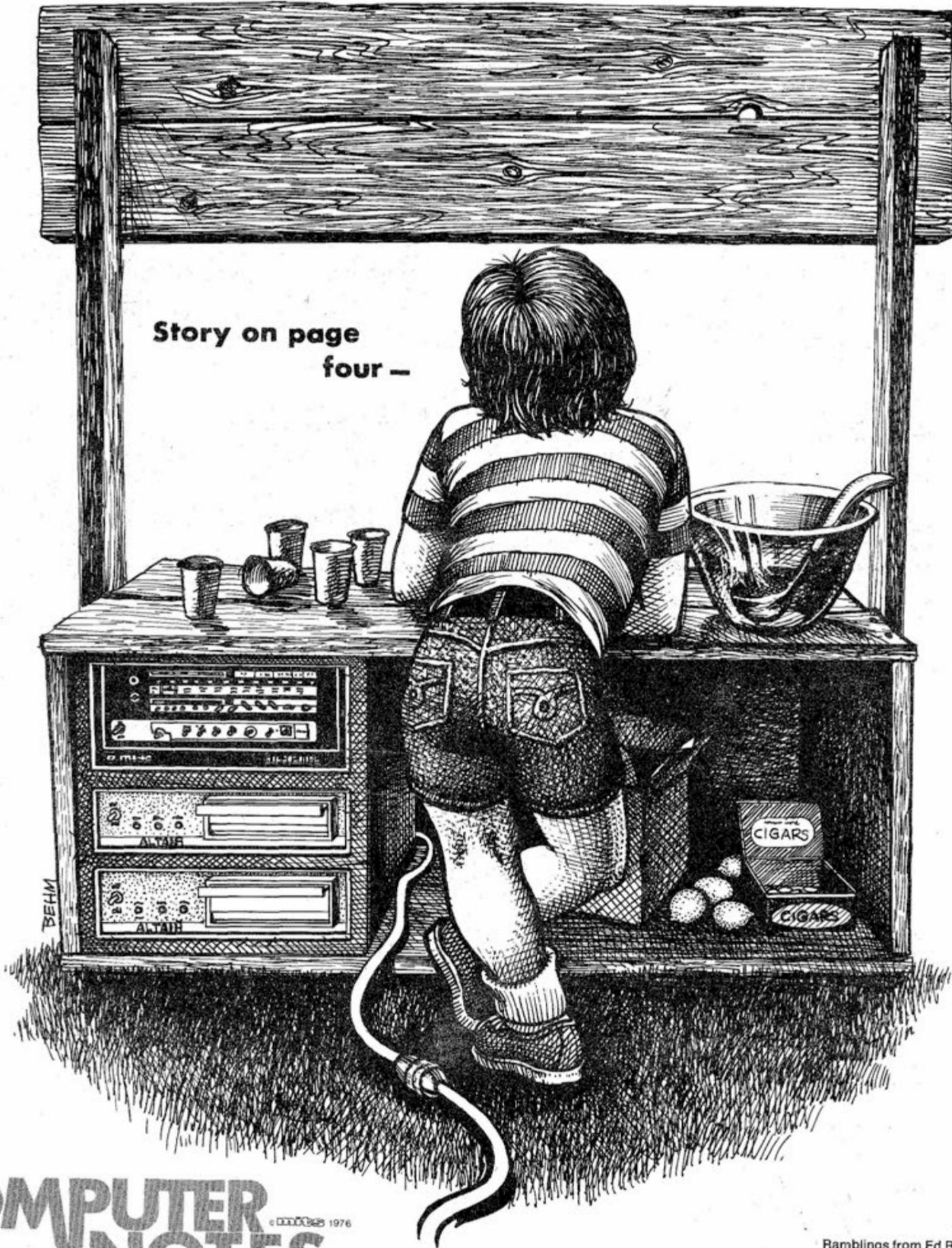


LEMONADE COMPUTER SERVICE CO.



Story on page
four -

COMPUTER
NOTES © 1976
AUGUST Vol. 2 Issue 3

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HAMS, CONTESTS, ARTICLES

by David Bunnell

In this issue of Computer Notes we've changed our format somewhat--most notably by using a full-page graphic on the front cover.

It is our intention to broaden the scope of C. N. Soon we'll be starting a column for HAMS who are interested in microcomputers. During this past year we have attended a number of ham conventions around the country and we've found a great deal of interest in Altair computers.

MITS is the only microcomputer manufacturer to show much interest in hams, and believe me, there's more coming. (See Ed Roberts' column.)

Another area of interest is applications. Altair users are interested in what other users are doing with their machines. They especially want to know how a particular application was accomplished.

Therefore, we are starting another feature to be called "Altair Application of the Month". If you've done something interesting with your Altair and you'd like to share your experience with other users, by all means take advantage of our offer. We'll pay \$200.00 in credit towards the purchase of Altair equipment to each month's winner.

To enter, send us a complete, detailed description of your Altair system. Include a complete list of all hardware involved. Tell us how you set this up, what software you are using, what problems you encountered and what future developments you have in mind. This should be typewritten, double spaced, and it should be at least three pages.

Also, send black and white photographs. These should be of reasonable quality (no Polaroids, please). 4 x 5's or 8 x 10's are best. Try to photograph your system from more than one angle. (Use your imagination.)

These will be judged by the staff of C.N. with consultation with the technical staff of MITS, Inc. MITS employees and their relatives are not eligible.

Today there are opportunities for anyone interested in microcomputers who happens to be able to write. Editors are begging for articles. And, most importantly, they are willing to pay good fees.

Here, at Computer Notes, we pay about \$50/page depending upon the content and quality of an article. If you're interested, send your manuscript to Andrea Lewis. We'll buy "first North American serial rights" which means that once your article is published in Computer Notes, you're free to publish it elsewhere (and collect double).

One important hint--study the content of a magazine thoroughly before you submit anything. Every publication has its own unique style and editorial interests. Make sure your article "fits in". Another hint--don't be discouraged if the article is rejected. Rejection slips are a way of life for any writer, even the best. Revise your manuscript or simply send it elsewhere.

I used to decorate the walls of my study with rejection slips from publications like Esquire and Playboy, until I ran out of space.

One writer of note, Dr. William A. Nolan, The Making of a Surgeon and more recently, Surgeon Under the Knife, told me that he had collected over 1000 rejection slips before he had anything published. Then one day he received a call from one of the editors at Esquire, and one thing led to another . . .

I'm not suggesting that you'll become rich and famous . . . but, who knows? There are certainly plenty of Lemonade Computer Services and one or two of us is bound to cash in.

Below is a list of editors and publications willing to pay for microcomputer articles.

Andrea Lewis, Editor
Computer Notes
c/o MITS, Inc.
2450 Alamo SE
Albuquerque, NM 87106

Nels Winkless, III, Editor
Personal Computing
c/o TBF Associates
3520-F Pan American Freeway NE
Albuquerque, NM 87107

John Craig
I/O Editor, 73
RFD Box 100D
Lompoc, CA 93436
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Carl Helmers, Editor
BYTE Magazine
70 Main Street
Peterborough, NH 03458

Bob Jones, Publisher
Interface
McPheters, Wolfe, and Jones
6515 Sunset Blvd.
Suite 202
Hollywood, CA 90028

If you want further directions, refer to the back pages of BYTE Magazine where you'll find a block of type entitled "Articles Policy". Or better yet, read Wayne Green's column in the I/O section of 73, August issue.

We've lost a friend

I was very saddened Monday morning (August 16) to learn of the death of Hugh Scupp.

Hugh, whose formal name is Hubert B. Scupp, was MITS' Manager of Industrial Sales. But titles don't reveal much and to those of us who knew him, Hugh was much more than that.

Mr. Scupp was one of the pioneers of the personal computing market. He was primarily responsible for the "MITS-MOBILE" seminars that traveled throughout the United States in 1975. Several of today's successful personal computing clubs and certainly much of the enthusiasm for home computers is due to his efforts.

Mr. Scupp was later the organizer of our industrial sales department. He brought a level of professionalism and sophistication to our marketing department that is going to be hard to replace.

We at MITS will remember Hugh Scupp as a congenial, intelligent man. One who rarely blew his cool even under the most adverse pressure. He was kind and considerate--rare qualities for a man of his talents.

Mr. Scupp was born on May 19, 1922. He was a veteran of World War II and he leaves behind his wife, mother and three sons. He died Saturday, August 14, in New Jersey, where he was vacationing with his family.

I'm afraid that a little bit of the pioneering spirit of personal computing has died with him. We'll miss Hugh Scupp.

- David Bunnell

Ramblings from Ed Roberts

PROBLEMS

At the present time delivery on most products is off-the-shelf. But there is still a shortage of discs and the new 16K static memory cards. The popularity of these two products has been overwhelming and they are certainly worth the wait.

Repair is now cycling most units in a two to three week period. Certain "funny" machines or cards with intermittent problems may take longer. The major cause of problems in returned kits is still cold solder joints and solder bridges. It is amazing how many machines are repaired simply by reheating all of the solder connections.

COMPETITION AND THE ALTAIR BUS

Another machine has appeared which uses the Altair bus - the Processor Technology SOL. We haven't seen a SOL yet, but in concept it does appear to represent a new approach to the low cost computer and not just an imitation Altair.

While we would probably prefer not to have any competitors, the fact is competition is of enormous value to you the user. Especially when the competition is introducing innovative changes in the market as opposed to copying design. The Processor Technology SOL and video display units are good examples of innovative additions to the hobby market. The Cromemco Dazzler and Cyclops also are innovative contributions which benefit all of us.

THE ALTAIR AND AMATEUR RADIO

For a year and a half a number of foresighted hams have been predicting and even using the Altair in ham applications. We at MITS have noticed their work and have on occasion even half-heartedly assisted these efforts. Unfortunately, my view of ham radio was grossly distorted. Last week I had a lengthy discussion with Wayne Green (Editor and Publisher of 73 Magazine). As you may remember Wayne was one of the people involved in Byte Magazine during its initial stages.

During that discussion Wayne made me aware of many aspects of ham radio that I had missed. On the assumption that at least two other people who read this column are as uninformed as I was, the following will give you some idea of the interesting computer applications in ham.

Slow Scan TV

Slow scan TV is a scheme which allows the transmission of TV pictures over low bandwidth radio links. Modulation frequencies are 1200 to 2400 Hz. This same technique could certainly be used over conventional phone lines. It also may be one of

the lowest cost versions of graphics displays. Another interesting spin-off is the fact that a conventional, unmodified audio tape recorder can be used to store the pictures. The hobby and industrial possibilities of such a system are impressive even without the radio link. With the radio link it should be possible to play chess on TV with someone 15K miles away (or even in the next county if you are less grandiose). Imagine a modified two player Startrek game with a Russian (I tend to be grandiose).

OSCAR

OSCAR satellite communication on short wave lengths is an interesting possibility. The OSCAR satellites were launched for amateur communication. They operate in the VHF and UHF regions. It's possible with a relatively low cost antenna system and computer aided tracking system to have reliable communication links with a large part of the world surface. The computer aided tracking is really not an absolute requirement, but it does simplify things significantly.

Repeaters

A popular pasttime with some hams is to communicate via repeaters. This allows the user to reliably cover a radius of 100 miles or more with a hand-held walkie-talkie.

The implication of the repeater in computers is that it can be connected to a computer thereby allowing a group of hams to share the cost of the system. At the present time this type of operation is not legal unless there is an operator at the computer, but Wayne feels that the rules on repeater operation/non-operator system will change in the near future.

Ham Related Application

CW code conversion units allow the operator to use CW code in much the same way he uses a TTY. A number of hams have developed schemes which allow both transmission and receiving of CW. Of course, the trick is receiving, the sending part is the trivial case.

An automatic antenna pointing system is another interesting application pointed out by Wayne Green. A number of hams have the hobby of DXing, i.e., talking to foreign countries. The automatic antenna pointing scheme allows the operator to simply insert the call code for the country he wishes to call. The computer determines the correct beam heading and points the antenna automatically. The list of potential ham applications is enormous and very intriguing.

If you are interested in getting involved in ham radio, 73 Magazine publishes a number of excellent study guides and audio cassettes which make the process relatively painless.

As a matter of fact, several of us here at MITS will be operating on the novice bands in the coming months and before the end of the year we will be "hamming" with the Altair. If your model of a ham is similar to the one you have for CBer, then you also need to reevaluate.

