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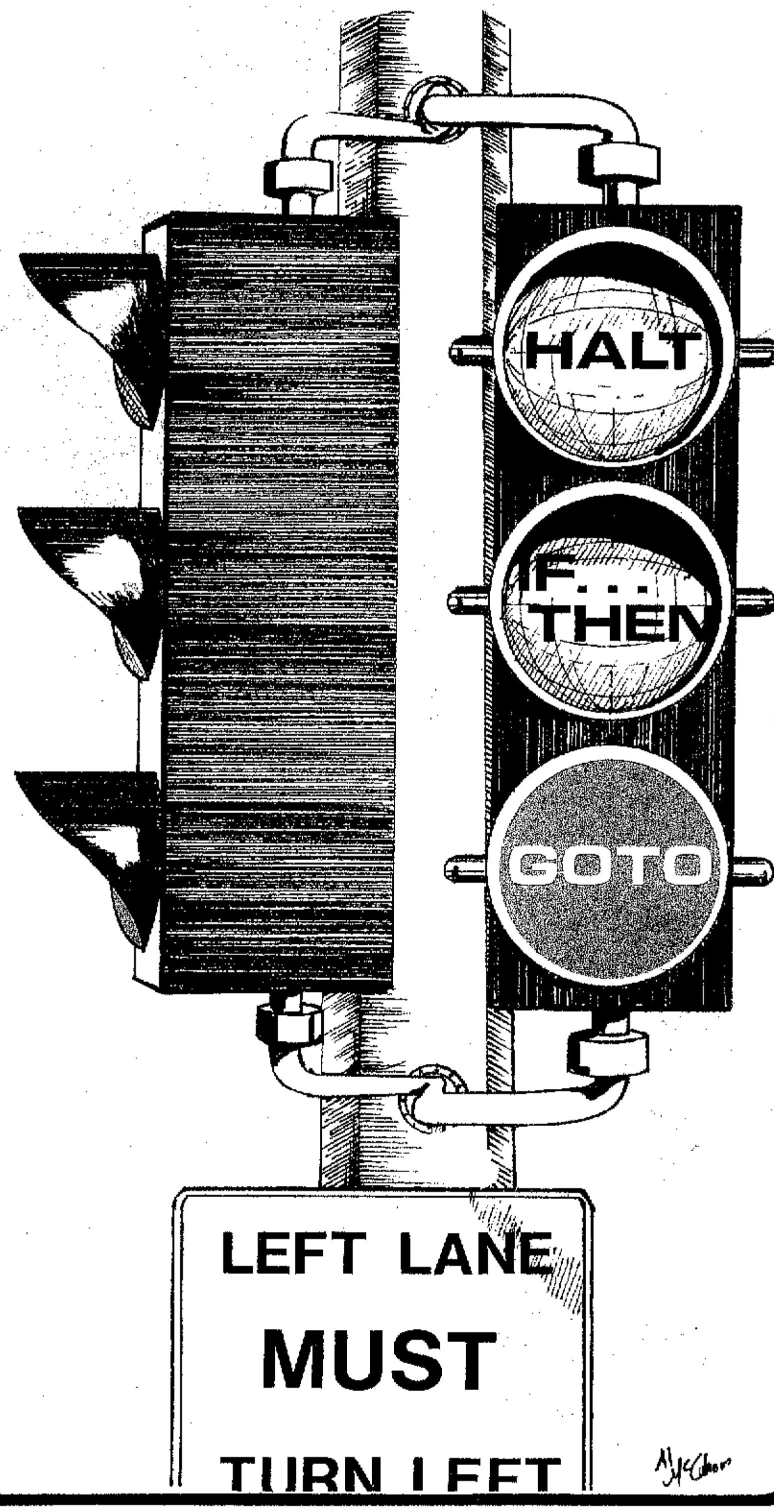

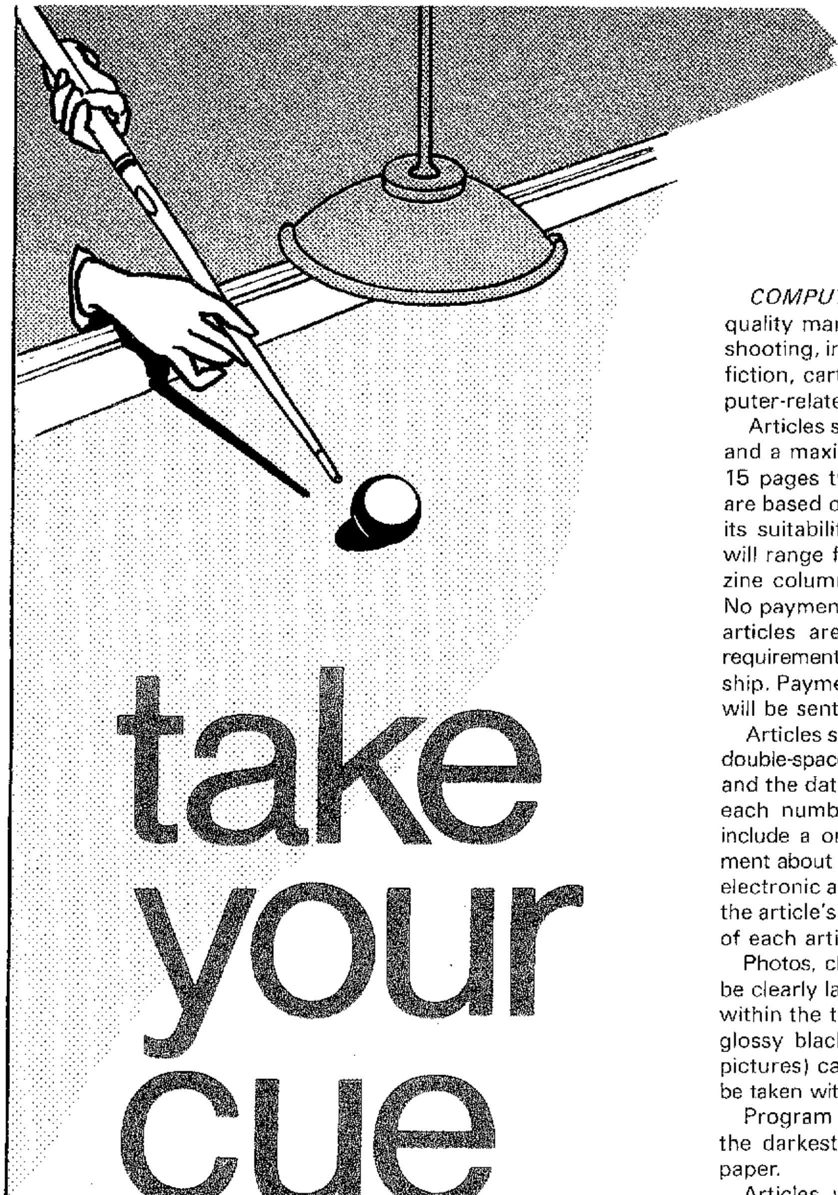

COMPUTER NOTES is continually seeking quality manuscripts on applications, trouble-shooting, interfacing, software, book reviews, fiction, cartoons and a variety of other computer-related topics.

Articles should be a minimum of 800 words and a maximum of 3600 words long (about 15 pages typed double-space). Honorariums are based on an article's technical quality and its suitability for *C.N.'s* readership. Payment will range from 50¢ to $1 per typeset magazine column inch for all text and programs. No payment will be made for illustrations. All articles are subject to editing to fit space requirements and content needs of our readership. Payment for articles which are accepted will be sent upon publication.

Articles submitted to *C.N.* 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.

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) can be accepted. All photos should be taken with uniform lighting and sharp focus.

Program listings should be recorded with the darkest ribbon possible on blank white paper.

Articles which are not accepted will be returned.

Computer Notes
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BITS AND PIECES

By Sondra Koppenheffer

Computer Notes Subscriptions

Anyone who purchases an Altair microcomputer directly from MITS or one of our dealers, will receive a free one-year subscription to COMPUTER NOTES. However, after that first year, subscriptions must be purchased at our regular rate of $5 per year in the U.S. and $20 per year overseas. Beginning with subscriptions that expire in April, 1977, we will send out renewal notices one month prior to expiration. Due to the large volume of mail we handle, we can only accept one-year subscriptions to C.N. and send them all via bulk rate.

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After a refund is requested, please allow up to three weeks for receipt of your check. If you don't receive your check after three weeks, please contact us.

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Software

The following suggestions and prices should help with the purchase of software copies and updates.

When updating BASIC, simply take the difference between the two versions and add either a $15 (4K, 8K and Extended BASIC) or $25 (Disk Extended BASIC) copying charge plus $1 for postage and handling.

Updating:

4K to 8K BASIC

$15 difference
+ $15 copying charge
$1 postage & handling
Total: $31

4K to Extended BASIC

$90 difference
+ $15 copying charge
$1 postage & handling
Total: $106

4K to Disk Extended BASIC

$140 difference
+ $25 copying charge
$1 postage & handling
Total: $166

8K to Extended BASIC

$75 difference
+ $15 copying charge
$1 postage & handling
Total: $91

8K to Disk Extended BASIC

$125 difference
+ $25 copying charge
$1 postage & handling
Total: $151

Extended BASIC to Disk Extended BASIC

$50 difference
+ $25 copying charge
$1 postage & handling
Total: $76

The above prices, which are subject to change without prior notification, apply only to customers who are eligible for minimum system price discounts. If you have not purchased a minimum system from MITS or one of our dealers, you must pay the full amount each time you order BASIC. Any versions of BASIC other than those listed above that you have purchased, can be obtained only for a copying charge.

New Computer Publications Emphasize Self-Instruction

DYMAX now offers three new publications--YOUR HOME COMPUTER, INSTANT BASIC and CALCULATOR/COMPUTER Magazine--specifically designed for home or classroom instruction in basic computer operation, beginning programming and practical computing material for educational purposes.

Written for the computer novice, YOUR HOME COMPUTER introduces the reader to general microcomputer functioning and programming in addition to some of the exciting happenings in personal computing. Author James White has included such special features as:

- guidelines for selecting and building your own microcomputer
- how to use your home computer
- lists of computer clubs and stores
- personal computing periodicals
- clearly defined terminology

YOUR HOME COMPUTER is well-suited for classroom usage, because it is written in an easy-to-understand style and includes review questions at the end of each chapter.

INSTANT BASIC is written by Jerald Brown, one of the authors of the classroom-oriented text BASIC.

Continued on Page Four

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IN THIS ISSUE

Inspection Helps Avoid Teletype Interfacing Problems

By Doyl Watson

The Altair SIO and 2SIO interface boards come from the factory with provisions for driving Teletype terminals. Before connecting the Teletype to the computer, however, some preliminary checks and adjustments must be made to the Teletype. The following list includes some checks and adjustments that should be made as well as some diagnostics for checking the operation of your system.

1) Conversion of Teletype:

Converting your Teletype from 60 milli-Amp half duplex to 20 milli-Amp full duplex operation is a simple process. If the unit is a MITS call control, no conversion is necessary. If the call control is a Teletype "Private Wire Call Control" (i.e. line-local, off knob), the conversion can easily be done because of the standard color-coded wiring.

Remove the cover (see manual). The call control has several 15-pin Molex connectors in the back. Beneath them, with a protective covering, is the terminal block where connections to the computer are made. Locate and remove the brown-yellow wire on the terminal block position 3 and remove the white-blue wire from 4. Connect both wires to 5. Then remove the purple wire from 8 and connect it to position 9.

2) Connection of Teletype to I/O Card:

The 2SIO or SIOC cards should be connected as shown in Figure 1. Be sure to check the system operation before replacing the cover.

3) Proper Operation of the System:

The operation of the computer-Teletype combination can be tested with an "echo loop." (Refer to the manuals on your particular I/O board for manual loading of echo routines.)

The following is a useful routine for transmitting characters from the sense switches to the Teletype.

This routine repeatedly prints the character "U" or "*" on your Teletype until you press "STOP." If the above program and your echo routines run correctly, your Teletype is free of any problems.

4) Visual Inspection:

If problems still exist, check power, connections and fuses. If your Teletype works in "LOCAL" but not "on line," the problem is in the call control circuit or in the I/O board. If the Teletype runs open "on line" but not in local, short the Ground to the "Xmit" line of the 25-pin Molex connector (pins 2 to 3). If this closes the circuit, the trouble is in the computer and not in the Teletype. If the problem also appears in "LOCAL," check the printing and tapes for garble.

To check for garbled printing, turn the Teletype switch to "off" and depress a key. Cautiously rotate the plastic motor fan forward until a definite pattern appears in the code bars under the carriage of the unit. The code bars are numbered "S 1 2 3 4 5 7 6 8" from the back. (S is for spacing.) If the bar is raised, that bit is 1.

Look for obvious broken, worn or shorted parts. Don't try to repair any but the simplest problems. The Model 33 is an amazing but delicate piece of mechanical hardware, and breaking a part will not only cause more problems but will void your warranty.

Continued on Page Three

OCTAL ADDRESS	2SIO (Instruction)	SIOC
000	076	333
001	003	377
002	323	323
003	020 (Control Channel)	001 (Data Address)
004	076	303
005	021	000
006	323	000
007	020 (Control Channel)	Lower switches A15-A0 and press EXAMINE. Set up ASCII Code of the echo character on switches A15-A8. (01010101 is a "U" and 10101010 is an "*.") Press RUN
010	333	
011	377	
012	323	
013	021 (Data Channel)	
014	303	
015	010	
016	000	
	Examine to 000. Set up ASCII Code. (010 10101 is a "U") RUN.	

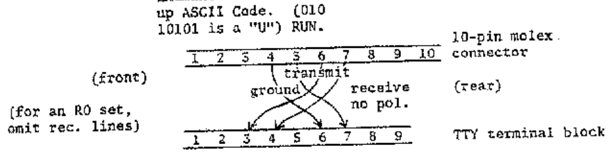

Figure 1

Game Corrected

The following corrections should be noted in BAGLES (Altair Software Library #5-6-761, see August issue of C.N.). In line 9090 an "=" should replace the "-."

