic polarity, decimal and overload indication
- No zero adjustment and no full-scale ohms adjust
- Battery-operated — NiCad batteries; also AC line operation.
- Large LED display for easy reading without interpolation
- Size: 1.9" H x 2.7" W x 4" D
- Parts & labor guaranteed 1 year
- Tilt stand option \$3.50
- Leather case \$20.00

Purchase any of the LM series Meters and buy the LEATHER CASE for 1¢

MS-15 MINISCOPE With Rechargeable Batteries & Charger Unit

\$318.

- 15 megahertz bandwidth.
- External and internal trigger.
- Time base — 1 microsec. to 0.5 Sec/div - 21 settings ±3%.
- Battery or line operation.
- Automatic & line sync modes.
- Power consumption < 15 watts.
- Vertical Gain — 0.1 to 50 Volts - 12 settings ±3%.
- Viewing area 1.1" x 1.30".
- Case size 2.7" H x 6.4" W x 7.5" D, 3 pounds.
- Parts & Labor guaranteed 1 year.
- 10 to 1.10 meg probe
- Leather carrying case

PROBE 1¢ with the purchase of SCOPE and the MENTION of this MAGAZINE

MS-215 Dual Trace Version of MS-15 \$435.

SALE S-100 BUS EDGE CONNECTORS SALE

\$100-WWG 50/100 Conn. 125 cts.
 3 LEVEL WIRE WRAP .025" sq. posts on 250 spaced rows. GOLD plated.
 1-4 5-9 10-24
 \$4.00 \$3.75 \$3.50

\$100-STG 50/100 Conn. 125 cts.
 DIP SOLDER TAIL on 250 spaced rows for VECTOR and MASI motherboards GOLD plated.
 1-4 5-9 10-24
 \$4.00 \$3.75 \$3.50

RG81G 50/100 Conn. 125 cts.
 DIP SOLDER TAIL on 140 spaced rows for ALTAIR motherboards. GOLD plated.
 \$5.00

RG81-3 50/100 Conn. 125 cts.
 PERCED SOLDER EYELET tails. GOLD.
 \$7.35

Other Popular Edge Connectors

RG44-G 22/44 Conn. 156 cts.
 PERCED SOLDER EYELET tails. GOLD plated.
 1-4 5-9 10-24
 \$3.00 \$2.75 \$2.50

RG44-3 22/44 Conn. 156 cts.
 WIRE WRAP tails. GOLD.
 \$4.71

ATTN: OEM's and Dealers, many other connectors available call or quotation.

3 LEVEL GOLD WIRE WRAP SOCKETS

	1-24	25-49	50-99	100-249	250-999	1K-5K
8 pin*	.41	.38	.35	.31	.27	.23
14 pin*	.39	.38	.36	.32	.29	.27
16 pin*	.43	.42	.39	.35	.32	.30
18 pin	.63	.58	.54	.47	.42	.36
20 pin	.80	.75	.70	.63	.58	.53
22 pin*	.90	.85	.80	.70	.61	.57
24 pin	.90	.84	.78	.68	.63	.58
28 pin	1.10	1.00	.84	.76	.71	.66
40 pin	1.50	1.40	1.30	1.20	1.04	.89

Sockets purchased in multiples of 50 per type may be combined for best price.

All sockets are GOLD 3 level closed entry *End and side stackable. 2 level, Solder Tail, Low Profile, Tin Sockets and Dip Plugs available. CALL FOR QUOTATION

8803
 NOTHER BOARD FOR S100 BUS MICRO-COMPUTERS

Kit includes 12 tantalum capacitors for +5, +12, -12 buses and inter-related mounting spacers. Wiring side shown. Component side bare epoxy glass with white markings for component locations.

610 epoxy glass board with 2 ounce copper, solder plated and .038 diameter holes for leads.

Solder mask with solder windows on etched circuit to avoid accidental short circuits.

Mounts 11 microchips with 100 contacts (2 rows) on 125 centers with 250 row spacing. Vector part number RG81-2, or mounts 10 microchips plus interconnectors to smaller mother board for expansion.

Includes etched circuit and instructions for option of active, pull-up, or floating terminations.

Large buses: +5V and GND (10 AMP), +5V and 15V (1 AMP). Current ratings are per MIL-STD-275 with 100°C rise.

Fits in Vector p.c. enclosures.

Fits in MASI 8080 microcomputer as expander board.

Price: \$29.50

Vector 8800V
 Microcomputer/processor plugboard, use with S-100 bus. Complete with heat sink & hardware. 5.3" x 1.4" x 1.16"

1-4	5-9	10-24
\$19.95	\$17.95	\$15.95

8801-1
 Same as 8800V except plain; less power buses & heat sink.

1-4	5-9	10-24
\$14.95	\$13.45	\$11.95

Plugboards

3677 9.6" x 4.5"
\$10.90

3677-2 6.5" x 4.5"
\$9.74

3662 6.5" x 4.5"
\$7.65

3662-2 9.6" x 4.5"
\$11.45

Gen. Purpose D.I.P. Boards with Bus Pattern for Solder or Wire Wrap. Epoxy Glass 1/16" 44 pin con. spaced .156

CARD EXTENDER 3690-12
 Card Extender has 100 contacts-50 per side on .125 centers-Attached connector is compatible with S-100 Bus Systems \$25.00
 3690 6.5" 22/44 pin .158 cts. Extenders \$12.00

1/16" Vector BOARD
 .042 dia holes on 0.1 spacing for IC's

Phenolic

PART NO.	SIZE	1-9	10-19
64P44XXXP	4.5x6.5"	\$1.49	1.34
169P44XXXP	4.5x17"	\$3.51	3.16

Epoxy Glass

64P44	4.5x6.5"	\$1.70	1.53
84P44	4.5x8.5"	\$2.10	1.89
169P44	4.5x17"	\$4.30	3.87
169P84	8.5x17"	\$7.65	6.89

SLIT-N-WRAP
 Wraps insulated wire on .025" square posts
FOUR TIMES FASTER
 than regular manual wrap-post tools

P180
 with two 100' spools of 28 ga. wire
\$24.50

P180-4T
 Includes 4 spools of 28 ga. wire
\$75.00

"Daisy-chain" runs. Relates and easy to use. Manual or power operation.

SLIT-N-WRAP WIRE
 NO. 28 GAGE INSULATED WIRE, 100' SPOOLS
 W28-1-Pkg. 3. Green W28-2-Pkg. 3. Clear W28-3-Pkg. 3. Red W28-4-Pkg. 3. Blue

2708 8K 450 ns

EPROM

FACTORY PRIME

\$9.00 EA.

25 + Call For Price

14 & 16 PIN GOLD 3 LEVEL WIRE WRAP SOCKETS

14 - G3 100 for \$30.00

16-G3 100 for \$30.00

50 of each for \$32.00

Sockets are End & Side stackable, closed entry

LIQUID CRYSTAL DIGITAL CLOCK-CALENDAR

- For Auto, Home, Office
- Small in size (2x2 1/2")
- Push button for seconds release for date.
- Clocks mount anywhere with either 3M double sided tape or VELCRO, included.
- 2 MODELS AVAILABLE:

LCD-101, portable model runs on self-contained batteries for better than a year.

LCD-102, runs on 12 Volt system and is back lighted.

LCD-101 or LCD-102 your choice.

\$34.95.. \$2.00

LEDU MG 10A List \$72. SPECIAL \$44.95

Perfectly balanced, fluorescent lighting with precision magnifier lens. For profi, techn1 & hobbyist. Has die cast protective shade, inst. start 3 disputer lens. 42" reach.

\$44.95

SC-5 With Rechargeable Batteries & Charger Unit \$98

FM-7 With Rechargeable Batteries & Charger Unit \$215

Features include: • By using the new NLS SC-5 Prescaler, the range of the FM-7 Frequency Meter, which is 10 Hz to 50 MHz, may be extended to 512 MHz (the upper VHF & UHF frequency bands). • The FM-7 utilizes an LED readout, providing 7-digit resolution. • The SC-5 is accurate to one part per million. • Each unit has 30 millivolts sensitivity, is battery powered and has a charger unit included. • Dimensions of each are 1.9" H x 2.7" W x 3.9" D. • The units may be obtained separately or as a "Frequency Duo." • Parts & Labor guaranteed 1 year.

Tilt stand option \$3.50
 Leather case \$20.00

MICRO-KLIP
 for .042 dia. holes (all boards on this page)
 T42-1 pkg. 100 \$1.50
 T42-1 pkg. 1000 \$11.00
 P-149 hand installing tool \$2.03

8" LED ALARM CLOCK

12 hr. LED Alarm Clock uses 3 1/2 digit 8" LED Display with AM/PM indicators and colors. Direct drive. PIN to PIN interface with **ST908A** I.C. Just add switches, AC Supply, Alarm. Display and I.C. only.

\$7.95 or 2/\$15.00

Price Breakthrough! \$17.50

MA1003 CAR CLOCK

Bright Green Fluorescent Display Crystal Time Base Assembled, just add switches and 12 VDC.

SPECIAL

14CS2 100 for \$14.00
16CS2 100 for \$16.00
14 pin CS2 10 for \$2.00
16 pin CS2 8 for \$2.00

These low cost DIP sockets will accept both standard width plugs and chips. For use with chips, the sockets offer a low profile height of only .125" above the board. These sockets are end stackable.

PRIORITY ONE ELECTRONICS

4911B West Rosecrans, Hawthorne, CA 90250

Terms: VISA, MC, BAC, check, Money Order, C.O.D., U.S. Funds Only. CA residents add 6% sales tax. Minimum order \$10.00. Orders less than \$75.00 include 10% shipping and handling; excess refunded. Just in case please include your phone no. "Sorry, no over the counter sales" Good thru October, 1978

phone orders welcome (213) 973-4876 OEM and Institutional inquiries invited.

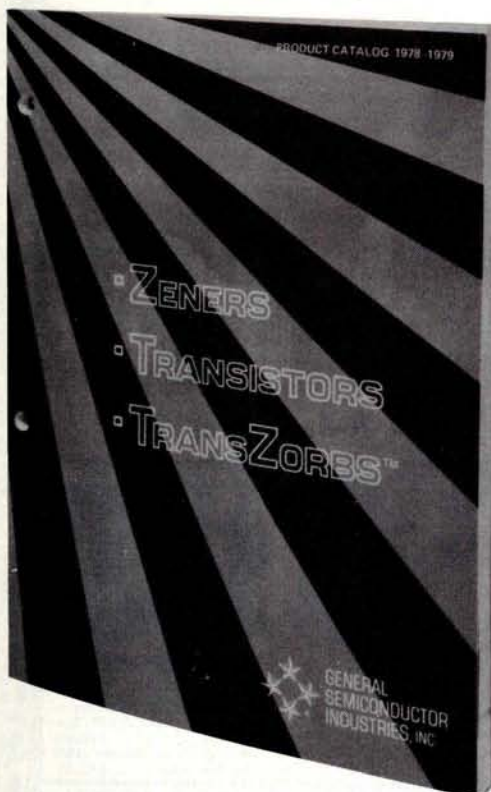
24 PIN DIP PLUGS WITH COVERS

3 / \$1.00
40 / \$10.00

SALE S-100 BUS EDGE CONNECTORS SALE

NLS MS-215 DUAL TRACE MINISCOPE \$435.00

New 1978-79 General Semiconductor Industries Product Catalog



The new 1978-79 General Semiconductor Industries Product Catalog contains a complete listing of the company's entire line of Zener diodes, temperature compensated diodes, NPN switching transistors, TransZorb silicon transient voltage suppressors, and C²R high speed and high voltage switching transistors.

This 238 page publication contains detailed device characterization and applications information for many of the units listed. The catalog lists the devices numerically within specific categories. General Semiconductor's environmental facilities and equipment is also listed. Contact General Semiconductor Industries Inc, 2001 W 10th Pl, Tempe AZ 85281. ■

Circle 622 on inquiry card.

