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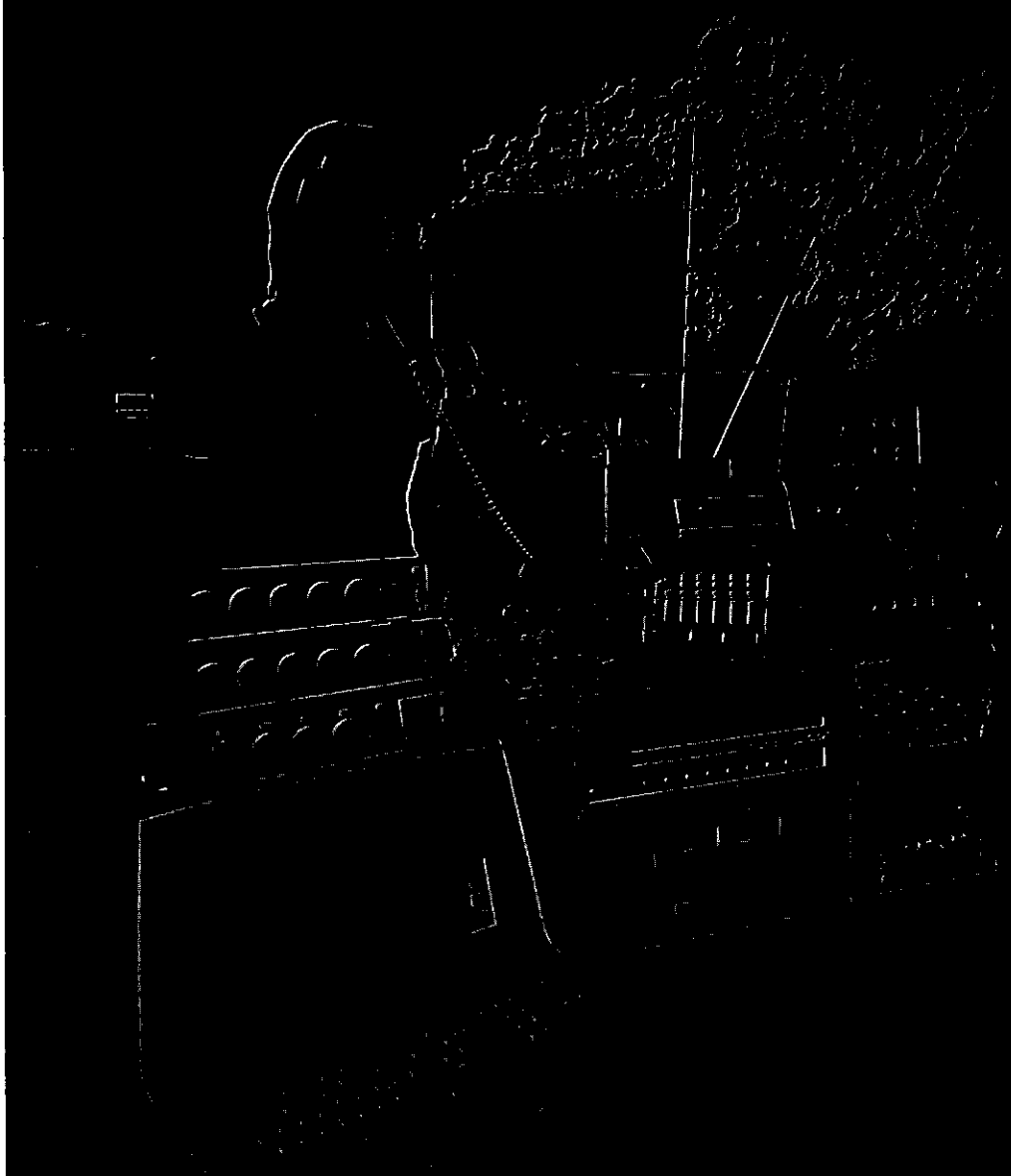

SUBMITTAL SPECIFICATIONS

Articles submitted to **Computer Notes** should be typed, double-space, with the author's name, address and the date in the upper left-hand corner of each numbered page. Authors should also include a one-sentence autobiographical statement about their job, professional title, previous electronic and/or computer experience under the article's title. Authors should retain a copy of each article submitted.

All illustrations, diagrams, schematics and other graphic material should be submitted in black ink on smooth white paper. Prints and PMT's are acceptable. No pencil drawings unless properly "fixed." No halftone or wash drawings.

All artwork should be mailed flat, never folded. Unless requested, graphics are not returned. Sketches, roughs and "idea" drawings are generally not used.

Photos, charts, programs and figures should be clearly labelled and referred to by number within the text of the manuscript.

Only clear, glossy black and white photos (no Polaroid pictures) will be accepted. Photos should be taken with uniform lighting and sharp focus.

Program listings should be recorded with the darkest ribbon possible on blank white paper. A paper tape for each program submitted **must** also be included.

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2450 Alamo S.E., Albuquerque, New Mexico 87106

Compose Yourself with the New Altair 88-MU1

By Thomas G. Schneider
MITS

Through the gray gloom and the midnight mist swirling around the gnarled branches of long-dead vegatation, the castle loomed dark and foreboding on the edge of a huge cliff. I viewed the scene with some apprehension, but called to the driver to move on. When the ancient creaky carriage finally rumbled into the cobble-stoned courtyard, I thought that I heard swells of medieval organ music booming ominously through the stone walls. "How gothic," I quipped to myself, jumping down from the carriage and peering suspiciously at the "KILOBAUD Sold Here" sign in the window.

Approaching the heavy wooden door with large brass knockers, I had a funny feeling of deja vu. Hmm. Maybe it was that Gene Wilder movie about monsters I had seen recently. Just then the door opened abruptly, and a black-cloaked gentleman with pointed teeth appeared. Bowing, he introduced himself as the count.

"You've probably heard this line before," he said in a slow, thick accent, "but, good evening. Welcome to my castle. Your rooms are awaiting. Dinner will be served at 8:00. Afterwards, we will give the demonstration," he said with a ghoulish smile as he turned to leave.

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in this issue

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As I prepared for dinner, I wondered what he had in store for me. Strange man, this count . . .I couldn't help but think I knew him from somewhere else. Oh well, the demonstration would be interesting.

After a delicious repast of undetermined substance, the count led me down a wooden cobwebbed stairway to what I assumed could only be the dungeon. "Don't mind the bats," he said. "They give the place character." He fumbled with the heavy iron padlock and pushed against the old dungeon door. My heart raced. Finally, the door gave way and slowly creaked open to reveal an amazing spectacle.

I had expected to see an immense pipe organ of the kind usually seen only in well-preserved European cathedrals, but I was wrong. Occupying all four walls of the dungeon and reaching almost to the ceiling was the largest collection of sound equipment I had ever laid eyes upon. Completely covering three walls were woofers, tweeters, midranges, folded horns, ring radiators, and all sorts of sound reproducing devices. The fourth wall was obscured by racks and racks of high-power audio amplifiers, tape machines, equalizers, and other audio processing equipment. "Listen carefully," he said, flipping up a bat-handle toggle switch.

The machinery clicked, popped, and buzzed for several mintues before I finally heard what I had come all this way to experience. Emanating simultaneously from hundreds of speakers came the most musically precise rendition of Johann Sebastian Bach's **Toccata and Fugue in D Minor** that I had ever heard. Every massive chord, every subtle passage was accurately reproduced. But from where??? None of the tape machines were running... something strange was going on here. As strains of the Fugue floated through the dungeon I asked the count how it was all done.

"Very simply," he replied, pointing to an object in the corner.

"An Altair? What are you doing with an Altair? Counting bats?!"

"Let's not be silly, my good man," he said, somewhat miffed. "Nowadays, what self-respecting vampire would be without a computer? Besides, how else could I make such splendid music?"

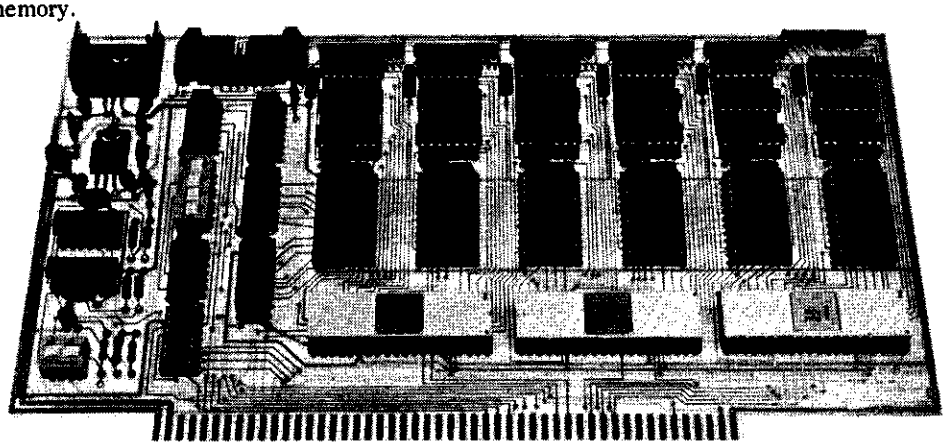
"You must be joking. How can a microcomputer do all this?"

"Very easily," he said. "Since my friends at MITS came up with the 88-MU1 and the MOS-DOS software for composition, I can play just about anything using my Altair!"

"Tell me more," I implored.

"Very well," he sighed and provided me with the following information.

The Altair 88-MU1 is a polyphonic six-channel note generator card. With it, the user can generate, under complete software control, six independent musical sequences all running simultaneously in real time. The 88-MU1 comes with a sophisticated, high-level software package with full composition and editing capabilities. It also includes output connectors designed to connect to most stereo amplifiers. The software package will run in any Altair disk system with at least 16K of memory.



Altair™ Note Synthesizer Board (88-MU1)

Composition using the 88-MU1 software is simple. The software allows the creation of six independent text files which can be saved and recalled from disk. Each group of six files can be given a common name up to eight characters long. The 88-MU1 software also incorporates a powerful text editor for listing files, inserting or deleting lines, and renumbering files.

Listing 1 is a sample listing for one channel of a six-channel composition. Each line contains three fields describing note, octave and timing parameters. For example, line 1 specifies a C note in the fourth octave lasting 1/8 of a second. Line 2 specifies a D note in the fifth octave lasting 1/8+1/16 of a second. (The period after the eight specifies a dotted eighth note.) Line 3 specifies an F# note in the seventh and eighth octaves lasting one second. The length of each channel of a composition is limited only by the amount of memory in the user's machine.

Listing 1

```
1  C, 4, 8
2  D, 5, 8
3  F#, 78, 1
```

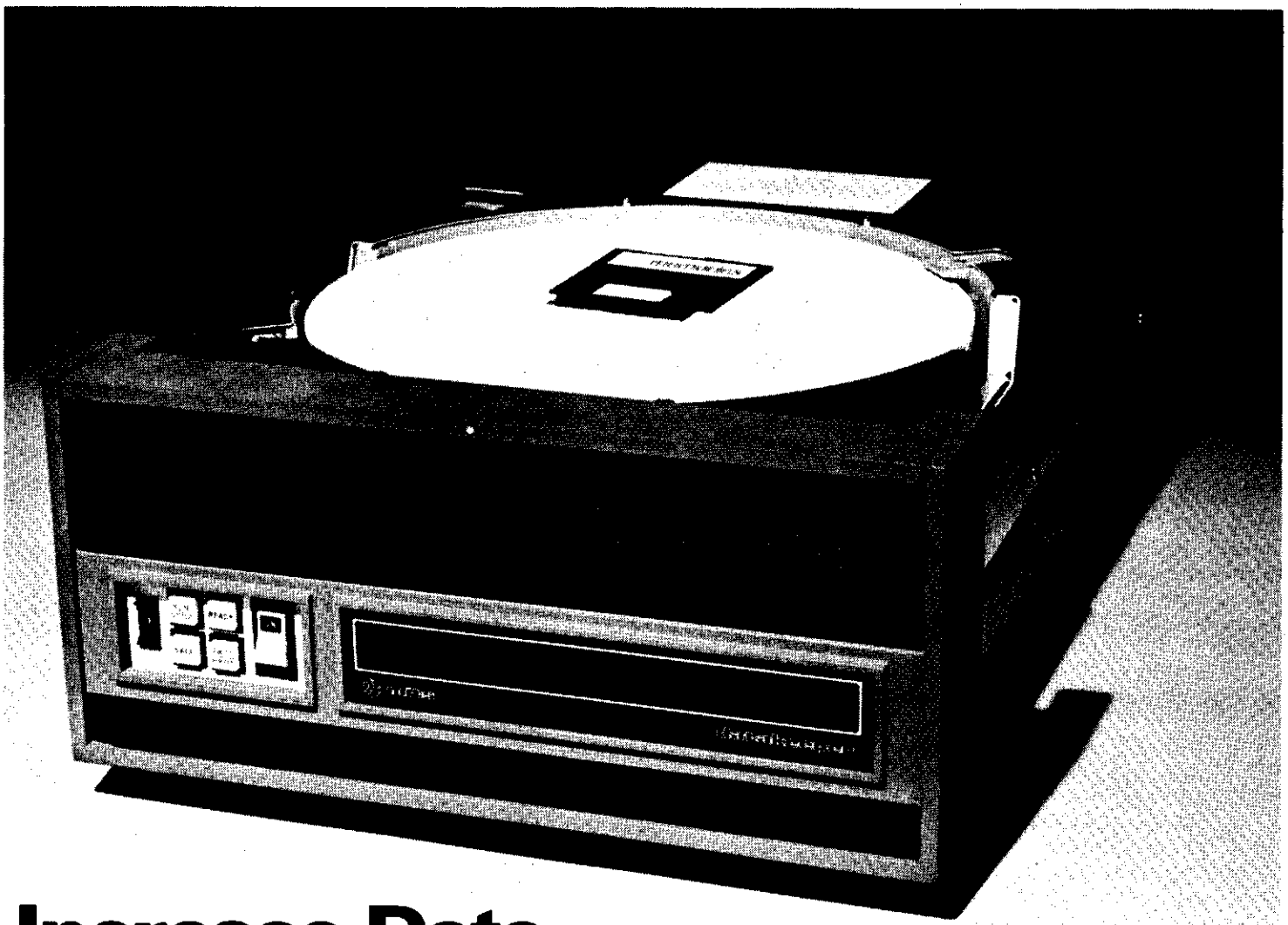
As the system is expanded, special characters may be added to the end of each line. These characters will control such functions as envelope shaping, filtering, and vibrato effects. After all channels of the composition have been entered, the composition can be played at a variety of tempos determined by the user.

For those users desiring musical effects, the 88-MU1 can also be easily accessed by user routines written in machine code. Figure 1 shows what the 88-MU1 looks like to software. The base address can be set from 0 to octal 360 in increments of 16. For even more flexibility, the 88-MU1 can accept two external signals: one is the reference frequency for the 88-MU1's pitch generator. This signal is normally derived from the Altair 8800's two MHZ clock, but can also be externally applied by the user. For example, inputting a one MHZ signal will cause the 88MU1's entire range to be shifted down one octave. The other signal is the software synchronization signal. It normally occurs at a frequency of 128 HZ, but can be externally applied, giving the user control of the rate of the composition execution speed.

"This 88-MU1 is fascinating," I said to the count.

"Yes indeed, most remarkable. . .but unfortunately, I must be leaving you now," he said. "It's getting close to dawn, so I must retire. I trust the demonstration pleased you." he remarked as he escorted me to the courtyard where the same black carriage was waiting. "Most impressive. I enjoyed every bit of it."

As the carriage started rolling, I couldn't help but lean out the window and shout, 'Fangs a lot for everything!" The count grimaced painfully as the carriage moved through the castle gate. But I hurried on, eager to get home and treat my Altair to a brand new 88-MU1.



Increase Data Storage up to 80 MBytes with Altair™ Hard Disk System

By Bennett Inkeles
MITS

The new Datakeeper Hard Disk System (88-HDSK) from MITS offers a unique form of expanded mass storage for Altair 8800 series microcomputers. It consists of the Altair Datakeeper Controller and a Pertec D3422 Hard Disk Drive. The 88-HDSK has a data storage capacity of approximately 10 MBytes.

(A 20 MByte drive option is also available. Business management, education, and scientific applications are among the numerous possibilities in which the 88-HDSK may be incorporated.

The following components make up and are included with the purchase of the Datakeeper Hard Disk System:

A. Altair Datakeeper Controller in a self-contained cabinet.
B. 1 pair of interconnect cables for controller to computer connection
C. 1 cable assembly for controller to Pertec Hard Disk Drive connection.
D. 1 Pertec D3422 Hard Disk Drive with Fixed Platter.
E. 1 5440 Removable Top Loading Cartridge with Altair Datakeeper BASIC.
F. 1 set of Bootstrap Loader PROMs for system initialization.
G. Datakeeper Hard Disk System Documentation

The Datakeeper Controller acts as the interface between the Hard Disk Drive and the Altair 8800 computer. Up to four disk drives may be interfaced with one controller allowing a total storage capacity of approximately 40 MBytes. The controller unit includes a five-slot, bus-oriented motherboard, three plug-in interface boards and power supply. The plug-in Interface boards are:

A. Processor Board--contains a 8 x 300 bipolar processor, TTL ROM, 1K byte of buffer RAM for data transfers, and two bidirectional I/0 ports for communicating with the computer.

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Increase Data Storage

continued

B. Disk Data Board--has serial to parallel and parallel to serial converters, FIF0 Registers, CRC generator/checker, and bit counters.
C. Disk Interface Board--includes the write data rate clock, I/0 ports, and line drivers for communicating with the Hard Disk Drive.

The Altair computer communicates to the Datakeeper Controller through two ports of an 88-4-PI0.

The 88-HDSK utilizes the Pertec D3422 Hard Disk Drive with 24 sectored format. It allows for approximately 5 MBytes of storage using the Fixed Platter and increases to 10 MBytes when the Removable Top Loading Cartridge is added.

To properly implement the 88-HDSK, the Altair 8800 series mainframe requires:

A. 48 K bytes of RAM memory (three each of either the Altair 88-16MCD or 88-16MCS)
B. 2 parallel ports (one each of Altair 88-4 PI0 and 88-PP)
C. 1 PROM Memory Card (Altair 88-PMC)
D. Serial I/0 Board for terminal communication (Altair 88-2SI0)
E. Terminal--CRT or Teletype™

The Datekeeper Hard Disk System design emphasizes operational reliability and user convenience. Turnkey Operation assures fast and efficient power-up and program loading. Modular construction permits future expansion and easy component access. The Pertec D3000 series Hard Disk Drives have been proven in the field in a wide variety of applications and environments. This combination of optimum design and "state of the art" technology further extends the programming and data manipulation possibilities for the Altair 8800 series.

Controller Specifications

A. Power Requirements

70 watts typical, 120 watts maximum
Wired for 105-130V, 50/60 HZ
210-260 V, 50/60 Hz available on request

B. Physical Specifications

Size - Height 5.3 in (13.5 cm)
Width 16.85 in (40.5 cm)
Depth 17.3 in (41.5 CM)
Weight 20 lbs. (9.1 Kg)
Cabinet styling matches the Altair 8800b and 8800b Turnkey. A keyswitch on the front panel controls the power switch, and CPU Reset and Run mode.

Drive Specifications

A. Drive Type
Pertec D3422-E024-MWU
B. Data Storage Capacity
1 each Fixed Platter
4,988,928 Data Bytes
1 each 5440 type Removable Cartridge
4,988,928 Data Bytes
TOTAL 9,977,856 Data Bytes
C. Physical Format

Tracks per inch	200
Cylinders	406
Disk Surfaces	4
Tracks	1624
Sectors	24
Data Bytes/Sector	256

D. Serial Data Transfer Rate
2.5 MBits/second, determined by:
Spindle speed - 2400 RPM
Density - 2200 BPI
E. Access Time
1. Latency - Maximum 25.0 ms± 1%
- Typical 12.5 ms ± 1%
2. Seek Time - Minimum (Adjacent Track) 10 ms, Max.
Average (⅓ Full Stroke) 40 ms, Max.
Maximum (Full Stroke) 65 ms, Max.
3. Total maximum access time to read a Sector: 92 ms (25 ms Latency, 65 ms Seek, 2 ms Read)
F. Power Requirements
1100 watts Peak (start/stop cycle only)
400 watts typical
95-125V
or Must specify nominal voltage
190-250 V
48 to 52 Hz
or Must specify if nominal line
58 to 62 Hz frequency is 50 Hz
G. Physical Specifications

Height 8 ¾ inches	(22.2 cm)
Width 19 inches	(48.3 cm)
Depth 29 ¼ inches	TOTAL (74.3 cm)
Weight 130 lbs.	(59 Kg)

H. Reliability
Meantime between failure - MTBF - 4000 hrs.
Service life 5 years or 24,000 hrs.
Meantime to repair - 1 hr.