NEW COLUMN

Effective next month Computer Notes will have a new column edited by Wayne Cronin (WA5VIF). This column will be devoted exclusively to the amateur radio and related technologies. If you have any articles, questions, suggestions, etc., concerning amateur radio/Altair, contact Wayne Cronin here at MITS.

The amateur radio group will be the first formal subgroup of the Altair User Group. There is such a large number of Altairs in use now that we certainly can justify additional user groups in special areas. However, we need guidance from you as to what areas should be considered for these subgroups.

Please feel free to chair a subgroup. If you are interested in starting such a group, we will be happy to support your efforts.

COMPUTER NOTES

Publisher	David Bunnell
Editor	Andrea Lewis
Production	Tom Antreasian Al McCahon Grace Brown
Contributors	Ed Roberts Gale Schonfeld Paul Allen Tom Durston Steve Pollini Pat Godding Mark Chamberlin

Personal Technology

More Strength in a Free Society

July, 1976

by Nels Winkless, III
Editor, Personal Computing

You've probably seen an ad and heard some rumors about PERSONAL COMPUTING, but we've been so busy getting our show on the road that we haven't yet talked with many of the people whose interest is important to us.

We want you to know what we're up to and how our approach to a technology-based magazine is different from what's come before. It isn't easy to put this in a nutshell, because personal computing is part of a major revolution in human thought. It would have been tough to explain to people in 1700 how much fun they could look forward to in the coming industrial revolution. The information processing revolution has just begun to touch the common man and we're looking forward to lots of excitement, though the crystal balls are cloudy.

The best way to tell you about PERSONAL COMPUTING, we decided, was to pass along the text of a short talk I've been giving to service clubs, most of whose members don't know the difference between a computer and toaster. They've found this useful. Maybe you can make use of it in estimating the excitement we all look forward to in PERSONAL COMPUTING.

-NBWIII

Seventeen more channels have now been allotted to

CB

-NBWIII

P.C. wants to be useful to those expensively embittered computer users.

This is news to the typical audience of lurching businessmen... and news now to a lot of people who will soon be involved in personal computing. We want to be useful to them, too.

You may have noticed some strange things happening in technology lately. Ordinary people have been gaining the use of technology that was previously limited entirely to the use of specialists.

The obvious example of this is in CB radio. Even companies like RCA, that wouldn't have touched the field five years ago are now offering CB products to what they regard as a mass consumer market.

Popular pressure has even forced action from the bureaucracy in Washington. In theory, every CB radio user must be licensed and must follow a tightly specified ritual in using the radios.

In practice Washington could not process license applications fast enough to keep applicants from complaining bitterly to their congressmen about lack of service. Unlike the respectful ham operators of the past, who were wrapped up in the technology of their equipment, the CB people want only to use CB radios, not learn how they work and build more. So, they used them, Washington permit or not, and the feds were forced to surrender. The FCC has eased license requirements, is issuing permits to all comers, and makes no pretense of being able to police the field. They will never catch up and are actually now considering doubling the number of channels allotted to

CB.

People can afford CB equipment and they are unwilling to tolerate rules that seem unrelated to the bare fact that almost any fool can make a CB radio work, licensed or not. You've already heard a lot about CB.

You may not have heard so much about similar activity in the area of computers, because no licensing is involved and computers don't do anything much overt that comes to your attention. There are people, in fact, who think that computers really do nothing but blow hot air on your shoe while they soak up your money.

Even so, a quiet revolution of major proportions is under way in the computer field and things will never be the same again.

A couple of years ago the first so-called microprocessors (tiny, densely packed integrated circuits) reached the market at prices of about three hundred dollars apiece. A microprocessor is, loosely, the heart of a computer system, the central processing unit that makes computers what they are.

The microprocessor is not a complete computer in itself. It needs a power supply, memory, input/output circuitry, switches, lights, and so on, to become a general purpose computer that a programmer can apply to various tasks.

At three hundred dollars, though, the microprocessors were miraculous, replacing larger systems that had cost two or three thousand dollars--a 90% cut in cost for equal performance.

Within months, microprocessors dropped to around thirty dollars. Prices are still dropping gradually and new devices are entering the market with increased capability.

It is probably reasonable to say that the cost of small central processing units has dropped 99% in five years. The cost of switches, transformers, cabinets, and all that have not dropped proportionally in the same time, so the cost of a full system has not declined so steeply as the CPUs and memory chips.

Still, you can buy for a thousand dollars today a complete computer that would have cost ten or twelve thousand dollars a few years ago. This puts computers into the price range of hi-fi equipment, skiing outfits, motorcycles, and power shop equipment.

When MITS, Inc. gained national publicity in January, 1975, for a microcomputer kit that a hobbyist could assemble for around six hundred dollars, the company thought it would do well to sell four hundred kits in the first year. They sold over five thousand.

Other manufacturers (IMS, SPHERE, SWCS, among others) have sold thousands of additional personal computers and the demand is increasing.

Notice that the market for microcomputers is served chiefly by new, small companies, not the big, established computer firms. The established companies apparently did not perceive the eagerness of private individuals and small businesses to get their hands on inexpensive systems of their very own.

Presumably, the established, bigger companies will enter the personal computing field in grand style when they determine a strategy for dealing with the consumer market.

Some three dozen retail stores for personal computers and related equipment have already sprung up around the country and more stores are opening almost weekly.

Dozens of computer clubs have formed, with U.S. membership at perhaps 20,000 and estimates that three or four hundred thousand people will be involved in the next couple of years.

Three national magazines are already being published for computer non-professionals and dozens of monthly newsletters are circulated by clubs and manufacturers.

A new magazine is about to be published and some of us expect it to do very well. Benwill Publishing Corporation, a respected trade magazine house, will put out the first issue of PERSONAL COMPUTING in October of this year.

Benwill had been considering a computer hobbyist magazine when David Bunnell, whose agency now handles MITS advertising and some related accounts, encouraged Benwill to develop a more broadly based magazine treating computers and computing as matters of exciting importance to individuals throughout our society. "Like what?" said they, and he made some suggestions.

A man of excellent taste, Bunnell suggested that Benwill ask me to write some material for the magazine . . . and that's why I'm so full of information and enthusiasm for the publication.

PERSONAL COMPUTING will be different from other offerings in the field, complementing them, we think, not competing with them.

The notion is that computers, like CB radio, like videoplayers that haven't arrived yet, and like automobiles a few decades ago are significant in our private lives. All of us are profoundly affected by computers and some of us may be profoundly frustrated.

For the thirty years in which they've been among us, computers have been mysterious and somewhat threatening. The people who use them--for us or against us, take your pick--have always spoken about them in an unknown technical tongue that intimidates and annoys the rest of us.

PERSONAL COMPUTING hopes to dispel some of the mystery (but preserve the fun) by talking about computers and computer applications in literate, plain language, not only for fanatical hobbyists, but for those who merely wish to be comfortable with the computers that surround them and to make sensible decisions about their use.

We expect dedicated hobbyists to use the magazine and contribute to it, but we hope to be useful to some millions of additional people who just want to be informed--and entertained.

PERSONAL COMPUTING will be a consumer magazine.

My own feelings about all this are so strong that they surprise me. I'm a writer, a professional outsider with a very broad, but shallow understanding of technology. You can't depend on me to be ignorant; there are some deep spots in my

← This thought has never crossed the minds of most of the people we talk to casually about our subject. People inside the computer world simply can't imagine how exotic their work still seems to most tax payers.

← P.C. is not directed to a snobbish elite. IBM and there will be recruiting from the ranks of personal computing fanatics in a few years. We want to be important in this process.

← and that's why I've become editor of Personal Computing—I fell into the middle of the project, dragging 18 years of relevant experience with me.

← We're scheduling a series called Spaghetti BASIC, showing even slow learning editors how to do good things with the computer in the next room.

lake of knowledge, but I don't know how to program computers and it's all I can do technically to plug in my electric shaver, never mind assembling computer kits. My computer knowledge is chiefly philosophical.

Taking a broad view, I believe that CB radio, personal computers, and automobiles have a great deal in common.

Consider cars. There's some self-righteous talk lately of breaking off the romance between individual Americans and their individual automobiles.

"Give up those cars, you people! Into the buses, onto the trains, back into the cities where you can walk to anything you might want! We'll set schedules for you."

Oh, yeah?

Americans do love cars. As soon as ever they could scrape up the cash for Mr. Ford's Model T's, Americans bought cars and adapted everything else to their use. Automobiles represent freedom from those buses, trains, cities, and schedules.

Automobiles are not efficient. Freedom is not efficient. We could move everything and everybody equal numbers of miles at a fraction of the cost with mass transit systems. No question about it.

It is equally obvious that automobiles and trucks are more effective than centralized systems. The automobile system as a whole doesn't break down and can't be shut down, even on purpose. If an invader tears up the tracks, it won't keep us from moving. No coup in Washington will paralyze us. The system is effective because people love the freedom, not the cars per se.

The efficiency experts who want to change that system are attacking a freedom that Americans take for granted. When the experts grow so insistent, so tyrannical, that people notice what they're attacking, we may suddenly lose a few experts. Freedom is the real issue.

CB radio? People love the CB mystique, the freedom it gives them, the ability to squirm out of the control of the establishment, to outmaneuver Smokey, to learn what's happening around them, and to influence events to their own satisfaction.

All CB radio communications traffic could be handled efficiently in a central system. CB reduces efficiency, increases effectiveness, increases personal freedom. Surely, national security is increased by the inability, even of our own government, to chop off our communications.

And personal computing? The fact is that even most dedicated hobbyists are just playing with their computers, literally playing games, not doing useful work. Some people also drive for pleasure and most of the CB chatter is for fun, never mind laws forbidding fun on the air. By playing with technical systems, we learn what they can do.

Private individuals and small companies with little to lose can innovate with computers, apply them to silly, fascinating, and wonderful tasks that the elite establishment can't or won't deal with.

Computers, like automobiles, are more than hardware; they're an approach to reality.

Computer technology is a way of thinking about things. The kids who grow up with computers as everyday appliances will be completely at ease with computing as most of us are at ease with automobiles.

We could build a few huge computer systems at much less cost to handle all of the processing that individual systems will handle. Personal computers are inefficient, but they're effective and they increase personal freedom.

I think it will be difficult for anybody full of either wickedness or good will to seize our transportation, communications, and data processing systems to control our society. As a people, we seem to be stronger, more comfortable, and able to accomplish more in the turmoil of diversity than with efficient, simple, central control.

Personal computing, with other aspects of technology, is working a major revolution in the society around us. I find that reassuring in this bicentennial year.

On the last few years, before it passed away, my poor old Studebaker wagon worked only when spoken to, firmly and gently. A lot of us who can't solder properly, look forward to learning how to speak words of encouragement to our computers.

Computers are new and different. The only way to be efficient with them is not to do anything.

Doesn't it make you uneasy to realize that you're surrounded by kids smarter and more skilled than you? Maybe they can pull us through this tough world if we give them the means.

The kid (husband, wife, uncle, niece...?) who thirsts for a computer may have a tough time justifying the expenditure, even when the money is his very own, saved up from countless birthdays and paid labors.

PERSONAL COMPUTING will run a series of articles on The Lemonade Computer Service Company, pointing out that nothing in our society is more respectable than an enterprise like a paper route or a lemonade stand, whose proprietor not only performs useful service, but learns how hard it is to break even in the effort to turn a nickel.

The Lemonade Computer Service Company may contract to plan out all the vegetable gardens in the neighborhood, for example. The proprietor would pump into his computer system all manner of agricultural data—temperature, sunshine, soil acidity, moisture, rate of growth, nutrient needs, bug discouragement, and cultivation techniques. Properly disciplined, the computer would print out detailed weekly instructions for the management of each specific garden and crop in the scheme.

The proprietor would make his daily rounds to distribute information and gather data. By season's end, he'd have earned perhaps thirty-four cents an hour and more produce than he could carry home... more than minimal justification for acquiring the computer.

And why not Lemonade Diet Management, Lemonade Transportation Planning, Lemonade Library Services, Lemonade Property Management, Lemonade Shopping Comparison Service...? We look forward to real Lemonade Computer Service Company case histories in future issues.