Surge, Hash and Transient Protection

A new flyer from Electronic Specialists, POB 122, Natick MA 01760, discusses AC power line surges and hash. Suggestions are offered for protection from microprocessor damage or malfunction. Included are protection against lightning and error-producing power line hash. When writing for this free flyer, specify flyer AEP-7. Send stamped, self-addressed envelope. ■

Circle 623 on inquiry card.

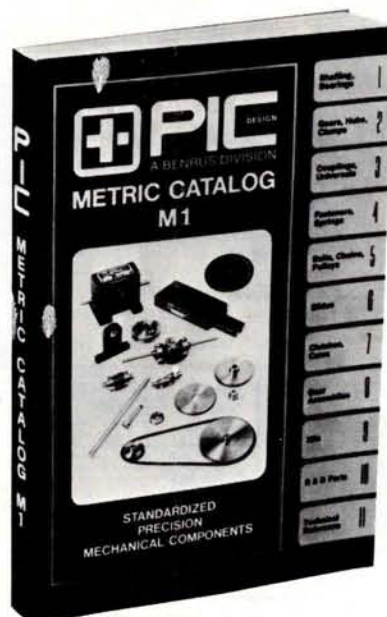
New Electronic Test Equipment Catalog



This new 76 page 1978 catalog features electronic test equipment from major manufacturers including B & K Precision, Continental Specialties, Hickok and Simpson. North American Electronics specializes in direct catalog marketing of name brand electronic test equipment. The free catalog can be obtained by writing to Dept AA 78, North American Electronics, 1468 W 25th St, Cleveland OH 44113. ■

Circle 624 on inquiry card.

New Metric Components Catalog

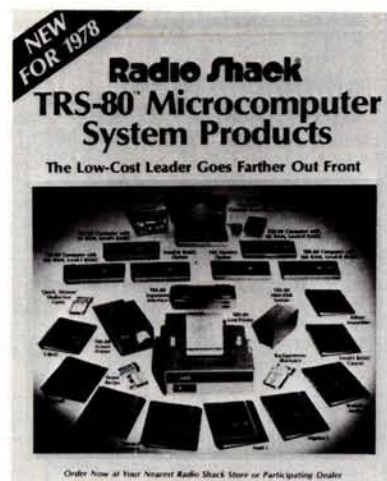


A compilation of metric system standardized precision mechanical components and assemblies has been produced by PIC Design, POB 335, Benrus Center, Ridgefield CT 06877.

The 208 page edition contains over 25,000 components covering 24 different product categories. Also included in the catalog are working prints, technical reference data tables, gear data, metric terms and formulas, and many other design and production aids. ■

Circle 625 on inquiry card.

Radio Shack Microcomputer Catalog



Now available from Radio Shack is the 8 page *TRS-80 Microcomputer System Products* catalog. The catalog features Radio Shack's \$599 TRS-80 microcomputer system and provides information on upgraded systems, peripherals and ready to use software developed specifically for the TRS-80. The basic TRS-80 system offers Level I BASIC with 4 K bytes of read only memory and 4 K bytes of programmable memory.

Also included in the catalog is information on expanding your existing TRS-80 system with details of Level II BASIC, and an order worksheet that helps customers to custom tailor a TRS-80 system to their particular needs. The Radio Shack *TRS-80 Microcomputer System Products* catalog is available free on request from Radio Shack stores and dealers. ■

Circle 626 on inquiry card.

Free Book and Educational Products Catalog

Sybox's 12 page book and educational products catalog contains a broad range of books (including foreign versions), self-study courses and video cassettes for TV systems for the personal computer user. For a free copy of this catalog, write Sybox, 2161 Shattuck Av, Berkeley CA 94704. ■

Circle 621 on inquiry card.

1977 Periodical Guide for Computerists

The January thru December 1977 *Periodical Guide for Computerists* indexes over 2200 articles from 25 hobby and professional electronic and computer publications. Articles, editorials, book reviews and letters from readers which have relevance to the personal computing field are indexed by subject under 100 categories. An author index is included which lists the subjects that each author wrote about. The more than 60 page book is available postpaid for \$5 from E Berg Publications, 1360 SW 199th Ct, Aloha OR 97005. ■

Circle 620 on inquiry card.



IBM® Selectric-Based I/O Writers

Excellent Hobby Printers

- Series 72/731
- Heavy Duty
- 8½" Platen
- All Solenoids
- BCD Code

These terminals are from a large airline reservation system. They are heavy duty and were under continuous maintenance. The units have been in storage. We make every effort to ensure that all essential parts are included. Most work when plugged in. No warranties are given or implied.

\$249.95
CLEANED
&
CHECKED
OUT

\$199.95
AS IS

Selectric Controller

The 3S-01 is a complete controller for the IBM Model 731 I/O typewriter for both input and output operations. With this controller the 731 becomes a versatile ASCII printer with the world famous Selectric quality and an alphanumeric ASCII-encoded keyboard with the wonderful Selectric feel. An eightbit parallel input/output port (bidirectional or separate) is all that is necessary to add the KING of the hardcopy terminals to your system. Serial RS-232C is also available for connection to a serial communications port or modem.

Power supply requirements are 5VDC at .75A and 48VDC at 1A for the basic parallel controller. Additional power needed for the serial unit is \pm 12VDC.

PRICE \$249.95
ASSEMBLED BOARD

Surplus power supply for above \$30.00

Print only interface unit \$59.95
Board and instructions only

Complete Terminal Unit

This unit consists of:

1. A cleaned, checkout, repainted used selectric. This unit has been converted for upper & lower case with new ball containing all BASIC characters.
2. Selectric controller unit allowing both input and output
3. Power supply (used)
4. Terminal table (new)
5. Assembled and tested. Ready to plug in and go.
6. ASCII to computer
7. Crated for shipping by motor freight (collect)

PRICE \$775.00 FOB TULSA
DEALER INQUIRY INVITED

Have 10 HP 2671B card readers left at \$299.95 each FOB Tulsa.

Cashier Check or Money Order.
Personal check allow 3 weeks. Units shipped collect. Price Net FOB Tulsa.

3 S Sales, Inc.
P. O. Box 45944
Tulsa, OK 74145
1-918-622-1058

SUPER SALE

4801 STATIC, TTL IN/OUT 4096x1 N-MOS RAM

GENERAL DESCRIPTION

Part Number 4801 is a 4K semiconductor random access memory organized as 4096 1-bit words. It is fully static and needs no clock or refresh pulses. It requires a single +5 volt power supply and is fully TTL compatible on input and output lines. The 4801 is packaged in a convenient 18 pin dual in-line package.



FEATURES

- Single +5V Power Supply
- 4Kx1 Organization
- Replaces 4 1024x1 Static RAMs
- Completely Static—No Clocks or Refresh
- 18 Pin Package
- Access/Cycle Times 600 nsec max
- 250 mw Typical Operating Power
- Separate Data In and Data Out
- TTL Compatible I/O
- Three State Outputs
- Data Bus Compatible I/O Function

4804 STATIC, TTL IN/OUT 1024x4 N-MOS RAM

GENERAL DESCRIPTION

Part Number 4804 is a 4K semiconductor random access memory organized as 1024 4-bit words. It is fully static and needs no clock or refresh pulses. It requires a single +5 volt power supply and is fully TTL compatible on input and output lines. The 4804 is packaged in a convenient 18 pin dual in-line package.



FEATURES

- Single +5V Power Supply
- 1Kx4 Organization
- Replaces 4 1024x1 Static RAMs
- Completely Static—No Clocks or Refresh
- 18 Pin Package
- Access/Cycle Times 600 nsec max
- 250 mw Typical Operating Power
- Common I/O Bus
- TTL Compatible I/O
- Three State Outputs

4801 or 4804 4K RAM's
\$8.95 8/\$60.00 16/\$100.00



TRI-TEN
7808 North 27th Avenue
Phoenix, Arizona 85021
(602) 995-9352

16,384-BIT DYNAMIC RANDOM ACCESS MEMORY

The MCM4116 is a 16,384-bit, high-speed dynamic Random Access Memory designed for high-performance, low-cost applications in main-frame and buffer memories and peripheral storage. Organized as 16,384 one-bit words and fabricated using highly reliable N-channel double-polysilicon technology, this device optimizes speed, power, and density tradeoffs. By multiplexing row and column address inputs, the MCM4116 requires only seven address lines and permits packaging in standard 16-pin dual in-line packages. This packaging technique allows high system density and is compatible with widely available automated test and insertion equipment. Complete address decoding is done on chip with address latches incorporated. All inputs are TTL compatible, and the output is 3-state TTL compatible. The data output of the MCM4116 is controlled by the column address strobe and remains valid from access time until the column address strobe returns to the high state. This output scheme allows higher degrees of system design flexibility such as common input/output operation and two dimensional memory selection by decoding both row address and column address strobes. The MCM4116 incorporates a one-transistor cell design and dynamic storage techniques, with each of the 128 row addresses requiring a refresh cycle every 2 milliseconds.

• Flexible timing with read-modify-write, RAS-Only refresh, and Page-Mode capability.

• Industry standard 16 pin package

• 16,384 X 1 organization

• \pm 10% tolerance on all power supplies

• All inputs are fully TTL compatible

• Three-state fully TTL-compatible output

• Common I/O capability when using "Early Write" mode

• On chip latches for addresses and data in

• Low power dissipation—462mW active, 20mW standby(Max)

• Fast access time: 200nS

• Easy upgrade from 16-pin 4K RAMs

• Pin compatible with 2117, 2116, 6616, uPD416 and 4116

MCM4116.....\$24.95

Specs.....\$.60

- For premium shipping (first class, special handling, etc.) add extra. Excess will be refunded.
- Please give street address for UPS shipping when possible.
- C.O.D. NO parcel post C.O.D.
- UPS C.O.D. Add \$5 to order.
- Any correspondence not connected with your order, please use separate sheet and include SASE for reply.
- Claims for shortages or damaged material must be made within 10 days of receipt of package.
- Prices are subject to change without notice.
- Any refunds will be by check, not credit vouchers.
- If we should be temporarily out of stock on any item, it will be placed on back order. If we cannot ship in 30 days, you will be notified of the expected shipping date and furnished with a postage paid card with which to cancel your order if desired.
- Terms: Check, money order, credit card. Net 30 days to retail firms, schools and government agencies.
- Claims for defective material must be made within 60 days of receipt of parcel. Claim must include invoice number, date & defective parts.



DATA CONNECTORS

Popular 25 pin subminiature "D" connector as used in RS232 interfaces.

Special sale prices!

	1-9	10-99	100-up
DBC-25P (male)	\$2.19	19.80	173.00
DBC-25S (female)	\$3.19	30.50	265.00

DATA PHONE HOODS

"Clam Shell" type junction shell for 25 pin data connectors.

DB-51226.\$1.39



SCREW LOCK ASSEMBLY

Set of 2 Male/Female screw lock adapters for joining socket and plug connectors.

D20418.....\$1.19



BK PRECISION

New 3-1/2 Digit Portable DMM



- Reliable—fully overvoltage protected
- 3-1/2 digit easy to read LED display
- Completely portable—use it anywhere
- Auto zeroing
- High Low power ohms for in-circuit accuracy
- 1mv, 1 A, 5.1 ohm resolution
- 10 meg input impedance, industry standard
- Excellent temperature coefficient

MODEL
2800

Model 2800.....\$99.95

CATCH-A-PULSE II LOGIC PROBE

- 10 Nsec pulse response
- Open circuit detection
- Replaceable tip & cord
- High input impedance
- Pulse stretching
- Multi-family

10 Nsec SPEED AT 4 to 15V LEVELS ONLY \$44.95

Compatible with DTL, TTL, CMOS, MOS, and Micro-processors using a 4 V to 15V power supply. Thresholds automatically programmed for multi-logic family operation. Automatic resetting memory for single or multi-pulse detection. No adjustment required. Visual indication of logic levels, using LEDs to show high, low, bad level or open circuit logic and pulses. Highly sophisticated, shirt-pocket portable (protective cap over tip and removable coiled cord). Eliminates need for heavy test equipment. A definite plus in time and money for engineer and technician.

Send \$44.95
Shipping add \$2.00 per probe.

Dealer inquiries welcome (Calif. residents add 6% sales tax) to:

AEK ELECTRONICS

Box 19299, San Diego, CA 92119 (714) 447-1770

Circle 24 on inquiry card.