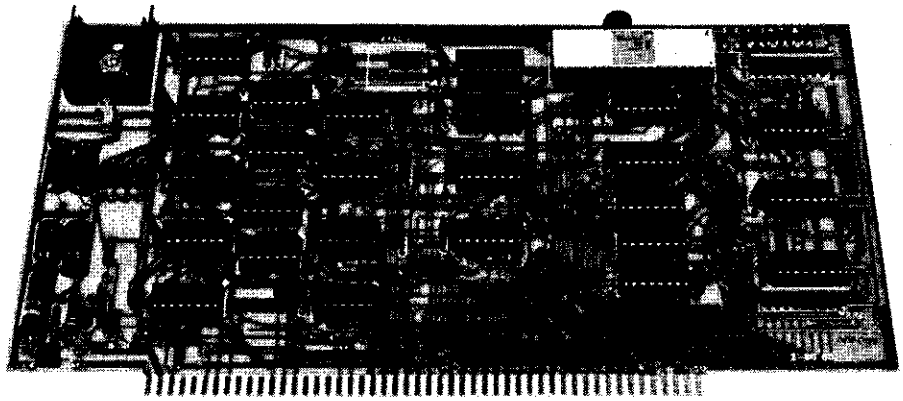
I. Recommended Preventive Maintenance
-Alignment check using CE pack recommended after moving or every 3 months/1000 hrs.
-1000 hr/3 months inspection and cleaning recommended
-2000 hr/6 months replace air filter, inspect for wear

NOTES

1. If using the Altair 8800 Turnkey, the 88-PMC and 88-2SI0 are not required.
2. The 88-HDSK System is not designed to run with the Altair Floppy Disk or Minidisk Systems.

Z-80 CPU Increases Processing Capabilities

By Susan Blumenthal MITS



Z-80 CPU

MITS introduces a Z-80-based Control Processing board to increase the processing capabilities of the Altair™ 8800 series microcomputers.

Designed as a replacement for the 8080 CPU, the Z-80 contains a powerful extended instruction set in addition to the standard 8080 instruction. It is compatible with any Altair 8800 series microcomputer with complete compatibility. (The Z-80 CPU Board is not compatible with the 88-PMC 8, 8K Prom Memory Card.) No hardware modifications are necessary to accomodate the board.

The internal hardware of the Z-80 microprocessor consists of:

--12 General purpose registors
-- 2 Accumulators
-- 2 Index registers
-- 2 Flag registers.

The Z-80 operates under a variety of software which includes:

Z-80 BASIC - a modified version of Altair BASIC (all current versions 4K, 8K, Extended and Disk)

DOS (Disk Operating System) Current available versions of DOS will operate with the Z-80.

The Z-80 CPU provides all 78 of the 8080 microprocessor instructions and an additional 80 instructions. Some of these added valuable instructions include:

--A block transfer group
--A block search group
--Individual bit manipulation group.

The Z-80 includes all 8080 addressing modes plus indexed and bit modes. With the increased capabilities of a more comprehensive instruction set and addressing modes, the amount of memory required for machine language programs decreases.

The Z-80 CPU is available for $295 fully assembled and $275 in Kit form. It's also available in a fully assembled Altair microcomputer.

Specifications

Power Requirements:
5 vdc at 500 MA
+12vdc at 40 MA

Instruction Cycle:
2 microseconds (minimum)

Block Transfer rate:
95,000 bytes per second including increment and decrement overhead

Dimensions:
10" x 5"

Altair™ 88-16MCD Compatible with 8800A

By Robert Lopez
MITS

Since the introduction of the Altair 88-MCD, there has been some confusion among many of our customers about whether or not it's compatible with the 8800A and other Altair computer plug-in boards. With a simple power supply modification to the 8800A, the 16MCD becomes compatible with both the 8800A and all Altair 8800 series plug-in boards.

The Power supply lines of the Altair Bus System are unregulated supply lines, i.e. the voltage present can vary depending upon input A.C. line voltage and frequency and the load power demand. Regulation for each supply line is done individually on each printed circuit board. An Altair 8800A should have bus lines #1 and #51 not less than +7v. (+7.5 NOMINAL), bus line #2 not less than +14v (+15 Nominal), and Bus Line #52 not less than -14v (-15 Nominal).

Changes in technology lead to printed circuit boards which loaded down the +7.5v line to less than +7v. voltages less than +7v cannot be regulated to a clean +5v. The power supply modification printed in the September 1975 CN allowed increased loading.

Several changes have since been made in the Altair 8800B which weren't incorporated in the 8800A. Bus lines #1 and #51 in the 8800B should be not less than +7v (+8 Nominal), line #2 should be not less than +17v (+18 Nominal), and line #52 should be not less than -17v (-18 Nominal).

The 16MCD was designed to run in the Altair 8800B and the Altair 8800B Turnkey, which has the same bus specifications as the 8800B. The requirement of the 16MCD which limits its operation to the 8800B is the +15V necessary for the Mostek 4096 Rams. A 7815 regulator is used to regulated the +15v. For complete regulation, a 7815 requires a minimum of +17v.

So to use the 16MCD in an 8800A, it's necessary to convert to 8800A power supply to 8800B specifications. In order to accomplish this conversion, the 8800A power transformer must be replaced with MITS part #102621. Owners of Altair 8800A's who purchase a 16MCD will receive the new power transformer at no cost.

Use the Interrupt Vector in Single-Level Interrupt Systems

By Steve Gride
MITS Engineering Dept.

A number of new Altair™ computer users have said that they don't understand how the interrupt system is used in the Altair 8800 series. This has led to a misunderstanding concerning single-level interrupts; how are they generated, and what happens during their acknowledgement? Users also ask, "How can I change a single-level interrupt to jump to a location other than 070(8)?" This article will attempt to address these questions.

The Altair 8800 microcomputers use an eight-level vectored interrupt system. This system is based on the interrupt-response vector built into the 8080 CPU chip. It has the following effect: When an interrupt occurs, the device generating the interrupt creates a vector address, which the CPU uses as a restart address during the interrupt-acknowledge cycle. This results in a call to one of the low-memory restart areas

In the Altair system, the restart vector address is usually created by the 88-VI board (vectored interrupt board). This board allows the prioritizing of up to eight levels of interrupts in the restart area. When this board is absent, however, it is the responsibility of the interrupting device to generate the interrupt address. This is usually not done, resulting in a "floating" input to the CPU during interrupt-acknowledge time. These "floating" inputs look like a vector-7 to the CPU, which acknowledges with a restart to 070(8). So most single-level interrupt systems automatically generate a restart to level 7.

(Note: All MITS standard software recognizes single-level interrupts at level 7, therefore, any hardware modifications will require a corresponding change in software.)

The way to jump to a different location in the interrupt vector is illustrated schematically in Figure 1. During the interrupt-acknowledge cycle, the CPU generates the status signals M1 and SINTA. When these two signals occur concurrently, the restart vector is gated onto the data bus.

This circuit may be built up "piggy-back" on the I/0 or other board which will use it, or it may be built on a separate breadboard and plugged into the bus.

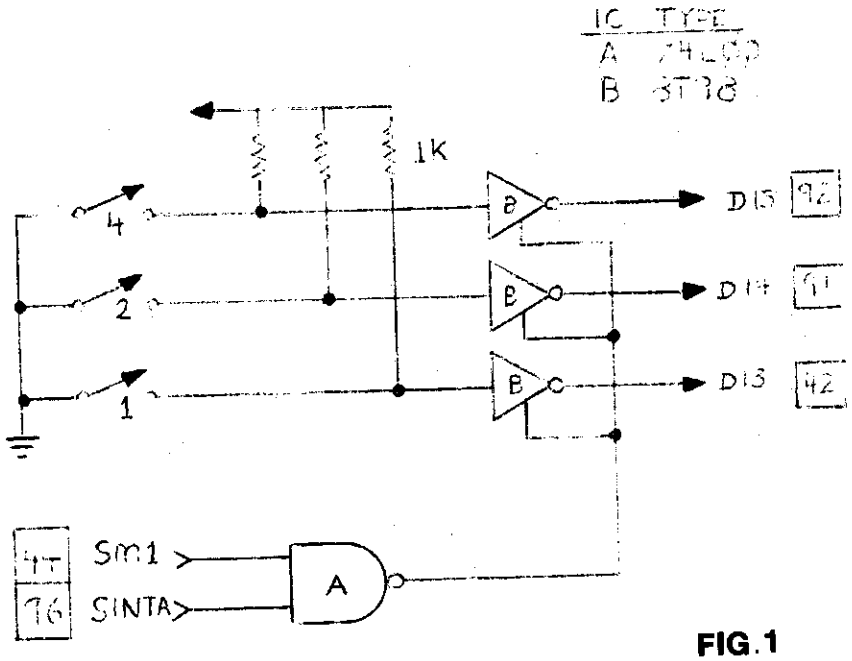


FIG.1

FLOPPY DISK:

Does Your Drive Buzz During a Mount?

By Thomas Durston

If your Floppy Disk Drive makes a loud buzzing noise during Mounting of a diskette, the problem can be eliminated by adjusting a resistor on Floppy Disk Controller Board #2.

The buzzing is caused by the Drive's head trying to step in farther than it should. This occurs during a Mount if an error is detected when reading the track number. The track number error causes the track counter (software) to think it is farther out than it should be, stepping the head in and against the stop at the end of the stepping shaft. The result is the buzzing noise.

This buzzing noise occurs only on certain diskettes if the Head Load time constant is less than 45 ms. It is a function of the Mount routine which reads every eight sectors.

To correct the problem, adjust R8 on Controller Board #2 to yield a 50ms ± 4ms pulse at I.C. B1 pin 13 (TP-6) during a Mount command. The value of R8 will be approximately 16K, and a 20K or 50K trimpot may be used for adjustment in place of R8.

Program Allows Disk Timesharing to Read Non-Timesharing Diskettes

By: Gale Schonfeld
MITS

Many of you are now sharing our excitement over the new Altair Timesharing BASIC. Those of you who have the disk version may be perturbed about a problem with loading 4.0 or 4.1 Disk BASIC program files under Timesharing. However, with only a few minutes of your time and the computer's, the problem can be solved.

In the disk version of Timesharing BASIC, an optional password may be specified during SAVEing of a program. In regular Disk BASIC, the password facility is not provided. Therefore, the problem may occur when a LOAD or RUN command is issued in Timesharing for a program on a regular BASIC disk. Timesharing may respond to the command with PASSWORD FOR FILE "XXX. . ."?, and the user will not know with what password to answer.

This problem is due to the format of the directory track on the diskettes. To review, each sector of the directory track is comprised of eight file name slots. Each slot contains 16 bytes--eight bytes for the file name, one byte for the track pointer, one byte for the sector pointer, one byte indicating whether the file is random or sequential and in regular Disk BASIC, and five unused bytes normally set to nulls. In Timesharing Disk BASIC, these extra five bytes are used for passwords. Occasionally, "garbage" can get into these extra bytes on the normal BASIC diskettes. When Timesharing tries to access these files, it "sees" a password which the user is unaware. If all five bytes are null, Timesharing realizes that a password is not required.

The following program, when executed in 4.0 or 4.1 Disk BASIC, will correct the directory track of a 4.0 or 4.1 diskette. The functions of PASSCHEK are to set the last five bytes of the file name slots to nulls and recalculate the checksum of the sector so it can be read by Timesharing. The program PASSCHEK contains detailed comments regarding its execution. The remark statements can be left out when entering the program in order to utilize a minimum amount of memory.

To use PASSCHEK, enter it into memory using 4.0 or 4.1 Disk BASIC. (It will **not** run in Timesharing.) Place the diskette you need to correct in **Disk Drive** and **MOUNT** it. Now type RUN. PASSCHEK will run for approximately two to three minutes, printing "DONE - CHECK USING PIP DAT COMMAND" when it's finished. If you wish to check using PIP, the format of the floppy disk is described in Appendix H of the Altair BASIC Manual.

For those of you who have old 3.4 Disk BASIC program files that you want to run under Timesharing Disk BASIC, a few extra steps are needed before running PASSCHEK on the 3.4 diskette. Since Timesharing will read only 4.0 or 4.1 formatted files, you must convert your 3.4 files to the 4.0 format. This is easily done by first LOADing and then re-SAVEing all 3.4 program files in ASCII (e.g. SAVE "XXX", O, A), using 3.4 Disk BASIC, and then using the 4.0 PIP CNV command on the diskette to convert the files to the 4.0/4.1 format. After this, you can run PASSCHEK.

Program

```
10 CLEAR 500
20 '
       LINES 30-80 POSTION DISK HEAD TO TRACK 70

30 DT=70                'DESIRED TRACK IS 70
40 IF (INP(8) AND 64)<>0 THEN WAIT 8,2,2:OUT 9,2:
   GOTO 40
50                      'TEST FOR TRACK 0, IF NOT AT 0 STEP HEAD OUT ONE
                         TRACK AND TEST AGAIN
60 IF DT<0 OR DT>76 THEN PRINT "ERROR":STOP
70 FOR K=1 TO DT:WAIT 8,2,2:OUT 9,1:NEXT K
80                      'STEP DISK HEAD IN DT TRACKS, TO TRACK 70
90 '
       LINES 100-160 GET EACH SECTOR OF TRACK 70 AND REPLACE
       5 BYTES OF FILE SLOT WITH NULLS

100 FOR SC=0 TO 31      'GET EACH SECTOR OF TRACK 70
110 A$=DSKI$(SC)        'READ CURRENT SECTOR
120 FOR SL=0 TO 7       'GET EACH FILE NAME SLOT (8 SLOTS/SECTOR)
130 Y$=STRING$(5,0)
140 MID$(A$,19+(SL*16),5)=Y$
150                     'REPLACE LAST 5 BYTES OF EACH FILE NAME
                         SLOT WITH NULLS
160 NEXT SL             'GET NEXT SLOT
170 '
       LINES 190-290 CORRECT CHECKSUM BYTE OF EACH SECTOR AND
       PUT MODIFIED SECTOR BACK ON DISK

180 CK=0                'SET CHECKSUM COUNTER TO ZERO
190 FOR I=6 TO 135      'ADD UP BYTES 6 THROUGH 135
200 CK=CK+ASC(MID$(A$,I,1))
210 NEXT I
220 FOR J=3 TO 4        'ADD BYTES 3 AND 4 TO THE SUM OF 6-135
230 CK=CK+ASC(MID$(A$,J,1))
240 NEXT J
250 CK=CK AND 255       'MASK OUT HIGH ORDER 8 BITS SO THAT CHECK-
                         SUM IS ONLY ONE BYTE
260 MID$(A$,5,1)=CHR$(CK)    'REPLACE BYTE 5 OF THE SECTOR WITH
                              NEW CHECKSUM BYTE
270 DSKO$ A$,SC         'PUT MODIFIED SECTOR BACK ON DISK
280 NEXT SC             'GET NEXT SECTOR
290 PRINT "DONE - CHECK USING PIP DAT COMMAND"
300 END
OK
```

PRACTICAL PROGRAMMING

By Gary Runyon
MITS

This new column will discuss some of the things we're learning in the MITS Computing Services Department about how to program in Altair™ Basic. Although the articles will be aimed at the beginning programmer, even the most advanced programmer should find the column useful and interesting. Complete listings of programming aids we've developed (cross, reference list program, variable name replacement programs, etc.) will be included when necessary. But,there will be nothing about programming in machine code, except possibly a few USR routines.

Each month's column will become a chapter of the Computing Services Standard Practices Manual, which will be used by programmers here at MITS.

LINE COUNTING

One of the first problems the beginning programmer tangles with is line counting, i.e. how to tell that you're at the bottom of the page when printing a report so that you know when to space to the top of the next page. After much work, the beginner's report program can decide when to space to the next page, but for some reason it spaces too far or not far enough. By adding a patch, everything works fine, except for an extra space between the first and second pages. A hokey patch is added and all works well until the program needs its first modification.

The solution? Adopt a convention, understand it, and stick to it. Here at MITS the variable name L9 is reserved for line counting in all programs.

L9 points to the next line to be printed. It is initialized to one plus the number of lines printed at the exit of the page header routine. L9 is incremented by one for every line printed thereafter. For L9=L9T066: LPRINT:NEXT is the routine for getting from the bottom of a page to the top of the next page.

The 66 in the routine comes from six lines per inch, 11 inches per page. If you're printing special forms (checks, invoices, W2, etc.), or have a printer that doesn't print six lines per inch, replace the 66 with the appropriate lines per page. If you need to print a really oddball form, such as three ¼" checks, the trick is to throw in an extra line every other check. The following will handle three ¼" forms on a standard printer:

```
FORL9=L9T019:LPRINT:NEXT:IF A
THEN LPRINT:A=0 ELSE A=1.
```

Test for bottom of the page when you have something to print. Testing for bottom of page after printing can result in an occasional sloppy header with no data at end of report.

The usual test for bottom of page is: IF L9>XX THEN GOSUB [space up and print heading]. This results in XX lines printed per page with 66-XX spaces between the bottom and top of each page.

The test for bottom of page before printing n lines when n is greater than one is: IF L9>XX+1-n THEN GOSUB[]. For example, if a report has three lines per item, five lines of totals, and is not to go below line 64, the test before printing each item would be: IF L9>62THEN GOSUB[]; the test before printing the totals would be: IF L9>60 THEN GOSUB[].

In those cases where n is not a fixed constant, the test for bottom of page will appear in the form IF L9+n XX+1 THEN GOSUB [] (see example program). The concept is, "Will the hokey patch work well until the program allowed value (XX+1) after these n lines are printed?"

The example program PROGLIST demonstrates how to line count. The program reads a program saved in ASCII and prints a listing with the program name, the current date, and page YY of pages ZZ at the top of each page. In order to provide at least three blank lines between each page, the program does not print past line 63.

The two clear statements in line 70 grab off as much string space as is available. This holds to a minimum the time lost to string space garbage collection. Line 100 allows you to input a file name ending with a comma and number to specify files on other than disk drive zero. Line 120 checks for the null string that is at the beginning of every ASCII file. Lines 140-190 read through the file, duplicating what will happen to L9 and the page count when the file is listed. Line 220 prints the heading at the top of the first page.

The FORL9=L9T0132 in line 250 spaces the printer to the top of page twice, leaving the listing where it can be easily torn off.

Lines 290 and 300 show the standard print out for one-line:

1. Test for bottom of page when ready to print
2. Print
3. Increment the line counter

Lines 320-350 determine how many lines will actually print when a program line with the line feeds prints. Each part of the line is loaded into the array L$ so that it can be printed separately. This avoids problems caused by line printers reacting differently to the line feed carriage return embedded in program lines.

Lines 360-370 show the standard print out for more than one-line:

1. Test for bottom of page when ready to print
2. Print
3. Increment the line counter

Line 390 is the standard to-to-top-of-page routine.

Line 420 sets L9 to one plus the number of lines printed in the header (one information line and one blank line) before exiting the heading routine.

To summarize, L9 is the next line on the page to be printed. L9 is initialized to one plus the number of header lines at the exit from the header routine. L9 is incremented by one after each line printed. The test for bottom of page is executed when the program is ready to print. The space to top of page routine is:

```
FORL9=L9T066:LPRINT:NEXT
```

Letter Writing Program Solves Photographers Mailing Problems

By: Lee Wilkinson
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Wilkinson currently runs his own photography studio. For the past 15 years he has been an avid ham radio hobbyist, but had no previous computer experience before purchasing an Altair 8800 to use in his business. In addition to the mainframe, his system now consists of 24K memory, a Teletype, ADM-3, 8-PMC, 88-ACR, 88-SIOA, 88-SIOB and wire wrap board for morse code. Wilkinson has also recently published three other software articles in KILOBAUD.