Line 9030 should read LEN(C$)) rather than (LEN(CS). This error is caused when, under certain circumstances, STR$(INT((D/BT-INT(D/BT))*BT)) is not equal to Q=INT((D/BT-INT(D/BT))*BT): STR$(Q). Therefore, the following patch will result in a fix:

```
9080 Q=(D/BT-INT(D/BT))*BT:B$=
B$+STR$(Q):D=INT(D/BT): IFD =
01/BT THEN 9080
```

New Club Formed

A new computer club was recently formed in Bloomington, Indiana. The Bloomington Association for the Computer Sciences is now holding regular meetings. For more information, contact club president:

Remy M. Simpson
901 East 13th St.
Bloomington, Ind. 47401
(812)-339-1046

WACC-II POSTPONED

The second World Altair Computer Convention II, advertised on the back cover of March COMPUTER NOTES, has been postponed until later this year. The major reason for the postponement is time--the WACC-II was scheduled too close to the NCC, which caused difficulties for people who wanted to attend both conventions.

We wish to thank everyone who expressed an interest in the WACC-II. We hope that you will continue your support in the future.

Watch future issues of COMPUTER NOTES for more information about the rescheduling of WACC-II.

Charles Olsen
Public Relations

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87106

SOFT WARE TIDBITS

By Mark Chamberlin

1. A fix for the EOR bug in the Altair 680 Assembler 1.Ø:

Due to an erroneous table entry in the Altair 680 Assembler, the EOR opcode does not assemble properly. This problem can be solved by simply using the Monitor's M command to deposit an $88_{(16)}$ into location $\text{Ø3A7}_{(16)}$ after the Assembler is loaded. My thanks to John E. Smith of Colorado Springs, Colorado, for bringing this problem to the attention of the MITS Software Department.

2. Using CSAVE and CLOAD in 8800 BASIC 4.Ø:

A number of users of Altair BASIC 4.Ø have asked about the use of the CSAVE and CLOAD commands. In earlier versions of Altair BASIC, these commands had the form CSAVEX and CLOADX, where X was a single character file name. In Altair BASIC 4.Ø, the commands are of the form:

CSAVE string expression and
CLOAD string expression.

A string expression is a formula which, when evaluated, results in a character string. In its simplest form, a string expression is merely a quoted character. For example, the command CSAVE"A" would save the program in memory on cassette under the name A.

Altair BASIC evaluates the string expression and uses the leftmost character of the resultant character string as the file name. So, CLOAD"ABC" is the same as CLOAD"A" because both commands load the file named A from the cassette. CSAVE A$ uses the leftmost character of the character string stored in the variable A$ as the file name.

All of the commands listed below are valid forms of CSAVE and CLOAD.

CSAVE"A"	Save program A
CLOAD"ABC"	Load program A
CSAVE A$	Save program specified by leftmost character of string in variable A$
CLOAD "3" + "FOO"	Load program 3
CSAVE "3"	Save program 3

By the way, programs CSAVED with 3.2 8K BASIC can be CLOADED with 4.Ø 8K BASIC. However, 3.2 and 4.Ø Extended cassette files are not compatible.

Altair BASIC 4.Ø also supports the csaving and cloading of numerical data. The commands are of the form:

CSAVE* array name
CLOAD* array name

where array name is the name of the array that contains the data to be saved or into which the data is to be loaded.

The array used must be dimensioned prior to using CSAVE* and CLOAD*. For example, the following program saves the numbers Ø through 99 on the cassette.

```
10   DIM A (99)
20   FOR I=Ø to 99
30   A(I)=I
40   NEXT I
50   CSAVE*A
60   END
```

The file saved on cassette is not named, so it may be read back into any array of the same type and dimension. In other words, the array saved on tape in the example program above could be read back into an array C, which had been dimensioned with the statement:

DIM C(99).

If the array type is incorrect, the results will be undefined. If the size is not correct, Altair BASIC will do one of two things: (1) not read all of the data on the cassette (if the array being loaded into is smaller than the array on the cassette) or (2) continue to search the tape for more data and not return control to the terminal (if the array being loaded into is larger than the array on the cassette).

Continued on Page Four

Inspection Helps Avoid Teletype Interfacing Problems

CONTINUED

5) Adjustment for the Printer Rangefinder:

Refer to issue 3, section 574-122-100TC, Vol. II of the TTY Manual. Note: The rangefinder may need to be lowered near to "40" for the printer to be compatible with the MITS Call Control Unit.

The rangefinder is the gauge at the left rear of the Teletype. To adjust the rangefinder, loosen the screw on the pointer plate to friction point. Raise and lower the pointer until typing errors occur. Then tighten the pointer in the center of this range.

b_4	b_3	b_2	b_1	b_7 0 / b_6 0 / b_5 0	0 / 0 / 1	0 / 1 / 0	0 / 1 / 1	1 / 0 / 0	1 / 0 / 1	1 / 1 / 0	1 / 1 / 1
0	0	0	0	NULL	DC_0	ƀ	0	@	P	UNASSIGNED	UNASSIGNED
0	0	0	1	SOM	DC_1	!	1	A	Q		
0	0	1	0	EQA	DC_2	"	2	B	R		
0	0	1	1	EOM	DC_3	#	3	C	S		
0	1	0	0	EOT	DC_4 STOP	$	4	D	T		
0	1	0	1	WRU	ERR	%	5	E	U		
0	1	1	0	RU	SYNC	&	6	F	V		
0	1	1	1	BELL	LEM	' (apos)	7	G	W		
1	0	0	0	FE	S_0	(	8	H	X		
1	0	0	1	MT / SK	S_1	)	9	I	Y		
1	0	1	0	LF	S_2	*	:	J	Z		
1	0	1	1	TAB	S_3	+	;	K	[		
1	1	0	0	FF	S_4	, (comma)	<	L	\		ACK
1	1	0	1	CR	S_5	- (hyphen)	=	M	]		①
1	1	1	0	SO	S_6	. (period)	>	N	↑		ESC
1	1	1	1	SI	S_7	/	?	O	←		DEL

SOFT WARE TIDBITS
CONTINUED

Disk BASIC Information:

A. Converting to 4.Ø:

Program files saved under Altair Disk BASIC 3.4 can be converted for use under Altair BASIC 4.Ø by following this simple procedure.

1) "Bring up" 3.4 BASIC
2) Load each program file and resave it in ASCII
3) "Bring up" 4.Ø and load PIP from the 4.Ø disk
4) Unload the 4.Ø disk
5) Mount the 3.4 diskette containing the files to be converted
6) RUN PIP's CNV function on the 3.4 disk
7) All files on the 3.4 disk are now ready for use with 4.Ø.

The CNV function in PIP 4.Ø must be run to insure that the stop byte of each sector is in fact a 255 (for details, see sector format, page 118, Altair 4.Ø BASIC manual). Data files created under 3.4 are ready for use with 4.Ø after the CNV function has been run on the disk on which they reside.

B. Stop! UNLOAD that disk first!

It is absolutely imperative that an UNLOAD command be issued before removing a diskette from its drive. It is also necessary to issue a MOUNT command each time a disk is placed in the drive. The following discussion will clear up any confusion about why these commands must be used.

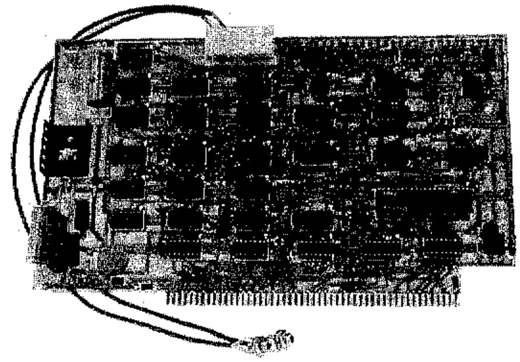
Altair Disk BASIC dynamically allocates disk space for program and data files. It is therefore necessary for BASIC to know what portions of the diskette are in use and what portions are free to be allocated to new files. This information is kept in a table in memory. The table is constructed by the MOUNT command.

The UNLOAD command tells BASIC that the information in the disk allocation table is not current. It also disables the disk drive. (Diskettes should not be removed while the disk is enabled.)

The allocation information differs for two different diskettes. So, if a MOUNTed diskette is removed from the drive and replaced with another diskette without the UNLOAD and MOUNT sequence, the allocation information in memory will be incorrect. If a file is saved with this incorrect information, the existing files on the diskette will probably be overwritten by the new file. This situation leads to disaster! An attempt to access a file that has been overwritten in this manner produces a File Link Error. So remember, every time you change diskettes, do an UNLOAD and a MOUNT.

KCACR INCREASES ALTAIR 680B's POTENTIAL

By Thomas Durston



The Altair 680b has received yet another boost to its limitless versatility. With the introduction of the 680b-KCACR Audio Cassette Interface, the Altair 680b continues to be one of the most powerful computers for the money.

Designed to interface the 680b bus with an audio cassette recorder/ player, the 680b-KCACR enables mass storage and retrieval of data. The KCACR circuitry is based on the Kansas City Standard, making data transfers highly reliable without any component adjustments and under widely varying conditions.

Other design features include a digital demodulator, CMOS logic allowing low power consumption, a motor control circuit for starting and stopping tape motion and the use of test points at key circuit areas.

All ICs are socketed. A complete set of documentation containing diagnostic software, test point waveforms, theory of operation and a detailed operators section is also provided.

Altair 680b CSAVE BASIC, available on audio cassette, has been developed for use with the KCACR. It includes the standard functions and operators of 680b BASIC, along with the capability of storing and loading software through the 680b-KCACR.

Check with your local dealer for prices and availability.

Specifications

Frequencies used (self clocking)

LOCIG 1 = 2400 HZ
LOGIC Ø = 1200 HZ

Data Rate: 300 BAUD (27 bytes/ second)
36.67 ms per byte (3.3 ms per bit)

Data Format: One start bit - logic Ø
Eight data bits
Two stop bits - logic 1
(11 bits per byte)

Demodulator Playback Speed Tolerance: +20, -25% from recorded speed

Demodulator Input Levels (Playback): 300MV peak to peak minimum (100MV RMS)
10V peak to peak maximum (3.5V RMS)

Demodulator Input Impedance: 10K ohms

Modulator Output Level: 30MV P-P (suitable for microphone input)

Modulator Output Impedance: 1K ohms

CONTINUED

New Computer Publications Emphasize Self-Instruction
CONTINUED

Brown developed INSTANT BASIC for the reader with no previous programming experience. The book is written in a unique self-teaching style in the popular Altair BASIC and DEC BASIC PLUS. It includes exercises that keep typing to a minimum so that the reader can focus his complete attention on learning BASIC and developing good programming techniques. Self tests and activities are also included for checking progress.

CALCULATORS/COMPUTERS Magazine was developed to fill a distinct void in the availability of practical computing material written for educational purposes. The goal of CALCULATORS/COMPUTERS Magazine is to search out material from equipment manufacturers, hobbyists, teachers, etc. and to present it in a form suitable for use in the home or the classroom.

For more information about any of these three new publications, write to:

Dymax
P. O. Box 310
Menlo Park, Calif. 94025

Altair Disk Drive Alignment Permits Precise Operation

By Tom Woods and Glenn Wolf

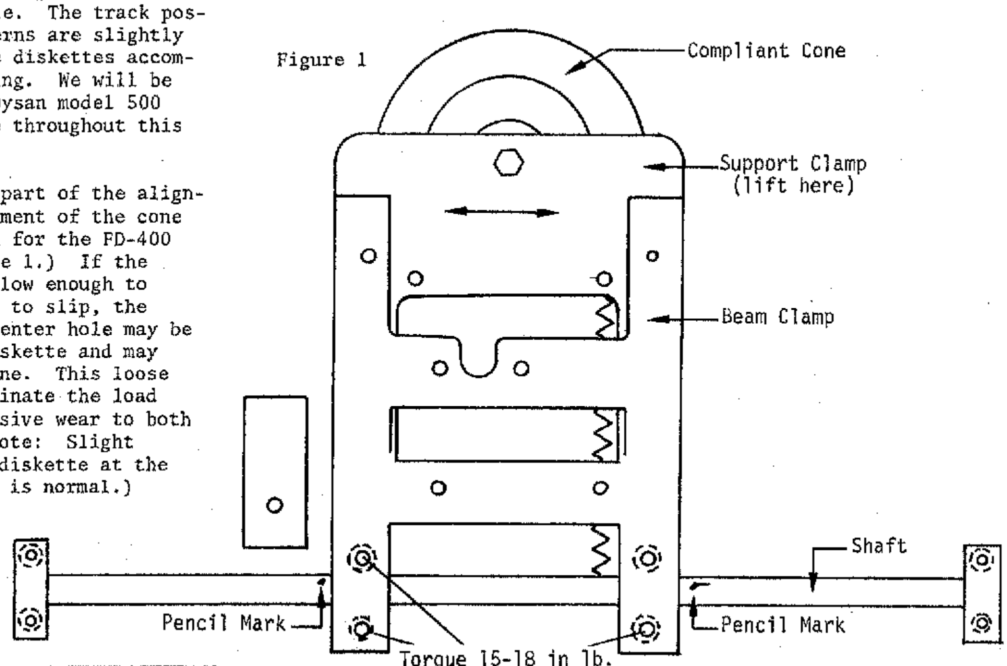
Maintaining proper alignment of the Altair disk drive is essential for trouble free operation of the floppy disk. The alignment involves the adjustment of the index pulse timing and head positioning (track and skew). Necessary equipment includes an oscilloscope with an A + B (differential mode), a CE alignment diskette (available through MITS, Part Number 101661 at $40.00 per disk), 1/4" nut driver, screwdrivers and a mallet.

There are two types of alignment diskettes available. The track positioning and patterns are slightly different, but the diskettes accomplish the same thing. We will be referring to the Dysan model 500 alignment diskette throughout this article.