NEW PRICES!

TAPE RECORDER!

\$269.00 5 TRACK, 4 CASSETTE EASY TO MODIFY TO PLAY ONE, RECORD ON ANOTHER! ALL CONTROL SIGNALS ON EDGE CONNECTORS! 2000FT 1/4" TAPE/ CASSETTE, PRINTED CIRCUIT MOTORS & TACH GENERATOR, 15/16"/SEC; 12V 5A REQ'D. DATA & 1 CASSETTE FURNISHED; WT85LBS SHIP'D COD. BOOK \$25 REFUNDED; CASSETTE \$25

CIRCUIT BOARDS!

\$25.00 WIRE WRAP, GOLD, 8-16PIN, 32-14PIN, 8-26PIN, 0.255 SQ. MALE RIBBON CONNECTORS, YOU STRIP, EACH \$10.00. NEW KLUGE BOARDS! EPOXY-GLASS 2 SIDE COPPER, 1/16" X 1/2" X 10 1/2" DRILLED FOR 7-16PIN, 28-14PIN, 1-24PIN, 8-4-28PIN SOCKETS MANY THRU HOLES, 1/4" CLEAR 3 EDGES, YOU ETCH. EACH \$50.00. NO. 2 SAME EXCEPT 1/16" X 1/2" X 10 1/2" DRILLED FOR 13-16PIN, 8-36-14PIN SOCKETS, MATCH YOUR SYSTEM YOU ETCH! EA \$75.00

PC CUT CAPACITORS NOW \$30/\$100

SEE JUNE BYTE FOR LIST! ALL SIX ONLY \$55.00

DC MOTORS

\$2.00 SMALL, 15/8" DIA 2 7/16" LONG, SHAFT 1/8" DIA 1/2" LONG, PM FIELD, BALL BEARING, 28VOLT EA \$6.00. HI TORQUE, 3/16" DIA 3 3/4" LG, PM FIELD, 2 1/4" DIA 2 7/8" LONG, B.B., 28VOLT, D.C. HAS MU-METAL SHIELD, PUSH-ON TERMINALS, EACH \$7.50. TACHOMETER GEN, PM FIELD, 1/8" DIA 3/8" LONG SHAFT, 1" DIA X 1 3/4" LONG FIELD, EACH \$5.00. LARGE MOTOR & TACH \$10.00. ALLOW \$3.00 P&H BAL REFUNDED; MIN ORDER \$10.00

J & E ELECTRONICS SALES
PO BOX 4504, FT. WORTH, TX 76106

Circle 193 on inquiry card.

LIMITED OFFER THIS MONTH, WHILE SUPPLY LASTS!

ALL NEW!

Mini Discs \$3.70 ea. in boxes of 10

Two-tier walnut formica enclosure for S. A. 400 Shugart. . . \$39.95

- A. Horizon - 2
- B. Centronic 779
- C. Hazeltine 1500
- D. Hazeltine 1400

A, B & C: \$4,150 **A, B & D: \$3,852**

We also stock Imsai, Seals, Okidata, ADM-3A, Xitan and Cromemco. Mail order only.

TORA SYSTEM
29-02 23rd Avenue
Astoria, NY 11105
(212) 932-3533

Circle 373 on inquiry card.

LSI-11/2 USERS

AAM-11 • Auto-answer/Auto-dial low speed modem/serial interface. Requires only a 'CBS' DAA unit. Emulates DL-11E and DN-11. Software transparent. \$650

BUS-11 • Direct X-Y graphics display of bus activity on your oscilloscope. Selectable qualifiers and address window. Use stand-alone or connect to logic analyzer. Start/stop address strobes for software loop timing analysis. *Invaluable diagnostic.* \$300

TEXT-11 • Screen editor package for RT-11. Use with any cursor controlled CRT. Context switch between 2 files. *What you see is what you get!* \$500

Dealer/OEM inquiries invited

Nortek
The LSI-11 specialists.
2432 NW Johnson • Portland, OR 97210
503-226-3515

Circle 284 on inquiry card.

16K RAM MEMORY CARD

\$27.00



SWTPC MSI DSD

16K RAM card using TMS 4045 or SY 2114 1024 x 4 Memories. Selectable to any two 8K blocks of memory. Single 5V supply. Compatible to all SS-50 BUS Computers.

Other Cards Available

DSD 1802-4K-8K	CPU card	\$27.00
DSD S6011	Serial card	\$12.00
DSD P8212	Parallel card	\$12.00
DSD C 1/0-2M	Cassette card	\$12.00
DSD I/O-N	I/O Network	\$29.00
DSD SS-50-5	Mother board	\$29.00

All cards with connectors only.

DIGITAL SERVICE & DESIGN
P. O. Box 741
Newark, Ohio 43055

Order direct by check, VISA or Master Charge. Ohio residents add 4% sales tax.

Circle 103 on inquiry card.

CURRENT Opportunities

- Product Support Engineers mini-computers \$27,000
- Support Engineers Micro-mini-computers \$23,000
- Field Service Engineers mini peripherals \$20,000

Call or write: Steve Bagley

- Compiler Design \$30,000
- Real Time Operating Systems \$28,000
- Micro-Processor Programmers \$23,000

Call or Write: Walt Abrams

MANY MORE CHALLENGING OPPORTUNITIES

JUDGE

ELECTRONICS SERVICES, INC.

PERSONNEL CONSULTANTS
Suite 100
Two Newton Executive Park
Newton Lower Falls, MA 02162
(617) 965-9700

Circle 203 on inquiry card.

LOW LOW COST S 100 BUS MICRO COMPUTER HEAVY CURRENT POWER SUPPLY KITS

3 Hour Assembly Time—Complete Instructions Included
Dimensions of kit 13" (l) x 5" (w) x 4 3/4" (h)

KIT A: \$57.50 4 Unregulated Voltages Available
→ 8.5V/25A, → 8.5V/3A, → 17V/3A

Includes TRANSFORMER T₂ (25A, size 3 3/4" (l) x 4 1/4" (w) x 3 1/4" (h)), CAPACITOR C₁ (100,000 UF, 15V), BRIDGE RECTIFIERS: D₁ (30A, 50V) & D₂ (4A, 50V), FUSE HOLDER, BARRIER STRIP, ALUMINUM PLATE (13" (l) x 5" (w) x 3/16" (t)), 3X CAPACITORS (6,000 UF, 45 V), 4X RESISTORS and All Necessary Mounting Parts.

KIT B: \$47.50 4 Unregulated Voltages Available
→ 8.5V/15A, → 8.5V/2A, → 17V/2A

All Parts are same as in KIT A, EXCEPT: CAPACITOR C₁ (52,000 UF, 15V) and TRANSFORMER T₁ (15A, Size 3 3/4" (l) x 4" (w) x 2 13/16" (h)).

You May Buy Transformers Alone:
T₂ (25A) & T₁ (15A) at \$22.50 and \$17.50 respectively.

SHIPPING CHARGES: \$4.75 per TRANSFORMER
FOR EACH KIT: \$5.00 in California, \$7.00 for all other States.
California Residents add 6% sales tax.
Master Charge & BankAmericard. OEM Available

SUNNY INTERNATIONAL

Mail Order Store
P.O. Box 4296 7245 E. Alondra Blvd.
Torrance, CA 90510 Paramount, CA 90723
(213) 530-3732 Mon.-Sat.: 9 am - 6 pm

Circle 354 on inquiry card.

RADIO SHACK COMPUTER OWNERS TRS-80

MONTHLY NEWSLETTER

**BUSINESS • PERSONAL FINANCE
PRACTICAL APPLICATIONS
GAMBLING • GAMES
LATEST TRS-80 DEVELOPMENTS
SOFTWARE EXCHANGE • MARKET PLACE
QUESTIONS AND ANSWERS
PROGRAM PRINTOUTS
... AND MORE**

MAJOR PROGRAMS PUBLISHED MONTHLY • INCOME TAX PROGRAM - LONG AND SHORT FORMS • INVENTORY CONTROL • EXTENSIVE MAILING LIST AND FILE PROGRAM • PAYROLL • STOCK SELECTION • PICKING WINNING HORSES • REVENUE PROGRAM LINES • CHESS • CHECKERS • FINANCIAL APPLICATIONS PACKAGE • PERSONAL FINANCE PACKAGE • GRAPHICS • STATISTICS • MATHEMATICS • EDUCATION ... AND MORE

\$24 Per Year—Sample Issue \$4
VISA MasterCard

MATHEMATICAL APPLICATIONS SERVICE
Box 149 RB
NEW CITY, NY 10956
(914) 425-1535

(Send for our FREE Software Catalog)

Circle 217 on inquiry card.

COMPUTER PROFESSIONALS



Top New England clients seek key individuals for several outstanding opportunities. Salary range \$16 - \$50K.

CRITICAL NEEDS: Hardware/Software Engineers, Analysts and Programmers in Scientific Environments. Experience desired in Digital Design, Data Communications, Graphics, Radar, Distributed Processing, Minis and Micros, PDP-11, RSX-11, GCOS, CAD, CAM, Assembly, PL-1, Algo and Pascal.

Call us collect
(603) 889-0112
or send resume.
**PREFERRED
POSITIONS, INC.**
142 Main Street
Nashua, N.H. 03060

Circle 304 on inquiry card.

BECKIAN ENTERPRISES



All Prime Quality — New Parts Only
Satisfaction Guaranteed

EDGE CARD CONNECTORS: GOLD PLATED.

BODY: Non brittle, solvent resistant, high temp, G.E. Valox. The finest you can buy.
CONTACTS: Bifurcated Phos./Bronze; Gold/Nickel.

ALTAIR S-100: Cont./Ctrs. .125" Row Spacing, .140"

50/100 Dip Sold.	\$3.95 ea.	5 pcs.	\$3.75 ea.
50/100 Sold. Eye.	6.95 ea.	5 pcs.	6.50 ea.

IMSAI S-100: Cont./Ctrs. .125" Row Spacing, .250"

50/100 Dip Sold.	\$4.20 ea.	5 pcs.	\$3.95 ea.
50/100 W/Wrap 3	3.75 ea.	5 pcs.	3.50 ea.
IMSAI CARD GUIDES:	0.19 ea.	5 pcs.	0.16 ea.

CROMEMCO S-100: Cont./Ctrs. .125" Row Spacing, .250"

50/100 Dip Sold.	\$6.50 ea.	5 pcs.	\$6.00 ea.
(Or short W/Wrap)			

OTHER CONNECTORS AVAILABLE

.100" Contact Ctrs., .140" Row Spacing.

22/44 Dip Sold.	\$2.30 ea.	5 pcs.	\$2.10 ea.
25/50 Sold. Eye.	2.95 ea.	5 pcs.	2.75 ea.
40/80 Sold. Eye.	4.80 ea.	5 pcs.	4.50 ea.
43/86 Dip Sold.	4.90 ea.	5 pcs.	4.70 ea.
43/86 Sold. Eye.	4.90 ea.	5 pcs.	4.70 ea.

.156" Contact Ctrs., .140" Row Spacing.

6/- Sgle. Row (PET)	\$1.00 ea.	5 pcs.	\$0.90 ea.
22/44 Sold. Eye. (KIM)	1.90 ea.	5 pcs.	1.80 ea.
22/44 Dip Sold. (KIM)	1.90 ea.	5 pcs.	1.80 ea.
43/86 Dip Sold.	4.90 ea.	5 pcs.	4.70 ea.

.156" Contact Ctrs., .200" Row Spacing.

15/30 W/Wrap 3	\$1.05 ea.	5 pcs.	\$0.95 ea.
22/44 W/Wrap 3	2.30 ea.	5 pcs.	2.10 ea.
36/72 Sold. Eye.	3.45 ea.	5 pcs.	3.30 ea.
36/72 W/Wrap 3	3.85 ea.	5 pcs.	3.70 ea.
43/86 W/Wrap 3	5.50 ea.	5 pcs.	5.00 ea.

POLARIZING KEYS FOR ALL OF THE ABOVE:

Specify: IN Contact or BETWEEN Contact:
1 to 49 pcs. \$0.10 ea. 50 pcs./Up \$0.08 ea.