One of the most beneficial and frequently used programs in my collection of software is a letter writing program. When used in conjuction with our regular direct mail promotion program, it has been an invaluable advertising aid.

Originally, we were sending about 200 letters each month to parents of new babies, one year olds, and two year olds. The parent's names were compiled from the local newspaper, and the letters were prepared on our printing press. Records of appointments made show about a three percent rate of response to this promotion. This is about the national average for direct mail advertising.

We used the Altair computer for printing mailing labels for our children's promotion campaign and for writing personalized letters. Our first mailing brought a 17% return. Needless to say, we continued with this personalized type of mailing, and are still enjoying the same increased response.

However, there were several problems in preparing the mailings. First, the type style of the Teletype wasn't appropriate, and the standard roll paper wasn't a very high quality. Remembering an old cliche, "lemons can be turned into lemonade", an idea came to mind. Why not get a rubber stamp made that said "STUDI-O-GRAM" and imprint each letter so that it would look like a telegram? By using this stamp and placing the letter in a window envelope we created a personalized package that the recipient felt compelled to open.

We've used the "STUDI-O-GRAM" for the local births for about a year now and still enjoy excellent success. We've expanded the "STUDI-O-GRAM" to include about every conceivable list we've ever stored on cassette. This includes doctors, realtors, past patrons, businessmen, little league coaches, and churches, just to mention a few.

For those interested in adapting the program for their own use, a sample listing is enclosed. There's nothing really exotic about the program, and users should have no trouble following it. The body of the letter is inserted from lines 200-279. Lines 500-580 print the title (Mr., Mrs., Rev., etc.) and the last name. Mailing labels can be generated by the subroutine 600-690. The label format can be altered by changing lines 620 and 650-670. The inclusion of the subroutine at lines 700-745 allows a "town code" to be typed for the local area post offices and saves much time and a great deal of memory when typing local lists. However, any city, state, and zip may be typed on any data line (1000 and up), and the program will recognize it. The subroutine at 10000 switches from CRT (port 000// and 00/) to TTY (port 024 and 025 Q) and back to the CRT in my MITS 8K, Ver. 4.0 BASIC.

One of these days I hope to replace the ACR with a disk and a faster printer and then really increase sales.

Practical Programming

```
10 '              ******************
20 '              *                  *
30 '              *    PROGLIST      *
40 '              *                  *
50 '              ******************
60 '
70 CLEAR 400:CLEAR FRE(0):LF$=CHR$(10):DIM L$(50):DEFINT A-Z
80 LINE INPUT"TODAY'S DATE ? ";DA$
90 LINE INPUT"PROGRAM NAME ? ";N$
100 IF MID$(N$,LEN(N$)-1,1) = "," THEN R$=RIGHT$(N$,1):
       IF "0"<=R$ AND R$<="9" THEN N$=LEFT$(N$,LEN(N$)-2):N=VAL(R$)
110 OPEN"I",1,N$,N
120 LINE INPUT#1,L$:
       IF LEN(L$) THEN PRINT"ASCII FILES ONLY PLEASE.":END
130 '
       DETERMINE # OF PAGES TO BE PRINTED
       ***********************************
140 NP=1:L9=3
150 IF EOF(1) THEN200
160 LINEINPUT#1,L$:I=0:M=0
170 M=M+1:I=INSTR(I+1,L$,LF$):IFITHEN170
180 IF L9+M>64 THEN NP=NP+1:L9=3
190 L9=L9+M:GOTO150
200 NP$=" OF"+STR$(NP)
210 '
       START PRINTING
       **************
220 GOSUB400
230 CLOSE:OPEN"I",1,N$,N:LINEINPUT#1,L$
240 '
       READ UP LINES FOR PRINT
       ***********************
250 IF EOF(1) THEN FORL9=L9TO132:LPRINT:NEXT:CLOSE:CLEAR200:END
260 LINE INPUT#1,L$
270 I=INSTR(L$,LF$):IFITHEN320
280 '
       LPRINT NO LINE FEED LINE
       ************************
290 IF L9>63 THENGOSUB390
300 LPRINTL$:L9=L9+1:GOTO250
310 '
       LPRINT LINE WITH EMBEDDED LINE FEEDS
       ************************************
320 M=1:H=1
330 IFI=HTHENL$(M)=""ELSEL$(M)=MID$(L$,H,I-H)
340 M=M+1:H=I+2:I=INSTR(H,L$,LF$):IFITHEN330
350 IFI=HTHENL$(M)=""ELSEL$(M)=MID$(L$,H)
360 IFL9+M>64THENGOSUB390
370 FORI=1TOM:LPRINTL$(I):NEXT:L9=L9+M:GOTO250
380 '
       SPACE TO HEAD OF FORM AND LPRINT HEADER
       ***************************************
390 FORL9=L9TO66:LPRINT:NEXT
400 PG=PG+1:PG$="PAGE"+STR$(PG)+NP$
410 LPRINTN$;" LISTED ";DA$;TAB(75-LEN(PG$));PG$
420 LPRINT:L9=3:RETURN
```

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Trace Program Simplifies Debugging for Altair™ 680b

By Doug Jones
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The software interrupt instruction (SWI hex 3F) in the Altair™ 680b computer permits a rather unique method of setting program breakpoints for debugging. The PROM MONITOR manual contains a rather good discussion of this routine in Section V, which also includes a very short program to print out the contents of the processor's registers each time a program breakpoint occurs.

There are two methods of handling a SWI by the MONITOR. (1) If you haven't set a bit 7 of BRKADR (00F2), anytime a SWI is executed in the assembled code, a return is made to the MONITOR. Using the (N)ext command, all registers may be inspected and, if you wish, modified. Continuation of the program is made by the (P)roceed command. Everything is returned back from the stack, and processing continues. (2) If bit 7 of BRKADR is set, upon execution of the SWI, control is vectored to address 0000 where a user routine, such as the print register routine, must be waiting.

Consider the program shown in the sample run. Assume that this program is giving you trouble, or perhaps you would like to watch the values loaded into the A register. To use the SWI, the program would have to be opened up just before the BEQ instruction, a SWI inserted, and then one of the two methods described above used to watch the A register contents.

Once the program error has been corrected, it must either be reassembled to remove the SWIs that you have used, or they must be NOPed out.

DEBUG TRACE will co-exist in memory with your program. It will wrap itself around your program so to speak and allow you to control its running. It will replace every instruction encountered in your program with a SWI, give you a dump of register content if you want it, replace your original instruction, and continue processing through that instruction.

In abbreviated format, here are particulars of the program:

Length 1K.
Starting address (j) 4000.
Commands:

D Dump registers while in the command mode.
M Return to MONITOR. After (M) and (N)ing any part of memory, a (P)roceed will return control to DEBUG.
J Jump to program. You will be queried about the starting address. Program execution from that point on the will be under control of DEBUG.
A/B/C/X allows you to set the indicated register.
I Set instruction breakpoint. Zero (0000) for none.
O Set operand breakpoint. Zero for none.
T Set trace on and trace off addresses. To kill trace, set to FFFF and 0000 respectively.
(ESC) Escape can be used any time during controlled program run or register dump for return to command mode.

****CAUTION****

Any address set or register set MUST be valid hex characters or you will return to MONITOR. A (J)ump command must be executed back to DEBUG to return operation to normal.

PRINTOUTS

Type of dump:

D called by dump command (extended);
T trace dump;
B dump due to I or 0 breakpoint (extended)
X illegal operation attempted (extended).

I The instruction you are about to process.
Operand will show none, one, or two bytes, depending on the instruction.
Stack will show where the user's program placed it.

Program counter will normally show the address of the instruction you are **going into**. It will show the destination address **if** a jump or conditional branch is executed.

Illegal operations are RTI ($3B), WAI ($3E). RTS ($39) will also be an illegal operation if the number of returns exceeds the number of subroutine calls.

Any return to DEBUG command mode will normalize and cancel all subroutine linkages. User program must be restarted with a (J) XXXX.

Legal calls to MONITOR subroutines OUTCH, INCH, OUTS, and OUT2H are allowed, executed, and printed (with echo), but are not traced.

As shown in Table 2, wherever the user program defines the stack, approximately 11 bytes will be utilized by DEBUG. All pointers will be returned to where you left them.

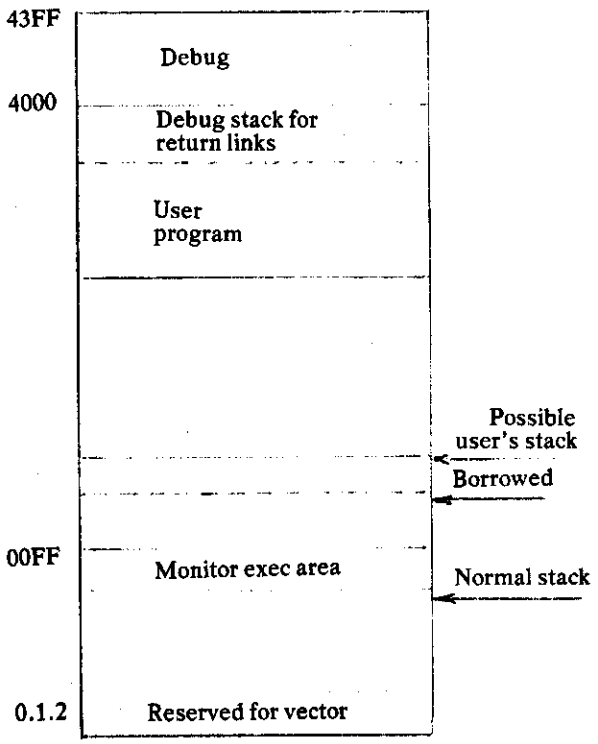
DEBUG is volatile. In order to keep the program length to 2 K or under, many checks and cross-checks had to be eliminated. One, for example, was a range check that would stop all activity equal to or above DEBUG's stack area. Some bells and whistles also had to be excluded; for example, the ability to proceed from a breakpoint or an (ESC)ape.

The user's program will run with no trace or breakpoints established and is interruptable by (ESC). You will, however, notice a 100-fold increase or greater in user program run time.

Table 1 Printout Format.

Trace Only	(extended)
TII0000SSSSCCBBAAXXXXPPPPTTTT	
TT TT II II 00 00	
Operand breakpoint	
Instruction breakpoint	
Trace off	
Trace on	
Program counter	
X-register	
A-register	
B-register	
Condition code register	
Stack pointer	
Operand	
Instruction	
Type of dump	

Table 2 Memory Map.



OBJECT CODE

```
S00B0000444542554720202020
S10400F3FF09
S11E4000BF439D07B743A6CE43788D57BE439DBF43A4CE3FFFFF43967F439A6A
S11E401BFE439BB643A0A7007F439BCE43728D38CE4239DF01867E9700439727
S11E4036F2BD4307CE43B5E600270EF1439F27050808080F2EE016E00CE43FA
S11E40518E8D0F20B6B7439F8611B7434DBD431A20F1E6002706BDFF81082036
S11E406CF639D7F3D7F23F7E40078D18FF43AD8D13FF43AF20DF8D0CFF43B1BF
S11E408720F78D05FF43B320F0CE4381BD40637E42F8BD4313F743A620DFBD13
S11E40A24313F743A720F6BD4313F743A820EE8DE3FF43A920E78DD6A600B78D
S11E40BD43A07E4256BD42E1F7412C7F412BFE412BBD4293C6022019BD42EED2
S11E40D8B643A0FE43A1FF412BBD4293817E271C81BD2721C603FE43AB5D2750
S11E40F304085A20F9FF42CD7E42B4FE43ABBD4147FE412BFF43AB5F20E18C39
S11E410EFF81270F8CFF6D270A8CFF0027058CFF8226DDBD42FFB643A8F64314
S11E4129A7BD0000B743A8F743A7BD4302BD4274FE43AB080808A600B743A0D7
S11E41447E4256080808FF42CDBF4398BE4396B642CE36B642CD36BF4396BEA2
S11E415F43987C439A39B643A0818D2715818C270B818E270781CE27037E403E
S11E417AC2BD42EE7E40ECFE43AB8DC27E4212BD42DCF643A0C1392716C13BD9
S11E419527 0DC13E2709C13F2705C6017E40EE86587E40567D439A27F67A43E3
S11E41B09ABF4398BE439632B742CD32B742CEFE42CDFF43AB8F4396BE439809
S11E41CB7E40F8BD42E1FE43A9FF412B0C5FB643A18D17B643A081AD270781CB
S11E41E66E27097E40CEFE43ABBD41487E4104BB412CF9412BB7412CF7412B87
S11E420139BB412C2405FB412B20EFFB412B5A20E9BD42E1FE43AB0808FF41B8
S11E421C2BB643A0B74227B643A60600220BE0C5FB643A12A038DCE8C8DBEB6
S11E42372 0B9FE439BB643A0A7008607CE43A633E700084A26F9BF43A48D1A57
S11E4252FE43AB09FF43ABB643A084F0444444CE43D3084A2AFCEE006E00BD1D
S11E426DFF24240ABDFF04C11B26037E400739BC43B1272EB643AEF643AD800C
S11E42880 1C200B0412CF2412B2506BC43B3271739B643B0F643AFB0412CF2E5
S11E42A3412B25F18654B7439F7E431A86427EA056BE43A48607CE43ACE6007B
S11E42BE37094A26F9FE43ABFF412BBD427CCE0000A600B743A0863FA700FFED
S11E42D9439B3B4FB743A33986018DF8FE43ABE601F743A1398602BDF1E602A7
S11E42F4F743A2398D05BDFF6220038 6038C86FF97F3398DF6BDFF00F7439F4E
S11E430F8D5220EF8DEABDFF5320E8CE438ABD4063F6439F8D3BB643A08D430F
S11E432AB643A32714B643A1BDFF6DB643A34A270AB643A2BDFF6D20048D242A
S11E43458D228D20CE43A4C609270AA600378D1833085A20F48609B7434D390E
S11E4360BDFF81BDFF827E426C8DF820F6BDFF6D20F10D0AFF4020000D0AFF36
S11E437B4445425547002041444452203F20000D0AFF002A4552524F522A000E
S11E43963FFF0000000000000003F000000000000000000000000FFFF00008D
S11E43B100000004D406E4340994240A14140A95840B15440764F4089494095
S11E43CC824A40B444059004189418942124189418941 8941CE40D5416540E1
S11043E7C241CE40D5416540C241CE40D513
S10400F30305
S9030000FC

TOTAL ERRORS 00000

ENTER PASS
```

continued on page 12

Trace Program Simplifies Debugging

Source Listing

```
 FFEF$$
 NAM DEBUG
*
*SOURCE 1.2.0
*

*JUNE 1977 DLJ
*
 OPT NOG
*
  ORG $00F3
  FCB $FF
*

* INSTRUCTIONS:

*
* D = (D)UMP REGISTERS
* M = (M)ONITOR RETURN
* J = (J)UMP
* A/B/C/X/I/O/T =
* SET REGISTERS/BREAKPOINTS/TRACE
*
BADDR EQU $FF62
BRKADR EQU $00F2
BYTE EQU $FF53
ECHO EQU $00F3
INCH EQU $FF00
OUT2H EQU $FF6D
OUTCH EQU $FF81
OUTS EQU $FF82
POLCAT EQU $FF24
*
  ORG $4000
START STS STKSV SAVE IT
  TPA
  STA A CCREG
*

DEBUG LDX #MES1  SEND 'DEBUG'
  BSR MSG
*
EXEC LDS STKSV
 STS STKHI
 LDX #START-1
 STX MYSTK
 CLR SUBCNT
 LDX SWIADR
 LDA A INST
 STA A X
 CLR SWIADR
  LDX #PRMPT  POP OUT A @
  BSR MSG
  LDX #RUNVCT  SET RUN VECTOR
  STX 1  STORE AT SWI
  LDA A #$7E  LOAD A JMP
  STA A 0 STORE IT AT SWI
  COM A  SET HIGH BIT
  STA A BRKADR  AT BREAK ADDR
  JSR IN  GET A CHRCTR
 LDX #JMPTB JUMP TABLE
EXEC1 LDA B X GET LTR
 BEQ BUM DONE=
 CMP B WHAT MATCH?
 BEQ JMPCMD
 INX TO NEXT LTR
 INX
 INX
 BRA EXEC1
JMPCMD LDX 1,X TAKE IT
 JMP X
*
BUM LDX #EM BUMMER
 BSR MSG
BUM1 BRA EXEC  BACK YOU GO
*
DMP1 STAA WHAT
DMP LDA A #$11
  STA A HMNY  SET FOR BIG DMP
DMP3  JSR PRNTRG
DMP2 BRA BUM1 EXEC
*
MSG LDA B 0,X
 BEQ MSG1
 JSR OUTCH
 INX
 BRA MSG
MSG1 RTS
*
MONIT  STA B ECHO
  STA B BRKADR
  SWI  BACK TO MONITOR
  JMP DEBUG  READY FOR (P)ROCEED
*
TSET BSR ADPRM TRACE SET  GET ADDR
  STX TON  TRACE ON ADR
  BSR ADPRM
  STX TOFF  TRACE OFF ADR
TS1 BRA DMP2 EXEC
*
BI BSR ADPRM  INST BREAKPT
  STX BIADR
  BRA TS1  EXEC

*
BO BSR ADPRM  OPRND BKPT
  STX BOADR
 BRA TS1
*
ADPRM LDX #MES2
ADPRM1 JSR MSG
ADPRM2 JMP BAD & RTRN
*
STC JSR BY CNDTN REG
  STA B CCREG
STC1  BRA TS1
*
STB JSR BY BREG
  STA B BREG
  BRA STC1
*

STA JSR BY AREG
  STA B AREG
  BRA STC1
*
STX BSR ADPRM2 XREG
  STX XREG
*
ST5 BRA STC1 EXEC
*
JMPXX BSR ADPRM GET ADR
 LDA A X GET INST
 STA A INST
 JMP RUN2
*
DIR JSR POP1 LOAD OPRND
 STA B CKADR+1
 CLR CKADR
 LDX CKADR
DIR3
     JSR EXMOP
DIR2 LDA B #2 NEXT SWI
 BRA EXT1A
*
EXT JSR POP2 LOAD OPRND
  LDA A INST
  LDX INST+1 GET ADR
 STX CKADR
 JSR EXMOP
  CMP A #$7E  JMP?
  BEQ EXT2
 CMP A #$BD JSR?
  BEQ EXT3
EXT1  LDA B #3 NEXT SWI
EXT1A LDX PCREG
EXT1B TST B
 BEQ EXT1C
 INX
 DEC B
 BRA EXT1B
EXT1C STX HERE
 JMP REPAK
EXT2 B LDX PCREG
 JSR SAVLK3
EXT2  LDX CKADR
 STX PCREG  SWAP
 CLR B NEXT SWI
 BRA EXT1A
EXT3 CPX #OUTCH
 BEQ DOIT
 CPX #OUT2H
 BEQ DOIT
 CPX #INCH
 BEQ DOIT
 CPX #OUTS
 BNE EXT2B
DOIT  JSR EON
 LDA A AREG
 LDA B BREG
**********
 FCB $BD JSR
CKADR FCB 0,0

**********
 STA A AREG
 STA B BREG
 JSR EOF
 JSR CKHUM3 ESCAPE?
 LDX PCREG NO
 INX PAST JSR
 INX
 INX
 LDA A X
 STA A INST
 JMP RUN2
*
SAVLK3 INX SAVE LINK
SAVLK2 INX
SAVLK INX
 STX HERE
 STS STKTMP
 LDS MYSTK
 LDA A HERE+1
 PSH A
 LDA A HERE
 PSH A
 STS MYSTK
 LDS STKTMP
 INC SUBCNT
 RTS
*
IMM LDA A INST
  CMP A #$8D BSR?
  BEQ BSIMM
  CMP A #$8C CPX?
  BEQ IMM3
  CMP A #$8E  LDS?
  BEQ IMM3
 CMP A #$CE  LDX?
 BEQ IMM3
 JMP DIR
IMM3 JSR POP2 OK
 JMP EXT1
BSIMM  LDX PCREG
 BSR SAVLK2
 JMP REL
*
INHER JSR POP0 FILL OPRND
 LDA B INST
 CMP B #$39 RTS
 BEQ INH1
 CMPB #$3B RTI
 BEQ INHOUT
 CMPB #$3E WAI
 BEQ INHOUT
 CMP B #$3F SWI
 BEQ INHOUT
 LDA B #1
 JMP EXT1A
INHOUT LDA A #'X  WON'T ALLOW
 JMP DMP1 PRINT & EXEC
INH1 TST SUBCNT
 BEQ INHOUT TOO MANY RTS?
 DEC SUBCNT
 STS STKTMP
 LDS MYSTK
 PU
   L

     A
 STA A HERE
 PUL A
 STA A HERE+1
```