New Products

7000 Graphics/Printer

by Patrick Godding

The MITS 7000 Graphics/Printer is a multifunction, hard-copy output device. The Printer is plug compatible with both the 680 and 8800 mainframes via one PIO port. The print mechanism is electrostatic to provide extremely fast and quiet operation. Copies made from the printed output are actually more legible than copies of typed paper. The cost of the electrosensitive paper is very low; approximately 1 cent per foot, and the paper is available from MITS and several other sources.

Since the print electrodes are driven directly by software, the unit becomes the most flexible output device on the market, providing essentially three modes of operation:

PRINT MODE

When used as a line printer, Altair BASIC supports three different sizes of character sets (each with upper and lower case) to produce line widths of 20, 40, or 80 characters in the 4" wide printing area. Speed is 160 characters/second (at 80 character per line) or 120 lines/minute. Different character sizes are selected with the CHR\$ function in BASIC. Characters are generated using a 5x7 dot matrix.

PLOT MODE

There are 8 electrodes in this

unit as opposed to 7 in most printers: This eighth printing electrode provides symmetry along the horizontal and vertical axes required for plotting. The vertical distance between electrodes is equal to the distance between lines so there is no gap from line to line. (In the PRINT mode, only 7 dots are used to provide a one dot space between lines.) Symmetrical plots provide 320 points horizontally and 320 points vertically for a total plot field of 102,400 points. The horizontal resolution can be increased up to approximately 550 dots depending upon user requirements. The PLOT mode is also supported by a complete software package. The speed is 1,200 columns per second (8 vertical dots per column).

GRAPHICS MODE

Since there is no gap or space from line to line, the 7000 becomes ideal for graphics. Pictures can be produced that show either a distinct outline or a sophisticated, detailed picture with shaded areas. When the 8-dot columns are printed close together, the effect is a very dark image; when the columns are printed farther away from each other, the image appears lighter. By varying this distance, the 7000 becomes a powerful graphics machine.

SPECIFICATIONS

Printing medium:	Electrosensitive paper (5 inches wide)
Horizontal resolution:	A. Internal timing-80 dots/inch B. External timing-better than 128 dots/inch
Vertical resolution:	65 dots/inch
Printhead speed:	0.0175 inches/msec. \pm 0.1%
Timing markers:	A. Every 1/80 inch of printhead travel (Dt) B. Every 1/10 inch of printhead travel (Ct)
Plotting speed:	2 lines per second; 8 dots vertical
Input raster:	8-bit parallel
Power:	115V AC. 36 VA
Weight:	14 lbs.
Interface:	1 PO Port (88-4PIO or parallel port on 680 UIO board)

SPECIFICATIONS

Input Range*:	Unipolar 0 to +5v 0 to +10v Bipolar -5 to +5v -10 to +10v
Resolution:	12 bits
Conversion Time:	50 us max.
Accuracy--	
Quantizing Error:	$\pm 1/2$ LSB
Nonlinearity:	$\pm 1/2$ LSB
Offset:	Adjustable to zero
Stability--	
Offset vs. Temp:	20 PPM/ $^{\circ}$ C max.
Gain vs. Temp:	80 PPM/ $^{\circ}$ C max.
Nonlinearity vs. Temp:	20 PPM/ $^{\circ}$ C max.
Gain vs. Supply Voltage:	± 30 PPM/%Vs max.
Input Impedance:	300K Ω
Operating Temp Range:	0 to +70 $^{\circ}$ C
Power Supply Requirements:	+5v @ 500mA +15v @ 25mA -15v @ 30mA
Price:	\$524.00

*Direct input to buffer amplifier. If 8-channel MUX is used, input range is 0 to +5v unipolar or -5 to +5v bipolar. However, larger voltages can be scaled down according to the user's application.

Analog/Digital Converter

by Dave Antreasian

88-ADC

Many of the current applications for the Altair computer require the ability to interface with real world analog signals. As a result, MITS is pleased to introduce the 88-ADC 12-bit A-to-D converter card. This new product permits the Altair to measure analog voltages often encountered in scientific and industrial applications with an accuracy of 1 part in 4096.

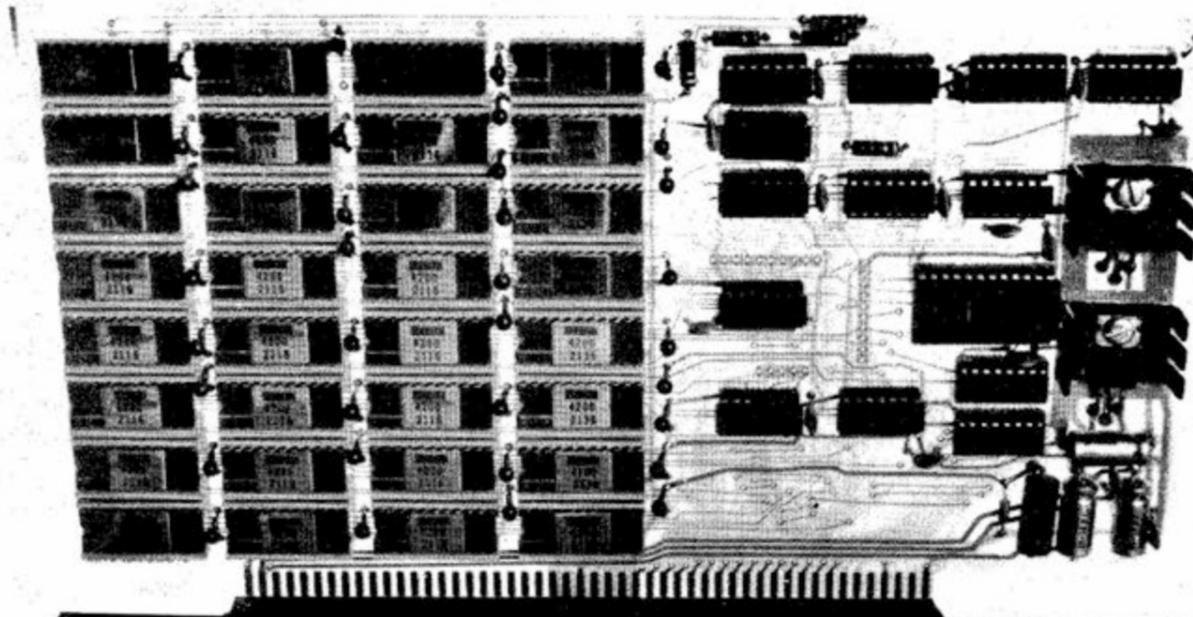
The heart of the 88-ADC is the analog-to-digital converter module which contains virtually all of the circuitry needed to represent the analog voltage as a 12-bit binary value. In addition, the 88-ADC in-

cludes a buffer amplifier (with a true differential input instrumentation amplifier option), an 8-channel multiplexer (used to select one of the eight input signals), circuitry to address the card (the ADC is treated as an I/O device), and the associated timing circuitry.

Optionally, a 24-channel multiplexer (88-MUX) card may be added to replace the on-card, 8-channel multiplexer. More on the 88-MUX card in next month's C/N.

The 88-ADC is completely bus-compatible with the Altair 8800A or Altair 8800b and is easily accessed using 8K BASIC.

One Slot!



Altair™ 16K Static

Almost too good to be true, the Altair 16K Static RAM board is easily the most advanced memory module yet developed for the Altair 8800, 8800a and 8800b computers.

Four Altair 16K Static boards add up to the entire 64K of memory directly accessible by the Altair.

The Altair 16K Static board offers two surprise features—minimal power requirements and fast access time. One Altair 16K Static board draws less current than any 8800 compatible 4K boards, thus four Altair 16K Static boards can be plugged into the Altair 8800 without beefing up the power supply.

The maximum access time of the Altair 16K Static board is 215 nanoseconds, which makes this board the **fastest Altair compatible static board in existence.**

The Altair 16K Static is now in full production. Special introductory price is \$765 in kit form and \$945 assembled.

MAIL THIS COUPON TODAY

Enclosed is check for \$ _____

BankAmericard # _____

or Master Charge # _____

Altair 16K Static Kit Assembled
(include \$3 for postage and handling)

Please send free information package and price sheet.

NAME _____

ADDRESS _____

CITY _____ STATE AND ZIP _____

MITS/2450 Alamo SE/Albuquerque, NM 87106/505-243-7821

Prices, delivery and specifications subject to change. Allow up to 60 days for delivery.

2450 Alamo SE/Albuquerque, NM 87106/505-243-7821

Altair 8800 Clock Modification

By Harvey Lee

Have you ever found yourself in this situation? You finally find some time to play with your computer, you turn the power on and only the data and address LEDs light. No amount of fooling with the switches will change the situation. Or perhaps the computer does run for a short time, then the data and address lights all come on while the status lights go out.

If you have experienced any of the above situations, you have been the victim of clock failure. While there are many possible causes and cures, we feel the following modification is the proper cure to use.

Step 1: Remove R37, R38, R39, and R40 from the Altair 8800 CPU Board.

Step 2: On the back of the board cut the land to R39 from pin 3 of IC "P". Make sure the land between R40 and pin 3 of IC "P" remains intact (see figures 1-a and 1-b).

Step 3: Also on the back of the board, remove the land that connects the lower ends of resistors R37 and R38 (figures 1-a and 1-b).

Step 4: Install two 470 ohm resistors vertically in the holes of R37, R38, R39, and R40 closest to IC "P" (see figure 2).

Step 5: Install a 50 picofarad capacitor as shown in figure 3.

Step 6: On the back of the board install a jumper from pins 4 and 5 of IC "P" to the bottom hole for R39 (see figure 1).

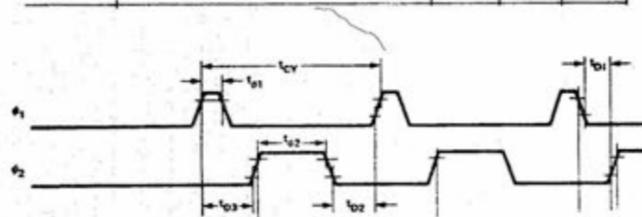
Step 7: Install another jumper from the bottom hole for R38 to the land immediately above it. The land goes to pin 2 of IC "P" (see figure 1).

The above steps will produce a clock circuit that oscillates much more reliably.

One other area of the CPU clock circuit that may give trouble is IC "Q". This chip is a 74123 single shot. It is used to derive ϕ_1 and ϕ_2 from the 2MHz clock. We have found that a TI74123 is most reliable with the components supplied on our board.

In any case, the relationship between ϕ_1 and ϕ_2 should conform to the diagram below.

Symbol	Parameter	Min.	Max.	Unit
$t_{CY}^{(3)}$	Clock Period	0.48	2.0	μ sec
t_r, t_f	Clock Rise and Fall Time	5	50	nsec
t_{ϕ_1}	ϕ_1 Pulse Width	60		nsec
t_{ϕ_2}	ϕ_2 Pulse Width	220		nsec
t_{D1}	Delay ϕ_1 to ϕ_2	0		nsec
t_{D2}	Delay ϕ_2 to ϕ_1	70		nsec
t_{D3}	Delay ϕ_1 to ϕ_2 Leading Edges	130		nsec



Two other changes have been made on the CPU since it first came out. Resistors R9 through R16 have been changed from 4.7K ohm to 4.3K ohm. This gives a faster rise time on the bidirectional data bus. The other change was to use a 74LS74 for IC "L" rather than a 74L74. As the Schottky device is faster, it synchronizes the PRDY pulse to the leading edge of ϕ_2 more closely.

