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## The Small Computer Magazine

ISSUE # 6 June 1977

## Articles



## Features

# CT-64 TERMINAL SYSTEM

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* 128 CHARACTER ASCII SET
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# I Print "Publisher's Remarks" 10 No End Run

*Wayne Green*

## Some New Ideas

Using the Los Angeles Personal Computing show as an excuse, I made a fast trip to California and spent a few days seeing what was doing around the industry. The show came off okay, with reasonable crowds of computer hobbyists turning out to see the perhaps twenty or so exhibits. The main purpose of the show was to attract pre-hobbyists and get them enthusiastic and into the hobby. Judging from the people I met at the *Kilobaud* booth and in talking around the show, the pre-hobbyists did not materialize. There were plenty of dedicated hobbyists and they made the exhibiting worthwhile for everyone.

The biggest exhibit was by Computer Power and Light, where they had set up a number of training stations and were giving sample computer intro classes. The most impressive new piece of equipment, at least for me, was an IBM Selectric II complete with black box (actually, it was blue) to run from your parallel output port . . . price $1295 . . . brand new. I keep an eye peeled for new hardware which will get the small business market going, and this seems to be right down that alley. These are being brought out by Microcomputer Devices.

After the show Sherry (our marketing manager), John Craig and I drove up to visit Polymorphic Systems and see their new Poly 88. They are hard at work there keeping up with business and developing some new items which are exciting . . . trying to have them ready to show at the Faire.

We dropped John off at his home in Lompoc and went on to visit Cromemco, Apple, Imsai, Byte Inc., and Bill Godbout (with George Morrow coming over to join us for a fine dinner . . . it sure is lucky that Morrow and Godbout live 3000 miles away from me, otherwise none of us would get much done).

One of the problems which is concerning just about everyone in the microcomputer business is the generation of radio frequency interference (RFI) by the systems. An unshielded computer can wipe out shortwave and even television for quite a distance. The clock running at 2-4 MHz (or more) is bad enough, but then we use that to generate nice sharp square waves with harmonics on up into the VHF channels.

Both Godbout and Morrow have some new mother boards which are designed to minimize the radiation of RFI. Their designs are clever and you could do worse than take a good look at them. Cromemco seems to be the most serious about the problem, with a mother board which has a maximum of shielding of all lines and a new cabinet which resembles a Mosler safe. It even has a filter in the power line coming out the back.

The Cromemco mother board uses both sides of the board, with half the lines on top and half on the bottom. This leaves room for a relatively wide ground strip between every bus line. The bus lines are very narrow and this makes most of the board covered with the ground bus, thus providing good distributed capacity to hold down noise and plenty of shielding. Top and bottom bus lines are staggered so each is opposite a ground bus.

## Power Supplies

Ever since the beefs over the "inadequate" power supply which came with the first Altairs . . . it seemed adequate when they started the Altair, but it didn't take hobbyists long to plug in too many boards for the first supplies, so Mits provided a heavier duty supply to cope with this . . . ever since then I've wondered why manufacturers took valuable desk top space in their cabinets for a heavy and hot power supply. Ham manufacturers have for years provided external power supplies. After all, it isn't anything you ever have to get at . . . you don't even need the on-off switch on it. Why not put the power supply in a separate box and run a power cable to the computer? This would make a lot more room for expanding systems . . . would keep the heat down substantially . . . and would make computers easier to carry around. And we do carry them around . . . quite a bit . . . like to the computer store for checking . . . to a club meeting . . . or to visit a friend and show off.

A visit to Apple surprised me. They have done the obvious . . . obvious, once you see it . . . by using a transistor oscillator and running the power transformer at a much higher frequency, they have cut the size of the transformer down to about one fifth the size and weight of the monsters now showing up in other systems. The result is a supply which is small enough to put on a PC board and fits into their new molded cabinet. The Apple 2 is impressive, but I hope the fellows aren't having so much fun designing and programming their stuff that they are unable to stop somewhere along the line and get into production. It is very frustrating to both hardware and software people to have to stop, and it takes a strong minded businessman to call a halt to development and get into production. There is always that next step which will put you way ahead of everyone else . . . and will only take a couple more weeks.

The Apple 2 is expected to weigh in at around 10 pounds . . . that's with keyboard built-in . . . cassette I/O, etc. There is a place on the top of the flat cabinet (looks like a portable typewriter) to set the video monitor. They showed me some of their color graphics and I got a lot of good ideas from what I saw. Computer stores could get a lot of attention by running this sort of thing in their windows . . . and I'll be setting up something like this in the *Kilobaud* van . . . how much better and more apropos than painted pictures of desert, mountains or devils which are on most vans. If any computer stores set up a demo like this in their delivery trucks or vans I sure hope they send in some pictures and info on how they did it.

## Where's M&R

I tried to reach M&R (remember the Astral 2000 which got such an enthusiastic writeup in *Byte*?) to see how they were doing . . . no answer to my phone calls. Industry people explained that M&R had given up. That's a pity for I visited their development lab last year and was very impressed by the mechanical design of their system . . . one of the best I've seen. And their software seemed to be really coming along well too. But there is a lot more to running a business than having a good product . . . you also have to have more money than you think to get going . . . and some shrewd brains behind advertising and promotion.

## Where Are We Going?

Computer hobbyists, like hams, are split into many sub-hobbies. Some are inveterate hardware tinkerers and express themselves by building their systems from scratch . . . to hell with kits.

They rationalize this by pointing out that it is cheaper (it can be) and a lot more fun (undoubtedly) . . . and you for sure know what your system is doing when you design and build it yourself. With the Osborne book in hand you are well along the road to designing your own system (*An Introduction to Microcomputers*).

I suspect that the amount of self-discipline needed to get seriously involved in computers as a hobby will tend to limit the growth of the hobby seriously . . . probably to the extent that it will never be a really big market for mass merchandisers. I suspect that Heath will be disappointed in sales . . . as will Radio Shack, should they venture into the field. I think this will grow about the way high fidelity did . . . slowly, with a small group of firms supplying the hobbyists.

The hobbyist is providing an important service . . . he is supporting the development of the coming small business computer . . . the coming small school computer . . . and the coming home computer. All of these will be giant industries in a few years and all will stem, I feel, from the development work going on today for a handful of computer hobbyists.

Obviously this is a golden opportunity for hobbyists. The more you know about computers, the better chance you'll have of grabbing the gold ring. The hobbyist who designs and builds his own system is putting in the groundwork which can be invaluable to him in the future. The hobbyist who goes to work for a computer store and learns to service all kinds of systems . . . to interface anything and everything . . . to work quickly and surely with BASIC (and later any other languages that come along), assembly and even machine language . . . will be ahead of everyone else.

Working in a small store also provides training in purchasing, merchandising . . . an interface with customers which is invaluable later on. You can learn bookkeeping, accounting, advertising, develop programs to handle all of the nitty gritty of the business such as invoicing, statements, inventory, profit and loss, payroll, form letters . . . etc. You get to learn about packaging, shipping, using the mails, trucking, insurance, banking, etc.

When you are in a position to set up your own firm you are already expected to know the above . . . it is too late to start learning unless your father is very, very wealthy and can afford to subsidize your learning at great expense. It's much better to learn all of these things on someone else's money.

I'll be surprised if the first really big explosion in the micro field isn't for small business. There is an enormous market for the $6000 computer system which will allow the small store keeper and small office to keep records and do all other business details. Since $6000 nets out to about $100 per month, just about any company can afford that. Hardly any can afford not to spend the $100 a month!

How much computer can we give them for $6000? Get out your pencil and start figuring. Can you give them a nice printer for letters, statements and invoices? How much of a mailing list will it process? Will it use disks? Tape? How about service?

If your system will enable the firm to save one salary a month, then you can sell them a pretty fair system for that price! With service that comes to about $500 per month . . . which isn't much these days.

I see school systems as a little further down the road, but as a big market when they arrive. I see a terminal on every desk . . . intelligent terminals connected to a large data base and big computer for the whole school. But I have little knowledge of this, so why don't *you* write and tell me (and the readers) how you think school systems will evolve.

Home systems are bound to come along. They will have to be simple and probably won't go in much for home creative programming. I see them as a way to expedite mail, shop, and be entertained . . . a suppliment to television. Oh yes, they'll help with home security too.

If this barrage of ideas hasn't got you itching to sit down and write, you're a tougher case than I thought. *Kilobaud* is here to exchange ideas . . . to help you learn . . . and to help you help others.

## What Are You Looking For?

Many prospective authors write in asking this . . . and the answer is so obvious to me that I hardly know how to answer. But I'll try . . . perhaps using some examples to get across the gestalt.

I've heard a lot about disk operating systems . . . how this one is pretty good and that one is minimal. Hmmm . . . how about an article which will put this into perspective for me. I'd like to understand what a disk operating system can do . . . why one is minimal and what I should look for in more sophisticated systems. I'd like to have a general idea of what I can do and can't do with the DOSs available to me from hobby computer disk manufacturers . . . a comparison of the features and limitations of the Altair, Northstar, Imsai, and all the other popular systems.

Despite the Hal Walker article on cassette tapes, there is a lot more I want to know. I'd like to see a discussion of various standards of formatting on tape . . . pros and cons. Altair, KC, Digital Group, Tarbell, Apple, National Multiplex . . . and any others. How about a board which will let me I/O *any* of those with my computer?

Speaking of boards . . . I'd like to see a relatively simple Baudot Teletype I/O board which would do it all


kilobaud T.M.

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Kilobaud is published monthly by 1001001, Inc., Peterborough NH 03458. Subscription rates in the U.S. and Canada are $15 for one year and $36 for three years. Outside the U.S. and Canada, please write for foreign rates. Application to mail at second class postage rate pending at Peterborough NH 03458 and additional mailing offices. Phone: 603-924-3873.


INCLUDE OLD ADDRESS AND ZIP CODE WITH ADDRESS CHANGE NOTIFICATION.

in hardware or else use its own up for the software operations.

### Write Us a Program

Sure, our little computers are able to do all sorts of helpful things, but that doesn't stop us from having fun with them by putting in a game program . . . particularly if we have some friends visiting. I'd like to see some games in BASIC submitted to *KB* such as a simulation of a one armed bandit . . . roulette . . . blackjack . . . craps . . . Keno . . . Bingo . . Chuck A Luck . . . Baccarat . . . Faro . . . Boule . . . poker. How about Go? And is there much of a possibility for any serious chess games?

I jumped at the chance to get "Game Playing With Computers," second edition and published by Hayden. Curses, foiled again . . . virtually nothing whatever in programs, just familiarization with the games involved mostly. The DEC book of 101 games is a start, but it doesn't take long to tire of Hangman, Wumpus, Grumpus, and Grilch . . . and find a growing need for games which friends can play without a lot of explanation. Hamurabi is fun, but it takes a lot of practice to keep from killing a lot of innocent people. Ditto Startrek. You know, those Klingons may be basically rotten, but is that any excuse to wipe 'em out by the gross? We're not allowed to wipe out people just because they are rotten.

Let's get those programs written and send 'em in . . . and be sure to guarantee that you personally are the author of the program and that it wasn't "borrowed" from somewhere else.

I'd still like to see a comprehensive list of all of the boards available for the Altair bus . . . and the other computer systems which have interfaces to work with these boards. There are enough of these boards now so you may need a computer to keep track of all of them . . . what they do . . . the prices . . . etc.

If you've I/Od to any ham gear I'd like to know what, how it works, how you did it, any programs you've written . . . etc. I'm sure that some group somewhere must be experimenting with high speed Morse, generated by computer and decoded by computer . . . so let's know about it and how you solved the problems involved . . . what the reactions of other hams were to the experiments . . . how much interference bothers such communications . . . etc. More and more computerists are getting the itch to interconnect their systems with others and ham radio presents an excellent approach to this need . . . particularly when you consider the limitations of phone lines in both bandwidth and cost.

There are a lot of things we are *not* looking for . . . such as meandering articles with neither a hardware or software core. We'll pass up humor which is not outrageously funny . . . science fiction . . . stuff like that. *Creative Computing* has established the type of article it wants to publish, none of which would be acceptable to *Kilobaud* . . . and I'm sure the reverse is true. We just have different concepts of what we are trying to do. Ditto *Personal Computing*, which is doing a fantastic job of putting out a beautifully done magazine aimed at the prehobbyist. Ditto *Byte* . . . very little of the material appearing in *Byte* would be accepted by *Kilobaud*. Ditto *Interface Age*, which seems more aimed at the OEM market . . . admittedly a much larger market and a lot more lucrative . . . but not as much fun. I do try to read the other magazines with my hobbyist's hat on rather than my publisher's hat.

I want to learn as much as I can about the hows and whys of the equipment on the market . . . and get as much input as I can on how other hobbyists have solved problems they've encountered. I'd like to get as much in the way of programs as I can . . . know about any I/O for my SR-52 to a uC . . . and find out as much as I can about ways for hobbyists to make money out of this fantastic hobby. I think that the career possibilities are virtually unlimited and I'd like to see more written about how you got into business with your micro.

In talking with hobbyists at shows I seldom find anyone without the material for at least one good *Kilobaud* article . . . and usually it is a problem to decide which article should come first. Most of us have done something which is of interest to others and is unique . . . and that means we should write about it. We've already published data on writing for *Kilobaud*, but a copy of the instructions can be had for a SASE to Kilobaud . . . Peterborough NH 03458.

### Call For Papers

A major part of the First New England Computerfest at Boston, August 25-27th, will be the presentation of papers on microcomputing. Many of these will be published in the *Computerfest Program Magazine*. This will not interfere with possible reprinting of the papers in *Kilobaud* at a later date and the payment of regular article rates for the material.

Papers are requested from computerists and from industry sources, with the understanding that they should be prepared so as to be understandable by the average computerist rather than only by computer professionals.

It is hoped to have symposiums on all of the standards which are being proposed for microcomputers and microcomputer systems . . . hardware, software and system standards, so articles are particularly solicited along these lines.

The plans are to make time available for the demonstration, with Q&A periods, of most of the commercially available microcomputer systems. This is an opportunity for manufacturers to show their systems to a relatively large group of people at once . . . and answer their questions. It is an excellent opportunity for computerists to get the full explanation from the manufacturers on their systems. The big question in most minds is . . . what system should I buy? What better chance to get the full information than attending a series of talks on demonstrated systems?

Papers are due by July 1, 1977. This will allow enough time for them to be prepared for publication in the *Program Magazine*. Please submit all papers to The First New England Computerfest, c/o *Kilobaud*, Peterborough NH 03458.

### Another Computerfest Conflict

It looks as if there may be a conflict between the recently announced Boston Computerfest . . . which they are calling the New England Computerfest (NEC-77), but which will be in the Northeast Trade Center in Woburn, one of the small towns which make up Greater Boston . . . which is mostly a very large number of small towns which gradually grew together . . . and the PC-77. The element of doubt is there because I've received nothing whatever from the PC-77 group to indicate that they are for real this year. There was an ad for it in one of the magazines, but we've seen a lot of shows advertised which never materialized, so I don't put much stock in magazine ads for shows anymore . . . unless they are in *Kilobaud*.

If there is a conflict, it means manufacturers will have to choose between grubby Atlantic City, which was like a sauna last year, or Boston. Boston would seem to have several advantages . . . such as the enormous concentration of computer oriented businesses in the area, which should bring in hordes of prospective hobbyists . . . the nearness of a

*continued on page 20*

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John Craig

## Computer Stores

I don't particularly like the idea of taking a negative approach when discussing a subject. When I decided to address my impressions of the computer store situation, I gave a lot of thought to starting off with some ideas on how I think the ideal store should handle a customer. I can't do that though. The reason is there needs to be a different approach for different kinds of customers.

I had a very interesting time conducting my research. I made stops at three different computer stores down in the Southern California area and in each case I pretended to be a person interested in purchasing a personal system. At the first store I played the part of a complete novice and layman with no background in computers or electronics (I had read about home computers in several publications and was quite interested in finding out how I could put one to use). At the second store I was going to be a small businessman (about 5' tall) looking for a system, but a better situation cropped up and I didn't play that role. I walked into the third store as a typical computer hobbyist who was ready to make the plunge and buy a system.

Three stores isn't really much of a sampling, but I'll be willing to bet that most of the good and bad things I encountered can be found in the majority of stores around the country. See if you don't agree.

In looking back and trying to think of some of the good first impressions I had in the first store, I'm unable to think of any. I walked in and there was a teenager behind the counter talking on the phone. He looked just like a salesman in a computer store should look . . . surfer tee shirt, blue jeans and tennis shoes! I wandered around the store and gazed upon the dusty shelves and the equipment on them . . . and the dirty equipment, such as Teletypes and other terminals, on the floor. After he got off the phone I continued to walk around the store because he went over to visit with a couple of his friends who were playing a game on one of the computers. I was finally able to establish contact with the young man by catching his eye, motioning him over, and then asking him if the Teletype machine I was looking at "had a computer inside." I'm sure he must have been thinking, "Oh boy, I've really got one here." He went on to explain that the TTY was just a terminal for a computer as he led me over to a system. During that initial conversation he did ask what I intended to do with a computer. I replied that I had read some articles recently in the *Wall Street Journal* and *Business Week* about home computers and they had fired up my curiosity. I wanted to find out just what a home computer could be used for (you've heard that question before, right?). His response to that question was to load a game (naturally) from cassette to demonstrate the value of a home computer. I'm afraid I became bored with the game rather quickly (about 45 seconds) and asked him what else a home system could be used for. Then he really blew it! He proceeded to tell me that I could *write my own programs* to make the computer do just about anything I wanted it to. I had already established the fact that I was a total novice by asking him if the Teletype contained a computer . . . plus I had told him that I had no experience at all with computers. "No problem," he said, "let me show you just how easy it is to write computer programs, using a language called BASIC." It turned out his objective was in fact to "show me" rather than teach me. He huddled over the video terminal for a moment while he entered several BASIC statements then stood back and said, "Watch this." The entire screen immediately filled up with numbers. He explained that he had entered some kind of a whiz-bang mathematical program. I can't remember exactly what the program was supposed to do . . . but it's for sure I was supposed to be impressed by it!

I explained that what I would really be interested in would be a system I could take home, plug in, load a program from the recorder and run it. He said they did have some cassettes with several games on each one. I asked him if games were the primary use for a home computer. He asked me what I wanted to use it for. I said that I had come in there to get ideas along that line . . . not offer them . . . because I didn't really know what it could be used for. We reached an impasse.

Next step was to go over to the magazine/book rack and ask him for a recommendation for the best magazine for me to buy. He suggested *Byte!* As we were stumbling through recommendations for good books for me to buy another salesman arrived on the scene, quickly put his finger on the situation (i.e., he found who he was talking to, my "background" . . . and addressed himself to that particular background), and then came up with some decent book recommendations. He also made sure I didn't leave the store empty-handed . . . he gave me one of their brochures to take home and look over.

Let's go back and take a closer look at this whole fiasco. To begin with, I wouldn't doubt for a moment that the young man who waited on me is probably one of the sharpest programmers for miles around. Apparently the owner or manager of the store felt this qualified him for being a *salesman!* Or is it that they simply left him to "watch the place?" In either case, the big question is, why wasn't he given *some* training for the job?

I don't care if I owned a service station, a paint store, a hamburger joint, or a computer store; my employees would have the training to conduct my business in the manner in which it should be conducted! Notice I said "service" station. Don't see too many of those nowadays, do you? Regardless of the business, it should be a *service* business. And whether the employees are high school teenagers, or whatever, they can be taught how to give this service.

Most of it boils down to a lot of little things, such as, introducing yourself and asking if you can help the customer when he comes in (not 10 minutes later), taking pride in your appearance and making sure it's appropriate for the job, taking pride in the shop and dusting those shelves and equipment off once in awhile. But the biggest and most important thing is for that salesman to be able to talk (and sell) to the people coming into the store (hobbyists, laymen, small businessmen, or a guy with a Ph.D. in Computer Science). Quite often this isn't a natural ability . . . but it's something that can be taught.

Knowing the equipment and other merchandise in the store is number two (and *very* close to one!). And if that salesperson doesn't take the time and extra effort required to learn these things then they should be told to take a walk! Being a sharp programmer or sharp hardware type isn't enough. The person should be just as familiar with the general interfacing requirements of a piece of equipment as how it should be programmed. Books and magazines are good selling items in computer stores and there's no excuse for someone not being familiar with all the magazines. Trying to read all the books might present a problem though. The answer to that "problem" is for them to read the book reviews in the magazines!

I had every intention of going into store #2 with the idea of pretending to be a small businessman looking for a microcomputer system. I had a real stroke of luck here because as I sat there waiting for the owner to finish with the customer he was with, I realized that the customer *was* a businessman looking for a system! They were sitting at the end of a long conference table and I was sitting at the other end waiting . . . so I simply eavesdropped on the conversation! He was asking all the questions I had in mind . . . and more. He was the owner of a small book store and was looking for a system in the $3,000 price range to take care of his inventory and accounts receivable and payable. They finally came up with a system right at three thousand which didn't include a hard-copy device.

I was very anxious to talk to this gentleman about his experience in the store so I went outside and waited for him. He came out . . . I introduced myself . . . and we had a very nice chat. One of the first things I asked him about was the software they had offered with the package. Seems the only thing they had to offer were the books from Scientific Research loaded with pages upon pages of listings of business programs in BASIC. I asked him if the store had any kind of an after-sales training program. He said they didn't. I've had several phone conversations with this gentleman since our first meeting and he has now visited six stores in the L.A. area in search of a system. He still hasn't found it.