continued

for Altair™ 680b continued

```
  LDX HERE
  STX PCREG
  STS MYSTK
  LDS STKTMP
  JMP EXTIC
*  .
INDX JSR POP1  LOAD OPRND
   LDX XREG
   STX CKADR
   CLC
   CLR B
   LDA A INST+1   LOAD INDEX VALUE
  BSR ADDM
INDX2   LDA A INST
   CMP A #$AD
                JSR?
  BEQ INDX4
  CMP A #$6E JMP
  BEQ INDX5
INDX3 JMP DIR3
INDX4 LDX PCREG
  JSR SAVLK2
INDX5 JMP EXT2
*
ADDM ADD A CKADR+1 LS BITS
   ADCB CKADR MS BITS
ADDM1 STA A CKADR+1
   STA B CKADR
  RTS
*
SUBM   ADD A CKADR+1
  BCC SUB1
  ADD B CKADR
  BRA ADDM1
SUB1 ADD B CKADR
  DEC B
  BRA ADDM1
*
REL JSR POP1  OPRND
  LDX PCREG
  INX
  INX
  STX CKADR
   LDA A INST  GET READY FOR JUMP
   STA A PSEUDO
   LDA A CCREG   LOAD CNDTNS
   TAP
**********
PSEUDO FCB 0,2
**********
  BRA INDX3   DOES NOT JMP
REL2 CLC   DOES JMP
   CLR B
   LDA A INST+1
   BPL REL3   IS JMP POS OR NEG
   BSR SUBM
   FCB $8C CPX
REL3 BSR ADDM
REL4 BRA INDX5   MAKE SWAP
*
RUNVCT   LDX SWIADR RESTORE INSTR
  LDA A INST
  STA A X
  LDA A #7
  LDX #CCREG
SAV1 PUL B
  STA B X
  INX
  DEC A
  BNE SAV1
  STS STKHI
   BSR CKHUM   CHECK HUMAN
RUN LDX PCREG
  DEX  DUE TO SWI
RUN2 STX PCREG
  LDA A INST
  AND A #$F0 CLEAR JNK
  LSR A
  LSR A
  LSR A
  LDX #TABLE-1 SET FOR JMP
R1 INX
  DEC A
  BPL R1
  LDX X
  JMP X TAKE JMP
*
```

```
CKHUM JSR POLCAT   HUMAN WANT CONTROL?
   BCC CKHUM2   NO
CKHUM1 JSR INCH+4
CKHUM3   CMP B #$1B   ESCAPE?
   BNE CKHUM2   NOPE
   JMP DEBUG   SCRAM
CKHUM2 RTS   BACK YOU GO
*
EXMDR   CPX BIADR   INST BKPNT?
   BEQ BKPT
  LDA A TON+1
  LDA B TON
  SUB A #1 CRRCT FOR CARRY
  SBC B #0
  SUB A CKADR+1
  SBC B CKADR
  BCS EX2
EXMOP CPX BOADR OPRND BKPNT?
  BEQ BKPT
EX1 RTS
EX2 LDA A TOFF+1
  LDA B TOFF
  SUB A CKADR+1
  SBC B CKADR
  BCS EX1
EX3   LDA A #'T
   STA A WHAT
  JMP PRNTRG DMP & RTRN
*
BKPT LDA A #'B
  JMP DMP1 PRINT & EXEC
*
REPAK   LDS STKHI   REPAK STACK
   LDA A #7
  LDX #PCREG+1
REP1   LDA B X
   PSH B
   DEX
   DEC A
   BNE REP1
  LDX PCREG ANYTHING GOING ON?
  STX CKADR
  JSR EXMDR GO SEE
  FCB $CE LDX #
HERE FCB 0,0

  LDA A X
  STA A INST
  LDA A #$3F
  STA A X
  STX SWIADR
  RTI
*
POP0 CLR A   NO OPRND
   STA A ASCFG
   RTS
POP1 LDA A #1
   BSR POP0+1
   LDX PCREG
   LDA B 1,X
   STA B INST+1
   RTS
POP2 LDA A #2
   BSR POP1+2
   LDA B 2,X
   STA B INST+2
   RTS
*
BAD BSR EON   ECHO ON
   JSR BADDR   GET ADDR
  BRA EOF
*
EON LDA A #$03
   FCB $8C CPX
EOF LDA A #$FF
  STA A ECHO
   RTS
*
IN BSR EON
   JSR INCH
  STA B WHAT
  BSR PNTS
   BRA EOF
*
BY BSR EON
   JSR BYTE
   BRA EOF
*
```

```
PRNTRG LDX #MES4
  JSR MSG
   LDA B WHAT   WHAT TYPE DMP
   BSR PNT1
   LDA A INST   INST
  BSR OUT2
  LDA A ASCFG   OPRND?
   BEQ PRN3   NONE
   LDA A INST+1
   JSR OUT2H
   LDA A ASCFG   MORE?
  DEC A
   BEQ PRN2   NOPE
   LDA A INST+2
   JSR OUT2H
   BRA PRN1
PRN3 BSR XX
PRN2 BSR XX
PRN1 BSR XX
  LDX #STKHI
**********
   FCB $C6   (LDA B #)
HMNY FCB 9
**********
PRNLP BEQ PRN4
  LDA A X
  PSH B
  BSR OUT2
  PUL B
  INX
  DEC B
  BRA PRNLP
PRN4 LDA A #9 FORM RESET
  STA A HMNY
  RTS
*
PNT1 JSR OUTCH
PNTS JSR OUTS
PNTC JMP CKHUM
*
XX BSR PNTS
  BRA PNTS
*
OUT2 JSR OUT2H
  BRA PNTS
*
PRMPT FCB $0D,$0A
  FCB $FF
   FCC /@ /
   FCB 0
*
MES1 FCB $0D,$0A
  FCB $FF
   FCC /DEBUG/
   FCB 0
*
MES2 FCC / ADDR ? /
   FCB 0
*
MES4 FCB $0D,$0A
  FCB $FF,0
*
EM FCC /*ERROR*/
   FCB 0
*
MYSTK FDB START-1
STKTMP FCB 0,0
SUBCNT FCB 0
SWIADR FCB 0,0
STKSV FCB 0,0
*
WHAT FCB 0
INST FCB $3F,0,0
ASCFG FCB 0
STKHI FCB 0,0
CCREG FCB 0
BREG FCB 0
AREG FCB 0
XREG FCB 0,0
PCREG FCB 0,0
TON FCB $FF,$FF
TOFF FCB 0,0
BIADR FCB 0,0
BOADR FCB 0,0
*
JMPTB FCC /M/ MONITOR
  FDB MONIT
  FCC /C/ CREG
  FDB STC
  FCC /B/ BREG
```

continued on page 14

Trace Program Simplifies Debugging

Source Listing
continued

```
 FDB STB
 FCC /A/ AREG
 FDB STA
 FCC /X/ XREG
 FDB STX
 FCC /T/ TRACE
 FDB TSET
 FCC /O/ OPR BKPT
 FDB BO
 FCC /I/ INST BKPT
 FDB BI
 FCC /J/ JMP
 FDB JMPXX
 FCC /D/ DMP REG
 FDB DMP
 FCB 0
*
TABLE FDB INHER
 FDB INHER
 FDB REL
 FDB INHER
 FDB INHER
 FDB INHER
 FDB INDX
 FDB EXT
 FDB IMM
 FDB DIR
 FDB INDX
 FDB EXT
 FDB IMM
 FDB DIR
 FDB INDX
 FDB EXT
*
 ORG $00F3
 FCB $03
*
 END

@
```

Assembled Listing

```
00001                        NAM       DEBUG
00002                *
00003                *SOURCE 1.2.0
00004                *
00005                *JUNE 1977 DLJ
00006                *
00007                        OPT       NOG
00008                *
00009 00F3                   ORG       $00F3
00010 00F3 FF                FCB       $FF
00011                *
00012                * INSTRUCTIONS:
00013                *
00014                * D = (D)UMP REGISTERS
00015                * M = (M)ONITOR RETURN
00016                * J = (J)UMP
00017                * A/B/C/X/I/O/T =
00018                * SET REGISTERS/BREAKPOINTS/TRACE
00019                *
00020       FF62     BADDR   EQU       $FF62
00021       00F2     BRKADR  EQU       $00F2
00022       FF53     BYTE    EQU       $FF53
00023       00F3     ECHO    EQU       $00F3
00024       FF00     INCH    EQU       $FF00
00025       FF6D     OUT2H   EQU       $FF6D
00026       FF81     OUTCH   EQU       $FF81
00027       FF82     OUTS    EQU       $FF82
00028       FF24     POLCAT  EQU       $FF24
00029                *
00030 4000                   ORG       $4000
00031 4000 BF 439D START     STS       STKSV     SAVE IT
00032 4003 07                TPA
00033 4004 B7 43A6           STA A     CCREG
00034                *
00036 4007 CE 4378 DEBUG     LDX       #MES1     SEND 'DEBUG'
00037 400A 8D 57             BSR       MSG
00038                *
00039 400C BE 439D EXEC      LDS       STKSV
00040 400F BF 43A4           STS       STKHI
00041 4012 CE 3FFF           LDX       #START-1
00042 4015 FF 4396           STX       MYSTK
00043 4018 7F 439A           CLR       SUBCNT
00044 401B FE 439B           LDX       SWIADR
00045 401E B6 43A0           LDA A     INST
00046 4021 A7 00             STA A     X
00047 4023 7F 439B           CLR       SWIADR
00048 4026 CE 4372           LDX       #PRMPT    POP OUT A @
00049 4029 8D 38             BSR       MSG
00050 402B CE 4239           LDX       #RUNVCT   SET RUN VECTOR
00051 402E DF 01             STX       1         STORE AT SWI
00052 4030 86 7E             LDA A     #$7E      LOAD A JMP
00053 4032 97 00             STA A     0         STORE IT AT SWI
00054 4034 43                COM A               SET HIGH BIT
00055 4035 97 F2             STA A     BRKADR    AT BREAK ADDR
00056 4037 BD 4307           JSR       IN        GET A CHRCTR
00057 403A CE 43B5           LDX       #JMPTB    JUMP TABLE
00058 403D E6 00     EXEC1   LDA B     X         GET LTR
00059 403F 27 0E             BEQ       BUM       DONE?
00060 4041 F1 439F           CMP B     WHAT      MATCH?
00061 4044 27 05             BEQ       JMPCMD
00062 4046 08                INX                 TO NEXT LTR
00063 4047 08                INX
00064 4048 08                INX
00065 4049 20 F2             BRA       EXEC1
00066 404B EE 01     JMPCMD  LDX       1,X       TAKE IT
00067 404D 6E 00
                             JMP       X
00068                *
00069 404F CE 438E BUM       LDX       #EM       BUMMER
00070 4052 8D 0F             BSR       MSG
00071 4054 20 B6     BUM1    BRA       EXEC      BACK YOU GO
00072                *
00073 4056 B7 439F DMP1      STA A     WHAT
00074 4059 86 11     DMP     LDA A     #$11
00075 405B B7 434D           STA A     HMNY      SET FOR BIG DMP
00076 405E BD 431A DMP3      JSR       PRNTRG
00077 4061 20 F1     DMP2    BRA       BUM1      EXEC
00078                *
00079 4063 E6 00     MSG     LDA B     0,X
00080 4065 27 06             BEQ       MSG1
00081 4067 BD FF81           JSR       OUTCH
00082 406A 08                INX
00083 406B 20 F6             BRA       MSG
00084 406D 39        MSG1    RTS
00085                *
```

continued

for Altair™ 680b continued

```
00086 406E D7 F3   MONIT  STA B      ECHO
00087 4070 D7 F2          STA B      BRKADR
00088 4072 3F             SWI                 BACK TO MONITOR
00089 4073 7E 4007        JMP        DEBUG    READY FOR (P)ROCEED
00090                *
00091 4076 8D 18   TSET   BSR        ADPRM    TRACE SET  GET ADDR
00092 4078 FF 43AD        STX        TON      TRACE ON ADR
00093 407B 8D 13          BSR        ADPRM
00094 407D FF 43AF        STX        TOFF     TRACE OFF ADR
00095 4080 20 DF   TSI    BRA        DMP2     EXEC
00096                *
00097 4082 8D 0C   BI     BSR        ADPRM    INST BREAKPT
00098 4084 FF 43B1        STX        BIADR
00099 4087 20 F7          BRA        TSI      EXEC
00100                *
00101 4089 8D 05   BO     BSR        ADPRM    OPRND BKPT
00102 408B FF 43B3        STX        BOADR
00103 408E 20 F0          BRA        TSI
00104                *
00105 4090 CE 4381 ADPRM  LDX        #MES2
00106 4093 BD 4063 ADPRM1 JSR        MSG
00107 4096 7E 42F8 ADPRM2 JMP        BAD      & RTRN
00108                *
00109 4099 BD 4313 STC    JSR        BY       CNDTN REG
00110 409C F7 43A6        STA B      CCREG
00111 409F 20 DF   STC1   BRA        TSI
00112                *
00113 40A1 BD 4313 STB
                          JSR        BY       BREG
00114 40A4 F7 43A7        STA B      BREG
00115 40A7 20 F6          BRA        STC1
00116                *
00117 40A9 BD 4313 STA    JSR        BY       AREG
00118 40AC F7 43A8        STA B      AREG
00119 40AF 20 EE          BRA        STC1
00120                *
00121 40B1 8D E3   STX    BSR        ADPRM2   XREG
00122 40B3 FF 43A9        STX        XREG
00123                *
00124 40B6 20 E7   ST5    BRA        STC1     EXEC
00125                *
00126 40B8 8D D6   JMPXX  BSR        ADPRM    GET ADR
00127 40BA A6 00          LDA A      X        GET INST
00128 40BC B7 43A0        STA A      INST
00129 40BF 7E 4256        JMP        RUN2
00130                *
00131 40C2 BD 42E1 DIR    JSR        POP1     LOAD OPRND
00132 40C5 F7 412C        STA B      CKADR+1
00133 40C8 7F 412B        CLR        CKADR
00134 40CB FE 412B        LDX        CKADR
00135 40CE BD 4293 DIR3   JSR        EXMOP
00136 40D1 C6 02   DIR2   LDA B      #2       NEXT SWI
00137 40D3 20 19          BRA        EXT1A
00138                *
00139 40D5 BD 42EE EXT    JSR        POP2     LOAD OPRND
00140 40D8 B6 43A0        LDA A      INST
00141 40DB FE 43A1        LDX        INST+1   GET ADR
00142 40DE FF 412B        STX        CKADR
00143 40E1 BD 4293        JSR        EXMOP
00144 40E4 81 7E          CMP A      #$7E     JMP?
00145 40E6 27 1C          BEQ        EXT2
00146 40E8 81 BD          CMP A      #$BD     JSR?
00147 40EA 27 21          BEQ        EXT3
00148 40EC C6 03   EXT1   LDA B      #3       NEXT SWI
00149 40EE FE 43AB EXT1A  LDX        PCREG
00150 40F1 5D      EXT1B  TST B
00151 40F2 27 04          BEQ        EXT1C
00152 40F4 08             INX
00153 40F5 5A             DEC B
00154 40F6 20 F9          BRA        EXT1B
00155 40F8 FF 42CD EXT1C  STX        HERE
00156 40FB 7E 42B4        JMP        REPAK
00157 40FE FE 43AB EXT2B  LDX        PCREG
00158 4101 BD 4147
                          JSR        SAVLK3
00159 4104 FE 412B EXT2   LDX        CKADR
00160 4107 FF 43AB        STX        PCREG    SWAP
00161 410A 5F             CLR B               NEXT SWI
00162 410B 20 E1          BRA        EXT1A
00163 410D 8C FF81 EXT3   CPX        #OUTCH
00164 4110 27 0F          BEQ        DOIT
00165 4112 8C FF6D        CPX        #OUT2H
00166 4115 27 0A          BEQ        DOIT
00167 4117 8C FF00        CPX        #INCH
00168 411A 27 05          BEQ        DOIT
```

continued on page 18

Classified Ads

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Correction

GLITCHES, p. 19, Oct. CN

The last line in the second paragraph should read, "Kits and assembled units will use **74LS13** for ICA and B. There's no such chip as a 74SL5153.

Also, note that a separate 25-pin DB connector is used for RS-232 (wired as before), and a separate 25DB connector is used for the TTY printer.

Destroying Klingons Can

Audio Star Trek Using the 88-MU1
By Thomas G. Schneider
MITS

Bleep-Bleep!

Klingon at sector 4-8, Captain. I recommend immediate action.

Blow him away, Sulu!

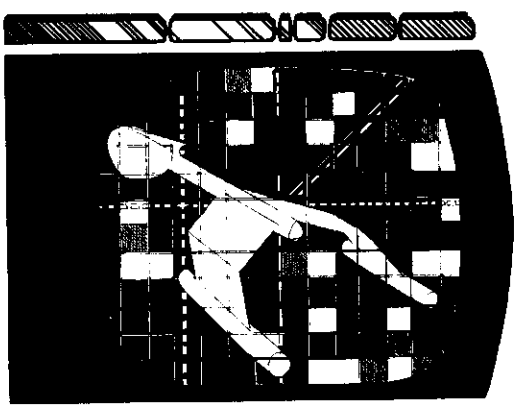
BZZZZZZZZZZZZZT. . .Poot!

Klingon destroyed, Captain!

Wouldn't computer Star Trek be really far-out if it actually made those sounds? Let's face it, watching those K's disappear on your screen quietly and undramatically leaves a lot to be desired. But now, with the new Altair™ 88-MU1, you can produce almost any sound effects for practically any purpose, including Star Trek.

Listing 1 is a version of Star Trek modified for sound effects. These effects are generated by the subroutines listed at the end of the program. Sounds are produced for maps, warp engines, photon torpedos, phasors, destruction of stars and klingons, and command prompts. As an added feature, an appropriate melody is played to insult the user who misses a klingon. If you want to modify Star Trek even more radically, refer to listing 2, which shows where the sound routines are called.

