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MICROSYSTEMS™

NOV/DEC 1980

VOL. 1/NO. 6

IMPLEMENTING THE CP/M* IOBYTE FUNCTION

See Pages 22-26

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- Directory Program for CP/M Systems** by Mark M. Zeiger **Page 38**
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Complete Table of Contents on Page 3

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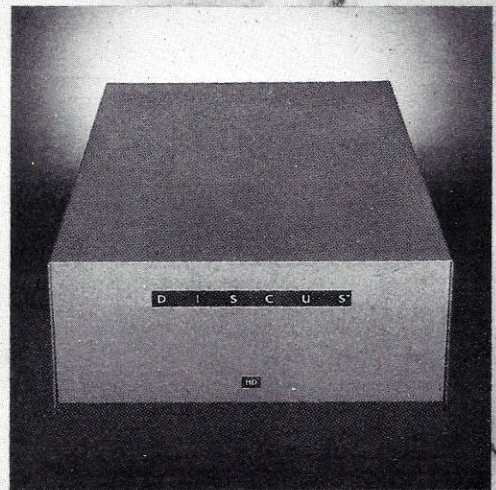
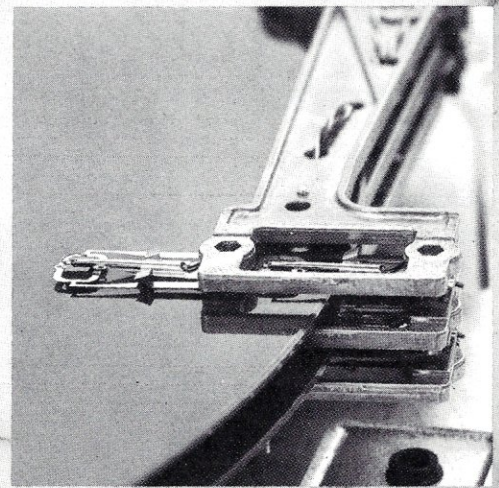
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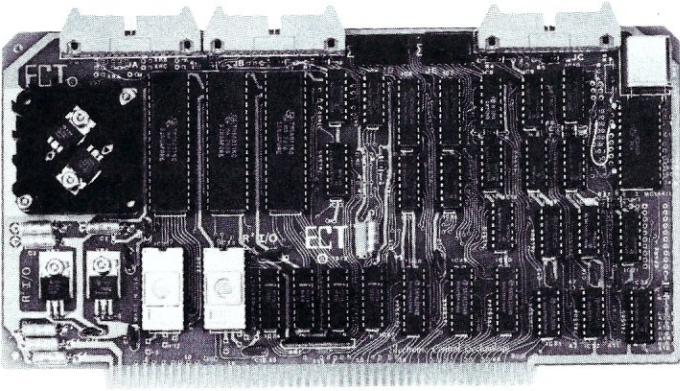
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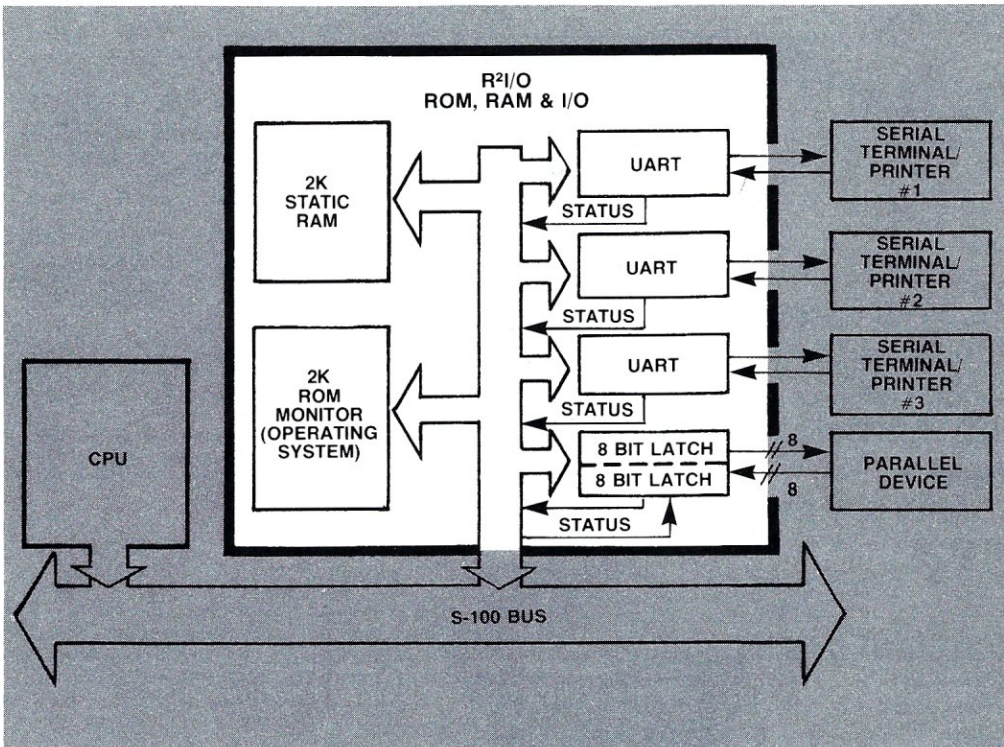
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- B - Branch to user routine A-Z
- C - Undefined
- D - Display memory on console in Hex
- E - End of file tag for Hex dumps
- F - Fill memory with a constant
- G - GOTO an address with breakpoints
- H - Hex math sum & difference
- I - User defined
- J - Non-destructive memory test
- K - User defined
- L - Load a binary format file
- M - Move memory block to another address
- N - Nulls leader/trailer
- O - User defined
- P - Put ASCII into memory
- Q - Query I/O ports: Q1 (N)-read I/O; Q0(N,V)-send I/O
- R - Read a Hex file with checksum
- S - Substitute/examine memory in Hex
- T - Types the contents of memory in ASCII equivalent
- U - Unload memory in Binary format
- V - Verify memory block against another memory block
- W - Write a checksummed Hex file
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- Y - 'Yes there' search for 'N' Bytes in memory
- Z - 'Z END' address of last R/W memory location

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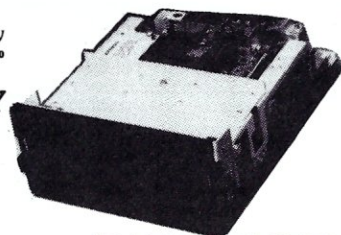
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S-100 MICROSYSTEMS™

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by Sol Libes



EDITOR'S PAGE

With this issue of MICROSYSTEMS I am retiring from the position of publisher and will only be the editor of the magazine. In other words, I have decided to sell MICROSYSTEMS. The magazine will become a subsidiary of Creative Computing.

I found it necessary to sell the magazine because it had gotten too big for me to handle. MICROSYSTEMS has become a great success. But success comes at a high price. I found that publishing a magazine was an all-consuming undertaking that affected my family relationships, health and job. I was at the point where to continue the magazine meant quitting my job and hiring a staff. My basement looked like a combination of warehouse and production department; we would have needed to move into offices. I examined the alternatives and feel that I have made the right decision—for the readers, my family and for myself.



MICROSYSTEMS staff at PC/80 show in Philadelphia. From left to right: Claudette Moore, Sol and Lennie Libes.

In addition, I am not a businessman. I find it difficult to hire and fire. Also, I like my job and want to

keep it (for those that do not know, I am a teacher in a Community College). I found that the major portion of my time was spent in publishing activities rather than editing activities. I cannot describe the time spent dealing with subscribers, dealers, advertisers, printers, typesetters, mailing service and worst of all the U.S. Mail Service (or as Jim Warren says: "The U.S. Snail Service"). This last one alone must have driven my blood pressure up by at least 10 points.



George Morrow, Sol Libes and Bill Godbout get together to discuss the S-100 scene at the PC/80 show in Philadelphia.

Being relieved of the publishing load I will be free to spend more time on editing. I will have total editorial control of MICROSYSTEMS, assuring that it will continue with the same editorial focus as before. All other tasks will now be handled by a professional publishing staff. I am pleased that Dave Ahl, owner of Creative Computing, has organized the staff of MICROSYSTEMS as a separate entity from the Creative Computing organization. Claudette Moore is now the Managing Editor. She handles the day-to-day running of the maga-

zine, including advertising and promotion. Further, she assists me in editorial matters and oversees the production of the magazine. Actual production, typesetting and artwork, subscriptions, warehousing, etc. will be handled by the Creative Computing staff.

Dave Ahl has also undertaken a large promotional effort to increase the circulation of the magazine and its distribution through dealers. These efforts were just not possible with the limited facilities and staff that I had access to previously. Thus, I expect MICROSYSTEMS readership and advertising to increase substantially in the coming year.

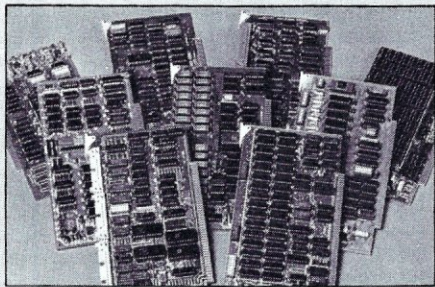


MICROSYSTEMS readers in Japan. Y. Mitazaki (left) and T. Nagayama with a room full of S-100 systems.

You are already seeing results from this new change. First, the size of the magazine has been increased by eight pages to provide more editorial content and advertising space. I expect that size of the magazine will continue to grow with MICROSYSTEMS advertising support. Secondly, we hope to increase the amount of editorial

At Intersystems, "dump" is an instruction. Not a way of life.

(Or, when you're ready for IEEE S-100, will your computer be ready for you?)



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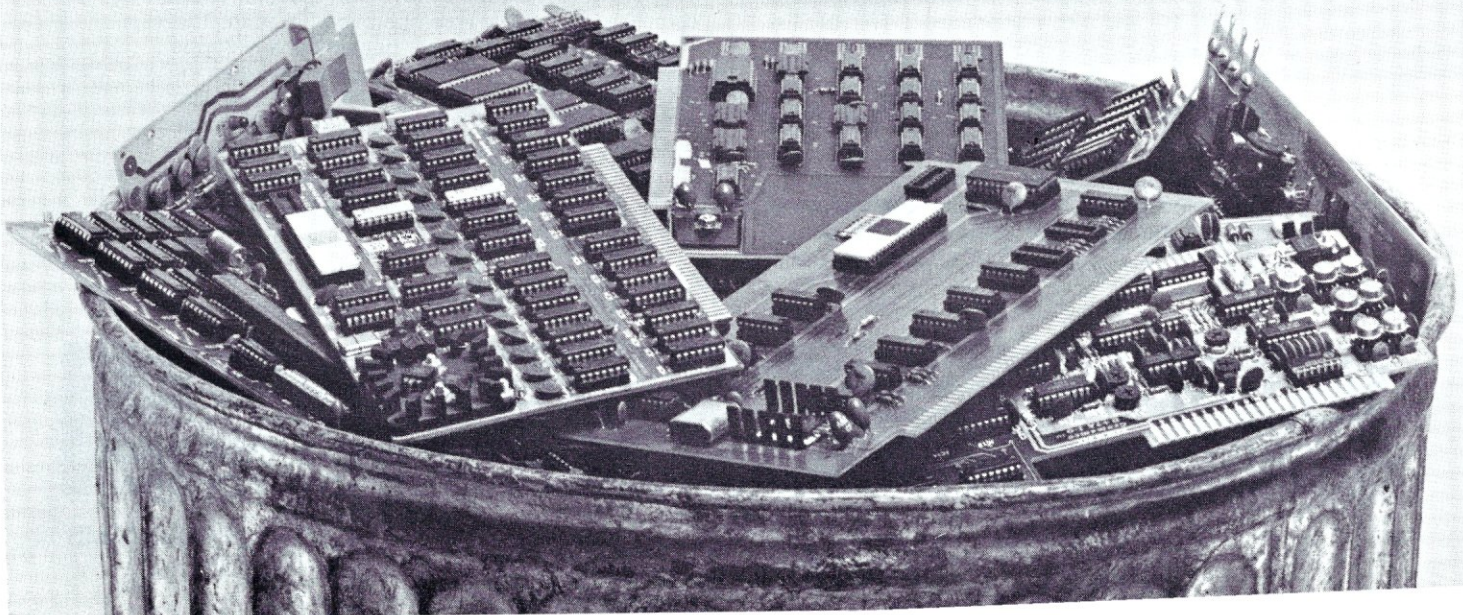
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Whatever your needs, why dump your money into obsolete products labelled "IEEE timing compatible" or other words people use to make up for a lack of product. See the future now, at your Intersystems dealer or call/write for our new catalog. We'll tell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

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Editor's Page cont'd...

space devoted to product reviews. In this issue we feature one hardware and one software product review. I will try to continue and increase the number of these product reviews in every issue. We are looking for more product reviewers, particularly software product reviewers.

If you have suggestions for improving MICROSYSTEMS do not hesitate to write or call me. (You will find my telephone number on the Table of Contents page.) I wish to thank all the readers, authors and advertisers who helped me get MICROSYSTEMS off the ground, making it a viable publication. I would also like to thank the following friends who helped unselfishly: Russell Gorr, Fred Gohlke, Jon Bondy, Randy Reitz, Jake Epstein, Bill Yarnall, George Lyons, Marty Nichols, Bob Stewart and Larry Stein. I am also indebted to my wife, Lennie and my son and daughter, Don and Susan who shared in the "dirty work". (I should mention that my wife is a professor of mathematics and my children at doctoral candidates at the University of Rochester and M.I.T.) □



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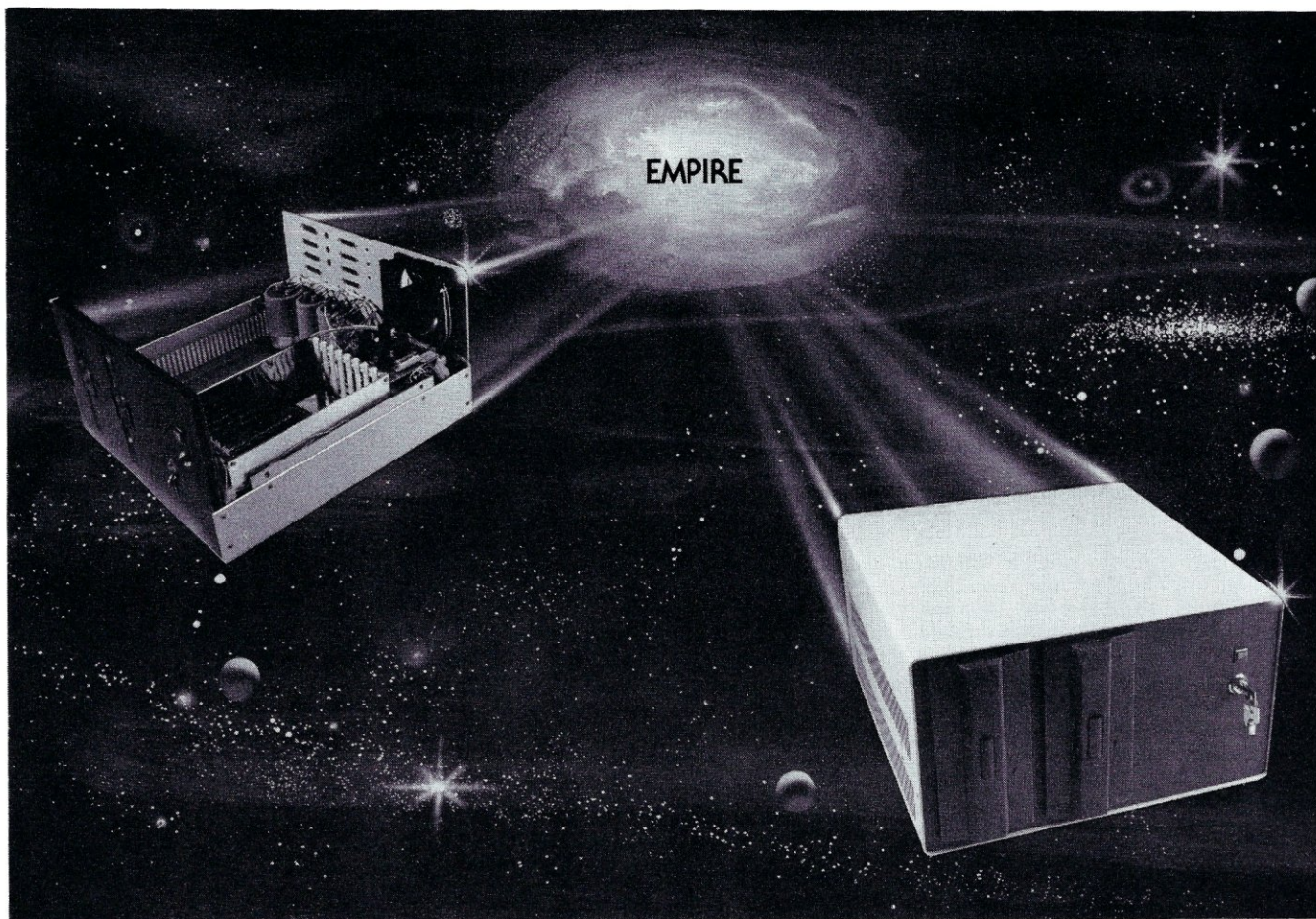
Software on a CP/M* compatible floppy disk is provided free with the purchase of the synthesizer. This software includes a waveform creation, music compiling and a real time operating program. The waveform creation software generates waveforms from user supplied data. This program, written in BASIC utilizes a FFT algorithm. A music compiler program converts music data, entered using data statements to an executable format. The real time operating program, written in 8080 assembly language loads the waveforms and plays the music generated from the compiler.

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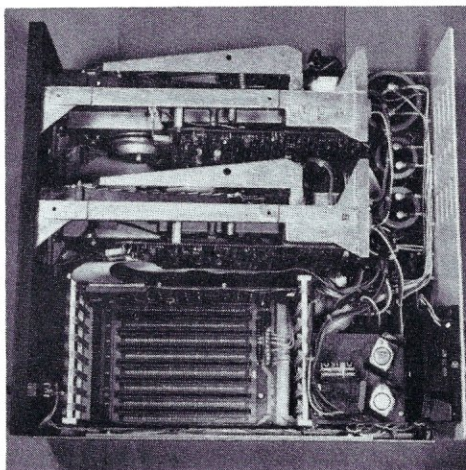


New Mainframe opens more areas for development

In one quantum leap Tarbell has expanded its popular Empire (the vertical disk subsystem) into a full line. This entire series now encompasses 5 variations. Each one contains different components so the S-100 system designer, hobbyist, or serious business user can arrive at the exact custom state he wants and needs.

The basic Empire still includes two Shugart or Siemens 8" disk drives; the compact cabinet with fan and power supply; a Tarbell floppy disk interface; CP/M*; Tarbell BASIC; the necessary cables, connectors and complete documentation. Naturally, it's fully assembled and Tarbell tested.

The new, top of the line Empire contains the basic model's components with the Tarbell design-approved Mainframe. Beside the 8-slot S-100 motherboard with an active terminated bus, there's a cardcage with card guides and a double-density interface.



You're the master of your Empire

You can call the shots in the Empire. Tarbell's made sure of that by offering them as complete subsystem packages . . . or, as separate units. For example, the mainframe may be ordered with 1, 2 or no drives. Whichever way you go, however, you always get the reliability of Tarbell tested components and leadership-engineering.

To get control of your own Empire, see your quality computer store for quick delivery. Or, contact us for dealer locations or further information.

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LETTERS

TO THE EDITOR

Dear Editor:

Small C is a compiler by Ron Cain. It was printed in source form in DDJ, May '80. The article discussed Ron's interest in C, dealing with Tiny-C, but then deciding he wanted a compiler. He did not have "by choice" CP/M. He tried developing the compiler under Tiny-C, but just didn't have the room (in memory). So he "borrowed Unix time" and got it going.

It generates 8080 assembler code directly, and requires a run time library to handle file open, char. read and write (disk and console) 16 bit multiply and divide, and several arithmetic and logical comparison subroutines, and indirect memory reference instructions for fetching local variables.

The compiler, being based on Tiny-C, is quite limited: No FOR, DO, CASE, etc. Just "while" like "teeny-C" as we call it. But it does handle "i + + " and a few things I don't believe (but don't recall) T-C did.

Of course, the big news is that the compiler compiles itself (in about 20 minutes on a 2MHz 8080). It is quite readable code. Seems quite bug-free, although I stumped it with an obscure "pointer-memory addr" which erroneously doubled the memory addr, thus was pointer minus 2* memory addr, which was garbage. I solved it by saying that an int = the pointer. I then had int minus memory reference.

I am having a real ball with Small-C, have gotten the author's permission to put it in the CP/M U.G. and just last night, a friend with a 6809 got it running with my help. Johy Byrns took the source from me (he wrote a compatible modem transfer program for his '09), modified the code generator to put out macros (i.e. machine independent code) and then sent it back to me.

I compiled his compiler with mine, then compiled his compiler with itself, thus outputting macros. I sent them to him, he reviewed the output, asked for some changes (due to 8080 putting low-byte-first in a word, while the '09 does high-byte-first). I compiled it again, sent it to him, and he got it going.

I am very interested in pursuing the addition of a code optimizer to the end of it. Right now it generates "bullet proof" code, i.e. the expression processor does "PUSH H" whenever more is to be processed in the expression. Thus (for Global variable "k") $k = k + 1$;

generates:

```
LHLD k
PUSH H
LXI H,1
POP D
DAD D
SHLD k
```

If instead of directly producing 8080 code, pseudo code were output, say into a 25 element table, than a pattern recognizing optimizer could see:

```
PUSH H    and replace  XCHG
LXI H,xxx it with:     LXI H,xxxx
POP D
```

Several more passes thru the optimizer for this block of pseudo code could theoretically recode it to:

```
LHLD k
INX H
SHLD k
```

Just blue skying right now, but you see the "place" for Small-C, namely a super facility for hacking with compilers. Thanks for writing it to Ron Cain, for DDJ for publishing it, and to Alan McNeil and Jim Kirns for getting the copy that I have keyed in and running.

The Code Works is selling a copy on CP/M disks for \$15 + postage. The address is: Box 550, Goleta CA 93017. Phone: (805) 967-0905.

Small C doesn't have "for" but it appears it could be added in about an hour. The code for "while" is very similar. Only a routine to test things would have to be changed in the original code, as that routine tests for a condition in " ("")", where as the "for" the test condition isn't in parens.

More easily perhaps to get done, would be adding "do", as that ends in a while test, which is in parens.

Ward Christensen
Dolton, Illinois

Dear Editor:

During the coming year we can expect a proliferation of systems utilizing the Z8000 microprocessor. These systems can be expected to upgrade existing Z80 systems.

Indications are at this time that UNIX will probably become the standard DOS, replacing the present dominance of CP/M.

This presents something of a "retrofit" or old disk file usage problem since UNIX in Z8000 code does not fit on two 8" floppy tracks and it doesn't like CP/M style disks.

A number of CP/M style DOS systems are in the field. Since the authors of these systems have the source code, they can probably be cross compiled into Z8000 code relatively easily. To name a few of these systems, we have K3, SDOS, LDOS, TPM, OS and PDOS — for which we have the source.

CP/M offers a definite advantage over other microcomputer DOS systems in the way it does a DOS entry via address 0005 with the appropriate commands and data in certain registers. This "standardization" enables Basic's, Pascal, Fortran, Cobol, PL, "C" and other high level languages to be written explicitly for CP/M disk file control. This is not to mention all the utility programs — assemblers, debuggers, etc. which are dependent upon the same DOS entry.

Digital Research indicates they have no interest in Z8000 software at this time. Microsoft has a Basic using UNIX ready for release and will also probably offer UNIX. This may still leave the industry with a lot of CP/M files it cannot digest.

Cross Compiling Z80 to Z8000 code results in about a 2.5/1 increase in byte size. This is too much for two tracks of single density 8" disk to hold a DOS of CP/M's present complexity. However, re-editing code to take advantage of Z8000 instructions and byte doubling up in messages make it appear that a DOS of the size of CP/M 2.2 with adequate Z8000 I/O handling can be accommodated on two tracks of 8" double density. CP/M type file structures, directories, etc. can there-

fore be preserved. Format programs can accommodate double density system tracks and single or double data.

Therefore, we propose:

- 1) Authors of DOS systems and other software useable on Z80's who wish to compile Z8000 code should agree upon a standard.
- 2) The standard should return CP/M style file structure and entry concepts so that present disks with files will still be readable—at least in single density. There is no double density standard which could apply.
- 3) Instead of 8080/Z80 registers, the ZILOG Cross assembler registers should be used.
- 4) AF = 0, BC = RH1, DE = RH2, HL = RH3, IX = RHD, IY = RHE, SP = RHF. C, E, L are RL parts of their respective registers. This information is given in the ZILOG translator users guide. Where any intermediate register is required, Register RH 4 can be used. The remaining registers are open to use as well.

At the zero Address:

0000 -0005 Warm Boot

0006 -000B DOS Entry (Functional)
(Replaces CP/M) 0005

000C - I/O Byte

000D - Default Drive

000E -004F Interrupts, Restarts*
and/or Scratch

0050H - 007F Default file control.

Note that 6 bytes (3 words) are reserved even though the jump mode used may require only two. This allows the software writer to use any mode and to use segments and offsets.

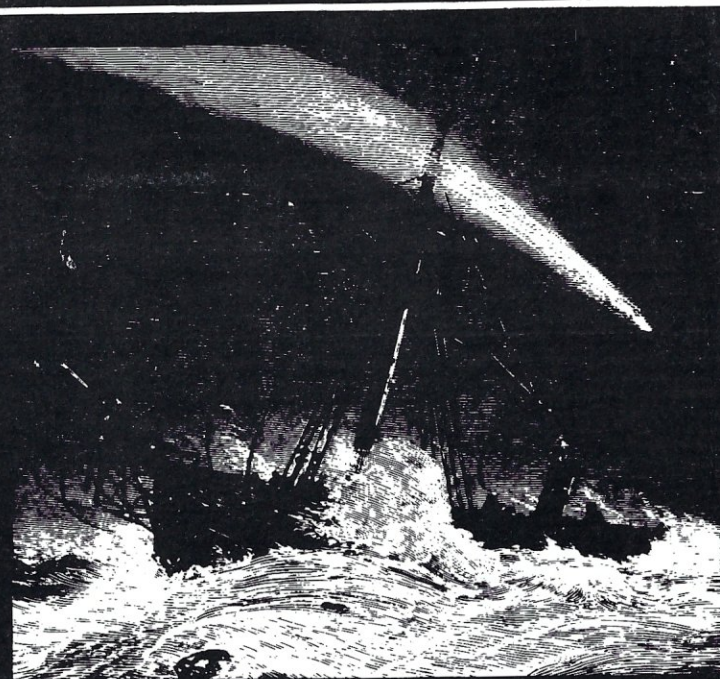
Restarts are not valid in Z8000 code but equivalent addressing concepts can be used.