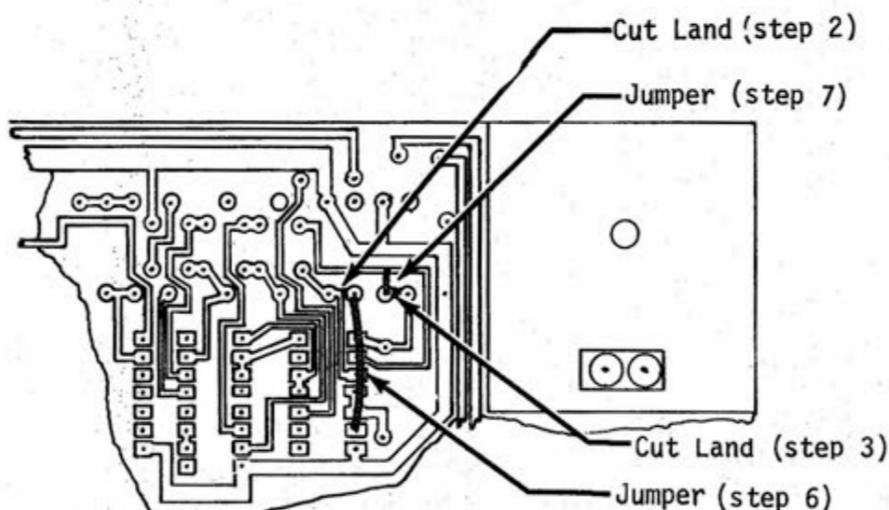


Figure 1a

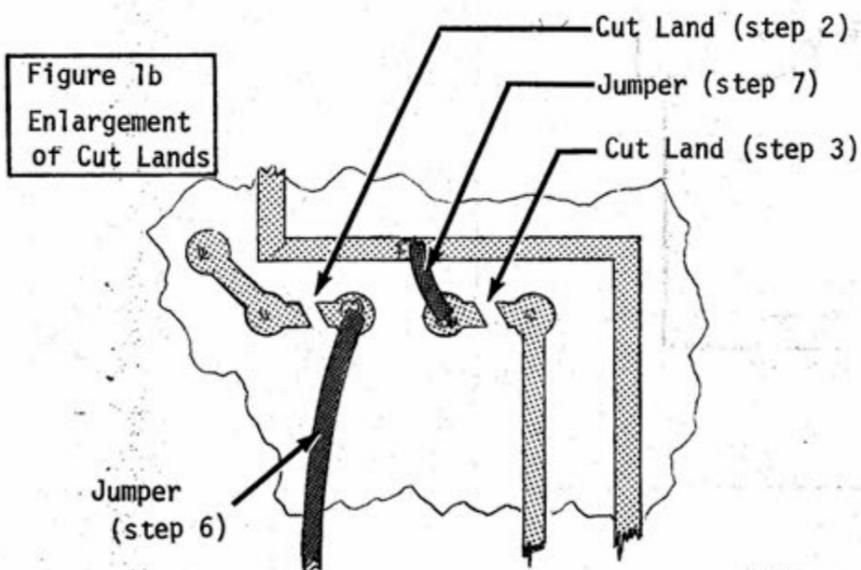


Figure 1b
Enlargement
of Cut Lands

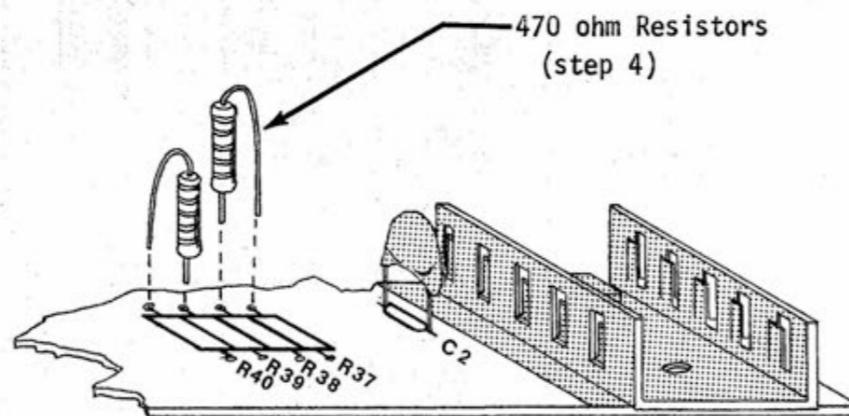


Figure 2

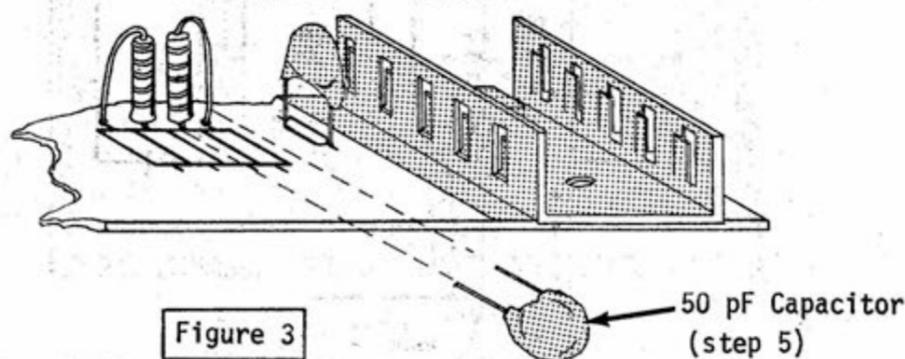


Figure 3

My Computer Just Stares at Me...

For those of you who read part one of "My Computer Just Stares" (C/N July, 1976, p. 13), I hope the things we discussed helped get you better acquainted with your computer. Part one examined the inner workings of the microprocessing unit (MPU) and investigated the functions of its internal registers. That, however, is not the entire story.

This month we'll take a closer look at some of the electronics inside the wonderbox. To begin, take a look at the system diagram of the Altair 680b computer included on this page.

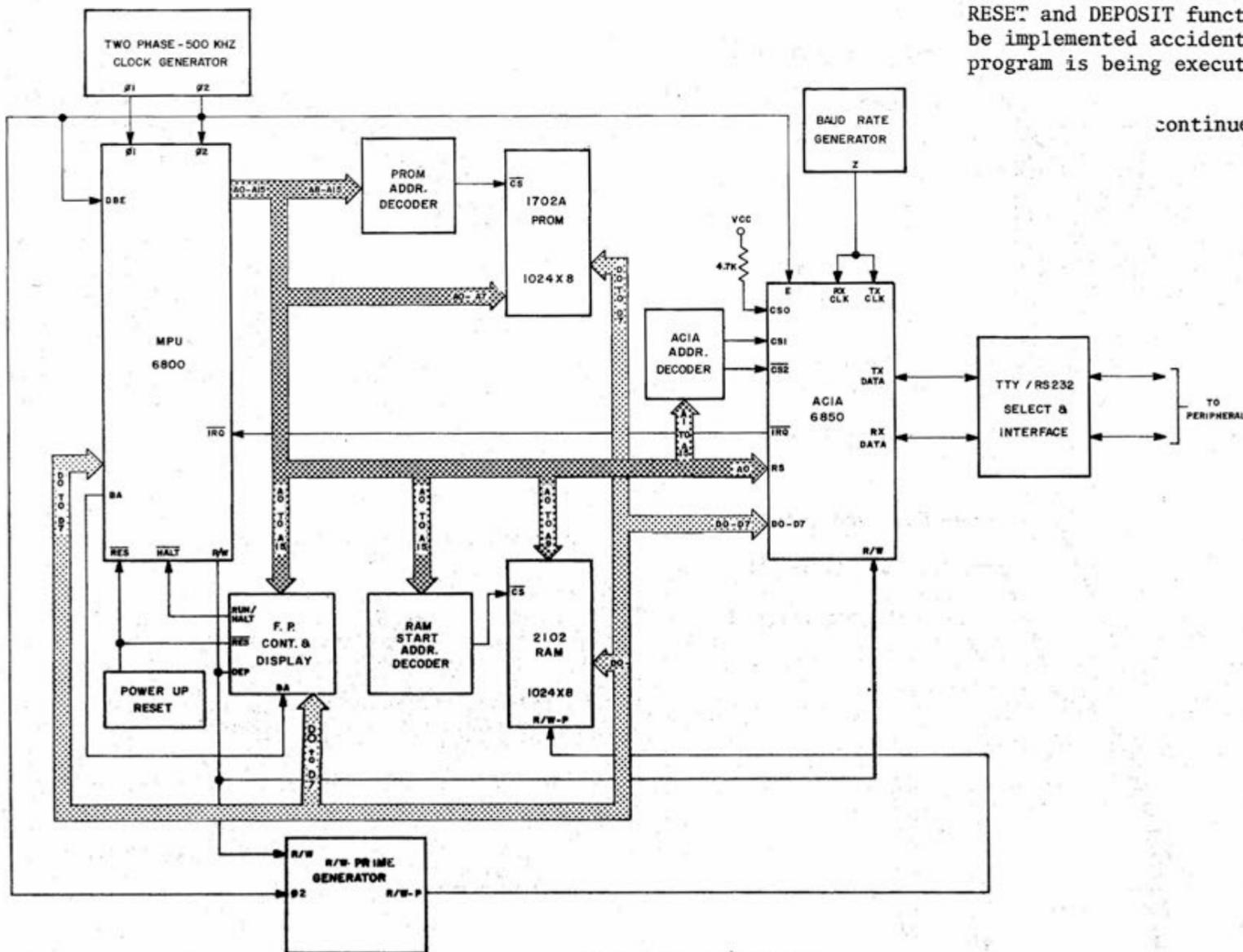
Notice the dark shaded area starting at the MPU that is labelled "A0-A15". This is the Address Bus. As we said last month, the Address Bus consists of sixteen (16) signal lines that are used by the MPU to designate a particular memory address. The address can be either a location in read-write memory (RAM) or programmable read only memory (PROM); or it can designate an input-output (I/O) device. As can be seen, the Address Bus goes to just about every device in the system.

One place the Address Bus goes is directly to the Front Panel, where the front panel uses it when the MPU is in the HALT mode. By using the switches on the front panel, it is possible to force an address onto the Bus and deposit data at that location. It is at times inefficient or impossible to have all of the Address lines go directly to each device or memory block in the system. That is why many of the devices have Chip Select (CS) inputs. The CS input is an input which enables the entire chip for address selection. Take, for example, the resident 1024 bytes (1K) or RAM in the 680b system. Address lines A0 through A9 are used to select any one of these 1024 bytes. However, it is possible to locate this 1K block of memory anywhere within the possible 65K of memory space. Therefore, the upper order addresses are decoded to determine the starting address of the 1K memory block and when the proper address is presented to the decoder, a chip select (CS) signal is sent to the memory. (The bar over the CS designation on the diagram means that the signal that is sent is a low-level signal.) Thus when the memory block is selected by the CS and a memory location is selected by the Address Lines, the data at that location can be read or deposited depending upon the state of the Read-Write line.

This brings us to another important signal in the system. The Read-Write (R/W) line is the one that determines the direction of data flow. If it is in the high state or Read condition, data is being read into the MPU from memory or an I/O device. If the R/W line is in the low state or write condition, data is being written into memory or an I/O device. In most systems the Data Bus is enabled or active only during certain periods of time. In this system, it is enabled only when the Phase 2 (ø2) clock is high. This is accomplished by driving the Data Bus Enable (DBE) line of the MPU with the ø2 clock. Therefore, data can only be valid when the Data Bus is enabled because this is when the MPU is set up to send or receive data. To prevent data from being read or written during periods of invalid data, the R/W signal is ANDED with DBE. In this way, the R/W inputs to memory are only enabled when the DBE signal is present.

The signal line that tells the MPU when to start and stop executing programs is the HALT line. When the HALT line is in the low state, the MPU is in the HALT mode. Also, the Bus Available (BA) output of the MPU is high, signifying that the Address and Data Bus and the R/W line of the system are available for use by some device other than the MPU. With the Altair 680b, the BA signal is used to enable the front panel RESET and DEPOSIT functions. In this way, the RESET and DEPOSIT functions cannot be implemented accidentally while a program is being executed.

continued on page 16



680b SYSTEM DIAGRAM

Microcomputers are highly complicated devices. When you buy one you want to make sure the manufacturer has a solid reputation for reliability and support. You want to make sure he'll be in your corner a year or two down the road.

The Altair 8800 from MITS was the first general-purpose microcomputer. Today, there are more Altair computers up and running than all the other general-purpose microcomputers combined. Today, Altairs are successfully used for literally hundreds of personal, business, scientific, and industrial applications.

Because we are so popular, many people have tried to copy us. The pages of microcomputer magazines are full of advertisements for Altair compatible devices and Altair imitation computers.

Because we are NUMBER ONE, we offer a much broader range of products and services than any of our competitors. One manufacturer

might be able to copy one of our computers. Another might be able to produce a working memory card. But no one can copy the overall Altair concept.

The Altair concept is a system concept aimed at practical, cost effective applications. That's why we offer three mainframes including the Altair 680b, Altair 8800a, and Altair 8800b; ten peripherals including a multi-disk system; and over 20 plug compatible modules including our new, low power 16K static memory board. That's why we are the only microcomputer manufacturer to go to the extra expense of providing our customers with quality, higher language software.