So plug in your new 88-MU1, load up audio Star Trek, turn up your amplifier, and get those klingons.



```
9 GOSUB1500
10 DIM D(5),K1(7),K2(7),K3(7),S(7,7),G(7,7),D$(5)
20 G$=". EKB*"
30 D$(0)="WARP ENGINES"
40 D$(1)="SHORT RANGE SENSORS"
50 D$(2)="LONG RANGE SENSORS"
60 D$(3)="PHASERS"
70 D$(4)="PHOTON TORPEDOES":D$(5)="GALACTIC RECORDS"
80 INPUT"PLEASE ENTER A RANDOM NUMBER";E$:I=ASC(E$)
90 I=I-11*INT(I/11):FOR J=0 TO I:K=RND(1):NEXT:PRINT"WORKING-"
100 DEF FND(N)=SQR((K1(I)-S1)^2+(K2(I)-S2)^2)
110 GOSUB 610:GOSUB 450:G1=X:G2=Y:X=8:Y=1:X1=.2075:Y1=6.28:X2=3.28
120 Y2=1.8:A=.96:C=100:W=10:K9=0:B9=0:S9=400:T9=3451:GOTO 140
130 K=K+(N<X2)+(N<Y2)+(N<.28)+(N<.08)+(N<.03)+(N<.01):K9=K9-K:GOTO 160
140 T0=3421:T=T0:E0=4000:E=E0:P0=10:P=P0:FOR I=0 TO 7
150 FOR J=0 TO 7:K=0:N=RND(Y):IF N<X1 THEN N=N*64:K=(N<Y1)-Y:GOTO 130
160 B=(RND(Y)>A):B9=B9-B:G(I,J)=K*C+B*W-INT(RND(Y)*X+Y):NEXT J,I
170 IF K9>(T9-T0) THEN T9=T0+K9
180 IF B9>0 THEN 200
190 GOSUB 450:G(X,Y)=G(X,Y)-10:B9=1
200 PRINT LEFT$("STARTREK ADAPTED BY L. E. COCHRAN 2/29/76",8):K0=K9
210 PRINT"OBJECTIVE: DESTROY";K9;"KLINGON BATTLE CRUISERS IN";T9-T0;
220 PRINT"YEARS.":PRINT" THE NUMBER OF STARBASES IS";B9
230 A=0:IF G1<0 OR G1>7 OR G2<0 OR G2>7 THEN N=0:S=0:K=0:GOTO 250
240 N=ABS(G(G1,G2)):G(G1,G2)=N:S=N-INT(N/10)*10:K=INT(N/100)
250 B=INT(N/10-K*10):GOSUB 450:S1=X:S2=Y
260 FOR I=0 TO 7:FOR J=0 TO 7:S(I,J)=1:NEXT J,I:S(S1,S2)=2
270 FOR I=0 TO 7:K3(I)=0:X=8:IF I<K THEN GOSUB 460:S(X,Y)=3:K3(I)=S9
280 K1(I)=X:K2(I)=Y:NEXT:I=S
290 IF B>0 THEN GOSUB 460:S(X,Y)=4
300 IF I>0 THEN GOSUB 460:S(X,Y)=5:I=I-1:GOTO 300
310 GOSUB 550:IF A=0 THEN GOSUB 480
320 IF E<=0 THEN 1370
330 I=1:IF D(I)>0 THEN 620
340 FOR I=0 TO 7:FOR J=0 TO 7:PRINT MID$(G$,S(I,J),1);" ";:GOSUB1700:NEXT J
350 PRINT"  ";:ON I GOTO 380,390,400,410,420,430,440
360 PRINT"YEARS =";T9-T
370 NEXT:GOTO 650
380 PRINT"STARDATE=";T:GOTO 370
390 PRINT"CONDITION:  ";C$:GOTO 370
400 PRINT"QUADRANT=";G1+1;"-";G2+1:GOTO 370
410 PRINT"SECTOR =";S1+1;"-";S2+1:GOTO 370
420 PRINT"ENERGY=";E:GOTO 370
430 PRINT D$(4);"=";P:GOTO 370
440 PRINT"KLINGONS LEFT=";K9:GOTO 370
450 X=INT(RND(1)*8):Y=INT(RND(1)*8):RETURN
460 GOSUB 450:IF S(X,Y)>1 THEN 460
470 RETURN
480 IF K<1 THEN RETURN
490 IF C$="DOCKED" THEN PRINT"STARBASE PROTECTS ENTERPRISE":RETURN
500 FOR I=0 TO 7:IF K3(I)<=0 THEN NEXT:RETURN
510 H=K3(I)*.4*RND(1):K3(I)=K3(I)-H:H=H/(FND(0)^.4):E=E-H
520 E$="ENTERPRISE FROM":N=E:GOSUB 530:NEXT:RETURN
530 PRINT H;"UNIT HIT ON ";E$;" SECTOR";K1(I)+1;"-";K2(I)+1;
540 PRINT" (";N;"LEFT)":RETURN
550 FOR I=S1-1 TO S1+1:FOR J=S2-1 TO S2+1
560 IF I<0 OR I>7 OR J<0 OR J>7 THEN 580
570 IF S(I,J)=4 THEN C$="DOCKED":E=E0:P=P0:GOSUB 610:RETURN
580 NEXT J,I:IF K>0 THEN C$="RED":RETURN
590 IF E<E0*.1 THEN C$="YELLOW":RETURN
600 C$="GREEN":RETURN
610 FOR N=0 TO 5:D(N)=0:NEXT:RETURN
620 PRINT D$(I);" DAMAGED.";
630 PRINT" ";D(I);"YEARS ESTIMATED FOR REPAIR.":PRINT
640 IF A=1 THEN RETURN
650 FORLL=1TO7:PRINTMID$("COMMAND",LL,1);:GOSUB1600:NEXT:GOSUB1500:INPUTA
660 IF A<1 OR A>6 THEN 680
670 ON A GOTO 710,310,1250,1140,690,1300
680 FOR I=0 TO 5:PRINT I+1;"= ";D$(I):NEXT:GOTO 650
690 IF D(4)>0 THEN PRINT"SPACE CRUD BLOCKING TUBES.";:I=4:GOTO 630
700 N=15:IF P<1 THEN PRINT"NO TORPEDOES LEFT":GOTO 650
710 IF A=5 THEN PRINT"TORPEDO ";
720 INPUT"COURSE (1-8.9)";C:IF C<1 THEN 650
730 IF C>=9 THEN 710
740 IF A=5 THEN P=P-1:GOSUB1900:PRINT"TRACK:";:GOTO 900
750 INPUT"WARP (0-12)";W:IF W<=0 OR W>12 THEN 710
760 IF W<=.2 OR D(0)<=0 THEN 780
770 I=0:PRINT D$(I);" DAMAGED, MAX IS .2 ";:GOSUB 630:GOTO 750
```

continued

Bring Music to Your Ears

```
780 GOSUB2000:GOSUB 480:IF E<=0 THEN 1370
790 IF RND(1)>.25 THEN 870
800 X=INT(RND(1)*6):IF RND(1)>.5 THEN 830
810 D(X)=D(X)+INT(6-RND(1)*5):PRINT"**SPACE STORM, ";
820 PRINT D$(X);" DAMAGED**":I=X:GOSUB 630:D(X)=D(X)+1:GOTO 870
830 FOR I=X TO 5:IF D(I)>0 THEN 860
840 NEXT
850 FOR I=0 TO X:IF D(I)<=0 THEN NEXT:GOTO 870
860 D(I)=.5:PRINT"**SPOCK USED A NEW REPAIR TECHNIGUE**"
870 FOR I=0 TO 5:IF D(I)=0 THEN 890
880 D(I)=D(I)-1:IF D(I)<=0 THEN D(I)=0:PRINT D$(I);" ARE FIXED!"
890 NEXT:N=INT(W*8):E=E-N-N+.5:T=T+1:S(S1,S2)=1
900 Y1=S1+.5:X1=S2+.5:IF T>T9 THEN 1370
910 Y=(C-1)*.785398:X=COS(Y):Y=-SIN(Y)
920 FOR I=1 TO N:Y1=Y1+Y:X1=X1+X:Y2=INT(Y1):X2=INT(X1)
930 IF X2<0 OR X2>7 OR Y2<0 OR Y2>7 THEN 1110
940 IF A=5 THEN PRINT Y2+1;"-";X2+1,
950 IF S(Y2,X2)=1 THEN NEXT:GOTO 1060
960 PRINT:IF A=1 THEN PRINT"BLOCKED BY ";
970 ON S(Y2,X2)-3 GOTO 1040,1020
980 PRINT"KLINGON";:IF A=1 THEN 1050
990 FOR I=0 TO 7:IF Y2<>K1(I) THEN 1010
1000 IF X2=K2(I) THEN K3(I)=0
1010 NEXT:K=K-1:K9=K9-1:GOTO 1070
1020 PRINT"STAR";:IF A=5 THEN S=S-1:GOTO 1070
1030 GOTO 1050:2L29E76C
1040 PRINT"STARBASE";:IF A=5 THEN B=2:GOTO 1070
1050 PRINT" AT SECTOR";Y2+1;"-";X2+1:Y2=INT(Y1-Y):X2=INT(X1-X)
1060 S1=Y2:S2=X2:S(S1,S2)=2:A=2:GOTO 310
1070 PRINT" DESTROYED!";:GOSUB2200:IF B=2 THEN B=0:PRINT". . .GOOD WORK!";
1080 PRINT:S(Y2,X2)=1:Q(Q1,Q2)=K*100+B*10+S:IF K9<1 THEN 1400
1090 GOSUB 480:IF E<=0 THEN 1370
1100 GOSUB 550:GOTO 650
1110 IF A=5 THEN PRINT"MISSED!":GOSUB2300:GOTO 1090
1120 Q1=INT(Q1+W*Y+(S1+.5)/8):Q2=INT(Q2+W*X+(S2+.5)/8)
1130 Q1=Q1-(Q1<0)+(Q1>7):Q2=Q2-(Q2<0)+(Q2>7):GOTO 230
1140 I=3:IF D(I)>0 THEN 620
1150 INPUT"PHASERS READY: ENERGY UNITS TO FIRE";X:IF X<=0 THEN 650
1160 IF X>E THEN PRINT"ONLY GOT";E:GOTO 1150
1165 GOSUB2100
1170 E=E-X:Y=K:FOR I=0 TO 7:IF K3(I)<=0 THEN 1230
1180 H=X/(Y*(FND(0)^.4)):K3(I)=K3(I)-H
1190 E$="KLINGON AT":N=K3(I):GOSUB 530
1200 IF K3(I)>0 THEN 1230
1210 PRINT"**KLINGON DESTROYED**":GOSUB2200
1220 K=K-1:K9=K9-1:S(K1(I),K2(I))=1:Q(Q1,Q2)=Q(Q1,Q2)-100
1230 NEXT:IF K9<1 THEN 1400
1240 GOTO 1090
1250 I=2:IF D(I)>0 THEN 620
1260 PRINT D$(I);" FOR QUADRANT";Q1+1;"-";Q2+1
1270 FOR I=Q1-1 TO Q1+1:FOR J=Q2-1 TO Q2+1:PRINT"    ";
1280 IF I<0 OR I>7 OR J<0 OR J>7 THEN PRINT"***";:GOTO 1350
1290 Q(I,J)=ABS(Q(I,J)):GOTO 1340
1300 I=5:IF D(I)>0 THEN 620
1310 PRINT"CUMULATIVE GALACTIC MAP FOR STARDATE";T
1320 FOR I=0 TO 7:FOR J=0 TO 7:PRINT"  ";
1330 IF Q(I,J)<0 THEN PRINT"***";:GOTO 1350
1340 E$=STR$(Q(I,J)):E$="00"+MID$(E$,2):PRINT RIGHT$(E$,3);
1345 GOSUB1800
1350 NEXT J:PRINT:NEXT I:GOTO 650
1360 PRINT:PRINT"IT IS STARDATE";T:RETURN
1370 GOSUB 1360:PRINT"THANKS TO YOUR BUNGLING, THE FEDERATION WILL BE"
1380 PRINT"CONQUERED BY THE REMAINING";K9;"KLINGON CRUISERS!"
1390 PRINT"YOU ARE DEMOTED TO CABIN BOY!":GOTO 1430
1400 GOSUB 1360:PRINT"THE FEDERATION HAS BEEN SAVED!"
1410 PRINT"YOU ARE PROMOTED TO ADMIRAL":PRINT KO;"KLINGONS IN";
1420 PRINT T-T0;"YEARS.  RATING=";INT(KO/(T-T0)*1000)
1430 INPUT"TRY AGAIN";E$:IF LEFT$(E$,1)="Y" THEN 110
1500 REM 88-MU1 INITIALIZE
1510 OUT&0363,128:OUT&0367,128:OUT&0373,128
1520 RETURN
1600 REM COMMAND BEEPER
1605 GQ=1
1610 O=3
1620 N=INT(255*RND(GQ))AND&0360
1630 OUT&0360,O:OUT&0362,N
1640 FORDD=0TO14:NEXT
1650 RETURN
1700 REM MAP #2 SOUND
1705 IFS(I,J)<2THENRETURN
1706 IFS(I,J)<>3THEN1710
1707 OUT&0361,128:OUT&0360,128:OUT&0362,16:FORDD=0TO100:NEXT:GOSUB1500:RETURN
```

continued on page 18

```
1710 OUT&0361,S(I,J)
1720 OUT&0362,2^I
1730 GOSUB1500
1740 RETURN
1800 REM MAP #3 AND #6 SOUND
1805 IFQ(I,J)<100THEN1810
1806 OUT&0361,128:OUT&0360,128:OUT&0362,16:FORDD=0TO100:NEXT:GOSUB1500:RETURN
1810 OUT&0361,Q(I,J)
1820 OUT&0362,2^I
1830 GOSUB1500
1840 RETURN
1900 REM PHOTON TORPEDO SOUND
1905 O=128
1910 O=O/2
1920 FORN=0TO11
1930 OUT&0362,N:OUT&0361,O
1940 NEXT:IFO<>1THEN1910
1945 GOSUB1500
1950 RETURN
2000 REM WARP SOUND
2005 FORKK=1TO3
2010 OUT&0361,&0300
2015 OUT&0360,&040
2020 FORN=0TO11
2021 NN=N*16:OUT&0362,NN+N
2025 FORDD=0TO50:NEXT
2040 NEXT
2045 NEXT
2050 OUT&0360,0:OUT&0361,0:RETURN
2100 REM PHASOR SOUNDS
2110 FORPP=1TO200
2112 OUT&0361,3
2115 PN=ABS(PN-1)
2116 OUT&0362,PN
2130 NEXT
2140 OUT&0361,0
2150 RETURN
2200 REM DEAD ITEM SOUND
2205 OUT&0361,&0300
2210 FORN=11TO0STEP-1
2215 FORDD=0TO40:NEXT
2220 OUT&0362,N
2230 NEXT
2240 OUT&0361,0:RETURN
2300 REM INSULT MELODY
2310 READN,TT
2315 IFTT=0THEN2350
2320 OUT&0361,&010:OUT&0362,N
2330 FORD=0TOTT:NEXT
2340 GOTO2310
2350 OUT&0361,0:RESTORE:RETURN
3000 DATA3,100
3001 DATA12,4
3002 DATA3,100
3003 DATA0,100
3004 DATA5,100
3005 DATA3,200
3006 DATA0,200
3010 DATA0,0
```

TRACE PROGRAM

Assembled Listing continued

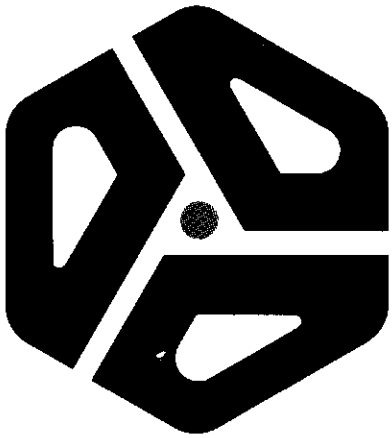
```
00169 411C 8C FF82        CPX       #OUTS
00170 411F 26 DD          BNE       EXT2B
00171 4121 BD 42FF DOIT   JSR       EON
00172 4124 B6 43A8        LDA A     AREG
00173 4127 F6 43A7        LDA B     BREG
00174                     **********
00175 412A BD             FCB       $BD       JSR
00176 412B 00             FCB       0,0
00177                     **********
00178 412D B7 43A8        STA A     AREG
00179 4130 F7 43A7        STA B     BREG
00180 4133 BD 4302        JSR       EOF
00181 4136 BD 4274        JSR       CKHUM3    ESCAPE?
00182 4139 FE 43AB        LDX       PCREG     NO
00183 413C 08             INX                 PAST JSR
00184 413D 08             INX
00185 4140 A6 00          LDA A     X
00186 4142 B7 43A0        STA A     INST
00187 4145 7E 4256        JMP       RUN2
00188                     *
00189 4148 08             SAVLK3 INX            SAVE LINK
00190 4149 08             SAVLK2 INX
00191 414A 08             SAVLK1 INX
00192 414B FF 42CD        STX       HERE
00193 414E BF 4398        STS       STKTMP
00194 4151 BE 4396        LDS       MYSTK
00195 4154 B6 42CE        LDA A     HERE+1
00196 4157 36             PSH A
00197 4158 B6 42CD        LDA A     HERE
00198 415B 36             PSH A
00199 415C BF 4396        STS       MYSTK
00200 415F BE 4398        LDS       STKTMP
00201 4162 7C 439A        INC       SUBCNT
00202 4165 39             RTS
00203                     *
00204 4166 B6 43A0 IMM    LDA A     INST
00205 4169 81 8D          CMP A     #$8D      BSR?
00206 416B 27 15          BEQ       BSIMM
00207 416D 81 8C          CMP A     #$8C      CPX?
00208 416F 27 0B          BEQ       IMM3
00209 4171 81 8E          CMP A     #$8E      LDS?
00210 4173 27 07          BEQ       IMM3
00211 4175 81 CE          CMP A     #$CE      LDX?
00212 4177 27 03          BEQ       IMM3
00213 4179 7E 40C2        JMP       DIR
00214 417C BD 42EE IMM3   JSR       POP2      OK
00215 417F 7E 40EC        JMP       EXTI
00216 4182 FE 43AB BSIMM  LDX       PCREG
00217 4185 8D C2          BSR       SAVLK2
00218 4187 7E 4212        JMP       REL
00219                     *
00220 418A BD 42DC INHER  JSR       POP0      FILL OPRND
00221 418D F6 43A0        LDA B     INST
00222 4190 C1 39          CMP B     #$39      RTS
00223 4192 27 16          BEQ       INH1
00224 4194 C1 3B          CMP B     #$3B      RTI
00225 4196 27 0D          BEQ       INHOUT
00226 4198 C1 3E          CMP B     #$3E      WAI
00227 419A 27 09          BEQ       INHOUT
00228 419C C1 3F          CMP B     #$3F      SWI
00229 419E 27 05          BEQ       INHOUT
00230 41A0 C6 01          LDA B     #1
00231 41A2 7E 40EE        JMP       EXTIA
00232 41A5 86 58   INHOUT LDA A     #'X       WON'T ALLOW
00233 41A7 7E 4056        JMP       DMP1      PRINT & EXEC
00234 41AA 7D 439A INH1   TST       SUBCNT
00235 41AD 27 F6          BEQ       INHOUT    TOO MANY RTS?
00236 41AF 7A 439A        DEC       SUBCNT
00237 41B2 BF 4398        STS       STKTMP
```

continued

TRACE PROGRAM

Assembled Listing continued

```
00239 41B4 BE 4396          LDS         MYSTK
00240 41B7 32               PUL A
00241 41B8 B7 42CD          STA A       HERE
00242 41BB 32               PUL A
00243 41BC B7 42CE          STA A       HERE+1
00244 41BF FE 42CD          LDX         HERE
00245 41C2 FF 43AB          STX         PCREG
00246 41C5 BF 4396          STS         MYSTK
00247 41C8 BE 4398          LDS         STKTMP
00248 41CB 7E 40F8          JMP         EXT1C
00249                  *
00250 41CE BD 42E1 INDX     JSR         POP1        LOAD OPRND
00251 41D1 FE 43A9          LDX         XREG
00252 41D4 FF 412B          STX         CKADR
00253 41D7 0C               CLC
00254 41D8 5F               CLR B
00255 41D9 B6 43A1          LDA A       INST+1      LOAD INDEX VALUE
00256 41DC 8D 17            BSR         ADDM
00257 41DE B6 43A0 INDX2    LDA A       INST
00258 41E1 81 AD            CMP A       #$AD        JSR?
00259 41E3 27 07            BEQ         INDX4
00260 41E5 81 6E            CMP A       #$6E        JMP
00261 41E7 27 09            BEQ         INDX5
00262 41E9 7E 40CE INDX3    JMP         DIR3
00263 41EC FE 43AB INDX4    LDX         PCREG
00264 41EF BD 4148          JSR         SAVLK2
00265 41F2 7E 4104 INDX5    JMP         EXT2
00266                  *
00267 41F5 BB 412C ADDM     ADD A       CKADR+1     LS BITS
00268 41F8 F9 412B          ADC B       CKADR       MS BITS
00269 41FB B7 412C ADDM1    STA A       CKADR+1
00270 41FE F7 412B          STA B       CKADR
00271 4201 39               RTS
00272                  *
00273 4202 BB 412C SUBM     ADD A       CKADR+1
00274 4205 24 05            BCC         SUB1
00275 4207 FB 412B          ADD B       CKADR
00276 420A 20 EF            BRA         ADDM1
00277 420C FB 412B SUB1     ADD B       CKADR
00278 420F 5A               DEC B
00279 4210 20 E9            BRA         ADDM1
00280                  *
00281 4212 BD 42E1 RL     JSR         POP1      OPRND
00282 4215 FE 43AB          LDX         PCREG
00283 4218 08               INX
00284 4219 08               INX
00285 421A FF 412B          STX         CKADR
00286 421D B6 43A0          LDA A       INST        GET READY FOR JUMP
00287 4220 B7 4227          STA A       PSEUDO
00288 4223 B6 43A6          LDA A       CCREG       LOAD CNDTNS
00289 4226 06               TAP
00290                  **********
00291 4227 00          PSEUDO FCB       0,2
00292                  **********
00293 4229 20 BE            BRA         INDX3       DOES NOT JMP
00294 422B 0C          REL2 CLC                     DOES JMP
00295 422C 5F               CLR B
00296 422D B6 43A1          LDA A       INST+1
00297 4230 2A 03            BPL         REL3        IS JMP POS OR NEG
00298 4232 8D CE            BSR         SUBM
00299 4234 8C               FCB         $8C         CPX
00300 4235 8D BE       REL3 BSR         ADDM
00301 4237 20 B9       REL4 BRA         INDX5       MAKE SWAP
00302                  *
00303 4239 FE 439B RUNVCT LDX           SWIADR      RESTORE INSTR
00304 423C B6 43A0          LDA A       INST
00305 423F A7 00            STA A       X
00306 4241 86 07            LDA A       #7
00307 4243 CE 43A6          LDX         #CCREG
00308 4246 33          SAV1 PUL B
00309 4247 E7 00            STA B       X
00310 4249 08               INX
00311 424A 4A               DEC A
00312 424B 26 F9            BNE         SAV1
00313 424D BF 43A4          STS         STKHI
00314 4250 8D 1A            BSR         CKHUM       CHECK HUMAN
00315 4252 FE 43AB RUN      LDX         PCREG
00316 4255 09               DEX                     DUE TO SWI
00317 4256 FF 43AB RUN2     STX         PCREG
00318 4259 B6 43A0          LDA A       INST
00319 425C 84 F0            AND A       #$F0        CLEAR JNK
00320 425E 44               LSR A
00321 425F 44               LSR A
00322 4260 44               LSR A
00323 4261 CE 43D3          LDX         #TABLE-1    SET FOR JMP
00324 4264 08          R1   INX
00325 4265 4A               DEC A
```



COMPUTER NOTES IS MOVING. . .