We have contacted Microsoft about their Basic and they have informed us they see no difficulty in using this concept. The change from UNIX is relatively simple for them. You can expect to see Microsoft Basic at some of the upcoming shows.

The CDL (TDL/XITAN) Basic should be relatively easy to compile after changing the Math routines. The same should be true of their ZTEL and TOP. We have written a MACRO assembler cross compiler which we will make available to them. At this time there are no readily available Z8000 assemblers and text editors other than those sold by AMD software movement than helping it.

Softtech (UCSD Pascal) is not interested. No matter, there are much better Pascals around.

National Multiplex Corp.
Middlesex, NJ



**Your CP/M system just isn't worth
its salt...until it's been through
a night like this.**

The Pirate stands ready to challenge your CP/M system to a battle of wit and endurance. As you traverse uncharted lands and seas, you'll meet up with wild animals, magical beings and a smart alec parrot. **Adventureland** and **Pirate Adventure** are two of the most mind-bending game simulations you'll ever encounter. (CS-9003) \$24.95.

Original Adventure is an undisputed classic. The treasures you seek are hidden in underground caverns. All you have to do is find them. It's easy...just overcome a giant clam, nasty little dwarves and other deathly perils. This game is bi-lingual so, to make it really a cinch, just type in "GO FRANCE" and the characters will speak and understand only French. (CS-9004) \$24.95.

The Basic Games Library features 190 top-notch simulations, battles and strategy games from the celebrated Basic Computer Games Book and its sequel, More Basic Computer Games. **Volume I** (CS-9001) and **Volume II** (CS-9006) include Super Star Trek, Slalom, and Checkers. Each disk is \$24.95. Both disks and the Basic Computer Games Book are available for only \$50.00 (CS-9000).

Volume III (CS-9005) and **Volume IV** (CS-9006) feature Yahtzee, Tennis, Wumpus and Grand Prix. The disks are \$24.95 each. Both disks and the More Basic Computer Games Book are \$50.00 (CS-9007). The entire four disk collection also includes both big games books, edited by David Ahl, and is \$95.00 (CS-9008). All are on 8" disks, require 48K and Microsoft Basic.

Your local computer store should carry Creative Computing Software. If your favorite retailer does not carry the software you need, have him call in your order to 800-631-8112. Or, you can order directly from Creative Computing. Write to Creative Computing Software, Dept. AHHG, P.O. Box 789-M, Morristown, NJ 07960. Include \$1.00 for postage and handling. For faster service, call in your bank order toll free to 800-631-8112.

sensational software

NEWS & VIEWS

by Sol Libes

NEW S-100 PRODUCTS SHOWN AT WESCON

The WESCON/80 show, held September 16-18th in Anaheim CA, saw the introduction of some really new S-100 products.

Morrow Designs announced a "Unix-Equivalent" operating system running on a Z-80 based system with a special S-100 CPU board. The board has the Z-80, a floating point processor circuit, interrupt system and task supervisor/memory management circuitry.

Godbout Electronics introduced a digital multiplexer board using an 8085 that provides multiplexed communications with any portion of the computer. It takes over the tasks of transferring storage or I/O memory via DMA cycle stealing, which halts the main processor to transfer data. The device acts as a bus master and uses only about 1% of the available bandwidth. Godbout also showed an S-100 RAM board using 20-pin rather than 18-pin sockets. The board will accommodate the standard 18-pin 4K RAM ICs or the new 20-pin shadow RAMs (EEPROMs) expected to become available next year. Shadow RAMs retain data during power interruptions.

Cromemco showed their new \$995 System Zero, a four slot S-100 system using a Z-80 CPU, up to 8K ROM, 1K RAM, one serial and three parallel ports in one slot. The remaining three slots can be used for a floppy/hard disk controller card, 64K RAM card, modem card, etc. Cromemco also showed their new \$595 "Quadart" communications card designed for multiplexed communications. The card permits multiple operations, allowing the system to communicate with an IBM mainframe via a variety of user-definable protocols.

Measurement Systems & Controls showed a 64K dynamic RAM card with each of 4 memory banks selectable via I/O ports. Up to 256 banks may thus be selected. The board contains 4 LEDs to indicated when a bank is being accessed.

SOFTWARE REVIEW PUBLISHED

John C. Dvorak is publishing a monthly four page review of software. The primary emphasis is on North Star system software. A subscription is \$5/year (foreign \$10). The sample issue I received contained a great deal of useful information. John also distributes a wide selection of North Star software. For more information write: Software Review, 704 Solano Ave, Albany, CA 94706.

370 MICRO USER GROUP FORMING

This may be the first user group to be formed before the fact rather than the usual practice of after the after. Rumors are floating around that Intel, Motorola and Fujitsu are working on a microprocessor chip set that executes the IBM 370 instruction set. Mokurai Cherlin (Box 1131, Mt. Shasta CA 96067) has decided to form a user group in anticipation of the 370-micro. Membership is \$10 for individuals and \$25 for companies. You will get a newsletter and access to a computer database.

There is no doubt that if such an IC is released someone will put it on the S-100 bus. Mokurai points out that

"There is more free, public domain software for the 360 than you can buy for all present micros together, including operating systems, languages, tools and applications. There have probably been about a thousand languages brought up on a 360 or 370 over the last 16 years. IBM itself has a list of more than 2500 public domain programs available for a copying and media charge — the universities and users generally have an awful lot more. You don't have to wrestle with IBM operating systems and Job Control Language if you don't want to, because here are numerous software houses that have improved on IBM in all sorts of ways."

MICROPOLIS USER GROUP FORMED

The Micropolis Users Group (MUG) has been formed to maximize the use of the Micropolis supplied software. The group is compiling a directory of all software which runs on MDOS or Micropolis Basic without requiring a second operating system (such as CP/M). The group would appreciate suppliers of such software informing them of their products.

Membership is \$12/year for 12 monthly newsletters. Micropolis Users Group, c/o Buzz Rudow, 604 Springwood Circle, Huntsville AL 35803.

UCSD USER'S SOCIETY FORMED

A User's Group has been formed to support UCSD products such as PASCAL. Membership is \$20/year. UCSD System User's Society, Chip Chapin Secretary, c/o Softech Microsystems Inc., 9494 Black Mountain Road, San Diego CA 92126.

SOL SOFTWARE AVAILABLE

Processor Technology Company, manufacturer of the SOL computer went out of business over a year ago but its software lives on. PROTEUS (the SOL Users Group) is now distributing the Processor Technology software with hopes of soon having it available on 8" soft sector-disk. They are furnishing the complete source code for PTDOS, Basic, ALS8, Games and Test Routines. The charge range from \$50 to \$95. PROTEU, 1690 Woodside Drive, Suite 219, Redwood City CA 94061; tel: (415) 368-3331.

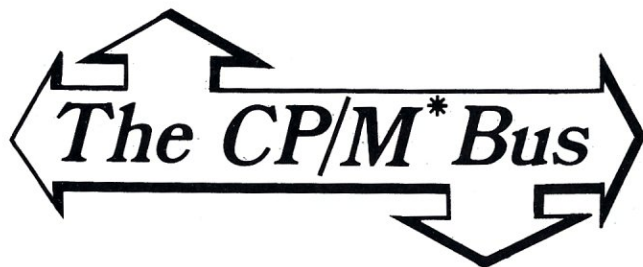
RUMOR

It is rumored that early next year Intel will introduce an enhanced 8251 serial I/O chip. It will include baud rate generator, five timer/counters, two full parallel ports and a complete interrupt controller; all in a 40 pin DIP.

MICROSYSTEMS BACK ISSUE NEWS

The premier issue (JAN/FEB) of MICROSYSTEMS has been reprinted and can be ordered by writing: MICROSYSTEMS, Box 789-M, Morristown, NJ 07960. The price is \$5.00. Vol. 1/NO.3 (MAY/JUNE) is out of stock. We do not foresee a second printing.

This is the first of what I hope will be a regular column in S-100 Microsystems. The column will serve as a forum on CP/M. Readers are encouraged to send in questions about CP/M, which the author will attempt to answer. The questions can be both technical and non-technical. Until the questions are received, here is some news about the CP/M world.



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

SIG/M-ACG/NJ Generates First Three CP/M Disks

The Special Interest Group for CP/M (SIG/M) of the Amateur Computer Group of New Jersey (ACG-NJ) has produced three disks of CP/M software containing different versions of the ever popular Adventure game. The software has been placed in the public domain. The disks are the following:

SIG/M0001 - Adventure (350 pts) 8080 object code, for 48K RAM system.

SIG/M0002 - Adventure source code in Microsoft Fortran.

SIG/M0003 - 'Super' Adventure (550 pts) Z80 object, for 52K RAM system.

The disks are available for copying at meetings of the ACG-NJ CP/M User Group and at the New York Computer Club Flea Markets. Disks must be supplied and a \$1/disk contribution to the club is requested.

The ACG-NJ is really not prepared to furnish copies via mail. Therefore, it will accept orders only from other bona-fide clubs. Only one copy will be shipped to a club (8" single density); the club will then be responsible for providing copies for its members. It is asked that the club make a contribution to the ACG-NJ of \$4/disk plus \$2 to cover mailing and handling. ACG-NJ, 1776 Raritan Road, Scotch Plains, NJ 07081.

CP/M User Group News

The Chicago Area Computer Hobbyist Exchange (CACHE) is presently engaged in putting together twenty new 8" disks for the CP/M User Group to distribute. CACHE is the group that put together the last batch of CP/MUG disks. This is strictly a volunteer effort; no one in CACHE will be paid for their efforts. Jim Mills is coordinating CACHE's efforts.

Jim says that these new disks will include the following, among other things:

RATFOR adapted for Fortran-80

Household Budget Management (CBasicII)

Math Primer (CBasicII)

Osborne's A/P, A/R & G/L (CBasicII)

TDL Basic Games, Utilities, tutorials, I/O Drivers and Interactive Retrieval Info System (IRIS)

Loader/Relocator (TDL MAC 6.ASM)

TDLEBAS.AZM (allows TDL Extended Basic to run under CP/M)

CPM.ASC (simulates CP/M mode with TDLEBAS.AZM)

SSM PROM Burner Program (.ASM)

Pictures (ASCII files)

Dungeons & Dragons (MBasic)

Maillist (Ward Christensen's program in MBasic)

And lots more!

S-100 MICROSYSTEMS

6809 S-100 ads™

SINGLE BOARD COMPUTER

- MEETS I.E.E.E. S-100 STANDARD
 - 10 addressing modes
 - 24 indexed sub modes
 - auto increment/decrement
 - constant indexing from PC
- 4K/8K/16K ROM • 2K RAM
ROM/RAM relocatable on 4K boundary
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- 20 PARALLEL I/O LINES • 256 I/O PORTS
ACIA provides RS-232 lines for asynchronous communications with limited modem control at 8 selectable baud rates; I/O locatable at any 4K boundary
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P.C. Board & Manual \$69.95* + shipping
- adsMON: ADS MONITOR SUPPORTS BREAKPOINTS
User definable interrupt service & more.

Available in PROM, write for prices.

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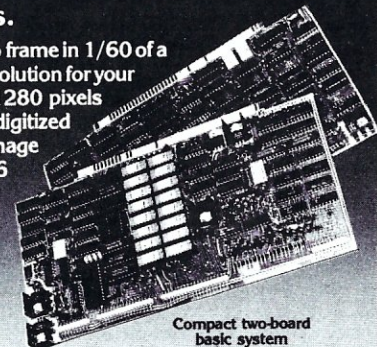
Ackerman Digital Systems, Inc.

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The original 256-color imaging system with high resolution video FRAME GRABBER for the S-100 bus.

Capture and digitize a video frame in 1/60 of a second. Select the best resolution for your application, from 256 to 1280 pixels per TV line. Display your digitized or computer processed image with 256 gray levels or 256 colors on standard B&W, NTSC or RGB color TV monitors.



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Features:

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All Lifeboat programs require CP/M, unless otherwise stated.

- CP/M* FLOPPY DISK OPERATING SYSTEM**—Digital Research's operating system configured for many popular micro-computers and disk systems.
- | System | Version | Price |
|---|---------|------------|
| Apple II* | 2.x | \$349/25 |
| SoftCard* with Z80 | | |
| Microsoft BASIC version 5 with high resolution graphics | | |
| North Star Single Density | 2.x | \$170/25 |
| North Star Double/Quad | 2.x | \$170/25 |
| Durango F-85 | 2.x | \$170/25 |
| iCOM Micro-Disk 2411 | 1.4 | \$145/25 |
| iCOM 3712 for MITS 88-2SIO Console | 1.4 | \$170/25* |
| iCOM 3712 for 3P-S/MITS SIO | | |
| Rev non-zero console | 1.4 | \$170/25* |
| iCOM 3812 | 1.4 | \$170/25* |
| Mits 3202/Altair 8800 | 1.4 | \$145/25 |
| Health H89 + H17 | 1.4 | \$145/25 |
| Health H89 | 1.4 | \$145/25 |
| Health H89 by Magnolia | 2.x | \$300/25 |
| Ohio Scientific C3 | 2.x | \$200/25 |
| Onyx C8001 Standard | 2.x | \$250/25 |
| Onyx C8001 Enhanced | 2.x | \$330/25 |
| TRS-80 Model I | 1.4 | \$145/25 |
| TRS-80 Model II | 2.x | \$170/25 |
| TRS-80 Model II + Corvus | 2.x | \$250/25 |
| Processor Technology | | |
| Helios II | 1.4 | \$145/25 |
| Intel MDS Single Density | 2.x | \$170/25 |
| Intel MDS Double Density | 2.x | \$170/25 |
| Micropolis Mod I | 2.x | \$200/25 |
| Micropolis Mod II | 2.x | \$200/25 |
| Mostek MDX STD Bus System | 2.x | \$350/25** |
- The following configurations are scheduled for release soon:
- | | | |
|------------------------|-----|------------|
| North Star Double/Quad | | |
| Corvus | 2.x | \$250/25 |
| Ohio Scientific C3-C | 2.x | \$250/25 |
| iCOM 3812 | 2.x | \$225/25* |
| iCOM 4511/Pertec D3000 | 2.x | \$375/25** |
- Software consists of: the operating system, text editor, assembler, debugger and other utilities for file management and system maintenance. Complete set of Digital Research's documentation and additional implementation notes included. Systems marked * and ** include firmware on 2708 and 2716. Systems marked + include 5440 media charge. Systems marked @ require the special @ versions of software in this catalog. @ includes hardware addition to allow our standard versions of software to run under it.
- Z80 DEVELOPMENT PACKAGE**—Consists of: (1) disk file line editor, with global inter and intra-line facilities; (2) Z80 relocating assembler, Zilog/Mostek mnemonics, conditional assembly and cross reference table capabilities; (3) linking loader producing absolute Intel hex disk file \$95/\$20
- ZDT**—Z80 Monitor Debugger to break and examine registers with standard Zilog/Mostek mnemonic disassembly displays. \$35 when ordered with Z80 Development Package \$50/\$10
- AVOCET SYSTEMS**
- XASM-68**—Non-macro cross-assembler with nested conditionals and full range of pseudo operations. Assembles from standard Motorola MC6800 mnemonics to Intel hex \$200/\$25
 - XASM-65**—As XASM-68 for MOS Technology MCS-6500 series mnemonics \$200/\$25
 - XASM-48**—As XASM-68 for Intel MCS-48 and UPI-41 families \$200/\$25
 - XASM-18**—As XASM-68 for RCA 1802 \$200/\$25
- DISTEL**—Disk based disassembler to Intel 8080 or TDL/Xitan Z80 source code, listing and cross reference files. Intel or TDL/Xitan pseudo ops optional. Runs on 8080 \$65/\$10

Genuine CP/M for Apple II Available now!

- DISELOG**—As DISTEL to Zilog/Mostek mnemonic files \$65/\$10
- SMAL/80 Structured Macro Assembler**
- Language—Package of powerful general purpose text macro processor and SMAL structured language compiler. SMAL is an assembler language with IF-THEN-ELSE, LOOP-REPEAT-WHILE, DO-END, BEGIN-END constructs \$75/\$15
- PHOENIX SOFTWARE ASSOCIATES**
- PASM***—Z80 macro assembler, Intel/TDL mnemonics. Generates Intel hex format or relocatable code in either TDL Object Module format or PSA Relocatable Binary Module format. Supports text insertion, conditional branching within macros, recursive macro calls and parameter passing. \$129/\$25
 - EDIT**—Character oriented text file editor. Handles macro definition capabilities. Includes insertion, deletion, searching, block move, etc. for files of any length. Does not require a CRT \$129/\$25
 - PLINK***—Two pass disk-to-disk linkage editor/loader which can produce re-entrant, ROMable code. Can link programs that are larger than available memory for execution targeted on another machine. Full library capabilities. Input can be PSA Relocatable Binary Module, TDL Object Module or Microsoft REL files. Output can be a COM file, Intel hex file, TDL Object Module or PSA Relocatable file. \$129/\$25
 - BUG* and μBUG***—Z80 interactive machine level debugging tools for program development. BUG has full symbolic trace and interactive assembly (mnemonics compatible with PASM). Dynamic breakpoints and conditional traps while tracing (even through ROM!). μBUG is a subset of BUG and is used in memory limited situations \$129/\$25
- DIGITAL RESEARCH**
- MP/M**—Installed for single density MDS-800. Multi-processing derivative of the CP/M operating system. Manual includes CP/M2 documentation \$300/\$50
 - MAC**—8080 Macro assembler. Full Intel macro definitions. Pseudo Ops include RPC, IRP, REPT, TITLE, PAGE, and MACLIB. Produces absolute hex output plus symbol table file for use by SID and ZSID (see below) \$120/\$15
 - SID**—8080 Symbolic debugger. Full trace, pass count and breakpoint program testing. Has backtrace and histogram utilities. When used with MAC, provides full symbolic display of memory labels and equated values \$105/\$15
 - ZSID**—Z80 Symbolic debugger with all features of SID \$130/\$15
 - TEX**—Text output formatter to create paginated, page-numbered and justified copy. Output can be directed to printer or disk \$105/\$15
 - DESPOOL**—Utility program to permit simultaneous printing from text files while executing other programs \$80/\$10
- tiny C**—Interactive interpretive system for teaching structured programming techniques. Manual includes full source listings \$105/\$50
- BDS C COMPILER**—Supports structures, unions, 2 dimensional arrays, pointers, recursion and overlays. Features optimized code generator, variable sized buffers for file I/O, and capability to produce ROMable code. Includes macro package to enable user to produce linkable modules with MAC (see under Digital Research). Floating point functions, full run-time package and machine code library sources provided. Linker, library manager and textbook included. Compiler lacks initializers, statics, floats and longs. \$145/\$25

- WHITESMITHS C COMPILER**—The ultimate in systems software tools. Produces faster code than a pseudo-code Pascal with more extensive facilities. Conforms to the full UNIX* Version 7 C language, described by Kernighan and Ritchie, and makes available over 75 functions for performing I/O, string manipulation and storage allocation. Linkable to Microsoft REL files. Requires 60K CP/M \$630/\$30
- MICROSOFT**
- BASIC-80**—Disk Extended BASIC, ANSI compatible with long variable names.
 - WHILE/WEND**, chaining, variable length file records. MBASIC version 4.51 also included on disk \$325/\$25
 - BASIC COMPILER**—Language compatible with BASIC-80 and 3-10 times faster execution. Produces standard Microsoft relocatable binary output. Includes MACRO-80. Also linkable to FORTRAN-80 or COBOL-80 code modules \$350/\$25
 - FORTAN-80**—ANSI 66 (except for COM-PLX) plus many extensions. Includes relocatable object compiler, linking loader, library with manager. Also includes MACRO-80 (see below) \$425/\$25
 - COBOL-80**—Level 1 ANSI 74 standard plus most of Level 2. Full sequential, relative, and indexed file support with variable file names. Powerful interactive, formatted screen handling with ACCEPT and DISPLAY verbs. Program segmentation for execution of programs larger than memory and CHAIN command with parameter passing. Full support of CP/M version 2 files. Includes MACRO-80 (see above), linking loader, and relocatable library manager. Requires 48K CP/M \$700/\$25
 - MACRO-80**—8080/Z80 Macro Assembler. Intel and Zilog mnemonics supported. Relocatable linkable output. Loader, Library Manager and Cross Reference List utilities included \$149/\$15
 - XMACRO-86**—8086 cross assembler. All Macro and utility features of MACRO-80 package. Mnemonics slightly modified from Intel ASM86. Compatibility data sheet available \$275/\$25
 - EDIT-80**—Very fast random access text editor for text with or without line numbers. Global and intra-line commands supported. File compare utility included. \$89/\$15
 - PASCAL/M***—Compiles enhanced Standard Pascal to compressed efficient Pcode. Totally CP/M compatible. Random access files. Both 16 and 32-bit integers. Runtime error recovery. Convenient STRINGS. OTHERWISE clause on CASE. Comprehensive manual (90 pp. indexed). SEGMENT provides overlay structure. IMPORT/EXPORT and untyped files for arbitrary I/O. Requires 56K CP/M. Specify 1) 8080 CP/M, 2) Z80 CP/M, or 3) Cromemco CDS. \$175/\$20
 - PASCAL/Z**—Z80 native code PASCAL compiler. Produces optimized, ROMable re-entrant code. All interfacing to CP/M is through the support library. The package includes compiler, relocating assembler and linker, and source for all library modules. Variant records, strings and direct I/O are supported. Requires 56K CP/M \$395/\$25
 - PASCAL/MT**—Subset of standard PASCAL. Generates ROMable 8080 machine code. Symbolic debugger included. Supports interrupt procedures, CP/M file I/O and assembly language interface. Real variables can be BCD, software floating point, or AMD 9511 hardware floating point. Includes strings enumeration and record data types. Manual explains BASIC-PASCAL conversion. Requires 32K \$250/\$30
 - APL/V80**—Concise and powerful language for application software development. Complex programming problems are reduced to simple expressions in APL. Features include up to 27K active workspace, shared variables, arrays of up to 8 dimensions, disk workspace and copy object library. The system also supports auxiliary processors for interfacing I/O ports. Requires 48K CP/M and serial APL printing terminal or CRT \$500/\$30
 - ALGOL-60**—Powerful block-structured language compiler featuring economical run-time dynamic allocation of memory. Very compact (24K total RAM) system implementing almost all Algol 60 report features plus many powerful extensions including string handling direct disk address I/O etc. \$199/\$20
 - CBASIC-2** Disk Extended BASIC—Non-interactive BASIC with pseudo-code compiler and run-time interpreter. Supports full file control, chaining, integer and extended precision variables, etc. Versions of CRUN for CP/M versions 1.4 and 2.x included on disk. \$120/\$15
- MICRO FOCUS**
- STANDARD CIS COBOL**—ANSI 74 COBOL standard compiler fully validated by U.S. Navy tests to ANSI level 1. Supports many features to level 2 including dynamic loading of COBOL modules and a full ISAM file facility. Also, program segmentation, interactive debug and powerful interactive extensions to support protected and unprotected CRT screen formatting from COBOL programs used with any dumb terminal \$850/\$50
 - FORMS 2**—CRT screen editor. Output is COBOL data descriptions for copying into CIS COBOL programs. Automatically creates a query and update program of indexed files using CRT protected and unprotected screen formats. No programming experience needed. Output program directly compiled by STANDARD CIS COBOL \$200/\$20

- NEVADA COBOL**—Subset of ANSI-74. Features fast compilation and execution with small object modules. Has extended arithmetic with 18 digit accuracy. Extended I/O includes random access files and sequential files of both fixed and variable length records, and interactive accept/display verbs. Good error messages and debugging facilities enhance program development. Requires a 32K CP/M system \$149/\$25
- EIDOS SYSTEMS**
- KBASIC**—Microsoft Disk Extended BASIC version 4.51 integrated with KISS Multi-Keyed Index Sequential and Direct Access file management as 9 additional BASIC commands. KISS included as relocatable modules linkable to FORTRAN-80, COBOL-80, and BASIC COMPILER. Specify CP/M version 1.4 or 2.x when ordering. Requires 48K CP/M \$585/\$45
 - Licensed users of Microsoft BASIC-80 (MBASIC) \$435/\$45
 - XYBASIC Interactive Process Control BASIC**—Full disk BASIC features plus unique commands to handle byte rotate and shift and to test and set bits. Available in several versions:
 - Integer ROM squared \$350/\$25
 - Integer CP/M \$350/\$25
 - Extended ROM squared \$450/\$25
 - Extended CP/M \$450/\$25
 - Extended Disk CP/M \$550/\$25
 - Integer CP/M Run Time Compiler \$350/\$25
 - Extended CP/M Run Time Compiler \$450/\$25
 - RECLAIM**—A utility to validate media under CP/M. Program tests a diskette or hard disk surface for errors, reserving the imperfections in invisible files, and permitting continued usage of the remainder. Essential for any hard disk. Requires CP/M version 2. \$80/\$5
 - BASIC UTILITY DISK**—Consists of: (1) CRUNCH-14—Compacting utility to reduce the size and increase the speed of programs in Microsoft BASIC 4.51, BASIC-80 and TRS-80 BASIC. (2) DPFUN—Double precision subroutines for computing nineteen transcendental functions including square root, natural log, base 10, sine, arc sine, hyperbolic sine, hyperbolic arc sine, etc. Furnished in source on diskette and documentation \$50/\$35
 - STRING-80**—Character string handling plus routines for direct CP/M BDOS calls from FORTRAN and other compatible Microsoft languages. The utility library contains routines that enable programs to chain to a COM file, retrieve command line parameters and search file directories with full wild card facilities. Supplied as linkable modules in Microsoft format. \$95/\$20
 - STRING/80** source code available separately \$295/NA
 - THE STRING BIT**—FORTRAN character string handling. Routines to find, fill, pack, move, separate, concatenate and compare character strings. This package completely eliminates the problems associated with character string handling in FORTRAN. Supplied with source \$65/\$15
 - VSORT**—Versatile sort/merge system for fixed length records with fixed or variable length fields. VSORT can be used as a stand-alone package or loaded and called as a subroutine from CBASIC-2. When used as a subroutine, VSORT maximizes the use of buffer space by saving the TPA on disk and restoring it on completion of sorting. Records may be up to 255 bytes long with a maximum of 5 fields. Upper/lower case translation and numeric fields supported. \$175/\$20
 - CPM/374X**—Has full range of functions to create or re-name an IBM 3741 volume, display directory information and edit the data set contents. Provides full file transfer facilities between 3741 volume data sets and CP/M files \$195/\$10
- Coming Soon*
- CPAids***
- MASTER TAX**—Professional tax preparation program. Prepares schedules A, B, C, D, E, F, G, R/RP, SE, TC, ES and forms 2106, 2119, 2210, 3468, 3903, 2441, 4625, 4726, 4797, 4972, 5695 and 6251. Printing can be on readily available, pre-printed continuous forms on overlays, or on computer generated, IRS approved forms. Maintains client history files and is interactive with CPAids GENERAL LEDGER II (see below) \$995/\$30
 - Annual Update Fee \$350
 - STANDARD TAX**—As above for schedules A, B, C, D, E, G, R/RP, SE, TC and forms 2106 and 2441. Also, does not maintain client history files \$495/\$30
 - Annual Update Fee \$175
 - GENERAL LEDGER II**—Designed for CPA's. Stores complete 12 month detailed history of transactions. Generates financial statements, depreciation, loan amortizations, journals, trial balances, statements of changes in financial position, and compilation letters. Includes payroll system with automatic posting to general ledger. Prints payroll register, W2's and payroll checks. \$450/\$30