An important part of the alignment is the adjustment of the cone clamping mechanism for the FD-400 drive. (See Figure 1.) If the clamping force is low enough to allow the diskette to slip, the oxide around the center hole may be scraped off the diskette and may build up on the cone. This loose oxide could contaminate the load pad, causing excessive wear to both pad and media. (Note: Slight scratching of the diskette at the cone clamping area is normal.)

To adjust the cone clamping mechanism, close the door and loosen the four screws (7/64 allen bit) that are holding the beam clamp to the shaft. Press firmly on the support clamp and move the beam clamp to the extreme right and left. Make a pencil mark on both ends of the shaft. Center the beam clamp between the two pencil marks. Exact centering of the beam clamp is essential for free motor spin.

Figure 1



While pressing firmly on both sides of the beam clamp, open the door approximately 5/8" and tighten screws progressively. With the door closed, rest one finger lightly on both the support clamp and the compliant cone. Use a force gauge to pull upward on the end of the support clamp until you detect a slight relative motion between the cone and clamp. The clamping force should be 6 1/2 to 9 pounds. Make the proper adjustments until the correct clamping force is obtained.

There are two different PC boards used in the PERTEC FD-400--the 600-191 and the 600-321. These numbers are stamped on the PC board.

Place the unit on its side and attach the scope probes as follows:

	600-191	600-321
A and B probes	T.P. 3 and 5	T.P. 4 and 5
Sync probe (leading edge of index pulse)	T.P. 14	T.P. 10
Ground clip	T.P. 36	T.P. 1

CONTINUED

KCACR INCREASES ALTAIR 680B's POTENTIAL

CONTINUED

Error Rate: Relative to quality of recorder and tape, typically less than 1 error in 10^6 bits READ with low noise audio tape.

Power Requirements: +8 Volts unregulated --220MA typical -16 Volts unregulated --50MA typical (less than 3 watts total power)

Requires 1 slot in 680 bus.

Audio Cable Connectors: Mini phone jacks, 3.5MM dia mounted on back panel.

Board Address: FØ1Ø - Status & Control
FØ11 - Read & Write Data

Altair Disk Drive Alignment Permits Precise Operation

CONTINUED

Set up your scope for A + B with B inverted and then for EXT SYNC.

The following program, written by Steven Zook from the Computer Store in Santa Monica, California, permits loading and stepping of the head to the desired track under sense switch control.

After loading the program into memory, examine the starting location and run. A15 will load and unload the head while A8 through A14 will control the step functions.

The first step in alignment is to apply the necessary power and control to seek track 0. Then manually twist the stepping screw (shaft) clockwise to the next track in. (this is 1/8 of a full revolution). You should hear the track 0 switch close approximately midway between track 0 and track 1. Upon the verification of track 0, step-in to track 38.

Insert the alignment diskette and load the magnetic head. CAUTION: Do not enable the write or erase modes of operation while a CE diskette is in the drive because alignment data on the diskette may be destroyed. You should now observe the "cats-eye" pattern located at track 38. The desired waveform should be a symmetrical pattern as shown in Figure 2 and 3.

If you notice an improper waveform, twist the stepping screw slightly while you observe the scope pattern to see in which direction the head must move to correct the waveform. Loosen the two 1/4" hex h head mounting screws on the stepper motor approximately 1/8 turn. Place a blunt instrument against the end of the stepper motor and tap the motor sharply while observing the cats-eye pattern. When a symmetrical pattern is achieved (one lobe of the cats-eye being 80% of the other, minimum), tighten the mounting screws snugly.

Step to track 1 and set the oscilloscope horizontal time base to 20 μsec/Div. You should now observe the index-sensor burst shown in Figure 4.

Reinsert the alignment diskette several times to check for constant registration. If the index burst shifts more than 40 μs., the cone/hub mechanism is faulty, or the alignment diskette has too large an opening. Use the average position of the index burst for making the following adjustments.

CONTINUED

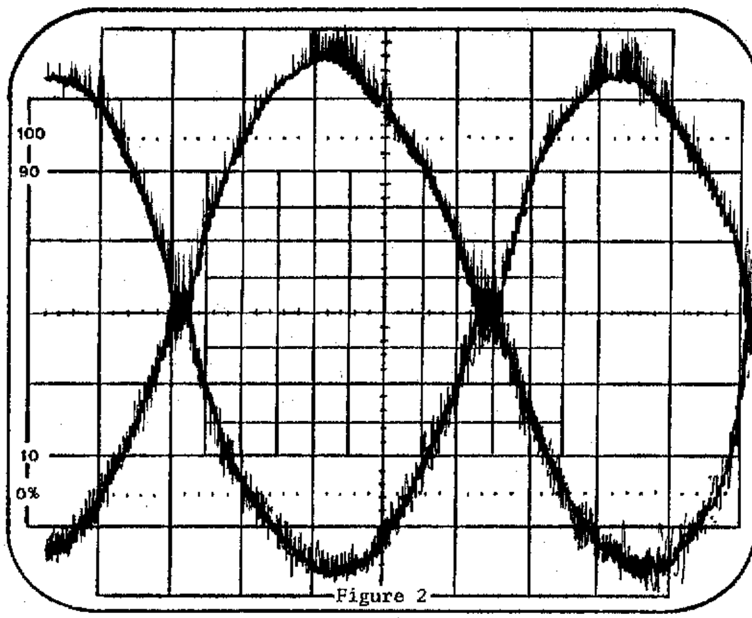


Figure 2

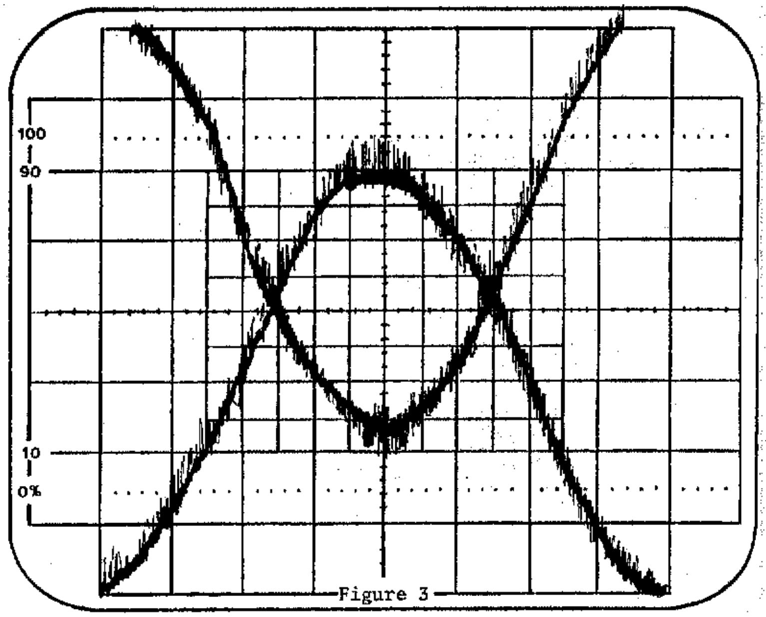


Figure 3

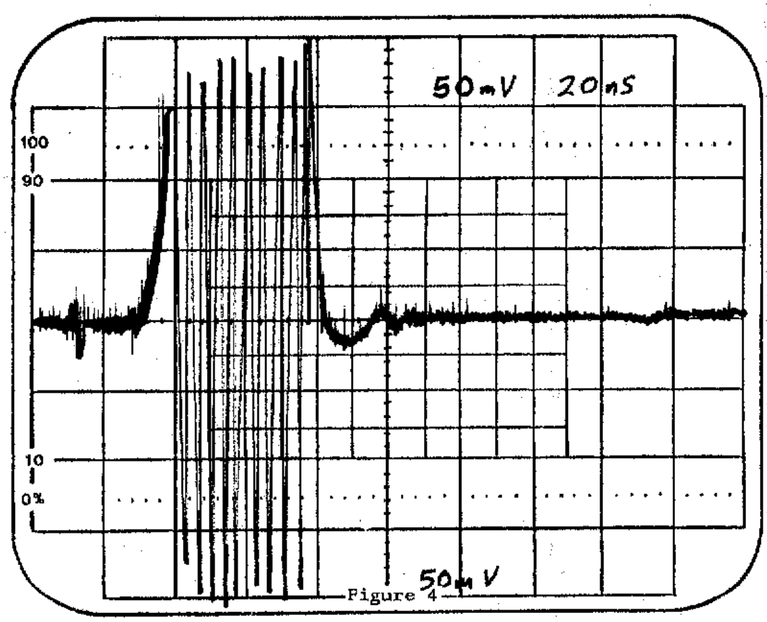


Figure 4

Sequential Data Files Best for Storing Routines

By Chuck Vertrees

Once an assembly language routine has been debugged and is in the computer's memory, it's helpful to have a method to save the routine, particularly if it's a long one.

With Altair Disk Extended BASIC, the routine can be stored as a program file that uses explicit POKE statements. But for long routines, this is a very slow, error-prone method. The best way to save a routine is as a sequential data file.

With the two BASIC programs listed below, consecutive memory locations can be stored in a disk data file and restored from that same file. The first program, "SAVE," dumps memory between two locations that you specify onto the disk. The data is stored in a sequential file whose name you must specify. The program allows you to specify the disk upon which you want the file to be saved. Before specifying the locations for saving, it also shows what files are currently on the specified disk.

When you specify a file name, the "SAVE" program adds "I:" to the file name. This is to help identify those files created by the "SAVE" program, which are actually image files.

Continued on Page Eight

"SAVE" PROGRAM

```
10 'MEMORY DUMP TO DISK
        WILL SAVE SPECIFIED LOCATIONS OF MEMORY IN SEQUENTIAL FILE
        FOR USE BY THE "RESTORE" PROGRAM.
20 DEFINT A-Z
30 PRINT:PRINT:PRINT
40 PRINT"MEMORY DUMP AND SAVE TO DISK PROGRAM.
50 DN=0
60 PRINT:INPUT"WHICH DISK";DN
70 PRINT:PRINT"HERE ARE THE FILES CURRENTLY ACTIVE ON DISK";DN:PRINT
80 FILESDN
90 PRINT:PRINT:PRINT
100 LINEINPUT"FILE NAME YOU WISH SAVED UNDER ?  ";N$
110 N$="I:"+N$
120 OPEN"O",1,N$,DN
130 PRINT#1,"IMAGEFILE"
140 PRINT
150 INPUT"STARTING MEMORY ADDRESS ";SA
160 INPUT"ENDING MEMORY ADDRESS ";EA
170 PRINT#1,SA,EA
180 PRINT:PRINT"SAVING ........."
190 FORI=0TOEA-SA
200 K=PEEK(SA+I)
210 PRINT#1,K
220 NEXTI
230 CLOSE
240 PRINT:PRINT
250 PRINT"FILE SAVED AS '";N$;"' AND CLOSED."
260 PRINT:PRINT:END
```

See "RESTORE" PROGRAM on page 10

Altair Disk Drive Alignment Permits Precise Operation

CONTINUED

Step to track 76 and observe the index sensor burst. This burst must be within ± 20 µsec. of the position of the burst on track 1. If the bursts are not within ± 20 µsec. of each other, position the stepper motor (sideways to bring the burst into alignment. To position the stepper motor, insert a flat bladed screwdriver between the stepper motor frame and chassis. The screwdriver may be used as a lever to move the stepper motor in the desired direction.

Return to track 1 to ascertain that the bursts are within 20 µsec. of each other. If not, repeat the previous procedure, always moving the bursts at track 76 to meet the burst at track 1. Then go back and check the cats-eye and realign it if necessary. Always recheck the cats-eye and bursts when you do any adjustments.

The beginning of the 40 µsec. burst should occur 40 µsec. ± 20 µsec. after the index pulse. To adjust this pattern, loosen the screws retaining the photo-transistor bracket, 1/4 turn and lightly tap the bracket until the proper burst position is obtained. Then retighten the bracket.

Problems may occur when software other than MITS Disk BASIC is used to write data on the diskette. PERTEC has been supplying the FD-400 with trim erase generated internally on the 600-321 PC board in the drive. If the MITS disk controller has a shorter trim erase time constant than the FD-400, step commands will be enabled before the drive is ready. MITS Disk BASIC will automatically relocate the desired track, but other software drivers may have trouble stepping after writing. The correct fix for this problem is to change the jumpers on the 600-321 PC board as follows: Disconnect W3 and install W4. (Refer to drawing #600-320 sheet 4 of the PERTEC FD-400 manual--available through MITS, Part Number 101595, at $10.00 each).

The drive should maintain alignment for at least 6 months under normal operating circumstances.

On the Floppy Disk drive cabinet, we had some complaints concerning ripple on the +5 volt power supply. This problem causes intermittently erratic operation of the disk system and is usually a result of AC line voltage under 115 volts. The problem is corrected by replacing T2 (small transformer) with MITS Part Number 102620, which has more conservative ratings. If you replace this transformer, please return the original for warranty credit. The new transformer may be identified by dual primary windings, which must be parallelled for 110 volt operation. Another fix is to parallel a second 3300 Mf capacitor with the existing filter for the +5 volt supply.

A new policy has been adopted for the shipment of the Altair Disk Drive. The chassis and the PERTEC drive will be shipped in separate boxes to insure proper alignment upon arrival. A change was also made last year concerning the mounting of the disk drive in the chassis. A three-point stance is now used to avoid warping of the drive chassis or any undue stress that may result in misalignment.

See DISK EXERCISER PROGRAM on page 12

Designing Consumer-Peripherals System

By Thomas Durston

This article first appeared in the February issue of DIGITAL DESIGN.

The design goals we formulated in March 1975 for the Altair floppy-disk system were essentially the same as those formulated for other Altair products. Striving to keep our approach general at first, we decided to:

- Design the hardware to interface the Altair 8800 computer to currently available floppy-disk drives
-Design the hardware to allow efficient use of software
-Design the system for low cost without sacrificing reliability
-Complete the hardware design in a minimum time
-Design for the simplest circuitry to allow easy troubleshooting
-Create a product that a user can build from a kit
-Use a minimum number of special components
-Design a product that can operate from a variety of ac supply voltages and frequencies.