The main editorial office of Computer Notes will be located at Pertec offices in California.

Due to the change in location and editorial staff the publication of the November and December issues has been delayed.

Manuscripts and letters may still be sent to the MITS address. Watch the upcoming issues of CN for the new mailing address.

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String Character Editing Routine Runs in BASIC

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If you read my article ("Writing Machine Helps Prepare Manuscripts") in the July '77 **Computer Notes**, then you might have noticed that I mentioned plans to write a string character editing routine for my word processor program. I also said that I didn't see how it could be done in BASIC. Well, it can, and the following article explains how to do it.

The heart of the program is lines 65ØØ-651Ø. This subroutine inputs a character from the terminal without echoing it. The routine supports a subset of the MITS SI0A Rev. 1 I/0 board. Changes of the port numbers and status flags will enable you to use the 2SI0 board.

Essentially, the program supports a subset of the MITS BASIC character editing function. This version recognizes (n)C, (n)D, L, Q, I, H, and X. These are usually ample for most editing requirements. The S would also be useful, so I may add it later. The routine also recognizes the delete (rubout, backarrow, or whatever) command when in the insert mode (or after X or H). Edit commands can be in upper or lower case. As in MITS BASIC, editor command letters and numbers are not echoed.

Line	Description
6ØØØ	ED=1: Set edit flag in my program. The query gets the identifying number of the string to be edited in C. We transpose that to D for the program, set some program flags you don't need to be concerned with, get the length of the string in Z4, and initialize the variable.
6Ø1Ø	Here we get the character input without echo in routine 65ØØ.
6Ø2Ø-6110	Here we get the EDIT command in upper or lower case.
612Ø	Error signal (bell); if input is not in edit routine repertoire, then the bell is sounded, and we go back to 6Ø1Ø for a valid input.
613Ø	Space input; if LE (length of edited string is greater than Z4 (length of original string), then 612Ø.
614Ø	Space input; print next character in string and transfer it to the edited string. Increment edited string character count. Go get next input character.
615Ø	Numeric input; Z1$ contains the numeric characters received so far. Put number Z1$ or add to number already there.
616Ø	Get next character input.
617Ø	C input; if no number prefix (Z1$), then 6174.
6171	C input; set up for (n) changes of C.
6172	C input; get next character. Print it. Add it to edited string.
6173	C input; back to 6171 if more characters to change. When finished, add new characters to edited string count. Put null in Z1$ (numeric input). Get a new command.
6174	C input with no numeric prefix; print new character. Add to edited string character count. Add edited character to edited string. Get new command.
618Ø	D input; if no numeric prefix then 622Ø.
619Ø	D input with numeric prefix. Print initial "/". Set up character deletion corresponding to numeric input.
62ØØ	Print deleted characters as per numeric input.

continued

```
LIST 6000-

6000 ED=1:PRINT"WHAT IS THE LINE NUMBER?":INPUT C:D=C:Z=Z+1:CH(Z,Ø)=C:
     GOSUB 3010:Z4=LEN(C$):LE=1:D$="":Z1$=""
6010 GOSUB 6500
6020 IF Z$=" "THEN 6130
6030 IF Z$=>"1"AND Z$<="9"THEN 6150
6040 IF Z$="C" OR Z$="c" THEN 6170
6050 IF Z$="D" OR Z$="d"THEN 6180
6060 IF Z$="L" OR Z$="l"THEN 6230
6070 IF Z$="Q" OR Z$="q"THEN 6260
6080 IF Z$="I" OR Z$="i" THEN 6270
6090 IF Z$="X" OR Z$="x" THEN 6290
6100 IF Z$="H" OR Z$="h"THEN 6320
6110 IF Z$=CHR$(13) THEN 6330
6120 PRINT CHR$(7);:GOTO 6010
6130 IF LE>Z4 THEN 6120
6140 PRINT MID$(C$,LE,1);:D$=D$+MID$(C$,LE,1):LE=LE+1:GOTO 6010
6150 IF Z1$<>""THEN Z1$=Z1$+Z$ ELSE Z1$=Z$
6160 GOTO 6010
6170 IF Z1$=""THEN 6174
6171 FOR Z2%=LE TO LE+VAL(Z1$)-1
6172 GOSUB 6500:PRINT Z$;:D$=D$+Z$
6173 NEXT:LE=Z2%:Z1$="":GOTO 6010
6174 GOSUB 6500:PRINT Z$;:LE=LE+1:D$=D$+Z$:GOTO 6010
6180 IF Z1$=""THEN 6220
6190 PRINT"\";:FOR Z2%=LE TO LE+VAL(Z1$)-1
6200 PRINT MID$(C$,Z2%,1);:NEXT
6210 PRINT"\";:LE=Z2%:Z1$="":GOTO 6010
6220 PRINT"\";:PRINT MID$(C$,LE,1);:PRINT"\";:LE=LE+1:GOTO 6010
6230 FOR Z2%=LE TO Z4
6240 PRINT MID$(C$,Z2%,1);:D$=D$+MID$(C$,Z2%,1)
6250 NEXT:C$=D$:D$="":PRINT:Z4=LEN(C$):LE=1:GOTO 6010
6260 PRINT:D$="":GOTO 270
6270 GOSUB 6500
6272 IF Z$=CHR$(127)THEN 6370
6274 IF Z$=CHR$(27)THEN 6010
6275 IF Z$=CHR$(13)THEN 6330
6280 PRINT Z$;:D$=D$+Z$:GOTO 6270
6290 FOR Z2%=LE TO Z4
6300 PRINT MID$(C$,Z2%,1);:D$=D$+MID$(C$,Z2%,1)
6310 NEXT:LE=Z4:GOTO 6270
6320 Z4=LE:GOTO 6270
6330 IF LE=>Z4 THEN PRINT CHR$(13):D$=D$+CHR$(13):C$=D$:GOSUB 3120:GOTO
270
6340 FOR Z2%=LE TO Z4
6350 PRINT MID$(C$,Z2%,1);:D$=D$+MID$(C$,Z2%,1)
6360 NEXT:PRINT CHR$(13):D$=D$+CHR$(13):C$=D$:GOSUB 3120:GOTO 270
6370 PRINT"\";
6380 PRINT MID$(D$,LEN(D$),1);:D$=LEFT$(D$,LEN(D$)-1)
6390 GOSUB 6500:IF Z$=CHR$(127)THEN 6380
6400 PRINT"\";:GOTO 6274
6500 WAIT 0,&O1,&O1
6510 Z2=INP(1)AND&O177:Z$=CHR$(Z2):RETURN
OK
```

6210 Finished deletion. Print "/". Add deleted character count to pointer for original string. Put null in Z1$. Get next comma or charac-character.

6220 D input with no numeric prefix. Print initial "/". Print deleted character. Pring final "/". Incremented original string pointer. Get next command.

6230 L input; set up move to the end of the string.

6240 Print all characters in the original string to end and add to edited string.

6250 Transfer edited string to original string variable. Initialize variables to new string. Get next command.

6260 Q input; put null in edited string. Return to calling program.

6270 I input; get next command or character.

6272 I input; if rubout, then 6370.

6274 I input; if escape, then get next command.

6275 I input; if carriage, return then 6330.

6280 I input; if none of above, then print character. Add to edited string. Get next character or command at 6270.

6290 X input; set up loop to print remainder of the line.

6300 X input; print next character in original string. Add to edited string.

6310 X input; loop to get next character. If finished, set last character to end of string. Go to 6270 and insert mode.

6320 H input; Make end of edited string end of string. Go to 6270 and insert mode.

6330 Carriage return. If at end of original string, add carriage return to edited string. Return to calling program.

6340 Carriage return. If not at end of original string, set up loop to print remaining character.

6350 Carriage return. Print next character in original string. Add to edited string.

6360 Loop back for next character. If finished, print carriage return. Add carriage return to edited string. Return to calling program.

6370 Rubout mode. Print "/".

6380 Print last character. Delete last character from edited string.

6390 Rubout mode. Get next character or command. If rubout, go to 6370.

6400 Rubout mode. If character input in 6380 is not a rubout, then print "/". Return to insert mode.

6500 Wait for a character input from terminal &01 is octal 1.

6510 Character received. Mask to 7 bits with octal 177. Change to single character string. Return.

END

TRACE PROGRAM Assembled Listing continued

```
00326 4266 2A FC          BPL       R1
00327 4268 EE 00          LDX       X
00328 426A 6E 00          JMP       X          TAKE JMP
00329                     *
00330 426C BD FF24 CKHUM  JSR       POLCAT     HUMAN WANT CONTROL?
00331 426F 24 0A          BCC       CKHUM2     NO
00332 4271 BD FF04 CKHUM1 JSR       INCH+4
00333 4274 C1 1B    CKHUM3 CMP B    #$1B       ESCAPE?
00334 4276 26 03          BNE       CKHUM2     NOPE
00335 4278 7E 4007        JMP       DEBUG      SCRAM
00336 427B 39       CKHUM2 RTS                 BACK YOU GO
00337                     *
00338 427C BC 43B1 EXMDR  CPX       BIADR      INST BKPNT?
00339 427F 27 2E          BEQ       BKPT
00340 4281 B6 43AE        LDA A     TON+1
00341 4284 F6 43AD        LDA B     TON
00342 4287 80 01          SUB A     #1         CRRCT FOR CARRY
00343 4289 C2 00          SBC B     #0
00344 428B B0 412C        SUB A     CKADR+1
00345 428E F2 412B        SBC B     CKADR
00346 4291 25 06          BCS       EX2
00347 4293 BC 43B3 EXMOP  CPX       BOADR      OPRND BKPNT?
00348 4296 27 17          BEQ       BKPT
00349 4298 39       EX1   RTS
00350 4299 B6 43B0 EX2    LDA A     TOFF+1
00351 429C F6 43AF        LDA B     TOFF
00352 429F B0 412C        SUB A     CKADR+1
00353 42A2 F2 412B        SBC B     CKADR
00354 42A5 25 F1          BCS       EX1
00355 42A7 86 54    EX3   LDA A     #'T
00356 42A9 B7 439F        STA A     WHAT
00357 42AC 7E 431A        JMP       PRNTRG     DMP & RTRN
00358                     *
00359 42AF 86 42    BKPT  LDA A     #'B
00360 42B1 7E 4056        JMP       DMP1       PRINT & EXEC
00361                     *
00362 42B4 BE 43A4 REPAK  LDS       STKHI      REPAK STACK
00363 42B7 86 07          LDA A     #7
00364 42B9 CE 43AC        LDX       #PCREG+1
00365 42BC E6 00    REP1  LDA B     X
00366 42BE 37             PSH B
00367 42BF 09             DEX
00368 42C0 4A             DEC A
00369 42C1 26 F9          BNE       REP1
00370 42C3 FE 43AB        LDX       PCREG      ANYTHING GOING ON?
00371 42C6 FF 412B        STX       CKADR
00372 42C9 BD 427C        JSR       EXMDR      GO SEE
00373 42CC CE             FCB       $CE        LDX #
00374 42CD 00       HERE  FCB       0,0
00375 42CF A6 00          LDA A     X
00376 42D1 B7 43A0        STA A     INST
00377 42D4 86 3F          LDA A     #$3F
00378 42D6 A7 00          STA A     X
00379 42D8 FF 439B        STX       SWIADR
00380 42DB 3B             RTI
00381                     *
00382 42DC 4F       POP0  CLR A               NO OPRND
```

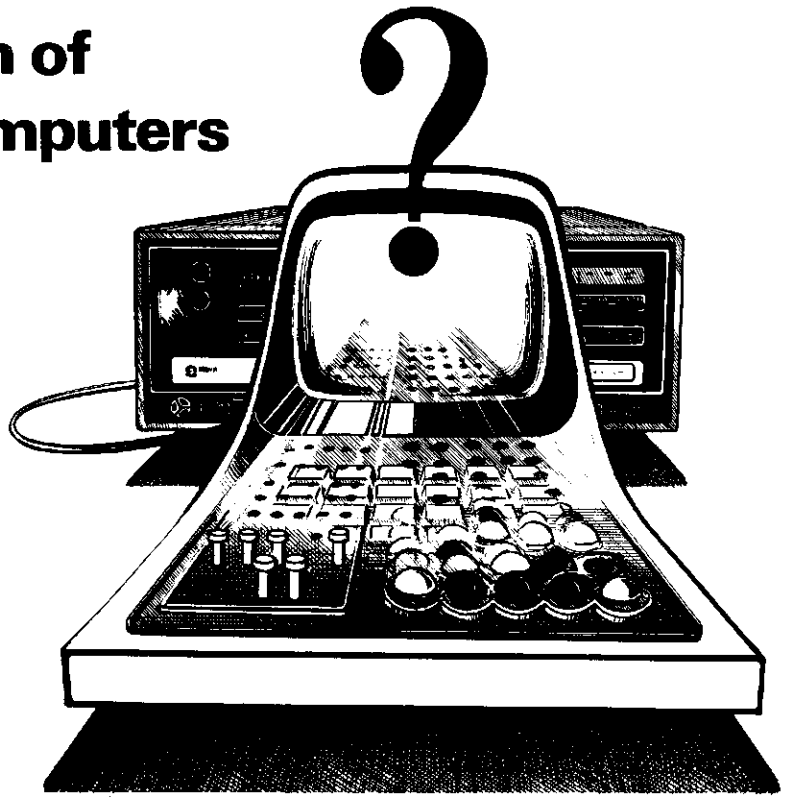
continued on page 22

```
00383 42DD B7 43A3          STA A    ASCFG
00384 42E0 39               RTS
00385 42E1 86 01    POP1    LDA A    #1
00386 42E3 8D F8            BSR      POP0+1
00387 42E5 FE 43AB          LDX      PCREG
00388 42E8 E6 01            LDA B    1,X
00389 42EA F7 43A1          STA B    INST+1
00390 42ED 39               RTS
00391 42EE 86 02    POP2    LDA A    #2
00392 42F0 8D F1            BSR      POP1+2
00393 42F2 E6 02            LDA B    2,X
00394 42F4 F7 43A2          STA B    INST+2
00395 42F7 39               RTS
00396                *
00397 42F8 8D 05    BAD     BSR      EON        ECHO ON
00398 42FA BD FF62          JSR      BADDR      GET ADDR
00399 42FD 20 03            BRA      EOF
00400                *
00401 42FF 86 03    EON     LDA A    #$03
00402 4301 8C               FCB      $8C        CPX
00403 4302 86 FF    EOF     LDA A    #$FF
00404 4304 97 F3            STA A    ECHO
00405 4306 39               RTS
00406                *
00407 4307 8D F6    IN      BSR      EON
00408 4309 BD FF00          JSR      INCH
00409 430C F7 439F          STA B    WHAT
00410 430F 8D 52            BSR      PNTS
00411 4311 20 EF            BRA      EOF
00412                *
00413 4313 8D EA    BY      BSR      EON
00414 4315 BD FF53          JSR      BYTE
00415 4318 20 E8            BRA      EOF
00416                *
00417 431A CE 438A  PRNTRG  LDX      #MES4
00418 431D BD 4063          JSR      MSG
00419 4320 F6 439F          LDA B    WHAT       WHAT TYPE DMP
00420 4323 8D 3B            BSR      PNT1
00421 4325 B6 43A0          LDA A    INST       INST
00422 4328 8D 43            BSR      OUT2
00423 432A B6 43A3          LDA A    ASCFG      OPRND?
00424 432D 27 14            BEQ      PRN3       NONE
00425 432F B6 43A1          LDA A    INST+1
00426 4332 BD FF6D          JSR      OUT2H
00427 4335 B6 43A3          LDA A    ASCFG      MORE?
00428 4338 4A               DEC A
00429 4339 27 0A            BEQ      PRN2       NOPE
00430 433B B6 43A2          LDA A    INST+2
00431 433E BD FF6D          JSR      OUT2H
00432 4341 20 04            BRA      PRN1
00433 4343 8D 24    PRN3    BSR      XX
00434 4345 8D 22    PRN2    BSR      XX
00435 4347 8D 20    PRN1    BSR      XX
00436 4349 CE 43A4          LDX      #STKHI
00437                **********
00438 434C C6               FCB      $C6        (LDA B #)
00439 434D 09       HMNY    FCB      9
00440                **********
00441 434E 27 0A    PRNLP   BEQ      PRN4
00442 4350 A6 00            LDA A    X
00443 4352 37               PSH B
00444 4353 8D 18            BSR      OUT2
00445 4355 33               PUL B
00446 4356 08               INX
00447 4357 5A               DEC B
00448 4358 20 F4            BRA      PRNLP
00449 435A 86 09    PRN4    LDA A    #9         FORM RSET
00450 435C B7 434D          STA A    HMNY
00451 435F 39               RTS
00452                *
00453 4360 BD FF81  PNT1    JSR      OUTCH
00454 4363 BD FF82  PNTS    JSR      OUTS
00455 4366 7E 426C  PNTC    JMP      CKHUM
00456                *
00457 4369 8D F8    XX      BSR      PNTS
00458 436B 20 F6            BRA      PNTS
00459                *
00460 436D BD FF6D  OUT2    JSR      OUT2H
00461 4370 20 F1            BRA      PNTS
00462                *
00463 4372 0D       PRMPT   FCB      $0D,$0A
00464 4374 FF               FCB      $FF
00465 4375 40               FCC      /@ /
00466 4377 00               FCB      0
00467                *
00468 4378 0D       MES1    FCB      $0D,$0A
00469 437A FF               FCB      $FF
00470 437B 44               FCC      /DEBUG/
00471 4380 00               FCB      0
00472                *
00473 4381 20       MES2    FCC      / ADDR ? /
00474 4389 00               FCB      0
00475                *
00476 438A 0D       MES4    FCB      $0D,$0A
00477 438C FF               FCB      $FF,0
00478                *
00479 438E 2A       EM      FCC      /*ERROR*/
00480 4395 00               FCB      0
00481                *
00482 4396 3FFF     MYSTK   FDB      START-1
00483 4398 00       STKIMP  FCB      0,0
00484 439A 00       SUBCNT  FCB      0
00485 439B 00       SWIADR  FCB      0,0
00486 439D 00       STKSV   FCB      0,0
00487                *
00488 439F 00       WHAT    FCB      0
00489 43A0 3F       INST    FCB      $3F,0,0
00490 43A3 00       ASCFG   FCB      0
00491 43A4 00       STKHI   FCB      0,0
00492 43A6 00       CCREG   FCB      0
00493 43A7 00       BREG    FCB      0
00494 43A8 00       AREG    FCB      0
00495 43A9 00       XREG    FCB      0,0
00496 43AB 00       PCREG   FCB      0,0
00497 43AD FF       TON     FCB      $FF,$FF
00498 43AF 00       TOFF    FCB      0,0
00499 43B1 00       BIADR   FCB      0,0
00500 43B3 00       BOADR   FCB      0,0
00501                *
00502 43B5 4D       JMPTB   FCC      /M/ MONITOR
00503 43B6 406E             FDB      MONIT
00504 43B8 43               FCC      /C/ CREG
00505 43B9 4099             FDB      STC
00506 43BB 42               FCC      /B/ BREG
00507 43BC 40A1             FDB      STB
00508 43BE 41               FCC      /A/ AREG
00509 43BF 40A9             FDB      STA
00510 43C1 58               FCC      /X/ XREG
00511 43C2 40B1             FDB      STX
00512 43C4 54               FCC      /T/ TRACE
00513 43C5 4076             FDB      TSET
00514 43C7 4F               FCC      /O/ OPR BKPT
00515 43C8 4089             FDB      BO
00516 43CA 49               FCC      /I/ INST BKPT
00517 43CB 4082             FDB      BI
00518 43CD 4A               FCC      /J/ JMP
00519 43CE 40B8             FDB      JMPXX
00520 43D0 44               FCC      /D/ DMP REG
00521 43D1 4059             FDB      DMP
00522 43D3 00               FCB      0
00523                *
00524 43D4 4189     TABLE   FDB      INHER
00525 43D6 4189             FDB      INHER
00526 43D8 4212             FDB      REL
00527 43DA 4189             FDB      INHER
00528 43DC 4189             FDB      INHER
00529 43DE 4189             FDB      INHER
00530 43E0 41CE             FDB      INDX
00531 43E2 40D5             FDB      EXT
00532 43E4 4165             FDB      IMM
00533 43E6 40C2             FDB      DIR
00534 43E8 41CE             FDB      INDX
00535 43EA 40D5             FDB      EXT
00536 43EC 4165             FDB      IMM
00537 43EE 40C2             FDB      DIR
00538 43F0 41CE             FDB      INDX
00539 43F2 40D5             FDB      EXT
00540                *
00541 00F3                  ORG      $00F3
00542 00F3 03               FCB      $03
00543                *
00544                       END

TOTAL ERRORS 00000

ENTER PASS
```

TRACE PROGRAM continued on page 32

Computer Evaluates Human Logic

A Generalized Version of "Master Mind" for Computers



By Doyl Watson
MITS

Master Mind™ is a popular board game marketed by Invicta Plastics LTD. of Leicester England. Based on logic, it involves two players--the code maker and code breaker. Since the Altair™ microcomputer is an ideal code maker which can easily evaluate each play the code breaker makes, I've adapted Master Mind into the following computer program. Because it's more general than the board version, it's even more challenging and fun.