SPECIAL

12/24 Pin .156" Cont./Ctrs. .200" Row Spacing.
TIN PLATED CONTACTS.
IDEAL FOR PET INTERFACE & PARALLEL USER PORT.
\$1.25 ea. 5 pcs. \$1.10 ea.

SUBMINIATURE CONNECTORS: (DB 25 SERIES, RS 232.)

DB 25P Male Plug	\$2.50 ea.	5 pcs.	\$2.20 ea.
DB 25S Female Socket	3.60 ea.	5 pcs.	3.40 ea.
DB 51212-1 Grey Hood	1.20 ea.	5 pcs.	1.10 ea.
DB 51212-1A Black Hood	1.30 ea.	5 pcs.	1.20 ea.
D 20418-2 Hardware Set	0.75 ea.	5 pcs.	0.70 ea.

SAVE: BUY A SET: (1 DB25P, 1 DB25S, Any Hood.)

1 Set: \$6.35 ea. 5 sets: \$6.15 ea.
NOTE: For Hardware, (D20418-2) Add \$.65/Set.

WHISPER FANS

Excellent for computer cabinet cooling. This is the most quiet fan you will find. Only measures 4 3/4" square by 1 1/2" deep. U. L. Listed.
\$21.00 ea. 5 pcs. \$19.00 ea.

I. C. SOCKETS. GOLD.

WIRE WRAP 3 TURN.

14 pin	\$0.36 ea.
16 pin	0.38 ea.

I. C. SOCKETS.

Dip Solder. Tin.

14 pin	\$0.15 ea.
16 pin	0.17 ea.

2708 EPROMS PRIME

\$14.00 ea.

8080 PRIME

\$9.00 ea.

WRITE FOR LARGER QUANTITY DISCOUNTS. DEALER INQUIRIES ARE WELCOME.

WE ARE CONNECTOR (EDGE CARD) SPECIALISTS. IF YOU DO NOT SEE WHAT YOU NEED IN THIS ADVERTISEMENT, PLEASE WRITE US. WE WILL REPLY.

TERMS: Minimum Order \$10.00: Add \$1.25 for handling and shipping. All orders over \$25.00 in USA and Canada: WE PAY THE SHIPPING.

NOTE: CA residents please add 6% sales tax.

NO C.O.D. SHIPMENTS OR ORDERS ACCEPTED.

MAIL ORDERS TO: **Beckian Enterprises**

P.O. Box 3089

Simi Valley, CA 93063



cybercom BOARDS

MB-1 MK-8 Computer RAM (not S-100), 4KX8, uses 2102 type RAMs, PCBD only \$22.00

MB-3 1702A EROM Board, 4KX8, S-100 switchable address and wait cycles, kit less PROMS \$58.00

MB-4 Basic 4KX8 ram, uses 2102 type rams S-100 buss. PC board \$25.95

MB-6A Basic 8KX8 ram uses 2102 type rams, S-100 buss. KIT 450 NSEC \$125. PCBD \$24.95

MB-7 16KX8, Static RAM uses P410 Protection, fully buffered. KIT \$299.95

MB-8A 2708 EROM Board, S-100, 8KX8 or 16KX8 kit without PROMS \$75.00

MB-9 4KX8 RAM/PROM Board uses 2112 RAMs or 82S129 PROM kit without RAMs or PROMS \$72.00

IO-2 S-100 8 bit parallel I/O port, 2 of boards is for kludging. Kit \$46.00 PCBD \$25.95

IO-4 Two serial I/O ports with full handshaking 20/60 ma current loop: Two parallel I/O ports. Kit \$130. PCBD \$25.95

VB-1B 64 x 16 video board, upper lower case Greek, composite and parallel video with software, S-100. Kit \$125.00 PCBD \$25.95

Altair Compatible Mother Board, 11 x 11 1/2 x 1/8". Board only \$40.00. With 15 connectors \$94.95

Extended Board full size. Board only \$ 8.95

With connector \$12.95

SP-1 Synthesizer Board S-100

PCBD \$39.95 KIT \$135.95

PRIME DEVICES

82S23	\$1.50		
82S123	1.50		
82S126	1.95	8080A	\$ 9.95
82S129	1.95	8212	3.45
82S130	3.00	8214	6.50
82S131	3.00	8216	3.75
MMI6330	1.50	8224	4.00
4N26	.75	8228	6.50
4N27	.75	8251	9.95
4N28	.75	8255	9.95
LM323	2.95	21L14	7.95
		4116 (apple ram)	19.50



WAMECO INC.

MEM-1 8KX8 fully buffered, S-100, uses 2102 type rams. PCBD \$24.95

QM-12 MOTHER BOARD, 12 slot, terminated, S-100 board only \$34.95

CPU-1 8080A Processor board S-100 with 8 level vector interrupt PCBD \$25.95

RTC-1 Realtime clock board. Two independent interrupts. Software programmable. PCBD \$25.95

EPM-1 1702A 4K Erom card PCBD \$25.95

EPM-2 2708/2716 16K/32K EPROM CARD PCBD \$25.95

QM-9 MOTHER BOARD. Short Version of QM-12. 9 Slots PCBD \$27.95

MEM-2 16K x 8 Fully Buffered 2114 Board PCBD \$25.95

2102AL-2 Prime 250 NSEC \$1.70

2102AL-4 Prime 450 NSEC \$1.30

2708 Prime (National) \$9.95

2501B \$1.50 1488N \$1.50

2502B 1.50 1489N 1.25

2504 1.50 MC4044 2.25

2507V 1.50 8038 3.90

2510A 1.50 5320 5.95

2517V 1.50 5554 1.90

2518B 1.50 5555 2.50

2519B 1.50 5556 2.50

2521 1.50 5055 1.25

2522 1.50 5312 4.00

2525 1.50 MH0025 1.50

2527 1.50 MH0026 1.75

2532V 1.50 MH0028 1.90

2529 2.75 5262 .50

2533V 1.95 2101 3.50



419 Portofino Drive
San Carlos, California 94070

Please send for IC, Xistor and Computer parts list

KITS

MIKOS PARTS ASSORTMENT
WITH WAMECO AND CYBERCOM PCBDS

MEM-1 with MIKOS #1 450 NSEC 8K

RAM \$125.00

CPU-1 with MIKOS #2 8080A CPU 89.95

MEM-2 with MIKOS #3 250 NSEC 8K

RAM 155.00

QM-12 with MIKOS #4 13 slot mother

board 79.95

RTC-1 with MIKOS #5 real time clock 60.95

VB-1B with MIKOS #6 video board less

molex connectors 89.95

MEM-2 with MIKOS #7 16K RAM 275.95

EMP-1 with MIKOS #10 4K 1702 less

EPROMS 49.95

EPM-2 with MIKOS #11 16-32K EPROMS

less EPROMS 49.95

QM-9 with MIKOS #12 9 slot mother

board 67.95

MIKOS PARTS ASSORTMENTS ARE ALL FACTORY PRIME PARTS. KITS INCLUDE ALL

PARTS LISTED AS REQUIRED FOR THE COMPLETE KIT LESS PARTS LISTED. ALL

SOCKETS INCLUDED.

VISA or MASTERCHARGE. Send account number, interbank number, expiration date and sign your

order. Approx. postage will be added. Check or money order with 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. \$1.00

service charge on orders less than \$10.00.

What's New?

New Enclosure for Homebuilt Microcomputers and Terminals

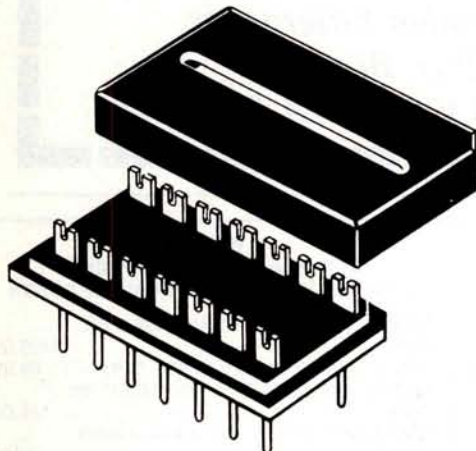


Designed with the personal computer user in mind, this new case is now avail-

able for home built microcomputers and terminals. Constructed of molded fiberglass, the case is large enough (18 by 20 by 8 inches (46 by 51 by 20 cm)) to enclose a variety of components and sturdy enough to support a monitor or portable TV. The keyboard area will accommodate both a full-size keyboard and a hex pad (not included with case). The textured polyester finish is available in beige, white or black. Cutouts may be easily made with an ordinary sabre saw. Cast-in brackets are provided for mounting to a base plate. The price of the case is \$59.95. An optional aluminum base plate is available for \$15.95. For more information contact Technical Products Company, POB 12983, Gainesville FL 32604.■

Circle 582 on inquiry card.

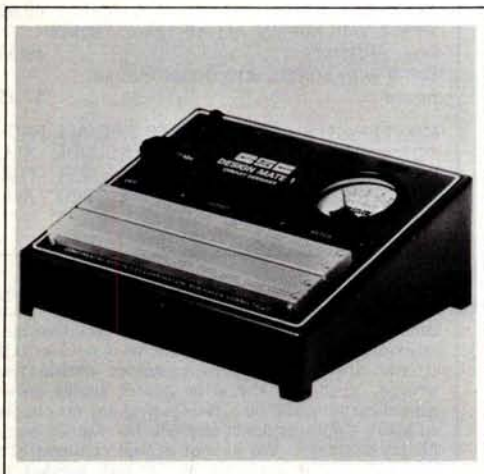
New DIP Plugs and Covers



For the personal computer user or prototype engineer who needs to make interconnection assemblies, OK Machine and Tool Corp, 3455 Connor St, Bronx NY 10475, offers 14 and 16 pin plugs that fit into standard dual in line package (DIP) sockets. Plugs feature United Laboratories recognized glass filled thermo plastic bodies, and solder lugs on the top side are slotted for easy attachment of cable leads. Rectangular legs aid in the insertion into the socket. The leg and solder lug are one piece gold plated phosphor bronze. Packed two to a package, complete with slotted top-entry covers, the plugs are \$1.45 for two 14 pin units and \$1.59 for the 16 pin version.■

Circle 583 on inquiry card.

DM-1 Design Mate Adds Power, Metering to Solderless Breadboards



The Design Mate-1 is a self-contained unit that adds a 5 to 15 V variable regu-

lated power supply and a 0 to 15 VDC voltmeter to a solderless breadboard terminal and bus strips.

The output of the DM-1 variable regulated power supply is 5 to 15 VDC at up to 600 mA for 9 W maximum of electronic drive. The 0 to 15 VDC meter and the power supply are brought out to their own binding posts on the face of the Design Mate case. The meter can then be used to set up the power supply voltage and reconnected to measure voltage parameters within the circuit being designed. Load and line regulation is better than 1%; ripple and noise are less than 20 mV at full load.

The package weighs 3 pounds (1.4 kg) and comes assembled with detailed operating instructions. The 117 VAC 60 Hz version is priced at \$69.95. A 220 V 50/60 Hz version is available for 10% more. For further information contact Continental Specialties Corp, 70 Fulton Ter, New Haven CT 06509.■

Circle 585 on inquiry card.

Combination Coding and Video Layout Form Introduced for BASIC Users

A new coding form designed for BASIC or other line number oriented languages is available from Stirling/Bekdorf, 4407 Parkwood, San Antonio TX 78218. With grid lines lithographed in soft blue on a white sheet, Form 78C1 combines coding and interactive video layout functions into one unit. The form has 28 coding lines and retains the 6 mm by 3 mm (.02 inches by .01 inches) grid needed for comfortable writing.

Both 16 line by 64 character and 24 line by 80 character standard video formats are indicated on the form. Developed for minicomputer and microcomputer programming, Form 78C1's paper stock is a 22# opaque sheet which will take a plastic tip marker without spreading and will accept soft pencil equally well.