As I mentioned before, I went into the third store posing as a hobbyist who was ready to make the plunge and buy a system. I liked the appearance of the store very much (carpeting, display cases, clean equipment, classroom area, etc.) and I enjoyed the treatment I got at the hands of the owner . . . with one exception. When I started asking him about what system I should buy he did what I've come to believe is a very natural thing. He took me over and showed me a *game!* Arrgh!

Don't get me wrong. I like games. I think it's great the way they get kids turned onto computers. I enjoy playing them myself. But . . . there's a lot more to all of this than just games. I would dearly love to walk into a computer store and have someone demonstrate a neat educational program (or two, or three), a home accounting program, small business accounts receivable and payable, billing, inventory, music generation, voice synthesis just to name a few (and what the heck, maybe even a couple of games!).

I think the lack of low-cost business software is a sign of the times . . . it's still just a little bit too early. Undoubtedly, there are a number of people out there working on the development of this software. Probably the best bet for a computer store is to get to know some of the sharp software types in the area and work out an arrangement for the development of these programs (to the mutual benefit of all concerned . . . the store, the programmer, the customer and the advancement of personal computing).

I really don't think there is any reason for all the heavy emphasis on games for demonstrations. Then where are the stores, or anyone else, going to get these other demo/applications programs? A lot of them can be taken right out of the pages of this magazine!

The lack of salesmanship training I noticed in that young man in the first store was not an isolated example. I've noticed the same situation in visits to other stores. So why am I even concerned about it? It's no skin off my nose if that computer store goes broke, right? Wrong. The failure of a computer store means one less place for people to go see, and discuss and buy personal systems. Every time that untrained individual turns off a prospective customer we're all losing.

Let me go back to the analogy I mentioned earlier: When I was a kid I used to work in a *service* station and I wasn't just a money collector like we see standing around in most *gas* stations today. I was a *salesman* and that was simply because someone took the time and effort to show me how to be one. Plus, I cared.

## What's This?

I just heard something interesting. Someone was telling me how they submitted an article to one of the other magazines and they *accepted* it, but didn't *buy* it! They were told the article would be used sometime in the future "when space could be found" and that the author would be paid when it is published. Ridiculous! They don't have any claim to that manuscript whatsoever. Get it back . . . send it to us . . . and let's see if it belongs in *KB*, okay? If it does, it certainly shouldn't be sitting in some editor's file "waiting for a space."

## Letters to the Editor

I really love the letters section. The feedback (good, bad, or whatever) is always interesting. Unfortunately, we only have so much space and there are a mountain of letters left over at the end of each month which I couldn't fit in. I make every effort to answer all letters and I'm just sorry there isn't more room for publishing all those we receive.

It's also very sad to get really interesting letters which are *handwritten!* We can't retype those letters . . . no matter how good they are. And, we can't hand them to the typesetters if they're handwritten (period). If you've got something of great interest that you really want to share with people through the letters section then please type it with double spacing, okay?

## Midwestern Affiliation of Computer Clubs (MACC) Computerfest

Look out Cleveland! The MACC is holding their second annual computerfest there on June 10th, 11th and 12th (in the Bond Court Hotel).

The MACC is an affiliation of 13 (or more) clubs in the Midwest who seem to have a knack for getting things organized and done right. Last year's computerfest was a booming success from all the accounts I've heard. *Kilobaud* will have a double booth there. Drop by and see us!

For more information contact John P. Colket, MACC, PO Box 83, Brecksville OH 44141. (Hope they have some booths left!)

## Looking Back – June 1975

A rather significant month for the computer hobbyist movement . . . two of the largest organizations in the country were formed and the first steps in getting the first national publication were taken.

The first meeting of the Amateur Computer Society of New Jersey was held June 13th in Scotch Plains, New Jersey. The meeting was attended by 32 people . . . Sol Libes was appointed president . . . and everyone had a good time. Today their organization numbers up in the hundreds . . . Sol Libes is still president . . . and I hope they're still having a good time (I wouldn't know . . . I don't make too many of their meetings).

This month also saw the beginning of the Southern California Computer Society. The society was the brainchild of Pearce Young, a superior court judge, and Don Tarbell, a computer systems engineer. The first

*continued on page 20*

# The BASIC Forum

*John Arnold/Dick Whipple*

Since the last BASIC Forum, we have received some correspondence concerning our original question – the Standardization of BASIC. Most of the comments received thus far have come from readers with wide experience in programming languages. This was to be expected, since newcomers to computing and BASIC are probably not in a position to form definite conclusions. Rather than paraphrase the various letters, we thought we would publish substantial portions of a couple of the best we received. We will reserve our comments until after you have read these reader responses.

---

**From Sigurd Andersen, Elkton MD 21921** . . . A comment on Dr. Kemeny's view of structured BASIC – I heartily disagree. I have been programming since I was 16/17 (in 1965), using a language called Intercom 500 on a Bendix G-15. Since, I've worked mainly with FORTRAN and have used APL (I love it), BASIC, some PL/I, etc. In the past few years I have learned how valuable a structured orientation is to writing good programs. A language designed to be structured makes the job much easier.

With BASIC, however, not only are there poor conditional (IF-THEN-ELSE) and limited iterative (FOR-TO . . . NEXT) structures, as also occurs in FORTRAN, but also there are no (standard) ways of writing separate modules (SUBROUTINES, FUNCTIONS) with independent, local variables and argument lists. In this instance, FORTRAN is much better than BASIC, although some versions of BASIC (of those I've used) do have limited use of argument lists.

This statement comes after spending over 5 out of the last 12 years (on and off) as a programmer. When I look back even two or three years to the programs I wrote then and considered good, I realize how important structure is.

---

**From James L. Larsen, American Data Services, Inc., Salt Lake City UT 84111** . . . The right way to standardize BASIC (and probably the only way that could really work) is to scrap the language and start over. BASIC had its place at Dartmouth, and it taught all of us that programming can be fun, interesting, even stimulating. But, let's face it, BASIC has outlived its usefulness . . . I have taught BASIC and am familiar with several versions (including PDP-11, Univac, RTB from NYU, and HP3000), and I have found one fault common to all versions: That is that each one started with a simple language designed to teach FORTRANish programming methods, and then each one tried to add features to make the language more useful, but unfortunately added features can't hide the foundation which is essentially pre-1960. Now of course, the major deficiencies of BASIC could be overcome. One could add longer variable names, block structure, local variables, and procedures with parameters (and some designers are doing just that), but such additions would only add more confusion and make the new versions even less compatible with previous and current versions.

What we need to do is decide what has made BASIC so popular and then design a new language that better fulfills the needs of easy programming on small computers. My own suggestions are:

1. The popularity of BASIC depends on the easy editing of programs, the easy debugging (because of interpretive implementations), and the low cost (because of time-sharing). Secondary factors have been the easy I/O and file handling and the fact that a small subset (like MICRO-BASIC) can be easily implemented on a small computer and still be useful.

2. A block structured (ALGO-like) language could easily be designed with the above features. In fact a language like PASCAL could easily become the most popular general purpose computer language (and I think better than PL/1) if it had those features.

3. I propose the development of such a language along these lines:

a. It should be designed at three different levels simultaneously. A level suitable for micro implementation, one suitable for mini implementation and one suitable for the largest mainframe implementation. Each level must be upward compatible with the next level, and each level must be consistent.

b. BASIC type I/O and file handling should be used (or something just as simple).

c. APL type (or COBOL type) handling of structured data should be included.

d. PASCAL/COBOL/PL/1 data structures should be available.

e. PASCAL control structures should be used.

The highest level of this language would compare to COBOL or PL/1, and the lowest level would compare to N. Worth's PL/0 (with the addition of arrays). If such a language existed (and I belive it's possible today) computer manufacturers would be less likely to deviate from its standard form, and everyone from hobbyists to system designers would have a tool they could all understand and use.

4. The hobbyists will have to take the initiative since systems programmers and manufacturers seem to be delighted with the present confusion and complexity of languages.

I'm not antagonistic towards BASIC; we do about 90% of our programming in HP3000 BASIC, but if we are going to talk about standardization, we should first consider if it is worthwhile to meddle with a language that is bound to be inadequate for future programming methods.

---

After reading these two letters, the newcomer to personal computing might question the worth of learning BASIC. While many of the points brought out are certainly valid, there is another side to the issue we think you should hear. Around the country are literally thousands of people who are quite happy with BASIC and who use it to advantage in writing programs. On the whole, they seem to be unaware they are using an inferior language.

The present quandary over BASIC's suitability as a language for computer hobbyists strikes us as more an academic question than a truly practical one. I (D. W. speaking now) am reminded of a similar situation that occurred a few years ago regarding FORTRAN. I was in the middle of my college years at the University of Houston. My very first programming course was set for the fall and was I excited! At last I would learn about those fantastic computers and get a chance to work with one. The first few weeks of the course were spent introducing the FORTRAN language. I vaguely recall a few remarks sprinkled here and there that, despite FORTRAN popularity as a scientific language in industry, it was doomed to failure because of certain inherent weaknesses. (For those with some knowledge of FORTRAN, two weaknesses I remember were: 1. no zero or negative array arguments and, 2. no noninteger indices in DO-LOOPs.)

*continued on page 20*

# NEWS OF THE INDUSTRY

*470B Floppy Disk from OSI.*

### New Products From OSI

The OSI Challenger is the first fully assembled mainframe computer which is priced competitively with hobby kits. This 8-slot tabletop unit with UL approved power supply comes equipped in its smallest configuration of serial interface, 1K RAM and PROM monitor for $439. Video systems which do not require an expensive terminal, start at $675.

The Challenger is now supported by thirteen accessory boards available bare, in kit form, and fully assembled. Challenger peripherals now include single and dual drive floppies, cassettes, a keyboard, and a video display unit. Software now includes as assembler, a small and a large BASIC, a disk operating system, an extended monitor, several games, and several real time analog and graphics packages.

### 470B Floppy Disk

The 470B is an upgrade of OSI's popular 470 floppy disk. The new disk features a GSI model 110 disk drive for 240K bytes single density storage or 480K bytes double density storage. The new disk also features a head load indicator and a prefabricated fifty line interconnecting cable. The introductory special for the 470B is $599 for a fully assembled drive and cable harness, 6502 disk operating system, and controller board in kit form.

The drive is also available fully assembled for OSI Challengers including matching case and power supplies for $990. OSI's floppy disk bootstrap PROM allows the owner of any OSI system to use his floppy disk immediately on power up and is available for $29 with either version of the 470B.

For further information contact Ohio Scientific Instruments, 11679 Hayden Street, Dept. S, Hiram OH 44234.

### 6502 8K BASIC

OSI's new 8K BASIC for the 6502 was written by Microsoft, the people who wrote Altair 8K BASIC for the 8080. OSI's 6502 8K BASIC is identical to this powerful and popular 8K BASIC with two very important exceptions: our OSI 6502 8K BASIC has automatic string space handling, and it runs faster. Up to 8 times faster than the 8080 BASIC. And hundreds of times faster than many 6800 BASICs.

In fact, the OSI Challenger with OSI 6502 8K BASIC can actually outperform most small and medium-scale minicomputers, as well as every micro there is! And that includes the Z-80.

Perhaps even more amazing than its superlative performance is its surprisingly low price: either $50 or free. OSI 6502 8K BASIC is available to OSI System kit-builders for $50, on your choice of paper tape, audio cassette or floppy disk. And OSI 6502 8K BASIC comes *free* with the purchase of any 12K or larger OSI Challenger.

### Auto-load Cassettes

A full set of software is available on cassette for use with any 6502 system equipped with OSI's 65V PROM monitor. Through the use of this monitor's load command, these cassettes automatically generate a complete operating system in the computer including CRT routines, keyboard routines, cassette I/O and the program of interest. Thus, the user simply turns the computer on and types an "L" at the keyboard – the cassette does the rest!

Programs now available include: Tiny BASIC for 4K and 8K computers, 6502 Resident Assembler, an Extended Monitor, "Life," a Graphics Editor, some games and OSI's new 6502 8K BASIC by Microsoft. Prices range from $5 to $50 including manuals.

### New Floppy Disk For Altair-Imsai S-100 Bus

Peripherals Vision has announced a full-size floppy disk for the Altair-Imsai plug-in compatible S-100 Bus is now available with prices starting as low as $750 for the interface card kit and assembled and tested drive. A 24 volt at 2 Amp power supply is also available in kit form for $45 or assembled for $65; and a cabinet is offered for an additional $85.

The floppy disk interface card supports 8 drives and stores over 300,000 bytes per floppy. A bootstrap EPROM is included to make system startup automatic. The floppy is completely S-100 plug-in compatible, and interface cabling is included.

The floppy disk drive is from Innovex (the originator of the floppy concept) and comes assembled and tested. A disk operating system with file management system is included on the floppy. For details contact Peripheral Vision, PO Box 6267, Denver CO 80206.

### Text Editing System

The new TSC Text Editing System for the 6800 microprocessor is the most extensive text editor available to the micro user. It supports many of the standard commands, such as PRINT, INSERT, DELETE, FIND, REPLACE, and

*Peripheral Vision's new full-size floppy disk.*

# POPULARITY EXPLOSION!


**JUPITER II A**
**6800 System**
**$795**

ASSEMBLED

**JUPITER III A**
**Z80 System**
**$865**

ASSEMBLED

If you thought the quality of a wire-wrapped system was beyond your price range — Take a look at what we have now!

The Jupiter IIA and the Jupiter IIIA Basic computer systems. You get the system module cage with fully assembled backplane, fully assembled plug-in ferro-resonant power supply, front panel and your choice of 6800 or Z80 CPU module. All less than the price of the two best selling 8080 systems!

Plus you can choose from the fastest growing selection of memories and peripherals available from any manufacturer, like our 2KB EPROM/4KB RAM/serial RS-232 module and our new 1024 character video module. Both can transform your basic computer system into a real star.

And remember, all Wave Mate products meet the highest quality industrial standards, with rugged construction unmatched by anyone! Join the popularity explosion and get yours now! Write or call for more info and your closest Wave Mate authorized distributor.

You get your choice of microprocessors!
And you get wire-wrapped modules too!

Now you have a low cost way to get started into personal computing without sacrificing future growth capability!

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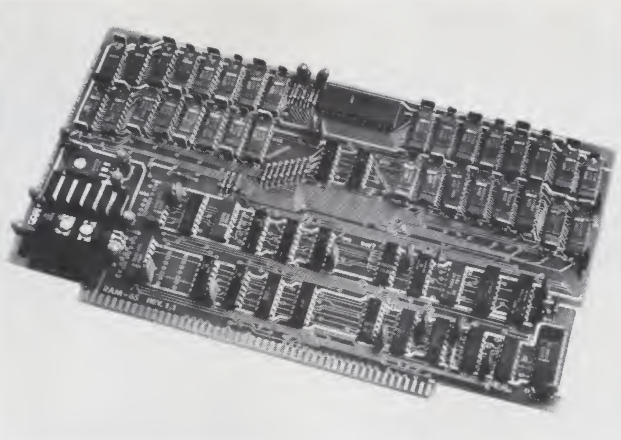
VERIFY. Convenient pointer movers are provided for file TOP and BOTTOM, an APPEND command allowing any string to be appended to any or all lines starting in a specified column, text block COPY and MOVE are easily performed with a single command, and a very extensive CHANGE command allowing one to change any or all specified occurrence of one string into a second string.

Other features include, tab character definition, TAB column set, special character SET command, line NUMBERS on or off, and EXPAND tab character commands, easy pointer positioning using the NEXT command, a RENUMBER command, auto line numbering, STOP and LOG command, as well as a unique OVERLAY command, allowing the user to conveniently change a line by typing over an existing line.

This list is not complete, but shows the completeness of the TSC Text Editing System. As with all TSC software, a complete source listing, hex dump listing, sample output, and complete users manual are all provided. The price for all this is only $23.50 and delivery is from stock. Order number SL68-24. For further information contact Technical Systems Consultants, Box 2574, W. Lafayette IN 47906.

### World's First Megabyte Memory System



*65K RAM Board from Imsai.*

Imsai Manufacturing Corporation announces the world's first megabyte memory system for microcomputers. System modules offered at this time include: 65K, 32K and 16K RAM boards controlled by Imsai's unique Intelligent Memory Manager (IMM).

The Imsai megabyte memory system is a complete memory system for the Imsai 8080 and other Altair bus computers. It consists of the RAM-16, RAM-32 and RAM-65 dynamic memory boards and intelligent memory manager (IMM) controller board. It may be implemented in a variety of configurations ranging from a single board 16K byte conventional memory to a 17-board one megabyte system with an Intelligent Memory Manager/interrupt controller. Larger multiprocessor systems may be implemented by using multiple Imsai mainframes and the Imsai Shared Memory Facility. Shared memory blocks can be up to 65K bytes and each processor can address up to one megabyte total of shared and local memory.

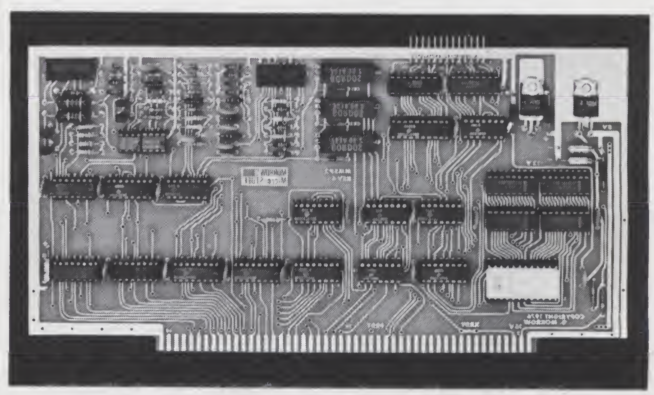
The RAM-16, RAM-32 and RAM-65 are 16K, 32K and 65K byte low power dynamic memory boards respectively. They may be used alone or in combination to form a conventional memory system of up to 65K bytes. With 400 ns access time and "hidden refresh," no wait states are required when accessed by the MPU. (One wait state may occasionally be required for refresh when accessed by some DMA controllers.) The address of each 16K byte block is individually selectable. Provision is included for read and write-protect and expansion to one megabyte when used with the IMM controller board.

The IMM is an Intelligent Memory Manager/interrupt controller board. It provides for memory expansion to one megabyte, write protect for each 1K block in the extended space, read protection, fully vectored interrupts, "time of day" clock and real time clock.

The memory modules are offered in both assembled and kit form. Prices are as follows: 65K RAM Board Kit $2,599, assembled $3,899; 32K RAM Board Kit $749, assembled $1,099; 16K RAM Board Kit $449, assembled $679; IMM ROM Control Kit $299, assembled $399; IMM EROM Control Kit $499, assembled $699.

For more information contact Michael Stone, Imsai Manufacturing Corporation, 14860 Wicks Blvd., San Leandro CA 94577.

### Cassette Interface — I/O Board



*Morrow's combined cassette interface — I/O board.*

Fully compatible with the Altair bus and "Kansas City" standard data format, this board links your computer to three inexpensive audio cassette machines for mass memory applications (including sort and merge operations). A serial port allows simultaneous communication with a Teletype incorporating reader control, as well as any RS-232 serial device (such as a Modem or video terminal); a general purpose, 8-bit parallel port with handshaking signals accommodates such devices as an ASCII keyboard or tape reader. The board carries firmware in ½ Kbyte of p/ROM, which stores all routines needed for cassette interfacing, UART simulation, and data transfer between the microcomputer's memory and the ½ Kbyte of onboard RAM.

Buffers isolate internal data paths from the bus; onboard regulation simplifies power requirements. Available both in kit form $120) and assembled/tested/warranted ($165) by mail or from many computer stores. Includes documentation. Available from stock. For further information contact Morrow's Micro-Stuff, Box 6194, Albany CA 94706.

### The Digital Group

An ever-growing number of software packages designed for all levels of support is being offered by the Digital Group for the company's line of microprocessor systems. For only $5 each, they offer Tiny BASIC Extended and a cassette full of game programs. Both are on audio cassette that the Digital Group system can read. Programs can be displayed on the system's video screen. Other software programs

include six volumes of Tiny BASIC games, including Chomp, Checkers, 20 Questions, Chief and others; "Galaxy," and Z-80 packages including Educator, Assembler, Dis-Assembler and Text-Editor. Prices range from $5 to $15.

Digital Group systems are complete and specifically designed to be easy to use. With video-based operation, all that is required is turning power on and loading a cassette.

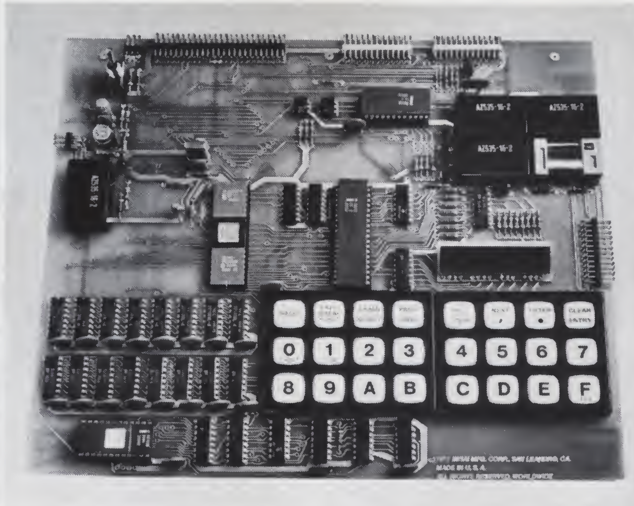
All components are available with custom cabinets, and prices start as low as $475 for a Z-80 based system. Details on all Digital Group products – hardware and software – are available by contacting the Digital Group, PO Box 6528, Denver CO 80206.