The object of the game is for the code breaker to guess a sequence of colors which has been preset by the code maker. Each time the code breaker tries guessing the ordered list of colors, the code maker responds with the score or evaluation for that guess. The score consists of two numbers: (1) the number of colors that have been guessed correctly and in the correct positions, and (2) the number of additional colors that have been guessed but incorrectly positioned. At the end of each round, the number of guesses taken by the code breaker is tallied and then used as a criterion for how well the player has done. For a given number of positions and colors, two code breakers can compare the number of guesses that they used to break the code.

For example, you've already requested that the computer set up a secret color code using three colors and three positions. Suppose that code is, "RED, BLACK, BLACK." (Notice that repititions are allowed.) Now suppose your first guess is, "BLACK, WHITE, BLACK". The computer would then respond with three numbers. First, the number of correct colors in the right positions =1. (BLACK in the third position of the code matches the BLACK in the third position of the guess.) The second number representing additional correct colors in the wrong places is 1. (BLACK in the second position of the code matches BLACK in the first position of the guess.)

The following program enables the computer to set up a pseudo-random color code when the code breaker enters the number of colors and the number of positions he or she is willing to guess from. (Obviously, difficulty increases with the number of colors or with the number of positions.) The code breaker also must enter a random number from 1 to 10. The computer will then ask "What is your guess." The breaker will respond with a guess, and the computer will then evaluate the guess. The game proceeds accordingly until the code breaker has built up a table of enough guesses and evaluations to deduce the color code.

SAMPLE GAME PRINTOUT

```
INSTRUCTIONS FOR 'LOGIC':  DEDUCE THE SECRET COLOR CODE
   AFTER ENTERING TRIAL LISTS OF COLORS. ENTER THE
   FIRST 3 LETTERS (AT LEAST) OF EACH COLOR
   SEPERATING ENTRIES BY COMMAS.
WHEN COMPUTER RESPONDS WITH THE EVALUATION FOR EACH GUESS,
   'TRU' IS THE NUMBER OF CORRECT COLORS WHICH ARE ALSO IN
   THE TRUE POSITIONS.  'XTR' IS THE NUMBER OF ADDITIONAL
   COLOR MATCHES WHICH ARE IN THE INCORRECT POSITIONS.
   'GSS' IS THE NUMBER OF GUESSES THAT HAVE BEEN TAKEN.

ENTER:    NUMBER OF COLORS, NUMBER OF POSITIONS
? 6 ,  4
ENTER A RANDOM NUMBER FROM 1 TO 10
? 3
COLORS BLACK,WHITE,RED,YELLOW,GREEN,BLUE
ENTER YOUR GUESS HERE                          EVALUATIONS APPEAR HERE
?BLA, BLU, GRE, YEL
                                               TRU= 1  XTR= 1  GSS= 1
?BLA, WHI, YEL, RED
                                               TRU= 0  XTR= 3  GSS= 2
?YEL, YEL, WHI, BLA
                                               TRU= 1  XTR= 3  GSS= 3
?WHI, YEL, YEL, BLA
                                               TRU= 2  XTR= 2  GSS= 4
?WHI, YEL, BLA, YEL
   YOU ARE CORRECT!!!  IN  5  GUESSES.
```

Logic "Master Mind"

continued

```
10 PRINT"INSTRUCTIONS FOR 'LOGIC':  DEDUCE THE SECRET COLOR CODE
20 PRINT"   AFTER ENTERING TRIAL LISTS OF COLORS. ENTER THE"
30 PRINT"   FIRST 3 LETTERS (AT LEAST) OF EACH COLOR
40 PRINT"   SEPERATING ENTRIES BY COMMAS."
50 PRINT"WHEN COMPUTER RESPONDS WITH THE EVALUATION FOR EACH GUESS,"
60 PRINT"   'TRU' IS THE NUMBER OF CORRECT COLORS WHICH ARE ALSO IN"
70 PRINT"   THE TRUE POSITIONS.  'XTR' IS THE NUMBER OF ADDITIONAL"
80 PRINT"   COLOR MATCHES WHICH ARE IN THE INCORRECT POSITIONS."
90 PRINT"   'GSS' IS THE NUMBER OF GUESSES THAT HAVE BEEN TAKEN."
95 REM
100 REM          -MAIN PROGRAM-
110 REM
120 PRINT
130 PRINT"ENTER:   NUMBER OF COLORS, NUMBER OF POSITIONS"
140 INPUTC,N
150 IFC=1THENST$="BLACK":GOTO250
160 IFC=2THENST$="BLACK,WHITE":GOTO250
170 IFC=3THENST$="BLACK,WHITE,RED":GOTO250
180 IFC=4THENST$="BLACK,WHITE,RED,YELLOW":GOTO250
190 IFC=5THENST$="BLACK,WHITE,RED,YELLOW,GREEN":GOTO250
200 IFC=6THENST$="BLACK,WHITE,RED,YELLOW,GREEN,BLUE":GOTO250
210 IFC=7THENST$="BLACK,WHITE,RED,YELLOW,GREEN,BLUE,ORANGE":GOTO250
220 IFC=8THENST$="BLACK,WHITE,RED,YELLOW,GREEN,BLUE,ORANGE,PURPLE":GOTO250
230 IFC=9THENST$="BLACK,WHITE,RED,YELLOW,GREEN,BLUE,ORANGE,PURPLE,GOLD"
240 IFC=10THENST$="BLACK,WHITE,RED,YELLOW,GREEN,BLUE,ORANGE,PURPLE,GOLD,GRAY"
250 PRINT"ENTER A RANDOM NUMBER FROM 1 TO 10"
260 INPUTR
270 GOSUB 770:   REM   GET COLOR CODE.
280 PRINT"COLORS ";ST$
290 PRINT"ENTER YOUR GUESS HERE";TAB(48);"EVALUATIONS APPEAR HERE"
300 FORJJ=1TON
310 CC$(JJ)=M$(C,1+ABS(JJ-R))   :REM   CODE GENERATOR
320 NEXTJJ
330 REM   GUESSES ENTERED HORIZONTALLY.. SEPERATED BY COMMAS.
340 IFN=1THENINPUTG$(1):GOTO440
350 IFN=2THENINPUTG$(1),G$(2):GOTO440
360 IFN=3THENINPUTG$(1),G$(2),G$(3):GOTO440
370 IFN=4THENINPUTG$(1),G$(2),G$(3),G$(4):GOTO440
380 IFN=5THENINPUTG$(1),G$(2),G$(3),G$(4),G$(5):GOTO440
390 IFN=6THENINPUTG$(1),G$(2),G$(3),G$(4),G$(5),G$(6):GOTO440
400 IFN=7THENINPUTG$(1),G$(2),G$(3),G$(4),G$(5),G$(6),G$(7):GOTO440
410 IFN=8THENINPUTG$(1),G$(2),G$(3),G$(4),G$(5),G$(6),G$(7),G$(8):GOTO440
420 IFN=9THENINPUTG$(1),G$(2),G$(3),G$(4),G$(5),G$(6),G$(7),G$(8),G$(9)
430 IFN=10THENINPUTG$(1),G$(2),G$(3),G$(4),G$(5),G$(6),G$(7),G$(8),G$(9),G$(10)
440 GOSUB530   :REM      MAKE EVALUATION OF THE GUESS.
450 IFB=NGOTO480:   REM  GUESS IS CORRECT.
460 PRINTTAB(48);"TRU=";B;" XTR=";W;" GSS=";T
470 GOTO300
480 PRINT"   YOU ARE CORRECT!!!  IN ";T;" GUESSES."
490 END
500 REM
510 REM          -GUESS EVALUATION-
520 REM
530 B=0:W=0
540 FORK=1TON
550 REM   FIRST 3 LETTERS OF GUESS COMPARED TO FIRST 3 OF ANSWER.
560 IFCC$(K)<>LEFT$(G$(K),3)THENGOTO620
570 B=B+1
580 REM   POSITIONS ALREADY MATCHED ARE MADE UNIQUE SO THAT-
590 REM    NO ENTRY IS TALLIED TWICE.
600 CC$(K)=CHR$(K+11)
610 G$(K)=CHR$(K+22)
620 NEXTK
630 FORK=1TON
640 FORJ=1TON
650 IFCC$(K)<>LEFT$(G$(J),3)THENGOTO700
660 W=W+1
670 CC$(K)=CHR$(K+11)
680 G$(J)=CHR$(K+22)
690 J=N
700 NEXTJ:NEXTK
710 T=T+1
720 RETURN
730 REM
740 REM          -RANDOM DATA-
750 REM
760 REM   DATA SHOULD BE CHANGED OCCASIONALLY.
770 FORP=1TO10
780 FORQ=1TO10
790 READM$(P,Q)
800 NEXTQ:NEXTP
810 DATABLA,BLA,BLA,BLA,BLA,BLA,BLA,BLA,BLA,BLA
820 DATAWHI,BLA,WHI,BLA,WHI,BLA,BLA,WHI,WHI,BLA
830 DATARED,BLA,RED,WHI,RED,BLA,BLA,WHI,RED,RED
840 DATABLA,RED,BLA,RED,YEL,YEL,WHI,WHI,RED,WHI
850 DATAGRE,YEL,YEL,BLA,RED,WHI,BLA,RED,RED,YEL
860 DATABLA,YEL,WHI,RED,GRE,BLU,GRE,BLA,BLU,BLU
870 DATAORA,YEL,GRE,RED,WHI,BLA,BLA,ORA,RED,YEL
880 DATABLU,BLU,BLU,GRE,ORA,RED,WHI,PUR,RED,BLU
890 DATAYEL,GRE,PUR,ORA,BLA,GOL,WHI,GRE,BLU,WHI
900 DATAGOL,GRA,RED,YEL,PUR,ORA,BLA,GRE,RED,GOL
910 RETURN
```

Letter Writing Program Solves Photographers Mailing Problems

```
10 REM LETTER WRITING PROGRAM--INSERT LETTER BODY FROM 200 TO
12 REM 279.    DATA FROM 1000 AND UP
20 PRINT "FUNCTIONS:";TAB(15)"(1) LIST DATA STATEMENTS"
25 PRINT TAB(15)"(2) PRINT MAILING LABELS":PRINT TAB(15)"(3) WRITE LETTE
RS"
30 PRINT TAB(15)"(4) PRINT 'TOWN CODE'"
35 INPUT "FUNCTION ( 1,2,3, OR 4 )";K
40 IF K=1 THEN GOSUB 10000:LIST 999
45 IF K=2 THEN RUN 600
50 IF K=3 THEN RUN 95
55 IF K=4 THEN GOTO 65
60 PRINT"PLEASE ANSWER  1, 2, 3, OR 4":GOTO 35
65 GOSUB 10000:PRINT:PRINT"-- TOWN CODE --"
67 FOR J=1 TO 10:PRINT J;" -- ";
70 ON J GOSUB 700,705,710,715,720,725,730,735,740,745
75 PRINT C$(J)
80 NEXT J
85 GOSUB 10020
90 GOTO 35
95 INPUT"DATE";D$:GOSUB 10000
97 J=0
100 READ A$,B$,C$
101 IF A$="END" THEN GOSUB 10020
102 J=VAL(C$)
104 IF J=0 THEN GOTO 110
106 ON J GOSUB 700,705,710,715,720,725,730,735,740,745
108 C$=C$(J)
110 FOR I=1 TO 10:PRINT:NEXT I
120 FOR I=1 TO 72:PRINT"*";:NEXT I
130 PRINT:PRINT:PRINT D$
140 FOR I=1 TO 4:PRINT:NEXT I
150 PRINT"WILKINSON STUDIO":PRINT"2306 NEW WALLAND HWY"
160 PRINT"MARYVILLE, TN.  37801"
170 FOR I=1 TO 7:PRINT:NEXT I
180 PRINT A$: PRINT B$: PRINT C$
185 PRINT:PRINT
190 PRINT"DEAR  ";:GOSUB 500:PRINT":"
199 PRINT :   REM  BODY OF LETTER FROM 200 TO 279
280 PRINT:PRINT"SINCERELY,":PRINT
290 PRINT"LEE WILKINSON":PRINT"PHONE 982-6703"
300 FOR I=1 TO 11:PRINT:NEXT I
305 GOTO 100
500 FOR I=1 TO 8:PRINT MID$(A$,I,1);
505 C=0
510 IF MID$(A$,I,1)=" " THEN I=8
520 NEXT I
530 X=LEN(A$)
540 FOR I=X TO 1 STEP -1
550 C=C+1
560 IF MID$(A$,I,1)=" " THEN I=1
570 NEXT I
580 PRINT RIGHT$(A$,C);:RETURN
590 REM  SUB ROUTINE FOR MAILING LABELS -- TYPE END,END,END FOR THE
599 REM  LAST THREE LINES IN THE DATA STATEMENTS --
600 GOSUB 10000
605 DIM A$(2),B$(2),C$(2)
610 I=0:J=0
620 FOR I=1 TO 2
630 READ A$(I),B$(I),C$(I)
632 T=VAL(C$(I))
634 IF T=0 THEN GOTO 640
636 ON T GOSUB 700,705,710,715,720,725,730,735,740,745
638 C$(I)=C$(J)
640 NEXT I
650 PRINT A$(1) TAB(38) A$(2)
660 PRINT B$(1) TAB(38) B$(2)
670 PRINT C$(1) TAB(38) C$(2)
675 IF A$(2)="END" THEN GOSUB 10020
680 PRINT:PRINT:PRINT:REM      SPACES BETWEEN LABELS
690 GOTO 620
699 REM     DATA FOR  CITY CODES
700 C$(J)="MARYVILLE, TN.  37801":RETURN
705 C$(J)="ALCOA, TN.  37701":RETURN
710 C$(J)="FRIENDSVILLE, TN. 37737":RETURN
715 C$(J)="GREENBACK, TN.  37742":RETURN
720 C$(J)="LOUISVILLE, TN. 37777":RETURN
725 C$(J)="MENTOR, TN.  37808":RETURN
730 C$(J)="ROCKFORD, TN. 37853":RETURN
735 C$(J)="SEYMOUR, TN.  37865":RETURN
740 C$(J)="TOWNSEND, TN.  37882":RETURN
745 C$(J)="WALLAND, TN.  37886":RETURN
999 REM                                DATA STATEMENTS FROM 1000 AND UP
9997 REM
```

continued on page 26

Letter Writing Program Solves Photographer's Mailing Problems

continued

```
9998 REM
9999 REM                              SUB-ROUTINES FOR HARD COPY *****
10000 INPUT"WANT HARD COPY";H$
10005 IF LEFT$(H$,1)<>"Y" THEN RETURN
10008 PRINT"TURN ON PRINTER -- PRESS SPACE BAR":WAIT 0,1,1
10010 POKE1352,20:POKE1360,21:POKE1367,20:POKE1374,21:RETURN
10020 POKE1352,0:POKE1360,1:POKE1367,0:POKE1374,1:RETURN
OK
```

Sample Letter

```
************************************************************

OCTOBER 1 1977



WILKINSON STUDIO
2308 NEW WALLAND HWY
MARYVILLE, TN.  37801







MRS. GEORGE JONES
123 ANYSTREET
MARYVILLE, TN.  37801


DEAR  MRS.  JONES:

         *****  HAPPY BIRTHDAY TO BABY  *****

TO HELP CELEBRATE BABY'S BIRTHDAY WE HAVE A SPECIAL OFFER
FOR YOUR FAMILY.

                    ** 6 MONTH BIRTHDAY SPECIAL  **

1 - 8 X 10 COLOR PORTRAIT FOR YOURSELVES
2 - 5 X 7 COLOR PORTRAITS FOR GRANDPARENTS

ALL FOR ONLY $19.95 *****

AND MRS.  JONES, IF YOU'LL CALL US WITHIN 3 DAYS OF RECEIPT
OF THIS LETTER WE WILL INCLUDE WITH YOUR BIRTHDAY SPECIAL
PACKAGE, ABSOLUTELY FREE, 8 COLOR WALLETS.

REMEMBER MRS.  JONES, TIME FLIES SO CALL US TODAY !

SINCERELY,

LEE WILKINSON
PHONE 982-6703
```

Sample Listing

```
LIST 199
199 PRINT :   REM  BODY OF LETTER FROM 200 TO 279
200 PRINT"         *****  HAPPY BIRTHDAY TO BABY  *****"
210 PRINT:PRINT"TO HELP CELEBRATE BABY'S BIRTHDAY WE HAVE A SPECIAL OFFE
R"
220 PRINT"FOR YOUR FAMILY.":PRINT
230 PRINTTAB(20)"** 6 MONTH BIRTHDAY SPECIAL  **":PRINT
235 PRINT"1 - 8 X 10 COLOR PORTRAIT FOR YOURSELVES"
240 PRINT"2 - 5 X 7 COLOR PORTRAITS FOR GRANDPARENTS":PRINT
245 PRINT"ALL FOR ONLY $19.95 *****":PRINT
250 PRINT"AND ";:GOSUB 500:PRINT", IF YOU'LL CALL US WITHIN 3 DAYS OF RE
CEIPT"
255 PRINT"OF THIS LETTER WE WILL INCLUDE WITH YOUR BIRTHDAY SPECIAL"
260 PRINT"PACKAGE, ABSOLUTELY FREE, 8 COLOR WALLETS."
265 PRINT:PRINT"REMEMBER ";:GOSUB 500:PRINT", TIME FLIES SO CALL US TODA
Y !"
280 PRINT:PRINT"SINCERELY,":PRINT
290 PRINT"LEE WILKINSON":PRINT"PHONE 982-6703"
```

AUDIOSYNCRACIES

Unique Audio Processing Applications of the 88-AD/DA

By Thomas G. Schneider
MITS

AUDIOSYNCRACIES is a three-part series devoted to exploring unconventional applications of the Altair 88-AD/DA board. Hardware and software theory and implementation of the board in the Altair 8800 series mocrocomputers will be covered.