When you buy an Altair, you're not just buying a piece of equipment. You're buying years of reliable, low-cost computing. You're buying the support of the **NUMBER ONE** manufacturer in the micro-computer field.



mits

2450 ALAMO SE. / ALBUQUERQUE, NEW MEXICO 87106 / 505-243-7821

altairTM 8800b

TECHNICAL INFORMATION

The ALTAIR 8800b computer is a general purpose byte-oriented machine (8-bit word). It uses a common 100-pin bus structure that allows for expansion of either standard or custom plug-in modules. It supports up to 64K of directly addressable memory and can address 256 separate input and output devices. The ALTAIR 8800b computer has 78 basic machine language instructions and is comprised of a power supply board, an interface board, a central processing unit (CPU) board, and a display/control board.

Power Supply Board

The Power Supply Board provides two output voltages to the ALTAIR 8800b computer bus, a positive and negative 18 volts. It includes a bridge rectifier circuit and associated filter circuit, a 10-pin terminal block connector, and the regulating transistors for the positive and negative 18 volt supplies.

Interface Board

The Interface Board buffers all signals between the display/control board and the ALTAIR 8800b bus. It also contains eight parallel data lines which transfer data to the CPU from the Display/Control board.

CPU Board

The CPU board controls and processes all instruction data within the ALTAIR 8800b computer. It contains the model 8080A microprocessor circuit, the master timing circuit, eight input and eight output data lines to the ALTAIR-bus, and control circuits.

Display/Control Board

The Display/Control Board conditions all ALTAIR 8800b front panel switches and receives information to be displayed on the front panel. It contains a programmable read only memory (PROM), switch and display control circuits, and control circuits to condition the CPU.

NEW DESIGN FEATURES

Several new design features have been incorporated into the electronic and mechanical areas of the ALTAIR 8800b computer. Some of the new design features include additional front panel capabilities, redesigned power supply, and various electronic and mechanical design advancements.

New Front Panel Switches

Five new front panel switch positions have been added to the ALTAIR 8800b computer to expand the front panel capability.

1. SLOW position: Permits execution of a program at a rate of approximately 2 machine cycles per second or slower. The normal machine speed is approximately 500,000 machine cycles per second. The ALTAIR 8800b operates in the slow mode as long as the SLOW switch is depressed on the front panel.
2. DISPLAY ACCUMULATOR position: Displays the contents of the CPU accumulator register on the ALTAIR 8800b front panel.
3. LOAD ACCUMULATOR position: Loads the information present on the lower eight front panel address switches into the CPU accumulator register.
4. INPUT ACCUMULATOR position: Inputs the information present at an Input/Output device into the CPU accumulator register. The Input/Output device is selected on the upper eight front panel address switches.
5. OUTPUT ACCUMULATOR position: Outputs the contents of the CPU accumulator register to a selected input/output device. The input/output device is selected on the upper eight front panel address switches.



New Power Supply

The new power supply in the ALTAIR 8800b contains an 8 volt, 18 ampere tapped secondary supply which permits the addition of up to 16 printed circuit cards, and pre-regulated positive and negative 18 volt, 2 ampere supplies. A multiple tapped primary transformer provides for 110/220 volt operation and a 50/60 Hz operation.

Electronic Design Advancements

The electronic design advancements on the ALTAIR 8800b are in the CPU and front panel circuit boards.

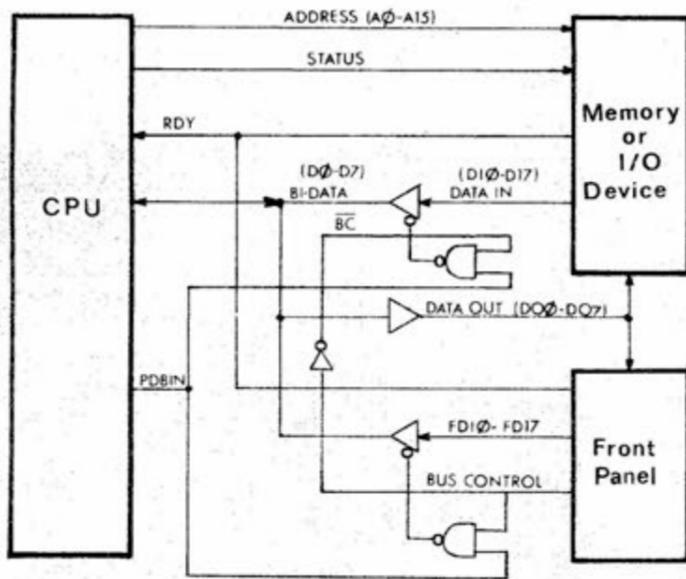
1. CPU. The new CPU circuit board uses the Intel 8224 clock generator integrated circuit (IC). The 8224 IC provides a specified clock frequency to the ALTAIR 8800b using an external crystal and dividing the crystal frequency down to 2MHz. Therefore, both the clock pulse widths and phasing (as well as frequency) are crystal controlled.
2. Front Panel. All front panel data lines are connected to an interface which buffers them from the rest of the ALTAIR 8800b. The front panel circuits also use a programmable read only memory (PROM) which contains programs for the following eight functions:
EXAMINE
EXAMINE NEXT
ACCUMULATOR DISPLAY
ACCUMULATOR LOAD
DEPOSIT
DEPOSIT NEXT
INPUT ACCUMULATOR
OUTPUT ACCUMULATOR

The front panel circuits also have a wiring option which allows the CPU to perform a complete instruction cycle or a single machine cycle during the single step or slow operation.

Mechanical Design Advancements

The mechanical design advancements on the ALTAIR 8800b are incorporated for ease of assembly and maintenance.

1. The wiring harness connection which exists on the front panel of the ALTAIR 8800 is replaced with ribbon cables. These ribbon cables connect the front panel circuits to the interface circuits.
2. The four slot expander cards in the ALTAIR 8800 have been replaced by a single piece 18-slot motherboard. The 18-slot motherboard contains 100 solder lands which comprise the 100 pin bus.
3. A new multi-color and redesigned dress panel is used in the ALTAIR 8800b. The front surface of the dress panel has a protective sheet of mylar to insure that the graphics are not rubbed or scratched off.



8800b BLOCK DIAGRAM

8800b BLOCK DIAGRAM DESCRIPTION

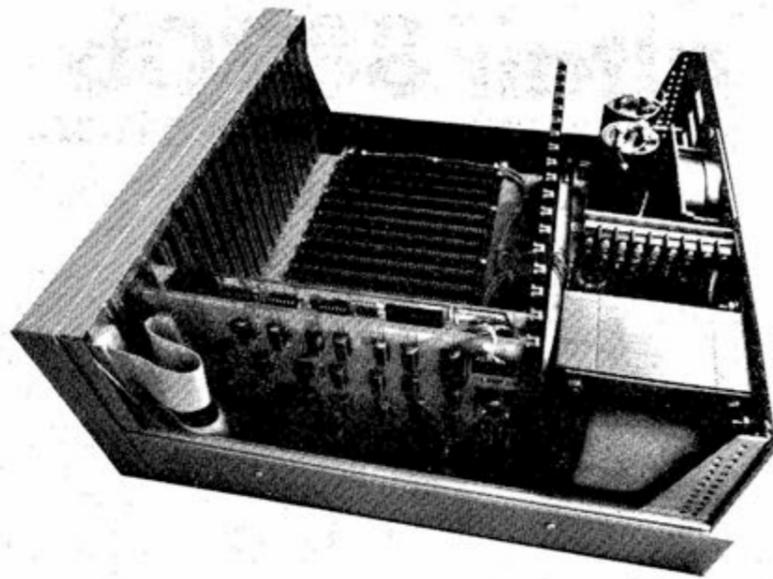
The 8800b computer contains four main circuits: a Central Processing Unit (CPU), a Memory, an Input/Output (I/O), and a Front Panel. The CPU controls the interpretation and execution of software instructions, and the Memory stores the software information to be used by the CPU. The I/O provides a communication link between the CPU and external device. The Front Panel allows the operator to manually perform various operations with the 8800b. The 8800b block diagram description explains: A) the communication between the CPU and the memory or I/O circuits; and B) the communication between the CPU and the front panel.

CPU to Memory or I/O Operation

The Memory or I/O operation requires several main signals which allow for transfer of data to and from the CPU. The ADDRESS (A0-A15) signal consists of sixteen individual lines from the CPU to the Memory or I/O device. This signal represents a particular memory address location or external device number which is needed to establish communications with the Memory or I/O Device. Once the ADDRESS (A0-A15) data is presented to the Memory or I/O device, the CPU generates various STATUS signals. The STATUS signals either enable decoding of a memory address, or they condition the I/O device card to send or receive data from the CPU. Data from the Memory or I/O device is presented on the DATA IN (DI0-D17) lines and applied to eight non-inverting bus drivers. The drivers are enabled by a PDBIN signal from the CPU and a BC (bus control) signal. The BC signal is LOW when the Front Panel is not in operation. The eight non-inverting bus drivers, when enabled, present the input data to BI-DATA (D0-D7) lines which apply the data from the Memory or I/O device to the CPU. Data to the Memory or I/O device is presented on the DATA OUT (DO0-DO7) lines from the BI-DATA (D0-D7) lines from the CPU. The RDY (ready) line either forces the CPU to a wait state while data is being transferred or allows the CPU to process data.

Front Panel Operation

The Front Panel Operation is very similar to the Memory or I/O operation. The Front Panel gains control of the CPU by producing a HIGH BC signal. The BC signal disables the DATA IN (DI0-D17) lines from a Memory or I/O device and enables the FDI0-FDI7 lines. The FDI0-FDI7 lines contain Front Panel data which is transferred to the CPU upon the occurrence of the PDBIN signal. All data from the CPU to the Front Panel is applied to the DATA OUT (DO0-DO7) lines and displayed on the Front Panel.



COMPATABILITY

Compatibility

All of the current 8800 software is compatible with the 8800b, and all the current plug-in circuit boards are compatible, with the exception of the 8800a CPU Board.

Memory Cards

- 1. 4K Dynamic RAM Memory Board
- 2. 4K Static RAM Memory Board
- 3. 16K Static RAM Memory Board
- 4. PROM Memory Board

Interface Cards

- 1. Serial Interface Board
- 2. Parallel Interface Board
- 3. Audio-cassette Interface Board
- 4. Disc Controller Board

ALTAIR 8800b Specifications	
Number of Boards	Up to 18
Microprocessor	
Model	8080A
Technology	NMOS
Data Word Size, Bits	8
Instruction Word Size, Bits	8
Clock Frequency	2M Hz
Add Time, Register to Register, Microsec. Per Data Word	2
Number of Instructions	78
Input/Output Control	
I/O Word Size, Bits	8
Number of I/O Channels	256
Direct Memory Access	Optional
Interrupt Capability	Std.
Vectored Interrupt (8 priority levels)	Optional
Software	
Resident Assembler	Yes
Higher-level Language	BASIC
Monitor or Executive	Sys. Mon.; text edit.
Complete Software Library Separately Priced	Yes



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

Disk Boot Loader Octal Listing

THE FOLLOWING IS AN OCTAL LISTING OF THE
DISK BOOT LOADER FOR THOSE PEOPLE WHO HAVE
DISK SYSTEMS WITHOUT CASSETTE OR PAPER TAPE CAPABILITIES

ADDRESS	CONTENTS	ADDRESS	CONTENTS	ADDRESS	CONTENTS
46000	363	46050	004	46120	132
46001	061	46051	302	46121	114
46002	142	46052	045	46122	035
46003	115	46053	114	46123	333
46004	257	46054	076	46124	012
46005	323	46055	020	46125	167
46006	010	46056	365	46126	043
46007	076	46057	325	46127	302
46010	004	46060	305	46130	104
46011	323	46061	325	46131	114
46012	011	46062	021	46132	341
46013	303	46063	206	46133	021
46014	031	46064	200	46134	327
46015	114	46065	041	46135	114
46016	333	46066	324	46136	001
46017	010	46067	114	46137	200
46020	346	46070	333	46140	000
46021	002	46071	011	46141	032
46022	302	46072	037	46142	167
46023	016	46073	332	46143	276
46024	114	46074	070	46144	302
46025	076	46075	114	46145	301
46026	002	46076	346	46146	114
46027	323	46077	037	46147	200
46030	011	46100	270	46150	107
46031	333	46101	302	46151	023
46032	010	46102	070	46152	043
46033	346	46103	114	46153	015
46034	100	46104	333	46154	302
46035	302	46105	010	46155	141
46036	016	46106	267	46156	114
46037	114	46107	372	46157	032
46040	021	46110	104	46160	376
46041	000	46111	114	46161	377
46042	000	46112	333	46162	302
46043	006	46113	012	46163	170
46044	000	46114	167	46164	114
46045	333	46115	043	46165	023
46046	010	46116	035	46166	032
46047	346	46117	312	46167	270