## New Control Computer

*The Imsai 8048 Control Computer,* a complete control computer on an 8½ x 10" board, is based on Intel's new 8048 micro computer chip. It is the *world's first* single chip control computer that contains all of the following features:

1. 8-bit CPU.
2. 2.5 microsecond instruction cycle, 96 instructions.
3. BCD arithmetic capability.
4. 1K words of ROM or compatible EPROM program memory.
5. 64 words of internal register memory.
6. 27 I/O lines.
7. Internal timer/event counter.
8. Oscillator and clock driver.
9. Reset circuit.
10. Interrupt circuit.
11. Uses single 5 volt supply.
12. TTL compatible.

In addition, to create a one board user programmable controller suitable for use with model railroads, energy conservation systems, ham radios, household appliances, lights, light shows, and a myriad of other applications, the following system features have been added:




*Single Chip Control Computer from Imsai.*

1. Cassette Interface.
2. Serial I/O (RS232, current loop).
3. 5 relays capable of handling 2 Amps at 220 volts, 3 Amps at 110 volts, or 5 Amps at 24 V dc.
4. 1K (optional additional 1K) of user programmable program memory.
5. DC power supply or battery operated.

The Intel 8048/8748 microcomputer chip is designed to accommodate three separate and unique memory spaces: Program memory, Internal register memory, and External RAM (Random access memory).

The Control Computer comes in two different versions. In one version, the system monitor will be contained on the 8048 chip itself (ROM version). In the other, the system monitor will be contained on an Intel 8716 2K EROM. Both versions will contain the same 64 byte internal register RAM and 1K of external memory with space for an additional 1K of external memory.

The Control Computer provides the following functions: Enter programs into program memory; enter data into both internal and external memory; examine any memory location, internal or external; execute a user program in stand alone mode; execute a user program with software breakpoints for debugging; save/retrieve user programs on cassette tape; save and retrieve programs from serial port; e.g., Teletype paper tape reader.

The Imsai 8048 Control Computers are offered in both assembled and kit form. The ROM version is $249 kit and $299 assembled. The EROM version is $399 kit and $499 assembled. The Five Volt Power Supply is $99.

For more information contact Michael Stone at Imsai Manufacturing Corporation, 14860 Wicks Blvd., San Leandro CA 94577.

## KIM Software Contest

1st Prize – KIM-3 8K Memory Expansion Board (value $289).

2nd Prize – KIMROM-1 Resident Assembler/Editor ROM set (value $150).

3rd thru 10th Prizes – KIMath Source listing and User Manual (value $15).

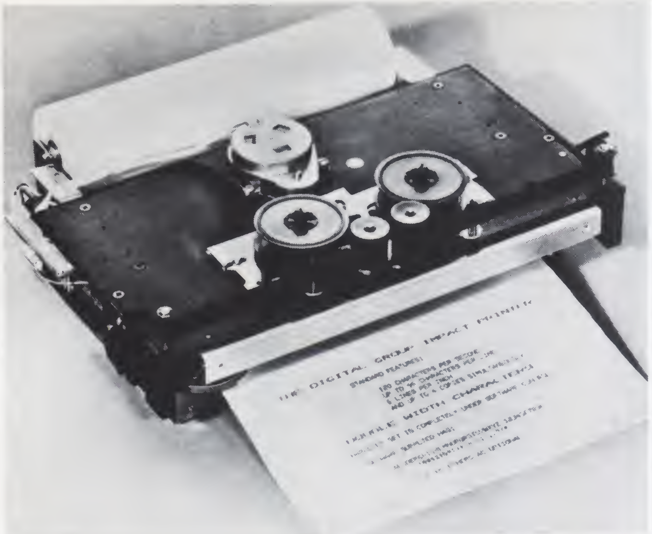
The KIM programming contest is open to all KIM owners and users. All entries must contain program documentation and source code listing (hand assembled source is OK). All entries become the property of MOS Technology, Inc., and will be turned over to the KIM Users Group for possible publication. Additional prizes may be awarded for noteworthy programs by beginners. Prizes will be awarded August 1, 1977. Entries should be sent to KIM Software Contest, MOS Technology, 950 Rittenhouse Rd., Norristown PA 19401. Entries will be judged on the basis of originality and usefulness to the user community. If external hardware is required, a schematic should be provided. Complex programs taking more than 1K of memory, such as high-level languages, assemblers, cross-assemblers, text editors, etc., will be awarded a duplicate first prize if accompanied by working source tape or cassette. All entries must be received by July 1, 1977.

## 8080 Disassembler and 8080 trace Programs

Designed to run on an 8080 based machine, one program disassembles 8080 object code, producing a "source" listing in format identical to that produced by an Intel Assembler, as well as an ASCII listing of the object code and a symbol cross reference listing.

Designed as a teaching and troubleshooting aid, the other program resides in memory with the subject program, which is executed under trace control. The machine condition is displayed after each subject instruction is executed. Display includes instruction address, instruction in machine code (hexadecimal) and mnemonic, contents of all registers, and latest stack entry.

Both the *Disassembler* and Trace programs are available on iCOM Floppy Disk or punched paper tape in Intel Hex-ASCII object format at a cost of $250 each, or $400 for both. Programs are specialized to run on user's equipment and updates resulting from continuous program improvements are automatically sent to purchasers of Cybergrafix Software. For further information contact Cybergrafix, PO Box 430, Glendale CA 91206.



*The Digital Group's impact matrix printer.*

## Full-Size Impact Matrix Printer

A full-size impact printer, designed for use with microcomputers, is an affordable printer available for computer hobbyists and the small businessman. Kit prices start at $495 for the printer and interface card.

The printer is fast, printing 120 characters per second with 96 characters per line, 12 characters per inch horizontal and 6 lines per inch. It makes up to four copies simultaneously.

The character set and pitch are variable under software control, allowing for double width characters, different width characters within the same line, etc. The printer has a 5-by-7-inch character matrix, and the ribbon has built-in re-inkers for a life of 10,000,000 characters. Paper can be either a standard 8½ inch roll, fanfold or cut page. The printer interfaces to 8-bit parallel ports.

For further information contact the Digital Group, PO Box 6528, Denver CO 80206.

## New Products From IDS Frequency Counter Module

The 88-UFC is a universal 9-decade frequency and interval counter. The 88-UFC is completely contained on one pluggable printed circuit board which is compatible with Altair/Imsai and S100 bus computers. All features and functions are software controlled making remote programming and reading possible for process control applications if the computer is equipped for data communications (such as 88-Modem).

## Temperature Sensing Module

The TSM Temperature Sensing Module is a self-contained peripheral device for use with any computer system. Interface requirements are a single TTL level parallel input bit for data transfer from the TSM to the computer and an optional TTL level parallel output bit which is used by the computer to turn the TSM on and off. The TSM may also be used with the IDS 88-UFC Frequency Counter Module in which case a parallel input bit to the computer is not required. The TSM provides measurement of frequency over the range 0 to +120 degrees farenheit (-18 C to +49 C). Resolution is better than 1 degree. Applications for the TSM include measurement of ambient inside and outside temperature for computerized climate control systems, automated weather observations, and monitoring of operating temperatures of equipment.

## Digital to Analog Converter

The DAC-8 is an eight bit digital to analog converter for use with any computer system. Interface requirements are a single latch 8 bit TTL level parallel output port. The DAC-8 is designed for use in applications requiring the generation of audio frequencies between 0 and 20,000 Hz and applications requiring 8 bits of resolution for analog voltage control. Applications include speech synthesis, music synthesis, and control of voltage controlled devices (such as voltage controlled oscillators used in music synthesizers).

## 88-Modem Module

The 88-Modem module with auto dialer allows your computer to originate or accept data transmission to or from remote computer systems or terminals at 300-600 baud. The system is compatible with Bell type 103 data sets and can originate or accept data from these sources at 300 baud. When communicating with other 88-Modem modules rates from 0 to 300 baud are possible.

For further information contact International Data Systems, Inc., 400 N. Washington St., Suite 200, Falls Church VA 22046.

## Des Moines Computerfest

The 1977 Hawkeye Ham and Computerfest, slated for August 20 and 21 under the sponsorship of the Des Moines Amateur Radio Association, will be held in Des Moines, Iowa, at Camp Dodge. Four buildings have been set aside for the fest including a theater for presentations by manufacturers of radio and computer equipment aimed at hams and electronics hobbyists.

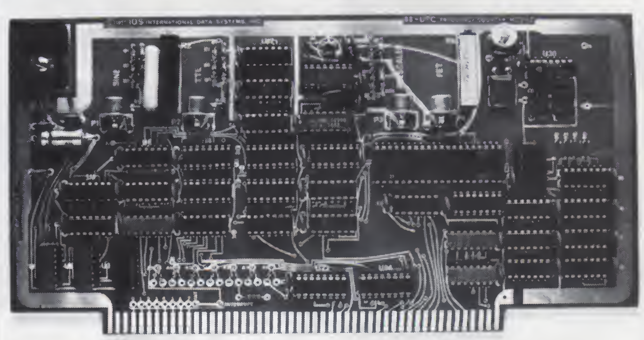
The public is invited to attend the 8:30 am to 4:30 pm sessions each day, which we hope will be highlighted by technical talks, equipment and parts displays and a massive flea market. Other agencies with which the DMRAA works in public service projects, also have been asked to participate. There will be a communications display by the IA Army National Guard, and the Des Moines Police will have their new $30,000 crime prevention van there as well.

For more information contact Charlie Corcoran, DMRAA, Box 88, Des Moines IA 50301.

## New Orleans Computerfest

The Jefferson Amateur Radio Club and the Crescent City Computer Club would like to announce the New Orleans Hamfest/Computerfest which will be held at the Hilton Inn in Kenner LA (directly across from the New Orleans International Airport) September 24 and 25. This is the ARRL Delta Division Convention for 1977 and is the largest "Ham" outing in the deep south. This will not only be the largest Com-

*continued on page 20*



*Frequency Counter Module from IDS.*

# Letters to the Editor

## Computer Chess Newsletter

There is now a computer chess program available in BASIC, plus one for the 8080 plus one for the KIM. Also, 2 chess-playing machines have been announced. Each year there is a US Computer Chess Tournament, in which programs play against each other, and in some years an International Tournament. And on many campuses and elsewhere, people are writing computer chess programs.

Despite this great rise of interest in computer chess, there has been no medium of communication among devotees of computer chess. Some articles appear in the newsletter of the Special Interest Group On Artificial Intelligence of the Association For Computing Machinery, and others in a British journal, but these are not accessible to the average reader.

So, having tried to get others to do it, I decided to follow the example of Hal Singer's Micro-8 Newsletter, and start a Computer Chess Newsletter. No issues have yet appeared, and no price, size, or periodicity have yet been determined. This must depend upon the response. The content will come from the readers.

This is a plea for contributions. Write a letter. Have you ever played chess against a computer program? What machine? What program? What did you think of the program? What about the presentation of the board and moves? Could you suggest improvements? Have you ever thought of trying to write a chess-playing program? If so, how did you get started? Have you kept a record of interesting games played against a program? These are of interest to chess players.

Tutorial articles are especially needed. If you have had any experience, tell us about it. All sorts of comments, suggestions, news reports, reports on articles about computer chess – anything related is welcome.

Most computer chess programs are worked out independently. Perhaps by sharing information, comparing programs and program philosophies, etc., the state of the art could be advanced more rapidly. And certainly more interestingly.

To show that this sort of thing is not beyond the range of the computer hobbyist, the KIM program occupies only 1100 bytes! And the program of John Ford of Santa Maria, California runs on a 4K byte 8008. The program is in two parts, an opening part which then calls in the second part into memory from cassette automatically.

A number of chess-playing programs are available on computers on campuses and time-sharing systems. If you have tried them, tell us about it. Please write something for the computer chess newsletter.

Anyone interested in receiving the first issue should send a letter enclosing two 13¢ stamps to defray costs for the first try.

Doug Penrod
1445 La Cima Road
Santa Barbara CA 93101

## Random Criticism

The random number generator in the article "Submarine" in the February Kilobaud is technically incorrect and is no good for playing blackjack or "some serious jobs."

The author starts with a tried and proven method but he changes it and fails to warn of pitfalls so the result is wrong but the user may think his results are satisfactory.

Publishing material like this is worse than not publishing at all.

Charles C. Worstell, PHD.
Auburn WA

*I've been known to make mistakes . . . but Pete Stark? Never! By the way, don't you write for Byte Magazine, Charles? – John.*

## More Math!

I just finished reading Glen Charnock's letter in *KB* #4 p. 115 on Big Bad Math. I couldn't agree more!!! Even though I only have a rusty BS in Engineering, I'm not afraid of math. In fact I'm hungry for it. Now that I finally have a BASIC-speaking computer waiting on me, I find myself at a loss. I'm tired of playing Galaxy, Tic Tac Toe, Kingdom, Where's the Whatsit – etc. I want to put this gizmo to *work*. I can't find a serious problem that takes more than a few seconds to complete. Surely there are interesting, useful, and challenging math problems that are not routinely solved merely because they take too much iterative number crunching. That's just the kind I want to tackle. I even went to the local college library and borrowed some books on numerical analysis and the approximation of functions. Unfortunately, they were published when computers were called "automatic calculating machines" and they do no more than mention that certain functions can be solved by them.

I'd be extremely interested in an article or series on how to implement different equation solving schemes in BASIC.

Verlynn J. Johnson
Storm Lake IA

## What's A DPUG?

The acronym stands for Diablo Professional Users Group. It has been meeting at Diablo Valley College on the 4th Wednesday of each month since November.

The Professional referred to includes two categories. One, the novice in computers – who's an expert in some other field (where he makes his living). Two, the expert in computers – who can provide the answers to the first. (For you budding technical types, here's your chance to get in on the ground floor of microcomputer consulting; the novices you'll meet represent a gamut of various industries and professions. They are looking for those with practical knowhow. And in case you don't recognize yourself, you're in the consultant category even if you're a high school or college student – but have been involved in the hardware and/or software uP scene for several years.)

Meetings are held in the College library large conference room from 8-10 pm, on the 4th Wednesday of each month (March 23rd, April 27th, May 25th, etc.) DVC is near the Willow Pass exit of Freeway 680. For details write or call: Bob Hendrickson, Electronics Dept. DVC, Pleasant Hill CA 94523; (415) 687-8373.

Wm. J. Schenker, M.D.
Chairman pro-tem
Walnut Creek CA

*Wow! What a fantastic idea! This is just the sort of thing that all the clubs and stores around the country should be getting into . . . bringing the small business systems designers and developers (the hobbyists?) together with the people who are going to be buying those systems. The exchange of information between those two groups would be most interesting* and mutually beneficial. – *John.*

## PC Board For Prudhomme's Scope Mux

Just a short note about Bill Prudhomme's 8 channel scope mux, (April issue). In the schematic on page 31, it would work much nicer if pins 4 & 8 on the 555 were shown returned to +5 reg. Luckily, the PC board is OK.

Definitely count 1 interest in a CMOS version. I won't even try to build the TTL version till I see if Bill will do it in CMOS.

If there is enough interest, I will have boards available (undrilled or drilled, single-side, G-10, unplated). Cheap, too. I don't make a living doing boards, it's just a part of the hobby.

Keep the software coming – going to sit down now and learn how to sort!! (Page 34 April).

Al Klein W2PMX
Miller Place NY

### Dairymen and Computers

I have a question relating to a small computer applications problem. A dairy farmer friend of mine wants to keep records for his cows (about 200) feed, milk output, butter fat content, etc., and be able to call them up on a CRT in his milking barn with a graphic display (for a 30 day period). Then enter new data as he collects it while milking (milking system carosel automated). He would also like to have a hard copy printout.

Can you have someone with an Altair quote a system that would accomplish this? I have some experience with the BASIC language and could probably handle the programming.

Les Hamilton
Electronics Instructor
Illinois Valley
Community College
Oglesby IL 61348

*I sincerely hope you come up with the hardware combination you're looking for, Les. And after that software is developed I'd like very much to see it because I have a very good friend who is a dairyman (and I've been telling him for years how much better things would be if he had his own computer system). Besides, it would make for a good article. – John.*

### Sustaining Oscillations

I found Mark Borgerson's A/D converter hit the nail on the head (*Kilobaud* #3). I predict the Borgerson converter will be seen in many projects to come.

I would like to propose that you change the name of Dick Whipple/John Arnold's column to "The Altair BASIC Forum" and find someone to write a regular column on BASIC with broad appeal. Perhaps ANSI X3J2 standard BASIC may be a better reference than MITS 8K.

I also notice feedback to John is so delayed, it is too far out of phase to sustain oscillation.

Richard Wright
Tiffin OH

*What kind of "oscillation" did you have in mind? – John.*

### The "Secret" Good Guys

I am about one-third of the way through the second issue of *Kilobaud* . . . it takes me longer to read it than any of the other half dozen computer related magazines I get every month, because everything in it seems to teach me something.

I have had my own personal computer for nearly 18 months now, and most of the time it is on line, doing something. I must have a very good one, because in every magazine and flyer that I receive (including *KB*) someone is taking a cheap shot at it. Or the company that makes it. Or the lack of support that other people that bought my particular brand of micro receive. And on and on.

Ya know something, gentlemen? Mine works!! And I've learned quite a bit about this particular brand of micro in the process. The two problems I had with mine when I first assembled the kit were quickly and courteously solved over the phone with a $2.70 call to the manufacturer. All my correspondence with this company has been answered within two weeks. Some of my questions were rather involved. No matter, the answer came back in English, not computerese. Even though this company has grown quite a bit since I first purchased their "box," I still feel that they deal with me as a person and a customer rather than a purchase order number.

My micro may be out of date by 1977 standards. I am holding off buying any more goodies for mine until I see an updated CPU board and a disk system that is somewhat more up to date than the one currently offered by this particular company. (I also want to see it debugged first as well). But when this company does come out with what I am looking for, I will probably buy it from them.

You see, I have some confidence in what they sell. I feel comfortable with their products. My past experience with their products is very favorable. I *like* doing business with them.

Perhaps I was overcharged for their product. Perhaps I was a sucker to pay what I did for their software. After all, I was offered the same software bootleg for quite a bit less. And as I said, it can't be a very good product, I see constant criticism of it in the magazines. Yet somebody out there must feel as I do, because my brand of micro continues to sell very well, thank you. Is it possible that for all of it's bad points (and I know it has some) it is basically a good product? That works when it is assembled right? And does what it is advertised to do?

The true test of any product is in the marketplace. When the dust has settled and some of the manufacturers (and computer stores) fall by the wayside, I'm betting that mine will survive. Just as I know that *Kilobaud* will. I have confidence in both products . . . my micro and *KB* (read that Wayne Green).

Anyone who wants more information can send me a letter with an SASE and I'll be glad to relate my experiences with this particular manufacturer.

M. Douglas Callihan
Berkley St. RFD 1
Berkley MA 02780

*Ah, you don't want to send him a letter to find out what company he's talking about! Doug really had me sitting right on the edge of your seat all the way to the end . . .* then *he wouldn't reveal the name of the company! I thought that was pretty dirty and I wrote and told him so. He replied that he's the proud owner of a MITS Altair 8800 but he was afraid of making his letter "sound too commercial." We're all so quick to criticise . . . seems we should be just as quick (and generous) with the praise. – John.*

### Thoughts On Software

A few comments on this new field of yours that I've gotten interested in. Namely, microprocessors. I'm a Ham and I've had a great deal of experience in electronics, including ICs, but no software at all. I guess that puts me in the same class as a lot of other would-be computer hobbyists. I'm also an author of sorts and I've sold Wayne a couple of articles. I'm working on an IC breadboard series that I think he can use. You might even hear from me if I can find the time.

How about a Hints and Kinks type feature for ideas that aren't long enough for an article but don't really belong in the letters section? Payment in books or subscription extentions might bring in a lot of small but valuable ideas.

A few thoughts on software: I'm just getting my feet wet but it seems to me that we are doing a number of things with hardware that could more easily be done in software. Maybe that is because we have more poeple who understand the equipment than we do who understand programming. I see comments that this gadget or that will save memory by handling this routine or that. Memory is cheap and getting cheaper — the processors are getting better and faster all of the time. I'm aiming for the minimum hardware that will do the job. If it will use more memory or more processor time, so what.

Speaking of speed; I read a lot about processor speed, memory wait states, and all of the things that can be done with both hardware and software to reduce the time it takes to do a given job. Right now I feel that any of the presently available micros are more than fast enough to do anything that the hobbyist requires. In other words, I feel that too much emphasis has been placed on speed for speed's sake.

An awful lot of emphasis has also been put on software copying. This will hurt the hobbyist and the individuals or companies that might supply software for a price. The emphasis, not the copying! I own three tape recorders but I still buy commercial musical recordings. We are in the pioneering phase of microprocessors and pioneers work with what they can get. Software is expensive, easily copied, and copying is undoubtedly being done, but those who want to make money selling their software designs need to take the long view. Once the die-hard hobbiest has his machine up and computing, the market is going to peter out unless processors and programs are provided that can be used by people who have no interest in what's happening inside the box. When the non-technician needs a new program he's going to buy it, not copy it. That's where the market is and where the money will be made. That's also when prices will come way down and we'll all benefit.