T/MAKER—Powerful new tool for preparing management reports with tabular data. Makes financial modeling projects easy. Do you want a weekly profitability report? Set up the table and compute. Just change the sales figures for next week and compute. You have a new report! T/MAKER includes a full screen editor for setting up tables which pages left, right, up and down. Compute includes standard arithmetic, percents, exponents, common transcendental functions, averages, maxima, minima, projections, etc. Requires 48K CP/M, CBASIC-2, CRT Terminal with addressable cursor positioning. **\$275/\$25**

BSTAM—Utility to link one computer to another also equipped with BSTAM. Allows file transfers at full data speed (no conversion to hex), with CRC block control check for very reliable error detection and automatic retry. We use it! It's great! Full wildcard expansion to send *, COM, etc. 9600 baud with wire. 300 baud with phone connection. **Both ends need one.** Standard and versions can talk to one another. This software requires a knowledge of assembler language for installation. **\$150/\$10**

BSTMS—Intelligent terminal program for CP/M systems. Permits communication between micros and mainframes. Sends character data files to remote computers under complete control. System can record character data sent from remote computer systems and data banks. Includes programs to EXPAND and COMPRESS binary files for transmission. This software requires a knowledge of assembler language for installation. **\$200/\$25**

WHATSI?*—Interactive data-base system using associative tags to retrieve information by subject. Hashing and random access used for fast response. Requires CBASIC-2 **\$175/\$25**

SELECTOR III-C2—Data Base Processor to create and maintain multi-key data bases. Prints formatted sorted reports with numerical summaries or mailing labels. Comes with sample applications, including Sales Activity, Inventory, Payables, Receivables, Check Register, and Client/Patient Appointments, etc. Requires CBASIC-2. Supplied in source **\$295/\$20**

GLECTOR—General Ledger option to SELECTOR III-C2. Interactive system provides for customized COA. Unique chart of transaction types insure proper double entry book-keeping. Generates balance sheets, P&L statements and journals. Two year record allows for statement of changes in financial position report. Supplied in source. Requires SELECTOR III-C2, CBASIC-2 and 56K system. **\$350/\$25**

DMA

CBS—Configurable Business System is a comprehensive set of programs for designing custom data files and application systems without using a programming language such as BASIC, FORTRAN, etc. Multiple key fields for each data file are supported. Set-up program customizes system to user's CRT and printer. Provides fast and easy interactive data entry and retrieval with transaction processing. Report generator program does complex calculations with stored and derived data, record selection with multiple criteria, and custom formats. Sample inventory and mailing list systems included. **No support language required.** **\$395/\$40**

MICROPRO

SUPER-SORT I—Sort, merge, extract utility as absolute executable program or linkable module in Microsoft format. Sorts fixed or variable records with data in binary, BCD, Packed Decimal, EBCDIC, ASCII, floating & fixed point, exponential, field justified, etc. Even variable number of fields per record! **\$225/\$25**

SUPER-SORT II—Above available as absolute program only. **\$175/\$25**

SUPER-SORT III—As II without SELECT/EXCLUDE. **\$125/\$25**

DATASAR—Professional forms control entry and display system for key-to-disk data capture. Menu driven with built-in learning aids. Input field verification by length, mask, attribute (i.e. upper case, lower case, numeric, auto-dup, etc.). Built-in arithmetic capabilities using keyed data, constant and derived values. Visual feedback for ease of forms design. Files compatible with CP/M-MP/M supported languages. Requires 32K CP/M **\$350/\$35**

WORD-STAR—Menu driven visual word processing system for use with standard terminals. Text formatting performed on screen. Facilities for text paginate, page number, justify, center and underscore. User can print one document while simultaneously editing a second. Edit facilities include global search and replace. Read/Write to other text files, block move, etc. Requires CRT terminal with addressable cursor positioning. **\$445/\$40**

WORD-STAR-MAIL-MERGE—As above with option for production mailing of personalized documents with mail lists from DATASAR or NAD. **\$575/\$40**

WORD-MASTER Text Editor—In one mode has superset of CP/M's ED commands including global searching and replacing, forwards and backwards in file in video mode, provides full screen editor for users with serial addressable-cursor terminal. **\$145/\$25**

MAGIC WAND—Word processing system with simple, easy to use full screen text editor and powerful print processor. Editor has all standard editing functions including text insert and delete, global search and replace, block move and library files for boiler plate text. Print processor formatting commands include automatic margins, pagination, headings & footings, centered and justified text. Also prints with true proportional spacing, merges with data files for automatic form letters, and performs run-time conditional testing for varied output. Requires 32K CP/M and CRT terminal with addressable cursor. **\$395/\$40**

TEXTWRITER III—Text formatter to justify and paginate letters and other documents. Special features include insertion of text during execution from other disk files or console, permitting recipe documents to be created from linked fragments on other files. Has facilities for sorted index, table of contents and footnote insertions. Ideal for contracts, manuals, etc. Now compatible with Electric Pencil* and Word-Star prepared files. **\$125/\$20**

DATEBOOK—Program to manage time just like an office appointment book but using the speed and memory of a computer. Keeps track of three appointment schedules (three dental chairs, three attorneys, etc.) at once. Appointments consist of name, reason for the appointment, the date and time, and the length of the appointment. System can be quickly customized for the individual user. Many helpful features for making, changing, finding, and reporting appointments. Requires 48K CP/M and 180K bytes diskette storage. Not available for Apple CP/M. **\$295/\$25**

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General accounting software for small businesses. Each product can be used alone or with automatic posting to the general ledger. Supplied in source for Microsoft BASIC 4.51.

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Comprehensive accounting software written in CBASIC-2 and supplied in source code. Each software package can be used as a stand-alone system or integrated with the General Ledger for automatic posting to ledger accounts. Requires CBASIC-2.

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INVENTORY SYSTEM \$555/\$40
JOB COSTING \$805/\$40
APARTMENT MANAGEMENT \$805/\$40
CASH REGISTER \$805/\$40

POSTMASTER—A comprehensive package for mail list maintenance that is completely menu driven. Features include keyed record extraction and label production. A form letter program is included which provides neat letters on single sheet or continuous forms. Includes NAD file translator. Requires CBASIC-2. **\$150/\$20**

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Complete interactive accounting software for business. Each product can be used stand-alone or with automatic posting to the general ledger. Each product is thoroughly tested and very well documented. Each product requires CBASIC-2.

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ACCOUNTS PAYABLE \$820/\$40
PAYROLL \$820/\$40
INVENTORY CONTROL \$820/\$40

LIFELINES NEWSLETTER FROM LIFEBOAT

LIFELINES is the first step in software support for the serious microcomputer user. Each issue reports new revisions together with information on the purpose for each such release, be it for correction of bugs or the addition of features and facilities.

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ANALYST—Customized data entry and reporting system. User specifies up to 75 data items per record. Interactive data entry, retrieval, and update facility makes information management easy. Sophisticated report generator provides customized reports using selected records with multiple level breakpoints for summarization. Requires a disk sort utility such as QSORT, SUPER-SORT or VSORT and CBASIC-2. **\$250/\$15**

LETTERLIGHT—Program to create, edit and type letters or other documents. Has facilities to enter, display, delete and move text, with good video screen presentation. Designed to integrate with NAD for form letter mailings. Requires CBASIC-2. **\$200/\$25**

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CONDIMENTS

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DC 300 Data Cartridges Specify 450 XL or 300 certified. Pack of 5. **\$100**

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PASCAL USER MANUAL AND REPORT—By Jensen and Wirth. The standard textbook on the language. Recommended for use by Pascal/Z, Pascal/M and Pascal/MT users **\$12**

THE C PROGRAMMING LANGUAGE—By Kernighan and Ritchie. The standard textbook on the language. Recommended for use by BDS C, tiny C, and Whitesmiths C users. **\$12**

STRUCTURED MICROPROCESSOR PROGRAMMING—By the authors of SMAL/80. Covers structured programming, the 8080/8085 instruction set and the SMAL/80 language. **\$20**

ACCOUNTS PAYABLE & ACCOUNTS RECEIVABLE—CBASIC—By Osborne/McGraw-Hill **\$20**

GENERAL LEDGER—CBASIC—By Osborne/McGraw-Hill **\$20**

PAYROLL WITH COST ACCOUNTING—CBASIC—by Osborne/McGraw-Hill **\$20**

Hearty Appetite.

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TRS-80 is a trademark of Tandy Corp.
Pascal/M is a trademark of Sorcim.
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CPAIDS is a trademark of Computer Tax Service, Inc.
MAGIC WAND is a trademark of Small Business Application, Inc.
Peachtree Software is a trademark of Retail Systems, Inc.

Recommended system configuration consists of 48K CP/M, 2 full size disk drives, 24 x 80 CRT and 132 column printer.

Modified version available for use with CP/M as implemented on Heath and TRS-80 Model I computers.

User license agreement for this product must be signed and returned to Lifeboat Associates before shipment may be made.

This product Includes/excludes the language manual recommended in Condiments.

Serial number of CP/M system must be supplied with orders.

Requires Z80 CPU.

Ordering Information

MEDIA FORMAT ORDERING CODES

When ordering, please specify format code.

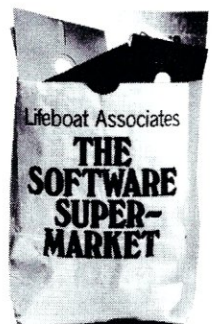
LIFEBOAT ASSOCIATES MEDIA FORMATS LIST. Diskette, cartridge disk and cartridge tape format codes to be specified when ordering software for listed computer and disk systems. All software products have specific requirements in terms of hardware or software support, such as MPU type, memory size, support operating system or language.

Computer system	Format Code	Computer system	Format Code	Computer system	Format Code
Altair 8800 Disk	See MITS 3200	iCOM 4511 5440 Cartridge		RAIR Double Density	RE
Altos	A1*	CP/M 1.4	D1 #	Research Machines 8"	A1
Apple - SoftCard 13 Sector	RG	iCOM 4511 5440 Cartridge		Research Machines 5 1/4"	RH
Apple - SoftCard 16 Sector	RR	CP/M 2.2	D2 #	REX	C3
AVL Eagle	RB	IMS 5000	RA	Sanco 7000 5 1/4"	RO
BASF System 7100	R9	IMS 8000	A1*	SD Systems 8"	A1*
Blackhawk Single Density	Q3	IMSAI VDP-40	R4**	SD Systems 5 1/4"	R3
Blackhawk Microplus Mod II	Q2	IMSAI VDP-42	R4**	Sorcerer	See Exidy Sorcerer
CDS Versatile 3B	O1	IMSAI VDP-44	R5**	SpaceByte	A1
CDS Versatile 4	O2	IMSAI VDP-80	A1**	SuperBrain	See Interlec
COMPAL-80	Q2	Intecolor	See ISC Intecolor	Tarbelle	A1*
Comromco System 3	A1*	Intel MDS Single Density	A2	TEI 5 1/4"	R3
Comromco Z2D	R6	Intel MDS Double Density	A5	TEI 8"	A1*
CSN BACKUP (tape)	T1 #	Intertec SuperBrain DOS 0.1	R7	Thinkertoys	See Morrow Discus
Delta	A1*	Intertec SuperBrain DOS 0.5-2 X	RJ	TRS-80 Model I 5 1/4"	R2
Digi-Log Microterm II	RD	Intertec SuperBrain DOS 3 X	RK	TRS-80 Model I - FEC Freedom	RN
Digital Microsystems	A1*	ISC Intecolor 8063/8360/8963	A1	TRS-80 Model I - Omikron 5 1/4"	A4*
Discus	See Morrow Discus	Kontron PSI-80	RF	TRS-80 Model I - Omikron 8"	A1
Durango F-85	RL	Mega 5 1/4"	P6	TRS-80 Model I - Shuffboard 8"	A1
Dynabyte DB2/2	R1	Micromation		TRS-80 Model I - Shuffboard 8"	A1*
Dynabyte DB8/4	A1*	(Except TRS-80 below)	A1*	TRS-80 Model II	A1*
Exidy Sorcerer - Lifeboat CP/M	Q2	Microplus Mod I	O1	VDP-40/42/44/80	See IMSAI
Exidy Sorcerer - Exidy CP/M	Q4	Microplus Mod II	O2	Vector Graphic	Q2
Health H8 - H17/H27	P4	MITS 3200/3202	B1	Vector HZ	Q2
Health H89 - Lifeboat CP/M	P4	Morrow Discus	A1*	Vector M2	See CDS Versatile
Health H89 - Magnolia CP/M	P7	Mostek	A1	Vista V80 5 1/4" Single Density	P5
Helios II - See Processor Technology		MSD 5 1/4"	RC	Vista V200 5 1/4" Double Density	P6
Horizon	See North Star	North Star Single Density	P1	Zenith Z89 - Lifeboat CP/M	P4
iCOM 2411 Micro Floppy	R3	North Star Double/Quad	P2	Zenith Z89 - Magnolia CP/M	P7
iCOM 3712	A1	Nylac Single Density	Q3		
iCOM 3812	A1*	Nylac Microplus Mod. II	Q2		
		Ohio Scientific C3	A3		
		Onyx C8001	T2 #		
		Perlec PCC 2000	A1*		
		Processor Technology Helios II	B2		
		Quay 500	RO		
		Quay 520	RP		
		RAIR Single Density	RR		

* Single-Side Single-Density disks are supplied for use with Double-Density and Double-Side 8" soft sector format systems.
** IMSAI formats are single density with directory offset of zero.

A media surcharge of \$25 for orders on tape formats T1 and T2 and of \$100 for orders on disk formats D1 and D2 will be added.

The list of available formats is subject to change without notice. In case of uncertainty, call to confirm the format code for any particular equipment.



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(212) 860-0300

Software Product Review

INFORMATION MASTER

reviewed by **Bill Machrone**

Information Master is a CP/M*—compatible information retrieval program oriented towards textual data. The program, available from Island Cybernetics, was originally written to perform retrieval from a large data base of articles and abstracts in the ecological sciences field. It, however, is a generalized program and is adaptable to a number of different retrieval needs.

Information Master operates under a variety of the CP/M-derivative operating systems, such as CDOS and IMDOS. It is "installable," in that some of the operating parameters can be changed for specific applications. The program is fast, since it maintains the dictionary in main memory during retrieval. The console displays are not sophisticated in that there are no cursor controls or even screen clears, but capabilities of that type are usually just window dressing, anyway. It does, however, format text going to the printer and gives you the option of sending it to a disk file for further editing or processing. Within its defined area of operation it does quite a lot, especially for the price, which is \$37.50 per copy.

Within its defined area of operation it does quite a lot, especially for the price, which is \$37.50 per copy.

One of the unique things about Information Master is that it does not have the input/data entry module that is usual for this type of program. Since its major function is to facilitate access to text, it is specifically intended for use with your current text editor. One advantage to this approach is that it isn't necessary to learn a new set of text editing rules in order to use Information Master. Whatever CP/M-compatible text editor you are familiar with is fine. There is also no reason why you can't use whatever high-level language you have at hand to create prompted input acceptable to Information Master. The files of information you create are considered "raw" text by Information Master; it processes them to build a

dictionary of retrieval terms and a pointer file that provides access to the text.

Island Cybernetics provides a demonstration data base with the programs, and it is worthwhile to experiment with it before you plunge into creating your own. The data base has extracts from articles which are cross referenced by the topics upon which they are likely to be retrieved. A feature of the program is that only the dictionary and pointer files need be present on one disk. The data itself may be on a completely separate disk, thus maximizing data storage.

The input requirements are simple. There are three "triggers" or delimiters that Information Master looks for in raw text in order to distinguish keywords from text. One of the delimiters is used to establish a "brief" retrieval heading, such as the title of an article. Below is an example from the Information Master manual:

*C
INFORMATIONMASTER,UsersManual,IslandCybernetics, 1979 *This short manual describes the use of the "INFORMATION MASTER" program for retrieval of text files using Boolean combinations of key words or phrases.

Vendor:
Island Cybernetics
P.O. Box 208
Port Aransas, TX 78373

*K
INFORMATION RETRIEVAL/CP/M/DATA
MANAGEMENT/8080 CPU Z-80 CPU

*E

If the above entry (and any number of similarly organized entries) is presented to Information Master as raw text, it will be cataloged and cross-indexed by the key-

words that follow the *K delimiter. The *E signifies the end of the entry. If you use the "short form" of retrieval, the program will display the text from the *C to the first*. If you specify the long form, it will display all of the text down to the *K.

Another nice feature of Information Master is that the output can be directed to either the list device or the console. While we're on the topic of nice features, another that deserves mention is the "not in dictionary" function. If you request a lookup under "Z-80" the program will inform you that there is no corresponding entry in the master dictionary and will then list the close matches to the entry you had specified. This makes it easy to pick out the entries you want. The "sounds like" algorithm may be a little generous in terms of giving you some matches that aren't even close to what you want, but it's better to have too many than too few.

Actual retrieval from the data base is done by specifying the keywords that you are looking for. Information Master provides a Boolean expression input capability, so that you can logically AND and OR your requirements. This feature alone sets it apart from the usual data retrieval applications written in Basic, which normally do not provide this function. Furthermore, most homegrown retrieval systems are limited in the number of keys that can be stored or retrieved upon. There is no limit to the number of keywords that can be associated with each piece of information, so that the cross-indexing capabilities are endless.

Information Master is unique in its "cataloging" capabilities of text and is adaptable to a variety of storage and retrieval needs.

Now that you know what Information Master does, the inevitable question arises, "What good is it?". Most of us don't have large data bases of articles and books to summarize, but we do have some commonplace data that could stand some organization, and there is the occasional unique application that can benefit from a program such as this. The manual contains some suggestions in addition to data bases of literature, including book collections, correspondence and recipes.

Taking recipes as an example, you can enter your favorite dishes and document where the recipes are located and what variants you have tried. Below is an example of how you might organize these entries:

```
*C
Chicken with walnuts in plum sauce
Bon Appetit, July, 1980 Page 8.
*Use 30% more sauce than recipe calls for. Breast
meat a good substitute for thighs. Goes well over
fried rice and with pina coladas. Simple but impres-
sively good.
*K
CHINESE/CHICKEN/GINGER/HOISAN/WAL-
NUTS/DINNER
*E
*C
Oven fried fish
Better Homes Cookbook, page 260.
*Season bread crumbs with parsley, bouquet
```

```
garni, parmesan cheese, dash garlic salt, tarragon,
basil, oregano, or whatever comes to mind. 8-10 min-
utes sufficient for thin fillets.
```

```
*K
FISH/DINNER/FAST
*E
```

Information Master's short and long form output enables you to list just the recipe titles and the publication or list your comments as well. Any number of entries such as the ones above can be present in the raw text file. Information Master provides the dual advantage of random access with variable length records for the most efficient possible utilization of your disk storage. If you carefully standardize the usage of keywords you will have no trouble retrieving whatever you want from the data base. For example, you can specify "FAST and DINNER," "CHINESE and CHICKEN and DINNER," or something like "CHICKEN or FISH and DINNER."

Information Master can do things that would otherwise take extensive custom programming or cost far more for a generalized data base management subsystem. It compares very favorably to data managers like WHATSIT and Selector III, especially considering the price.

A totally different potential application is a personal diary or a businessman's calendar. In this mode, you could use the keywords to establish the date, the type of event and meaningful cross-indexes. The short form entry need not be used. Here's an example:

```
*C
10:00 Meeting with Joe Tyler. Discussed new appli-
cations program and suggested that Steve Linden
be appointed as user liaison. Tyler not sure about
Linden; will get back to me by 30 June.
*K
MEETINGS/10/JUN/1980/APPLICATIONS/
TYLER
*E
*C
1:30 Phone with C. Daniels of Hairy Software Inc.
Determined availability of King Kong word
processing system. Version 1.0 will be replaced
in 45-60 days. Field upgrade to existing
licensees is for cost of media and manuals.
*K
10/JUN/1980/KING KONG/WORD PROCES-
SING
*E
```

In this kind of example, Information Master can manage past or future appointments and to-be-done items. With a little ingenuity, follow-up dates could be coded as part of the keyword area, so that an inquiry can tell you almost instantly what needs to be done by a certain date. Anyone can appreciate the permanence of the records and the ability to review a month's meetings or all those held on a given topic or with a specific individual.

Information Master cont'd...

In conclusion, Information Master is unique in its "cataloging" capabilities of text and is adaptable to a variety of storage and retrieval needs. If you don't need to do a lot of field-oriented further processing with the retrieved data and if simple list or console output is sufficient, Information Master can do things that would otherwise take extensive custom programming or cost far more for a generalized data base management subsystem. I think that it compares very favorably to data managers like WHATSIT and Selector III, especially considering the price. This is not to say that it would replace either of them; WHATSIT is uniquely capable in expressing hierarchical relationships among data items, while SELECTOR has a full range of report generation capabilities that are quite powerful in themselves. I feel, however, that neither of them could beat Information Master at its own game. It doesn't resort to cute "artificial intelligence" conversations with the user and, depending on how you set up your keywords, can represent hierarchical or relational data structures. It would be nice to see some substring operators so that it wouldn't be necessary to break up the year, month and day, and so you could pick out subcodings like "CPU" from both "Z-80 CPU" and "8080 CPU." A negation operator would be neat, too. Then you could say, in essence, "DINNER but not FISH."

But all this is quibbling. Information Master is a good buy, has no apparent bugs, is reasonably well documented and is both easy and fun to use. It is available from: Island Cybernetics, P.O. Box 208, Port Aransas, Texas 78373, tel: (512) 749-6673. The cost is \$37.50. □

PASCAL Moonshadow Text Formatter VER 3.0



The UCSD Pascal (TM) screen editor is convenient for creating and maintaining text files, but isn't a proper word processor by itself because it can't underline, paginate, or perform many other essential word processing functions.

Merrimack Systems' Moonshadow Text Formatter (MTF) post processes text files which have been produced using the screen editor or Pascal application programs. MTF's output, a fully-formatted document, may be sent to your printer, console display, or even to another text file.

Since its introduction in mid-1979, MTF has offered standard formatting functions such as centering, underlining, right-justification, full control over page dimensions, and pagination with "header" and "footer" titles. The original version also boasted many advanced features including form-letter production, special handling for even and odd pages, text file concatenation, and output character translation to compensate for exotic fonts and printers.

Now, the new and improved MTF VERSION 3.0 supports conditional formatting, automatic section numbering, and for Letter-quality printers such as QUME, Diablo, and Spinwriter, proportional spacing, boldfacing, sub- and super-scripting, overstriking, alternate fonts, and much more.

MTF 3.0, the flexible, capable tool which turns your Pascal computer into a powerful word-processor, is available for many UCSD Pascal (TM)-based systems, including Pascal I.5 and II.0 for 8080-family and DEC LSI-11/PDP-11 computers, Apple Pascal 1.0 and 1.1, North Star Pascal 1.0 and 2.0, and computers using the Western Digital MICROENGINE.

For just \$199, the MTF 3.0 package includes object code, user manual in printed and machine-readable forms, and an easy-to-use system configuration program which allows you to tailor MTF to take advantage of your printer's special capabilities. You can get it all from Merrimack Systems, PO Box 5218, Redwood City, CA 94063. Phone (415) 365-6281. California residents add 6% sales tax.

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The Talos DIGI-KIT-IZER Digitizing Tablet Kit

by Jon Bondy

I have always been fascinated with graphics applications for computers. I therefore purchased an analog to digital converter board just to be able to interface a joystick to my computer as a graphics input device. I expected to be able to designate locations on my graphics CRT screen with the joystick, and hoped that I would be able to draw some simple pictures with it, too. The joystick proved to be far less useful in these capacities than I had imagined, for two reasons.

If one hooks the joystick up so that the position of the stick is directly related to the position of a cursor on the graphics screen, it is difficult to keep one's hand still enough to specify a single point on the screen with any accuracy. If one modifies the joystick so that it represents the direction of motion of the cursor on the screen (i.e., pushing the stick up moves the cursor up), then any point can be designated on the screen with ease, but it is sometimes a slow process to move the cursor to the correct position.

In the midst of this frustration, a friend of mine at Apple computer commented to me that they had selected a digitizing tablet product because it had solved these problems and he felt that it was the best way to input graphic data into a computer. I picked up a manual for their tablet, and it and their software did seem to offer a lot. Unfortunately, I am not an Apple owner, and even if I were, the price (in excess of \$700) was more than I felt that I wanted to spend on that portion of my system hardware. I wanted to re-write the software anyway, to learn about how it fits together. I looked at the Summagraphics Bitpad and the Talos Digitizers, but they still were in the \$700 and up price range. I then discovered that Talos made a digitizing tablet kit listing for \$500 with an active area of 11 by 11 inches, a resolution of 200 coordinates per inch and a data rate of 100 coordinate pairs per second. I decided that this was worth a try, and ordered it from Cushman Associates, Inc. (2735 Skylark Road, Wilmington, Delaware, 19808) who supplied it for \$450. You may be able to find it locally for a similar price.

The kit comes with a parallel interface and no power supply, although a serial interface board and a power supply can be purchased as options at about \$100 each. I purchased the kit with no options, figuring that I could obtain power from my computer (+15 volts at 250 ma—

more on this later) and a parallel interface from my Cromemco TUART board. One thing which was not clear until I received the kit was that the parallel interface really requires 16 bits, taking up two 8-bit parallel input ports rather than the one which I had assumed.

My kit arrived in a box containing two large plastic bags, one for the main kit and one for the parallel output board. This allows Talos to easily mix various output options with the main kit. The main kit consists of two PC boards and some hardware with which to make the digitizing tablet box. Each of the sub-kits (main kit and output board) contains its own instruction manual.

The kit is intended for those who have built kits before, since the manuals do not go into the kind of detail which a HeathKit manual might, but the construction instructions are carefully plotted step by step, and are for the most part easy to follow. There was one typo in their output board manual (on page 3, a 10 ohm resistor was listed as Brown-Black-Brown, whereas it should have been Brown-Black-Black), but the manuals were surprisingly free of printing mistakes. On page 3 of the main manual, the builder is instructed to determine if the pen is a 'style A' or 'style B' pen, but no indication is made as to how to determine which pen style came with the kit. It turns out that there is a small paper tag on the pen cord indicating this. On page 12 of the main manual, the builder is instructed to place the ICs for the MUX board into their sockets, but no list of IC's is provided. It proved easy for this board, since IC's 9 and 10 are 74C42's, and the rest are CD4051's. The section on the final mechanical construction of the tablet (where the PC boards are united with some aluminum shields using nuts, bolts and spacers) was not completely clear, but I figured it out after playing with the pieces for about 30 minutes. The section describing the theory on how the tablet works is rather skimpy and the schematics are not annotated with signal names, so understanding the circuitry is not as easy as one might wish. All parts required for construction of the kit were present, down to the solder and wire needed for jumpers. One nice thing about this kit is that the parts are usually called out in the order in which they appear on the board, rather than by part number, so that you usually can locate parts rapidly and accurately. The plastic housing for the completed tablet was adequate for a hobby application, but probably would not stand up to a commercial environment.