As a first step toward making these goals more specific, we had to define the system configuration, decide upon the most efficient read/write format and consider the software required to drive the system. After examining our options, we set these more specific design goals:

-Utilize hard-sectored formatting
-Install one drive per cabinet, with provisions for connecting up to 16 drives in a system
-Partition the disk controller into seven major circuit groups.

These groups include addressing circuits for communication with the computer, index/sector circuitry, a Read Data circuit, disk-drive and controller status circuits, a Write Data circuit, a disk-drive-selection circuit and disk-drive function-control circuitry.

ACHIEVING THE GOALS

After we completed this initial design phase, we discovered that the required controller circuitry, which incorporates about 60 TTL ICs, was too dense to fit on one of the 5" x 10" cards used in the Altair computer. So we split the circuit functions--Disk Controller Board One provides address selection and also contains the three circuits that transfer information to the Altair CPU (input instruction), while Disk Controller Board Two handles outputs from the CPU (Fig. 1). Dividing the controller functions this way has simplified troubleshooting in the floppy-disk system.

CONTINUED

Floppy-Disk System Partition Function on Two Boards

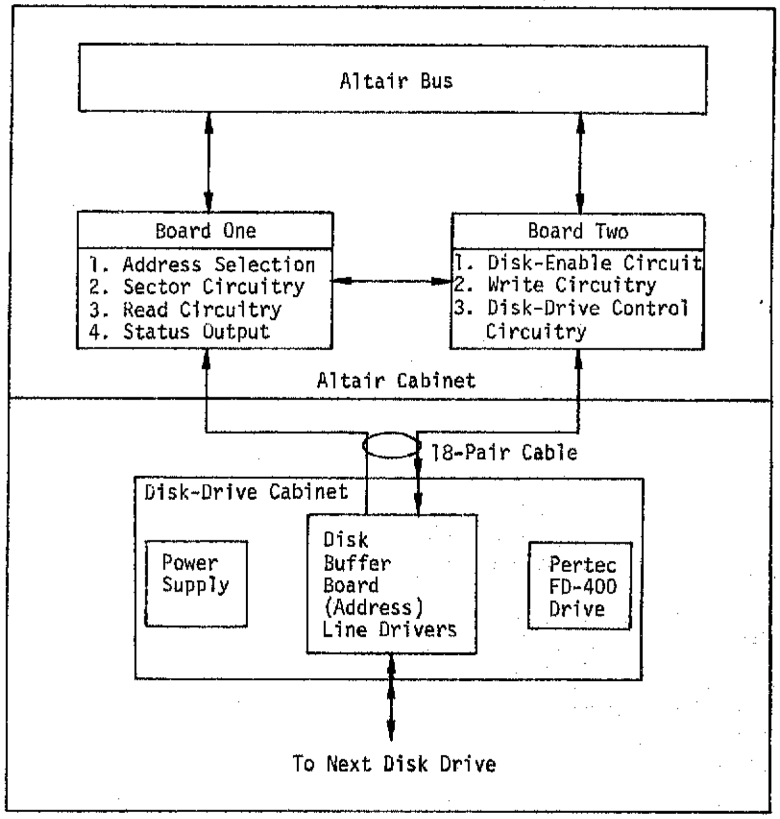


Figure 1

Sequential Data Files Best for Storing Routines

CONTINUED

Once you have specified (1) a particular disk, (if you don't specify a disk, it assumes disk Ø), (2) the file name under which you want the memory locations saved, and (3) the starting and ending addresses, the program saves those locations in the data file and closes it.

The "RESTORE" works much the same as the "SAVE" program but in reverse. The setup dialogue for the two programs is the same, except that the "RESTORE" program asks if you want to load the file. This provides an opportunity to stop the actual loading of the file if something is wrong with it. Any answer other than "Y" will cause the file not to be loaded into memory.

As the data is POKED into memory, it is immediately PEEKED back out and compared to the value just POKED. This is to check for bad memory locations. If a bad location is detected, the program will print a message to that effect and then stop. Otherwise, it will acknowledge that the data has been loaded and will stop.

When specifying the name of the file to be loaded, it's not necessary to type the "I:" in front of the file name, as in the "SAVE" program. The "RESTORE" program automatically adds this to each file name.

Note: Both of these programs are written for a CRT. If you do not use a CRT, then you will probably want to eliminate a large portion of the dialogue, because the programs are rather talky.

Floppy-Disk System Partitions Function on Two Boards

CONTINUED

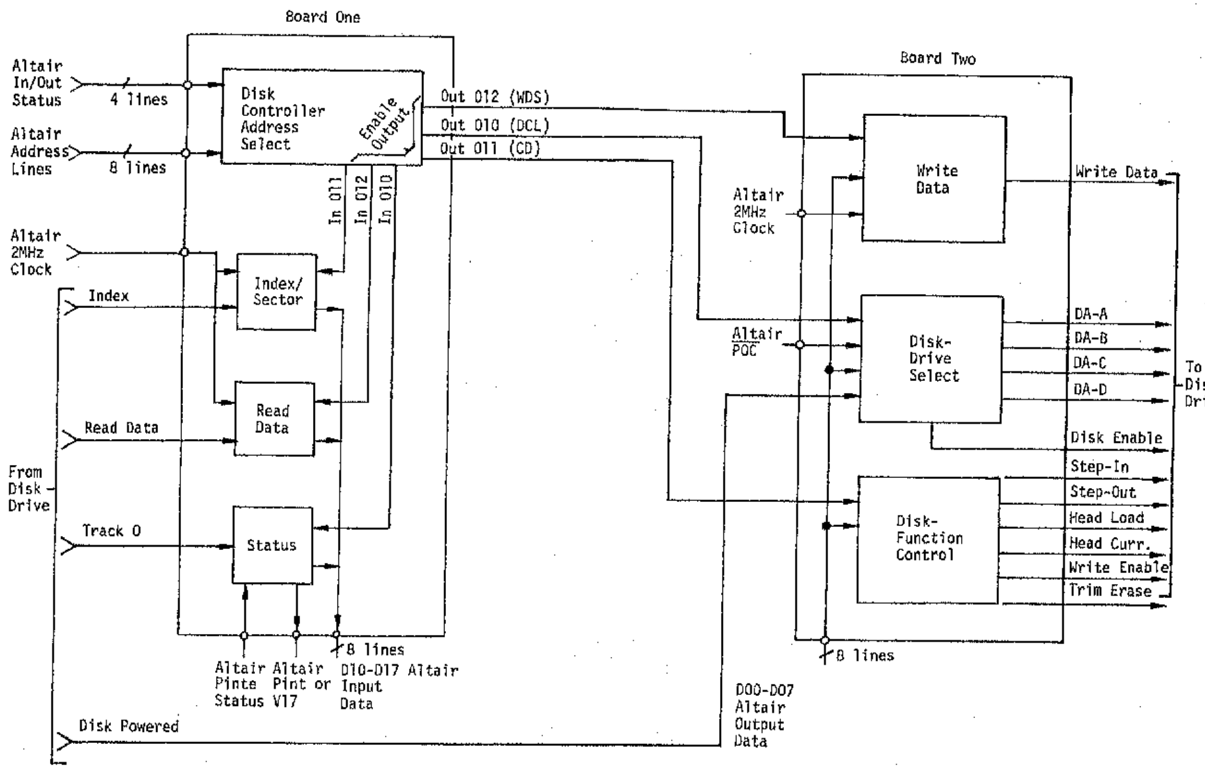


Figure 2

Some of the seven circuit groups (Fig. 2) were easily implemented. For the address selection logic on Board One, we used standard 7400-type gates to decode the system's eight address and four I/O status lines into the lines that enable the six controller circuits. Designing the logic for the index/sector circuitry and the Read Data Circuit was tougher. We used synchronous logic where possible; where timing delays were required, we achieved them through careful application of one-shot multivibrators. We designed the timing circuits in the index/sector decoder to allow a 20% variation in pulse width output, and we used 5% tolerance Mylar capacitors to ensure accuracy and stability. We also bypassed the Vcc supply at each one-shot, using 0.1 μf ceramic disk capacitors, and we located the timing components as close as possible to their respective pins on the IC. The Read Data circuit utilizes the only monostable multivibrator in the disk controller that requires 10% accuracy, and 5% tolerance mica capacitors minimize variations in it. The rest of the circuitry consists of logic connected synchronously to provide the sector count and the read data presented to the data input bus in the computer.

The other input circuitry on Board One is the status circuit, which we also designed as simply as possible. It consists of line drivers with their inputs connected to the various circuits as required by software and their outputs connected to the Altair data input bus. To reduce noise in the system, the +5 V Vcc supply for Board One contains bypass capacitors, and all unused inputs are either grounded or connected to Vcc through 1K pullup resistors.

The same design principles used on Board One apply to Board Two. We made the design of the Write Data circuit on Board Two completely synchronous, including the 9316 counters used to generate the write clock and data timing. This type of circuitry is highly stable and eliminates the ripple through counting noise found in nonsynchronous logic. The disk-drive-select circuitry is uncomplicated; it consists of a 4-bit latch, a flip flop and a one-shot timer. We designed the disk function-control circuit to operate the individual disk drive functions; each function requires at least one timing circuit. As before, we configured the required one-shot timers to allow for worst-case variations.

After investigating interconnect and wiring alternatives, we chose a method in which 0.1" center-pin connectors mate to sockets with crimp or solder pins; the scheme allows a kit builder to assemble typically expensive cables at good savings. For the interconnect wiring, we chose twisted-pair flat cable to provide what we feel is the best noise immunity and signal transfer characteristics.

For a floppy-disk drive, we selected the Pertec FD-400, both for its dc motor and performance characteristics (its dc motor is insensitive to line frequency variations and requires no drive belts) and its price. We designed a power supply to accommodate the floppy's requirements and keep special parts usage and cost to a minimum; to simplify the design and guarantee supply stability we chose 7800-type voltage regulators. The system's heatsinking utilizes aluminum extrusions and a cooling fan; external interconnections occur through DC-37 rectangular connectors, chosen because of availability, reliability and low cost.

Continued on Page Ten

PUBLICATIONS PROVIDE NOVICE WITH ESSENTIAL INFORMATION

By Rich Haber

Learning about microcomputers for the first time requires a great deal of new information. Since the microcomputer field is still in its infancy, adequate literature is often difficult to obtain.

The following list of periodicals, books and computer clubs should help the novice computer enthusiast locate the most up-to-date information.

BYTE
Peterborough, NH 03458
Monthly, $12/year

BYTE, usually a very thick publication, emphasizes hardware, with articles on microcomputer construction and design. Always comprehensive in its approach to any subject, BYTE occasionally devotes an entire issue to a particular topic.

CREATIVE COMPUTING
PO Box 789-M
Morristown, NJ 07960
Bimonthly, Institutional--$15/year, Individual--$8/year, Student--$6/year

CREATIVE COMPUTING describes itself as "the magazine of recreational and educational computing." Although it does give equipment profiles, it is not specifically aimed at the electronic aspect of microcomputers. Written in a rather informal style, CREATIVE COMPUTING includes fiction, games, puzzles, cartoons, book reviews, software and computer art.

KILOBAUD
Peterborough, NH 03458
Monthly, $15/year

KILOBAUD, another new publication, is an offshoot from "73," a popular amateur radio publication. Although KILOBAUD includes both hardware and software articles, it leans more toward the former.

PERSONAL COMPUTING
167 Corey Road
Brookline, MA 02146
Bimonthly, $8/year

PERSONAL COMPUTING, a newcomer to the field, is a very slick magazine that uses many colorful and interesting graphics. It takes a general approach to microcomputers and usually includes fiction articles on the social implications and applications of microcomputers.

CONTINUED ON TWELVE

Sequential Data Files Best for Storing Routines CONTINUED

"RESTORE" PROGRAM

```
10 'MEMORY RESTORE FROM DISK
      THIS PROGRAM LOADS MEMORY FROM A SAVED IMAGE FILE CREATED
      BY THE MEMORY "SAVE" PROGRAM

20 DEFINT A-Z
30 CLEAR 300
40 PRINT:PRINT:PRINT"MEMORY RESTORE FROM DISK"
50 DN=0
60 PRINT:INPUT"WHICH DISK";DN
70 PRINT"HERE ARE THE FILES CURENTLY ON DISK";DN:PRINT
80 FILESDN
90 PRINT:PRINT:LINEINPUT"WHICH IMAGE FILE DO YOU WISH TO LOAD ?  ";N$
100 N$="I:"+N$
110 OPEN"I",#1,N$,DN
120 LINEINPUT#1,I$
130 IF I$<>"IMAGEFILE" THEN PRINT:PRINT"NOT AN IMAGE FILE":PRINT:END
140 INPUT#1,SA,EA
150 PRINT:PRINT:PRINT"STARTING MEM ADDRESS IS",SA
160 PRINT"ENDING MEM ADDRESS IS",EA
170 PRINT:LINEINPUT"DO YOU WISH THE FILE TO BE LOADED (Y OR N) ? ";M$
180 IF LEFT$(M$,1)<>"Y" THEN PRINT:PRINT"FILE NOT LOADED":PRINT:END
190 PRINT:PRINT"LOADING..........":PRINT
200 FORI=0TOEA-SA
210 INPUT#1,K
220 POKESA+I,K
230 KK=PEEK(SA+I)
240 IF KK<>K THEN PRINT"MEMORY ERROR AT";SA+I:PRINT:END
250 NEXTI
260 PRINT:PRINT"ALL THROUGH:  LOAD OK."
270 CLOSE
280 PRINT:END
```

Floppy-Disk System Partitions Function on Two Boards

CONTINUED

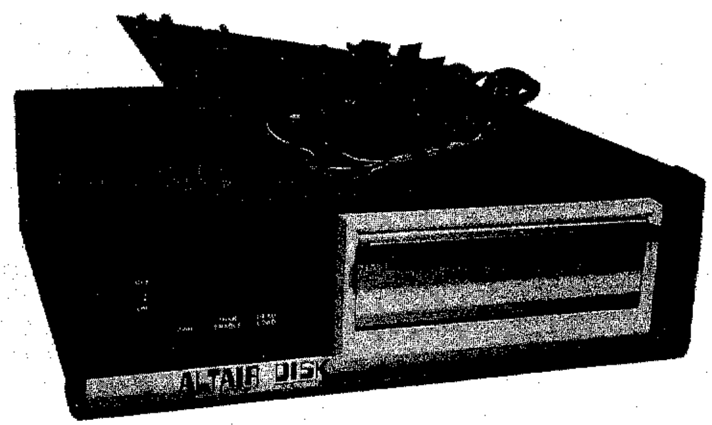


Figure 3

The resulting floppy-disk system (Fig 3) can store over 300K bytes/diskette and has an access time of less than one second. It usually uses Altair Disk Basic software, which resides in the lower 20K of memory and provides disk utilization routines. The system's two controller cards plug into the computer's bus; all control, status and data I/O goes through three I/O ports dedicated to disk control.