Well, John, that's it for now. I received a shipping notice from Processor Technology yesterday and should soon be the proud Papa of a SOL System. I haven't seen much on it in print yet, so maybe I'll write it up for you.

Rod Hallen WA7NEV
Tombstone AZ

## Another "Friendly" Letter!

In the article "Number Rounding Program" in the April 1977 issue, the author states that " . . . I could have simply added 0.005 and would have come up with the same end result. I have tried this in several programs and have found that it is not always reliable. I prefer to use this longer manipulation as I have had very good luck with it." I feel that ridiculous, wishy-washy statements such as the above have absolutely no place in any publication devoted to computers, as one must be totally precise in dealing with computers.

In addition, the above statement is incorrect, as adding 0.005 to a number N gives the same answer as INT(N*100+.5)/100 only in the very rare case that the thousandths digit of N is 5 and all less significant digits are 0.

The program as listed will also print its messages such as "IN THIS RUN THE THOUSANDTH DIGIT OF THE NUMBER WE ROUNDED WAS A 5" regardless of the actual value of the thousandth digit typed in. This is shoddy programming, even for a program intended only for a demonstration of the rounding formula. I also think it was quite unnecessary to use nearly a page each for the program listing and sample run since the program consists almost entirely of PRINT statements.

If you continue to waste space with such totally useless articles, I will start spending my $2 per month elsewhere. Even the most rank beginner would rather have an explanation of how a formula works and how to modify it for other applications than statements such as "I don't know how it works but I've had very good luck with it."

Mark Hilmantel
Nashua NH

## Reply from Jack Inman

I am sorry that you found my article so distasteful. I want to thank you for your letter and your interest. As a novice programmer and a "non-mathematician", I do not always know exactly where my programs have gone astray. Your letter caused me to go back and look at some of those programs where I had tried to use the .005 method. I found that I had left out some of the steps. To me this points out yet another advantage to the formula presented in the article. One formula does it all.

I realize that as written the program would print the same message even if the wrong number were used. The program was not intended to be a utility program that all readers would want to put in their systems. The program was designed to tell the story of how the number rounding formula works. As an author chooses his words I chose the numbers used in the run of the program to show what I wanted to show and no more.

I believe that the space for the program was a necessary part of telling the story. John obviously agrees with this or the program would not have been printed. The formula is broken down in the program in a step by step fashion.

Your last statement is a misquote for if I didn't know how the formula worked I could not have written the program to tell the story.

Jack A. Inman
Covina CA

## Need An IBM 360?

Thanks again for the assistance in the subscription matter. I trust that I will be receiving my issues soon. Hate to return Mickey Ferguson's each time I borrow them.

Concerning the IBM 360 D/30, I will sell it or trade for some smaller system or peripherals or what-have-you. It is in excellent condition. Under complete IBM maintenance until 6 weeks ago. It looks new. As best I can tell it has all mods up to date. Also, there are a couple of sets of interface cables and all service, operation, theory of operation, and maintenance manuals with it. There are manuals for programming and even a complete parts manual with blow-outs, showing every nut and bolt. I guess that even a non-IBM type could run and maintain it with all the support material in the manuals.

Thanks again for your assistance in the subscription mess-up. If ever I can do anything for you here in the Southeast, let me know. Best of everything to you there and believe me I honestly believe KB is the BEST going. Keep up the fine work.

Don Williams
Chattanooga TN

*Believe it or not, folks, the "smaller system" Don is interested in swapping for that 360 is a microcomputer system worth around $2,000! – John.*

## MITS BASIC Doesn't Run On Z-80

I am writing in reference to Carl Galletti's article "Will the Z-80 Crush All Competitors?" which appeared in issue #2 of *Kilobaud*. The article states that versions 3.4 and later of Altair BASIC will run on the Z-80. This is not the case.

The result of this error has been that a copy of Altair extended BASIC 4.Ø was purchased by someone who had been misled by the article. Of course, when he found out that it would not run on his Z-80, he was somewhat distraught.

In addition to this incident, we have been contacted by several people asking whether the information in the article is true.

Needless to say, MITS is concerned about incorrect information that is published about our products. I would assume that you would be very concerned

*continued on page 20*

# BOOKS

**Build Your Own Working Robot**
**David L. Heiserman**
**Tab Books, Summit PA**
**1976, $5.95**

Ever since *Forbidden Planet* (remember Robbie the Robot?) I've wished for my very own robot around the house. He'd be my companion, slave, confidante, pal, and pet. So, when I spotted this little volume (228 pages) at the local Heathkit Store, I was sure my dreams had come true. A quick skimming shows the beastie that David Heiserman describes to be closer to pet than anything "useful," but as the author points out, "What use is a puppy?" The answer lies not so much in the using as in the having, and having a little robot around the house is probably lots of fun. Furthermore, it looks like building your own robot pal could develop into the biggest techno-hobby yet, combining and far outshining computers, ham radio, R/C model building, and animal training. Manufacturers take note: The clitter-clatter of little pseudo-pods around the house could mean the sound of dollars in your pocket(s).

*Build Your Own Working Robot* is not a true beginner's book, but if you aren't intimidated by TTL circuitry, it's not hard reading. And if you expect a "how-to" book that will tell you precisely how to copy the author's robot, Buster, you won't be disappointed. But you will discover within the first few pages that, like *Zen and the Art of Motorcylce Maintenance,* this can be taken as several books in one.

Certainly author Heiserman will tell you more or less how Buster went together, though my guess is that if you really digest this book you'll wind up creating your own design details. More important, he takes up the subject of rudimentary artificial intelligence: Just what should a thinking machine think about to survive? Thrown in for a good measure is no small dose of down-home R&D philosophy such as: "I can attest to the fact that you can actually drive yourself to distraction trying to devise sensor systems for detecting every conceivable type of hazard . . . you draw the line somewhere in order to accomplish anything at all . . . even if it means that Buster will one day tumble down a flight of stairs."

Buster as grandsire to generations of home built robot rug-rats is very well planned. The author brings both him and us along by three broad development stages, each comprised of a number of systemic improvements. Buster I is a wired remote controlled mainframe incorporating the drive and steering mechanisms, only a bit more complicated than a fifty pound slot-car. Buster II has developed into a bumbling crawler who (at this stage you can't say *which* anymore) reacts to touch sensors, feeling his way around the house, and crying pitifully for help when he gets stuck or his batteries begin to get low. Buster III can fend for himself however. When his batteries get low, he tracks down his battery-charger nest. He will amuse himself for hours, exploring, yet respond to commands via a sophisticated accoustical link from his master. Buster IV, though not *alive* at the time of book publication, is seen clearly in the future. He will have microprocessor control for sure and develop an even more animal-like personality: a true pet.

*Build Your Own Working Robot*, at $5.95, is a perfect introduction to Home Robotics. Practical, yet far from trivial, the groundwork for larger systems is all here. And they won't be long in arriving. Case in point: The January, 1977 issue of *SCCS Interface* has pictures and a quick description of a KIM-1 microprocessor controlled Buster built by Tod Loofbourrow.

More timely robot stuff: *Peoples Computer Company*, volume 5, #4 (Jan/Feb 1977) has a long article by Robert Rossum called "Robots as Household Pets," which describes potential desirable attributes of home robot pets. In the same issue there is a letter from Glen R. Norris, president of the United States Robotics Society (Box 26484, Albuquerque NM 87102) describing that society's aims and plans. Looks *very* interesting. 1977 might be the Year of the Robot.

**Tom Scott**
**Mill Valley CA**

**Artist and Computer**
**Edited by Ruth Leavitt**
**Harmony Books, div.**
**Crown Publishers, Inc.**
**Price $4.95 Softbound**

A collection of the works and comments of 35 artists and other computer types is presented in a 160 page book which includes photographic representations, some in color and most in black and white. Each contributor accompanies his or her work with a description of the work itself, the artist's philosophies, and a little background. Some of the notables presented include Ken Knowlton, John Whitney, and Ruth Leavitt, the editor of this book.

As an artist with computer graphics interests (or a computer hobbyist with an artist's interest?) I picked up the book hoping to discover how to make the Altair work with the color TV to generate graphic design. I suppose everyone has specific expectations from a book; those were mine. I read it cover to cover, but alas no one in it had used a microcomputer. Most used large systems . . . probably the smallest was a PDP-10.

Ruth Leavitt introduces the contents with a description of the role of an artist as each sees it and comments about the relationships between artist and computer. Leavitt is a lecturer on computer art and has been involved in the process for several years. Her own work as an artist is the mobile; dynamic representations appear both in color and black and white. When she solicited articles for the book an outline of questions was included in her request of each artist. Some of the contributors answered the questions one by one, and others simply made a philosophic statement about their work. Some of the questions asked were: "How/why did you become involved with the computer (in producing art)?" "What role does the computer play for you . . .?" "Do you feel artwork created with a computer has now or will have an impact on art as a whole in the future?" Questions that were *not* asked, I would very much have liked answers to, such as: What components went into the computer system? What steps did you take to arrive at your result? How did you begin to design programs for your work? In other words, I wanted answers to more questions regarding detail than the book covered.

One of the more interesting aspects of this book is the tremendous range of goals and the variety of ways found to achieve the artists' purposes. The artists themselves include sculpturers, graphic designers, textile weavers and filmmakers. Most of the material is written by artists, for artists . . . not for computer enthusiasts. A great deal of discussion dealt with "what is art?", a question most of us answer for ourselves, and defensive dissertations on the use of computers. However, some interesting applications might be gleaned. The most informative article regarding equipment and procedures comes from Larry Press, a university instructor in Southern California. Larry's application employed an

IBM 360/44, mag tape, digitizer and line printer to reproduce photographs which are manipulated by using varying degrees of noise.

The most interesting application to me in terms of aesthetic appeal is with the use of video tape, recording electronic or laser beams, resulting in design that is fluid or which changes dynamically. Several artists represent this type of art: Ben F. Laposky produces "Oscillons"; Patsy Scala visualizes her poetry with video tape recorders and a PDP-10; Joseph Scala animates design using a PDP-10, video and film; John Whitney is well known for his filmed visuals of music; Herbert W. Franke's "graphic music" is a result of similar philosophies as Whitney's; Vicky Chaet creates beautifully flowing design on video tape.

Other applications and artistic results are widely represented. Some of the artists merely use the computer to suggest design . . . then recreate what the computer instigated, resulting in hand-finished paintings. Others make use of a line printer's ability to perfectly repeat a drawing a required number of times – something few of us have patience to do by hand.

The photographic reproductions are pleasing, or intriguing, and some downright exciting. However most of the photographs are black and white with nine in the center of the book reproduced in full color. A good deal of graphic excitement has surely been lost through lack of color.

Although *Artist and Computer* is less than a year old, the applications described could be considered obsolesced by the current wide use of microcomputers, at least by readers of this magazine. An updated version might now be appropriate which shows us how microcomputers can be used, describes the components of the system and the types of programming methods employed, and prints *color* reproductions of the works of art. Today *Artist and Computer* is merely a jumping off point for what is presently possible to produce and at a fraction of the cost of systems used by artists in this book. If what you're looking for is inspiration, however, do read it.

**Sheila Clarke**
**Glendale CA**

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**How To Buy and Use Minicomputers and Microcomputers**
**William Barden, Jr.**
**Howard W. Sams & Co., Inc. and Bobbs-Merrill Co., Inc.; 1976**
**Publication No. 21351**
**240 pages, $9.95, paperback**

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The words "minicomputer" and "microcomputer" conjure up very specific images in the minds of most computer hobbyists. The image that springs to mind in response to "minicomputer" is probably something like a full-blown PDP-11/40 with the details obscured by a big, glowing $20,000 price tag. Because of this image, and because of Mr. Barden's repeated use of "minicomputer" in the title and chapter headings of this book, many hobbyists probably get no further than idly scanning the first few pages while browsing in their favorite computer store.

That's unfortunate since the author really doesn't concentrate that heavily on minicomputers. He tends to use "minicomputer" and "microcomputer" interchangeably, and some chapters are sufficiently general that there is no need to make the distinction. As an example, the chapter titled "Minicomputer Software" includes a discussion of the MC6800 assembler. Obviously the chapter title is a bit misleading. That is generally the case with this book.

The first seven chapters are, in fact, general digital computer technology, with the emphasis on small computers of all types. There is the usual introduction and then a chapter on basic computer concepts; binary, octal, hex., ASCII, arithmetic operations, etc. The following chapter outlines the hardware organization typical of small computers. This chapter introduces the concepts of CPU, memory, registers and interrupts. The discussion of the various types of addressing (direct, indexed, indirect, immediate) is particularly clear.

Chapter 4 is a discussion of software. The reader is led through machine language, assemblers, compilers, loaders, and support programs such as text editors. The 6800 assembler is stressed as in BASIC. Chapter 5 is a survey of peripherals for the small computer. The author recognizes that price is the major consideration for most users and concentrates on low-cost devices. Approximate prices are given and, where applicable, there is some mention of the price for used equipment.

There is a brief and general chapter on setting up the criteria for selecting a machine and a longer but still general chapter on programming.

Only in the last two chapters do the words "minicomputer" and "microcomputer" assume their traditional meanings. Chapter 8 provides profiles of several currently popular microprocessor chips and the commercial microcomputers derived from these devices. The chips discussed are the 8008, 8080, 6800, F8 and MCS6502. This is an excellent survey of what is available to the hobbyist, although a bit behind the current state of the art in technology. The 8008, as an example, is probably no longer that important, and the Z80 has appeared since the book was published. However, the 8080 and 6800 are still dominant factors and the profiles on the machines derived from these chips are still valid.

The last chapter gives similar profiles for a variety of minicomputers. The emphasis here is on computers that are available in a very inexpensive configuration or that may be available in the used equipment market. This slants the chapter towards the hobbyist or other budget minded users (schools, clubs, etc.) and away from the commercial user where performance is at least as important as price.

The book concludes with the usual tables, some listing of references and manufacturers, and benchmark performances for the various machines discussed in the text.

All in all the author has delivered a useful and interesting book. It can provide the interested but uncommitted reader with an objective and realistic survey of the world of small computers and some idea of the entrance fee. The reader can then make an informed decision as to whether or not this particular mania is for him. The title is less confusing when you assume the book is *aimed at the* uninitiated. It's only those of us who already have a full set of preconceived ideas who find it confusing.

**A. H. McDonough**
**El Segundo CA**

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**The Big CMOS Wall Chart**
**Don Lancaster**
**Howard W. Sams & Co.**
**4300 West 62nd St.**
**Indianapolis IN 46268**
**$2.95**

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It has been said that time solves all problems, and it appears that a problem plaguing computerists has been rectified. The best-selling *Cookbooks* by Don Lancaster each contain a summary and pin-out section for the applicable logic family at the beginning of the book. These pages are invaluable to the experimenter, as they describe the characteristics of each chip as well as details about timing, clocking, and pin-outs. On more than one occasion I have torn or worn out pages while flipping back and forth during a design session. That problem has been solved. Howard W. Sams, the publisher of Lancaster's latest work, *CMOS Cookbook*, has released a wall chart containing information about CMOS logic, exactly as presented in the *Cookbook*. Appropriately dubbed *The Big CMOS Wall Chart*, this reference can be scanned for details about a specific CMOS chip without laying down your wire-wrap tool. The 23" x 35" chart is organized by package type, thus counters are described together, common gates together, etc. Each package is described exactly as in the *CMOS Cookbook*. The reference also contains "use rules" and general information about CMOS design.

The wall chart is available from Sams for $2.95. It is a must item for serious CMOS designers, and after all, it may save your *CMOS Cookbook* from a premature end due to a worn binding!

John Molnar
Executive Editor
73 Magazine

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**The Basic Software Library**
**Roger W. Brown**
**Scientific Research Instruments Co.**
**PO Box 2096**
**Ashland VA 23005**
**Vol. I — Business and Recreational, $24.95**
**Vol. II — Engineering and Statistics, $24.95**
**Vol. III — Advanced Business, $39.95**
**Vol. IV — General Purpose Programs, $9.95**
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**Vol. VI — A Complete Business System, $49.95**

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Several years ago the idea of computer "utilities" found many proponents within the computer industry. What is a Computer Utility? Like the gas, water, and electric utilities, a computer utility was conceived as a large central computing facility serving an extended geographic area via *terminals* in people's homes. 2001! A terminal in every home, with access to an extremely large data base consisting of hundreds of various programs for every conceivable use, and access to various *raw* data bases which each individual could access for whatever purpose. For instance, a user might log into the library data base to check on the availability of a particular book or document, or log into a newspaper's data base to check baseball or football statistics for the past season. Information of all types at your fingertips! Five or six of these large computer utility sites would serve the entire United States. But, although computer utility proponents are still to be found within the industry you don't hear so much about it these days, especially with the advent of the microcomputer!

Now, the prevailing theory is a *computer* in every home, and the microprocessor may just bring this about. But we all know that these magic boxes cannot operate without programs, without the software to make them perform. But where will all the software come from? (I remember a sign posted at the ARPAnet site I used to work at: "90% of the people don't want anything to do with programming!") Well, this is where Roger Brown and the Scientific Research Instruments Company come into the picture. R. W. Brown and Company are in the final stages of completing a 1000+ page library of programs written in the BASIC language and consisting of six volumes.

I have read other reviews of Mr. Brown's books and the one thing that keeps popping up in discussions of the merit of these volumes is the rather large amount of storage necessary to run the programs. Although it is true that some of the programs require more storage space than found on most contemporary microcomputer systems I feel that it is a rather shortsighted complaint (if that is the right word!) especially considering the decreasing prices of memory components in the semiconductor industry at present. I am sure that soon (1978) most standard hobbyist/home/micro business computers will have sufficient memory as a system *standard* . . . more than enough to run any of the programs in Brown's six volumes.

What kind of programs has Mr. Brown written? Well, everything from A to Z, practically! He has written games, picture generating programs, a number of statistical programs, two volumes are entirely devoted to business applications (payroll, inventory, stocks and bonds, PERT, Work Flow, etc.), mathematics, games and more games, and a number of highly specialized programs, such as calculating steel beam capacities. He has pretty well covered the spectrum.

Now here is what makes the volumes more than worth the price. Sooner or later, most likely sooner, Mr. Average Businessman is going to discover the benefits of microcomputer systems. These six volumes will do much in promoting this discovery. Every pharmacy, every stationery store, every liquor store, why, the surface hasn't even been scratched yet! All of these *micro* businesses and more will discover that microcomputers are within their reach, to assist them in their daily business. And then the rush will be on! Most computer stores now are discovering that anywhere from 50 to 75% of their customers have business applications in mind. I have people calling almost every day asking questions on micro systems, and most of them are concerning the availability of quality software to run them. Roger Brown's six volumes are definitely filling a void in the micro software arena.

Some of the computer stores are discovering the benefits of *bundling* Brown's six volumes with the *systems* that they sell. Systems . . . complete computer systems, are undoubtedly the way of the future. And no system is complete without software!

The Altair Software Distribution Company (a MITS subsidiary) has only recently announced the availability of its "business" software packages . . . but they are asking $4000 for the package . . . and that's as much as the hardware. With slight modifications Brown's programs will work on almost any hobby system going (although some of the BASICs in use are not of sufficient sophistication to derive full benefits from his programs) . . . there are various people now working on his programs for systems like Polymorphic, North Star, SWTPC, and TDL BASICs.

So what are we talking about here? We are talking about a set of books that retail at $159.70 for the entire series of six volumes (only six are planned, not seven as reported in another microcomputer magazine) . . . we are talking about a set of books that can make an empty computer quite full . . . we are talking about a set of books that "daddy" can take all of the business programs out of for his micro-business system and leave the rest of the games and programs on his home system for family usage.

And, we are talking about a set of books which will very shortly be available through the Kilobaud Microcomputer Software Library on cassette tapes. Yes, that's right! Plans are now underway at *Kilobaud* to market "cassette" program tapes. Roger Brown's programs will be among the first tapes available, both nationally and via mail order. The exact date of availability cannot be given at this time, but suffice it to say that packaging design, quality control methods, contractual work, etc., are proceeding at a rapid rate. Yes, the Kilobaud Software Library will shortly be a reality. We also have plans to market software via another medium besides cassette. This is further down the road, but rest assured that it will be state of the art.

(Inquiries concerning programming for the Kilobaud Software Library are encouraged and should be directed to me at the

Kilobaud Microcomputer Laboratory. Dealer inquiries concerning distribution rights are also encouraged.)

**Bob Leach**
**Systems Manager**

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**Microcomputer Primer**
**Mitchell Waite and Michael Pardee**
**Sams Publication No. 21404**
**1976, 180 pages, 2 appendices**

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This is a good book, a very good book, for the hardware oriented microcomputer novice. It draws together all the information necessary to understand the peculiar language we speak (MPU, EROM, DMA, VDM, etc.) and treats both hardware and software in clear language and diagrams, with well thought-out examples. The examples, by the way, are not tied to any particular processor (although the 6800 instruction set is used

*continued on page 84*

## NEWS OF THE INDUSTRY

*from page 13*

puterfest, but it is the *only* Computerfest in the area.

This year's event will feature a banquet Saturday night with entertainment, *two days* of commercial exhibits, flea markets and forums. There will also be a hospitality room, ladies' events, FCC examinations and more.

Information on tickets, room reservations and etc., will be furnished upon request by contacting the New Orleans Hamfest/Computerfests, PO Box 10111, Jefferson LA 70181.