In general, the instructions were good, but I assembled the boards in a slightly different manner than the manuals called for. I always install my sockets first, place a piece of cardboard over them, invert the cardboard and PC board and then solder all sockets in at once. In order to make sure that they are all in flush to the board, I tack solder them on two pins which are diagonally opposed (say 1 and 9 on a 16 pin socket) and then press them flush to the board while re-heating the two pins from the underside of the board. I find this to be easy and time-saving, as compared with placing a single socket in the PC board, turning the board over, crimping two leads, turning the board over again, etc. Since my

technique will not work if any other components are on the board, I had to do this out of the order specified in the Talos manuals. If you do as I did, be careful, two IC positions (U17 and U18) do not use sockets on the parallel output board.

Assembly took 4.5 hours, but I have been building kits for over ten years, so that probably is the shortest time which you could expect. Most of the time was spent stuffing components into the PC boards, but some of it was spent making over 40 jumper wires (archaic, but it really didn't take all that long) and performing the final mechanical assembly. I found that one way to make the

—CONTINUED ON NEXT PAGE—

```

Program tablet;
  const
    port1 = 132; ( msb's and up/down x/y -- 84 hex )
      ( bit 0 -- printer on line
        bit 1 -- printer busy
        bit 2 -- tablet data bit 8
        bit 3 -- tablet data bit 9
        bit 4 -- tablet data bit 10
        bit 5 -- tablet data bit 11
        bit 6 -- tablet stylus up/down
        bit 7 -- tablet x/y data flags )
    port2 = 148; ( lsb's -- 94 hex )
      ( bit 0 -- tablet data bit 0
        bit 1 -- tablet data bit 1
        bit 2 -- tablet data bit 2
        bit 3 -- tablet data bit 3
        bit 4 -- tablet data bit 4
        bit 5 -- tablet data bit 5
        bit 6 -- tablet data bit 6
        bit 7 -- tablet data bit 7 )
    mask = 128; ( select x/y bit )
    msbs = 60; ( select msbs (8-11) out of port1 )
    msbshift = 64; ( to shift msb's out of byte )
  var
    x, y, i : integer;

  function portread(port : integer) : integer; external;
  function pand(val1, val2 : integer) : integer; external;

  procedure readxy(var x, y : integer);
  begin
    ( await y data )
    while (pand(portread(port1),mask) <> 0) do begin end;
    y := portread(port2) + (pand(portread(port1),msbs) * msbshift);
    ( await x data )
    while (pand(portread(port1),mask) = 0) do begin end;
    x := portread(port2) + (pand(portread(port1),msbs) * msbshift);
    end; ( readxy )

  begin
  for i := 1 to 1000 do begin
    readxy(x,y);
    writeln(x;8,y;8);
    end;
  end.

```


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DIGI-KIT-IZER cont'd...

final 34 jumpers rapidly and easily was to wrap the jumper wire around a rod of approximately 1/2 inch diameter and then cut semicircles of wire off the resulting spiral. This enabled me to have uniform jumpers which did not rise above the level of the IC's, ensuring that no short circuits developed.

I am used to resistors with long leads which must be carefully formed in order to place them into the PC board. Talos supplied (for the most part) pre-formed resistors, so that they simply dropped into the holes in the PC board. This was a mixed blessing for me, since the leads were too short to bend easily, so the resistors tended to drop out of the board when it was turned over for soldering.

When it was complete, I ran the few tests which the manual recommended, using a multimeter, and then sat there staring at it. The tests said that it was O.K., but was it working, or not? I was using one of my TUART's parallel ports to sense the status lines of my printer, but I managed to squeeze enough bits out of the status lines to get the tablet and printer to share two 8-bit input ports. I wired the parallel interface up to my two TUART input ports, and wrote the following program in UCSD Pascal in order to see if the tablet was functioning as I expected. Surprise! Not only did the tablet work, but the program worked the first time I tried it!

A few notes on the tablet which were not mentioned in the manuals. The tablet works by emitting a magnetic

field (which changes at a high frequency) from the tip of the pen, and detecting it with a grid of sense lines just under the surface of the tablet's plastic cover. The magnetic field emitted by the pen is strong enough to destroy floppy disks, so be careful when the unit is running. It may also leave enough residual magnetism to cause problems when powered down, although I have not checked this! The power required to drive the magnetic fields in the pen is great enough that the tip of the pen will heat up noticeably, but this doesn't indicate a problem with the kit. If you become worried about the heating, put a scope on the two drive lines to the pen (I believe that these are jumpers R and T from looking at the output board schematic, but the main kit schematic would have you believe that they are jumpers Q and T). The signals should be undistorted sine waves; distortion indicates a parts mismatch in the oscillator, and could cause excess heating. The driver IC's for the pen are protected against thermal overload with automatic shut-down circuits, so even if the drivers were to overheat, they should recover after they cool off. Although the manuals indicate that a voltage of +15 is required to run the tablet, the factory told me that it would run on voltages as high as +17, and I am running it at +16.5 (off of my S-100 bus unregulated power supply). Final tablet assembly involves attaching one of the PC boards to the plastic case with adhesive backed paper. I wanted to avoid that step in order to be able to service the unit if necessary, and it turns out that my kit will 'press fit' into the case without any adhesive. □

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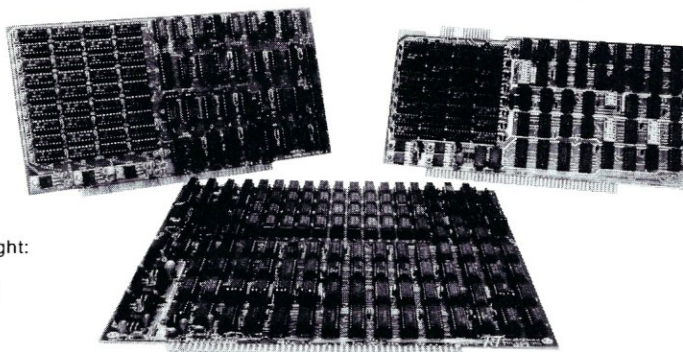
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The CP/M Connection

Part III—Implementing the IOBYTE Function

by Chris Terry

The CP/M System Alteration Manual (page 15) notes that "...the user can optionally implement the IOBYTE function which allows reassignment of physical and logical devices." Unfortunately, the clues to the procedure are scattered through the Facilities Manual, the System Alteration Manual and the Interfacing Manual, and no examples are given.

Why, in practice, would we want to change the active peripherals? We might, for example, have both a dot-matrix printer (on a parallel port) and a daisy-wheel printer (on a serial port); the IOBYTE function allows us to use the dot-matrix printer for numeric output, but to switch to the daisy-wheel for correspondence. Again, if we normally use an electronic keyboard and VDM as the console, but also have a keyboard/printer serial terminal such as a Teletype or Diablo or TI Silent 700, we can switch all console functions to the serial terminal whenever we wish, and switch them back when desirable.

Logical Devices

The ability to perform this switching implies that we have a logical I/O system in which each kind of I/O operation is performed by a separate logical device - that is, a software routine which controls the flow of data, and may do some formatting and CRC generation or checking, but does not directly talk to a physical I/O device.

Communication between the logical device and a physical device takes place through two intermediaries: a logical driver, which is permanently associated with the logical device, and a physical driver that is permanently associated with a particular physical device (see Figure 1). In the distribution version of CP/M, the logical and physical drivers are one and the same; that is, each logical device is permanently linked to one, and only one physical device.

However, when the IOBYTE function is implemented, the logical and physical drivers are separated. The logical driver then consists of a switching mechanism that allows its associated logical device to be linked to any one of four physical drivers (and their associated physical devices). The IOBYTE itself is part of this switching mechanism.

CP/M contains four logical devices. For convenience, they are named:

- 1) CON: 2) RDR: 3) PUN: 4) LST:
(The colons (:) are part of the names.)

The CON: device provides slow-speed communication between the operator and the operating system. It has three logical drivers: CONST, which checks the character ready/not ready status of the currently assigned console input device; CONIN, which fetches a single character from the console input device, and CONOUT, which outputs one character to the currently assigned console display device.

The RDR: device is for input only, from mass storage devices such as a paper tape reader, a cassette playback, a card reader, a badge reader, etc. It has one logical driver, called READER.

The PUN: logical device is for output only to paper tape, cassette recorder, etc. It complements the RDR: device. It has one logical driver, called PUNCH.

The LST: device is for output only. It is not used by the facilities built into the CCP, though it can be linked in tandem with the console display (ctrl-P toggles this link on and off). It is meant for directing the output of application programs to a printer or to mass storage devices other than the disk subsystem. It has one logical driver, called LIST.

Logical Drivers and the IOBYTE

In the distributed system, which does NOT have the IOBYTE function implemented, the logical drivers

actually contain the physical drivers. This means that each logical device is linked to one, and only one, peripheral.

When the IOBYTE function is implemented, this situation changes. The physical device drivers become separate routines (TTYIN, TTYOUT, etc.). The logical drivers then become selection routines, each of which may select one out of four possible physical drivers according to the code found in the corresponding section of the IOBYTE.

The IOBYTE is located at 0003H, and is divided into four 2-bit sections (see figure 2), each of which is associated with one of the logical devices. The 2-bit code (00, 01, 10, or 11) found in any given section of the IOBYTE selects one of the four physical drivers that can legally be associated with that particular logical device. Figure 2 also shows the names associated with the codes for each logical device. It is important to note that from the viewpoint of the switch mechanism in the logical driver, only the codes themselves matter. The names are merely identifiers of the legal codes in each section of the IOBYTE, and only become useful when the STAT utility is used to change the contents of the IOBYTE - that is, to assign a new peripheral to a logical device.

There are many possible ways of implementing the selection mechanism. A neat and straightforward solution can be found in a program called VBIOS31, by Jeff Kravitz, which is contained in Volume 1 of the CP/M Users' Group library. Each logical driver has the form shown in figure 3, except that after the LDA IOBYT instruction, the LIST driver has two RLC instructions, the PUNCH driver has four RLC instructions and the READER driver has two RRC instructions. The effect of these is to shift the bits of interest into bit positions 0 and 1 of the A register.

		IOBYTE AT 0003H			
Bit Position-->	Logical Dev.-->	7 6	5 4	3 2	1 0
		LST:	PUN:	RDR:	CON:
BINARY DEC		Device names known to PIP & STAT			
00 0		TTY:	TTY:	TTY:	TTY
01 1		CRT:	PTP:	PTR:	CRT:
10 2		LPT:	UP1:	UR1:	BAT:
11 3		UL1:	UP2:	UR2:	UC1:

Figure 2. Device Selection Codes in IOBYTE

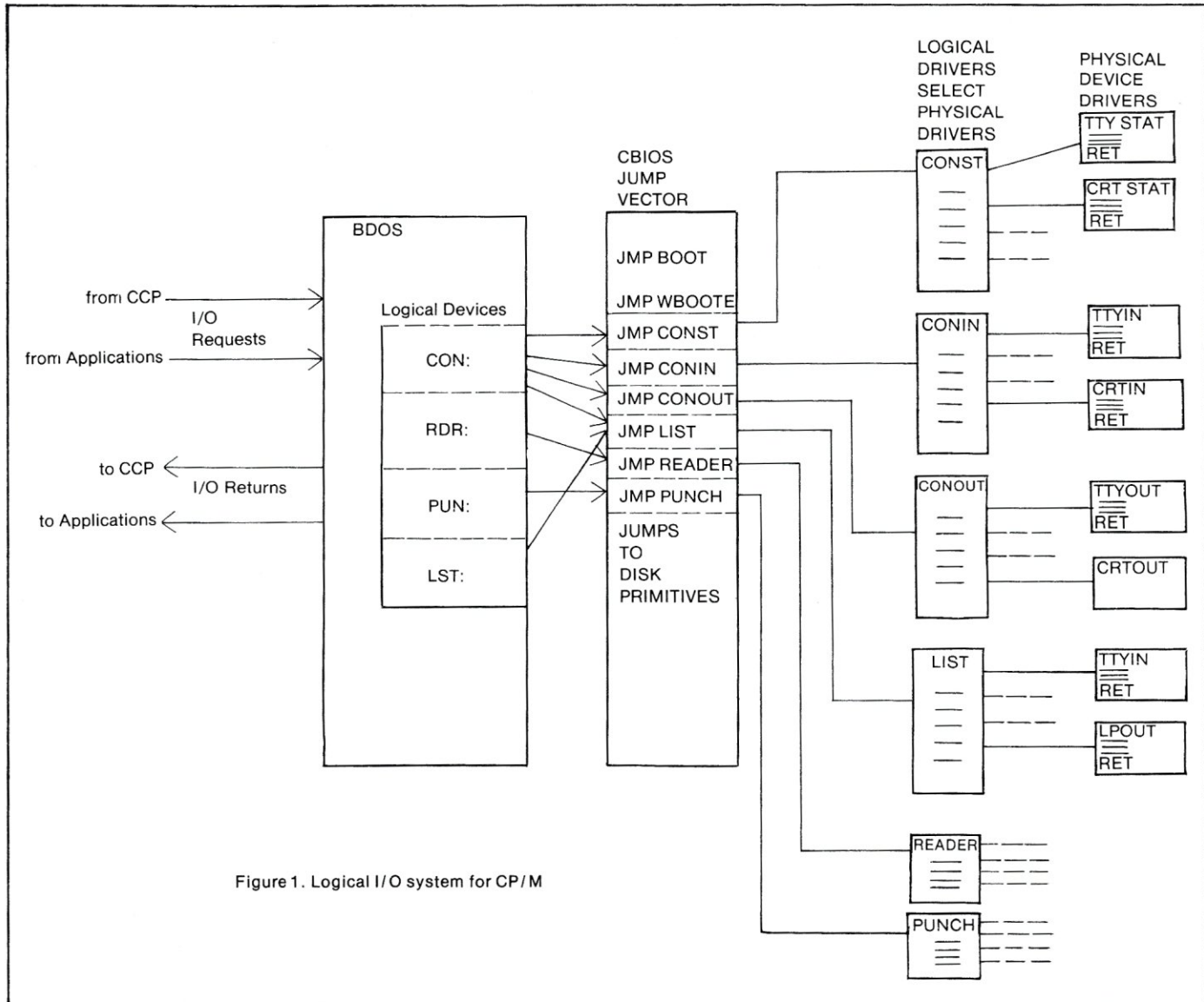


Figure 1. Logical I/O system for CP/M

CP/M Connection cont'd...

The CALL to the common I/O Dispatcher (IOCAL) puts the address of the first entry in the table of physical drivers on the stack as the Return address, although it will not be used as such. IOCAL's job is to find which table entry to use, and then to branch to the address contained in the entry. To do this, it uses the IOBYTE code as an offset to be added to the address of the first table entry. The original IOBYTE code ranges from 0 through 3; however, each table entry is two bytes long, and therefore our offset must be doubled so that its possible values are 0, 2, 4, or 6. This is done by the single RLC at the start of IOCAL. Now we set bits 0 and 3 through 7 of the A register to zero with the ANI 6 instruction, which leaves the absolute value of our doubled code in the register to be used as the offset.

The XTHL instruction saves the current contents of the HL register pair on the stack and brings what was on the top of the stack (the address of the first table entry) into HL. To this (after saving the contents of DE) we double-add our offset by clearing D, moving the offset from A into E, and doing a DAD D. The HL register pair now points to the table entry containing the address of the desired physical driver. The next five instructions bring the driver address itself into HL and restore the original contents of DE. The XTHL

again swap HL and the top of the stack, so that the physical driver address goes on the stack and the original contents of HL are restored. Finally, the RETurn instruction pops the driver address off the stack into the Program Counter, and we start executing the selected driver. The RETurn instruction at the end of the driver itself passes control back to whichever routine requested the I/O operation.

Thus, every I/O call, whether to BDOS or directly to any one of the logical drivers, causes the IOBYTE to be inspected and control to be passed to the physical driver specified in the appropriate section of the IOBYTE.

Other Considerations

The LST:, PUN:, and RDR: are one-way logical devices, and assigning a new physical device to one of them does not affect either of the other two. The only restriction is the obvious one that it is useless trying to obtain input from an output-only device, and vice versa. Care must be taken, however, in the assignments to CON:, on a two-way logical device. Every assignment to this device changes all three of the associated physical drivers simultaneously; that is, the status driver, the character input driver and the character output driver. The branch tables for these drivers must be set up so that a mistaken reassignment

```

CONIN: LDA      IOBYTE      ;Gets the complete IOBYTE
      (RLCs or RRCs      ;as needed to shift code into
      ;bits 0-1 of A. None needed for CON:)
      CALL     IOCAL      ;Puts the address of CITBL on stack
CITBL: DW      TTYIN
      DW      CRTIN
      DW      RDRIN
      DW      UC1IN

IOCAL: RLC                      ;Double the code bits of interest
      ANI      6              ;Mask out all other codes
      XTHL                    ;Save HL, get address of XXTBL
      PUSH    D
      MOV     E,A            ;Put doubled code in E
      MVI    D,0            ;and clear D
      DAD    D              ;Add doubled code to XXTBL address
      ;to find address of required entry
      MOV    A,M            ;Get low byte of entry
      INX   H              ;Now point to high byte of entry
      MOV    H,M            ;and put it into H
      MOV    L,A            ;Put the low byte into L
      POP    D              ;Restore DE
      XTHL                    ;Put entry address on stack, restore HL
      RET                      ;Pop entry address into PC to start
      ;executing the required driver (TTYIN)

TTYIN: ---
      ---
      ---
      RET                      ;Returns control to original caller
  
```

Figure 3. Typical Code for one Logical Driver (CONIN), an associated Physical Driver (TTYIN), and the common I/O Dispatcher (IOCAL).

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There have been several versions of the system available for CP/M systems and one which requires extensive assembly language programming to bootstrap.

The U.C.S.D. Pascal system II.0 is now available ready to run for systems using the Thinker Toys* (Morrow Designs) Discus II system. This outstanding 8" disk system offers 587,008 bytes of storage per drive as configured for U.C.S.D. Pascal and is exceptionally easy to install and use as well as offering a good deal of reliability.

The UCSD Pascal system now offered by Northwest Comm. includes the total Pascal system as released by the University of California as well as additional utility programs developed by Northwest Communications such as an interface to a Thinker Toys* M-26 hard disk (26 megabytes capacity) and a number of Pascal utility programs to assist you in the development of good software.

This software package is particularly easy to run on systems using Thinker Toys* Discus II controller boards because of Morrow Design's thoughtful inclusion of a serial I/O port on the disk controller board.

When you first receive your UCSD Pascal package from Northwest Communications, you may immediately boot the system into a program which will lead you through the steps necessary to configure the software for your system.

The program asks, in plain language, what the memory configuration is, and asks you which of several included I/O modules you wish to use.

The I/O modules supplied include one for only the on board serial port, one which uses a Thinker Toys* Switchboard as ports for a printer and remote unit and one which is similar to the I/O supplied with a NorthStar Horizon computer. Several other useful I/O modules are included as well as one which you may use to tailor the software to your own unique hardware if necessary. This module is blocked out for you in advance with all disk IO complete and requires that you just insert your own I/O routines and assemble using the excellent editor assembler included with the Pascal package. Use of the Disk Jockey serial port for this tailoring makes it very easy to implement. Remember, if you have a North Star Horizon, or wish to use only the on board serial port, or use a Thinker Toys Switchboard you have no programming to do, just answer yes to the IO question section of the configuration program and you're ready to go. Once the I/O and memory configuration has been set, the Pascal system will use the new information in all future bootstraps. You may alter the IO any time to reflect changes in your system.

Future releases planned are interfaces to North Star and Tarbell disk control boards as well as modules for IO involving many of the popular Video control boards and other useful hardware such as Mountain Hardware's Modem board. Also, we will introduce UCSD Pascal for the Heath/Zenith H-89 tabletop computer in January, 1981.

If you want to be informed when these programs are available please send us a letter or postcard with your name and address and a description of your

system. We will put your name on our mailing list and keep you posted on all future releases.

These enhancements will be available at a low cost to registered owners of our UCSD Pascal package.

TECHNICAL INFORMATION

Our UCSD Pascal system will run on any computer with a minimum of 48k of RAM located anywhere between 0000 hex and DFFE hex. The computer must have at least 1 DiscusII controller and 1 or more 8" drives. The software will support up to 4 Discus II 8" drives or 2 8" drives and 1 M-26 hard disk. Any IO configuration may be used. The system initially bootstraps using the Discus II serial port.

DOCUMENTATION

System documentation is available in two forms. The standard system includes Printed Documentation on the Northwest Communications UCSD Pascal system, as well

as the complete UCSD Pascal system documentation on a Pascal format disk. You may access this material either by scanning through it using the Pascal system editor, or by printing it out on a line printer. If you prefer, we will send you the complete printed documentation package in an indexed 3 ring binder with room to store several disks in looseleaf holders. As an introductory offer, on all orders for the UCSD Pascal system placed before Feb 1st, 1980, we will include at no extra charge our 'PRINTER.CODE' program. This program converts your Pascal system into a very powerful and easy to use Word processor. The program operates by the detection of symbols which you place into the text file. It operates on the text to format it to your specifications. The PRINTER.CODE program normally sells for 99.95 but is free with the purchase of a Pascal system. Why not get on board the Pascal Bandwagon?

```

*****
*
*          UCSD Pascal
*          -----
*
*
*   UCSD Pascal System for Discus II      349.95
*
*   System for Discus II                  379.95
*   and M-26 Hard disk
*
*   Standard Documentation pack           n/c
*                                         with system
*
*   Complete printed documentation       39.95
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*   PRINTER.CODE                          99.95
*   text formatting/word processing
*
*   Beginners guide to the UCSD Pascal   11.95
*   system by Dr. Kenneth Bowles
*
*****

```

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*Thinker Toys/Discus are trade marks of Morrow Designs. CP/M is a trade mark of Digital Research
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CP/M Connection cont'd...

command does not cause loss of all communication between the operator and the operating system.

Suppose we have a keyboard and VDM as our standard console, a serial CRT terminal as the alternative device and do not intend to use the BAT: (input from RDR:, output to LST:) or UC1: (user-defined) logical devices. Then in our CONST and CONIN logical drivers, the first table entry will branch to TTYST and TTYIN drivers, and in CONOUT the first table entry will branch to the VDM driver software. The second table entry in CONST and CONIN will branch to the CRTST and CRTIN routines, and the second entry in the CONOUT table will branch to CRTOUT. For the third (BAT:) and fourth (UC1:) table entries, we have two possibilities:

- a. In each table, make the 3rd and 4th entries the same as the first. This will automatically default them to the standard device.
- b. Put branches to an error handling routine. This might merely be a null input routine that returns a NULL (00) and a null output routine that copies C into A and then returns; or the error handling routine might include an error message.

Initialization. As we have seen, communication between the operator and the computer is now totally dependent upon having the correct code in bits 0 and 1 of the IOBYTE. At power-on time, this byte contains a random bit pattern. It is therefore essential that the CP/M Coldstart portion of the boot procedure be modified to include proper initialization of the IOBYTE. If the assignments are set up so that the first entry in each table (code 00) sets up our normal system configuration, the initializing code merely clears the A register (XRA A) and deposits this 00H in IOBYTE (STA IOBYT).

Device Assignment from the Console

The STAT utility has the ability to list the legal device assignments for each of the four logical devices, to list the current assignments, and to change the current assignments. STAT does not know (or care) how the logical driver tables are set up in the CBIOS; it is concerned only with examining the contents of the IOBYTE at location 0003H, reporting what it finds there, and changing specific bits in the IOBYTE while leaving the remainder untouched.

To obtain the list of legal assignments, we type the command:

```
A>STAT VAL:
```

which generates the response:

```
CON: = TTY: CRT: BAT: UC1
RDR: = TTY: PTR: UR1: UR2
PUN: = TTY: PTP: UP1: UP2:
LST: = TTY: CRT: LPT: UL1:
```

If we wish to know the current device assignments, we type the command:

```
A>STAT DEV:
```

If the IOBYTE contains the bit pattern 10 11 01 00, the response will be:

```
CON: IS TTY:
RDR: IS PTR:
PUN: IS UP2:
LST: IS LPT:
```

Now, if we wish to change the reader assignment from PTR: (which could be a fast paper-tape reader) to UR1: (which could be a cassette), we type the command:

```
A>STAT RDR:=UR1:
```

STAT would then change the code in bits 2 and 3 of the IOBYTE from 01 to 10. All subsequent requests for Reader input would then access the cassette instead of the paper-tape reader.

If we want to change more than one assignment, we can put up to four such commands on the same line, separating them with commas, e.g.:

```
A>STAT RDR:=UR2:,LST:=TTY:
```

STAT will detect and deny any request to assign an input physical driver to an output logical device, or to assign device names that are unknown to it, with the error message:

```
INVALID ASSIGNMENT
```

Space on the System Tracks

There is one last item which we must take into account: the space on the system tracks (0 and 1) that is available to expand the CBIOS. The standard CBIOS begins at 3E00 in a 16K system or 7E00 in a 32K system. Thus, we have 512 bytes available for all CBIOS functions (including the disk primitives). If our expanded CBIOS (with the new IOBYTE function) requires more than 512 bytes, then we shall have to move CP/M downward by 1K in order to fit the new CBIOS between the top of the BDOS and the top of available memory. This creates a space of $512 + 1024 = 1536$ bytes above the top of the BDOS. We cannot use all of this space, however, since only 9 sectors (1152 bytes) are available for the CBIOS on System Track 1. We must therefore ensure that the last byte of object code in our expanded CBIOS has a memory address no greater than XE7F (where CBIOS starts at XA00). There is nothing to prevent us from using the space XE80 thru XFFF as scratchpad memory.

If memory space is tight, and we only require (say) 640 bytes for the new CBIOS, we could move CPM downward by only one page (256 bytes). However, a shift of less than 1K will make computation of the ORG address of CBIOS and of the offset less convenient.

Introduction To CP/M

Part V of the "Introduction To CP/M," by Jake Epstein, will be continued in the next issue of S-100 MICROSYSTEMS. Regretfully, the manuscript arrived too late for inclusion in this issue.

a **WORD** to the wise...