According to the company, it is pure enough for magnetic ink character recognition scanning equipment. For maximum writing ease and legibility, pens with fine hard plastic capillary action points and black ink should be used. Such pens as the Pilot Razor Point, Sanford's Expresso Fine Point or Big Sig II, Berol Super Flash and Flair Ultra Fine give sharp, crisp coding. The Pentel 0.5 mm mechanical pencil using 0.5 mm HB soft lead will give good results.

The BASIC coding and video layout form is available in 3 hole punched loose-leaf style in 100 sheet packages and as 3 hole punched 50 sheet pads with chipboard backing.■

Circle 584 on inquiry card.

Let the 3rd Hand Hold Your Circuit Boards



The 3rd Hand is an aluminum circuit board holder featuring one hand operation. Clamped to the edge of the workbench it holds the board at a convenient angle for placing parts and then is flipped forward to solder parts in place. The vinyl gasket protects the board from damage while holding it securely in place. The open end design allows it to hold circuit boards of any size. The price is \$9.95 and the unit can be obtained from Studio 3, POB 1184, Kailua HA 96734.■

Circle 586 on inquiry card.

VISIBLE
OR
INFRA RED

USED FOR CHARACTER
RECOGNITION FOR
COMPUTERS WITH
EXTERNAL CIRCUITS

MAY BE USED IN
A VACUUM,
UNDER WATER,
HIGH ALTITUDE

IN MAGNETIC ENVIRONMENT
BECAUSE THERE IS NO
HIGH VOLTAGE OR
MAGNETIC DEFLECTION

MINIATURE SOLID STATE

202 VIDEO CAMERA KIT

FEATURING A... 100 x 100 BIT SELF SCANNING CHARGED COUPLED DEVICE

THIS UNIQUE UPDATED CAMERA KIT
FEATURES THE FAIRCHILD CCD 202C IMAGE SENSOR

ADVANTAGES

- IN THE FUTURE
WE WILL SUPPLY A
COMPUTER VIDEO INTERFACE CARD
- All clock voltages operate at 6V
requiring no adjustments
- Higher video output signal
- We supply the power board, so only
a 5V 1 Amp power source is needed
- The circuitry has been simplified for
easier assembly
- Two level TTL output is supplied for
interfacing

FEATURES

- Sensitive to infra red
as well as visible light
- May be used for IR surveillance
with an IR light source
- Excellent for standard
surveillance work, because
of light weight and small size
- All components mounted on
parallel 3 3/4" x 6 1/2" single
sided boards
- Total weight under 1 lb.



We supply all semiconductors, boards, data sheets,
diagrams, resistors and capacitors, and 8MM lens.
Sorry we do not supply the case, batteries and 5V supply.

\$349.00 KIT

Add \$75.00 to assemble and test
Add \$2.00 Postage and Handling

UNIVERSAL 4Kx8 MEMORY BOARD KIT

\$69.95

32-2102-1 fully buffered, 16 address lines, on
board decoding for any 4 of 64 pages, standard
44 pin bus, may be used with F-8 & KIM

EXPANDABLE F8 CPU BOARD KIT

\$99.00

featuring Fairbug PSU, 1K of static ram, RS 232
interface, documentation, 64 BYTE regis. er

C/MOS (DIODE CLAMPED)

4001	-18 4019	-37 4045	-35 74C23	-85
4002	-18 4020	-90 4050	-35 74C174	-45
4006	-95 4021	-90 4053	-110 74C83	-115
4007	-18 4022	-90 4055	-125 74C86	-40
4009	-37 4023	-18 4066	-70 74C93	-75
4010	-37 4024	-75 4071	-18 74C151	-140
4011	-18 4025	-18 4076	-97 74C160	-105
4012	-18 4027	-37 4520	-70 74C161	-105
4013	-29 4028	-80 74C00	-22 74C174	-105
4014	-75 4029	-95 74C02	-22 74C175	-105
4015	-75 4030	-33 74C04	-24 74C193	-120
4016	-29 4035	-97 74C08	-22 74C901	-48
4017	-90 4042	-65 74C10	-27 74C902	-48
4018	-90 4046	-135 74C42	-85 74C914	-170

2708 8K EPROM (450 ns)	\$ 9.75
2722 256 2K 16 BIT SR	\$ 1.95
2723 256 2K 16 BIT SR	\$ 1.95
2724 256 2K 16 BIT SR	\$ 1.95
2725 256 2K 16 BIT SR	\$ 1.95
2726 256 2K 16 BIT SR	\$ 1.95
2727 256 2K 16 BIT SR	\$ 1.95
2728 256 2K 16 BIT SR	\$ 1.95
2729 256 2K 16 BIT SR	\$ 1.95
2730 256 2K 16 BIT SR	\$ 1.95
2731 256 2K 16 BIT SR	\$ 1.95
2732 256 2K 16 BIT SR	\$ 1.95
2733 256 2K 16 BIT SR	\$ 1.95
2734 256 2K 16 BIT SR	\$ 1.95
2735 256 2K 16 BIT SR	\$ 1.95
2736 256 2K 16 BIT SR	\$ 1.95
2737 256 2K 16 BIT SR	\$ 1.95
2738 256 2K 16 BIT SR	\$ 1.95
2739 256 2K 16 BIT SR	\$ 1.95
2740 256 2K 16 BIT SR	\$ 1.95
2741 256 2K 16 BIT SR	\$ 1.95
2742 256 2K 16 BIT SR	\$ 1.95
2743 256 2K 16 BIT SR	\$ 1.95
2744 256 2K 16 BIT SR	\$ 1.95
2745 256 2K 16 BIT SR	\$ 1.95
2746 256 2K 16 BIT SR	\$ 1.95
2747 256 2K 16 BIT SR	\$ 1.95
2748 256 2K 16 BIT SR	\$ 1.95
2749 256 2K 16 BIT SR	\$ 1.95
2750 256 2K 16 BIT SR	\$ 1.95
2751 256 2K 16 BIT SR	\$ 1.95
2752 256 2K 16 BIT SR	\$ 1.95
2753 256 2K 16 BIT SR	\$ 1.95
2754 256 2K 16 BIT SR	\$ 1.95
2755 256 2K 16 BIT SR	\$ 1.95
2756 256 2K 16 BIT SR	\$ 1.95
2757 256 2K 16 BIT SR	\$ 1.95
2758 256 2K 16 BIT SR	\$ 1.95
2759 256 2K 16 BIT SR	\$ 1.95
2760 256 2K 16 BIT SR	\$ 1.95
2761 256 2K 16 BIT SR	\$ 1.95
2762 256 2K 16 BIT SR	\$ 1.95
2763 256 2K 16 BIT SR	\$ 1.95
2764 256 2K 16 BIT SR	\$ 1.95
2765 256 2K 16 BIT SR	\$ 1.95
2766 256 2K 16 BIT SR	\$ 1.95
2767 256 2K 16 BIT SR	\$ 1.95
2768 256 2K 16 BIT SR	\$ 1.95
2769 256 2K 16 BIT SR	\$ 1.95
2770 256 2K 16 BIT SR	\$ 1.95
2771 256 2K 16 BIT SR	\$ 1.95
2772 256 2K 16 BIT SR	\$ 1.95
2773 256 2K 16 BIT SR	\$ 1.95
2774 256 2K 16 BIT SR	\$ 1.95
2775 256 2K 16 BIT SR	\$ 1.95
2776 256 2K 16 BIT SR	\$ 1.95
2777 256 2K 16 BIT SR	\$ 1.95
2778 256 2K 16 BIT SR	\$ 1.95
2779 256 2K 16 BIT SR	\$ 1.95
2780 256 2K 16 BIT SR	\$ 1.95
2781 256 2K 16 BIT SR	\$ 1.95
2782 256 2K 16 BIT SR	\$ 1.95
2783 256 2K 16 BIT SR	\$ 1.95
2784 256 2K 16 BIT SR	\$ 1.95
2785 256 2K 16 BIT SR	\$ 1.95
2786 256 2K 16 BIT SR	\$ 1.95
2787 256 2K 16 BIT SR	\$ 1.95
2788 256 2K 16 BIT SR	\$ 1.95
2789 256 2K 16 BIT SR	\$ 1.95
2790 256 2K 16 BIT SR	\$ 1.95
2791 256 2K 16 BIT SR	\$ 1.95
2792 256 2K 16 BIT SR	\$ 1.95
2793 256 2K 16 BIT SR	\$ 1.95
2794 256 2K 16 BIT SR	\$ 1.95
2795 256 2K 16 BIT SR	\$ 1.95
2796 256 2K 16 BIT SR	\$ 1.95
2797 256 2K 16 BIT SR	\$ 1.95
2798 256 2K 16 BIT SR	\$ 1.95
2799 256 2K 16 BIT SR	\$ 1.95
2800 256 2K 16 BIT SR	\$ 1.95

CRYSTALS \$3.45 ea.	RIBBON CABLE
4,000 MHZ	FLAT (COLOR CODED)
6,000 MHZ	#30 WIRE
6,144 MHZ	26 cond. - .50/ per foot
8,000 MHZ	40 cond. - .75/ per foot
10,000 MHZ	50 cond. - .90/ per foot

CTS 206-8 eight position dip switch	... \$1.60
CTS 206-4 four position dip switch	... \$1.45
LIGHT ACTIVATED SCR	... \$1.70
TO-18, 200V 1A	

SILICON SOLAR CELLS	2 1/2" diameter	4V at 500 ma \$4.00
---------------------	-----------------	---------------------

FND 359 C.C. 4" \$5.00	LED READOUTS
FCS 8024 4 digit	DL-704 C.A. 3" \$7.75
C.C. 8" display	DL-747 C.A. 6" \$11.25
FND 503 C.C. 5" \$8.95	FND 803 C.C. 8" \$11.95
FND 510 C.A. 5" \$8.95	FND 810 C.A. 8" \$11.95
DL-704 3" C.C. \$8.95	

PRINTED CIRCUIT BOARD

4.1 2"x6.1 2" SINGLE SIDED EPOXY
BOARD 1.16" thick, unetched
\$6.00 ea. 5/\$2.60

7 WATT LD-65 LASER DIODE IR \$8.95

2N 3820 P FET	\$.45
2N 5457 N FET	\$.45
2N2646 UJT	\$.45
ER 900 TRIGGER DIODES	4 \$1.00
2N 6028 PROG. UJT	\$.65

MINIATURE MULTI-TURN TRIM POTS
100, 1K, 2K, 5K, 10K, 20K, 50K, 100K,
200K, 500K, 1Meg, 2Meg, \$.75 each 3/\$2.00

CHARGED COUPLE DEVICES

CCD 321 AH2-512 audio analog S.R. \$95.00
CCD 201C 100x100 Image Sensor \$95.00
CCD 202C 100x100 Image Sensor \$145.00

VERIPAX PC BOARD

This board is a 1/16" single sided paper epoxy
board, 4 1/2"x6 1/2" DRILLED and ETCHED which
will hold up to 21 single 14 pin IC's or 8,16 or LSI
DIP IC's with busses for power supply connector.