## 20 Print "Editor's Remarks" 30 End Run

*from page 6*

meeting was held in the recreational room at Don's apartment building on June 15th. The response was overwhelming! Turned out to be standing room only with over 150 people showing up.

An interesting letter from Carl Helmers to the editors of the *Micro-8 Newsletter* (Hal Singer and yours truly) was reprinted in the June issue of the Newsletter . . . "Just a page, to inform you of the demise of ECS Magazine and – like a Phoenix from it's mailing list arisen – the beginning of 'Byte'! I got a note in the mail about two weeks ago from Wayne Green, Publisher of '73 Magazine' essentially saying hello and why don't you come up and talk a bit. The net result of a follow up is the decision to create Byte Magazine using the facilities of Green Publishing, Inc."

How many magazines do we have now? I don't think I have enough fingers to count them all!

## The BASIC Forum

*from page 7*

At about the 8-week point, we put FORTRAN aside to study a language that was structurally superior to FORTRAN and likely to supplant same in the years to come. (I mean it just had to; it was so much better!) The new language was called MAD for Michigan Algorithm Decoder. I must admit that it did have lots of keen things that FORTRAN lacked. In a short time I was convinced that MAD was the only way to write programs. As time passed and my academic world gave way to the great industrial reality, a most striking thing happened. FORTRAN became the unquestioned leader among scientific languages while MAD fell into general disuse. How could such irrational behavior exist among trained professionals? It was at this point I discovered a characteristic of human behavior which I call "The Principle of Popular Momentum." Simply stated: Any idea that satisfies the following conditions: 1. a sufficient headstart, 2. popular appeal, 3. backing in powerful places, will inevitably win out even in the presence of fundamentally better ideas. If you think about it, the principle applies equally well to political movements or computer languages. FORTRAN simply satisfied the three conditions and beat out a superior language like MAD.

Here we are discussing BASIC and its relation to other languages. As clearly expressed in the letters above, BASIC suffers several inherent weaknesses; but in personal computing BASIC has Popular Momentum. Consider how it satisfies the three conditions above:

1. BASIC was the first high level language generally available in the personal computing field. The introduction of other, perhaps superior languages, has lagged poorly behind. Without question, BASIC got its headstart. Condition one satisfied.

2. BASIC is a conceptually simple language that lends itself to the conversational style of programming being used by so many computer hobbyists. Kids and adults alike take to it very readily. The average person can sit down with BASIC and write his first program in a very short time. BASIC's wide appeal is unmistakable. Condition two satisfied.

3. The biggest names in computing technology provide BASIC with their minicomputer systems. IBM, Hewlett-Packard, Data General, and DEC provide powerful BASIC software packages with their equipment. Even on the personal computing level, the manufacturers are breaking their necks to make "Super BASIC" available to their customers. Powerful backing – of course it's there. Condition three satisfied.

No question about it – BASIC has Popular Momentum. New languages will have a mighty uphill battle no matter what their relative merits. We at BASIC Forum, while recognizing its weaknesses, want to do all we can to assist the many present and future users of BASIC. If there are ways to improve it – maybe even start an evolutionary process to change it altogether – then we want to offer a vehicle through *Kilobaud* for this to happen.

If you have comments, questions, or contributions, please send them along to

BASIC Forum
c/o Dick Whipple
305 Clemson Drive
Tyler TX 75703.

## Letters to the Editor

*from page 16*

about false information finding its way into your otherwise outstanding publication. For this reason, I urge you to consult with reliable sources to insure the integrity of the information you print.

I hope you will publish this letter in order to let your readers know that Altair BASIC is not compatible with Z-80 CPU.

Mark Chamberlin
Director of Software,
MITS
Albuquerque NM

*Thank you, Mark, I'm afraid I blew it. – John.*

## 1 Print "Publisher's Remarks" 10 No End Run

*from page 4*

very major airport for fast travel to and from the show . . . a large assortment of first class hotels and motels, where they will have both sheets and towels . . . and even ice at no extra charge.

Boston also has a very large number of small businesses . . . and NEC-77 promises to emphasize the small business aspect of microcomputers in order to start attracting this group. Add to that over twenty colleges and universities and you have a prospective smash hit. Will there be

10,000 or more jammed into the Computerfest? It could go to 20,000 considering the number of people locally who are likely to be interested.

And don't forget that there are several computer clubs in the area . . . they'll be there in force. Boston is supporting quite a few computer stores . . . is Atlantic City?

Frankly, I think that there should not be two computerfests set up on the same weekend, and while I'm enthusiastic about the NEC-77 and still have a lot of very bad feelings left from last year's Atlantic City PC-76, I think the organizers should have made a better effort to avoid the conflict. It's probably too late now to change either one, which is a shame because it is certain that one must diminish the other to some extent and we need all of the enhancement in our growing field we can get. I'm hoping that the industry will be able to get together and sanction computerfests as a way of avoiding things like this.

The New England Computerfest is scheduled for August 25-27th. The exhibits will be open from 3-10 pm Thursday and Friday, and from 9-9 on Saturday. An avid computerfest goer could thus get to the show on Thursday and Friday and then quickly drive to Atlantic City, which will be running on Sunday the 28th.

The idea is to give exhibitors enough time to set up the exhibits on Thursday morning . . . and hold an industry meeting on Friday morning. Sundays historically do not pull very well, so this seems like a good time for exhibitors to pack up and go home. Exhibitors are the heart of any show, so the easier you can make life for them, the more you'll have . . . and the more interesting equipment you can see.

Atlantic City drew very few computerists on Sunday last year, so the exhibitors packed up early and pulled out. Dayton has been pulling more people on Friday than on Sunday since they started opening on Friday. It's something to think about.



## Making Clubs Work

A lot of computer clubs seem to be going the same route as a lot of ham clubs have . . . downhill. That's a pity, because a club can be a very satisfying experience if it is run right.

A club is nothing more than a bunch of people with a mutual interest who get together periodically. If the meetings are dull the members will stop coming and there will be no club. That's an obvious statement, yet many club officers tend to ignore it, possibly with a notion that there is an unlimited number of club prospects, so why worry if a few people drop out.

Making club members happy isn't difficult at all . . . the main way to get them enthusiastic is to pay attention to them. If you ignore them, present them with a dull speaker or hold long business meetings, they will find more entertaining things to do on club evenings.

Most people coming to club meetings are working on their computer systems or adding to them. Every one of these people is a fountain of information on things a lot of other members would like to know about . . . *if* you ask them. Instead of just having those attending a meeting lurch upwards for several milliseconds and grunt their names, why not have them give a report on what they've done lately . . . what problems they've had and how they solved them. If they are still unsolved, it's possible other club members might be able to help.

If you are lucky enough to have a manufacturer or a dealer in your immediate vicinity, you will have at least one interesting meeting while he demonstrates his gear and answers questions on it. Watch out for talks on things other than hobby systems or components . . . OEM stuff and even the mini stuff will put most members to sleep . . . and they will probably find it much more comfortable to sleep at home than in the chair at your meeting.

One or two member's computer systems brought to a meeting will liven things up. Everyone wants to see the latest in equipment and have a chance to get his hands on it. You won't have very many bored members if you keep them occupied with hobby systems.

Again . . . in case you've already put the word aside . . . the key to a contented membership is personal attention. If you make people feel that they are wanted and of value, you won't be able to keep them away. If there is someone who is a terrible bore and you want him to stop bothering everyone, just ignore him and he'll drop out.

*Michael L. Smith*
*17 Deerpath Drive*
*St. Peters MO 63376*

# Build Your Own Interface

## ... tips from a professional

*Mike Smith is a professional design engineer who is also an avid computer hobbyist. It always pleases me to no end to see professional hardware and software people sit down and write articles which will help the rest of us by sharing their technical expertise. Mike is no exception and he has a lot to share. I'm looking forward to this article being the first in a series on Altair bus interfacing (he's done enough designing on his home system to keep us supplied for quite awhile, too!). This first discussion deals with the Altair bus signals in general and moves into the three different types of I/O;* Flag Testing, Program Interrupt, *and* Direct Memory Access (DMA). *– John.*

One of the most interesting and rewarding areas of the personal computer hobby is that of designing and building custom interfaces. Aside from the sheer pleasure and satisfaction that comes with seeing your new design work, there is the possibility of interfacing something that has never been interfaced as well as the benefit of substantial money savings as compared to the purchase of a commercial kit or finished product.

This article deals specifically with interfacing to the Altair 8800 series of computers and applies equally to all three models (8800, 8800A, and 8800B). The first step toward successfully interfacing any computer is a thorough understanding of the bus. The Altair Bus is a 100 line printed circuit board bus, in which all like numbered connector pins connect to one another via etched copper lines. This structure allows any interface, CPU or memory printed circuit board to be inserted into any vacant connector slot. The 8800A and 8800B come equipped with an 18-slot bus (mother board), while the 8800 is provided with a 4-slot bus with space provided for 3 additional 4-slot mother boards.

Each of the 100 lines on the Altair Bus has a predefined function which must be fully understood in order to make good use of the bus.

Table 1 contains a complete breakdown of all the Altair Bus signals, given in functional logic notation. This means that in each signal mnemonic there are two parts. The first is the signal abbreviation and the second is the active level representation. The two parts are separated by a hyphen for clarity. The active level representation is in the form of an upper case H for active high and an upper case L for active low. Functional representation does not apply to power and ground lines. To correlate the functional logic shown here to the "positive logic" symbology shown in the Altair documentation, drop the active level representation and draw a Boolean NOT sign

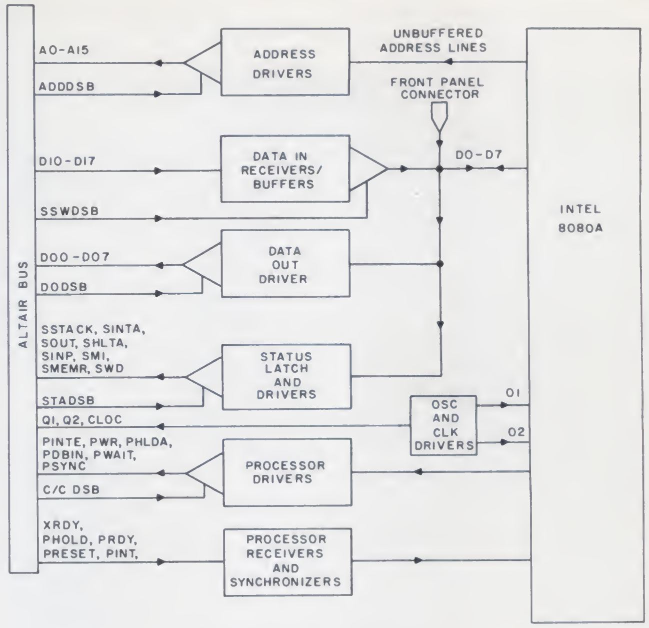


*Fig. 1. CPU Block Diagram.*

over the tops of these signals shown here as L. The functional notation is a far better approach because it reserves the use of the Boolean NOT symbol for use when NOT is intended. Positive logic notation, on the other hand, uses the NOT symbol every time an active low is indicated, so that every time the logical NOT function is desired, it will be confused with active low.

Let's take a look at the major groups of signals on the bus. The *address* lines are outputs from the CPU board and are inputs on all memory and I/O boards. The I/O boards use only the lower 8 bits (A0-H through A7-H) because during I/O transfers, the upper 8 bits are identical to the lower 8 bits. In the event that direct memory access (DMA) is used, the DMA controller must also generate an address on the address lines. In the 8800 and 8800A, these lines (through current limiting resistors) provide the drive for the Address indicators on the front panel. This seriously limits the high going drive of the 8T97 drivers on the CPU board and therefore it is suggested that each board receive the address lines using only one low power TTL or low power Schottky TTL device. In the event that a DMA controller is being designed, it is recommended that address drivers equivalent to the 8T97s on the CPU board be used.

The *data-out* lines are outputs from the CPU board and are inputs on all memory and I/O boards. In the event that DMA is used, the DMA controller must also drive the data-out lines when the direction of the data transfer is to the memory from the DMA controller. Assuming no more than the 18 cards that will fit in the cabinet are connected to the bus, up to 2 milliamps of low loading may occur on each board in the bus. This equates to one standard or Schottky load, 5 low power Schottky loads, or 10 low power TTL loads. A DMA controller should drive these lines with 8T97 Tri-state buffers or equivalent.

The *data-in* lines are inputs to the CPU board and are driven from the memories and I/O boards. In the event that DMA is used, the DMA controller is an additional input for the data-in lines. Also, the front panel is an input for these lines. Since the front panel and CPU both use 74LS04 receivers for the data-in lines and the lines are "pulled-up" using 1k Ohm resistors at the CPU board, almost any Tri-state or open collector TTL driver may be used to drive the data-in lines from the memory and I/O boards. However, to insure optimum noise immunity and capacitive drive over the length of bus, it is recommended that the 8T97 type buffers be used to drive the data-in lines.

The *status* lines are sent out to the bus from the CPU board (and from the DMA controller if installed). The status lines consist of 8 lines which are selectively used by the memories and I/O boards to obtain information about the nature of the cycle. Those lines are also displayed on the front panel. The status lines are electrically of the same nature as the address lines, which means that they should be loaded by only one low power TTL or one low power Schottky TTL load per board. A DMA controller must be capable of generating these signals during a DMA transfer. These lines are SINTA-H, SWO-L, SSTACK-H, SHLTA-H, SOUT-H, SM1-H, SINP-H, and SMEMR-H.

The *processor* lines are a buffered group of inputs and outputs which are derivatives of the Intel 8080 processor signals. The 6 processor output lines are PSYNC-H, PDBIN-H, PWAIT-H, PWR-L, PHLDA-H, and PINTE-H. The DMA controller has control of these lines during a DMA transfer. The 5 input lines are PRDY-H, XRDY-H, PHOLD-L, PINT-L, and PRESET-L. Since some of the output signals in this group are used to drive front panel indicators, the input loading should not exceed one low power TTL or one low power Schottky TTL load per board. The input signals are all "pulled-up" using 1k Ohm resistors so that they may be driven by any Tri-state or open collector TTL gate or buffer. Although many kits (and the Altair manual itself) advocate the use of the PRDY-H line for inducing "wait" states, a much better (and electrically correct) way of doing this is to use the XRDY-H line. The front panel drives PRDY-H with a constantly enabled 8T97 which has substantial high going drive capability. To pull this line down while the front panel is pulling it high causes large instantaneous surge currents in the devices, causing unnecessary noise spikes as well as abuse to the devices themselves.

The *disable* group of lines is used to disable the various Tri-state drivers on the CPU board when a DMA cycle occurs. The DMA controller then becomes responsible for driving the disabled lines. There are 4 disable signals which are used with DMA. They are STADSB-L, C/CDSB-L, ADDDSB-L, and DODSB-L. A fifth disable signal is SSWDSB-L, which has nothing to do with DMA, but instead is used to gate in the sense switches when an IN 377 (octal) instruction occurs.

The heart of the Altair 8800 system is the CPU board. A block diagram of this board is shown in Fig. 1. This block diagram is provided to give an overview of the CPU connections to the bus. All references of *in* and *out* in the Altair system are with respect to the CPU board. The bidirectional data lines of the 8080 microprocessor are split into data-in and data-out lines for use on the Altair bus. The contents of the bidirectional data lines are latched into the 8212 latch at SYNC time by the Ø1 signal. The outputs of the 8212 latch are buffered for system use by 8T97 Tri-state buffers. The processor output signals are also buffered using 8T97s and presented to the bus. The processor input signals are passed through receivers and then presented to the 8080 chip. The ready signals (PRDY-H and XRDY-H) are ANDed, synchronized with Ø2, sent to

| Pin # | Mnemonic | Description |
|---|---|---|
| 1 | + 8 Volts | Unregulated power supply for use by +5 Volt on-board regulators. |
| 2 | +16 Volts | Unregulated power supply for use by on-board regulators (typically to obtain +12 Volts). |
| 3 | XRDY-H | A normally high line, which if brought to the low state will cause the CPU to enter the WAIT state. |
| 4 | VI0-H | Vectored Interrupt priority 0 |
| 5 | VI1-H | Vectored Interrupt priority 1 |
| 6 | VI2-H | Vectored Interrupt priority 2 |
| 7 | VI3-H | Vectored Interrupt priority 3 |
| 8 | VI4-H | Vectored Interrupt priority 4 |
| 9 | VI5-H | Vectored Interrupt priority 5 |
| 10 | VI6-H | Vectored Interrupt priority 6 |
| 11 | VI7-H | Vectored Interrupt priority 7 |
| 12-17 | Not Used | |
| 18 | STADSB-L | Causes the 8 status line buffers on the CPU board to be Tri-stated (enter the high impedance state). |
| 19 | C/CDSB-L | Causes the 6 command/control line buffers on the CPU board to be Tri-stated (enter the high impedance state). |
| 20 | UNPROT-H | A signal which is ANDed with "board select" on a memory board to cause the PROTECT flip-flop to be cleared. |
| 21 | SS-H | Indicates a single-step is occurring in the CPU. |
| 22 | ADDDSB-L | Causes the 16 address line buffers on the CPU board to be Tri-stated (enter the high impedance state). |
| 23 | DODSB-L | Causes the 8 data-out lines on the CPU board to be Tri-stated (enter the high impedance state). |
| 24 | Ø2-H | Buffered TTL compatible version of CPU phase 2 clock. |
| 25 | Ø1-H | Buffered TTL compatible version of CPU phase 1 clock. |
| 26 | PHLDA-H | "Hold Acknowledge" which is the CPU board response to the HOLD-H input signal. |
| 27 | PWAIT-H | CPU signal indicating a WAIT state is occurring. |
| 28 | PINTE-H | CPU signal indicating that Interrupts are Enabled. |
| 29 | A5-H | Address Bit 5 |
| 30 | A4-H | Address Bit 4 |
| 31 | A3-H | Address Bit 3 |
| 32 | A15-H | Address Bit 15 |
| 33 | A12-H | Address Bit 12 |
| 34 | A9-H | Address Bit 9 |
| 35 | DO1-H | Data Out (from CPU) Bit 1 |
| 36 | DO0-H | Data Out (from CPU) Bit 0 |
| 37 | A10-H | Address Bit 10 |
| 38 | DO4-H | Data Out (from CPU) Bit 4 |
| 39 | DO5-H | Data Out (from CPU) Bit 5 |
| 40 | DO6-H | Data Out (from CPU) Bit 6 |
| 41 | DI2-H | Data In (to CPU) Bit 2 |
| 42 | DI3-H | Data In (to CPU) Bit 3 |
| 43 | DI7-H | Data In (to CPU) Bit 7 |
| 44 | SM1-H | CPU status signal indicating processor is in machine cycle 1 which is Instruction Fetch. |
| 45 | SOUT-H | CPU status signal indicating the current cycle is an Output cycle. |
| 46 | SINP-H | CPU status signal indicating the current cycle is an Input cycle. |
| 47 | SMEMR-H | CPU status signal indicating the current cycle is a Memory Read cycle. |
| 48 | SHLTA-H | CPU status signal indicating the CPU is Halted. |
| 49 | CLOC-L | A buffered 2 MHz clock for general use. |
| 50 | GND | System ground |
| 51 | +8 Volts | (Same as pin 1) |
| 52 | -16 Volts | Unregulated negative power supply for use by on-board regulators (typically to obtain -5 Volts or -12 Volts). |
| 53 | SSWDSB-L | "Sense Switch Disable" which is used during an IN 377 instruction to disable the data input buffers on the CPU board so that the sense switches can be "read" by the CPU. |
| 54 | EXTCLR-L | I/O clear signal generated by front panel. |
| 55-67 | Not Used | |
| 68 | MWRT-H | CPU signal indicating that the data on the data-out bus is to be written into the memory selected by the address lines. |
| 69 | PS-L | "Protect Status" of the selected memory. |
| 70 | PROT-H | A signal which is ANDed with "board select" on a memory board to cause the PROTECT flip-flop to be set. |
| 71 | RUN-H | Front panel signal indicating that the CPU has been "told" to RUN. |
| 72 | PRDY-H | A normally high line which if brought to the low state will cause the CPU to enter the WAIT state. Note: This line is driven by a continuously enabled Tri-state driver on the front panel board and contrary to what others may be doing, this line should *not* be used for any other purpose. The proper line to use for entering wait states by "slow" memories and I/O devices is XRDY-H (Pin 3). |
| 73 | PINT-L | "Interrupt Request". If Interrupts have been enabled, a low level on this line causes the CPU to enter the interrupt acknowledge condition at the conclusion of the current instruction. |
| 74 | PHOLD-L | An input signal to the CPU which causes a HOLD state to occur. PHOLD is the requesting signal for a DMA transfer. |
| 75 | PRESET-L | A system reset signal used primarily by the CPU board. (I/O boards normally use the EXTCLR-L signal for resetting). |
| 76 | PSYNC-H | A buffered CPU signal which indicates the beginning of a new machine cycle. This signal is used on the CPU board to enable the loading of the system status latch. |
| 77 | PWR-L | "Processor Write" which indicates that the data on the data-out bus is to be written either to a memory or an I/O device. |
| 78 | PDBIN-L | "Processor Data Bus In" is used to indicate to the selected memory or I/O device that the CPU expects data on the data-in bus. |
| 79 | A0-H | Address Bit 0 |
| 80 | A1-H | Address Bit 1 |
| 81 | A2-H | Address Bit 2 |
| 82 | A6-H | Address Bit 6 |
| 83 | A7-H | Address Bit 7 |
| 84 | A8-H | Address Bit 8 |

| | | |
|---|---|---|
| 85 | A13-H | Address Bit 13 |
| 86 | A14-H | Address Bit 14 |
| 87 | A11-H | Address Bit 11 |
| 88 | DO2-H | Data Out (from CPU) Bit 2 |
| 89 | DO3-H | Data Out (from CPU) Bit 3 |
| 90 | DO7-H | Data Out (from CPU) Bit 7 |
| 91 | DI4-H | Data In (to CPU) Bit 4 |
| 92 | DI5-H | Data In (to CPU) Bit 5 |
| 93 | DI6-H | Data In (to CPU) Bit 6 |
| 94 | DI1-H | Data In (to CPU) Bit 1 |
| 95 | DI0-H | Data In (to CPU) Bit 0 |
| 96 | SINTA-H | Interrupt Acknowledge signal from CPU. |
| 97 | SWO-L | CPU status signal indicating that the current cycle involves writing to a memory or I/O device. |
| 98 | SSTACK-H | CPU status signal indicating that the address bus contains the stack address and that a stack operation will occur on the current cycle. |
| 99 | POC-L | Power On Clear reset signal |
| 100 | GND | System ground |

*Table 1. The Altair Bus.*

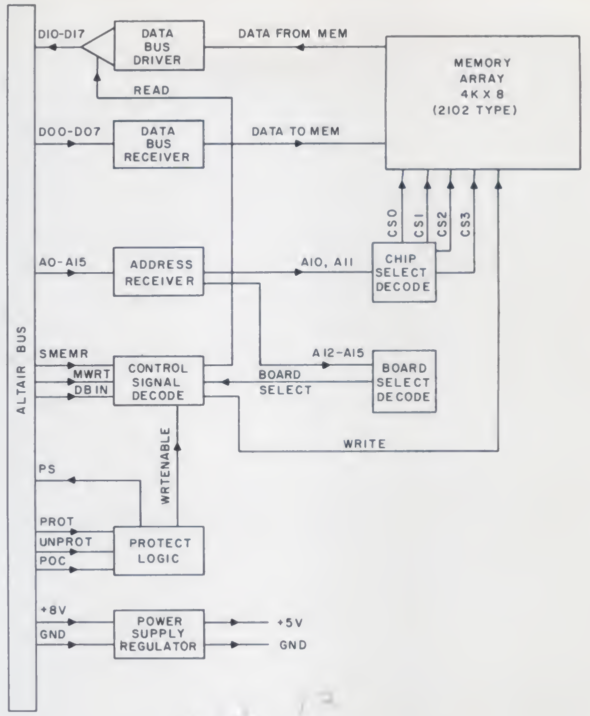


*Fig. 2. 4K Static Memory Block Diagram.*

the 8080. PHOLD-L is also synchronized with Ø2 before being sent to the 8080. The CPU block diagram should also be of value in the event that troubleshooting the CPU becomes necessary.