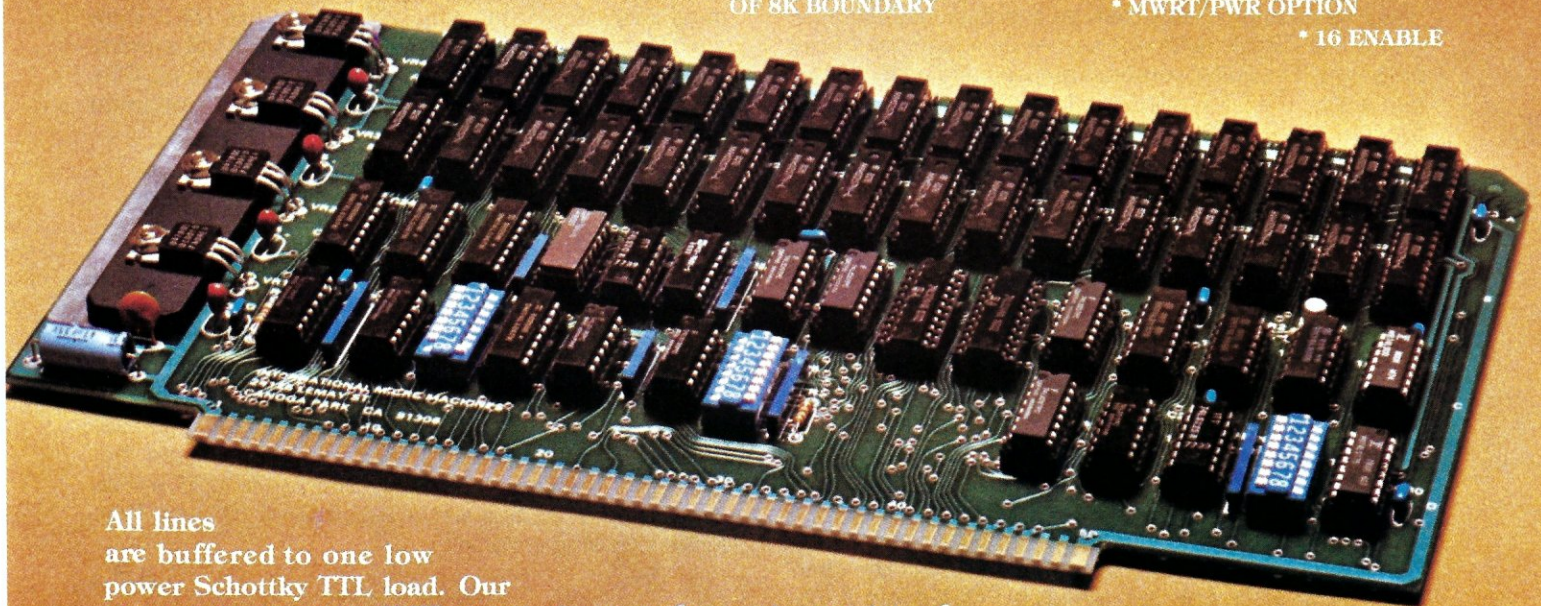


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Modifications to CBasic2

by Ben and Andy Galewsky

CBasic by Software Systems is a good language for many applications, especially in the business environment. The CBasic language comes as a package of two programs. The Basic source is entered into a file using a text editor, then compiled into intermediate code by the program CBAS2. The intermediate code is executed by invoking CRUN2.

Unfortunately, the language has one major shortcoming. There is no provision for outputting a single character to the console at the current cursor position; a buffer must be filled and then printed. This creates problems for users with memory mapped video displays. Formatted screens and other special programs also become difficult (i.e. Osborne and Associates' Payroll with Cost Accounting).

It is possible to write a machine language subroutine to output a single character and have CBasic load the program every time it is run. This has its own attendant problems. The solution presented in this article is a modification to CRUN2. A machine language subroutine is inserted into an unused portion of CRUN2. The character to be placed on the screen is POKEd into a memory location specified by the subroutine. The subroutine is then CALLED from Basic. Then the subroutine makes a call to CP/M to display the character at the cursor position. This eliminates the need to load the routine from disk every time the program is run because it travels along with CRUN2.

The second modification involves the CRUN2 sign-on message, allowing a more elegant and custom finish, as well as making computer operation easier for an inexperienced user.

Making The Modification

Before attempting to modify any program, especially expensive or irreplaceable software, a copy should be made and kept in a safe place free from magnetic radiation and high temperature.

With the backup made, it is now possible to begin the modifications. For this you will need to use DDT (Dynamic Debugging Tool) supplied with your CP/M system, or a similar program. First invoke DDT by typing DDT CRUN2.COM. DDT will return with the following prompt:

```
DDT VERS 1.4
NEXT PC
4300 0100
```

The 4300 under the NEXT shows the next available address after CRUN2. The 100 under PC tells the location of the program counter.

Starting around 110 hex is an embedded copyright notice. This area can be displayed by typing D100 (figure 1). It is here that the new machine language subroutine will be placed. To load the program into memory, the in-memory assembly function of DDT will be used. Type A120, to start the assembly at 120 hex. Type in the following program:

```
120 MVU C,02
122 LDA 130
125 MOV E,A
129 CALL 0005
129 RET
```

Key <RETURN> to end the in-memory assembly function. When called, this program loads the CP/M code for print character (2) in to the C register of the microprocessor. Then it fetches the character out of memory location 130 hex and moves it to the E register to be passed to CP/M. Finally CP/M is called at 0005 hex to place the character on the screen. This solves the single character output problem.

The next modification is to the sign-on message. This message is found at 2147 hex (on CRUN vs 2.05). Display this message by typing D2100 (figure 2). The new message may be up to 18 characters long including a

terminal dollar sign (the extra dollar signs may be written over). In our case we decided to have CRUN2 clear the screen and print

Please wait...

Which is a little less confusing and more reassuring to the inexperienced operator than the usual

CRUN VER 2.05

message. The revised message is shown in Figure 3. To put the proper characters into memory, use the DDT S command. This displays the memory contents and allows you to change it. Type S2147 and key in the proper ASCII codes (see figure 4). The 04 code at the beginning is the screen clear code for the Vector Mindless Terminal. Use whatever screen clear character your particular terminal uses. The remaining codes are for the Please wait... message. End the message with a "\$" (ASCII code 24). The dollar sign is the terminator of a message string used by CP/M. Type <Q> to Quit the change mode. Display the message again with the command D2147 to check for proper coding (see figure 4). This ends the modification.

The modified CRUN2 must be saved on the disk. To do this type control C. This does a warm start and returns to the A> prompt. Type SAVE 72 RUN.COM. This saves 72 256 byte pages into the file RUN.COM. We use the name RUN.COM to make programs easier to run. The operator only has to type RUN> filename.

Testing The Modifications

As with any program, all changes must be thoroughly tested. Testing the sign-on message is easily done; simply run any CBasic program and your sign-on message should be displayed in lieu of CRUN VS 2.OX

To test the single character printing, a short program will have to be written. The program in listing 1 is an example. This program uses the CONCHAR% function of CBasic. It will input a line of characters and then allow the editing of this line. The functions supported are:

<space bar> advances to the next character
 D deletes the current character
 C changes the current character
 <return> inputs a new line to edit

This program is quite useful as an editor of input data in a program. Function PRT uses the single character print routine to display the argument DISP\$.

In Conclusion

These modifications overcome some of CBasic's limitations. Combining these changes with the turnkey CP/M system described in December, 1979 *Creative Computing* will aid in the operation of your application programs. □

—PROGRAM ON NEXT PAGE—

```

-D100
0100 C3 A0 26 C3 00 00 00 0E 0D C3 05 00 C3 00 00 ..&.....
0110 50 00 43 4F 50 59 52 49 47 48 54 20 28 43 29 20 P.COPYRIGHT (C)
0120 31 39 37 37 20 20 31 39 37 38 20 20 31 39 37 39 1977, 1978, 1979
0130 20 43 4F 4D 50 49 4C 45 52 20 53 59 53 54 45 4D COMPILER SYSTEM
0140 53 20 49 4E 43 05 00 00 00 00 00 00 00 00 00 00 S INC.....
0150 00 00 00 00 00 00 00 00 00 00 00 00 E1 E3 78 B1 C8 1A .....X...
0160 77 0B 13 23 C3 5C 01 0A 12 03 13 0A 12 03 13 0A w...#\.....
0170 12 03 13 0A 12 03 13 0A 12 03 13 0A 12 03 13 0A .....
0180 12 03 13 0A 12 03 13 0A 12 03 13 0A 12 03 13 0A .....
0190 71 7B D3 00 C9 60 69 E9 21 B2 01 4E 23 46 2B CD a(...\i!..N#F+.
01A0 B6 01 21 B4 01 CD D3 01 21 B2 01 71 23 78 E6 7F ..!.....!..a#x..
01B0 77 C9 00 00 19 36 16 09 CD C7 01 CD D3 01 16 02 w....6.....

```

Figure 1

```

D2100
2100 0F 0F 0F 0F E6 60 C6 0F 2A 05 1A 4F 06 00 09 7E C6 .....\.*.0...~.
2110 07 0F 0F 0F E6 1F 4F E1 09 E5 0E 12 C3 F8 20 CD .....0.....
2120 5E 1A E1 AF 32 1A 1A C9 4E 4F 20 49 4E 54 45 52 ^...2...NO INTER
2130 4D 45 44 49 41 54 45 20 4C 41 4E 47 55 41 47 45 MEDIATE LANGUAGE
2140 20 46 49 4C 45 20 24 43 52 55 4E 20 56 45 52 20 FILE $CRUN VER
2150 32 2E 30 35 24 24 24 24 24 24 21 00 01 22 24 2.05$$$$$!.."$.
2160 41 21 5C 00 22 26 41 3A 45 41 1F DA 86 21 CD E6 A!\."&A:EA...!..
2170 17 01 47 21 CD 1A 27 0E 0D CD C4 26 0E 0A CD C4 ..G!..?....&....
2180 26 21 EF 01 36 00 CD CC 24 21 0E 43 22 FC 40 CD &!..6...$!..C".@.
2190 5D 25 4F 3E 02 B9 D2 A2 21 01 56 49 CD 1D 28 CD 1%>....!.VI..(.
21A0 0D 01 CD 5D 25 32 02 41 FE 2A CA FD 21 21 01 41 ...J%2.A.*...!.A
21B0 36 00 CD 5D 25 F5 3A 01 41 3C 32 01 41 4F 06 00 6...J%.:.A<2.AD..

```

Figure 2

```

D2100
2100 0F 0F 0F 0F E6 60 C6 0F 2A 05 1A 4F 06 00 09 7E C6 .....\.*.0...~.
2110 07 0F 0F 0F E6 1F 4F E1 09 E5 0E 12 C3 F8 20 CD .....0.....
2120 5E 1A E1 AF 32 1A 1A C9 4E 4F 20 49 4E 54 45 52 ^...2...NO INTER
2130 4D 45 44 49 41 54 45 20 4C 41 4E 47 55 41 47 45 MEDIATE LANGUAGE
2140 20 46 49 4C 45 20 24 04 50 6C 65 61 73 65 20 77 FILE $.Please w
2150 61 69 74 2E 2E 2E 24 24 24 24 21 00 01 22 24 ait...$$$$$!.."$.
2160 41 21 5C 00 22 26 41 3A 45 41 1F DA 86 21 CD E6 A!\."&A:EA...!..
2170 17 01 47 21 CD 1A 27 0E 0D CD C4 26 0E 0A CD C4 ..G!..?....&....
2180 26 21 EF 01 36 00 CD CC 24 21 0E 43 22 FC 40 CD &!..6...$!..C".@.
2190 5D 25 4F 3E 02 B9 D2 A2 21 01 56 49 CD 1D 28 CD 1%>....!.VI..(.
21A0 0D 01 CD 5D 25 32 02 41 FE 2A CA FD 21 21 01 41 ...J%2.A.*...!.A
21B0 36 00 CD 5D 25 F5 3A 01 41 3C 32 01 41 4F 06 00 6...J%.:.A<2.AD..

```

Figure 3

```

S2147
2147 43 04
2148 52 50
2149 55 6C
214A 4E 65
214B 20 61
214C 56 73
214D 45 65
214E 52 20
214F 20 77
2150 32 61
2151 2E 69
2152 30 74
2153 35 2E
2154 24 2E
2155 24 2E
2156 24 X
?
```

Figure 4

Modifications cont'd...

```

1: REM *****\
2: * CBASIC LINE EDITOR. *
3: * THIS PROGRAM DEMONSTRATES THE CBASIC *
4: * SINGLE CHARACTER OUTPUT ROUTINE *
5: * *
6: * WRITTEN JULY, 1980 *
7: * ANDY & BEN GALEWSKY *
8: *****\
9: REM FIRST DEFINE THE PRINT SINGLE CHARACTER FUNCTION
10:
11: DEF FN.PRN(DISP$)
12:     POKE 130H,ASC(DISP$) REM CHARACTER TO BE PRINTED
13:     REM IS PASSED IN 130 HEX
14:     CALL 120H REM CALL ROUTINE
15:     RETURN
16: FEND
17: CLR$=CHR$(4) REM SCREEN CLEAR CHARACTER FOR VECTOR MINDLESS TERMINAL
18: REM CHANGE TO SCREEN CLEAR ON YOUR TERMINAL
19: REM START OF PROGRAM
20: 5 PRINT "ENTER LINE TO EDIT "
21: INPUT " "; LINE EDIT$
22: PRINT CLR$
23: PRINT EDIT$ REM DISPLAY LINE AT TOP OF SCREEN
24: POINTER%=1 REM CHARACTER POINTER
25: DUM=FN.PRN("^") REM PLACE MARKER ON SCREEN
26: 10 INKEY%=CONCHAR% REM GET ONE KEYBOARD CHARACTER
27: IF INKEY%=32 THEN 20 REM SPACE BAR
28: IF INKEY%=ASC("D") THEN 30 REM DELETE CHARACTER
29: IF INKEY%=ASC("C") THEN 40 REM CHANGE
30: IF INKEY%=13 THEN 50 REM RETURN
31: GOTO 10
32: 20 POINTER%=POINTER%+1 REM INCREMENT POINTER
33: DUM=FN.PRN(CHR$(8)) REM MOVE CURSOR BACK
34: DUM=FN.PRN(CHR$(8))
35: DUM=FN.PRN(" ") REM ERASE OLD MARKER AND GO FORWARD
36: DUM=FN.PRN("^") REM PRINT NEW MARKER
37: GOTO 10
38:
39: REM DELETE CHARACTER
40:
41: 30 LEF$=LEFT$(EDIT$,POINTER%-1) REM GET LEFT OF DELETION
42: RIG$=MID$(EDIT$,POINTER%+1,LEN(EDIT$)) REM GET RIGHT
43: PRINT CLR$
44: EDIT$=LEF$+RIG$ REM REBUILD STRING
45: PRINT EDIT$ REM PRINT IT
46: POINTER%=POINTER%-1 REM DECREMENT CHARACTER POI
47: FOR MOV%=1 TO POINTER%-1 REM REPOSITION CURSOR
48: DUM=FN.PRN(" ")
49: NEXT MOV%
50: DUM=FN.PRN("^") REM PRINT MARKER
51: GOTO 10
52:
53: REM CHANGE CHARACTER
54:
55: 40 REPL$=CHR$(CONCHAR%) REM GET CHANGE
56: LEF$=LEFT$(EDIT$,POINTER%-1) REM LEFT PART
57: RIG$=MID$(EDIT$,POINTER%+1,LEN(EDIT$)) REM RIGHT PART
58: PRINT CLR$
59: EDIT$=LEF$+REPL$+RIG$ REM REBUILD STRING
60: PRINT EDIT$ REM PRINT IT
61:
62: FOR MOV%=1 TO POINTER%-1 REM REPOSITION POINTER
63: DUM=FN.PRN(" ")
64: NEXT MOV%
65: DUM=FN.PRN("^") REM DISPLAY MARKER
66: GOTO 10
67: REM GET NEW LINE TO EDIT
68:
69: 50 PRINT CLR$
70: GOTO 5

```


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for TRS-80* CP/M (Model I or II)
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 for 5 1/4" CP/M (soft sectored single density)
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Running North Star DOS and CP/M Together*

by **Randy Reitz**

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

I have always been interested in CP/M and its dynamic file management system. Last year I started to experiment with the Lifeboat implementation of CP/M for the North Star controller. Using CP/M is a great change from the North Star DOS. The North Star disk operating system (DOS) only performs directory maintenance and low level disk access whereas CP/M has features that should be found in a DOS such as file open, file close, etc. I became interested in how I could use my North Star programs under CP/M as well as use the CP/M editor to prepare text for my North Star Basic programs. The North Star system has some useful programs for poking around and I thought they would be helpful for exploring CP/M. For example, the North Star Monitor program easily dumps and modifies memory, while with the North Star RD command, the contents of a disk can be examined. So the natural outcome of this was to experiment with CP/M using North Star DOS, North Star Monitor and eventually North Star Basic.

Since the CP/M programs FDOS (Basic Input Output System—BIOS plus the Basic DOS—BDOS) and the Console Command Processor (CCP) are in high memory and the North Star DOS and its programs are at 2000H (in the Transient Program Area—TPA), my first idea was to load both systems and switch between them whenever desired. However, I quickly realized that simply running an unmodified North Star DOS in CP/M's TPA did not work well. When I did something in North Star DOS that required a disk access and then returned to CP/M, I would get unpredictable results. Since computers are supposed to be very predictable, I set out to find what was causing the incompatibility between North Star DOS and CP/M.

I didn't have to look too long to find 4 bytes in the North Star DOS that were causing the problem. I could say the problem was really with the North Star Micro-Disk System (MDS) controller. The North Star controller is simplicity itself. You may have noticed there is no "big" LSI chip on the North Star controller

board. Everything on the board is simple, ordinary TTL stuff. This simplicity is deceiving since simple hardware usually requires complicated software. Now, I don't want to say that the North Star DOS software is all that complicated; but since the North Star controller board is simple, the North Star software must do more than software that uses a TARBELL controller. For example, there is no way to query the North Star controller board to find out what drive or track is currently selected. This extremely relevant information must be maintained by the software.

Since the controller board is simple, the North Star DOS software must do more than software that uses a TARBELL controller.

Now, about those 4 bytes in the North Star DOS. In locations 2000H through 2002H, the current track number for each drive in the 3-drive North Star system is stored. In location 2003H, the number of the currently selected drive is stored. CP/M on North Star has to keep this same information in software, but since 2000H-2003H is smack in the middle of the TPA, Lifeboat's BIOS keeps this information elsewhere. This is the problem with running two systems together—these bytes need to be synchronized. You can imagine what happens when CP/M's BIOS looks and sees the drive motors are running (which means a drive has been selected) and checks its memory and finds the requested drive (or track) is selected, then proceeds when North Star DOS just finished with a different drive (or track). This condition guarantees unpredictable results.

Fortunately, the solution for this problem is straight forward. The folks at Lifeboat merely lifted the North Star DOS disk drivers that are in the ROM on the controller board and dropped the software unmodified into their BIOS. It didn't take too much work with a disassembler to find where the drivers were in

Lifeboat's BIOS. Lifeboat tried to discourage me since they inserted an extra byte after each RET and JMP instruction. This drives a disassembler wild; but once I figured out what was going on I could correct for it. It's hard to keep secrets from a good disassembler and a persistent software hack.

The following are the steps required to modify North Star DOS to use the CP/M disk drivers so one set of memory locations are used to keep track of the disk system status. I have been using this "patched" North Star DOS for a while and I can say that it is well behaved. I usually run North Star DOS with CP/M also resident and bounce back and forth easily.

Lifeboat tried to discourage me since they inserted an extra byte after each RET and JMP instruction. This drives a disassembler wild; but once I figured out what was going on I could correct for it. It's hard to keep secrets from a good disassembler and a persistent software hack.

The first 4 steps set up the environment to patch the North Star DOS. The Dynamic Debugging Tool (DDT) program in CP/M is well suited for this work. The Assembly and List (disassemble) commands are useful and the ASCII interpretation in the Dump command is also helpful.

1. Cold start (boot) CP/M for North Star (Lifeboat CP/M 1.4).
2. Cold start North Star DOS release 4.0 or 5.1S.
3. Insert the CP/M disk in drive A (North Star drive 1) and give the North Star DOS command JP 0. (i.e. get back to CP/M).
4. Issue the CP/M DDT command (i.e. start the CP/M dynamic debugging tool).

Now comes the point of this whole exercise.

5. Patch the North Star DOS in RAM at the following addresses:

<u>4.0</u>	<u>5.1S</u>	<u>Change to</u>	<u>Comment</u>
22C5H		MVI M,0E5H	for N* IN command
22D6H		LXI H,0E500H	for IN command
243BH	2381H	CALL BIOS+480H	use CP/M drivers
2497H	241DH	LDA BIOS+5FAH	use CP/M current
24A2H	2428H	STA BIOS+5FAH	drive selected

The value of BIOS above is calculated as MSIZE* 1024-512 where MSIZE is the size of your CP/M in kilobytes. For example, I have 56K of memory so the largest CP/M I can run is 52K since the Lifeboat BIOS is 4K larger than the regular CP/M BIOS. Hence

BIOS = 52*1024-512 = 52736 (CEOOH). These changes can be made easily with the DDT A(assemble) command.

6. Patch the North Star I/O area to use FDOS I/O functions. I will discuss below a suggested patch to use.

7. M2000, 2A00,100 (move North Star DOS to 100H).

8. Enter the following DOS mover program with the A(assemble) command:

```

100H    JMP      8E0H    use N*DOS buffer area
8E0H    LXI     H,BIOS+566H  for mover program
8E3H    LXI     D,906H    patch BIOS for 7 bytes
8E6H    MVI     C,7      with code at 906H
8E8H    LDAX   D
8E9H    MOV     M,A
8EAH    INX    H
8EBH    INX    D
8ECH    DCR    C
8EDH    JNZ    8E8H
8F0H    LXI     H,100H    now move N*DOS to
8F3H    LXI     D,2000H  proper location
8F6H    LXI     B,F600H  this is -A00H
8F9H    MOV     A,M
8FAH    STAX   D
8FBH    INX    H
8FCH    INX    D
8FDH    INX    B
8FEH    MOV     A,B
8FFH    ORA    A
900H    JNZ    8F9H
903H    JMP     20A8H    start N*DOS V5.1S
906H    MVI     A,FE     look for -1 command
908H    CMP    C        this is 5.1S single
909H    JZ     2740H    density disk init
90CH    NOP

```

9. Exit DDT with a control-C and execute the CP/M command "SAVE 10 NSTAR.COM".

The reason for moving the North Star DOS program to 100H is to create the NSTAR command on the CP/M disk. When in CP/M, typing NSTAR will load the 20 records (10 pages) saved above and then the CCP jumps to location 100H. At 100H is a JMP 8E0H that executes the patch and mover program (step 8). This program patches 7 bytes in the CP/M BIOS to accommodate the new North Star DOS 5.1S command (-1) for single density disk initialization. This command was added to the DCOM entry in 5.1S so a disk could be initialized without using a buffer outside the North Star DOS. This BIOS patch isn't needed if you are using release 4.0, but it can still be put in since release 4.0 will not recognize the -1 command. After patching BIOS, the program moves the North Star DOS to 2000H and starts the DOS at the point in the cold start routine that calls TINIT. This will execute whatever initialization routine you have provided as well as check the "auto" start byte. Hence, you could have the DOS do a "GO BASIC, 2" immediately. I located this patch and mover program in the middle of the disk buffer in the North Star DOS. The jump at 903H to start the North Star DOS should be JMP 208AH if you are using release 4.

When running North Star DOS with the CP/M disk driver, you should not have any problems if you are careful not to disturb the CP/M FDOS (BDOS + BIOS) and the bytes at 0-3 that contain the JMP WARM to get back to CP/M and the IOBYTE.

One motivation for running North Star DOS and CP/M together is to use the North Star monitor and

North Star, cont'd...

North Star Basic programs to experiment with CP/M. Another reason is to use North Star Basic to move files from a North Star disk to CP/M and vice versa. Following is a segment from a North Star Basic program that allows North Star Basic access to the CP/M FDOS facilities. The most important feature of this program is the assembly routine that provides the North Star Basic interface to CP/M. The segment of the program that does this is given below:

```
2 DEF FNC(N,D)
3   FILL 64,N
4 RETURN CALL(65,D)
5 FNEND
6 DATA 58,64,0,79,205,5,0,96,111,201,0
7 F=92
8 FILL F,0
9 FOR I=1 TO 11
10  FILL F+I,ASC("?")
11  READ X \ FILL 64+I,X
12 NEXT
13 R=FNC(13,F)
```

North Star Basic provides a method for accessing user written assembly language subroutines by using the CALL command. The CP/M FDOS can be considered such a subroutine. So a North Star Basic program can use FDOS to do the disk functions necessary to manipulate CP/M files. The FDOS cannot be called directly by North Star Basic since the conventions for passing arguments in the 8080 registers don't agree for North Star and CP/M. Hence, another small assembly language program is needed to adjust the 8080 registers.

The North Star Basic CALL command can contain one or two arguments. The first argument is a numeric value between 0 and 65535 that is the decimal value of the memory address at the beginning of the assembly language subroutine. If a second argument is used, it will be converted to an integer value between 0 and 65535 and placed in the DE register pair. Since the CALL command is a Basic function, it will return a value. The value returned is an integer from 0 to 65535 that represents the value in the HL register pair when the assembly language subroutine returns.

The CP/M FDOS entry point is at address 5. CP/M requires a function number in the C register. Any address information that the CP/M function requires should be in the DE register pair. CP/M returns single byte results in the A register. If a double byte result is returned, the high order byte is in the B register and the low order byte is in the A register. Now that the register conventions are known, it is simple to write an assembly language program that North Star Basic can use to access CP/M FDOS:

ADDRESS-CODE	LABEL	OPCODE	ARGUMENTS
40H 00	FUNCTION DB		0
41H 3A4000	DOCPM LDA		FUNCTION
44H 4F	MOV		C,A
45H CD0500	CALL		5
48H 60	MOV		H,B
49H 6F	MOV		L,A
4AH C9	RET		

The first byte of this program is used to pass the FDOS function value. This value is put in the C register

and FDOS is called. When CP/M returns, the return code is put in the HL register pair. Now look at the multi-line function in the North Star Basic program (lines 2-5). This function expects two arguments, N and D. The first argument, N, is the CP/M FDOS function number and is "poked" into the "FUNCTION" byte in the assembly language program above. The next argument, D, is used for address information. The CALL to the interface program is made with D as the second argument. Recall that the North Star Basic CALL command will put the second argument in the DE register pair, just where CP/M FDOS expects the argument to be, so no adjustment is required. The Basic "FNC" function expects the interface program to be at address 64. Address 64 stores the CP/M function value for the interface program and the CALL is made to address 65. CP/M provides a 16-byte space starting at 64 for the user's CBIOS. If your CBIOS doesn't use these 16-bytes, you can use it for the interface program. Finally, the interface program sets up the HL register pair with the CP/M return code and returns to North Star Basic.