FP 100 PHOTO TRANS. \$.50

RED, YELLOW, GREEN or AMBER

LARGE LED'S 2" 6/\$1.00

TIL-118 OPTO-ISOLATOR \$.75

MOLEX PINS 1000/\$5.00

1 WATT ZENERS: 3.3, 4.7, 5.6, 9, 11, 10,
12, 15, 18, or 22V 6/\$1.00

MC6860 MODEM CHIP \$9.95

MCM 6571A 7 x 9 character gen \$10.75

Silicon Power Rectifiers

PRV	1A	3A	12A	50A	125A	240A
100	06	14	30	80	370	500
200	07	20	35	115	425	650
400	09	25	50	140	650	950
600	11	30	70	180	850	1250
800	15	35	90	230	1050	1650
1000	20	45	110	275	1250	2000

SAD 1024 a REDICON 1024 stage analog "Bucket
 Brigade" shift register. \$18.95

IN 4148 (IN914) 15/\$1.00

RS232 CONNECTORS

DB 25P male \$2.95

DB 25S female \$3.50

HOODS \$1.00

REGULATORS

309K \$.95 340K-12.15

723 \$.50 or 24V \$.95

LM 376 \$.60 340T-5, 6, 8, 12

320T-12, 15 15, 18 or 24V \$.95

or 24V \$1.25 78 MG \$1.35

79 MG \$1.35

TRANSISTOR SPECIALS

2N6233-NPN SWITCHING POWER	\$ 1.95
MRF-8004 a CB RF Transistor NPN	\$ 1.50
2N3772 NPN Si TO 3	\$.75
2N1546 PNP GE TO-3	\$.75
2N4908 PNP Si TO 3	\$ 1.00
2N6056 PNP Si TO 3 Darlington	\$ 1.70
2N5086 PNP Si TO-92	4/\$ 1.00
2N3137 NPN Si RF	\$.85
2N3919 NPN Si TO 3 RF	\$ 1.50
2N1420 NPN Si TO 5	3/\$ 1.00
2N3767 NPN Si TO 66	\$.70
2N2222 NPN Si TO-18	5/\$ 1.00
2N3055 NPN Si TO 3	\$.50
2N3904 PNP Si TO 92	6/\$ 1.00
2N3906 PNP Si TO 92	6/\$ 1.00
2N5296 NPN Si TO 220	\$.50
2N6109 PNP Si TO 220	\$.55
2N3638 PNP Si TO 5	5/\$ 1.00
MP5A 13 NPN Si	4/\$ 1.00

TTL IC SERIES

7400	-13	7445	-68	74153	-61
7401	-13	7446	-58	74154	-94
7402	-13	7447	-68	74155	-58
7403	-13	7448	-15	74157	-55
7404	-15	7450	-25	74161	-55
7405	-13	7472	-25	74162	-55
7406	-16	7473	-28	74163	-55
7407	-20	7474	-28	74164	-85
7408	-18	7475	-45	74165	-95
7409	-18	7476	-30	74170	-80
7410	-13	7480	-21	74171	120
7411	-13	7483	-65	74174	-95
7412	-18	7485	-87	74175	-85
7413	-36	7486	-28	74176	-75
7414	-60	7489	-125	74177	-75
7415	-22	7490	-42	74180	-65
7416	-22	7492	-43	74181	90
7417	-25	7493	-43	74182	100
7420	-13	7494	-43	74191	-100
7425	-25	7493	-43	74192	-79
7426	-25	7496	-65	74193	-79
7427	-19	7496	-65	74194	-80
7430	-13	74107	-28	74195	-50
7432	-22	74121	-29	74196	-86
7433	-22	74122	-38	74197	-86
7438	-21	74123	-45	74367	-50
7440	-13	74125	-40	75325	-150
7441	-13	74126	-40	75326	-150
7442	-37	74150	-94	75492	-50

Unclassified Ads

WANTED: For Microdata 1600 processor (Reality) magnetic tape controller, disc controller and drive, core memory boards. Jack Hardman, 140 Forest Av, Glen Ridge NJ 07028, (201) 429-8880.

FOR SALE: Apple II Game of Life. High speed, 180 generations per minute for 36 by 36 cell matrix. Variable size color display and many features using game paddles and keyboard — requires 8 K of memory. On Apple cassette, \$12. C H Galfio, 602 Orange St, Charlottesville VA 22901.

FOR SALE: Apple II ham radio software package. Send and receive in Morse, Baudot or ASCII code. Variable size text buffer, 3 field screen display, stored messages and more features. Uses on board (game) IO — requires 8 K of memory. On cassette, \$18. C H Galfio, 602 Orange St, Charlottesville VA 22901.

FOR SALE: Blank 4 K memory cards, 2102 memories, buffered address and data lines, provisions for on board regulation and standby power utilization, \$18. Industrial quality G-10 glass epoxy boards with gold plated 44 pin edge connector, on board decoding to 32 K of memory. Specially manufactured for my personal system, but easily used for KIM or other expansion. I also have 5 slot mother boards — \$20 — and power supplies. Bob Ribbeck, 10990 Howe Rd, Clarence NY 14031.

FOR SALE: MITS Altair 88-S4K Synchronous 4 K memory board. Built by experienced kit builder, and checked out by local MITS computer store. Full documentation pack included. Wish to use slot for higher density board. Asking \$150. Dave Busse, 1510 W Dempster, Mount Prospect IL 60054, evenings (312) 364-0147.

FOR SALE: Distortion Analyzer TS-917/GG, Stelma model TDA-2 detects bias distortion and other faults of 5 level teleprinters. 60-75-100 WPM. With instruction manual, \$40. John Riley, 914 N Cordova, Burbank CA 91505.

FOR SALE: Radio Shack ASCII keyboard assembled and tested for \$40. Like new TI-58 programmable calculator—make offer or swap for SwTPC hardware. Dennis Doonan, 2307 Carlisle Av, Racine WI 53404.

FOR SALE OR TRADE: Stand and enclosure for chain printer. Can be modified to house a Centronics printer. Would consider trading for Teletype model 35 RO parts. James Mullen, RR 5, POB 106, Evansville IN 47711.

FOR SALE: Updating to bigger system. Must sell Digital Group Z-80 system complete with Z-80 processor, video and cassette IO board, four parallel ports, 8 K bytes static memory. Complete with case and full documentation. Originally \$1400, will sell for \$900. Ray Cote, POB 68, Peterborough NH 03458.

NEW UNCLASSIFIED POLICY

Readers who have equipment, software or other items to buy, sell or swap should send in a clearly typed notice to that effect. To be considered for publication, an advertisement must be clearly noncommercial, typed double spaced on plain white paper, contain 75 words or less, and include complete name and address information.

These notices are free of charge and will be printed one time only on a space available basis. Notices can be accepted from individuals or bona fide computer users clubs only. We can engage in no correspondence on these and your confirmation of placement is appearance in an issue of BYTE.

Please note that it may take three or four months for an ad to appear in the magazine.

FOR SALE: Autonetics ½ inch magnetic tape drive minideck and solid state electronic control circuits. Requires parallel interface. \$75 plus shipping (weight 45 lbs). Dick Jugel, 3814 N 85th Av, Omaha NE 68134, (402) 572-8441.

FOR SALE: Programs for HP-25. Sniper, Cannon, Wumpus, Wumpus 2, Artillery, Artillery 2, Golf, Hi-Lo, Blackjack, Mastermind, (including Random number generator, Roulette, Poker-machine, Parachutist, Biorhythm (includes 100 year calendar), Amplifier (designs simple amplifiers). \$4 each, 5 for \$18, 10 for \$32 or complete set for \$45. Also, programs custom written to requirements and to run on any of Hewlett-Packard range (specify). \$10 each. I Webber, 92 Royal Pde, St Johns Wood 4060, AUSTRALIA.

FOR SALE: A Heathkit H8 and H9 and cassette recorder, fully assembled and running with 16 K of memory, including many programs and three versions of BASIC. Will sell for \$2450 or over \$100 less than the price of the kits. Price includes shipping. George Walker, 67 Wyndham St, Guelph Ontario, CANADA (519) 823-1411.

WANTED: Intel 8008 (or -A) processor based system or parts thereto. Send specifications and requested pricing. Also need October 1977 BYTE in good condition. James Tucker, POB 471, APO New York NY 09305.

WANTED: Speech Synthesizer and Heuristics Speechlab in good condition. State price and condition. Contact William Yeap, 2217 7th Av, NW, Calgary Alberta, CANADA T2N 0Z9, (403) 283-6863.

WANTED: September 75 thru June 76, September 1976, January 1977 and February 1977 BYTE issues. Will accept all or separate copies. Will accept a reasonable price. Randy Pray, 3209 SW 2nd, Des Moines IA 50315, (515) 288-8189.

FOR SALE: TRS-80 sci-fi games (4 K, L1): Galactic Blockade Runner—a sophisticated space war game. You control your ship and its weapons, fight off enemy attacks and cope with hazards to run the blockade and to deliver vital supplies on time. \$9.95 for cassette and 12 page manual. SASE for list of games. Tim Quinlan, 219 Washington Av, Chelsea MA 02150.

FOR SALE: Two IMSAI 4A-4 static programmable memory boards. Professional construction, from an operational IMSAI 8080 system. Going to Z-80 and do not want the 450 ns slow programmable memory in the system. \$200 buys both boards. K J Halliwell, 2373 John Smith Dr, Apt F, Schaumburg IL 60194, or call after 6 PM (312) 885-0362.

FOR SALE: Heathkit H-8 Computer system, 16 K memory, H-8-5 serial IO and cassette interface. All available Heath software, assembled and working, \$900. Lear Siegler model 7700 Display Terminal, serial RS-232 output, 25 lines with 80 characters per line, service manual, \$450. Bob Majanski, 214 Coolidge Av, Hasbrouck Heights NJ 07604, (201) 288-3742.

FOR SALE: One Processor Technology 8 K programmable memory board, working, \$150. One Ithaca Audio 8 K programmable memory board, working, \$100. Two Godbout 4 K programmable memory boards, working, \$50 each. One Vector Graphics 18 slot mother board, assembled, \$75. One ICOM microfloppy system (board and floppy) complete with FDO5 III for the SOL, working, \$800. One PerSci dual floppy drive, working, \$800. All prices are negotiable. Jeff Roloff, 2214 Brookshire, Champaign IL 61820.

FOR SALE OR TRADE: Hewlett-Packard Model 180E dual trace oscilloscope. Excellent condition asking \$300 or trade for KIM-1 or similar system. Also power supply with ±24 VDC, ±12 VDC, ±5 VDC and -6 VDC all outputs rated at 5 A. Asking \$30. Contact Roger at (904) 651-4153.

FOR SALE: Five computer memory and IO boards (all units from Digital Equipment Corp.). They are all in new condition, but I cannot guarantee any of them as I do not have the equipment. Three of the boards are core memory (nonvolatile). There is a 4 K by 12 DEC part number H220 P-33, unmarked board, and a 64 by 64 by 18 IO part number CF-4. The remaining boards plug into a PDP-11. One is a memory driver G231E-P2; the other is a control and data loops board number G109C. Boards go to the highest bidder. Marty Bunshaft, 29A Forest Acres Dr, Bradford MA 01830.

FOR SALE: 12 issues of BYTE (October 1976 thru September 1977). Best offer or trade for what have you. G F Sabin, 6022 Sage Dr, Orlando FL 32807.

FOR SALE: PDP-15 computer 24 K of 18 bit core memory, 4 DEC tapes, Teletype, paper tape reader /punch, Fortran and Focal. Always on DEC full maintenance. Dr L K Steinrauf, Dept of Biochemistry, I U Medical School, Indianapolis IN 46202, (317) 264-7544.

FOR SALE: OSI-400 computer system. Assembled and tested by a professional. 4K programmable memory (unfinished 2nd 4 K board included). Cassette IO, video display, keyboard; \$900 value, best offer takes it. Assembled and running. Robert W Warfield, 3202 Boyd, Midland TX 79701, (914) 694-7035.

WANTED: IMSAI/iCOM/DEBBI owners to join European based users group for software exchange, mutual assistance; or alternatively CP/M European users group. Contact K A Geiger, 66, Rue Rothschild, 1202 Geneva SWITZERLAND.

FOR SALE: Fine 1959 SULLIVAN pipe organ with electric key and stop action ideal for artist/hobbyist integration of micro based C³ as described in two articles in February 1978 BYTE. Two manuals (61 keys), 32 pedals, nine ranks, 498 pipes, chimes, pistons, shutters; suitable for home or church installation (in daily use in home now). \$6200 plus optional packing and shipping. Send SASE for complete specification and details. Phil Bergstresser, 128 Jackson Av, Madison AL 35758.

I am looking for an individual or company willing to provide on site service contracts for the metropolitan New York City area. Equipment would be microcomputers and related peripherals. Also looking for other owners who would like to have on site service and maintenance for their equipment. B Rabinowicz, 1061 54 St, Brooklyn NY 11219.

MUST SELL: 3P+S Processor Technology IO card. Two parallel IOs and one serial IO. \$100, assembled and tested. Paper tape reader, Oliver Audio OP-80A, used only several times, assembled and tested, \$50; all that is needed is to interface a parallel input. PerCom Electronics cassette interface: all that is needed is a serial or parallel IO and cassette recorder. Assembled and tested, \$50. Godbout PROM board, holds 8 K (5204) and has Godbout monitor. \$75 takes assembled board and PROMs. Larry Belmontes Jr, 1762 Yale St, Corpus Christi TX 78416, (512) 855-2687 or (512) 854-2662.