Altair Computer Reproduces Voice: Complex Waveforms Made Simple

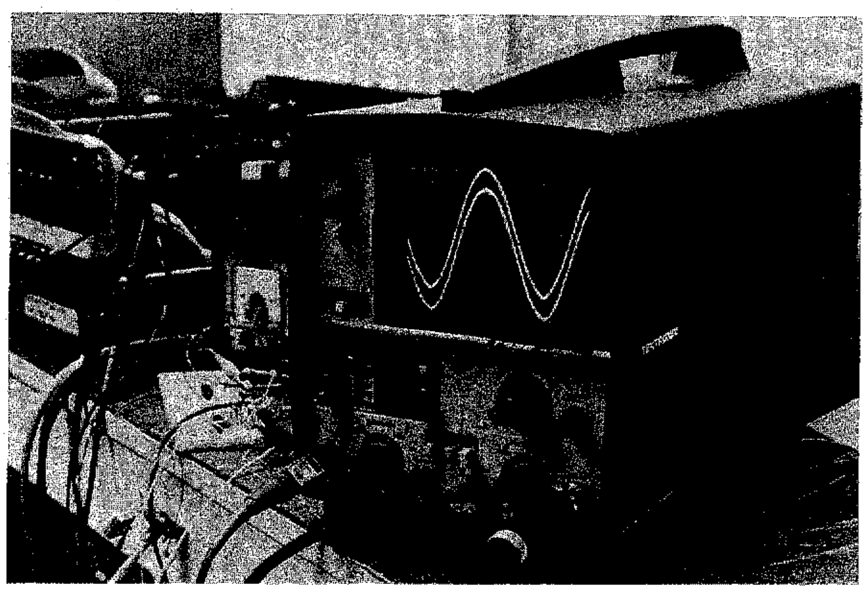
By Bill Kuhn

An Altair 8800a doesn't look much like a tape recorder, and it usually doesn't function much like one either. But that didn't stop me from trying to record my voice on my Altair computer system.

First, I plugged 64K of memory and an Altair 88-AD/DA Converter into my chassis. Then I connected a microphone and microphone preamp to an analog input, and an amplifier and loudspeaker to the output of the Altair 88-AD/DA. Next, I connected a push button to one of the CA1 handshake lines, and toggled in 130_8 bytes of initialization and program.

Pressing the button to start the "record" section of the program, I spoke into the microphone: "Altair 8800," I said as I watched the address lights cycle through the full 64K. With growing anticipation, I pressed the button again to start the "playback" section of the program. Squeeeek! Derdul! Hummmmmm! Bzzzzt! That didn't even vaguely resemble my voice. So I grounded the Altair 88-AD/DA input and tried again. Squeeeek, hummmmm!

I finally looked back at my program and discovered an error. After correcting the error, I tried recording my voice once again. This time, the computer played back: "Altair 8800." "Neat!," I said. "Neat!," replied my computer.



Obviously, there are less expensive devices on the market other than the Altair 8800 computer for recording voice. So why the big deal? My experiment illustrates that complex waveforms, like the sound of my voice, can be acquired, digitized, stored, retrieved and output again in analog form. Since this complex voice waveform can be stored, it can be analyzed or processed by the computer. If the computer can output such a complex waveform, any type of waveform that can be written in an equation can be generated at almost any speed.

The software included in this article causes the Altair computer and the Altair 88-AD/DA to sample the incoming analog signal at approximately 32 thousand times per second. This sample rate will fill the memory of a full 64K machine in about two seconds. However, it is faster than necessary for voice intelligibility.

CONTINUED
ON THIRTEEN

PUBLICATIONS PROVIDE NOVICE WITH ESSENTIAL INFORMATION CONTINUED

SCCS INTERFACE
Southern California Computer Society
Box 54751
Los Angeles, CA 90054
Monthly, $10 membership includes year's subscription

SCCS INTERFACE is the official publication of the Southern California Computer Society. It's a small but professional magazine with about six general interest articles geared toward the beginner.

INTERFACE AGE
13913 Artesia Blvd.
Cerritos, CA 90701
Monthly, $10/year

INTERFACE AGE describes itself as a magazine about "microcomputing for home and small business." The articles are very detailed and technically oriented. But they provide important information on many new developments in hardware and software.

Books on Microcomputer Design and Operation:

INTRODUCTION TO MICROCOMPUTERS, VOLUMES I AND II
Adam Osborne
Osborne & Associates
304 pp., $7.50 each

Detailed explanation of microcomputer architecture. Volume I is generalized. II deals with real microprocessors.

MICROPROCESSORS AND MICROCOMPUTERS
Branko Soucek
John Wiley & Sons
607 pp., $23

A very comprehensive introduction to the field. Covers binary system, digital logic, machine language instructions, interfacing and representative microprocessors. Not overpriced, considering its scope.

INTRODUCTION TO MICROCOMPUTERS AND MICROPROCESSORS
Barna & Porat
John Wiley & Sons
108 pp., $10.50

A textbook. Methodical approach to hardware and software.

MICROCOMPUTER PRIMER
Waite & Pardee
Howard W. Sams
224 pp., $7.95

Good introduction to computer hardware, architecture and peripherals.

CONTINUED

Altair Disk Drive Alignment Permits Precise Operation CONTINUED

DISK EXERCISER PROGRAM

ADDRESS	CODE	MNEMONIC
000	333	IN (CHANNEL)
001	377	
002	346	ANI (DATA)
003	017	
004	127	MOV D,A
005	172	MOV A,D
006	323	OUT (CHANNEL)
007	010	
010	333	IN (CHANNEL)
011	010	
012	074	INR A
013	312	JZ / 000005
014	005	
015	000	
016	333	IN (CHANNEL)
017	010	
020	346	ANI (DATA)
021	002	
022	302	JNZ / 000016
023	016	
024	000	
025	076	MVI A,/ 002
026	002	
027	323	OUT (CHANNEL)
030	011	
031	333	IN (CHANNEL)
032	010	
033	346	ANI (DATA)
034	100	
035	302	JNZ / 000016
036	016	
037	000	
040	006	MVI B,/ 000
041	000	
042	333	IN (CHANNEL)
043	377	
044	007	RLC
045	267	ORA A
046	037	RAR
047	117	MOV C,A
050	076	MVI A,/004
051	004	
052	322	JNC /000057
053	057	
054	000	
055	076	MVI A,/ 010
056	010	
057	323	OUT (CHANNEL)
060	011	
061	333	IN (CHANNEL)
062	010	
063	074	INR A
064	312	JZ /000005
065	005	
066	000	
067	075	DCR A
070	346	ANI (DATA)

CONTINUED

Altair Computer Reproduces Voice: Complex Waveforms Made Simple

CONTINUED

In general, for A to D conversion of this type, the input signal should be sampled at about three or four times the maximum frequency of interest. Voice is quite recognizable and intelligible with a 3KHz maximum frequency, so a sample rate of 10KHz might be a good compromise. Since most people's ears are sensitive to 10KHz, a lowpass filter with a 3 dB point of 3KHz should be used. This filter limits the amount of sample frequency that will come through.

In the playback part of the program, read the sense switches to determine the playback rate. 002_8 gives nearly one-to-one playback. Larger numbers slow down the playback, causing some unusual effects.

The schematics of the hardware and a listing of the software I used for the voice digitizing experiment follow.

Initialization (for Voice Digitizing Experiment)

Location	Contents	Mnemonic	Comments
000	257	XRA Acc.	Zero Accumulator
1	323		
2	100		
3	323		
4	101		
5	323		
6	102		
7	323		
010	104		
1	323		
2	106		
3	057	CMA	All 1's to Acc.
4	323		
5	103		
6	323		
7	105		
020	323		
1	107		
2	076	MVI Acc.	Load Accumulator Immediate
3	054	DATA	
4	323		
5	100		
6	323		
7	102		
030	323		
1	104		
2	323		
3	106		

CONTINUED ON FOURTEEN

Altair Disk Drive Alignment Permits Precise Operation

CONTINUED

071	002	
072	302	JNZ / 000061
073	061	
074	000	
075	171	MOV A,C
076	376	CPI (DATA)
077	115	
100	322	JNC / 000042
101	042	
102	000	
103	270	CMP B
104	312	JZ / 000042
105	042	
106	000	
107	332	JC / 000122
110	122	
111	000	
112	076	MVI A,/001
113	001	
114	323	OUT (CHANNEL)
115	011	
116	004	INR B
117	303	JMP / 000061
120	061	
121	000	
122	076	MVI A,/002
123	002	
124	323	OUT (CHANNEL)
125	011	
126	005	DCR B
127	303	JMP / 000061
130	061	
131	000	

PUBLICATIONS PROVIDE NOVICE WITH ESSENTIAL INFORMATION

CONTINUED

HOW TO BUY AND USE MINI AND MICRO-COMPUTERS
William Barden, Jr.
Howard W. Sams
240 pp., $9.95

Explains and compares various computers and peripherals. Not suggested as a first book.

BUGBOOK I, II & III
Larsen, Rony & Titus
E & L Instruments, Inc.

A very comprehensive book designed to help the user learn by doing.

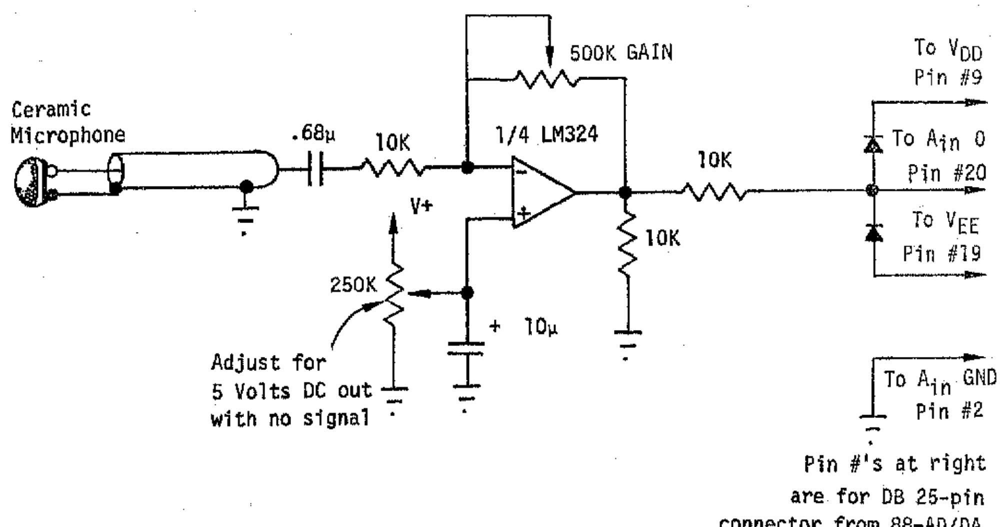
UNDERSTANDING DIGITAL COMPUTERS
Ronald M. Benrey
Hayden Publishing Co., Inc.
166 pp.,

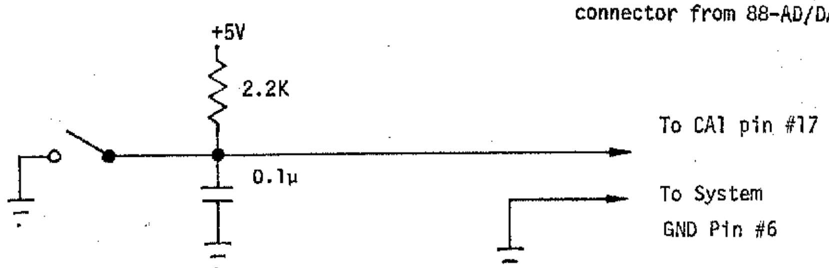
This is an old book, but most of the information is still relevant. Written in an easy-to-understand style, it covers the binary system, Boolean algebra, logic design, machine language programming and memory devices.

CONTINUED ON SIXTEEN

Program for Voice Digitizing Experiment

Loc.	Contents		Loc.	Contents	
040	333 IN	Wait for	100	027 RAL	Wait for
1	104	Status	1	322 JNC	Status
2	027 RAL	Start function	2	076	Clear
3	322 JNC		3	000	
4	040	Push Button	4	333	Clear
5	000		5	105	Status
6	333 IN	Clear	6	041 LXI-HL	Load Start
7	105	Status	7	001	Address
050	041 LXI-HL	Load Start	110	001	
1	000	Address	1	333 IN	Read S.S.
2	001		2	377	Setup Counter
3	001 LXI-BC	Load Increment	3	075 DCR	Decrement
4	001		4	302 JNZ	Counter
5	000		5	113	(Time Out)
6	067 SC	Clear	6	000	
7	077 CC	Carry	7	011 DAD	Increment Address
060	257 XRA Acc.	Zero Acc.	120	176 MOV Mem→ Acc.	
1	323	Start	1	323 OUT	Output D to A
2	103	Conversion	2	105	
3	011 DAD BE+ HL→HL	Increment Addr.	3	322 JNC	
4	332 JC	Jump on	4	111	
5	076	Mem. full	5	000	
6	000		6	303	
7	000 NOP		7	106	
070	333 IN	Read	130	000	
1	101	A/D data			
2	167 MOV Acc→ Mem	Store			
3	303				
4	060				
5	000				
6	333				
7	104				





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ACR ALIGNMENT AIDS IN TROUBLESHOOTING

By Rich Haber

Second article in a three-part series on the theory of operation and repair of Altair ACR cards.