The other important part of the Basic program is line 6, that contains the assembly code for the interface program, and lines 8-12 that put the assembly code into memory starting at address 65. This program is using the CP/M default FCB that is at address 5CH (92 decimal).

Now I'll show you a North Star Basic program that will move a text file from North Star disk to a CP/M disk in drive A (North Star drive 1).

This program begins the same way as the last one. On line 13 the name of the North Star file is requested. If the file does not exist, the name is requested again. Next, the CP/M filename is requested. This name must be less than 12 characters to be valid. Lines 18 to 22 move the CP/M filename from the string C\$ to the FCB. Notice that a "." is removed and the CP/M file type is loaded into "FT" field of the FCB. Lines 23-25 set up the CP/M file. If desired, this section of the program could detect if the CP/M file already exists, and if so, request permission to delete it. The CP/M file will be created on drive A. Line 27 opens the North Star file.

The file is transferred one byte at a time in the main loop (lines 28 to 39). Each CP/M sector of 128 bytes is loaded into the default buffer (lines 28 to 34) and then written to the CP/M disk (line 37). If more data remains (test in line 39) the main loop continues. Finally, the CP/M file is closed in line 40.

This program expects the North Star file to contain text that is separated by carriage returns. The program inserts a line feed character after each carriage return so the CP/M editor can be used. The North Star end-of-file is an SOH character (ASCII 1). When this is found, the CP/M end-of-file SUB character (ASCII 26) is substituted. The record loop from line 28 to 34 could be changed to accommodate any North Star data file format you desire. The program ends in line 43 by returning to CP/M. I included this to show that since the CP/M warm start entry doesn't require any data in the 8080 registers, the interface program is not required.

```
1 REM MOVE N* TEXT FILE TO CP/M
2 DEF FNC(N,D)
3   FILL 64,N
```



```

4 RETURN CALL (65,D)
5 FNEND
6 DATA 58,64,0,79,205,5,0,96,111,201,0
7 F=92 \ O=0 \ B1=0 \ W=0 \ DIM C$(16)
8 FILL F,0
9 FOR I=1 TO 11
10 FILL F+I,32
11 READ X \ FILL 64+I,X
12 NEXT
13 INPUT "N* FILENAME= ",IS
14 T=FILE(IS) \ IF T>0 THEN 16
15 PRINT IS," -- NOT FOUND" \ GOTO 13
16 INPUT "CP/M FILENAME= ",C$
17 IF LEN(C$)>12 THEN 46
18 FOR I=1 TO LEN(C$)
19 IF C$(I,I)="." THEN 21
20 FILL F+O+I,ASC(C$(I,I)) \ GOTO 22
21 O=8-I
22 NEXT
23 R=FNC(13,0) \ REM RESET CP/M
24 R=FNC(19,F) \ REM DELETE CP/M FILE
25 R=FNC(22,F) \ REM CREATE CP/M FILE
26 T$="CREATE" \ IF R>=128 THEN 44
27 OPEN #0%T,IS,L \ L=2*L
28 FOR I=128 TO 255
29 IF B1=13 THEN 33 \ REM END-OF-LINE
30 READ #0,&B1 \ PRINT CHR$(B1),
31 FILL I,B1 \ IF B1>1 THEN 34
32 FILL I,26 \ EXIT 35 \ REM END-OF-FILE
33 FILL I,10 \ B1=0 \ PRINT \ REM ADD LINE FEED
34 NEXT
35 PRINT
36 PRINT "WRITING CP/M RECORD # ",EXAM(F+32)
37 R=FNC(21,F)
38 T$="WRITE" \ IF R>0 THEN 44
39 W=W+1 \ L=L-1 \ IF L>0 AND B1<>1 THEN 28
40 R=FNC(16,F)
41 T$="CLOSE" \ IF R=255 THEN 44
42 PRINT "TRANSFER COMPLETE,"W," CP/M RECORDS"
43 PRINT "RETURNING TO CP/M" \ W=CALL(0)
44 PRINT "CP/M ERROR ON ",T$,
45 PRINT "RETURN CODE =",R \ STOP
46 PRINT "CP/M FILENAME TOO LONG"
47 STOP
48 END

```

This is a small example to show what can be done with North Star Basic by using the CP/M FDOS. It isn't difficult to modify this program to transfer files in either direction. So you might suspect that you could use the CP/M editor to prepare the text for a North Star Basic program and then transfer the program to North Star DOS. However, getting the text of the program into North Star Basic is a little tricky.

As a final topic, let me discuss the possibilities that arise when the CP/M FDOS facility is used to implement the North Star input/output routines. The North Star DOS provides a one-page (256 bytes) block at the end of the DOS to carry out four I/O functions:

```

COUT  —character output
CIN   —character input
TINIT —terminal initialization
CONTC —control-C detection.

```

At entry to the COUT and CIN routines, the A-reg contains a number that represents the device the routine should use to do the I/O. The CP/M FDOS facility uses a code in the C-reg to indicate the function requested. So, one consideration is simply to set up the information in the proper 8080 registers. For example, here is what the North Star COUT routine could look like:

```

; ORG 2900H
; N* I/O USING CP/M BIOS
;
COUT: PUSH B ;B-reg contains char
ORA A ;to output, A-reg is
MVI C,2 ;0 for console so use
JZ $+5 ;FDOS function 2
MVI C,5 ;function 5 otherwise
LDA ECHO ;check if this character

```

```

CMP B ;was just read with CIN
CNZ DOCPM ;output character if not
MVI A,0FFH ;reset ECHO flag
STA ECHO
POP B
MOV A,B ;N* expects char in A-reg
RET

```

The B-reg contains the character to output when the COUT routine is called. Since CP/M FDOS expects to find the character in the E-reg when function code 2 (output to console) or code 5 (output to list) is used, the DOCPM routine will make the adjustment. The only other consideration is that FDOS automatically "echoes" characters typed so the COUT routine should not. Therefore, the COUT routine compares the character it is about to output with the last character received by CIN.

Next, consider the character input routine:

```

CIN: PUSH B ;can't destroy any regs
MOV C,A ;save input device number
LDA NOFILE ;check if an "input file"
ORA A ;is active
JZ READCPM ;take all input from file
;if active
READEV:MOV A,C ;restore input device
ORA A ;input from console if 0
MVI C,1 ;use FDOS function code 1
JZ $+5 ;for console, code 3
MVI C,3 ;otherwise
CALL DOCPM
STA ECHO ;set ECHO flag
POP B
RET

```

Again, this routine is straightforward. The feature added to normal character input is the capability to read a CP/M file. In the implementation of North Star DOS for CP/M that I have been presenting, the North Star DOS exists as a CP/M command (COM) file. When the CP/M console command program (CCP) receives a string that does not start with the name of any built-in command, the CCP assumes that there is a file on the currently logged-in disk with the name given and an extension of COM. If this is so, the CCP loads the contents of the file into the TPA and sets up the default buffer at 80H with the remaining characters that were typed before the carriage return. CP/M programs usually understand these "arguments" to be CP/M file name(s). Hence, the North Star DOS can be considered a CP/M command that executes in the TPA and will accept a CP/M file name as an argument.

When the North Star DOS begins execution, the terminal initialization routine first gets control. Since CP/M has been running, the terminal doesn't need to be initialized. This routine can be used to check if a CP/M file name has been passed as an argument. For example:

```

TINIT: MVI A,0FFH ;initialize some flags
STA CASE ;my upper/lower case flag
STA ECHO
STA NOFILE ;assume no CP/M file
OUT 0FFH ;IMSAI front panel lights
LDA BUFF ;look in default buffer
ORA A ;for a CP/M file name
RZ ;all done if no file
LXI D,FCB ;prepare to "open" file
MVI C,15
CALL FDOS
CPI 255 ;check if successful
RZ ;return if no good
XRA A ;else indicate a CP/M
STA NOFILE ;file is active
STA FCBCR ;start at record 0
MVI A,80H ;force file read routine
STA IBP ;to get a new sector
RET

```


North Star, cont'd...

If the North Star DOS was "called" by the CCP with a file name as an argument, the TINIT routine will open the file and if the open is successful, TINIT will reset the NOFILE flag so CIN is forced to read characters from the given CP/M file.

Notice the CIN routine above will jump to the READCPM routine if a CP/M file is active. This routine follows:

```

READCPM: PUSH B      ;save all registers
         PUSH D
         PUSH H
         MVI C,11    ;check if any key has
         CALL FDOS   ;been hit on keyboard
         RRC         ;abort CP/M file if so
         JC FINIS
SKIPPLF: LDA IBP     ;get address of next
         CPI 80H    ;char in input buffer
         CZ DISKR   ;read another sector if
         MOV E,A    ;required - set up (DE)
         MVI D,0    ;to offset of char in
         INR A      ;buffer - update input
         STA IBP    ;buffer pointer
         LXI H,BUFF ;address of default buf
         DAD D      ;(HL) now points to next
         MOV A,M    ;character
         CPI 10     ;look for line feed
         JZ SKIPPLF ;skip line feeds
         CPI 26     ;look for CP/M eof
         JZ FINIS   ;terminate CP/M file
         POP H
         POP D
         POP B      ;BC pushed in CIN
         POP B      ;restore registers and
         RET        ;return char to N*
    
```

When a CP/M file is active, all input requested by North Star will be taken one character at a time from the CP/M file until the end of file is reached. Subsequent input will then be taken from the input device specified in the A-reg when CIN is called. The READCPM routine uses two subroutines:

```

DISKR:  LXI D,FCB   ;read the next sector
         MVI C,20   ;of the CP/M file into
         CALL FDOS  ;the default buffer
         CPI 0      ;check for read error
         RZ        ;return if no problem
         POP H     ;clear return address
FINIS:  MVI A,OFFH  ;set NOFILE flag
         STA NOFILE
         LXI D,FCB ;close CP/M file
         MVI C,16
         CALL FDOS
         POP H     ;restore registers
         POP D
         POP B
         JMP READEV ;return to CIN routine
DOCPM:  PUSH D     ;do FDOS function
         PUSH H
         MOV E,B   ;adjust register
         CALL FDOS
         POP H
         POP D
         RET
    
```

The DOCPM routine is used by COUT and CIN to execute the selected FDOS function. The only tricky code above is that when DISKR returns successfully, the A-reg is 0 so IBP will be properly initialized for the new sector.

The only other routine required in the North Star DOS I/O is the control-C detection routine. Here it is:

```

CONTC:  MVI C,11   ;see if a key has been
         CALL FDOS ;hit on the keyboard
         ANI 1     ;return with Z-flag
         XRI 1     ;reset if no ^C
         RNZ
         MVI C,1   ;a key has been hit
         CALL FDOS ;get character
         CPI 3     ;look for ^C
         STC      ;tell CP/M char was read
         RET
    
```

These routines use the following symbols:

```

ECHO DB 0 ;don't ECHO character
NOFILE DB 0 ;no CP/M file when 0
IBP DB 0 ;input buffer pointer
CASE EQU 0D5F9 ;subject for future
FDOS EQU 5 ;CP/M entry point
FCB EQU 5CH ;default FCB address
BUFF EQU 80H ;default buffer addr
    
```

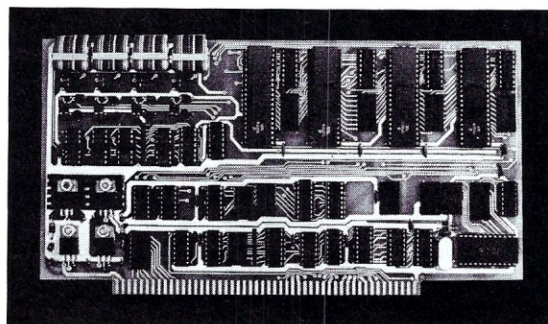
At this point you might question the usefulness of this discussion. I mentioned above that I could use the CP/M text editor to prepare North Star Basic programs. With this driver for the North Star DOS I/O, you can do the following:

1. Prepare the text of a North Star Basic program using the CP/M editor.
2. Make the first line of this file the North Star command "GO BASIC, 2".
3. Type the CP/M command "NSTAR <filename>.TXT".
4. Sit back and watch North Star Basic read in the program you have prepared.

The North Star DOS and any programs running under it will treat the CP/M file as a command file. The file will be read until an end-of-file condition is encountered, then all input will be taken from the device specified in the A-reg when CIN is entered.

This completes my discussions of using North Star DOS and CP/M together. If you would like to try this, but don't want to do it yourself, for \$15 I will supply a diskette containing the NSTAR command and some North Star Basic programs to demonstrate what can be done. You must have the Lifeboat CP/M 1.4 for single density North Star. □

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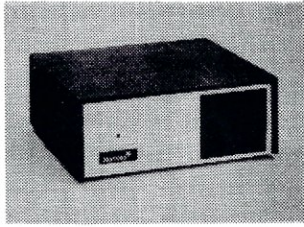
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Directory Program for CP/M[®] Systems

by Mark M. Zeiger

Like most computerists, I like things to be neat and orderly. I also like convenience, and having a large disk directory scroll off the screen before I can find what I'm looking for is not convenient. Therefore I was overjoyed when I discovered the CP/M Users Library had a program called **XDIR** that would output an alphabetized directory using the whole screen. I got a copy and literally ran home to try it out on my North Star CP/M system. Goodbye disk! I then tried it on a friend's eight inch double density system. While it didn't blow the disk, it also did not list the directory. Evidently the program was not CP/M compatible. However, once I had seen such a program, I had to have one for myself.

The program I have written is completely CP/M compatible. This means it does everything by using standard calls to the CP/M BDOS (which on most systems has its entry point at address 5 - if it doesn't, then it is not a "true" CP/M system). The only changes that have to be made from system to system are the commands that clear the screen and the tab control character (although the latter is pretty standard on most hardware).

The program has a number of "goodies"; the nicest being the Shell-Metzner sort. This sort is a fourteen line Basic program and it is not that much longer in assembly language. For a maximum of sixty-four items (the largest directory allowable in CP/M) almost any machine language sort would have been unnoticeable timewise. As near as I can tell, the Shell-Metzner sort takes less than one-quarter of a second.

The maximum of sixty-four entries is perfect for a 80 x 24 screen. The heading and the line skipped after it along with the twenty lines of names will fit on the screen and still allow the CP/M prompt to be shown at the bottom without the screen scrolling. If there is a sixty-fourth entry, it will be shown at the bottom of the third column. If you would like to adapt the program to a VDM, it would be easy to do if there are not more than forty entries in the directory. More than that will defeat the purpose of the entire program unless you put a pause after sixteen lines are printed.

I did try to make the program structured, and at first it was very much so. But naturally, as a few more things were added, the structure started to disappear. Below are the major routines that are called sequentially

at the beginning of the program and some of the more important subroutines:

CKDRIVE =====>	See if drive is requested, else use logged-in drive. Store drive name in heading.
SIGNON =====>	Print heading message.
GETNAME =====>	Checks to see if file name and/or type was requested; else finds all files.
CLEARBUFF =====>	Clears RAM where names are to be stored for sorting and output.
SEARCHRT =====>	Searches directory for names.
[
[- MOD4 ----->	Finds address of directory FCB in DMA
[
[- TRANS ----->	Moves name and number of records to area in RAM where all names are to be stored contiguously.
EXTSCH =====>	Searches for file extents. Notes the existence of extent, the number of extents, and the number of records in the last extent.
[
[
[
[
[- MATCH ----->	Searches buffer for matching 0th extent.
RECINDEC =====>	Divides by two to get the numbers of sectors (256 bytes). Then calculates total number of records in file in decimal. Puts number next to name with leading zeros suppressed. Adds 64 decimal to number of sectors for each extent.
[
[
[
[
[- ADDEXT ----->	
SORT =====>	Shell-Metzner Sort
[- COMPARE ----->	Compares the two names.
[- SWITCH ----->	Switches names in buffer if required.
PRINTOUT =====>	Prints names in three columns.
[
[- WRITENAME ---->	Checks to see if name in directory buffer has been output to screen.



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The only routine I will explain in detail is the "search" routine. When a search or "search next" is requested, CP/M loads the directory file control blocks into the DMA address (defaults in this program to 80H) in groups of four. These FCB's include files which have been erased as well as extents (which are not usually contiguous with the zeroth extent on the disk). The accumulator then returns a number which when divided by four will give a remainder that is the thirty-two byte part of the DMA address where the directory FCB is located. Thus, the remainders of 0, 1, 2, or 3 will correspond to 80H, 0A0H, 0C0H, 0E0H as the location of the FCB in the DMA address if the address is set at 80H. The MOD4 routine does this calculation. A 0FFH means the file does not exist. Extents have to be searched for as different files. Therefore, when first searching for the occurrence of a file, the DE registers must point to a RAM address containing the name and

extent of the file(s) being sought. The "search next" routine will then get other occurrences of that file name (assuming, of course, that the filename is a wildcard). To search for extents, the DE registers must again point to the filename with the new extent and the initial search and the "search next(s)" must be requested.

I hope that you will enjoy the convenience of this program as much as I have. One of the nice things about it is that it is slightly less than 1K of object code. This means that it will use the minimum amount of disk space (important for those of us who have mini-floppies). And also, is there anyone out there who knows how to calculate the amount of space left on a disk? The CP/M STAT program does it with a call to BDOS using 27 in the C-register, but I can not figure out the details of the routine. I would like to put it in this program. If anyone knows, I would appreciate hearing from you.

```

;CP/M DIRECTORY LIST PROGRAM

;COPYRIGHT 1979 BY MARK M. ZEIGER

;THIS PROGRAM WILL LIST AN ALPHABETIZED DIRECTORY OF A
;CP/M 1.4 DISK IN A FORMATTED OUTPUT ON A 80 X 24 SCREEN.
;NEXT TO EACH FILENAME IS THE NUMBER OF 256 BYTE PAGES
;IN THE FILE. THIS PROGRAM WILL WORK FOR ANY TYPE OF CP/M,
;WHETHER THE DISKS ARE IBM COMPATIBLE FORMAT OR NOT, BECAUSE
;ALL DISK ACCESSES ARE DONE BY STANDARD CP/M FUNCTION CALLS.

;TO USE THE PROGRAM, JUST TYPE "XDIR". ALL FILES ON THE DEFAULT
;DRIVE WILL BE LISTED. IF YOU WISH TO EXAMINE ANOTHER DRIVE,
;SAY DRIVE B, TYPE "XDIR B:". IF YOU WISH TO LIST ONLY CERTAIN
;FILES, SUCH AS ALL COM FILES, TYPE "XDIR *.COM".

;REVISED 9/80 BY HARVEY FISHMAN TO WORK FOR CP/M 2 EXTENSION FORMATS

```

```

0100                                ORG 100H

0100 C32D01                          JMP START

0005 =                               BDOS    EQU 5
0011 =                               SEARCH  EQU 17
0012 =                               NXTSCH  EQU 18
0009 =                               WRTBUF  EQU 9
0002 =                               CONOUT  EQU 2
005C =                               FCB     EQU 5CH
0015 =                               NOLINES EQU 21

0103 3F                               PRNTCNT DB 63
0104 00                               DIRCNT  DB 0
0105                                DESAVE  DS 2
0107                                STKSV   DS 2
0109                                WRTNUM  DS 1

;FCB FOR SEARCH ROUTINE. SEARCHES FOR
;ALL FILES UNLESS CHANGED BY GETNAME.

010A 003F3F3F ANYNAME DB 0,'????????????',0,0,0,0,0
011B 00000000 DB 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0

012D 210000 START LXI H,0 ;SAVE STACK
0130 39 DAD SP
0131 220701 SHLD STKSV
0134 319B05 LXI SP,NEWSTK

```



```

0137 CD5701      CALL CKDRIVE
013A CD7301      CALL SIGNON
013D CDCA01      CALL GETNAME
0140 CDB601      CALL CLEARBUFF
0143 CDDC01      CALL SEARCHRT      ;MAIN PROGRAM
0146 CD6202      CALL EXTSCB
0149 CDE602      CALL RECINDEC
014C CD4204      CALL SORT
014F CD6103      CALL PRINTOUT

0152 2A0701      LHL D STKSV      ;RELOAD CP/M'S STACK
0155 F9          SPHL
0156 C9          RET      ;RETURN TO CP/M

0157 3A5C00      CKDRIVE LDA FCB      ;GET DRIVE NUMBER IN FCB
015A 320A01      STA ANYNAME
015D FE00        CPI 0      ;IF DRIVE IS ZERO, THEN..
015F CA6801      JZ LOGDSK      ;..CALCULATE LOGGED-IN DRIVE.
0162 C640        ADI 40H      ;CHANGE TO ASCII
0164 329701      STA DRMSG
0167 C9          RET
0168 0E19        LOGDSK MVI C,25      ;CP/M GET CURRENT DRIVE CALL
016A CD0500      CALL BDOS
016D C641        ADI 41H      ;CHANGE TO ASCII
016F 329701      STA DRMSG
0172 C9          RET

0173 117A01      SIGNON LXI D,ONMSG      ;SCREEN CLEAR AND..
0176 CDFB03      CALL WRITOUT      ;..PRINT HEADING.
0179 C9          RET

017A 1A0C2044    ONMSG  DB 1AH, 0CH, ' Directory      ',9,' ', 'Drive '
0197 =           DRMSG  EQU $-1

0198 0909436F    DB 9,9, 'Copyright 1979 M. Zeiger',0DH,0AH,0

CLEARBUFF
;DIRECTORY BUFFER FILLED WITH SPACES. BUFFER IS 5 PAGES
;AT TOP OF PROGRAM.

01B6 3E20        MVI A,' '
01B8 219C05      LXI H,DIRBUFF
01BB 1605        MVI D,5
01BD 1E00        LP1   MVI E,0
01BF 77          LP2   MOV M,A
01C0 23          INX H
01C1 1C          INR E
01C2 C2BF01      JNZ LP2
01C5 15          DCR D
01C6 C2BD01      JNZ LP1
01C9 C9          RET

GETNAME
;PUTS FILE NAME AMD/OR TYPE INTO SEARCH FCB. IF DEFAULT FCB
;OF COMMAND LINE IS BLANK, THEN LEAVE SEARCH FCB WITH "?".S.

01CA 3A5D00      LDA FCB+1
01CD FE20        CPI ' '
01CF C8          RZ
01D0 215D00      LXI H,FCB+1
01D3 110B01      LXI D,ANYNAME+1
01D6 060B        MVI B,11
01D8 CDF904      CALL HTD
01DB C9          RET

```

```

SEARCHRT
;SEARCHES FOR NAMES AND TRANSFERS TO BUFFER ABOVE PROGRAM.

01DC 219C05      LXI H,DIRBUFF      ;SAVE ADDRESS..
01DF 220501      SHLD DESAVE      ;..OF DIRBUFF
01E2 0E11        MVI C,SEARCH      ;SEARCH FOR FIRST..
01E4 110A01      LXI D,ANYNAME      ;..OCCURANCE.
01E7 CD0500      CALL BDOS
01EA FEFF        CHECK1 CPI OFFH      ;IF FIRST SEARCH FAILS..
01EC CA1302      JZ NODIR      ;..NO ENTRY EXISTS.

;FIND NEXT VALID FILENAME IN DMA. MULTIPLY IT BY 32, THE LENGTH
;OF A DISK DIRECTORY. CALCULATE ITS ADDRESS IN DMA IN HL REG.

01EF CD5502      LOOP2 CALL MOD4
01F2 E5          PUSH H      ;ZERO THE 3 BYTES AFTER NAME
01F3 D5          PUSH D
01F4 110C00      LXI D,12
01F7 19          DAD D
01F8 3600        MVI M,0
01FA 23          INX H
01FB 3600        MVI M,0
01FD 23          INX H
01FE 3600        MVI M,0
0200 D1          POP D
0201 E1          POP H
0202 CD3402      CALL TRANS      ;TRANSFER TO DIRBUFF
0205 0E12        MVI C,NXTSCH      ;SEARCH FOR NEXT ENTRY
0207 110A01      LXI D,ANYNAME
020A CD0500      CALL BDOS
020D FEFF        CPI OFFH      ;NO MORE NAMES IF OFFH
020F C2EF01      JNZ LOOP2
0212 C9          RET

0213 112002      NODIR LXI D,NODIRMSG      ;COULDN'T FIND THE ENTRY
0216 0E09        MVI C,WRTBUF
0218 CD0500      CALL BDOS
021B 2A0701      LHL D STKSV
021E F9          SPHL
021F C9          RET

0220 0D0A0A4E    NODIRMSG DB 0DH,0AH,0AH,'No entry found',0DH,0AH,'$'

TRANS
;STORES A DISK FCB ALONG WITH NUMBER OF RECORDS IN THE
;NEXT 16 BYTES OF DIRBUFF.

0234 F5          PUSH PSW
0235 D5          PUSH D
0236 0610        MVI B,16
0238 E5          PUSH H      ;GET THE NEXT ADDRESS..
0239 2A0501      LHL DESAVE      ;..OF FILE IN DIRBUFF.
023C EB          XCHG      ;PUT IT INTO DE REG
023D E1          POP H
023E 7E          LOOP1 MOV A,M      ;DO THE TRANSFER
023F 12          STAX D
0240 23          INX H
0241 13          INX D
0242 05          DCR B
0243 C23E02      JNZ LOOP1
0246 EB          XCHG      ;SAVE THE LAST ADDRESS..
0247 220501      SHLD DESAVE      ;..OF DIRBUFF USED.
024A EB          XCHG
024B D1          POP D