ADDRESS	CONTENTS	ADDRESS	CONTENTS	ADDRESS	CONTENTS
46170	301	46240	333	46310	170
46171	353	46241	010	46311	323
46172	302	46242	346	46312	001
46173	265	46243	002	46313	303
46174	114	46244	302	46314	311
46175	361	46245	240	46315	114
46176	361	46246	114	46316	172
46177	052	46247	076	46317	274
46200	325	46250	001	46320	300
46201	114	46251	323	46321	173
46202	325	46252	011	46322	275
46203	021	46253	303	46323	311
46204	000	46254	043	46324	204
46205	377	46255	114	46325	000
46206	315	46256	076	46326	114
46207	316	46257	200	46327	044
46210	114	46260	323	46330	026
46211	321	46261	010	46331	126
46212	332	46262	303	46332	026
46213	276	46263	000		
46214	114	46264	000		
46215	315	46265	321		
46216	316	46266	361		
46217	114	46267	075		
46220	322	46270	302		
46221	256	46271	056		
46222	114	46272	114		
46223	004	46273	076		
46224	004	46274	103		
46225	170	46275	001		
46226	376	46276	076		
46227	040	46277	117		
46230	332	46300	001		
46231	054	46301	076		
46232	114	46302	115		
46233	006	46303	107		
46234	001	46304	076		
46235	312	46305	200		
46236	054	46306	323		
46237	114	46307	010		

Part Two

My Computer Just Stares at Me

continued

When the HALT line is in the high state or RUN condition, the MPU fetches the instruction addressed by the Program Counter and then begins execution of the instruction. This process continues until the MPU once again enters the HALT state.

The RESET input of the MPU is used to implement a master reset of the system. Just what that means is somewhat different for every computer system. In the Altair 680b it is used to initialize (set up) the system after a power down condition due to either an initial start-up or power failure. When the 6800 MPU receives a reset signal, the Program Counter is loaded with the contents of the reset vector location (in the MPU) which contains the starting address of the System Monitor. In this way, the computer will begin running the System Monitor as soon as the system is put into the Run mode.

Now there has to be a way for the MPU to know when an I/O device or interface wants to talk with it. To take care of this, the MPU has interrupt lines. The M6800 (the MPU which the 680b uses) has two interrupt lines: the Interrupt Request (IRQ) and the Non-Maskable Interrupt (NMI). The IRQ line is the one that is usually used. When an I/O interface such as the Asynchronous Communications Interface Adapter (ACIA) wants to talk to the MPU, it sends a signal over the IRQ line. The interesting thing about this signal line is that it is possible for the MPU to turn down the interrupt request if it is doing something more important at the time. An analogy would be if you were the president of a company and your secretary let you know that there was a salesman wanting to see you. You, as the president, would then have the choice of servicing the interrupt by seeing the salesman or "masking" the interrupt by not seeing the salesman.

With the Non-Maskable Interrupt (NMI) line, however, the tables are turned slightly. It would be more analogous to your being the secretary and having the president of the company interrupt something that you were doing. In this case there's no way that you'd ignore that interrupt, (unless, of course, you didn't mind getting fired!). Well, the MPU can't be fired, but the point is that if an interrupt signal comes over the NMI line, the interrupt must be serviced as soon as the MPU is finished executing its present instruction. This line is generally used if the system must go on standby power or some similar situation.

In a future issue of Computer Notes we'll discuss how all of these control lines along with the MPU registers and the system I/O and memory work together to execute a program.

Peter Smart and Darrel Van Buer

Top August Software Contest

By: Stanley Webb

The entries in the software contest this month showed an increase in both diversity and sophistication with which Altair computers are being used.

This month there was a tie for first place in the major program category. The winners are Peter Smart, for his 6800 cross assembler, and Darrel Van Buer, for his interrupt driven multi-processing system.

The 6800 cross assembler is similar to Jim Gerow's, but it is designed to run well on a machine with a large (at least 36 bit) word size. It was written for the CDC Cyber 74, but should run well on a 6600 or 7600 with little modification.

The multi-processing system uses interrupts from 2SIO ports to drive any number of tasks on a priority basis. It is the most technically interesting entry this month, and would be instructive for those of you who are interested in designing a multi-tasking system. Its only fault is the lack of documentation at the system level.

Third place this month goes to J. W. Klotz for a math drill program. This is a CAI (computer assisted instruction) program which covers elementary math, complete with integers, fractions, and decimals.

There was only one entry in the subroutine category this month. However, since the program is useful, I don't think that it should be penalized by the lack of response. Therefore, the first place subroutine is Matthew Smith's "BASES", which can convert a number in any base (from 2 to 16) to any other base (from 2 to 16).

There are three other entries I want to mention: Peter Graulich's "BIO RHYTHMS" and Tom Simpson's "TTT3D" program. Both these programs are exceptional because they are very well documented. The other entry worth mentioning is a fine example of a low cost way to greatly increase your computing power. Jeb Long's entry is an intelligent terminal program (JIT 1.0) which allows his Altair 8800 to communicate with a Univac 1108 timesharing system.

First Place Major Program - Tie

#7-12-761
 Author: Peter Smart
 Length: 1700 lines (Fortran)
 Title: 6800 cross assembler
 Altair 680 cross assembler written in CDC Cyber 74 Fortran

#7-29-762
 Author: Darrel J. Van Buer
 Length: 749 + 184 (max) bytes (assembler)
 Title: Interrupt driven multi-processing.
 Multi-tasking system driven by interrupts from a 2 SIO board.

Third Place Major Program.

#7-22-761
 Author: J. W. Klotz
 Length: 350 lines (5980 bytes) (Basic)
 Title: Math drill
 CAI program for teaching elementary math.

First Place Subroutine
 #7-19-762
 Author: Matthew Smith
 Length: 12 Lines (Basic)
 Title: Bases
 Base conversion subroutine

#7-26-761
 Author: Tom Simpson
 Length: 170 Lines (Basic)
 Title: TTT 3D
 Plays the game of 3D tic tac toe

#7-12-762
 Author: Peter Graulich
 Length: 225 Lines (Basic)
 Title: Bio-rhythms
 Plots Bio-rhythm cycles

#7-20-761
 Author: Jeb Long
 Length: 500 Bytes (assembler)
 Title: Intelligent terminal
 Interfaces an Altair 8800 to a time sharing computer

#7-22-762
 Author: Keith Fischer
 Length: 65 lines (disk extended basic)
 Title: Reseq +
 Resequences Basic programs on disk files.

#7-19-761
 Author: Charles Wells
 Length: 300 bytes (total)(assembler)
 Title: Baudot Printer Program
 A patch and some additions to 3.2 Basic to allow it to use a Baudot Printer.

#7-29-761
 Author: David Vomlehn
 Length: 10 bytes (Assembler)
 Title: Complete memory clear.
 A short memory clearing program that clears entire memory, including itself.

#7-28-761
 Author: Phillip L. Hansford
 Length: 25 Bytes + table (Assembler)
 Title: Jam Table
 An efficient command table lookup change to the JAMON monitor (#117752)

#7-22-763
 Author: George W. Rompot
 Length: 150 Bytes (Machine Language)
 Title: Creed
 Creed 75 output driver for use with JAMON.

#7-13-761
 Author: Harold Corbin
 Length: 90 lines (Basic)
 Title: Depreciation
 Program to compute depreciation by 4 methods.

#7-14-762
 Author: Roy Hann
 Length: 200 Lines (ICL 1900 Fortran)
 Title: Least-square curve-fitting program fits a curve to a set of experimental points by using least square method

#7-14-761
 Author: Roy Hann
 Length: 15 lines (Fortran)
 Titles: Finds value for Pi
 Finds a value for pi by Wallis' formula.



classified ads

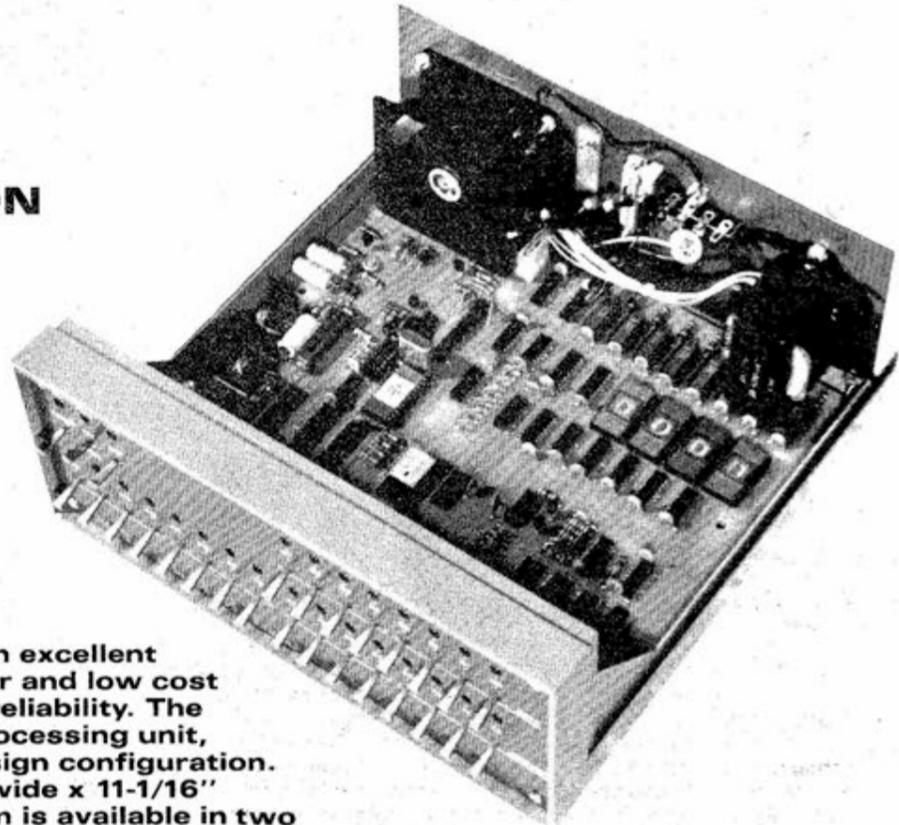
-Continued on page 22

For Sale: One MITS 4K Dynamic RAM board, works fine. All chips in sockets or Molex soldercons. First money order for \$110 takes it. Doug Anderson/755 Southmore Drive West/Ottawa Canada 613-731-1468

For Sale: ICC/MILGO 4400/48, 4800 baud modems. List price currently is \$4800 each. I have two for sale at \$800 each, or both for \$1500. These modems will operate in full duplex or simplex mode over normal unconditioned telephone lines. They have built-in equalizers and are interfaced through either EIA-RS232 or CCITT-V.24. Also, one ADS-448 data concentrator (four low speed lines to one 4800 baud line), \$600. Jim Brick/820 Sweetbay Drive/Sunnyvale, CA 94086/408-247-0312

altair^{T.M.} 680b

TECHNICAL INFORMATION



The ALTAIR 680b microcomputer is an excellent compromise between computer power and low cost structure, without sacrificing design reliability. The system is based on the 6800 microprocessing unit, which adapts nicely to a minimum design configuration. The ALTAIR 680b measures 11-1/16" wide x 11-1/16" deep x 4-11/16" high. The basic system is available in two configurations, depending on the intended application.

Almost all of the 680b circuitry is contained on a single large printed circuit board, including memory and a built-in I/O port. The full front panel model contains all of the controls necessary to program and operate the computer and includes an additional printed circuit board, which provides all of the logic circuitry necessary to reset, halt or start the processor. Also located on this board are switches and associated LED indicator lights for each of the sixteen address lines and eight data lines. The front panel circuit board mounts directly to the main printed circuit board via a 100-contact edge connector. The power switch is located on the back panel of the unit for safety purposes. A "turn-key" front panel model, which eliminates all control except restarting the processor, is also available.