Part I includes: Theory of the audio delay line, a simple audio delay line for producing echo effects, and a description of interface circuitry for this and subsequent audio application articles.

Audio signal processing is one of the more fascinating applications of the Altair 88-AD/DA board. This board's high speed of analog to digital conversion makes it particularly suitable for good quality digitalization of audio information.

One especially interesting application if the creation of audio delays using the 88-AD/DA board. By taking an audio signal, delaying it, and then recombining it with the original signal, a variety of interesting echo and reverberation effects can be produced. In the past, echo effects were produced by a tape loop. A diagram of this method is shown in Figure 1. The audio signal is recorded onto the magnetic tape loop by the record head and then played back off the tape by the multiple playback heads. The distance between the record and playback heads determines the amount of time that passes until an echo is heard. The number of echos that are heard is determined by how many playback heads the tape passes over after it passes the record head. There is a disadvantage to this method: it requires a tape transport, and magnetic tape is one of those mediums that deteriorates with age.

In this first article, we will explore the advantages of using the 88-AD/DA and the Altair computer to implement a solid-state no-moving-parts system which will perform this echo function in addition to producing several other interesting effects.

SOFTWARE

The method for producing the echo effect is shown in flowchart form in Figure 2. After briefly studying the flowchart, you will notice that we are essentially imitating the tape loop echo method, but the medium is the memory of the computer, and the "record" and "playback" head functions are implemented in software. The "record" function is accomplished by using pointer HL to write the digitalized audio information into memory. The "playback" function is accomplished by using pointer DE to retrieve the information from memory. Both pointers are simultaneously stepped through memory, but pointer DE runs behind pointer HL. The time it takes for pointer DE to reach and read data from the same point in memory that pointer HL has written data into, determines the delay time until the echo of the original signal is heard. As each pointer reaches the top limit of memory, it is reset back to the beginning, giving us a continually running loop. The amount of time that passes until the echo of the original signal is heard is determined by the difference in starting points of pointers HL and DE. The offset can be any value you choose, so a wide variety of delay times are possible. The maximum amount of delay is, of course, limited by the amount of memory in the computer. To obtain the maximum delay time, set pointer HL to the middle of the memory space and set pointer DE to the beginning of the memory space. For this first experiment, we will produce only one echo. The machine code program for our delay function is shown in Listing 1.

HARDWARE

To properly interface the 88-AD/DA with real world audio signals, you need to construct one relatively simple circuit. (See Figure 3.) The top half of this circuit takes a real world audio signal and shifts it into the voltage range acceptable by the 88-AD/DA's input. The voltage at the input of the 88-AD/DA must not be lower than ground and higher than 10 volts. Since audio signals usually go both above and below ground, the input conditioning circuit shifts the entire audio signal upwards so that all signals are above ground and below 10 volts. The two diodes at the output of the circuit ensure that the signal reaching the 88-AD/DA doesn't exceed the 0-10 volt range. The OP-AMP in this circuit can be just about any general purpose OP-AMP, like the 741, for example. The bottom half of the circuit in Figure 3 is used to mix the output of D/A convertor and the original input signal before these signals go out to the real world.

To adjust this interfacing circuitry, use the following procedure. Adjust the original signal gain pot and the delay gain pot to their positions of highest resistance. Adjust the input signal gain pot to its position of least resistance. With no input signal applied, adjust the offset pot so that 5 volts appears at the output of the OP-AMP. Apply an audio signal typical of what you will be running into the system and adjust the input signal gain pot so that the voltage at the output of the OP-AMP swings no more than about seven volts peak-to-peak. After toggling in the program, hit run and adjust the output mixing pots to obtain a pleasant mix of the original and delayed audio signals.

Referring again to the software, you can easily change the delay time by increasing or decreasing the starting address of the HL register. To run this software in your Altair computer, it may be necessary to change a few things in the program, depending on how much memory is available. The contents of the following addresses are important:

41 and 42 contain the starting address of the write pointer.

44 and 45 contain the starting address of the read pointer.

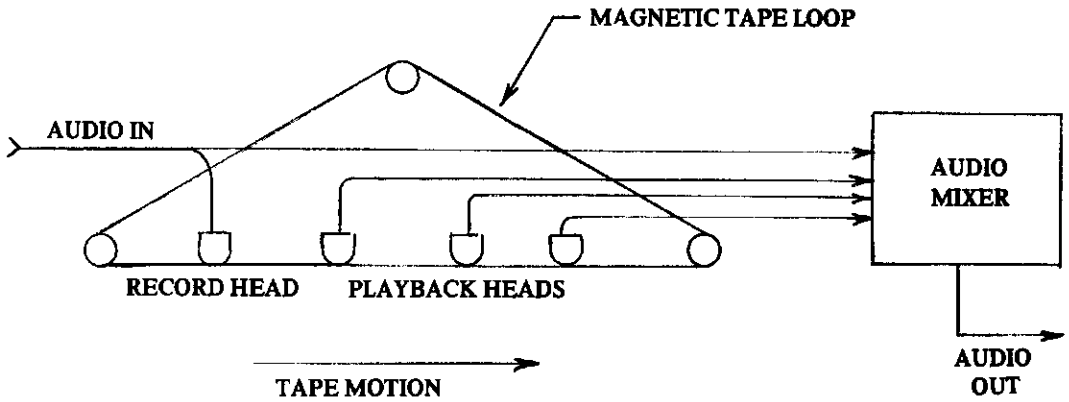
53 and 64 contain the most significan byte of the highest memory address used as storage space.

When modifying this program to suit your memory size, be careful not to write over the program. One thing to remember about audio modification programs...don't be afraid to modify the program itself. You may be surprised with some bizarre and unusual results!

Next month, AUDIOSYNCRACIES will cover a more flexible software routine for the audio delay line and interface circuitry modifications for producing continuously recirculating echo effects.

continued on page 28

FIGURE 1



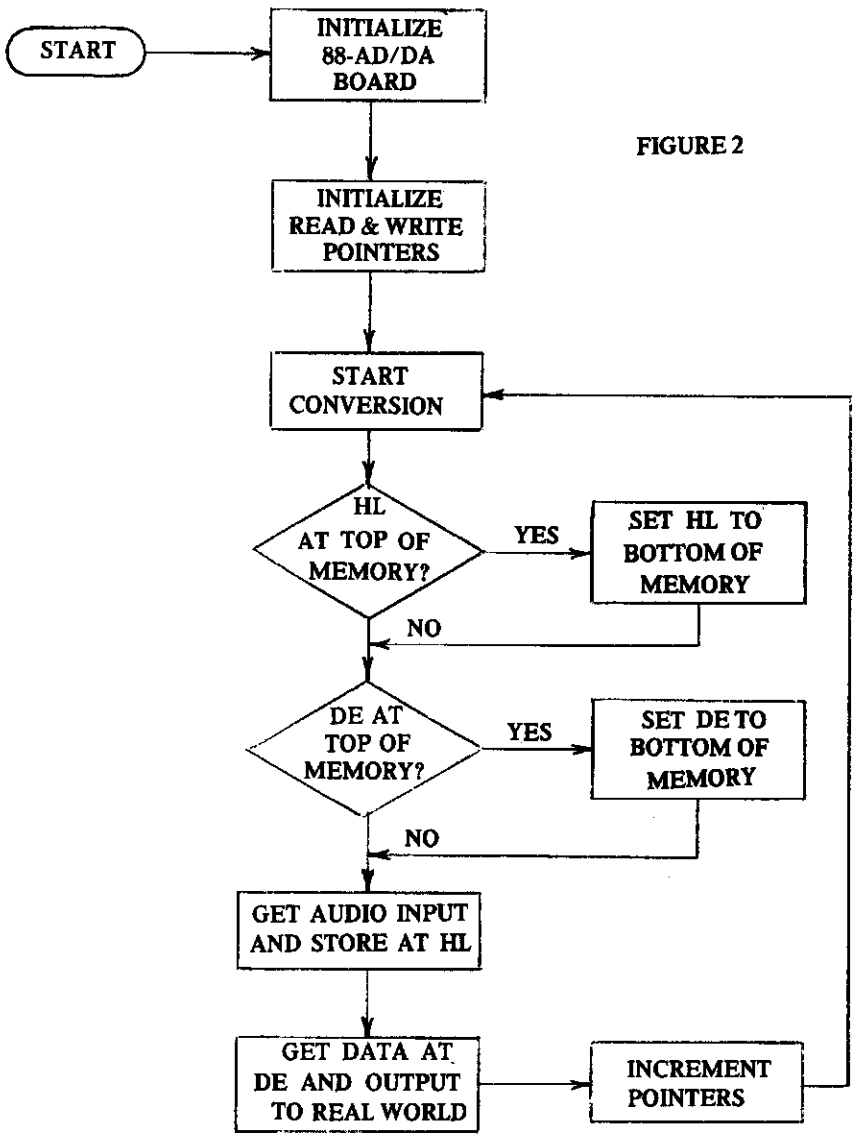


FIGURE 2

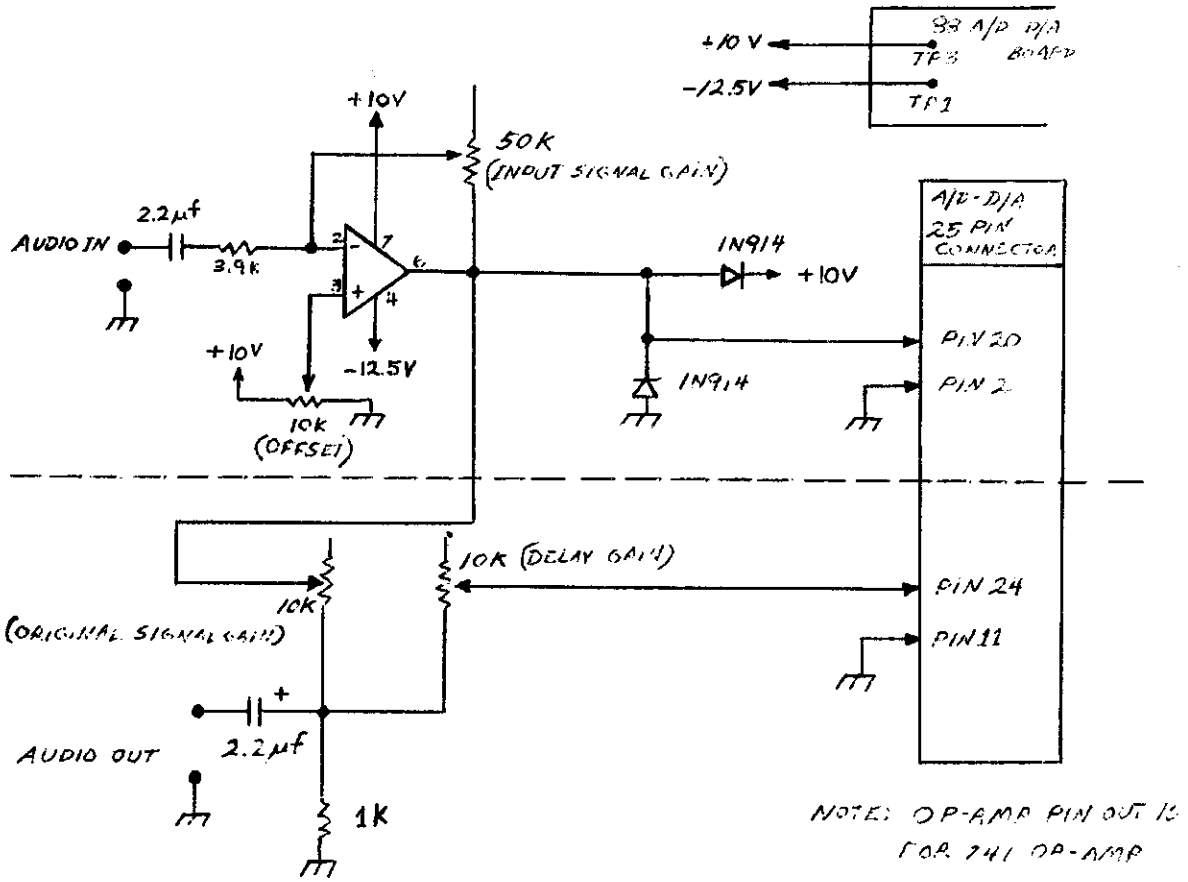
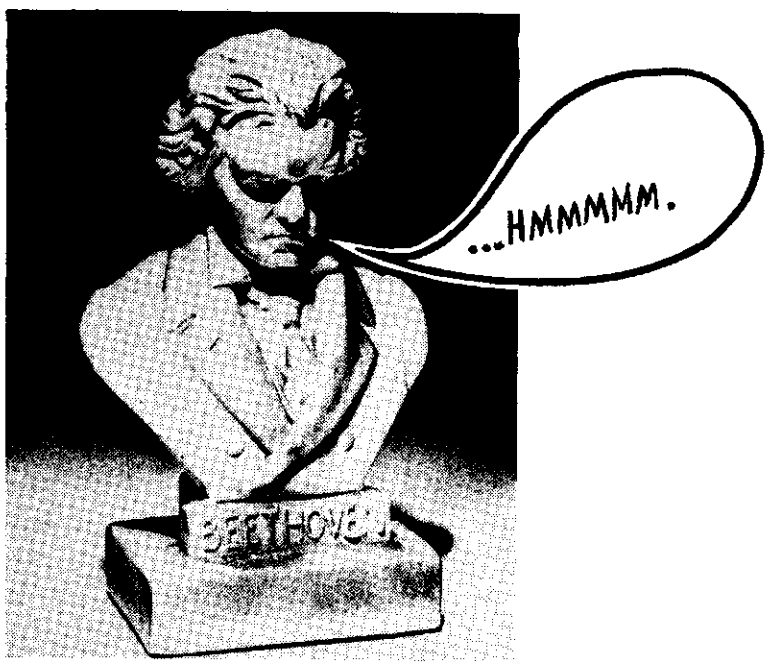


FIGURE 3

continued on page 30



```
AUDIO DELAY SOFTWARE ( ASSUMES A/D-D/A BOARD IS AT OCTAL ADDRESS 100 )

 0    257    INIT,   XRA A           PROGRAM LINES 0 - 33 INITIALIZE
 1    323            OUT 100         THE A/D-D/A BOARD
 2    100
 3    323            OUT 101
 4    101
 5    323            OUT 102
 6    102
 7    323            OUT 104
10    104
11    323            OUT 106
12    106
13    057            CMA
14    323            OUT 103
15    103
16    323            OUT 105
17    105
20    323            OUT 107
21    107
22    076            MOV A,054
23    054
24    323            OUT 100
25    100
26    323            OUT 102
27    102
30    323            OUT 104
31    104
32    323            OUT 106
33    106
34    000            NOP
35    000            NOP
36    000            NOP
37    000            NOP
40    041    START,  LXI H,020/000          LOAD HL WITH WRITE
41    000                                   POINTER STARTING ADDRESS
42    020
43    021            LXI D,001/000          LOAD DE WITH READ
44    000                                   POINTER STARTING ADDRESS
```

continued

```
45    001
46    257    CONV,   XRA A          OUTPUT A 0 TO PORT 103
47    323            OUT 103        TO START CONVERSION
50    103
51    174    CHKH,   MOV A,H        SEE IF HL POINTER HAS
52    376            CPI 200        REACHED THE TOP OF
53    200                           MEMORY SPACE
54    302            JNZ CHKD       IF NOT, CHECK THE DE
48    062                           POINTER
56    000
57    076            MVI A,001      LOAD H WITH 1
60    001
61    147            MOV H,A
62    172    CHKD,   MOV A,D        SEE IF DE POINTER
63    376            CPI 200        REACHED THE TOP OF
64    200                           MEMORY SPACE
65    302            JNZ INPT       IF NOT, GET AUDIO INPUT
66    073
67    000
70    076            MVI A,001      PUT 001 IN D
71    001
72    127            MOV D,A
73    333    INPT,   INP 101        GET AUDIO INPUT FROM A/D
74    101
75    167            MOV M,A        AND MOVE IT TO MEMORY
76    353            XCHG           SWAP POINTERS HL & DE
77    176            MOV A,M        GET DATA FROM MEMORY
100   323            OUT 105        AND OUTPUT IT TO D/A
101   105
102   353            XCHG           SWAP POINTERS BACK
103   043            INX H          INCREMENT HL POINTER
104   023            INX D          INCREMENT DE POINTER
105   303            JMP CONV
106   000
107   000
```

PROGRAM USED TO DEMONSTRATE SAMPLE RUN

```
00001                           NAM         SHOWEM
00002                           OPT         NOG,M
00003 3000                      ORG         $3000
00004                   *
00005                   *SHOWEM - A SAMPLE PROGRAM
00006                   *TO SHOW RUNNING FEATURES OF DEBUG
00007                   *
00008 3000 CE 300E XX           LDX         #TABLE
00009 3003 A6 00   ZZ           LDA A       0,X
00010 3005 27 FE                BEQ         *
00011 3007 BD 300C              JSR         YY
00012 300A 20 F7                BRA         ZZ
00013                   *
00014 300C 08      YY           INX
00015 300D 39                   RTS
00016                   *
00017 300E 41      TABLE        FCC         /ABC/
00018 3011 00                   FCB         0
00019                           END

TOTAL ERRORS 00000

ENTER PASS X
```

SAMPLE RUN OF DEBUG PROGRAM

```
 J 4000
DEBUG
@ T  ADDR ? 3000 ADDR ? 3011
@ D
D 3F       00 F1 D0 00 00 00 00 00 00 30 00 30 11 00 00 00 00
@
  J  ADDR ? 300C
T 08       00 F1 D0 00 00 00 00 30 0C
X 39       00 F1 D0 00 00 00 01 30 0D 30 00 30 11 00 00 00 00
@ J  ADDR ? 3000
T CE 300E  00 F1 D0 00 00 00 01 30 00
T A6 00    00 F1 D0 00 00 00 30 0E 30 03
T 27 FE    00 F1 D0 00 41 30 0E 30 05
T BD 300C  00 F1 D0 00 41 30 0E 30 0C
T 08       00 F1 D0 00 41 30 0E 30 0C
T 39       00 F1 D0 00 41 30 0F 30 0A
T 20 F7    00 F1 D0 00 41 30 0F 30 03
T A6 00    00 F1 D0 00 41 30 0F 30 03
T 27 FE    00 F1 D0 00 42 30 0F 30 05
T BD 300C  00 F1 D0 00 42 30 0F 30 0C
T 08       00 F1 D0 00 42 30 0F 30 0C
T 39       00 F1 D0 00 42 30 10 30 0A
T 20 F7    00 F1 D0 00 42 30 10 30 03
T A6 00    00 F1 D0 00 42 30 10 30 03
T 27 FE    00 F1 D0 00 43 30 10 30 05
T BD 300C  00 F1 D0 00 43 30 10 30 0C
T 08       00 F1 D0 00 43 30 10 30 0C
T 39       00 F1 D0 00 43 30 11 30 0A
T 20 F7    00 F1 D0 00 43 30 11 30 03
T A6 00    00 F1 D0 00 43 30 11 30 03
T 27 FE    00 F1 D4 00 00 30 11 30 05
T 27 FE    00 F1 D4 00 00 30 11 30 05
T 27 FE    00 F1 D4 00 00 30 11 30 05
T 27 FE    00 F1 D4 00 00 30 11 30 05
T 27 FE    00 F1 D4 00 00 30 11 30 05
T 27 FE    00 F1 D4
DEBUG
@ C 77
@ B 88
@ A 99
@ X AAAA
@ I  ADDR ? BBBB
@ O  ADDR ? CCCC
@ D
D 27 FE    00 F1 77 88 99 AA AA 30 05 30 00 30 11 BB BB CC CC
@ M
.
.
```

A Definition of Terms:

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