PROM PROGRAMMING: From binary paper tape: 1702A (\$4), 2708 (\$8). From hexadecimal or octal listing: 1702A (\$5), 2708 (\$16). You supply the read only memory. Quantity discounts for multiple copies. 48 hour turnaround. David Corbin, 111704 Ibsen Dr, Rockville MD 20852, (301) 881-7571 after 6 PM.

FOR SALE: First 16 issues of BYTE except number 11 (July 1976 BYTE). Also February, March and April 1977 Data Communications for free. No reasonable offer refused. L R Chauvenet, 11 Sussex Rd, Silver Spring MD 20910.

FOR SALE: Sharp Associates Selectric typewriter interface kit model SK2. Converts any selectric typewriter to printer and keyboard input peripheral. Includes power supply and transistor-transistor logic (TTL) compatible outputs, assembly and interface manuals. Partly assembled \$180. Contact Jeff Duntemann, 6208 N Campbell Av, Chicago IL 60659, (312) 454-2755 during business hours, otherwise (312) 764-5069.

FOR SALE: Altair 8800 with 16 slot motherboard and 16 edge connectors, cooling fan modification, 2SIO serial IO with both ports, 88PIO parallel IO board, 1 K static memory with 512 bytes of memory, 12 K static memory, 4 K read only memory software board with 8080 assembler, text editor, system monitor and all documentation. All A and T, original cost over \$2000, yours for \$1500 and you pay shipping. Don Cheeseman, 8231 Creekline Dr, San Antonio TX 78251, (512) 681-4938.

WANTED: Cheap optical paper tape reader; RAECO, OAE, or similar. Also cheap high-speed 8 level paper tape punch, hopefully with enough documentation to build a parallel port interface. Chuck Johnson, 17104 Via Alamitos, San Lorenzo CA 94580, (415) 278-6595 evenings.

FOR SALE: Digital Group system with 8080 processor, 6502 processor, 26 K programmable memory, erasable read only memory card 64/32 character displays, two phidecks and interface, keyboard, video monitor, audio cassette, 25 A power supply, processor cabinet, software, BASIC, assembler, editor and games. All for \$1500. Bill Seiler, number 202, 1717 Woodland Av, Palo Alto CA 94303, (415) 323-2083.

FOR SALE: A number of copies of BYTE, volume 1, number 1 at \$10 per copy. Copies will be mailed insured as long as supply lasts. Joe Haran, 517 Bridge St, Mont Clare PA 19453, (215) 935-0484.

WANTED: Literature on Intel SDK-80 (the MDS-80 Systems Development Kit). I am interested in specific applications of your SDK-80 (ie: distributive processing). Dave Fashenpour, 5411 Cerro Vista, San Antonio TX 78233.

FOR SALE: TI-59, PC-100A, two libraries (master and statistics), 40 magnetic cards, 22 thermal paper rolls, three card holders, one battery charger, one carrying case, all in perfect condition. Plus my own special programs including Horse Race, Universal Calendar, Personal Finance (Expense Analysis and Cash Register), Alphanumeric Entry Routine. All documents came with original shipment (they are still brand-new). Please quote offer; if no reply, outfit has been sold. H T Chen, Physics Dept, University of Georgia, Athens GA 30602, (404) 546-1065.

FOR SALE: Altair 8800A mainframe micro-computer with 40 K memory, 1/4 K programmable memory/read only memory resident bootstrap loader for diskette system, 88DCDD flexible diskette drive with controller and extended BASIC software version 4.1. Additional boards: vectored interrupt/real time clock, ARC tape IO, two SIO RS-232 IOs, PIO parallel IO etc. Retail value over \$3,500; asking \$2,000 for all, including many extras; will sell separates too. TVT Modified SwTPC 32 character line with video monitor and Pendar keyboard — \$150. Burroughs terminal/printer with logic controller — \$150. Ira Wilner, POB 582, Brattleboro VT 05301, (802) 254-8807.

WANTED: Any Micro Systems Design MF10-1 IO Board user. Help. Stephen Gladstone, 1103 Namdac Av, Bay Shore, Long Island NY 11706, (516) 666-8342.

PROM PROGRAMMING: From binary paper tape: 1702A (\$4), 2708 (\$8). From hexadecimal or octal listing: 1702A (\$5), 2708 (\$16). You supply the read only memory. Quantity discounts for multiple copies. 48 hour turnaround. David Corbin, 11704 Ibsen Dr, Rockville MD 20852, (301) 881-7571 after 6 PM.

WANTED: I need a design or kit to convert an IBM 2741 selectric terminal to ASCII. It presently uses correspondence code and requires a special element which I would like to replace with a regular element. Peter Baum, POB 399, Sunny-mead CA 92388.

WANTED: Floppy disc drives (any condition), line printer (100+CPS), OSI boards, S-100 boards, 6502 hardware and software, C-MOD (MMM/Celetron) boards and software. I R Peterson, 669-23 Av NW, St Paul MN 55112, (612) 633-1599.

FOR SALE: Persci model 70 8 inch floppy drive and model 1070 intelligent controller. Never powered up — perfectly new, \$1000. Elwood Downey, 1000 W Spring Valley, number 242, Richardson TX 75080, (214) 690-1523 home or 231-9303 ext 312 work.

WANTED: Modules/parts to restore a DEC RK05 disk drive for personal use. G180 read/write board, M7700 board, M7701 board, M7702 board, G938 board, H604 board, two 20 V regulator modules, 5 V regulator module. The above items do not have to be in working condition. Peter A Balkus, 18 Clearview Av, Lynn MA 01904.

GETTING MARRIED: So I'm selling the whole ball of wax to pay for my honeymoon: IMSAI with full motherboard and connectors, SDS Z-80 card, 24 K 500 ns memory, 3P+S IO card, Tarbell floppy controller, real time clock, Tarbell tape Interface, bus terminator, 2708/2716 erasable read only memory card (with two 2708s) 12 by 80 video display with built-in modem and much 8080/Z-80 Software. Complete documentation on everything. Worth much more than the \$2,000 I'm asking. Judd Ellmers, (201) 967-2645, 9 AM to 5 PM. [Congratulations from BYTE...DWH]

FOR SALE: Complete microcomputer system. IMSAI 8080 mainframe with Wunderbus, 4 MHz Z-80 processor, 56 K bytes of fully static programmable memory (250 ns) PerSci 277 dual disk drive with PerSci power supply and cabinet, DMA disk controller, D C Hayes modem board (set up for autoanswer timeshare using CP/M software), Lear Siegler ADM-2 video display terminal, Data General Dasher terminal/printer (60 cps matrix), complete library of CP/M software (version 1.4) with documentation, approximately 20 diskettes. Many many extras! Individual components cost over \$9800 in kit form. Asking price is \$8900 or best offer for this completely integrated system. (714) 521-2344 or 738-8086.

CASINO BLACKJACK: For TI Programmable 59. Most complete version available for a hand held unit. Allows up to six players to bet, hit, stand, double down, insure and split pairs against the house. Keeps score and displays all cards automatically. Cost is only \$3.50 and includes program listing and quality documentation. Send two mag cards and will record this 600+ step program for you as well. Game rules from Thorp's *Beat The Dealer*. Robert Griffin Jr, 104 Briar Rd, Nanuet NY 10954.

FOR SALE: TRS-80 level-1 tapes and program lists. Star Trek (runs on 12 K), list \$7, tape \$10. Lunar Lander (runs on 4 K), list \$3, tape \$6. Biorhythm (runs on 4 K), list \$4.50, tape \$9. J R Menzies, 7106 Colgate Dr, Alexandria VA 22307.

FOR SALE: Two Innovex floppy drives (compatible with Tarbell and Peripheral Vision interfaces), three 8 K memory boards (4 MHz), one Alpha Video II video board (4 MHz compatible, on board keyboard port with 5 V and status out, 1 K buffer, etc), one GRI keyboard (case and connector cable), one video monitor (as in Computer Warehouse ad). John Whiffen, 443-6324 or 279-1496, Toronto CANADA.

FOR SALE: Must sell ASAP an IBM 6420 computer system with 6425 magnetic ledger card reader attached. It contains 1 to 220 column tractor feed and 1 to 130 column friction feed selectric with a magnetic ledger card reader attached. Unit works and I have some manuals for it. Some boards and lots of extras are included. Unit sold new for \$55,000 a few years ago, will sell to first person with certified check for \$1200 or call and make offer above. Dave Dahlberg, 4375 Weber River Dr, number 95, Ogden UT 84401, (801) 399-2396.

HELP: Southern Connecticut New Haven area; anyone using Tarbell disk system please contact me for mutual system support. Also need help in maintenance, fine points of CP/M; will pay! James Van Pelt, 25 Sagamore Cv, Branford CT 06405.

WANTED: Programs for ecosystem and forest management simulation that could be used in a study of the feasibility of the utilization of wood for energy. Mitchell Bayersdorfer, 8325 New Second St, Elkins Park PA 19117, (215) 635-2126.

M6800 CROSS ASSEMBLER: A two pass cross assembler written in FORTRAN IV is available for the M6800 Motorola micro. Input is in fixed format; statements are similar to Motorola assembler language, most features of the language being supported. Additionally, a system symbol table is supported, enabling symbolic reference to system addresses, and assembly of routines to contiguous memory locations. Send \$1 for the manual, and \$5 for the listing, (or \$14 for a paper tape) to: G A R Trollope, 466 Caswallen Dr, West Chester PA 19380, (215) 431-2885.

FOR SALE: HP-25 Game Programs. I have several games including a neat golf game, two versions of Master Mind (or Comp IV), Football, Tic-Tac-Toe, Mortar Battlefield, Battle the Dive Bomber and others. \$2 each or trade. Jerry Hansen, 420 West 800 South number 1, Richfield UT 84701, (801) 896-6110.

FOR SALE: Fully assembled and fully operational Morrow Micro Stuff/Thinker Toys front panel processor board. All documentation included. First certified funds for \$300 gets rid of that "knuckle-buster," double clutching front panel, including UPS shipping charges. W Howard Adams, 1590 South Krameria St, Denver CO 80224, (303) 756-4052.

FOR SALE: ACT II, a video terminal capable of over the telephone communication with its built-in acoustic coupler. Complete with video display and RF Modulator. \$600. Contact: (516) 671-3957.

FOR SALE: Paper tape reader and punch; Heathkit H10, assembled and tested. 50 character per second reader, 10 character per second punch. \$320 delivered with manuals, cable and supply of tape. Write D T Mears, 32-E S Westmoor Av, Newark OH 43055.

FOR SALE: Built and tested SwTPC 6800 with 8 K (extra 2 K unbuilt), Hazeltine 2000 video display terminal, and Hazeltine thermal printer (with extra Texas Instruments print head) in excellent condition. Will make super system just by adding diskette or tape drive. \$1595 complete or best offer. Also BYTE volume one, number 1 in excellent condition. V Farmer, 78 Harvard St, Walpole MA 02081, (617) 668-7339.

FOR SALE: Elf II with 4 K memory, the giant board, and expansion power supply. \$200. Winston Cope, 302 Anderson St, Apt G, Durham NC 27705, (919) 684-0893.

FOR SALE: TVT II with keyboard, monitor and modem. Ready to go on line. Asking \$350. Jack S Davis, POB 5, Endwell NY 13760.

FOR SALE: Assembled SwTPC CT-64 terminal with Hitachi model P-05 TV monitor \$450. The ASCII terminal is in excellent condition and is configured for 16 lines of 64 characters. The serial interface is RS232 and can be strapped for various baud rates. Jim Crane, 5650 Windsor Way number 308, Culver City CA 90230, (213) 649-4187.

FOR SALE: PET BASIC action games including Bomber, Seawolf, Indy 500 and Aerial Dogfight. All four on cassette. Send \$6. Andy Fraley, 1753 York Rd, Reading PA 19610.