```



```

024C 3A0401      LDA DIRCNT          ;COUNT THE NUMBER OF..
024F 3C          INR A          ;..DIRECTORY ENTRIES.
0250 320401      STA DIRCNT
0253 F1          POP PSW
0254 C9          RET

MOD4
;CALCULATE THE ADDRESS OF THE DIRECTORY FCB IN DMA
0255 E603        ANI 03H          ;GET DIR ENTRY MODULO 4
0257 070707      RLC ! RLC ! RLC      ;MULT BY 32
025A 0707        RLC ! RLC
025C 218000      LXI H,80H        ;GET ADDR IN DMA (80H)
025F 85          ADD L
0260 6F          MOV L,A
0261 C9          RET

EXTSCH
;SEARCH FOR ALL FILES WITH EXTENT 1
0262 211601      LXI H,ANYNAME + 12 ;INCREASE EXTENT NUMBER
0265 34          INR M
0266 0E11        MVI C,SEARCH
0268 110A01      LXI D,ANYNAME
026B CD0500      CALL BDOS
026E FEFF        CPI OFFH          ;IF THERE IS NOT A FIRST EXTENT..
0270 C8          RZ                ;..THEN DONE WITH SEARCHES.

0271 47          MOV B,A          ;CODE TO NEXT BLANK LINE..
0272 3A1601      LDA ANYNAME+12    ;..ADDED FOR CP/M 2 BY..
0275 E601        ANI 1            ;..HARVEY FISHMAN.
0277 78          MOV A,B
0278 CA8802      JZ LOOP5
027B CD5502      CALL MOD4
027E C60C        ADI 12
0280 6F          MOV L,A
0281 7E          MOV A,M
0282 E601        ANI 1
0284 CAA802      JZ NXT1
0287 78          MOV A,B          ;END OF CODE BY H.F.

0288 CD5502      LOOP5 CALL MOD4    ;GET ADDR IN HL
028B EB          XCHG             ;PUT IT IN DE.
028C 219C05      LXI H,DIRBUFF
028F CDCF02      LOOP4 CALL MATCH  ;COMPARES EXTENTS WITH 0TH EXT.
0292 DA9C02      JC FOUNDMATCH    ;ITS ADDRESS IS IN HL REG
0295 011000      LXI B,16
0298 09          DAD B            ;TEST THE NEXT ADDRESS IN DIRBUFF
0299 C38F02      JMP LOOP4

FOUNDMATCH
029C EB          XCHG             ;PUT DMA ADDRESS IN HL REG
029D 010F00      LXI B,15
02A0 09          DAD B
02A1 EB          XCHG             ;DE POINTS TO # RECS IN EXT ENTRY
02A2 09          DAD B            ;HL POINTS TO # RECORDS IN DIRBUFF
02A3 1A          LDAX D           ;GET # RECORDS IN EXTENT
02A4 77          MOV M,A          ;PUT IT IN # RECORDS OF DIRBUFF
02A5 2B          DCX H            ;POINT HL TO A BYTE TO BE..
02A6 2B          DCX H            ;..DESIGNATED AS NUMBER OF EXTS.
02A7 34          INR M            ;COUNT NUMBER OF EXTENTS
02A8 0E12        NXT1 MVI C,NXTSCH ;SEARCH FOR NEXT FILE
02AA 110A01      LXI D,ANYNAME

02AD CD0500      CALL BDOS
02B0 FEFF        CPI OFFH

02B2 CA6202      JZ EXTSCH
02B5 47          MOV B,A
02B6 3A1601      LDA ANYNAME+12
02B9 E601        ANI 1
02BB 78          MOV A,B
02BC CA8802      JZ LOOP5
02BF CD5502      CALL MOD4
02C2 C60C        ADI 12
02C4 6F          MOV L,A
02C5 7E          MOV A,M
02C6 E601        ANI 1
02C8 CAA802      JZ NXT1
02CB 78          MOV A,B
02CC C38802      JMP LOOP5          ;END OF CODE BY H.F.

MATCH
;CALLED WITH DE POINTING TO FILENAME IN FCB AND HL POINTING
;TO FILE NAME IN DIRBUFF. RETURNS WITH CARRY SET IF THE
;NAMES ARE THE SAME.
02CF E5          PUSH H
02D0 D5          PUSH D
02D1 0E0B        MVI C,11
02D3 1A          LOOP3 LDAX D
02D4 BE          CMP M
02D5 C2E202      JNZ CLRCRY          ;THEY'RE NOT EQUAL. CLEAR CARRY
02D8 23          INX H            ;CHECK NEXT CHARACTERS
02D9 13          INX D
02DA 0D          DCR C
02DB C2D302      JNZ LOOP3          ;CHECK 11 CHARACTERS.
02DE D1          POP D            ;THEY'RE EQUAL
02DF E1          POP H
02E0 37          STC
02E1 C9          RET
02E2 B7          CLRCRY          ;CLEAR CARRY
02E3 D1          POP D
02E4 E1          POP H
02E5 C9          RET

RECINDEC
;GETS DECIMAL NUMBER OF PAGES (256 BYTES) IN FILE EXTENTS.
02E6 3A0401      LDA DIRCNT
02E9 47          MOV B,A
02EA 21AB05      LXI H,DIRBUFF + 15 ;NUMBER OF DIRECTORY ENTRIES IN B
02ED 7E          MOV A,M          ;POINT TO NUMBER OF RECORDS..
02EE 3C          INR A            ;..IN FIRST DIRBUFF ENTRY.
02EF B7          ORA A            ;INCREASE BY 1, THEN DIVIDE BY 2..
02F0 1F          RAR              ;..TO CHANGE RECORDS TO PAGES.
02F1 CD2B03      CALL DECIMAL      ;CHANGE BINARY TO DECIMAL
02F4 2B          DCX H            ;POINT TO NUMBER OF..
02F5 2B          DCX H            ;..EXTENTS PER FILE.
02F6 7E          MOV A,M
02F7 CD3B03      CALL ADDEXT      ;RETURNS WITH UNITS IN E..
02FA 2B          DCX H            ;..TENS IN D, HUNDREDS IN C.
02FB 79          MOV A,C
02FC FE00        CPI 0
02FE C21503      JNZ SKIP4
0301 F620        ORI 20H
0303 77          MOV M,A
0304 23          INX H

```



```

0305 7A      MOV A,D      ;..TEST TO SEE IF TEN'S..
0306 FE00    CPI 0        ;..SHOULD BE BLANK.
0308 C21003  JNZ SKIP9
030B F620    ORI 20H
030D C31C03  JMP SKIP10
0310 F630    SKIP9  ORI 30H
0312 C31C03  JMP SKIP10
0315 F630    SKIP4  ORI 30H      ;MAKE IT ASCII
0317 77      SKIP5  MOV M,A
0318 23      INX H
0319 7A      MOV A,D      ;TEN'S DIGIT
031A F630    ORI 30H      ;MAKE IT ASCII
031C 77      SKIP10 MOV M,A
031D 23      INX H
031E 7B      MOV A,E
031F F630    ORI 30H
0321 77      MOV M,A
0322 111100  LXI D,17      ;READY FOR NEXT ENTRY..
0325 19      DAD D        ;..IN DIRBUFF.
0326 05      DCR B
0327 C2ED02  JNZ LOOP8
032A C9      RET

```

DECIMAL

```

;CHANGES A-REG TO DECIMAL. RETURNS WITH TEN'S IN D,
;UNIT'S IN E.

```

```

032B 110000  LXI D,0
032E F5      PUSH PSW
032F D60A    LOOP9  SUI 10
0331 14      INR D          ;COUNT NUMBER OF TENS
0332 D22F03  JNC LOOP9
0335 15      DCR D
0336 C60A    ADI 10
0338 5F      MOV E,A      ;UNIT'S DIGIT IN E
0339 F1      POP PSW
033A C9      RET

```

ADDEXT

```

;FOR EVERY EXTENT, ADD 64 DECIMAL TO NUMBER OF PAGES.
;HUNDRED'S IN C, TEN'S IN D, AND UNIT'S IN E.

```

```

033B 0E00    MVI C,0
033D FE00    CPI 0        ;IF NO EXTENTS, EXIT
033F C8      RZ
0340 F5      PUSH PSW      ;SAVE NUMBER OF EXTENTS
0341 7A      MOV A,D      ;PUT TEN'S IN A(REG)
0342 0707    RLC ! RLC    ;GET IT IN UPPER NIBBLE
0344 0707    RLC ! RLC
0346 E6F0    ANI 0F0H    ;BLANK OUT LOWER NIBBLE
0348 B3      ORA E        ;GET UNIT'S IN LOWER NIBBLE
0349 C664    ADI 64H     ;EACH EXTENT IS 64 PAGES
034B 27      DAA
034C D25003  JNC SKIP2
034F 0C      INR C        ;COUNT HUNDREDS PLACE
0350 F5      SKIP2  PUSH PSW
0351 E60F    ANI 0FH     ;BLANK OUT TEN'S
0353 5F      MOV E,A     ;MOVE UNIT'S TO E
0354 F1      POP PSW
0355 0F0F    RRC ! RRC
0357 0F0F    RRC ! RRC  ;PUT TEN'S IN LOWER NIBBLE
0359 E60F    ANI 0FH     ;BLANK OUT UPPER NIBBLE
035B 57      MOV D,A     ;PUT TEN'S IN D
035C F1      POP PSW  ;GET BACK NUMBER OF..

```

```

035D 3D      DCR A        ;..EXTENTS AND DECREASE.
035E C33D03  JMP ADDEXT + 2

```

PRINTOUT

```

;WRITES DIRBUFF TO 80 X 24 SCREEN. WRITES IN 3 COLUMNS. IF
;64 ENTRIES, WRITES 64TH AT BOTTOM OF THIRD COLUMN. WRITES
;THE 1ST, 22ND, 43RD RECORD, THEN THE 2ND, 23RD, 44TH RECORD,
;ETC. IF THE RECORD HAS BEEN BLANKED IN DIRBUFF BECAUSE IT
;HAS ALREADY BEEN WRITTEN OR THERE ARE NO MORE RECORDS, IT
;DOES NOT GET WRITTEN.

```

```

0361 3A0401  LDA DIRCNT
0364 320901  STA WRTNUM
0367 CD2404  CALL CRLF
036A 3E00    MVI A,0
036C 321605  LOOP6  STA RECNO
036F CDB103  CALL WRITENAME
0372 C615    ADI NOLINES
0374 CDB103  CALL WRITENAME
0377 C615    ADI NOLINES
0379 CDB103  CALL WRITENAME
037C 3A0301  LDA PRNTCNT
037F D603    SUI 3
0381 320301  STA PRNTCNT
0384 FE00    CPI 0        ;CHECK FOR 64TH ENTRY
0386 CA9803  JZ PRINTEND
0389 3A0901  LDA WRTNUM  ;IF ALL ENTRIES ARE..
038C B7      ORA A        ;..PRINTED, RETURN.
038D C8      RZ
038E CD2404  CALL CRLF
0391 3A1605  LDA RECNO
0394 3C      INR A
0395 C36C03  JMP LOOP6

```

PRINTEND

```

;MUST GET THE 64TH ENTRY..

```

```

0398 3A0401  LDA DIRCNT  ;..IF THERE IS ONE.
039B FE40    CPI 64
039D C0      RNZ
039E 113A04  LXI D,TAB7  ;TAB TO LAST COLUMN FOR LAST ENTRY
03A1 0E09    MVI C,WRTBUF
03A3 CD0500  CALL BDOS
03A6 3E00    MVI A,0    ;STIFFLE ANYMORE TABS
03A8 322204  STA NULLIT
03AB 3E3F    MVI A,63
03AD CDB103  CALL WRITENAME
03B0 C9      RET

```

WRITENAME

```

;CHANGES "RECNO" TO (DIRBUFF+1) + 16*RECON. IT THEN STORES
;THAT ADDRESS IN HL AND PRINTS THE NAME AT THAT ADDRESS
;UNLESS IT IS BLANK.

```

```

03B1 C5      PUSH B
03B2 019D05  LXI B,DIRBUFF+1
03B5 6F      MOV L,A
03B6 2600    MVI H,0
03B8 2929    DAD H ! DAD H
03BA 2929    DAD H ! DAD H
03BC 09      DAD B
03BD F5      PUSH PSW
03BE 7E      MOV A,M
03BF FE20    CPI ' '    ;TEST TO SEE IF NAME WAS..
;..PREVIOUSLY OVERWRITTEN.

```



```

03C1 CAED03      JZ NOWRITE
03C4 3A0901     LDA WRTNUM
03C7 3D         DCR A
03C8 320901     STA WRTNUM
03CB 0E08       MVI C,8
03CD 110C04     LXI D,OUTBUFF
03D0 CDF003     CALL TRANS2
03D3 3E20       MVI A,' '
03D5 12         STAX D
03D6 13         INX D
03D7 0E03       MVI C,3
03D9 CDF003     CALL TRANS2
03DC 3E20       MVI A,' '
03DE 12         STAX D
03DF 13         INX D
03E0 12         STAX D
03E1 13         INX D
03E2 0E03       MVI C,3
03E4 CDF003     CALL TRANS2
03E7 110C04     LXI D,OUTBUFF
03EA CDFB03     CALL WRITOUT
03ED F1         NOWRITE POP PSW
03EE C1         POP B
03EF C9         RET

03F0 7E         TRANS2 MOV A,M
03F1 12         STAX D
03F2 3620       MVI M,' '
03F4 23         INX H
03F5 13         INX D
03F6 0D         DCR C
03F7 C2F003     JNZ TRANS2
03FA C9         RET

03FB 1A         WRITOUT LDAX D
03FC B7         ORA A
03FD C8         RZ
03FE C5         PUSH B
03FF D5         PUSH D
0400 0E02       MVI C,CONOUT
0402 5F         MOV E,A
0403 CD0500     CALL BDOS
0406 D1         POP D
0407 C1         POP B
0408 13         INX D
0409 C3FB03     JMP WRITOUT

040C           OUTBUFF DS 17
041D 20207C20  DB ' | '
0422 0900       NULLIT DB 9,0

0424 F5         CRLF  PUSH PSW
0425 D5         PUSH D
0426 C5         PUSH B
0427 E5         PUSH H
0428 113704     LXI D,CARLFD
042B 0E09       MVI C,WRTBUF
042D CD0500     CALL BDOS
0430 E1         POP H
0431 C1         POP B
0432 D1         POP D
0433 F1         POP PSW
0434 0603       MVI B,3
0436 C9         RET

0437 0D0A24     CARLFD DB 0DH,0AH,'S'

```

```
;TRANSFER NAME TO OUTPUT BUFFER
```

```
;AT LEAST ONE SPACE BETWEEN..
;..NAME AND TYPE.
```

```
;TRANSFER TYPE
```

```
;TRANSFER ROUTINE TO OUTPUT BUFFER
```

```
;OVERWRITE NAME WITH BLANKS
```

```
;WRITES OUT EACH CHAR..
;..INDIVIDUALLY SINCE USING..
;..CP/M'S PRINT STRING..
;..ROUTINE WILL NOT PRINT $'S..
;..WHICH ARE SOMETIMES FILETYPES.
```

```
;SEPARATER OF FILE NAMES..
;..FOR EACH COLUMN.
```

```
SORT
```

```
;THE FOLLOWING IS AN ADAPTION OF THE SHELL-METZNER SORT
;TAKEN FROM A BASIC PROGRAM.
```

```

0442 3A0401     LDA DIRCNT
0445 321605     STA RECNO
0448 321705     STA HALFREC
044B 3A1705     HALVE LDA HALFREC
044E B7         ORA A
044F 1F         RAR
0450 321705     STA HALFREC
0453 C8         RZ
0454 3A1705     LDA HALFREC
0457 47         MOV B,A
0458 3A1605     LDA RECNO
045B 90         SUB B
045C 321805     STA SPREAD
045F 3E00       MVI A,0
0461 321B05     STA J
0464 3A1B05     X2  LDA J
0467 321905     STA FIRSTREC
046A 3A1905     X1  LDA FIRSTREC
046D 47         MOV B,A
046E 3A1705     LDA HALFREC
0471 80         ADD B
0472 321A05     STA SECONDREC
0475 CDA404     CALL CHTOAD
0478 CDBF04     CALL COMPARE
047B D29204     JNC SKIPTRANS
047E CDD904     CALL SWITCHHD
0481 3A1705     LDA HALFREC
0484 47         MOV B,A
0485 3A1905     LDA FIRSTREC
0488 90         SUB B
0489 321905     STA FIRSTREC
048C FA9204     JM SKIPTRANS
048F C36A04     JMP X1

;N = M = NUMBER OF ITEMS
;M = INT(M/2)
;M = 0 ? YES - EXIT SORT
;K = N - M
;J = 0
;I = J
;L = I + M
;CHANGE RECORD TO ADDRESS IN DIRBUFF
;D(I) > D(J) ?
;IF NO CARRY SET, THEN DO NOT SWITCH
;ELSE MAKE THE SWITCH
;I = I - M
;IF I < 0 THEN LOOP BACK

;J = J + 1
;IS J > K
;IF J > K GOTO 'HALVE'
;IF J <= K GOTO 'X2'

SKIPTRANS
0492 3A1B05     LDA J
0495 3C         INR A
0496 321B05     STA J
0499 47         MOV B,A
049A 3A1805     LDA SPREAD
049D B8         CMP B
049E DA4B04     JC HALVE
04A1 C36404     JMP X2

CHTOAD
;CHANGES "RECNO" TO CORRECT ADDRESS IN DIRBUFF. HL POINTS
;TO FIRST RECORD AND DE POINTS TO SECOND.
04A4 3A1905     LDA FIRSTREC
04A7 CDB304     CALL ADJUST
04AA EB         XCHG
04AB 3A1A05     LDA SECONDREC
04AE CDB304     CALL ADJUST
04B1 EB         XCHG
04B2 C9         RET

```


ADJUST

;MULTIPLIES "RECNO" BY 16 AND PUTS IN HL TO POINT
;TO NAME IN DIRBUFF.

```
04B3 019C05      LXI B,DIRBUFF
04B6 6F          MOV L,A
04B7 2600       MVI H,0
04B9 2929       DAD H ! DAD H
04BB 2929       DAD H ! DAD H
04BD 09         DAD B
04BE C9         RET
```

COMPARE

;COMPARES THE NAMES IN THE FIRST AND SECOND ADDRESS. IF THE
;FIRST IS LARGER THAN THE SECOND, IT INDICATES A SWITCH
;SHOULD BE MADE BY SETTING THE CARRY.

```
04BF E5          PUSH H
04C0 D5          PUSH D
04C1 0E0B       MVI C,11
04C3 46         MOV B,M
04C4 1A         LDAX D
04C5 B8         CMP B
04C6 DACD04     JC RETWC
04C9 CAD004     JZ INCREASE
04CC B7         ORA A           ;CLEAR CARRY
04CD D1         RETWC     POP D
04CE E1         POP H
04CF C9         RET
```

INCREASE

;CHARACTERS WERE EQUAL. DO..

```
04D0 23         INX H           ;..ANOTHER COMPARE.
04D1 13         INX D
04D2 0D         DCR C
04D3 CACB04     JZ RETWC-2
04D6 C3C304     JMP COMPARE+4
```

SWITCHHD

;THIS ROUTINE SWITCHES THE FIRST RECORD WITH THE SECOND.

```
04D9 D5          PUSH D
04DA E5          PUSH H
04DB 110605     LXI D,TEMP           ;PUT THE SECOND RECORD IN..
04DE 0610       MVI B,16           ;.. TEMPORARY STORAGE.
04E0 CDF904     CALL HTD
04E3 E1         POP H           ;PUT THE FIRST RECORD..
04E4 D1         POP D           ;..IN THE SECOND.
04E5 EB        XCHG
04E6 0610       MVI B,16
04E8 CDF904     CALL HTD
04EB EB        XCHG           ;PUT THE TEMPORARY (SECOND)..
04EC E5         PUSH H           ;..IN THE FIRST.
04ED D5         PUSH D
04EE 210605     LXI H,TEMP
04F1 0610       MVI B,16
04F3 CDF904     CALL HTD
04F6 D1         POP D
04F7 E1         POP H
04F8 C9         RET
```

HTD

;THIS ROUTINE DOES THE TRANSFER. MOVES RECORD ADDRESSED BY
;HL TO RECORD ADDRESSED BY DE.

```
04F9 D5          PUSH D
04FA E5          PUSH H
04FB 7E         MOV A,M
04FC 12         STAX D
04FD 23         INX H
04FE 13         INX D
04FF 05         DCR B
0500 C2FB04     JNZ HTD+2
0503 E1         POP H
0504 D1         POP D
0505 C9         RET
```

```
0506          TEMP DS 16
0516          RECNO DS 1
0517          HALFREC DS 1
0518          SPREAD DS 1
0519          FIRSTREC DS 1
051A          SECONDRD DS 1
051B          J DS 1
```

```
051C          STACK DS 80H
059B =        NEWSTK EQU $-1
```

```
059C          DIRBUFF DS 16*64
```

```
099C          END
```


An S-100 Eprom Programmer Using the Intel 8255 PPI

by Ted Croal

The 8255 programmable peripheral interface is a convenient interface for an EPROM programmer.

For my first scratch-built computer project to add to my 8080A system, I selected the EPROM programmer circuit provided by Steve Ciarcia in the March 1978 issue of "BYTE". I was reading Adam Osborne's "An Introduction to Microcomputers, Vol. II" at the time and I thought that the 8255PPI would be a good way to provide the four parallel I/O ports required for the project. When the board was about half completed, I realized that I did not have specific instructions for connecting to the S-100 bus. After some trial and error, I arrived at a configuration that worked well for programming but would not read data in from the 2708 EPROM. It was not until I read David Condra's article in the October 1979 issue of "BYTE", that I realized that I did not properly isolate the data lines of the 8255 from the data in lines of the S-100 bus. I added tristate buffers to the data outlines and now the board is working as intended.

The 8255PPI is a 24 pin general purpose interface that can be programmed in a variety of ways. In my board it is used in the simplest mode (Mode 0, for basic I/O). Included in the device are three data ports, referred to as A, B, and C and a fourth port which is used for programming the 8255. By writing into this control port (the highest of the four consecutive port addresses used by the 8255), ports A, B, and C can be assigned to either input or output. Individual pins of port C can also be set or reset by appropriate control bytes.

Programmer Hardware Structure

I use port A for data to be loaded into the 2708 EPROM, or read from it, port B for the eight lowest address lines of the EPROM, and the two lowest bits of port C for the two highest address lines of the EPROM (page address). I use bit 2 of port C for programming mode (set for programming, reset for reading) and bit 3 for the programming pulse, leaving bits 4-7 of port C available for other uses.

Port assignments are made by writing a control byte in which bit 7 is set. Bits 6 and 5 are reset to indicate mode 0 for port A and bit 2 is reset to indicate mode 0 for port B. Bits 4, 3, 1, and 0 control the direction of port A, the upper half of port C, port B, and the lower half of port C respectively. They are set for input and reset for output.

Port C can be used in the usual manner by writing a byte to the port address or the bits of port C can be controlled individually by writing to the control port a byte in which bit 7 is reset. Bits 3, 2, and 1 of this byte form a binary number specifying the bit number of port C to be controlled and bit 0 specifies the state (reset for 0, set for 1). Bits 6, 5, and 4 of the control byte are ignored.

The control bytes used in the listings are:

***80H (200Q):** Ports A, B and C are defined as out ports and mode 0 is selected. This is in preparation for programming.

***90H (220Q):** Port A is defined as an in port and B and C as out ports. Mode 0 is selected. This prepares for reading the EPROM.

***9BH (233Q):** Ports A, B and C are assigned as in ports. This is intended to discourage a false pulse from reaching the EPROM when the power is turned off, but is not always effective. The 27V supply should be turned on after the main power supply and off before the main power supply.

***07H (007Q):** This sets bit 3 port C, initiating a programming pulse.

The following control bytes are useful in checking the operation of the board from the front panel or in a test program. (Port C must already be defined as an out port.)

***05H (005Q):** bit 2 of port C is set and the LED comes on to indicate "program mode".

***04H (004Q):** Bit 2 of port C is reset and the LED goes off to indicate "read mode".

The "program mode" LED also comes on when the 8255 is reset, as at power on, or when port C is defined as an in port.

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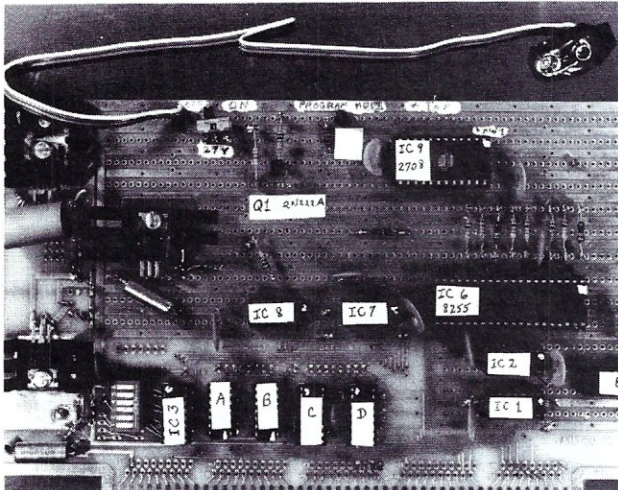
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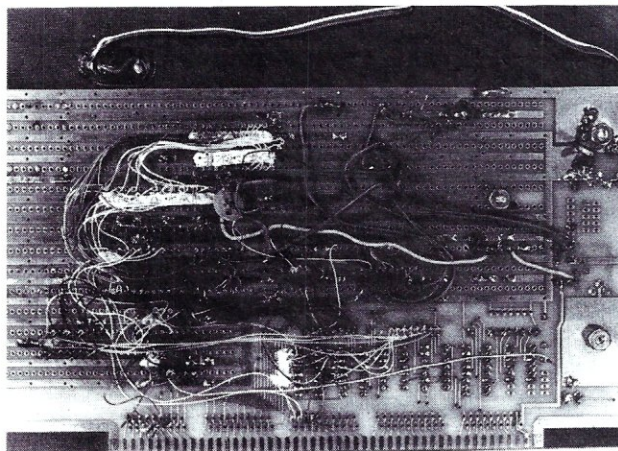
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Component side of board.

This board does not correspond to the schematic because it incorporates addressing decoding and data bus buffering. The data out lines are buffered with 2 input AND gates (74LS08, IC's A and B). This proved to be unsuitable for proper operation of the internal bidirectional data bus. Adding an additional tri-state buffer (IC E) to the data out lines and employing the unused gates of IC C and IC D (Tri-state hex buffers on the data in lines) corrected the problem. A, B, C, D, and E serve the same function as IC's 4 and 5 in the schematic. It would be simpler to build on a completely bare board, following the schematic which can be found at the end of this article.



Wire side of board.

The heavy wiring is for the extra power supply connections required by the 2708 EPROM. The +5V supply is to pin 24 of the EPROM. The +12V supply is pin 19 and the -5V supply is pin 21. Pin 12 is the ground. Some of the bypass capacitors have been placed on this side.