In this second portion of the series, I'll discuss alignment of the ACR modem, saving programs and some ACR troubleshooting hints.

But before attempting any of the following repair procedures, make sure that you fully understand the ACR theory of operation (see pp. 14-20, March, C.N.).

If the ACR isn't functioning properly (BASIC won't load or programs can't be recorded), the ACR alignment should be checked first.

Alignment of the Modem

Every cassette player and tape has slightly different speed and head specifications. So, the ACR must be realigned whenever the deck or tape is changed. One method of alignment is explained below.

1. Plug ACR into chassis, on top of an extender card (SIOB side to your right), if available.
2. Insert mini-plug into earphone (plug-in) jack and the other end into the ACR cable going to pin 2.
3. Plug ACR cable into the ACR board. Pin 4 is ground.
4. Insert test side of BASIC tape into player and rewind.
5. Turn on computer. Reset and deposit the following program.

   333
   007 (window program which displays input data on the data lights)

   Examine zero, then single step twice.
6. Attach the clip-on probe of the scope to pin 10 of the ACR Molex connector (pin furthest from you). This is the output of the demodulator.
7. Set scope for 2v/cm and 1 msec/cm.
8. Play tape with volume set midway or lower.
9. Adjust R29 (pot furthest from you) for an equal duty cycle. Each alternation should be about 3.2 msec. Data lights should display 1 25's (01 010 101).
10. Put scope probe into the test point hole (on Modem side of board near R29) labelled TP. Set scope for 4v/cm and 2 msec/cm.
11. Turn tape deck gain low.
12. Adjust the next port towards you for maximum gain and flat positive peaks (as shown below).

13. Adjust the port closest to you to do the same for the negative peaks and turn tape deck gain back up.
14. Advance the tape to the second test pattern (175's or 256's) and check for a stable display on the data lights.

This completes the alignment procedure. Now make sure that you can load BASIC.

How to Load BASIC

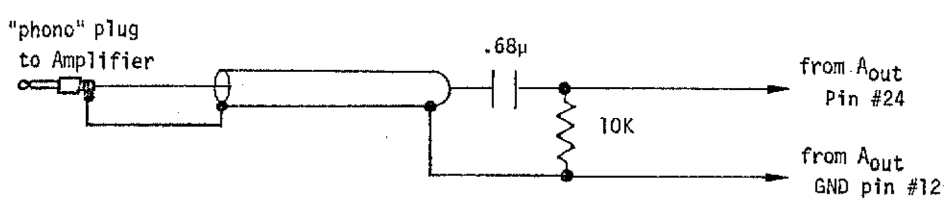
1. Deposit ACR bootstrap. If you have a multiboot PROM card, merely address the starting location of the ACR boot.
2. Install tape (BASIC side up) and rewind to beginning.
3. If you have loaded the boot by hand, examine address 000012 and single step twice. This is the window program and will allow you to see the 256's written on tape before BASIC starts. If you are using a PROM bootstrap, find 333 and 007 on the PROM, then single step twice from 333.
4. Start the tape.
5. After a few seconds, the data lights should show a stable display of 256 (10 101 110).
6. Quickly examine address 0.
7. Lift switch A15. If you are using a 2SIO for an I/O board, lift A11.
8. Hit RUN.
9. After about 20 seconds, the address lights will "jump." Address lights A3, A4 and A6 should go out.
10. After a few minutes, the terminal should say "memory size?"
11. Hit the return key on the terminal.
12. It will then ask what functions you want: "Want Sin, Cos, Atan?"
13. Answer Y for yes; N for no.
14. When it prints "OK," you are ready to write a test program.

If the terminal starts printing out C's (ccccccc, etc.) while it is loading, a "checksum error" is indicated. This is an error in transmission of data, possibly a bad tape. If it prints out M's (mmmmm, etc.), a memory error is indicated. One of your memory boards is probably bad.

CONTINUED ON SIXTEEN

Altair Computer Reproduces Voice: Complex Waveforms Made Simple

CONTINUED



ACR ALIGNMENT AIDS IN TROUBLESHOOTING
CONTINUED

The next step is to make sure programs can be saved.

Saving Programs through the ACR

The ACR can be used to store programs by utilizing the CSAVE command. (Note: Only 8K and Extended BASIC have the CSAVE capability.) When checking out any ACR, the following procedure should be done several times.

1. Write a simple test program.

   Example:

   ```
   10 Print "ABCDEFGHIJK . . ."
   20 GOTO 10
   ```

2. Run the program to see if it works.
3. Type "Control C" to stop the program.
4. Type C SAVE A (any label can be used).
5. Connect the cable from the record-out jack of the ACR cable to "MIC" or "record-in" jack of the tape deck.
6. Install a blank cassette in the ACR. If there are two holes in the back edge of the cassette, they should be covered with tape. (This system prevents accidental erasures of BASIC.)
7. Rewind the tape.
8. Press play and record. Let it run past the leader or about 15 seconds.
9. Press the return key on the terminal.
10. When the program has been stored, it will print "OK."
11. Reconnect the cable so that the earphone-out on deck is connected to play-in on ACR.
12. Type NEW on the terminal and hit return. This will erase the program from memory.
13. Rewind the tape.
14. Type CLOAD A (or whatever you have called your program) and hit RETURN.
15. Play the tape.
16. The terminal should respond "OK."
17. Type RUN and hit return.
18. Your program should run on the terminal.
19. Repeat this procedure several times.

If you type CLOAD (A), hit return and nothing happens; the computer either did not save or load properly. It will wait indefinitely for A to load. To reset the computer, stop it (examine ØØØ,ØØØ) and hit run. Check for errors and repeat this procedure several times.

ACR Troubleshooting Hints

1. 3.2 and higher versions of BASIC incorporate a larger frequency swing in the data stored on the cassettes than earlier versions. All the older ACR's should be modified to correctly interpret these cassettes. See the list of modifications at the end of this article.) Check to see that these modifications are correct on your boards. A revised board will usually work with 3.1 BASIC, but an unmodified board will not work at all with 3.2 or higher versions of BASIC.
2. If you have trouble getting a stable 125 on the data lights while running a test tape, check out R29, which may have collected dirt inside. Ohm it out over the entire range to see if it has a smooth response. Check the 5 µf capacitor for leakage.
3. If you are not receiving any data on the data lights after entering a window program, check the following:
   a. regulated voltages
   b. Baud rate--Look at pin 40 of the UART for a negative going 2.3 - 3.0 microsecond pulse every 208 microseconds.
   c. Play 125's from the test tape and check pin 8 of the XR-210 for a good square wave output (-12v to +5v). If there is no output, go to the test point labelled TP and look for a 14v p-p fm signal. By signal tracing around these points, you should be able to isolate a failure. If the problem is centered around the XR-210, refer to the table of waveforms in the ACR manual.
   d. If you have good output from the XR-210 and good continuity to pin 20 of the UART (IC M on the SIOB side), refer to the SIO section of this article.
   e. If you have good input to the XR-210 and bad output, check component values, especially C15, 16 and 17. If you still have problems, the XR-210 might be bad.

CONTINUED

PUBLICATIONS PROVIDE NOVICE WITH ESSENTIAL INFORMATION CONTINUED

Machine Language Programming Books:

SOFTWARE DESIGN FOR MICROPROCESSORS
Wester & Simpson
Available from Creative Computing
350 pp., $12.95

Detailed explanation of machine and assembly language programming for microprocessors.

PRACTICAL MICROCOMPUTER PROGRAMMING: THE INTEL 8080
Walt Weller
Northern Technology Books
$21.95, pp.

Reviewed in December issue of C.N. Application oriented, includes many examples.

8080 PROGRAMMING FOR LOGIC DESIGN
6800 PROGRAMMING FOR LOGIC DESIGN
Adam Osborne
Osborne & Associates

Sequels to his earlier volumes. Programming microprocessors for dedicated logic applications. Not for the beginner.

Books on BASIC Programming:

A large number of books on BASIC are available at college and technical book stores. THE BEST OF CREATIVE COMPUTING, Volume 1 (described later) has an article which reviews 21 different books on BASIC. I will mention just a few here.

BASIC
Albrecht, Finkel & Brown
John Wiley & Sons
325 pp., $3.95

An easy-to-understand programmed introduction to BASIC. Does not cover advanced BASIC.

BASIC BASIC AND ADVANCED BASIC
James S. Coan
Hayden Book Co.
256 pp., 186 pp. and $7.95, $6.95, respectively

A two-volume set that covers BASIC in detail.

BASIC PROGRAMMING
Kemeny & Kurtz
John Wiley & Sons
150 pp., $7.75

Written by the authors of the BASIC language, this book is considered one of the best texts available.

CONTINUED

ACR ALIGNMENT AIDS IN TROUBLESHOOTING

CONTINUED

4. If you cannot save programs:

   a. On the bottom of the modem there are a number of holes for interconnection wires to the SIOB. The second hole from the right (labelled GND) and the third from the right should both have wires going to the ground connection (pin 4) of the 10-pin molex plug. Check this connection.

   b. Deposit and run the following program:

333 377	input data to accumulator from sense switches
323	output accumulator
007	to channel 7 (ACR data channel)
303	jump
000	to
000	address zero

This program continually outputs data from sense switches A15-A8 to the modulator section of the modem. With this program running, you can signal trace the circuit.

1. Check IC H, pin 8, for a square wave output. You should be able to modulate the output by changing the sense switch patterns.

2. Check point R0 if there is an output at H8. You should see a modulated triangular wave. This is a very weak signal, approximately 100 mv. Note that R50 should be 22K ohm and not 220K ohm, as shown on the modem board schematic. (See ACR manual--modem board section.) R50 is a voltage divider and integrating circuit. You should be feeding into a high impedance MIC input, which demands a low level input.

3. If there is no output, check for a 2 MHz input to J2, K2 and E14. If there is no 2 MHz input, check for a low at G11. Do you have continuity from G12 to SØ on the SIOB side? Are ICs J, K and E dividing the signal?

Proper Strapping of the SIOB Card:

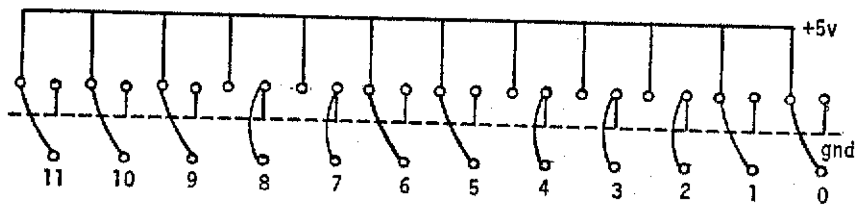
1. The ACR should be at channels 6 and 7. Therefore, look at the address straps at left center. I1 should be connected to A1, I2 should be at A2 and all others should be strapped low.

$A2 = 2^2 = 4$

$A1 = 2^1 = \underline{2}$

$\quad\quad\quad\quad\ 6$

2. The ACR operates at 300 baud. Notice the straps at the bottom right corner of the board. The diagram below shows the correct connections for a Rev. 1 SIOB board.

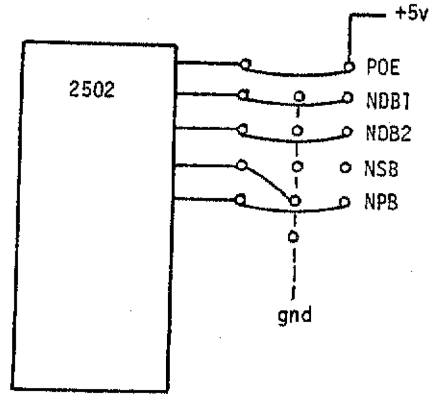


3. The following jumpers should be installed on the board:

   -v to -v
   0 to 0
   I to I
   C to C
   PC to PC

   The interrupt jumper (INT) should not be connected.

4. On the right side of IC M five jumpers should be connected as shown at right.



PUBLICATIONS PROVIDE NOVICE WITH ESSENTIAL INFORMATION CONTINUED

DISCOVERING BASIC: A PROBLEM SOLVING APPROACH
Robert E. Smith
Hayden Book Co.
203 pp., $6.85

Does not provide instruction on BASIC, but shows how it can be used to solve problems. Highly recommended for people who enjoy mathematical games.

Non-Technical Computer Books:

THE COMPLEAT COMPUTER (SIC)
Dennie Van Tussel
Science Research Associates
216 pp., $5.95

A collection of fiction and non-fiction articles by non-computer experts, discussing the uses, implications and effects of computers on society. Published by an IBM subsidiary.

THE BEST OF CREATIVE COMPUTING, VOL. 2
David H. Ahl, Ed.
Creative Computing Press
324 pp., $8.95

A collection of reprinted articles from CREATIVE COMPUTING magazine designed to promote the idea that computers can be a creative and pleasurable tool. Many games and a discussion of the sociological implications of computer use and misuse included.

COMPUTER LIB/DREAM MACHINES
Ted Nelson
Available from CREATIVE COMPUTING
127 pp., $7.00

Written in a WHOLE EARTH CATALOGUE format. Promotes the idea that computers should be understood and used by everyone. Touches aspects of the entire field. The kind of book that can be opened to any page for enjoyable reading.

ARTIST & COMPUTER
Ruth Leavitt, Ed.
Available from CREATIVE COMPUTING
132 pp., $4.95

A well-illustrated discussion of computer art.

101 BASIC COMPUTER GAMES
David H. Ahl
Available from CREATIVE COMPUTING
248 pp., $7.50

A listing and explanation of games written in BASIC.

CONTINUED ON NINETEEN

ɜir AD/DA Subsystem Reads and Generates Analog Signals

By Bill Kuhn

88-AD/DA: Analog I/O for 8800 Series

With the Altair 88-AD/DA, the Altair 8800 series can read or measure voltages and can also generate them to 8-bit accuracy.