Fig. 2 is a block diagram of a typical 4K byte static memory as implemented for the Altair bus. In the static memory board, the control is relatively simple, with the major effort in the area of address decoding and control signal generation. Fig. 3 shows how this might be accomplished. The methods chosen for use in Fig. 3 were chosen for simplicity and are based on readily available, inexpensive components. S1 through S4 are address selection switches, which determine the position in the address range the board will occupy. These switches are normally of the DIP-SWITCH type, but may be replaced by jumpers for economy. BOARDSEL-L will be active (low) if all 4 switches match the state of the respective address lines associated with the switches. BOARDSEL-L has several functions, which include enabling the CHIPSEL decoder which is a 7442 decoder, providing an enabling input to both the READ-L and WRITE-L gates and finally in allowing the PROTECT flip-flop (not shown) to be changed by either the PROT-L or UNPROT-L signals. The CHIPSEL decoder is connected so as to provide one of four chip selects according to the state of A10-H and A11-H. Either READ-L or WRITE-L is produced during a memory cycle based on the state of SMEMR-H, PDBIN-H, and MWRT-H lines at the time BOARDSEL-L is low. WRITE-L is used as a memory write pulse and is fed to pin 3 of all the 2102 chips on the board during a memory write cycle. Only those 2102s selected by an active (low) CHIPSEL signal will be written into. READ-L is used to enable the DATA BUS DRIVER which is composed of 8T97 buffers feeding the data-in lines. There are many ways to accomplish the address decoding other than as shown. Among these are the use of address comparator chips to produce BOARDSEL-L.

Keep in mind that the purpose of discussing the memory, CPU, and I/O interfaces is to give an insight into the Altair bus considerations for the boards, not to provide complete design details. With the information provided, it is hoped that you will be able to pick up the ball and make your own designs work. Also, many general designs shown in other articles may be adapted for your Altair, using the techniques in this article.

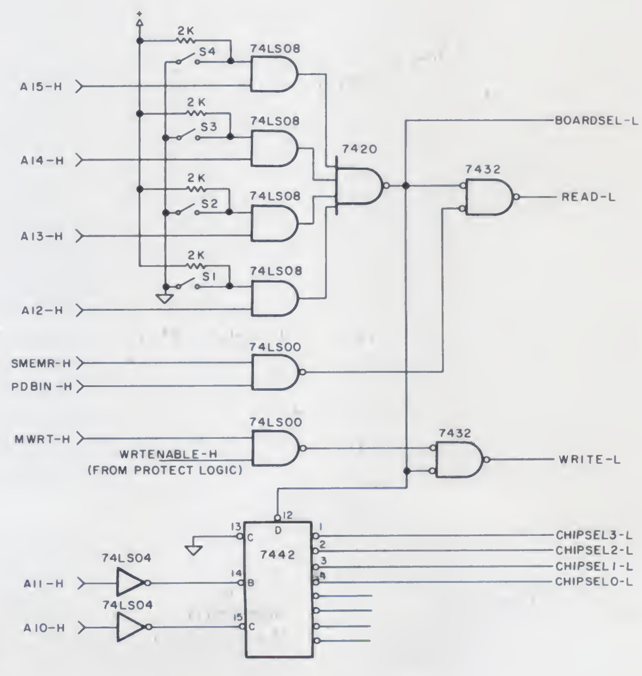


*Fig. 3. Address Decoding and Control Signal Generation.*

By far, the largest area open to hardware experimentation in the personal computer system is that of I/O interfacing. If you are starting to design an I/O interface from scratch, the first order of business is the conceptual design. This first involves deciding what function the interface board will

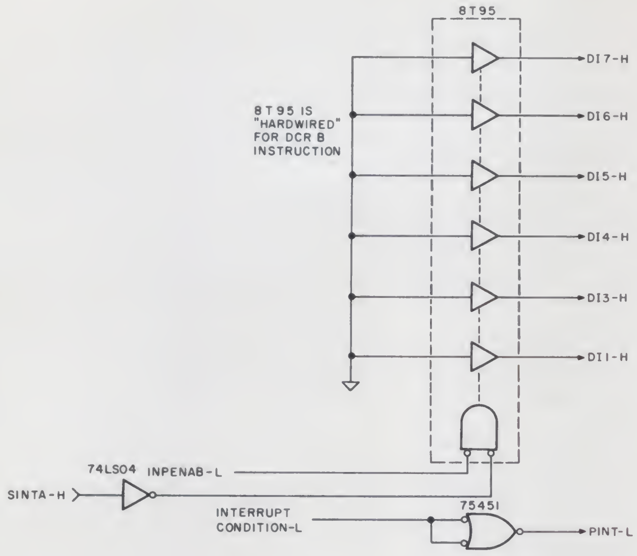


*Fig. 4. Interrupt Logic.*

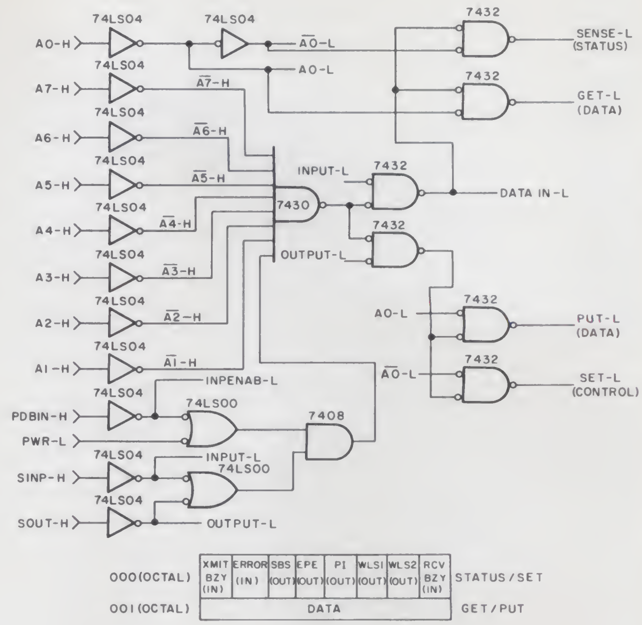


*Fig. 5. Port I/O Address Decoding.*

```
LOOP:    IN 6       ; GET STATUS
         RAL        ; POSITION READY BIT IN CARRY
         JNC LOOP;  TRY AGAIN IF NOT READY
         IN 7       ; GET THE DATA
         MOV M,A    ; STORE THE DATA
         . . . ETC
```

*Example 1.*

perform. Once the function has been defined, it must then be decided how the interface will *look* to your software. This is the area in which most of the design trade-offs take place. This is to say, for example, if the interface is to be extremely easy to control from the program, then the hardware complexity will likely increase. Conversely, minimal hardware complexity usually results in more difficult programming. This is the real beauty of designing your own interfaces . . . you make the design trade-offs to suit your own needs and tastes.

Many times it is helpful to jot down notes on the way your prospective interface *will* appear to the software and then make a trial subroutine using the scheme you have decided upon. If the results of your test subroutine are not pleasing to you, then rehash the conceptual design and try again. In this way, you will have a good feel for the way your interface will function before it is built. It will also become apparent as to which way the trade-offs must be moved before trying again.

Three major operating modes for I/O interfaces are *flag testing, program interrupt,* and *DMA* (direct memory access). The most frequently used (and easiest to implement) is the flag *testing method*. During the conceptual design, a particular bit is designated to indicate a particular meaning such as *device busy, device ready, device error,* etc. The meanings such bits may assume is limited only by your imagination. Normally, these bits are *read* by the program from an I/O port referred to as the *status register*. Also, the status register is usually the lowest port number associated with a device. An example might be a paper tape reader in which the status register is port 6. The *data register* would then be port 7. Bit 7 would be a good selection to indicate data ready in the status register. The software would then consist of a *ready loop* shown in Example 1. This type of I/O software is referred to as *flag testing*. Most devices are readily controlled in this manner. The primary shortcoming of the flag testing method is that the computer spends most of its time in the ready loop, waiting for the next data to become ready. In most personal computing situations this waiting is not a problem. If more than one process must occur simultaneously, it is possible to use program interrupt or DMA to *free* the processor for other processing while the I/O devices function more independently. In the case of program interrupt, the *ready* bit would be used to pull down the interrupt request line (PINT-L). The processor would then respond (if interrupts were enabled) with SINTA-H. The I/O interface would then use SINTA-H to gate an interrupt instruction onto the bus (see Fig. 4). The interrupt instruction is usually a restart (RST) instruction which would save the program counter on the stack and then vector to the I/O subroutine. The I/O subroutine would then process the data and execute a RET (return) instruction. The DMA type of operation will be discussed separately.

Another major decision to be made during conceptual design is whether standard I/O (port I/O) or memory mapped I/O addressing will be used. Each of these methods have advantages and disadvantages which must be weighed in your own mind. Port I/O has the advantage of having less address lines to decode (8) as well as leaving all 65K of the address space available for memory. It has the disadvantage of being limited to only two types of instructions in transferring data to and from the I/O device (IN, OUT). *Memory-mapped I/O* is a method in which the *I/O device* is treated as if it were a memory location or group of memory locations. Memory mapped I/O has the advantage of being able to use any of the transfer instructions that are used with real memory, including arithmetic and logical as well as move instructions. The disadvantages are the need to decode more address bits (16) and the fact that part of the memory address spectrum is consumed for I/O use. An example of

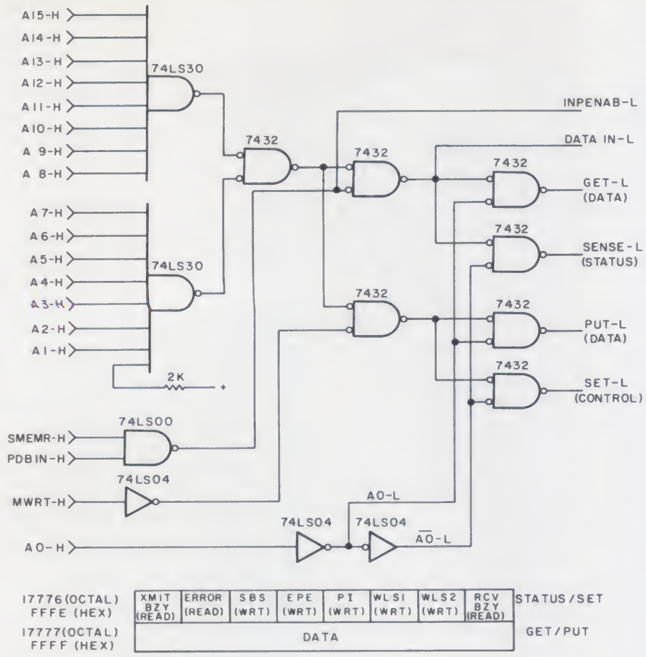


*Fig. 6. Memory — Mapped I/O Address Decoding.*

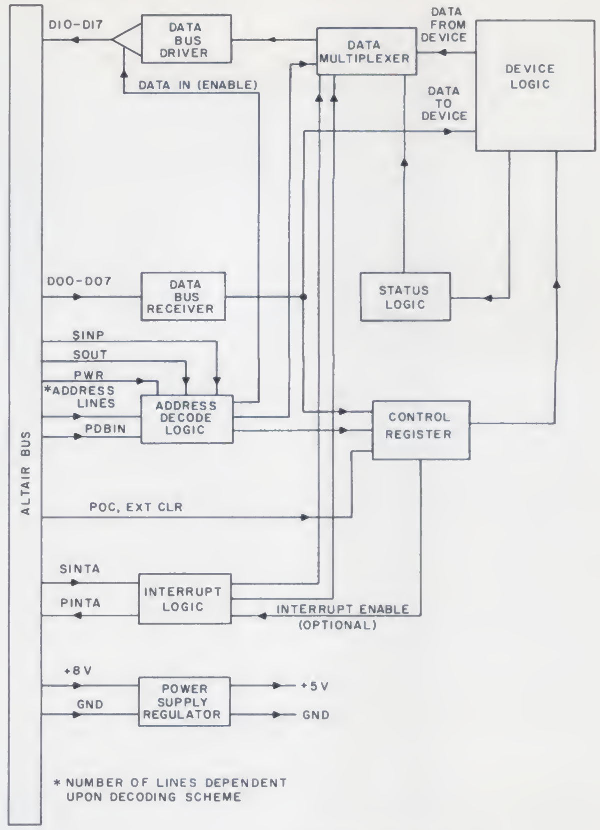


*Fig. 7. Typical I/O Block Diagram.*

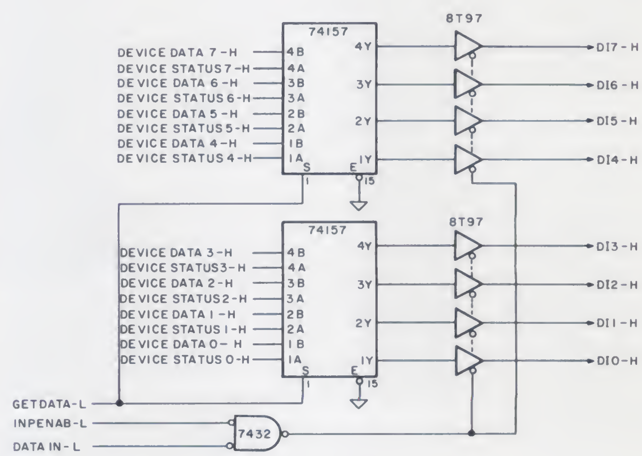


*Fig. 8. Data-In Driver/Multiplexer.*

port I/O address decoding is shown in Fig. 5. An example of memory mapped I/O is given in Fig. 6. A bit chart with addresses is provided in each of these figures. Each is set up to perform an identical function so that you may compare the complexity of one to another.

The next step in the design of the I/O interface is the design implementation. This is the part which is referred to by many people simply as the design stage. This is the actual drawing of the logic diagram in such a way to satisfy the requirements of your conceptual design as well as the fixed requirements of the bus (referred to as bus overhead). To aid you in this area a typical I/O interface block diagram is provided in Fig. 7. Also virtually every I/O interface requires the sending of data to the CPU board. A means of performing this function is shown in Fig. 8. Fig. 8 depicts a method in which data and status are multiplexed into the data buffers. Other methods of accomplishing this include separate 8T97s for the data and the status; thus, eliminating the 74157 multiplexers.

When designing an interface which makes use of large scale integration (LSI) components, the control register, status register, and device logic are all *built in* to a special purpose chip. Examples of this type of chip include the UART, PIA, ACIA, Programmable Peripheral Interface, etc. These chips are very useful because they were designed for microprocessor (or minicomputer) interfacing ease and package count efficiency. When using these devices, the specifications and application notes should be studied carefully, especially in the areas of operating modes, software considerations and performance. In the specification sheets, beware of using the *typical* values. Instead, use the minimum and maximum values as appropriate. This will help to assure glitch-free operation of your finished interface. Since most of these LSI components are MOS (Metal oxide semiconductor) chips, careful attention *must* be paid to output signal loading and timing specifications. Almost without exception, these devices can drive only one TTL load and should therefore be buffered. The 8080 MOS/LSI microprocessor chip itself is a good example of this fact. Notice that all output lines of the 8080 are buffered on the CPU board. Also most of these devices must be *fed* relatively wide timing pulses. In addition, some MOS/LSI devices are dynamic in nature and thus require a constant clock of some minimum frequency. These requirements are all relatively easy to meet, but overlooking them will, in most cases, cause disappointment in the performance of your interface. While these devices are more difficult to use than standard TTL integrated circuits on a chip for chip basis, the large number of chips and the printed cir-

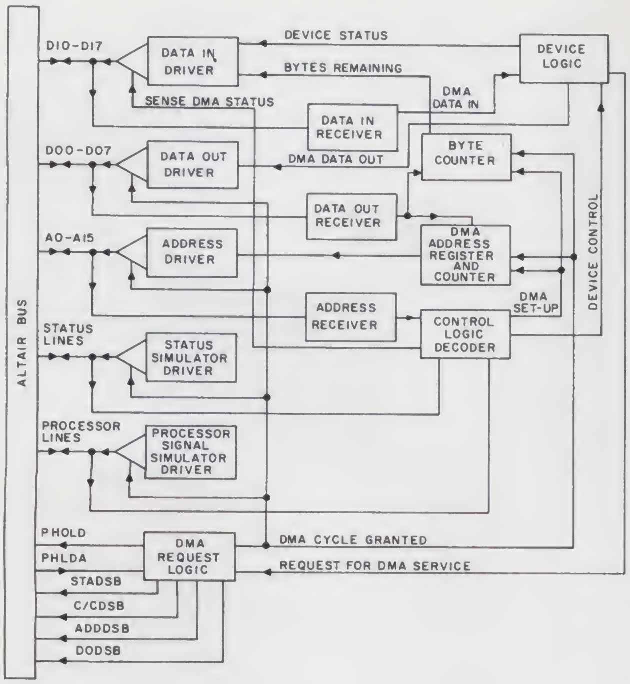


*Fig. 9. DMA Block Diagram.*

cuit space they replace make them very worthwhile additions to an interface design. Also, these devices use far less power than the group of TTL chips they replace. As in the handling of all MOS components, care must be taken in the handling of these devices as they are subject to damage from static charges.

Since the control register and status register are usually incorporated internally in the LSI components, the conceptual design must conform to the available control and status bits provided. In some cases, it is possible to augment the control/status of the LSI chip being used by providing additional external flag bits or status bits. An example of this would be an *interrupt enabled* control bit external to a 1402 UART (which has no such function internally). It is also possible in some cases to combine outputs (by using external gating) in such a way as to make the signals more useful to your unique application. In other cases, it is possible to ignore certain outputs or inputs if they are not suited to your needs. On the unused input signals, it is usually necessary to *tie* the pin high or low or to another driven input. Carefully review the specifications of the device for clues as to the handling of unused inputs. It is easy to be intimidated by the maze of data and buzz words contained in many manufacturers' data sheets. Keep in mind that reading these sheets does *not* require a degree in engineering and that the people preparing the data sheet *want* you to understand it. Also, remember that data sheets *do* sometimes contain errors, so if in doubt, check with the manufacturer or his representative (usually given on the back of the data sheet) or check on the data from a different vendor if the part is second sourced.