The basic ALTAIR 680b computer can be subdivided into five functional sections. These are the MPU and clock, the memory, an I/O port, control and indication, and the power supply. The first three of these sections, along with the power supply regulation components, are located on the main printed circuit board.

At the heart of the 680b system is the 6800 Microprocessing Unit, which is largely responsible for the overall simplicity of the 680b design. The 6800 MPU contains three 16-bit registers and three 8-bit registers. The program counter is a two byte register which keeps track of the current address of the program. The stack pointer is also a two byte register which keeps track of the current address of the program and contains the next address in an external, variable length push-down/pop-up stack. The index register is a two byte register used to store data or a memory address for indexed addressing operations. There are two single byte accumulators used for holding operands and results from the arithmetic logic unit (ALU). The 8-bit condition code register indicates the results of an ALU operation. In this register there are two unused bits, kept at a logic one. The remaining six bits are used to indicate the status of the following: carry; half carry; overflow; zero; negative; interrupt.

The 6800 has seven different addressing modes, with the particular mode being a function of both the type of instruction and the actual coding within the instruction. The seven modes include the following: Accumulator Addressing— one byte instructions, specifying either of the two accumulators; Immediate Addressing— two or three byte instructions, with the MPU addressing the location given in the 2nd or 2nd and 3rd bytes when the immediate instruction is fetched; Direct Addressing— two byte instructions which allow the user to directly address the lowest 256 bytes of memory in the machine; Extended Addressing— three byte instructions, the second two bytes referring to an absolute address in memory for the operation; Indexed Addressing— two byte instructions, the second byte being added to the 16-bit index register to give the address of the operand; Implied Addressing— one byte instructions and the instruction itself gives the address; Relative Addressing— two byte instructions where the second byte is added to the lower 8 bits, allowing the user to address memory + 129 to -125 bytes from the location of the present instruction.

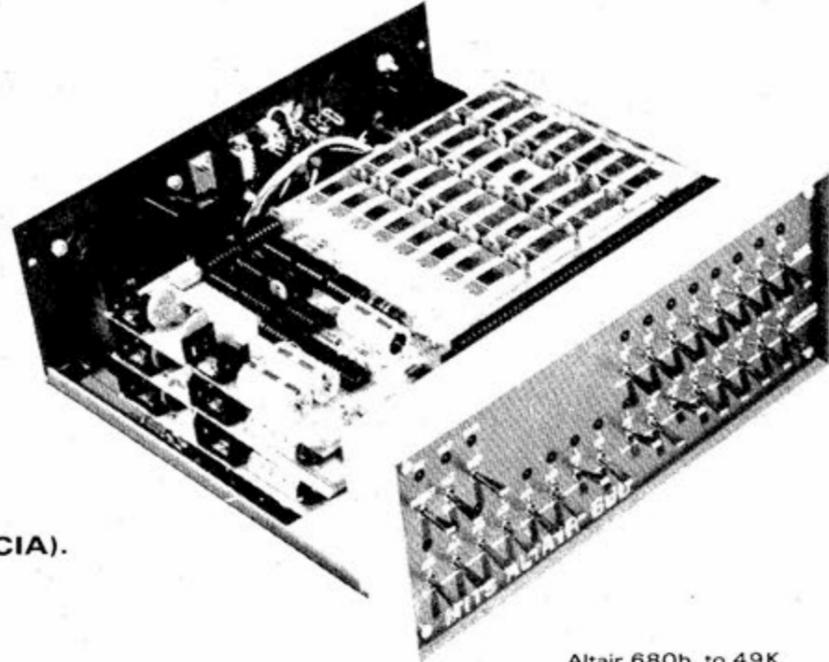
There are several timing and control signals required to operate the MPU. Two clock inputs are required, phase 1 and phase 2. These must be nonoverlapping and run at the Vcc voltage level. In the 680b the clock is a 2-MHz crystal controlled oscillator with logic to provide a 500-KHz two phase clock.

Sixteen active high address outputs are used to specify the sections of memory or I/O to be used. These can drive up to one standard TTL load and 130 pf. There are also eight bi-directional data lines with the same drive capability as the address lines.

NEW MEMORY FEATURES

MITS is pleased to announce the development of a 16K static memory card for the Altair 680b. With an access time of 215 nanoseconds and low power consumption of 5 watts, we feel that this is an excellent addition to the Altair 680b.

The 680b cabinet has room for up to three 16K static memory cards, thereby increasing the memory of the Altair 680b to 49K.



Altair 680b, to 49K.

SPECIAL FEATURES

PROM monitor.

1702A PROM monitor chip programmed so that you can immediately load and run paper tape object programs such as the text editor and assembler (see below).

Asynchronous Communication Interface Adapter (ACIA).

Allows the machine to transmit and receive a character at a time rather than one bit. Minimizes software needed for I/O routines. Contains crystal clock for baud rate synchronization. User-selectable for RS232, Baudot, TTY, 20ma current loop. Baud rates of 50, 75, 110, 134.5, 150, 200, 300, 600, 1200, 1800, 2400, 4800, and 9600.

Two Pass Resident Assembler and Text Editor

A two pass resident assembler and text editor will be available for assembly language programming. This software is compatible with Motorola's format for assembly language programs, text and object files. 8K bytes of memory are required to run this package. The assembler produces a full assembly listing on the second pass, including the hex codes for the location counter and the instruction mnemonics. A symbol table listing is also produced. The text editor has full capabilities for text editing, including line insertion, printing, deletion and modification; as well as commands for changing one string of characters to another and for searching the text buffers for a particular character string.

Basic Interpreter

A BASIC interpreter has been developed which will be comparable to the 8800 8K BASIC interpreter.

Buffered Data Lines

All data lines are buffered to provide fanout capability of over 20 standard TTL loads.



The Altair 680b is also available in this Turnkey Model which has a power indicator light and controls for RESET and RUN/HALT on the front panel. The system PROM monitor, when used in conjunction with a terminal, eliminates the necessity for toggling front panel switches to load bootstraps or to examine and change memory contents.

Altair 680b Specifications	
No. of Boards	Up to 3 additional
Microprocessor	
Model	6800
Technology	NMOS
Data Word Size, Bits	8
Instruction Word Size, Bits	8
Clock Frequency,	500KHz
Add Time, Register to Register,	
Microsec. Per Data Word	2
Number of Instructions	72
Input/Output Control	
I/O Word Size, Bits	8
Number of I/O channels	256 Memory Address Locations Designated
Interrupt Capability	Std.
Type of Interrupt System	Maskable (Interrupt Request) and Non-maskable Interrupt
Software	
Resident Assembler and Editor	Yes
Higher-level language	BASIC
Monitor	Resident System Monitor on PROM
Complete Software Library Separately Priced	Yes



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

Carl A. Argila

the teaching machine

Cecilio sits cross-legged, intently watching an old teletypewriter machine as it pounds out an arithmetic problem: $379 + 112$. Puzzling over the problem for a few moments, Cecilio cautiously pokes at the teletypewriter keys "481." "WRONG" fires back the machine, "TRY AGAIN."

Somewhat chagrined, Cecilio ponders the problem one more time, his face brightens and he confidently types "491." "CORRECT" responds the machine, and Cecilio proceeds to the next problem in his arithmetic lesson.

Though it sounds like something out of a science fiction movie, Cecilio actually has his own "teaching machine," or "computer assisted instruction" as it is known in educational circles. Cecilio is not unlike any of the thousands of other grade school students in Manila, with one exception--he is deaf; profoundly, pre-lingually deaf. But unlike other deaf students, Cecilio has been "mainstreamed" into a regular grade four class at Quezon City's Jose Abad Santos Memorial School (JASMS). Cecilio uses computer assisted instructional drill, of the type illustrated above, to help him "catch up" with his hearing classmates who have the benefit of both a better educational background and normal hearing.

Cecilio is drilled in other areas besides arithmetic; in spelling, for example, the computer asks:

WHICH OF THESE WORDS IS SPELLED WRONG?

1) SLOWELY 2) MISSED 3) PASSED 4) KNOWN

The computer will give Cecilio two chances to determine that "SLOWELY" is misspelled. If Cecilio does not answer correctly after two tries, then the computer gives him the correct answer and proceeds to the next problem. A record is kept of Cecilio's progress so that the level of difficulty can be adjusted as Cecilio demonstrates progress.

Most significantly, for a child with Cecilio's handicap, is that the computer can be "programmed" to drill him in auditory training. Utilizing Cecilio's miniscule residual hearing, the computer asks Cecilio to listen to highly amplified words, then to repeat those words, so that he can monitor his own voice, and then to identify how many syllables the words contain.

None of these applications of computer assisted instruction are unique, indeed to educational technologists abroad, they would be considered ridiculously trivial. What makes Cecilio's "teaching machine" significant to us in the Philippines is that it is the first of a new generation of electronic computers which are priced within the budget of many schools. An off-shoot of the recent revolution in "integrated circuit" technology, which brought about the ubiquitous pocket calculator, entire computers are now contained on miniature integrated circuit "chips." Cecilio's teaching machine consists of an ALTAIR 8800 computer, manufactured in the United States by MITS, Inc., Albuquerque, New Mexico (distributed locally by DATAPREP, Inc.) which was assembled locally as a kit, and an old teletypewriter machine which provides the "input" and "output" for the computer; this teletypewriter machine is exactly the same type used by local telegraph offices and available on the local surplus market. A cheap

cassette tape-recorder contains the computer programs which can be changed in a few moments from a program for audiometric drill to a program for advanced mathematics for college students. The complete system as shown on these pages has a price tag of under P5000! A comparable system a few years ago would cost from ten to a hundred times that much. And a few years from now the price will be a fraction of what it is today!

Making computers "affordable" to educators in the Philippines will, someday, be viewed as perhaps the most significant event in the development of the country--for the prospects are vast and mind-boggling. In a country like ours, with a dearth of trained specialists in such vital fields as engineering, economics, medicine, etc. more and more of the burden of routine work can be assumed by machines of the type described here, thereby freeing people for creative tasks--tasks which machines can't assume. I foresee the day when not only does every barrio have a schoolhouse, but every barrio schoolhouse has a computer. And these teaching machines will be, like educational radio, and other technological advances, an integral part of education in the "new society"--helping to fill the gap between all segments of society.

Computers are not new to education in the Philippines. Over three years ago, with the foresighted cooperation of the School of Engineering, we began at De La Salle College an experimental "computer-oriented" mathematics class in which the computer was used as a learning tool for the first two years of engineering mathematics.

--Carl A. Argila

Reprinted from the Philippine PANORAMA

July 11, 1976

Book Review

Artist and Computer

Ruth Leavitt, Editor

Artist and Computer edited by Ruth Leavitt is a collection of articles by thirty-five computer artists. In these articles the artists explain how they use the computer in their work.

Some of the artists were disappointed at their first attempts at computer art. Karen Huff, weaver, was "disappointed that the computer diagrams did not have the striking impact of the traditional representation." She later realized that the traditional form, because of its color bias, suppressed the possibilities of design. Since the color bias was removed in the computer diagram it was a more "pure representation," wherein she found more ideas for the use of color and different types of yarn and material.

The artists' opinions vary as to whether the computer is the artist or the tool of the artist. Ruth Leavitt for instance states, "I find that using the computer I do not have to give up my traditional role as an artist. The machine acts as a multifaceted tool which I control." On the other hand Heroshi Kawano feels that "It is never a computer artist, but a computer itself that produces works of art; ...just an 'art computer' should be called an artist, and a so-called computer artist is not an artist, but a teacher of an 'art computer.'"

Computer art has not yet become a popular art. The artist is not threatened by the possibility of being replaced by a computer. The computer is perhaps a very useful tool for artists, allowing them to increase the powers of their imagination and decrease the time and energy previously put into their work. It is Miljenenko Horvat's idea that "It has very little impact now on art as a whole; I hope the impact will grow in the future."

Artist and Computer is very well illustrated with over 160 illustrations, six of which are in full color. As one might expect, much of the art contained in the book is non-representational. There are, however, landscapes by Colette and Charles Bangert and portraits by Ed Manning. Some of the artists included are painters, graphic designers, sculptors, musicians, and others.