The new 88-AD/DA Converter is an analog I/O subsystem for the Altair 8800 series computers. The input (A to D) section of the board features an 8-channel Analog Multiplexer, a Sample and Hold Amplifier and an 8-bit resolution Analog to Digital Converter. The 8-channel MUX allows acquisition of analog data from eight different sources. The sample and hold allow accurate digitization of rapidly changing voltages.

The Output section (D to A) consists of two 8-bit resolution D to A converters. The voltage range of both the input and output sections is nominally 0-10VDC.

What is D to A Conversion?

Digital to Analog Conversion is the process of generating an analog quantity (usually voltage or current) from a digital (usually binary) number. The analog output is usually directly proportional to the digital numbers.

The D to A converters on the 88-AD/DA board system are the "switched binary current source" type. (See Figure #1.) With the eight current sources, there are 256 unique combinations of current possible at I_{in}. These range from 0 to $\frac{255}{256} I_{ref}$. These currents at I_{in} are connected to current-to-voltage converters:

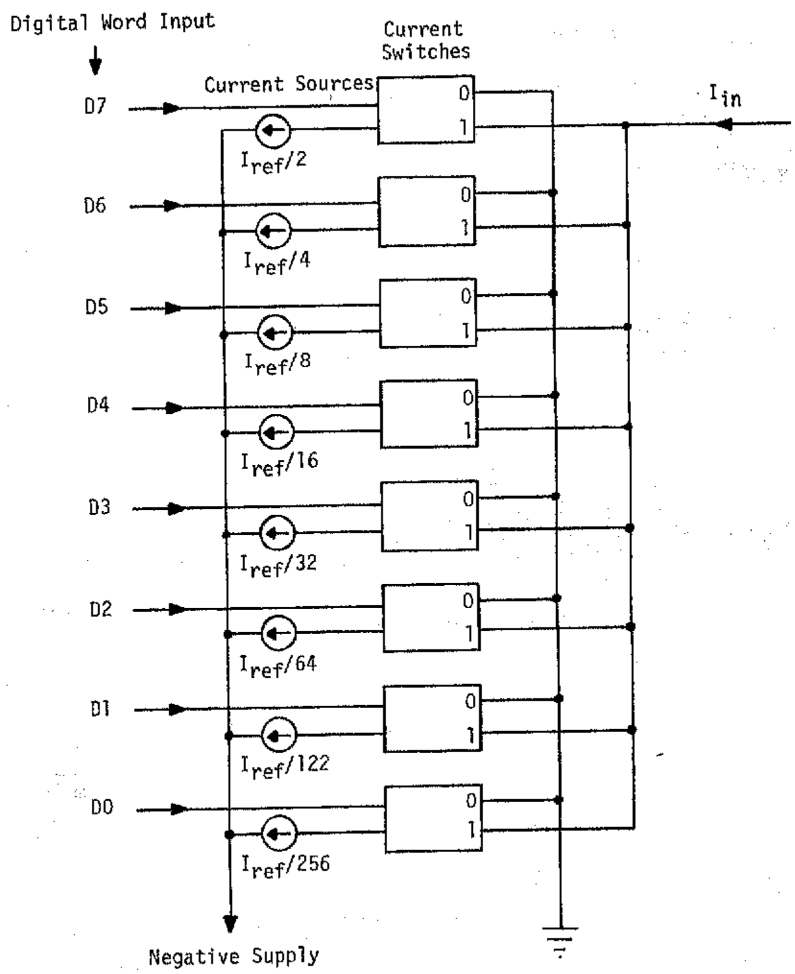


Figure 1

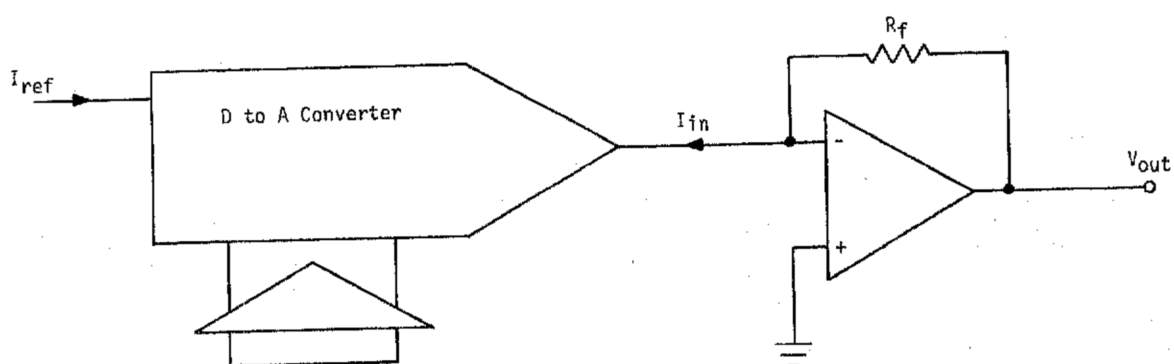


Figure 2

Altair AD/DA Subsystem Reads and Generates Analog Signals

CONTINUED

The current-to-voltage converter produces a voltage at its output equal to $I_{in} \times R_f$. The I_{ref} used for the 88-DA/AD is equal to 2MA and the R_f = 5K ohms, so the range of output supplied is from 0 to 9.961V $= (\frac{255}{256} \text{ X } 5\text{X}10^3 \text{ X } 2 \text{ X } 10^{-3})$. Nominally, this is called 0 to 10 volt output. This output is available in 256 steps of 39 millivolts each. So if the computer outputs a 200 octal to the D to A converter section of the board, an output of 5 volts results from the D to A converter.

For example, 377_8 gives 9.961V, 000_8 gives 0 volts, 001 octal gives .039V, etc.

What is A to D Conversion?

A to D Conversion is the process of generating a number (binary, octal, decimal or whatever) to represent an observed analog quantity. When you look at the position of the pointer on a voltmeter and interpret it as indicating a certain number of volts, you have performed an analog to digital conversion.

The A to D converter section of the 88-AD/DA is a "Successive Approximation" type. (See Figure #3.)

As previously described, a digital to analog converter is used. But this time it isn't connected to a current to voltage converter. Instead, the input current is connected to a node where a resistor-to-ground, a resistor from the Input voltage (voltage to be measured) and the input-to-a-voltage comparator meet. When the I_{in} (current out of the node) of the DAC and the current into the node from V_{in} through R_{in} are equal, there is no current in R_s. So the voltage of the node (referred to ground) is 0.

When a voltage is present, the Successive Approximation converter tries to bring that voltage as near zero as possible, without going below it. It does this by turning on the currents in the DAC (starting with the largest) in succession, testing the output of the comparator to see if it went below zero, leaving the current on if not and turning it off if it does go below zero. When all bits have been checked, the remaining digital word represents the nearest approximation possible of the analog quantity with that converter. At this point the converter gives out a signal called "Conversion Complete," which signals the computer that data is stable and may be read.

Table 3-1. Cable Connection		24-Pin Male Connector (P1)	25-Pin Female Connector (D8)
Analog Input Lines	AI0	18	20
	AI1	22	16
	AI2	23	15
	AI3	17	21
	AI4	3	4
	AI5	7	8
	AI6	4	5
	AI7	6	7
	GND	1	2
Control (Handshake) Lines PIA-U System	CB2	20	18
	CB1	2	3
	CA2	9	10
	GND	5	6
	VCD	8	9
	VEE	19	19
Analog Output Lines	GND	10	11
	GND	11	12
	GND	12	13
	A_{AOUT}	14	24
	A_{BOUT}	13	25
Control (Handshake) Lines PIA-T	CA1	21	17
	CA2	15	23
	CB1	24	14
	CB2	16	22

The Altair 88-AD/DA user's manual explains in much more detail the software and hardware arrangements necessary to use the board. It also covers circuit theory, application information and troubleshooting.

Table 3-1 shows the cable connections available from the 88-AD/DA board.

CONTINUED ON TWENTY

PUBLICATIONS PROVIDE NOVICE WITH ESSENTIAL INFORMATION

CONTINUED

Specialized Books on Digital Electronics:

TTL COOKBOOK
Don Lancaster
Howard W. Sams
335 pp., $8.95

Excellent book on designing TTL (transistor-transistor logic) circuits. Some previous knowledge of solid state electronics is needed.

MOS DIGITAL ICS
George Flynn
Howard W. Sams
176 pp., $5.95

Covers the theory and design of MOS chips--CMOS, NMOS & PMOS. Shows internal structure of chips and how they are used in circuits.

DIGITAL LOGIC CIRCUITS
Sol Libes
Hayden Book Co.
184 pp., $6.95

Explains how logic circuits work and how they are used. Some previous knowledge of semi-conductor theory is needed.

DIGITAL TROUBLESHOOTING
Richard Gasperini
Hayden Book Co.
$9.95

A well-illustrated guide to digital troubleshooting for the beginner.

TV TYPEWRITER COOKBOOK
Don Lancaster
Howard W. Sams
256 pp., $9.95

Covers how to interface your computer to a TV set for use as a terminal. Knowledge of electronics is needed.

CONTINUED ON TWENTY-ONE

r AD/DA Subsystem Reads and Generates Analog Signals

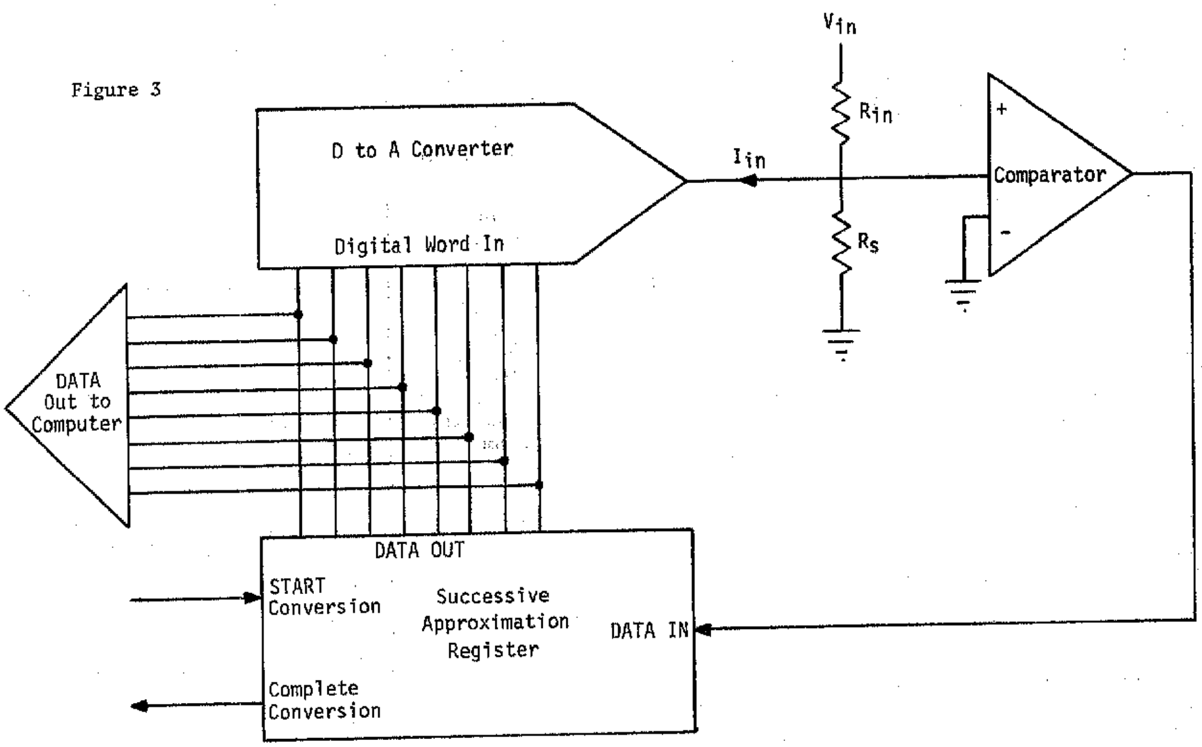
CONTINUED

The table below shows the addressing of the 88-AD/DA board.

Control/Status Register

Address	A Bit 2	B Bit 2	
Base + 0	X	NA	A/D Control/Status Register A
Base + 1	0	NA	Data Direction Register A
Base + 1	1	NA	A/D Data
Base + 2	NA	X	MUX Control/Status Register B
Base + 3	NA	0	Data Direction Register B
Base + 3	NA	1	MUX and Sequence Control Word
Base + 4	X	NA	D/A Control/Status Register A
Base + 5	0	NA	Data Direction Register A
Base + 5	1	NA	D/A Data A
Base + 6	NA	X	D/A Control/Status Register B
Base + 7	NA	0	Data Direction Register B
Base + 7	NA	1	D/A Data B

Figure 3



X=Don't Care
NA=Not Applicable

Hardware Applications

There are many potential applications for the Altair 88-AD/DA Converter. Just a few general input and output applications are listed below.

Inputs:

1. Joysticks (games, remote control, computer graphics)
2. Pressure Transducers
3. Temperature Transducers
4. Linear Position Transducers
5. Light Sensors
6. Frequency Sensors (using frequency to voltage conversion)
7. Modems (modulation/demodulation, for computer communication over telephone circuits)
8. Various Instruments
9. Magnetic Tapes (input any recorded signals)
10. General Purpose Amplifiers
11. Instrumentation Amplifier (biomedical, chemical, circuit analysis, acoustic analysis)
12. Inertial Devices (gyros, etc.)