Number	Type	+5V	GND
IC 1	74LS04	14	7
IC 2	74LS00	14	7
IC 3	DMB131	16	8
IC 4	DS8833	16	8
IC 5	DS8833	16	8
IC 6	8255PPI	26	7
IC 7	74121	14	7
IC 8	7406	14	7
IC 9	2708	24	12

(IC 9 also requires +12V (pin 19) and -5V (pin 21))

Power Supply Connections

Programmer Software

There are two subroutines, BURN (listing 1) and READ (listing 2), which address the EPROM. The subroutine CYCLE (listing 3) calls on BURN to program

the block of memory specified in three memory words into the EPROM, starting at the address in the EPROM specified by a fourth memory word.

```

BURN:   MOV    A,D      ; High byte of EPROM adr
        ANI    03H     ; Mask all but bits 0,1
        ORI    04H     ; Set bit 2 for program mode
        OUT   PORTC    ; Two highest adr lines of EPROM
        MOV   A,E      ; Low byte of EPROM adr
        OUT   PORTB    ; Remaining EPROM adr lines
        MOV   A,M      ; Data byte
        OUT   PORTA    ; Output to data lines
        MVI   A,07H    ; Control byte to set bit 3 port C
        OUT   PORTD    ; Write strobe
        MVI   B,85H    ; Delay count
        DCR   B        ; One millisecond delay
        JNZ  DELAY    ; during write strobe
        XRA   A        ; Clear accumulator
        OUT   PORTC    ; Clear port C
        RET                    ; Return from BURN
    
```

Listing 1

Subroutine to program a byte of memory specified by register pair HL at an address in EPROM specified by register pair DE. "PORT A" is the lowest of the four consecutive port addresses used by the 8255PPI. "Port B" and "Port C" are the next two and "PORT D" is the highest address, that is, the address of the control port. Ports A, B, and C must first be defined as out ports.

```

READ:   MOV    A,D      ; High byte of EPROM adr
        ANI    03H     ; Mask all but bits 0,1
        OUT   PORTC    ; Two highest adr lines of EPROM
        MOV   A,E      ; Low byte of EPROM adr
        OUT   PORTB    ; Remaining EPROM adr lines
        IN    PORTA    ; Data byte
        RET                    ; Return from READ
    
```

Listing 2

Subroutine to read a byte from the 2708 EPROM. Port A must first be defined as an in port, and ports B and C as out ports.

```

CYCLE:  MVI    A,80H    ; Code byte to define A, B, C
        OUT   PORTD    ; as out ports
        LHL   STDES    ; Starting adr in EPROM
        XCHG                    ; Place in DE
        LHL   STSRC    ; Starting adr of source block in HL
WLOOP:  CALL   BURN     ; Program a byte of EPROM
        INX   D        ; Increment EPROM pointer
        INX   H        ; Increment source pointer
        LDA   ENSRC    ; Adr of end of block
        CMP   L        ; Test low byte source pointer
        JNZ  WLOOP    ; Loop until same
        LDA   ENSRC+1 ; Get high byte of end adr
        CMP   H        ; Test high byte source pointer
        JNZ  WLOOP    ; Loop until same
        RET                    ; Return from CYCLE
    
```

Listing 3

Subroutine to program a block of memory into a given location in a 2708 EPROM. Each specified location in EPROM is given one programming pulse.

I have a routine (not listed) common to several programs that loads these memory locations. STSRC is the starting address of the source, that is, the starting address of the program to be loaded into EPROM. LNSRC is the length of the block and ENSRC is the first address past the end of the block (or STSRC + LNSRC). STDES is the address of the start of the block in the EPROM. Bits 7-2 of the high order byte of STDES are ignored so the address of the intended site for the EPROM can be used.

Before each programming run, the subroutine TSTER (listing 4) is called to see if the block to receive the program is blank. The status of the EPROM block is displayed. The message "error" indicates that at least

EPROM Programmer cont'd...

one bit of the block is reset. The operator may then abort the run or proceed to load over the block. (A set bit may be reset but a reset bit must be erased by ultra-violet light.)

```

TSTER:   MVI    A,90H    ; Code byte to define A as in, and
         OUT    PORTD    ; B and C as out ports
         LHLD  STDES    ; Starting adr in EPROM
         XCHG  STDES    ; Place in DE
         LHLD  LNSRC    ; Length of block in HL
TLOOP:   CALL  READ     ; Read a byte of EPROM
         INR   A        ; If byte erased, reg A is 0 after
         RNZ  A        ; increment, else return
         INX  D        ; Increment EPROM pointer
         DCR  H        ; Decrement block length
         MOV  A,L      ; Test for end of block
         ORA  H        ; Zero flag is set if HL is 0
         JNZ  TLOOP    ; Loop until done
         RET           ; Return with zero flag set
    
```

Listing 4

Subroutine to test a block of EPROM for complete erasure. If the block is erased, the zero flag is set on return. Else it is reset.

A full load (listing 5) of one kilobyte is complete in less than two minutes, and a quick load (listing 6) requires only a few seconds, and usually consists of only 2 cycles. The quick-loaded EPROM seems to work just as well as the full-loaded one but you may wish to copy the program with a full load after you have debugged the program which you are loading.

```

FLLOD:   MVI    C,100    ; Place count of 100 (64H,144Q) in reg C
         CALL  CARST    ; Clear and reset TV screen
         LXI  H,MES7    ; Inform user that
         CALL  MESGE    ; loading is in progress
CLOOP:   CALL  CYCLE    ; Program the block once
         DCR  C        ; Decrement count
         JNZ  CLOOP    ; Loop until done
         MVI  C,100    ; Restore count for display later
         JMP  LDONE    ; See listing 6
    
```

Listing 5

Subroutine to make a full load of a block of memory, consisting of 100 programming pulses of 1 ms each to each byte in the block. Register C starts and ends with the number 100 to indicate the number of cycles used.

```

QKLOD:   MVI    C,0H    ; Clear register to receive count
         CALL  CARST    ; Clear and reset TV screen
         LXI  H,MES7    ; Inform user that
         CALL  MESGE    ; loading is in progress
AGAIN:   CALL  CYCLE    ; Program the block once
         INR  C        ; Increment count
         MVI  A,9H     ; Ten cycles is maximum
         CMP  C        ; Compare count to 9
         JNC  LDONE    ; If exceeded abort run
         CALL  VERIFY  ; Compare load with source
         JNZ  AGAIN    ; If different, loop
         CALL  CYCLE    ; Else program once more
         INR  C        ; Increment count
LDONE:   CALL  CDISP    ; Display count
         CALL  VERIFY  ; Verify the load
         JNZ  ERMSG    ; If incorrect display "error" message
         LXI  H,MES5    ; Else point to "verified" message
         CALL  MESGE    ; Display message
         LXI  H,MES8    ; Point to "done" message
         CALL  MESGE    ; Display it
         MVI  A,9BH    ; Code byte to define A, B, C as in
         OUT  PORTD    ; to prevent false program pulse
         CALL  INTRT    ; Wait until key pressed (read display)
         JMP  UTILITY  ; Go to utility directory
ERMSG:   LXI  H,MES6    ; Point to "error" message
         JMP  STTUS    ; and display
    
```

Listing 6

Subroutine to make a quick load of a block of memory. The 2708 is checked after each cycle to see if the loading is correct. One additional cycle is made and the count of the cycles is displayed and the load verified. The run is aborted after ten unsuccessful tries (you probably forgot to turn on the programming power supply).

At the end of the run, the EPROM is compared with the source block by the subroutine VERIFY (listing 7) and the status displayed. The number of programming cycles used is also displayed.

```

VERIFY:  MVI    A,90H    ; Code byte to define A as in, and
         OUT    PORTD    ; B and C as out ports
         LHLD  STDES    ; Starting adr in EPROM
         XCHG  STDES    ; Place in DE
         LHLD  STSRC    ; Start of source in HL
RLOOP:   CALL  READ     ; Read a byte
         CMP  M        ; Compare with source
         RNZ  D        ; Return if different, zero is reset
         INX  H        ; Increment EPROM pointer
         INX  L        ; Increment source pointer
         LDA  ENSRC    ; Adr of end of block
         CMP  L        ; Test low byte source pointer
         JNZ  RLOOP    ; Loop until same
         LDA  ENSRC+1  ; Get high byte of end adr
         CMP  H        ; Test high byte source pointer
         JNZ  RLOOP    ; Loop until same
         RET           ; Return from VERIFY
    
```

Listing 7

Subroutine to verify the program loaded into the 2708 EPROM with the source in memory. If a byte is found that does not match, the zero flag is reset on return. If the load is verified, the zero flag is set.

I use a "menu" display in which the user can select the desired program. At the end of the run, the computer returns to the "utility directory" for selection of another program. Listing 8 shows how the subroutines can be combined to form a useful program. CARST (not listed) clears and resets the TV screen. CDISP (not listed) displays the contents of register C. Other programs not listed in this article display the contents of the EPROM and copy the EPROM into memory. These call on READ and can be written in the same manner as the routines listed. Several messages are used to inform the user of the progress of the program (listing 9). These are displayed by the subroutine MESGE (not listed). The routine at MENU (not listed) displays the choices, receives a keyboard entry, and jumps to the address specified in the table at MENTB (not listed).

```

LODIT:   CALL  CARST    ; Clear and reset TV display
         CALL  TSTER    ; Test for erased block
         JNZ  NOTER    ; If not erased point to "not"
         LXI  H,MES3    ; Else point to "erased"
INFRM:   CALL  MESGE    ; Display message
CHUSE:   LXI  H,MENTB   ; Point to address of menu table
         JMP  MENU     ; Display menu and jump to choice
NOTER:   LXI  H,MES4    ; Point to "not erased"
         JMP  INFRM    ; and display
    
```

Listing 8

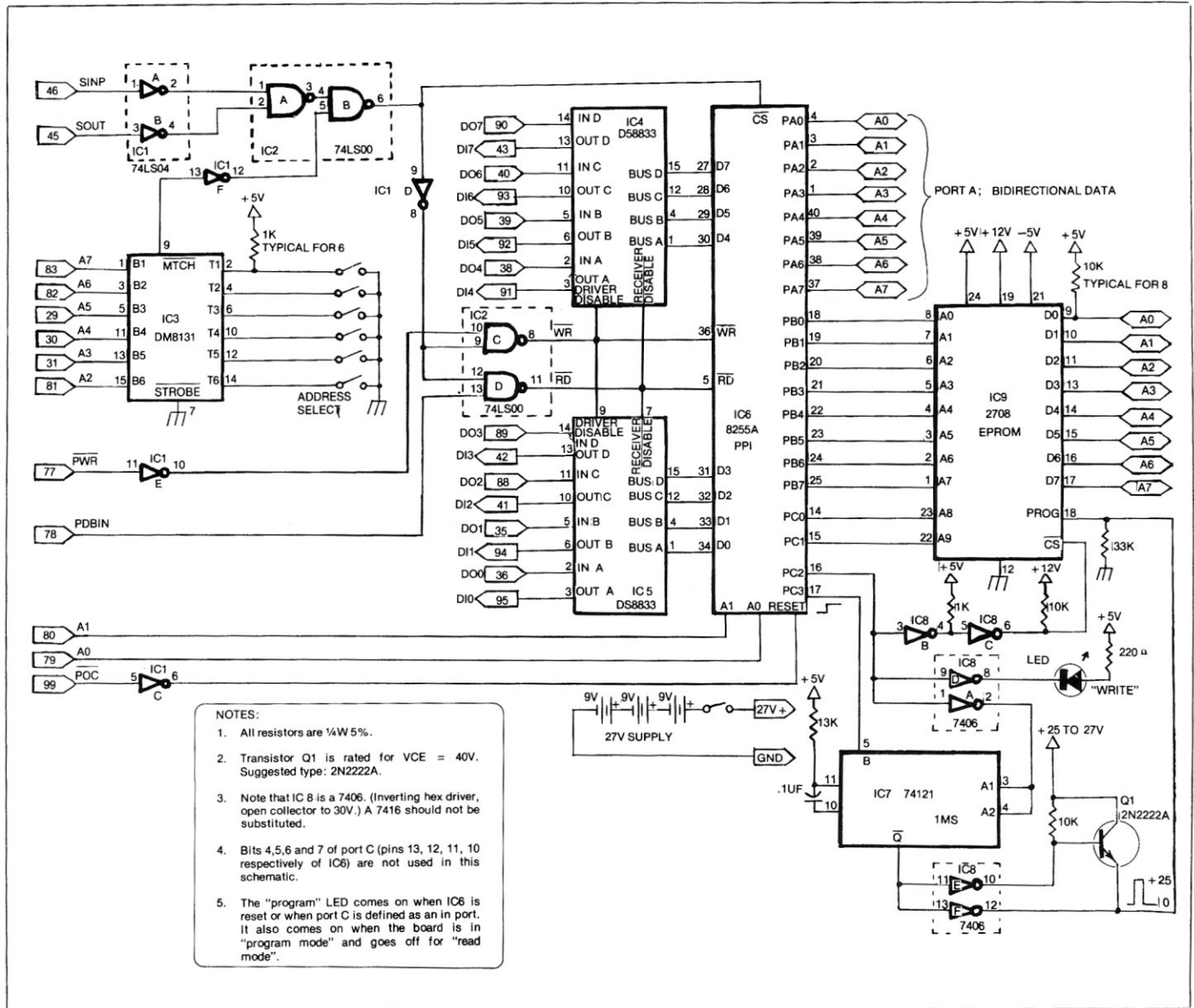
Program to select either a full load or a quick load for a block of memory. Choices are (1) for quick load, (2) for full load, or (ESC) for return to start of program (not listed) to redefine the block. All other entries cause a return to (CHUSE).

```

MES 1    1. Quick load (used by MENU)
MES 2    2. Full load (used by MENU)
MES 3    Block erased
MES 4    Block NOT erased
MES 5    Load verified
MES 6    Error!
MES 7    Loading in progress
MES 8    Done
    
```

Listing 9

Messages Used



If you are building this circuit, note that IC4 in Steve Ciarcia's article should be a 7406 not a 7407 (do not substitute a 7416). Note also that in Dave Condra's article there should be an inverter between pin 9 of IC3 (DM8131) and pin 5 of IC2 (74LS00). Use a section of IC1 (74LS04); connect pin 9 of IC3 to pin 13 of IC1 and pin 13 of IC1 to pin 5 of IC2. Although I did not use the DS8833 bus transceivers I would do so if I were building the circuit again.

References

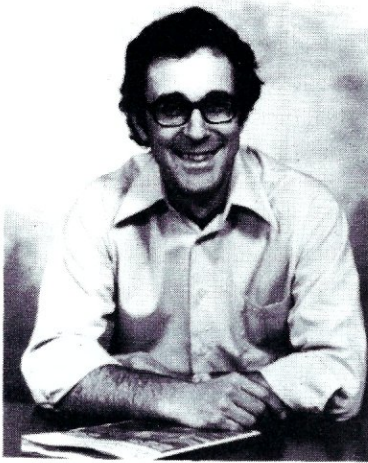
1. Program Your Next EROM in BASIC; Ciarcia, Steve; BYTE March 1978, page 84.
2. Interfacing the S-100 Bus with the Intel 8255; Condra, David L.; BYTE October 1979, page 124.
3. An Introduction to Microcomputers Vol. II; Adam Osborne and Associates, page 4-133. □

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David Ahl, Founder and
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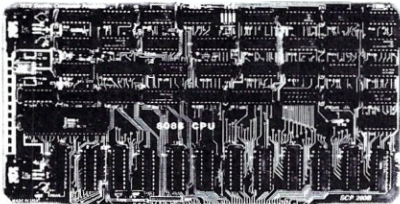
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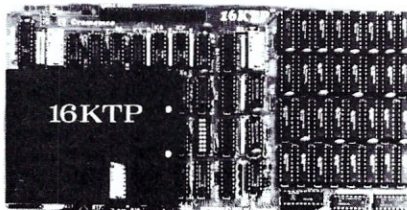
DISK OPERATING SYSTEM: The SCP 86-DOS is a complete operating system package. Provides a high level interface to I/O devices and disk system. Includes resident assembler, Z80 to 8086 source code translator, a utility to read CP/M files, a line editor and disk maintenance utilities. Price: \$95 (SCP owners), \$195 (others).

For more information contact: Seattle Computer Products, Inc., 1114 Industry Drive, Seattle WA 98188; (206) 575-1830.

16K and 48K TWO PORT MEMORY BOARDS

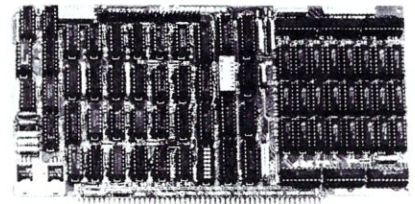
Cromemco introduces two new two-port memory boards, the 16KTP and the 48KTP, for use with their Model SDI high resolution, color graphics interface.

These two-port memory boards have two sets of address and data lines which give them the ability to process the SDI's memory refresh requests while the CPU simultaneously and independently executes a user program. Picture information is accessible by the SDI through a connector on the top of the memory boards. This direct connection of the SDI and the two-port memory bypasses the S-100 bus so the CPU accesses the two-port memory as though the SDI were not present. Consequently, use of the special two-port memory in a graphics system assures 75% to 100% CPU utilization, depending on the application software.



These two-port memory boards are also designed to work with Cromemco's

powerful graphics software package. This graphics package provides a full range of powerful, human oriented commands that operate from such common high-level languages as Basic, Fortran and Ratfor. The graphics software package will operate with one or two pages of two-port memory. Two pages of 48K bytes of RAM are required for complete utilization of all available software options.



Cromemco's two-board color graphics interface (Model SDI) is available for \$595. The 16K two-port memory board (Model 16KTP) is available for \$795 and the 48K two-port memory board (Model 48KTP) is available for \$1785. Cromemco's graphics software package is available on either 8" (Model SGS-L) or 5" (Model SGS-S) floppy diskette for \$295. For additional information, contact Cromemco, Inc., 280 Bernardo Avenue, Mountain View, CA (415) 964-7400.

HIGH RESOLUTION COLOR GRAPHICS FROM CROMEMCO

Cromemco has just announced a new software package for its high resolution graphics system. The Cromemco graphics system can be used to display color or black-and-white images with up to 756 x 482 point resolution on a high quality RGB monitor.

The cromemco system provides commands that operate from such common high-level languages as Basic, Fortran and Ratfor.

The graphics software package is designed to work with Cromemco's 48KTP and 16KTP (two port) memory boards

and will operate with one or two pages of two port memory. Two pages of 48K bytes of RAM are required for complete utilization of all available software options.

For those using the graphics software package, the subroutine calls provided are sufficient to fully utilize all the capabilities of the Cromemco SDI high resolution graphics interface board. These subroutines allow the user a number of powerful capabilities including: fast line generation; fast generation of regular shapes such as circles, rectangles, and polygons; area fill of these shapes in a designated color at video rates; text generation and rotation; the ability to open and close windows in the page of memory being displayed; the ability to simulate motion (animation); the ability to CLIP which eliminates problems which might arise from trying to plot outside the screen area; and the ability to scale the display area of the work page.

The programmer can generate and display an image in high resolution (756 x 482 points) as well as the 16 color medium resolution (378 x 241 points) using the same system. In addition, the programmer has the choice of plotting explicitly (i.e., specifying within a call all needed location and color information) or implicitly (i.e., specifying needed location information with regard to an implied cursor).

The software and hardware permit the user to select 16 colors for the color map from a palette of 4096 colors. The contents of any color in this color map can be modified by the user with a simple call define color command. In addition, when programming in Fortran or Assembly language, the programmer has the option of creating color maps using the command CMAPGEN.

The SDI color graphics software package is available from Cromemco on either 5" (Model SGS-S) or 8" (Model SGS-L) diskette for \$295. For additional information, contact Cromemco, Inc., 280 Bernardo Avenue, Mountain View, CA 94043, (415) 964-7400.

THE DS MICRO TRANSLATOR SYSTEM TRANSLATES BRAILLE & DOES WORD PROCESSING

DUXBURY SYSTEMS, INC., of Maynard, Mass. has introduced a microcomputer-based, word processing and braille translating system. It includes a North Star Z-80 based microcomputer with dual, quad-capacity diskettes for translation and storage; a screen terminal with keyboard for input; the Triformation Systems' LED-120 (Line Embossing Device, 120 characters per second) for braille production; Duxbury Systems software for text editing, braille translation, and formatting; and an optional letter-quality printing terminal for inkprint production. In addition to the LED-120 translated text can be transferred to any of the Triformation LED series embossing devices, or the press braille plate embosser, model PED-30, or the hand-held Digicassette braille recorder.

In operation, the system permits a sighted person with no knowledge of

Standard English Braille, which is a complex, semi-phonetic code, to enter and edit material from newsletters, memos, and class notes to full-length books. Entered text is automatically translated and formatted by the computer to produce high quality braille copies of the material, or formatted without translation for equivalent print copies.

The Braille translator follows the same internal procedures as Duxbury's mini-computer-based systems, currently in use by large braille production houses in North America and Australia; consequently the same close conformity to Standard Braille Code is maintained. Different language reference tables are available to produce Grade I (uncontracted) or Grade II (contracted) braille according to American rules or the slightly different British braille code. Grade I and Grade II braille are also available in Spanish, along with Grade I in four other languages. The micro translator renders text into braille at the rate of more than 300 characters per second. The system is also designed to be used eventually for large print production (for persons with low vision) and for translation from braille to print (e.g., from cassette braille recorded by a blind person).

The cost of terminal, computer, and software is \$8,950. The LED embosser costs between \$7,400 and \$14,500. An optional, letter quality printer adds \$2,500. For further information please contact: Duxbury Systems, 56 Main St., Maynard, Massachusetts, 01754.

COMPLETE DATA ACQUISITION AND VIDEO S-100 MICROCOMPUTER SYSTEMS

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3. 9" video monitor

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Portrait digitized with Tecmar's Video Microcomputer System (resolution: 128x128)

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Language: 8080 Machine Code
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Release: Available now
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Included with price: CP/M disk, 112 page user manual which includes an APL tutorial

Where to purchase it:
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36 Homestead Lane
Roosevelt NJ 08555

Program Name: ISSCAI SYSTEM
Hardware System: Standard CP/M or MP/M

Minimum Memory Size: 8K
Language: 8080 Assembler
Description: This is a set of three programs CAIGEN, TUTOR, and ENROLL which provide, with the use of a system editor, a complete COMPUTER AIDED INSTRUCTION system. CAIGEN formats a editor written text file to the requirements of TUTOR and creates an enrollment file for the course if needed. TUTOR is the heart of the system providing forward and reverse linking of text, prompting for answers even where there might be several that are correct, responding on correct or incorrect answers with replays if wanted, chaining to next

lesson, scoring, passwords, comments and several other functions. ENROLL provides complete enrollment file maintenance and teacher monitoring of student progress in a course, lesson by lesson, this program has password level access.

Release: Currently available
Price: \$250.00

Included in price: Object of three programs and users manual. System is available for RESALE LICENSE.

Author: G.B. Shaffstall

Where to purchase it:
International Software Service
13050 W. Cedar Drive #15
Lakewood, Colorado 80228

Program Name: Apparel Management System

Hardware System: CP/M 48K, 2-8" Drives

Language: CBASIC-2

Description: This system is designed to help management make decisions about their stores. Items to reorder that will make the season, items to be moved from one store to another and items to be marked down are some of the daily tools provided. A detailed inventory report by department shows inventory information (units, dollars in stock, etc.) and monthly sales information. A monthly analysis is done by store/department showing sales, COGS, profit, annual inventory turns, stock to sales ratio and sales compared with budgets. The annual report follows the key monthly analysis figures for a year, again for your comparison abilities. Other major reports include daily sales by department, yearly budgets and physical inventory taking sheets.

Release: Available now
Price: \$960.00

Included with price: User documentation, 31 programs warranty

Author: Keystone System, Inc.

Where to purchase it:
Keystone Systems, Inc.
P.O. Box 767
Spokane, WA 99210

Program Name: SCREENMASTER
Hardware System: 48K CP/M system. Dumb terminal = Hazeltine, ADM3A, TRS-80 II. Others easily accommodated.
Minimum Memory Size: 40K, 48K recommended.

Language: CBasic-2. Distributed in source code.

Description: Intended for programmers only, Screenmaster allows user to describe multi-screen input via data to the program. Program returns an array of responses, edited for validity. Programmer has pre-/post-input and submit exits where editing and control code may be inserted, commands = 90 to m, back n, forward n, prior (screen 0, next (screen), submit etc. End-user can also be given the commands. Flexible design allows any input scheme to be implemented in minutes rather than days.

Release: Available now
Price: \$295. Compiled Demo \$50. User manual alone \$25.

Author: Dr. Laird Whitehill & Joel Wittenburg.

Where to purchase it:
Micro-computer Business Systems
161 W. 75 St.
New York, NY 10023

Program Name: MWP-SEL
Hardware System: CP/M
Minimum Memory Size: 48K bytes
Language: Microsoft Basic

Description: Allows sophisticated selected records. Example: Select all records with 'AMOUNT DUE' greater than or equal to (=) 'CREDIT LIMIT'. You may combine selection criteria with AND' and 'OR' for complex task.

Release: Available now
Price: \$95; Licence Agreement Required

Included with price: Diskette, manual, examples, support

Author: The Software Store

Where to purchase it:
The Software Store
706 Chippewa Square
Marquette, MI. 49855

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Program Name: D—Directory and Disk Status

Hardware System: any CP/M system

Minimum Memory Size: 16K

Language: 8080 Assembler

Description: This program works with single or double density systems on any selectable disk drive. The directory is presented in 4 columns sorted into alphabetical order (the number of columns is equate selectable in the source program). The first line contains the following disk information: Disk:? Files:? Entries:?(? left) Space used:?(? K left).

Release: Available now

Price: \$40.00 Source \$20.00 Object

Included with price: Program and documentation.

Author: Hawkeye Grafix

Where to purchase it:

Hawkeye Grafix
23914 Mobile St.
Canoga Park, CA. 91307

Program Name: Tarbell Dual-Density DMA Support Package

Hardware System: 8080/Z80 S100 system with Tarbell DD/DMA disk controller.

Minimum Memory Size: N/A

Language: 8080 Assembly Language (ASM or MAC)

Description: CP/M 2.0 compatible BOOT and BIOS for Tarbell Dual Density disk controller, including all support programs required for normal operation (FORMAT, Disk validation, Fast absolute copy, auto-density sysgen, etc.) Not compatible with public domain code from Tarbell, this is all new code which supports IBM standard gaps and header information, has no known bugs, and is very clearly written. Currently supports CP/M with 128 byte sectors only, but will allow user to format and validate diskettes in any of the following formats (sectors/track x bytes/sector): Single: 26 x 128, 13 x 256, 8 x 512, 4 x 1024 Double: 48 x 128, 26 x 256, 15 x 512, 8 x 1024 Supports standard IOBYTE, remote console auto answer dial-in access, etc. Console/printer I/O currently uses IMSAI SI02-2 (very easy to modify).

Release: Available now

Price: \$50.00

Included with price: 8" 3740 CP/M style disk with source for BOOT, BIOS, FORMAT, VALDSK, ADCOPY and SYSGEN. Note: CP/M 2.0 from Digital Research required.

Authors: Lawrence E. Highes and Sam H. Adams

Where to purchase it:

Mycroft Labs
P.O. Box 6045
Tallahassee, Fla 32301

Program Name: PRO-TYPE Word Processor

Hardware System: CP/M North Star, MECA ALPHA TAPE

Minimum Memory Size: 16K

Language: Basex

Description: IMI's PRO-TYPE is a powerful word processor that is easy to learn and simple to use. Its comprehensive 72-page manual will guide you from beginner, to intermediate and on to advanced

applications. PRO-TYPE packs all of these convenient features into a single 8K program that supports fully interactive text entry, editing, and print formatting: Works with ANY type of terminal (memory mapped or not). Floating tabs and underlining. Change left and right margin, line spacing while printing, double text buffers for form letters, etc. Multiple print modes (justification, line fill, verify) Embedded "STOP" codes allow special text insertion command macros for repeated command execution.

Release: Available now

Price: North Star 5" SD & DD disk (with manual) \$25. MECA ALPHA tape (with manual) \$75. CP/M 8" disk (with manual) \$75. Add \$.75 Special 4th Class or \$1.50 Special Handling or UPS

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Author: Paul K. Warme

Where to purchase it:

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