As mentioned earlier, it is possible to free the processor of much of the work involved in I/O programming by using direct memory access (DMA). Fig. 9 shows the block diagram of a DMA controller. The basic operation of the controller involves setting the *DMA address register* to the desired starting address and the *byte counter* to the desired number of bytes to be transferred and then allowing the DMA controller (independent of the CPU) to transfer an entire block of data to (or from) the device from (or to) the main memory. When each byte is transferred, the byte counter is decremented while the address counter is incremented. When the byte counter reaches a count of zero, the DMA operation is complete. The DMA transfer consists of a number of a DMA bus cycles which is equal to the number of bytes specified when setting the byte counter. Each DMA cycle is initiated by the device requesting service, which results in HOLD-L being driven low (active). This is then recognized by the CPU board which sychronizes HOLD-L and eventually suspends program activity and responds with HLDA-L. When the DMA controller receives HLDA-L, the *disable* signals STADSB-L C/C DSB-L, ADDDSB-L, and DODSB-L are all brought low which removes virtually all CPU influence from the bus. The DMA controller then drives the disabled signals in such a way as to make the other boards in the system (especially the memory boards) *think* that the CPU is *talking* to them. The direction of the data transfer, the memory address, and all other control functions are determined by the way these lines are driven.

Among the advantages to be gained by using the DMA facility are transfer rates which greatly exceed the maximum programmed data rate (I/O under CPU control). The number of integrated circuits required to implement DMA is rather large, which tends to discourage its use in all but the most demanding situations. In most cases, due to the large number of components involved, the device logic and the DMA logic are contained on separate boards and are interconnected externally from the bus to one another by means of jumper *straps*.

While not one of the more glamorous aspects of computer interfacing, the need for proper power distribution remains ever present. The majority of the logic used in the Altair system requires the use of 5 volts which must be regulated to within 5% of nominal. The bus supplies unregulated positive voltage on pins 1 and 51 at approximately 8 volts. Each board then regulates this down to 5 volts for use on that board. The easiest way to accomplish this regulation is through the use of one of the 3-pin regulators which are available in several ratings and shapes. The two most common types are the 7805 and LM309 regulators. Most commonly, the 7805 comes in the TO-220 package while the LM309 uses the TO-3 package. Either type requires the use of an adequate heat sink as well as input and output filtering. Both types are nominally rated at 1.0 Amps. For current requirements in excess of 1.0 Amps, multiple regulators may be used, or heavier duty types may be used, such as the LM323 which is rated at 3.0 Amps. Also, it is important to bypass the regulated 5 volt line to ground at regular intervals using .01 uF ceramic capacitors. A good rule of thumb is one .01 uF capacitor for each six integrated circuits. Also, follow the manufacturer's guidelines for any special layout requirements. This is especially important in the area of analog interfacing. Don't overlook the importance of good grounding techniques when constructing your interface as deficiencies in this area sometimes show up as ghosts (erratic operation) and rarely can be found by logical means.

Interfacing is a key ingredient in making your computer perform useful functions as well as an interesting part of personal computing. Becoming skilled in the art and science of interfacing will pay many dividends in the enjoyment of this most interesting hobby. ■

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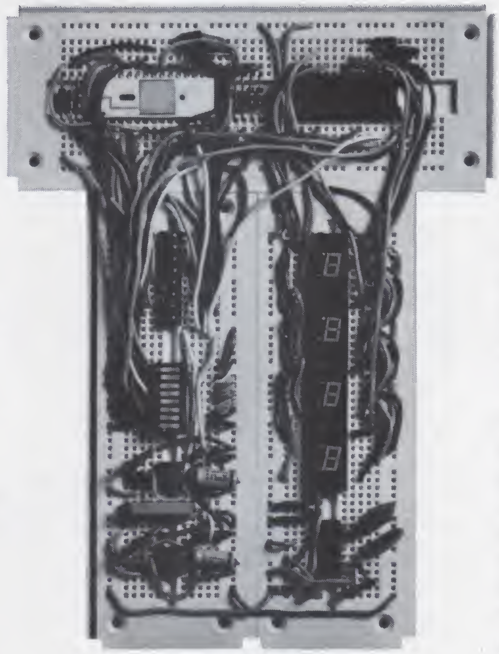

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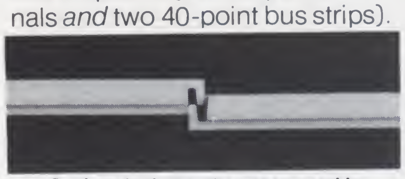

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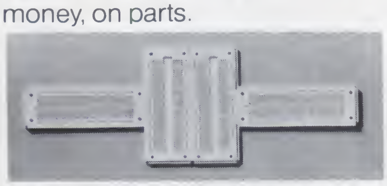

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*Great! Charles has got some fantastic ideas for promoting your computer club* and personal computers *at the county fair . . . and what's really neat is that the ideas will apply to just about any computer demonstration! — John.*

# Computer Club Promotional Techniques

Where can you find a better audience for microcomputers among the general public than at a county fair? People come to see new things, expect to have a good time, and are prepared to spend a little money, especially if they think they're getting a bargain.

### Know Your Audience

Precisely because a fair has an image of rural simplicity, it attracts a lot of sophisticated city slickers wanting to show their kids what a horse looks like. Meanwhile the farmers will be looking around for new ways to make their businesses more profitable. Microcomputers will fit right in with other technological marvels displayed by John Deere and makers of propane toilets.

In fact the farmer probably already uses a data processing service. (A certain small systems journal once bragged of sharing a computer with the American Guernsey Cattle Club, which may explain Wayne's theory that they're full of bull.) And what victim of batch processing wouldn't like to have his own machine?

### Get Started — Now

Once your club recognizes the potential benefits of having a booth at the fair, how can you make it a success both financially and in terms of gaining new members? The first step is to find out when the fairs are in your area and who is in charge. Check with the state bureau which promotes tourism, the AAA, or a club member from a town where a fair is held. If someone in the club has already worked at a fair, he can be a big help. It's not too soon to begin the process now.

You want a chance to reserve a booth in a high traffic location with adequate security and electrical power. My personal favorite is opposite the amusement area, although this is not without its disadvantages. One year I found that after a full day of listening to the same music repeated every five seconds I continued to hear the tune for a half hour after leaving the fair grounds. So if you're going to be showing off computer synthesized music, you might pick a spot near the refreshment stands. If you do want to be near the amusement area, it will be a good argument in your favor if you'll be offering video games.

### Grab Their Attention

What else will you have? Before you can sign up new members for your club you need something to get their attention. A good choice would be a Cromemco TV Dazzler. Place the TV high up toward the back of the booth so the view won't be blocked. This position will often lead to better contrast, though you may have to add a simple cardboard hood to prevent stray reflections.

Another attention-getter would be a Computalker speech synthesizer imitating a carnival barker. If one of your members becomes proficient at keyboard input, the patter could be personalized for the audience present. Or have a few standard subroutines programmed that can be put into action by single keystrokes. Then you could hit T and the computer would challenge all comers to ticktacktoe. Another thing you might do is have certain sentences triggered by pressure sensors or photocells. Example: "I'll make you a deal — I won't lean on you if you don't lean on me."

About now you're probably wondering where you're the last from you yet. Because your club is actually giving something away (everything else you sell). Anybody who stops by is entitled to a free chance at winning a computer hobby magazine subscription. All he has to do is fill in his name and address and answer a few short questions which will allow you to judge whether he's a prospective club member.

So far you've provided a membership form in the newsletter and gotten prospects through your prize drawing. Just so nobody feels left out you'll also have a sign-up sheet.

### It Gets Better

Finally you're all set to go. You arrive the first day of the fair prepared to fascinate hordes of the curious. Pretty soon you're wishing a lightning strike on the MOS chips of whoever got you into this fiasco. Unless, that is, you remember I told you things would start off slow.

The first day is the time to double-check everything and take turns looking over the other exhibits. Build up your inventory of printouts. Get out front and play a game. Out front's a good place to be anyway as you'll have more personal contact with passersby. *Don't sit around doing nothing.* If you look bored with your own show why should anyone else give it a second glance?

Evenings and on the weekend the crowds will increase and enough money to pay for the booth will finally dribble in. Your club exhibit will be prominently featured in TV, radio, and newspaper coverage of the fair. There will be a lot of your newsletters in circulation. The club will have some new members and lots of prospects. Next you notice you're in grave danger of making money on the project. In short, you've discovered that no computer club should miss out on the local fair. ■

# ... when you can't afford Madison Ave.

going to get all this hardware. The answer is on the sign on the back wall of the booth: "Following equipment courtesy of Cooperative Computer Dealer, Inc." He'll realize his demonstrators will be seen by thousands more people at your booth than in his store.

### Give Them a Bargain

Now that you've got people interested it's time to educate them and make your pitch for club membership. This is done in part by a special issue of your newsletter. While it carries the standard price in big print a sign says you're selling it for a penny during the fair. That's alright because ads for local electronics and hobby stores paid for the printing.

So why bother to charge a penny for it? Many fair-goers pick up all the freebies they can get and never look at them again. Your advertisers will appreciate knowing they're reaching a selective audience.

What's in the newsletter? It starts with introductory articles such as "What You Can Do With a Computer" and "Why Join a Computer Club?" There's notice of a club meeting you're having in the week after the fair ends. A club membership and newsletter subscription form is included. And there is the name and address of your club.

### Don't Let Them Forget You

*Everything* people carry away from your booth will include the name and address of your club. Biorhythm charts and pictures of Alfred E. Newman and Snoopy produced on your printer will have this typed on them. Paper tape with a message punched in it will be rubber stamped. The only exception is that when you break a dollar bill for someone you don't have to mark the change. To make up for this you'll have a large banner telling the folks who's responsible for the best show on the grounds.

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# Artillery Practice

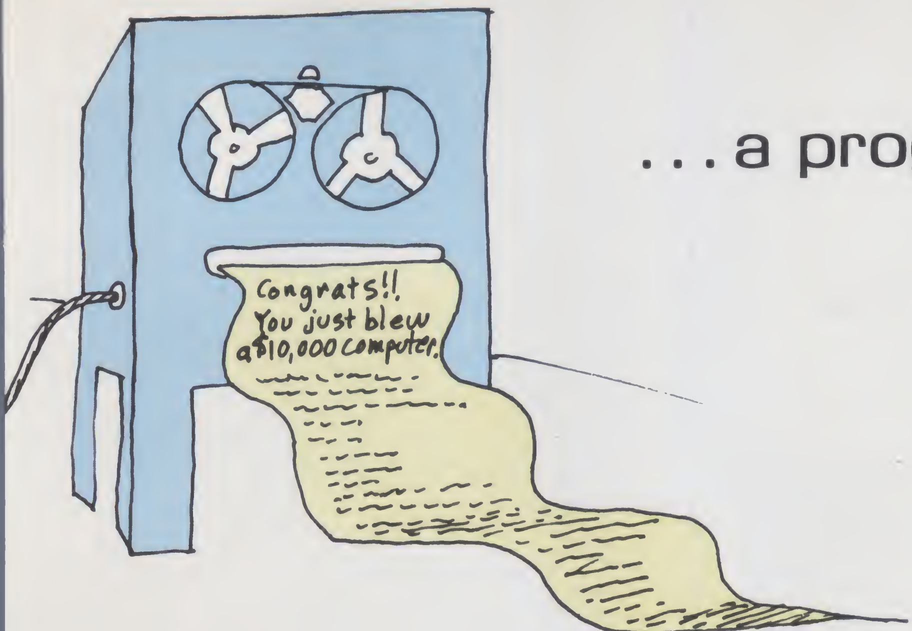
This program was written to simulate practice firing of artillery. The range covers 180 degrees from right to left, with 90 degrees straight ahead. The maximum distance you can shoot (elevation 45 degrees) is 4,650 feet. The only information you will be given is the X and Y coordinates of the target. From this you must estimate the angle to elevate the artillery and the angle to rotate it so the shot will hit the target. This simulation will fit a cannon or mortar because 15 degrees and 75 degrees will both hit the same point.

To make this more interesting, it is written as a game to play with your friends (1 or 2, or up to 10 can play along with you). The computer picks the target, reports the hits, keeps score and declares the winner, but does not enter in the competition. I find there is one drawback to this type of game. Once your friends have control of the computer, they might not want to return it to you.

This program was written for the SWTP 6800 with the CT-1024 CRT terminal and 8K BASIC. At least 10K of memory is needed. A flowchart (Fig. 1) is included for those who want to rewrite the program. The SIN, COS, and SQR statements are needed, but the DIGITS is not. Without DIGITS, the use of ABS in *all calculations* should make all lists in feet. This should be plenty good enough.

The use of the CRT terminal forces the use of short (32 character) lines and the use of HOME UP and ERASE EOL cursor controls. There are 5 PRINT "";  statements in the listing, and all contain the commands for a new frame in the quotation marks. The subroutine at 2100 is designed to hold a frame on the CRT until ready

*Herman DeMonstoy*
*2 Pioneer Rd.*
*Painted Post NY 14870*




# . . . a program eliminates white sand!

```
RUN
THIS IS A TARGET PRACTICE GAME
INSTRUCTIONS? YES

THE ELEVATION LOOKS LIKE THIS.

                 *      *
              *            *
          *                   *
YOU /                             +
         ELEVATION             TARGET

AN ELEVATION FROM 0 TO 45 WILL
INCREASE THE DISTANCE, BUT
BEYOND 45 THE DISTANCE WILL GET
SHORTER UP TO 90, WHEN IT WILL
GO STRAIT UP AND BACK ON YOU

HIT 'CR' TO CONTINUE?

ARTILLERY RANGE DIRECTION

                  90
                  :
                  :  Y
                  :
180  -X           :                X   0
------------- YOU ---------------

DIRECTION CAN BE FROM 0 TO 180
WITH 0 AT RIGHT,180 AT LEFT,
AND 90 STRAIT AHEAD.
NOTE X IS MINUS FROM 90 TO 180

HIT 'CR' TO CONTINUE?

YOU ARE TO FIRE AT A TARGET
AT THE X AND Y COORDINATES
LISTED. YOU WILL BE GIVEN THE
DISTANCE FROM TARGET AND THE
COORDINATES OF EACH OF 3 SHOTS
FIRED. A FINAL SCORE WILL BE
LISTED AFTER EVERYONE IS DONE.

LIST YOUR NAMES IN ORDER, WHEN
ASK. GOOD LUCK.
HOW MANY PLAYERS? 3

PLAYER 1 NAME? RON
PLAYER 2 NAME? STEVE
PLAYER 3 NAME? JIM
RON, YOUR TURN
TARGET AT X,Y 2662.6 , 2944.8
EL.,DIR.? 24,47
517.6 FT.AWAY 2356.7 , 2527.2

EL.,DIR.? 28,47
129.9 FT.AWAY 2629.1 , 2819.3

EL.,DIR.? 29.3,48.1
15.2 FT.AWAY 2650.6 , 2954.1

HIT 'CR' TO CONTINUE?

STEVE, YOUR TURN
TARGET AT X,Y 1435.0 , 562.4

EL.,DIR.? 9,22
105.5 FT.AWAY 1332.2 , 538.2

EL.,DIR.? 9.8,22
24.5 FT.AWAY 1446.2 , 584.3

EL.,DIR.? 9.65,21.8
11.5 FT.AWAY 1426.9 , 570.7

HIT 'CR' TO CONTINUE?

JIM, YOUR TURN
TARGET AT X,Y 2541.1 , 1987.3

EL.,DIR.? 24,38
229.5 FT.AWAY 2723.0 , 2127.4

EL.,DIR.? 22.5,38
62.0 FT.AWAY 2591.0 , 2024.3

EL.,DIR.? 22,38
4.4 FT.AWAY 2545.4 , 1988.6

HT 'CR' TO CONTINUE?

PLAYER              BEST SHOT

RON                   15.2 FEET
STEVE                 11.5 FEET
JIM                    4.4 FEET

*** WINNER IS *** JIM
ANOTHER GAME? NO
HOPE YOU LIKE THE ARTILLARY
RANGE. COME AGAIN.

END
```

*Fig. 2. Sample run as viewed on CRT.*

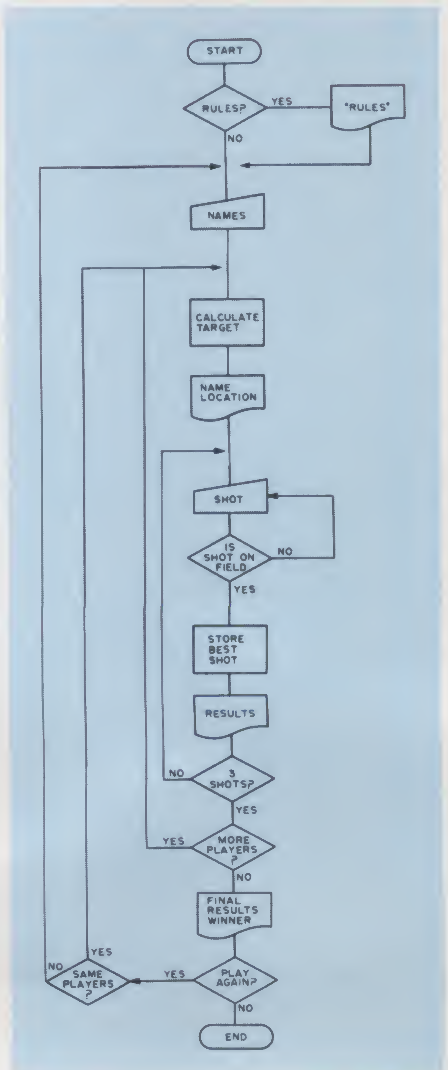



*Fig. 1. Flowchart.*

to go on. If you are going to use a TTY, then all the statements for control of the CRT terminal can be eliminated.

As the game is now, each player has 3 tries, of which the best is used in the final calculations for the winner. A sample run is shown in Fig. 2. I can see many ways to vary this game. Change the "amount of powder" to change the distance of shell travel. What happens if there is wind? This would make the cannon and mortar hit at different points. How about a handicap for the expert? Form teams and shoot at each other? Maybe that would be considered WAR and not practice.

I hope you enjoy the practice and can keep your computer in control. ■

```
0010 REM ** ARTILLERY PRACTICE **
0020 REM FOR 8K BASIC AND CRT
0030 REM BY H. DEMONSTOY 1-6-77
0040 REM RUN ON SWTP6800 WITH
0050 REM CT-1024 CRT TERMINAL
0060 REM 10K MEMORY NEEDED
0100 PRINT "THIS IS A TARGET PRACTICE GAME"
0110 INPUT "INSTRUCTIONS",Q$
0120 GOSUB 2200
0130 IF F=0 GOTO 490
0140 REM INSTRUCTIONS PAGE 1
0145 PRINT "";
0150 PRINT "THE ELEVATION LOOKS LIKE THIS."
0160 PRINT
0170 PRINT "              *       * "
0180 PRINT "          *               * "
0190 PRINT "      *                       * "
0200 PRINT "YOU /                            + "
0210 PRINT "        ELEVATION            TARGET"
0220 PRINT
0230 PRINT "AN ELEVATION FROM 0 TO 45 WILL"
0240 PRINT "INCREASE THE DISTANCE, BUT"
0250 PRINT "BEYOND 45 THE DISTANCE WILL GET"
0260 PRINT "SHORTER UP TO 90, WHEN IT WILL"
0270 PRINT "GO STRAIT UP AND BACK ON YOU"
0280 GOSUB 2100
0284 REM INSTRUCTIONS PAGE 2
0285 PRINT "";
0290 PRINT "ARTILLERY RANGE DIRECTION"
0300 PRINT
0310 PRINT "                  90"
0320 PRINT "                  : "
0330 PRINT "                  : Y"
0340 PRINT "                  : "
0350 PRINT "180 -X            :              X    0"
0360 PRINT "------------ YOU ------------"
0370 PRINT
0380 PRINT "DIRECTION CAN BE FROM 0 TO 180"
0390 PRINT "WITH 0 AT RIGHT,180 AT LEFT,"
0400 PRINT "AND 90 STRAIT AHEAD."
0405 PRINT "NOTE X IS MINUS FROM 90 TO 180"
0410 GOSUB 2100
0419 REM INSTRUCTIONS PAGE 3
0420 PRINT "";
0430 PRINT "YOU ARE TO FIRE AT A TARGET"
0435 PRINT "AT THE X AND Y COORDINATES"
0440 PRINT "LISTED. YOU WILL BE GIVEN THE"
0445 PRINT "DISTANCE FROM TARGET AND THE"
0450 PRINT "COORDINATES OF EACH OF 3 SHOTS"
0455 PRINT "FIRED. A FINAL SCORE WILL BE"
0460 PRINT "LISTED AFTER EVERYONE IS DONE."
0465 PRINT
0470 PRINT "LIST YOUR NAMES IN ORDER, WHEN"
0475 PRINT "ASK. GOOD LUCK."
0489 REM GET LIST OF PLAYERS
0490 INPUT "HOW MANY PLAYERS",P
0500 DIGITS= 0
0505 PRINT "";
0510 FOR I=1 TO P
0520 PRINT "PLAYER ";I;"NAME";
0530 INPUT P$(I)
0540 NEXT I
0659 REM MEASURE TO .1 FEET
0660 DIGITS= 1
0670 FOR I=1 TO P
0679 REM CALCULATE TARGET
0680   X=2600*RND+500
0690   Y=2600*RND+500
0700 IF RND >.5 THEN X=-X
0709 REM START PLAY-NEW PAGE
0710 PRINT "";
0715 PRINT P$(I);", YOUR TURN"
0720 PRINT "TARGET AT X,Y ";X;", ";Y
0730 FOR J=1 TO 3
0735 PRINT
0740 INPUT "EL.,DIR.",B,C
0749 REM KEEP SHOT ON THE RANGE
0750 IF B <90 THEN IF B >0 GOTO 760
0755 GOTO 2000
0760 IF C <180 THEN IF C >0 GOTO 770
0765 GOTO 2020
0769 REM GET SPOT HIT
0770   A=3.14159/180
0780   D=ABS(9300*SIN(B*A)*COS(B*A))
0790   X1=D*COS(C*A)
0800   Y1=D*SIN(C*A)
0810   D1=SQR ((X-X1)*(X-X1)+(Y-Y1)*(Y-Y1))
0819 REM KEEP BEST SHOT
0820 IF J=1 THE D(I)=D1
0830 IF D(I) >D1 THEN D(I)=D1
0840 PRINT D1;"FT.AWAY ";X1;", ";Y1
0850 NEXT J
0860 GOSUB 2100
0870 NEXT I
0889 REM NEW PAGE-FINAL RESULTS
0890 PRINT "";
0900 PRINT "PLAYER","BEST SHOT"
0905 PRINT
0910 FOR I=1 TO P
0920 PRINT P$(I),D(I);"FEET"
0930 IF I=1 THEN W=D(I)
0940 IF W >D(I) THEN W=D(I)
0950 NEXT I
0955 PRINT
0960 FOR I=1 TO P
0970 IF W=D(I) THEN PRINT "*** WINNER IS *** ";P$(I)
0975 NEXT I
0980 INPUT "ANOTHER GAME",Q$
0990 GOSUB 2200
1000 IF F=0 GOTO 1800
1010 INPUT "SAME PLAYERS",Q$
1020 GOSUB 2200
1030 IF F=0 GOTO 490
1040 GOTO 660
1800 PRINT "HOPE YOU LIKE THE ARTILLARY"
1810 PRINT "RANGE. COME AGAIN."
1819 REM GO TO FLOATING DECIMAL
1820 DIGITS= 0
1900 END
2000 PRINT "WRONG ELEVATION"
2010 GOTO 740
2020 PRINT "WRONG DIRECTION"
2030 GOTO 740
2100 PRINT
2110 INPUT "HIT 'CR' TO CONTINUE",Q$
2120 RETURN
2200 IF LEFT$(Q$,1)="N" GOTO 2240
2210 IF LEFT$(Q$,1)="0" GOTO 2240
2220   F=1
2230 RETURN
2240   F=0
2250 RETURN
2260 END
```