Outputs:

1. Oscilloscopes
2. Magnetic Recorders
3. X-Y Recorders
4. Data Terminals
5. Meters
6. Printers
7. Motors
8. Plotters
9. Instruments
10. Heaters

CONTINUED

Altair AD/DA Subsystem Reads and Generates Analog Signals

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11. Music Synthesizers (voltage control oscillator, voltage control amplifiers, direct wave synthesis, voltage control filters)
12. Voltage Programmable Power Supplies
13. Modems
14. Servos (as in robots, etc.)
15. Filters

Specific Applications:

1. Vector Graphics

The dual digital-to-analog outputs of the 88-AD/DA Converter make vector graphics possible. The general scheme for vector graphics is to generate a serial table in memory with successive points of a figure to be represented on an oscilloscope screen. The coordinates in this table are stored in an area of memory designated by the user/programmer as a "position table." These points are output in succession to the oscilloscope via the Digital-to-Analog Converter. Due to the short persistance of the phosphor on the oscilloscope screen, this position table must be continuously re-output so that the image is continually rewritten. Otherwise, only a brief image will flash on the screen.

To produce lines connecting the points on the oscilloscope screen, the value of the feedback capacitor across the output Operational Amplifiers should be increased. This increases the effective slew rate of the D to A Converter. A good starting point is .001 µf., but the actual value should be determined empirically.

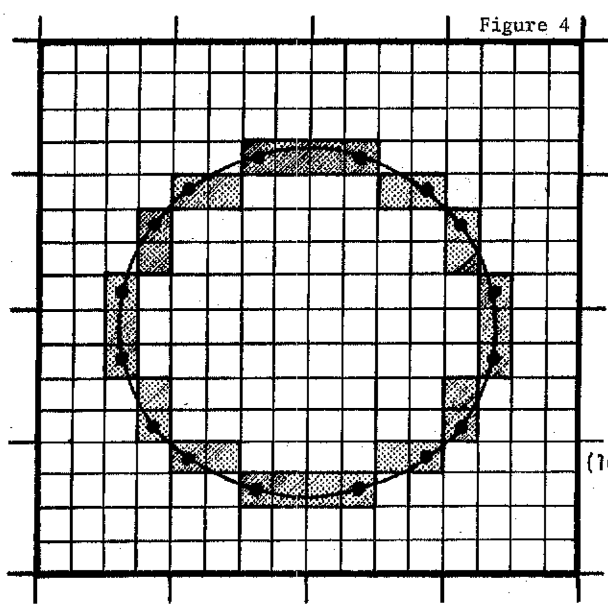
The same four-bit digital resolution generates better visual resolution with vector graphics than block graphics, and vector graphics will generally require less memory to store the image. For example, Figure 4 shows that a circle drawn with vector graphics appears much more like a circle than the circle drawn with block graphics. Both graphics are represented at the same four-bit digital resolution.

A specific application of vector graphics is a free-hand drawing using a joystick. This application requires a joystick with X and Y coordinate outputs. The full scale output should be adjusted for a 0 to 10 volt operating range. The full scale deflection for each axis of the oscilloscope should also be adjusted for 0 to 10 volt input.

To be able to view the figure while it is being generated, the two steps of acquiring the data from the joystick and displaying the table must be multiplexed. This is accomplished by outputting the table once after acquiring each new point.

To avoid filling the memory with redundant information when the joystick is stationary, the program should test each input location to see if it is different from the last character stored. Further reduction of memory used can be accomplished by masking off bits at the least significant end of the position word (the new position data must be different from the old by some amount before it is stored). Masking off 2 bits, yields 6 bits of resolution, which should be acceptable for most graphic use. Since two coordinates are involved, the amount of memory used for the position table is directly proportional to the square of the resolution (8 bits - 6 bits = 2 bits = 4 binary counts, $4^2 = 16$). Thus, an 8-bit system uses 16 times as much memory as a 6-bit system. So, by masking off 2 bits, the system uses 1/16 as much memory as with the full 8 bits.

Figure 4



CONTINUED ON TWENTY-TWO

PUBLICATIONS PROVIDE NOVICE WITH ESSENTIAL INFORMATION CONTINUED

MICROCOMPUTER DICTIONARY AND GUIDE
Charles J. Sipple
Matrix Publishers, Inc.
Over 500 pp., $17.95

A comprehensive dictionary to all terms used in the microcomputer field. Includes useful appendices on mathematical and statistical definitions, acronyms and abbreviations, number systems and language summaries.

Addresses of Book Publishers:

Matrix Publishers, Inc.
207 Kenyon Rd.
Champaign, IL 61820

John Wiley & Sons, Inc.
605 Third Ave.
New York, NY 10016

Osborne & Associates, Inc.
2950 Seventh St.
Berkeley, CA 94710

Dymax
PO Box 310
Menlo Park, CA 94025

73 Magazine
Peterborough, NH 03458

Science Research Associates
1540 Pagemill Rd.
Palo Alto, California

Creative Computing Press
PO Box 789-M
Morristown, NJ 07960

Cambridge University Press
32 E. 57th St.
New York, NY 10022

Hayden Book Co.
50 Essex St.
Rochelle Part, NJ 07662

Northern Technology Books
Box 62
Evanston, IL 60204

E&L Instruments, Inc.
61 First St.
Derby, CT 06418

CONTINUED ON TWENTY TWO

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CONTINUED

Figure 5 is a flow chart provided to aid in writing a program to do a free-hand drawing using a joystick.

Another possible option is the addition of a program to draw the current location of the joystick as a small square and only record new points when a sense switch is up. An erase function can be implemented in a similar manner.

2. Circuit Analysis

Another application of the 88-AD/DA Converter in an engineering lab is DC parameter testing in amplifier design. The objective is to manipulate a couple of parameters under the control of the computer and measure resulting variations using other parameters. Possible parameters under the control of the computer are supply voltage and bias voltage. Each can be controlled through a programmable power supply, or the bias voltage can be controlled directly. As these parameters are changed, the resulting variations in other parameters are acquired and measured by the Multiplexer and Analog-to-Digital Converter. The computer stores these measurements in memory for possible later printout or graph plotting.

PUBLICATIONS PROVIDE NOVICE WITH ESSENTIAL INFORMATION

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Clubs:

New microcomputer clubs are being formed everyday all over the country. They provide an excellent opportunity to pool knowledge and resources. The following list includes just a few of these computer clubs. Check with your local computer store or a hobbyist magazine for additional clubs.

Pittsburgh Computer Club
Fred Kitman
400 Smithfield St.
Pittsburgh, PA 15222

The Computer Hobbyist Group
N. Texas
2377 Dalworth 157
Grand Prairie, TX 75053

Valley Chapter SCCS
R. Stuart Gibbs
5652 Lemona Ave.
Van Nuys, CA 91411

El Paso Computer Group
c/o Al Schatte
9716 Saigon Dr.
El Paso, TX 79925

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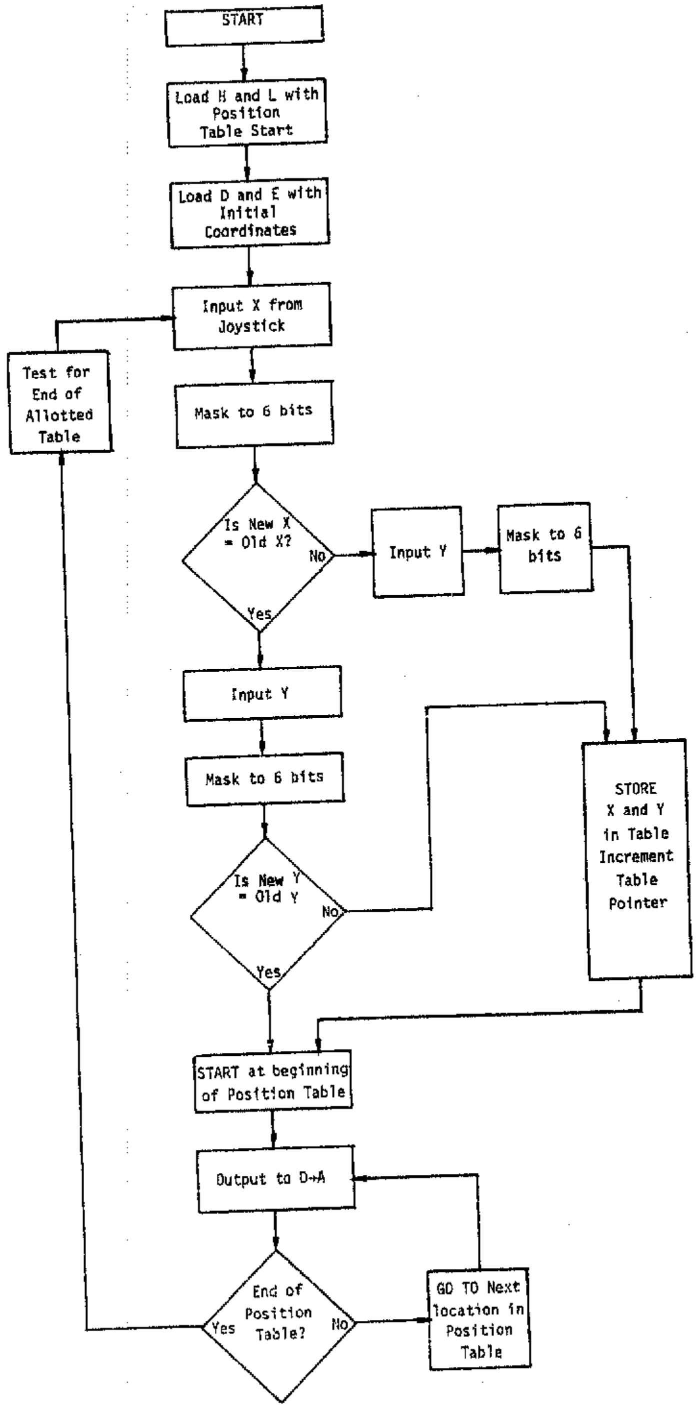


Figure 5

Altair AD/DA Subsystem Reads and Generates Analog Signals

CONTINUED

Listed below are measurable parameters and the necessary hardware to obtain the measurements:

Parameters	
Supply Current	Current Shunt and Instrumentation Amp
Bias Current	Current Shunt and Instrumentation Amp
Output Offset Voltage	Instrumentation Amp
Input Offset Voltage	Instrumentation Amp
Internal Bias Points	Voltage Divider or Amp
Temperature (such as output transistors)	DC Temperature Transducer and Amplifier

Possible tests include:

a) Offset vs. Supply
b) Temperature vs. Bias
c) Temperature vs. Supply
d) Power Consumption vs. Bias
e) Internal Bias vs. Bias

The 88-AD/DA Converter board can also be used to test frequency response. Again, possible parameters under control of the computer are the supply voltage and bias voltage. Some possible tests are:

a) Frequency Response
b) Gain vs. Frequency
c) Frequency vs. Bias

PUBLICATIONS PROVIDE NOVICE WITH ESSENTIAL INFORMATION

CONTINUED

Crescent City Computer Club
1119 Pennsylvania Ave.
Slidell, LA 70458

Wisconsin Area Computer Society
PO Box 159
Sheboygan Falls, WI 53085

Mid Michigan Microcomputer Group
William J. Serviss
13121 Tucker
De Witt, MI 48820

Southern California Computer Society
Louis G. Fields, Vice President
11662 Sunset Blvd., Suite 2
Los Angeles, CA 90049

Homebrew Computer Club
193 Thompson Square
Mt. View, CA 94043

South Florida Computer Group
Roberto Denis
4765 NW 4 Ct.
Plantation, FL 33317

Washington-Baltimore Computer Hobbyist Club-R. Rubinstein
7711 Elba Rd.
Alexandria, VA 22306

Amateur Computer Group of N.J.
UCTI 1776 Raritan Road
Scotch Plains, NJ 07076

Portland Computer Society
c/o Joe Bartel-Ratedata, Inc.
3243 N.E. Sandy Blvd.
Portland, OE 97232

CACHE
PO Box 36
Vernon Hills, IL 60061

Northwest Computer Club
c/o Steve Petchen
1334 N. 122
Seattle, WA 98133

Houston Amateur Microcomputer Club
c/o Troxell Ballou
3842 Grennoch
Houston, TX 77025

Permian Basin Computer Group
c/o John Rabenaldt
Ector County School District
820 MacArthur St.
Odessa, TX 79763

San Diego Computer Society
3649 Mount Everest Blvd.
San Diego, CA 92111

Southern New England Computer Society
267 Willow Street
New Haven, CT 06511

BCCS
c/o Karl Brackhaus
203-1625 W. 13th
Vancouver, Canada V6J 2G9

ASDC SEEKS USER'S HELP

The Altair User Group Software Library is one of the largest and most active user group libraries in existence. Your continuing interest and support will make it easier for other Altair users around the country to make the most effective use of their equipment.

Program Corrections

The Altair User Group Software Library is soliciting any corrections that Altair users identify in software distributed by the Library. Users should send a correction page that can be reproduced and put in the program file to be distributed to other Altair users, to:

User Group Library Administrator
Suite 343
3330 Peachtree Road
Atlenta, Georgia 30326

Software credit coupons will be given to users who submit corrections.

Programs in Machine Readable Form

Altair computer users are encouraged to submit machine readable programs on paper tape, cassette or diskette to the User Group Library. The User Group will issue software coupons and replace diskettes or cassettes to users assisting in this effort.

Software Contest Winners for Submissions during December, January and February.

Best Programs

First Place:

#1-18-773
Title: MVT (Multi Task-O/S Kernel)
Author: Darrell J. Van Buer
Venice, CA

Second Place:

#1-18-774
Title: 12-Tone-Row Generator
Author: John R. Lynch, Sr.
Lake Oswego, OR

Second Place (Tie):

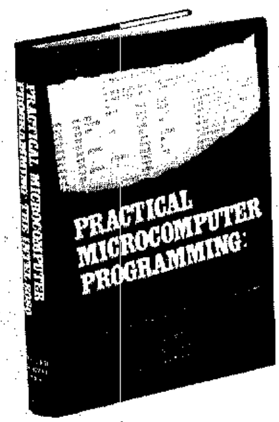
#1-18-771
Title: PROMON2 (a 1-K Monitor)
Author: Alan R. Miller
Socorro, NM

Third Place:

#2-16-771
Title: Wumpus
Author: Ron Santore
San Luis Obispo, CA

8080 programming problems?

IF you need to know how to:



- service interrupts
- do multi-precision arithmetic
- convert number bases
- handle arrays and tables
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