Artist and Computer is published by Harmony Books, a division of Crown Publishers, Inc. The paperback edition is available from the Creative Computing Catalogue, Dept. C, P. O. Box 789-M, Morristown, N. J. 07960 for \$4.95.

--Alice Regan

HELP WANTED

Engineers

MITIS, Inc. in Albuquerque, NM is currently accepting applications for qualified engineers who have 2-3 years experience in digital electronics. Experience with microprocessors is preferable but not required.

Send complete resume to: Engineering Department
(NO phone calls please) MITIS, Inc.
2450 Alamo SE
Albuquerque, NM 87106

Technical Writers

MITIS, Inc. in Albuquerque, NM currently has openings for Technical Writers who have 1-2 years experience in digital electronics. Applications will be accepted from individuals who have done technical writing or who have a background in digital electronics and a "knack" for writing.

Send complete resume to: Technical Publications Department
(NO phone calls please) MITIS, Inc.
2450 Alamo SE
Albuquerque, NM 87106

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ACRONYM GLOSSARY

A/D	Analog-to-Digital
ALU	Arithmetic Logic Unit
AOI	AND-OR-Invert
APL	A Programming Language
ASCII	American Standard Code for Information Interchange
BCD	Binary Coded Decimal
BCDIC	Binary Coded Decimal Information Code
BPS	Bits per second
CMOS	Complementary MOS
CPU	Central Processing Unit
D/A	Digital-to-Analog
DIP	Dual In-Line Package
DTL	Diode-Transistor Logic
DVM	Digital Volt Meter
EBCDIC	Extended Binary Coded Decimal Interchange Code (IBM)
ECL	Emitter-Coupled Logic
EIA	Electronics Industry of America (As in EIA-RS232 Interface Standard)
EPROM	Eraseable PROM
FET	Field-Effect Transistor
FF	Flip-Flop
FM	Frequency Modulation
FSK	Frequency Shift Keying
HTL	High-Threshold Logic
IC	Integrated Circuit
JFET	Junction FET
LED	Light Emitting Diode
LCD	Liquid Crystal Display
LTTL	Low Power TTL (74L00)
LSI	Large-Scale Integration
LSTTL	Low Power Schottky TTL (74LS00)
MOS	Metal-Oxide-Semiconductor
MPU	Micro-Processing Unit
MSI	Medium-Scale Integration
NBCD	Natural Binary Coded Decimal (8-4-2-1 Code)
OEM	Original Equipment Manufacturer
PLL	Phase-Locked Loop
PROM	Programmable ROM
RAM	Random Access Memory
ROM	Read Only Memory
RTL	Resistor-Transistor Logic
SCR	Silicon Controlled Rectifier
SR	Shift Register
SSI	Small-Scale Integration
STRL	Schottky Transistor-Resistor Logic
TTL	Transistor-Transistor Logic(7400)
TTY	Teletype
VCO	Voltage Controlled Oscillator

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88-16 mcs

"The memory of choice"

Dear Ed,

I have finished assembling the new 88-16MCS 16K Static Memory Card. Total assembly time was less than three hours (closer to two really). When I plugged it into my 8800, it worked right the first time.

Frankly, the card is almost too good to be true. 33 sockets (32 for memory chips, 1 for the 8212), 13 IC's, 6 resistors, 2 regulators, a handful of capacitors, a diode, a DIP switch, and its ready to run.

Admittedly, I am an experienced builder, but I do not believe that anyone with a minimum of experience and the RIGHT tools would have any trouble building this card. It almost falls together.

While this card represents a sizable investment, I really believe that it is worth it--not only for what you get (high speed, simplicity, and low power), but also for what you don't get (500 solder connections on the mother board, many-many jumpers, the occasional joys(?) of dynamic rams, etc). Also in a fully expanded Altair, perhaps the necessity of an expansion cabinet for the mainframe can be avoided.

I sincerely believe that the 88-16MCS will become the memory of choice for a serious 8800 computer system.

My compliments to the Chef.

Yours truly,
Carl J. Swift

Disk Hardware Notes

by Tom Durston

1. A problem has been found on Disk Controller Board #1 that can cause I/O errors on multiple Disk Drive systems. The trouble is due to the index pulse detector not being fully cleared during transfer of control from one drive to another.

To correct the problem on Disk Controller Board #1, cut pin 7 of IC B3 and bend it up from the PC board. Connect a jumper wire from pin 7 of IC B3 to the pad labelled "SSC" (pin 9 of IC B5).

This connects the J input of the index detect flip-flop to the 45 ms head load delay, preventing false indication of index hole detection.

2. Pertec is recommending mounting the FD-400 Disk Drive by 3 points rather than 4, as is currently being used in the Altair Disk. Mounting at 3 points prevents misalignment of the drive due to uneven mounting surfaces in the Disk Drive cabinet.

To do this, slide the disk cabinet subchassis out, and remove the Disk Drive's left-rear mounting screw (the one nearest the power supply board). Then swing the 9" spacer bar out from under the left-rear corner of the Disk Drive towards the front of the unit. Make sure the remaining 3 screws have lockwashers under their heads and are as tight as possible. If desired, the 9" spacer bar may be replaced by a 1/4" spacer with a large outside diameter.

CLASSIFIED ADS

-Continued from page 17

For Sale: Paper Tape Holder kit (\$8.00) or assembled (\$12.00). Guides rolled tape to reader mechanism free of kinks and twists. Will hold up to 300 feet of paper tape and can be used on either a Teletype or the 200 cps reader. Optional Paper Tape Rewinder is also available for \$4.00. (Prices include postage.) Contact:

C. V. Spinks
PO Box 9298
College Station, TX 77840
(713) 846-6585

For Sale: Factory-assembled Altair 4K Dynamic Memory Boards. Fully operable. I'm upgrading my Altair with 16K boards and wish to sell my 4K's. Please contact: Skip Pearce 8013 North 11th Ave./Phoenix, AZ 85021

Altair Users

Edwin F. Hampton
6950 SCT4 GP
Box 36
APO New York 09193

Toivo Rusokallio
Karikkokatu 4
53100 Lappeenranta 10
Finland

Daniel A. Enger
(new address)
928 St. Joe
Rapid City, SD 57701

Jose Mauricio Campos Salaverria
25 Ave. Sur y 6 Calle Pte 1405
San Salvador, El Salvador

John Swain
3687 NE County Line Road
Buck Creek, Indiana

Larry Cottrill
Cottrill Optical Company
3407 Kingman Blvd.
Des Moines, IA 50311

Ken Wolfe
150 No. Railroad St.
Palmyra, PA 17078

Skip Pearce
8013 North 11th Ave.
Phoenix, AZ 85021

Cape Canaveral Area

We are about a dozen individuals who are interested in micro-processor-based computer systems. Some of us are employed at the John F. Kennedy Space Center, while others are affiliated with Florida Institute of Technology and Florida Technological University. We utilize a variety of equipment; mostly 8080-based (several Altairs, an Intellec, several Home-brews) and also a 6800 exorciser. Many of our members also belong to the larger computer clubs such as the Southern California Computer Society and the Chesapeake Microcomputer Club. Our purpose is to further the usage of small computer systems through the mutual sharing of ideas and resources. You are invited to join with us.

Space Coast Microcomputer Club
Ray O. Lockwood
1825 Canal Court
Merritt Island, FL 32952
(305) 452-2159

Salt Lake City Area

We are happy to announce that Utah has a computer club of its own now that is alive and doing well. We have had two meetings to date and had an attendance of about fifty to each. The name of the club is "The Utah Computer Association". Interested parties may contact the following for more information.

James Hansen (801) 299-2276 S.L.C.
Wayne Bates (801) 376-2525 S.L.C.
Phil Bullock (801) 582-4000 S.L.C.
Dave Evans (801) 225-5197 Provo.

James B. Hansen
3635 So. 3400 W.
Salt Lake City, Utah 84119

Computer Clubs

College Station, Texas Area

The Texas A&M University Microcomputer Club (TAMUCC) has grown to about 55 members of widely varying backgrounds.

Meetings are held each Wednesday night at 8:00 PM in room 333B of the Zachry Engineering Center during the semester. Dr. Charles Adams is providing energetic leadership and may be reached in the evenings at 713-823-0877.

Club meetings usually consist of about an hour of general discussion followed by a program or meetings of several smaller groups with interests in specific areas. Currently there are interest groups in the implementation of the BASIC and APL programming languages, a group on computer games, and several groups based on the ownership of a specific brand of microprocessor.

May I extend a most cordial invitation to anyone who happens to be in the College Station area to come to one of our meetings.

Texas A&M University Microcomputer Club
PO Box M-9
Aggieland Station, Texas 77844

New England

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

customer service news

By Gale Schonfeld

Again another busy month has passed . . .

COMPUTER NOTES SUBSCRIPTIONS

Many of you have inquired as to when you should renew your "Computer Notes" subscription. Beginning in early November we will accept your renewal requests. I will let you know more information on subscription renewals in a future article.

"Computer Notes" is mailed from Albuquerque by three different methods, depending upon destination:

United States
APO & FPO with - Bulk Mail
Zip codes

Canada & Mexico - First Class Mail

International - Air Overseas (AO)*

*All overseas "Computer Notes" subscriptions are mailed via AO. The only difference between AO and Air Mail is that the flap is folded in rather than sealed for inspection purposes. It is impossible for us to accept special requests for Air Mail, due to the large volume of mail we handle each month.

If you are not receiving every issue of "Computer Notes", I suggest that you contact Sandy Koppenheffer in our Customer Service Department.

RETURNING ITEMS?

We have instituted a new system for customers who wish to return items for refund, credit or exchange. If you are planning to return merchandise to us, please contact the Customer Service Department for authorization and details.

SOFTWARE LIBRARY

ALL program entries to the software library are to be submitted on our forms or on white (heavy weight) 8 1/2 x 11 paper. They are to be typed using a black ribbon with good contrast.

We are sorry to say that any program submitted in any other form (Xerox copies, computer print-outs, etc.) will be returned to the customer for re-typing and will not be entered into the software library contest for that month.

680b BAUDOT HARDWARE OPTION

Since we received little response concerning the Altair 680b Baudot level conversion and isolation kit, we have decided NOT to market this kit at this time. Sorry.

Until next month - Gale

Easy as Spaghetti



"Learning to use a computer should be roughly equivalent to learning how to make spaghetti!"

Personal Computing is the new people/computer magazine that understands this concept. We believe that if you are bright enough to:

1. Brown $\frac{1}{2}$ pound of hamburger in a large saucepan. Add celery, 1 clove crushed garlic . . .

and etcetera, then you are probably bright enough to learn how to make practical use of your own, personal computer. You are probably bright enough to play games with it or make use of it for your own business or educational purposes.

Personal Computing looks at the computer as a handy, powerful mind tool. One that expands your ability to keep track of the many complicated aspects of a modern society.

The first issue of **Personal Computing** includes the following articles:

1. Part one of **Spaghetti BASIC**. Easy to learn course on programming a microcomputer in the simplest of computer languages, BASIC.

2. **Ten Steps to Becoming a Computer Hobbyist**. Tells you about the phenomena of this newest breed of electronic tinkerer. And if you'd like to join the fun, we'll try to guide you in the right direction.

3. **The Equalizer**. Zany feature by Nels Winkless III that views the personal computer as "the most powerful equalizer since the Colt 45 in the old frontier."

Personal Computing will provide educational articles on basic computer jargon, computer architecture, and computer programming. These articles will be written in easy to understand language for the beginner and they will serve as a reference for people already knowledgeable in the field.

Another regular feature on **Personal Computing** will be a section on "Future Computing." Also, each issue will include a poster sized, four color computer graphic.

Personal Computing is a new kind of magazine, completely different from existing hobbyist publications.

Benwill Publishing, the publishers of **Digital Design** and **Minicomputer News**, invites you to take advantage of a special, charter subscription offer. For a limited time only, you can subscribe to the first year of **Personal Computing** for only \$6. This includes a free copy of the initial, October-November kickoff issue, plus the six bi-monthly issues scheduled for 1977.

To subscribe to **Personal Computing**, fill out this coupon and return it with your check to:

Personal Computing

Benwill Publishing Corp., 167 Corey Road, Brookline, MA 02146, USA.

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