HELP: I have a DEC PDP-8/I mini with a Dataram Corp memory stack, P/N 2100270, S/N DR5049D. Does anyone know if the firm is still in business and the address where they may be contacted: or does anyone have any information on the stack? If you can help with any information please write. Thomas Parquette, 116 Sanford Av, Clinton New York 13323.

LEARN: Complete self-study microcomputer training system. Includes microcomputer, workbooks, texts, interfacing board and power supply. Will send full information to all sending me SASE. First \$500 takes this \$1200 package. Tony Durr, 2802 W Kenmore, Tampa FL 33614. ■

Reader Service

To get further information on the products advertised in BYTE, fill out the reader service card with your name and address. Then circle the appropriate numbers for the advertisers you select from the list. Add a 15 cent stamp to the card, then drop it in the mail. Not only do you gain information, but our advertisers are encouraged to use the marketplace provided by BYTE. This helps us bring you a bigger BYTE.

Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.
2	Administrative Systems 143	150	Godbout Electronics 77	288	PCE Electronics 202
3	AJA Software 167	*	GFI Industries 117	301	Per Com Data 45
4	Alpha Micro Systems 140, 141	157	Hamilton Logic Systems 202	302	Personal Software 94
7	Altos Computer Products 5	159	Hayden Book Publishing 133	303	Personal Systems Consulting 52
10	Anderson Jacobson 85	158	DC Hayes 149	321	Phone I 189
12	Apparat Inc 180	160	Heath Company 17	304	Preferred Positions 218
14	Apple Computer 14	170	Hobby World 192	306	Priority I 214, 215
15	Apple Computer 15	172	Honeywell 87	305	Processor Technology 8, 9, 10
*	Art-by-Computer 161	173	Houston Instruments 47	307	Program Design Inc 157, 159, 161
20	Artec Electronics 69	174	HUH Electronics 170	308	Programmers Software Exchange 149
22	ATV Research 202	177	IEE Corporation 202	309	PRS 51
24	AVR Electronics 218	175	IMSAI 13	311	Quest Electronics 195
26	Base 2 Inc 99	176	Information Terminals 35	*	Radio Shack 79
30	Beckian Enterprises 219	*	Information Unlimited 159	*	The Recreational Programmer 185
35	BITS Inc 127, 128, 129	178	Innotronics 181	313	Reston Educational Institute 120, 121
27	Biz Comp '78 167	179	Integrand 171	314	Rondure Co 213
28	Bootstrap Enterprises 163	180	Integrated Circuits Unlimited 209	316	S-100 188
29	Business Application Software 171	184	International Data Sciences 176	*	Scelbi CIII
32	Buss 147	190	Ithaca Audio 198	*	Scelbi/BYTE Primer 125
*	BYTE Back Issues 159	193	J & E Electronics 218	317	Schrier Software Index 175
*	BYTE Books 61, 62, 63, 64	195	Jade Company 197	*	Scientific Research 54, 55, 160
*	BYTE WATS Line 50	200	Jameco Electronics 210, 211	318	Seattle Computer Products 101
39	California Digital 201	201	Jim-Pak 71	319	Michael Shrayder Software 113
40	Canada Systems 181	203	Judge Electronics 218	312	Shugart CIV
45	Central Data 73	204	Kybe Corp 131	322	Signetics 37
46	Chrislin Industries 206	205	Lear Siegler 107	323	Small Business Computer Magazine 155
47	Computer Age 206	*	Lifeboat Associates 159, 161	324	Ed Smith's Software 161
65	Computer Corner 206	215	Logical Services 151	320	Smoke Signal Broadcasting 93
70	Computer Enterprises 92	217	Mathematical Application Services 218	326	Softside 170
72	Computer Lab of NJ 163	219	McGraw-Hill Publishing 139	330	Software Records 167
75	Computerland 10, 11	221	The Memory Coop 206	335	SSM 56, 57
73	Computer Mart of NH 206	222	Micro Mail 150	340	Solid State Sales 221
74	Computer Mart of NJ & PA 126, 206	223	Micromation 25	343	Soroc 41
76	Contemporary Marketing 109	224	MicroPro International Corp 49	350	Southwest Technical Products CII
77	Cosmic Search 158	226	Micro World 53	352	Stirling Bekdorf 65
78	CPAids 177	228	Micro Z 206	351	Structured Systems Group 29
*	Creative Software 189	229	Mikos 219	353	Summagraphics 152
80	Cromemco 1, 2	255	Morrow/Thinker Toys 23, 75	354	Sunny Trading Company 218
81	Datafacs 184	265	mpi 179	358	Sybex 39
83	Datoc 206	267	Mullen Computer Boards 126	355	Synchro Sound 66, 67
87	Digital Marketing 91	269	MVT Microcomputer Systems 68	359	Talos Systems Inc 43
89	Digital Pathways 97	271	NCC '79 123	360	Tarbell Electronics 105
95	Digital Research (CA) 175	280	Netronics 153	363	Taylor & Associates 150
100	Digital Research (TX) 203	281	NE Electronics 82	370	Technical Systems Consultants 119
103	Digital Service & Design 218	283	Newman Computer Exchange 111	372	Terrapin 138
110	Dynabyte 32, 33	284	Nortek Inc 218	356	3 S Sales Inc 217
112	Ed-Pro 151	285	North Star 7, 27	373	Tora Systems 218
114	Electro Analytic Systems 188	286	Northwest Microcomputing Systems 59	374	TransNet 60
115	Electrolabs 195	290	Ohio Scientific Instrument 18, 19, 20, 21	376	Tri Tek 217
120	Electronic Control Technology 177	291	OK Machine & Tool 31	381	Ultra Violet Products 174
125	Electronic Systems 205	293	Oliver Advanced Engineering 176	382	University Microfilms International 83
130	Electronics Warehouse 207	292	Osborne & Associates 137	383	US Robotics 97
132	EMM/CMP 156	*	Owens Associates 206	386	Vamp 202
134	EMM Semi Inc 185	294	Pacific Digital 174	388	Wameco 213
137	Exidy Inc 81	296	Pacific Office Systems 199	*	Whales 115
140	Forethought Products 148	297	Page Digital 199	395	Worldwide Electronics 202
142	Fuller Eng & Mfg 179	298	PAIA Electronics 180	397	X & Y Enterprises 202
144	General Electric 103	299	PanaVise 154	400	Xitex 146, 147

*Correspond directly with company.

BOMB— BYTE's Ongoing Monitor Box

Article No.	ARTICLE	PAGE
1	Kinzer: A Memory Pattern Sensitivity Test	12
2	Ciarcia: No Power for Your Interfaces?	22
3	Chung-Yuen: A "Tiny" Pascal Compiler: Part 2	34
4	Adams: Testing Memory in Basic	58
5	Letwin: PAM/8: A New Approach to Front Panel Design	70
6	The Spracklens: First Steps in Computer Chess Programming	86
7	Anderson: Linear Circuit Analysis	100
8	Smith: Solving the Eight Queens Problem	122
9	Steeden: Assembling the H9 Video Terminal	130
10	Burhans: A Simpler Digital Cassette Tape Interface	142
11	Hughes: Souping Up Your SwTPC 6800	144
12	Farnell: A Novel Bar Code Reader	162
13	Whaland: A Computer Chess Tutorial	168
14	Frey-Atkin: Creating a Chess Player	182

Readers Choose "Choosing a Microprocessor"

The first place winner in the July BOMB (BYTE's Ongoing Monitor Box) was "How To Choose a Microprocessor" by Louis Frenzel, page 124. Second prize went to Lane T Hauck for "Who's Afraid Of Dynamic Memories?", page 42. The first place article score was 1.4 standard deviations above the mean, and the second place article was 1.34 standard deviations above the mean—quite a close score. The authors will receive prizes of \$100 and \$50, respectively. "Antique Mechanical Computers," page 48, placed third, and the other two history articles tied for fourth place. ■

I haven't stopped laughing since I read Steve Ciarcia's new book, **"TAKE MY COMPUTER...PLEASE!"** It's Steve's first full length book, and it's the funniest to come along in years! It's even funnier if you're into computers! Just one crazy misadventure after another, based on Steve's true experiences, and his computer's inability to cooperate. You'll roar when you read how he tries to win at Jai-Alai and gets beaten at his own game. Or how he attempts a stock market killing that goes wrong when he logs into his broker's computer circuit! Imagine what happens when our hero sets up a computerized speed trap! And you'll fall on the floor when our hero builds a foolproof computer burglar alarm, and then locks himself out of the house with a souffle in the oven! You can't beat this book for computerized belly laughs. It's got lots of hilarious drawings that make Steve's easy writing style come to life even more. And, you can't beat the low, low price of only \$5.95 + S/H! Order your copy of **"TAKE MY COMPUTER...PLEASE!"** Do it today. It will tickle your fancy.

"Take my computer...please!"

by STEVEN CIARCIA

An outrageously funny book about a creative eager beaver and his uncooperative personal computer. 128 fun-filled pages. Hilarious illustrations. Hard cover. Order your copy now. Only \$5.95 + S/H. Another SCELBI hard core software book!

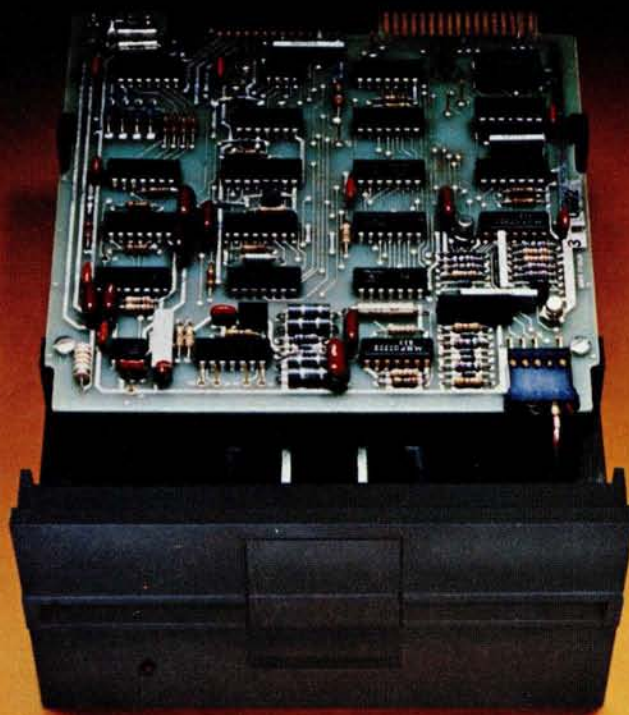


**SCELBI COMPUTER
CONSULTING INC.**

Post Office Box 133 PP STN
Dept B
Milford, CT 06460

Price shown for North American customers. Master Charge, VISA, Postal and Bank Money Orders preferred. Personal checks delay shipping up to 4 weeks. Pricing and availability subject to change without notice. **IMPORTANT!** Include 75¢ postage/handling for each book delivered by U.S. Mail Book Rate or \$2 for each book shipped First Class or via UPS.

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



Shugart invented the minifloppy in 1976. Today there are more than 100,000 of the little drives in use. That's because users want the affordable random access data storage of the minifloppy.

Shugart packs years of proven floppy drive technology into this tiny package. Up to 110 kbytes of data storage. Fast random access of about one-half second. And high speed data transfer of 125 kbits per second. Plus sensible, maintenance-free features like write protect to prevent accidental data loss, an activity light to indicate when the drive is selected by your computer and a door interlock to protect your media from damage.

Our proprietary read/write head provides maximum data interchange margins, and it is

positioned precisely on the selected track by a patented spiral cam actuator. The DC drive motor with integral tachometer assures accurate diskette rotation and low heat dissipation. A die cast aluminum base plate provides a solid foundation for the drive.

At Shugart, technology leadership is more than a slogan, it's a commitment. Get reliability and value when you invest your money for floppy disk storage. Ask for the standard of the industry. minifloppy. If it isn't Shugart, it isn't minifloppy.

 **Shugart Associates**

435 Oakmead Parkway, Sunnyvale, California 94086

For a list of manufacturers featuring Shugart's minifloppy in their systems, circle reader response number.
™ minifloppy is registered trademark of Shugart Associates

Circle 312 on inquiry card.