*Program listing.*

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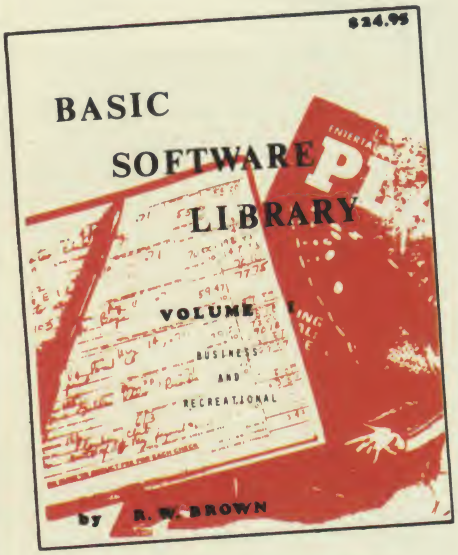



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This library is the most comprehensive work of its kind to date. There are other software books on the market but they are dedicated to computer games. The intention of this work is to allow tha average individual the capability to easily perform useful and productive tasks with a computer. All of the programs contained within this Library have been thoroughly tested and executed on several systems. Included with each program is a description of the program, a list of potential users, instructions for execution and possible limitations that may arise when running it on various systems. Listed in the limitation section is the amount of memory that is required to store and execute the program.

Each program's source code is listed in full detail. These source code listings are not reduced in size but are shown full size for increased readability. Almost every program is self instructing and prompts the user with all required running data. Immediately following the source code listing for most of the programs is a sample executed run of the program.

The entire Library is 1100 pages long, chocked full of program source code, instructions, conversions, memory requirements, examples and much more. ALL are written in compatible BASIC executable in 4K MITS, SPHERE, IMS, SWTPC, PDP, etc. BASIC compilers available for 8080 and 6800 under $10 elsewhere.

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*Harley Dyk*
*Math-Electronics Instructor*
*Mona Shores High School*
*Norton Shores MI 49441*

# Put a Micro in Your School

## ... getting started with zero bucks!

*I've seen other teachers go through the problems which Harley describes here in acquiring computers for their schools. Perhaps his experience will help other teachers with the same objectives. More important, his story might fire up those of you who aren't teachers to start looking at ways and means of getting computers into your children's schools. As a matter of fact, reprints of this article could be used as part of the ammunition in convincing a school board to buy a few microprocessor systems (especially with Sheila's happy smiling face as part of the package!). — John.*

I was introduced to computer programming in the summer of 1970 while taking graduate courses in mathematics at Central Michigan University. An introductory course in FORTRAN on the good old IBM 1130 very quickly made an addict of me. Keypunching all your own cards (the system was strictly batch) and losing 10 points on every problem for each time your program failed to run correctly was quite far removed from having your own microprocessor in your basement, but compared to nothing it was great and I was hooked.

*The way we were — Harley Dyk sitting at the keyboard of the retired Model 26 keypunch (photo by LCDR F. Wayne Brown).*

### Starting a High School Computer Class with Zero Bucks

Upon returning to teaching in the fall, I immediately began looking for computer time for 3 reasons. First, if I could so easily become hooked on programming and enjoy it so much, why couldn't (and shouldn't) high school students have the same opportunity and experience? Also, I felt that any student who wanted to learn the basics of programming or was curious about computers should have the opportunity to be exposed. Last, I needed some computer time to satisfy my addiction.

My search turned up the fact that our intermediate school district was the cheapest source of computer time. Our school district was paying a fixed amount per student for scheduling, report cards, etc., and could use the computer for instructional purposes at no additional cost. To make the arrangement irresistible, they agreed to do the keypunching. Since my school board favors most proposals that have little or no cost attached, the fall of 1971 found me teaching a new course called Computer Math. The FORTRAN language was used for 2 reasons: This was the only language I knew, and the computer center had a little used FORTRAN compiler on the shelf for the Honeywell 200.

Things went as well as could be expected. In spite of shuffled card decks, dropped program decks, lost programs, coding forms returned unpunched, computer breakdown, Murphy's Law, etc., some programming was taught. But who could complain? The price was right. But after a year the computer center moved to new facilities 10 miles away; consequently it was impossible to arrange transportation of coding forms, have them punched, program decks run, and returned by the next day. If you think it is bad to wait 24 hours to find out you used a comma where you needed a period, try 48 hours! Solution? Lease a keypunch, find a student to keypunch, offer her a credit in keypunching, and presto, back to 24 hour turnover.

Unfortunately the computer center was not on my route home, and as time went on, finding someone to pick up and deliver cards twice a day became more difficult and expensive. We were now spending about $150 a month on the keypunch, card delivery, and cards. The only good thing about our setup was that we had no limit on how many programs we could run each day.

It seemed like a logical time to begin thinking about and examining alternatives. Was something better available for $150 a month? A check of high schools in the area yielded the fact that one high school had decided that buying computer time via phone line and Teletype was getting too expensive and had leased a $14000 DEC PDP-8 with 2 Teletypes on time-sharing but at considerably more than $150 a month.

### A Dream

January, 1975 — enter the Altair 8800 computer via *Popular Electronics*. I wondered if there really was a garage in Albuquerque where this invention was being put into production. September of 1975 found me researching what was available for use in teaching my class. At this point I was convinced that we needed and could afford our own system. My goal — to get a computer system in my room by September, 1976 no matter how much work and time it took.

*Computer Math student Sheila Beaver at Teletype and Altair 8800A (photo by Gary Reed).*

### Conception

After seeing a DEC Classic and PDP-8 in action at other schools and attending the MITS Computer Caravan, I wrote a proposal for my school board to act on. My proposal outlined my rationale and presented 3 systems: The DEC Multiuser/11V03 at $20,000 (4 simultaneous users — 3 in BASIC and 1 in FORTRAN if desired), the DEC Classic with mark sense card reader at $17,000 (FORTRAN and BASIC), and 2 Altair 8800s at about $7,000 (BASIC only).

### A Difficult Pregnancy

I gave the superintendent the proposal in January of 1976 and was scheduled for the March 8th board meeting to present my ideas. Unfortunately 3 board members were out of town for the meeting and the other 4 did not feel adequately familiar with my proposal, so it was tabled until March 22nd when hopefully all members would be present for a more fruitful discussion. The March 22nd meeting was more productive, but still it was obvious that no one really had an idea how microprocessors were being used in high schools. My proposal was eventually tabled indefinitely — the money situation was not clear at that time and a millage (tax adjustment) election was coming.

The next few months found me educating my principal and assistant principal and later the school board president (an engineer familiar with computers). I simply took them to a high school that was using a DEC Classic configuration and exposed them to the enthusiastic instructor and students.

June brought a millage defeat and a last ditch effort. I rewrote my proposal, eliminating the more expensive DEC systems and asking for the Altair system. Having originally approached the school board with options was fast becoming a wise decision because the least expensive option was becoming more acceptable. Since I had written my original proposal, MITS had introduced the 16K static memory board, improved the 8800 yielding the 8800A, and Michigan now had its first computer store in Ann Arbor. I also had the chance to talk to a couple of Altair owners and was convinced that it could do what we needed. I mailed copies of my new proposals to the board members and superintendent and waited.

About the middle of July (a new superintendent had assumed his duties July 1), I received a phone call indicating that some money had been located and that I should come in for further discussion. July 27 found me at a third board meeting. Now I found out that had the administration and I come with a recommendation to buy a $20,000 system, we probably would have been given approval. But we were proposing the Altair system and were given an OK to proceed, pending a checkout of MITS and the local store. They checked out fine. Finally, on August 5th, I grabbed the phone and ordered our computer system (before anyone could change their mind). The order was for 2 Altair 8800As, each with 16K static memory, serial I/O board, ACR board, and RQ-413 Panasonic recorder. One computer was to have an ASR-33 Teletype (for needed hard copy), and the other an ADM/3 Lear-Siegler CRT. We also ordered 8K BASIC, Extended BASIC, and a supply of Maxell UDXL C-60 cassette tapes. Total cost was about $7000.

While waiting for the system, the Computer Store rushed me the BASIC manual and I boned up since I had not written any programs in BASIC. There was no real need for panic, school was not to start for at least 4 weeks. I found the transition from FORTRAN to BASIC very natural, easy and enjoyable. The fine manual on MITS BASIC helped a great deal. I doubt if switching from BASIC to FORTRAN would be as painless.

### Birth

Our system was tentatively scheduled to be delivered September 1, but the Computer Store was experiencing labor (growth) pains and was

*Computer Math student Mark Tietsort at CRT and Altair 8800A (photo by Gary Reed).*

not receiving shipments from MITS when expected, so birth was not quick and painless. The fact that I am 3 hours from the Computer Store did not help either.

The teletype was the first item to arrive. I had ordered the ASR-33 directly from the Teletype Corp., from whom I received excellent cooperation. The Teletype was delivered to my room at school exactly 28 days after I had phoned in the order!

Labor Day found me picking up the first computer (sweet labor!) from a brother-in-law of the store owner. He had just come back from Ann Arbor and was only about 45 minutes from me. The store had still not received any assembled units so had sent me their demo and were assembling a kit for me. The next week found me furiously programming in my basement by night while we began a week long unit on flowcharting in my class. The keypunch machine was still in my classroom, but we ignored it.

In late September the Computer Store put on a demonstration in my room for area high school instructors showing the 8800A, 8800B, 680, disk, etc. I was supposed to get the second computer then and keep the demo so I could be totally up and running. However, a bad ACR board prevented this. A few weeks later the second system was delivered (students had been saving programs on cassette from the CRT computer). However this ACR board would not allow us to save programs, only load them. At least we could load BASIC and load programs from the other computer, and use the paper tape feature of the Teletype to save programs. Some time later we got another ACR board and were totally up and running. Birth was complete!

**Early Childhood**

In spite of a difficult pregnancy and birth, early childhood has made it all worthwhile. Once our system was completed, we have had no hardware problems. I have loaded and saved hundreds of programs on cassette and have had only one failure which may have been due to my error. The computers are left on all the time (the terminals are turned off at night) so that loading Extended BASIC (which takes from 8 to 10 minutes) does not have to be done each morning. Occasionally BASIC may start acting strange or die, so each computer is loaded probably on an average of every 2 or 3 weeks. We have been using Extended BASIC Ver. 3.2 which gives us 5984 bytes for programming and 100 bytes for string space. This is adequate memory for most programs, but some games written by my students could have used more memory. I am sure that if we had 64K someone would still complain! We have found a few flaws in the Extended BASIC Ver. 3.2 but they are nothing that we couldn't program around. The flaws should be fixed in the 4.0 version which we have on order.

The computers are housed in a 10' by 10' office adjacent to my classroom so programmers can come during any hour without bothering the class in session. They have been used an average of 5 hours a day. It was decided to try time and material for maintenance on everything except the Teletype, on which we have a service contract for $216 for the nine month school year.

I was always under the impression that FORTRAN was a more powerful language than BASIC, but I have been able to do all my old FORTRAN programs in MITS BASIC and am very impressed with it. Some programs took more steps in BASIC, but the majority were easier to do in BASIC. I am no longer a member of STAB (Society To Abolish BASIC); as a matter of fact, I think STAB is dead.

The students love the computers, 2 or 3 of them are seriously considering purchasing their own system. One student has one on order for graduation. He thinks it is great that computers cost less than new cars, but he laments the fact that he can not take his girl out in a computer. The computers have been in such demand that the students created a number system to determine whose turn it was to work on the computer.

**Conclusion**

The main reason I wrote this article was to urge hobbyists (who may also be parents) to begin insisting that their junior high and senior high schools have computer classes and facilities. Many teachers (particularly math teachers) have had some education in programming, but are not familiar with the cost and capabilities of microprocessors. If you fall in this category, get off your duff and get your hands on a microprocessor. Find out if you can appropriate a couple of thousand for a system for your class. It's worth the effort! You will wonder why you didn't do it before. True, a system will cost less next year, but it is affordable now, and can you put a price on the education this year's students will miss?

Hobbyists, help that teacher get started. Maybe he is hardware shy, maybe he would be ready to move if someone in the community would be willing to help him get a system up and running. You can now buy a system (decent quality by my estimation) with 12K memory, 8K BASIC, connected to a keyboard, 16 line with 64 character video monitor, and cassette for under $1300. True, the computer itself is in kit form. But again, find someone to help; help is available if you look, or better yet, put it together yourself. With some assembly (maybe 50 hours), one should be able to set up 2 systems, one as above, another like it but with a Teletype, for about $3000. You could provide 4000 student hours on a computer in 2 years, not bad at less than $1 per hour!

Our baby is healthy, but my students have indicated in a recent survey I distributed that he must grow. They think we will need at least another terminal or system next year (due to increasing interest and more students in the class). We could use faster hard copy, and a floppy disk would be very useful. OK, where are the catalogues? Hm . . . time-sharing, line printer, floppy disk, DecWriter II, more memory . . . Say, when is the next board meeting? ■

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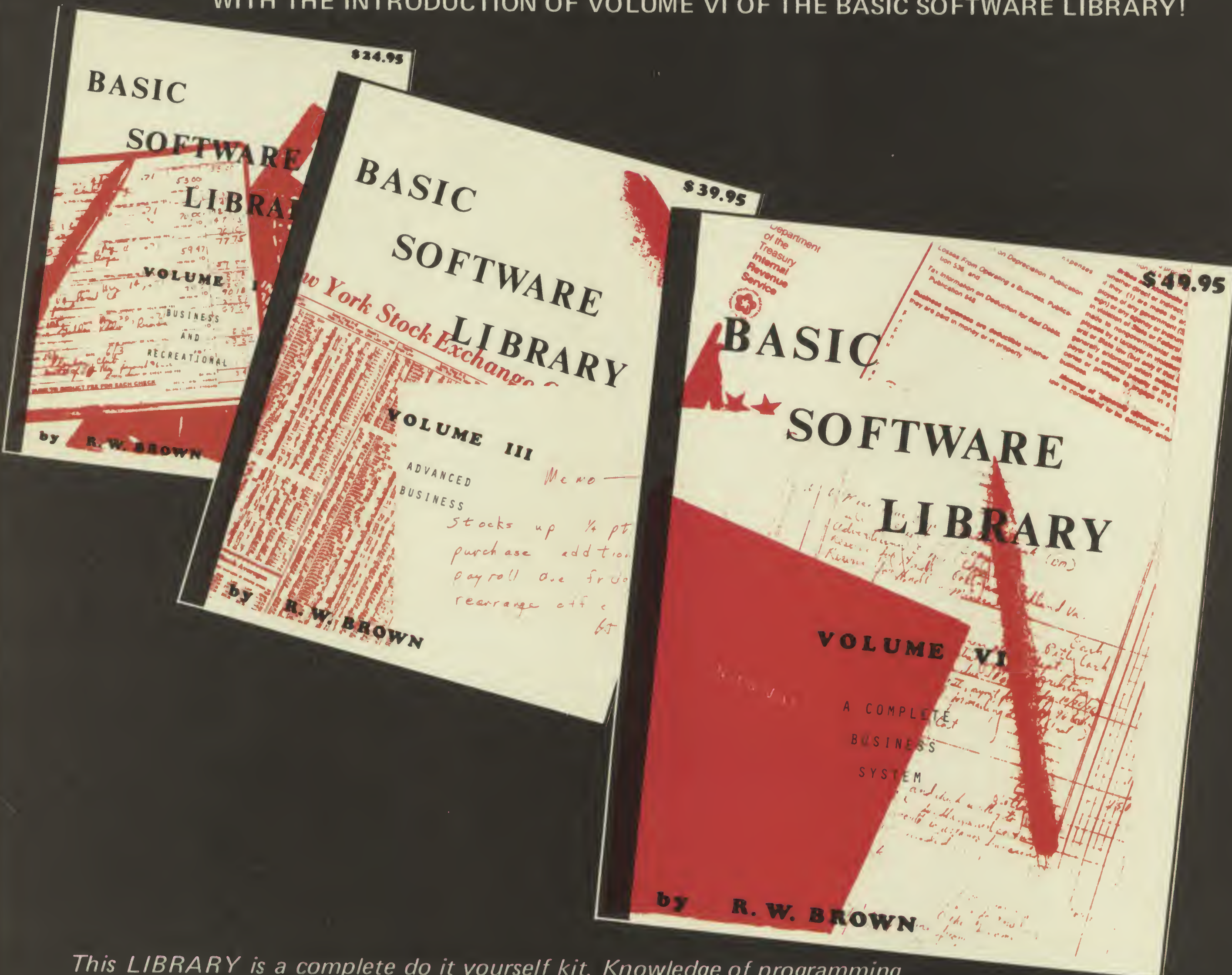


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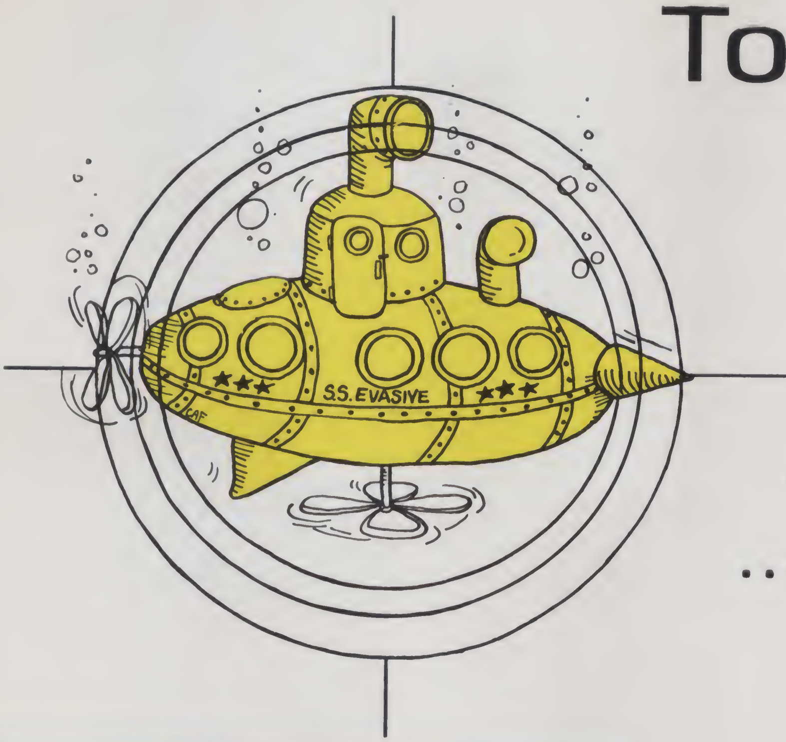


## ... submarine game for the SR-52

*Charles G. Hanson*
*Box 612*
*Carmel IN 46032*

Peter Stark (*Kilobaud #2*, p. 70) has created an interesting game concept for use on the SR-52. Unfortunately, his implementation has resulted in a game which is virtually unwinnable, and hence, is likely to generate terminal frustration on the part of the player. There are three major difficulties which I have eliminated in the attached program listing.

First, Pete's version provides the player no information concerning the location of the submarine which is directly usable in improving his next shot. The information consists only of a distance by which you missed. It is necessary to plot this information on a piece of graph paper in order to establish a new target point, but note that the sub could be anywhere on the circle. Firing a second shot will allow you to draw a second circle which will allow you to zero in on two possible areas in which the sub might be hiding. A third shot should now get you close enough to a defi-

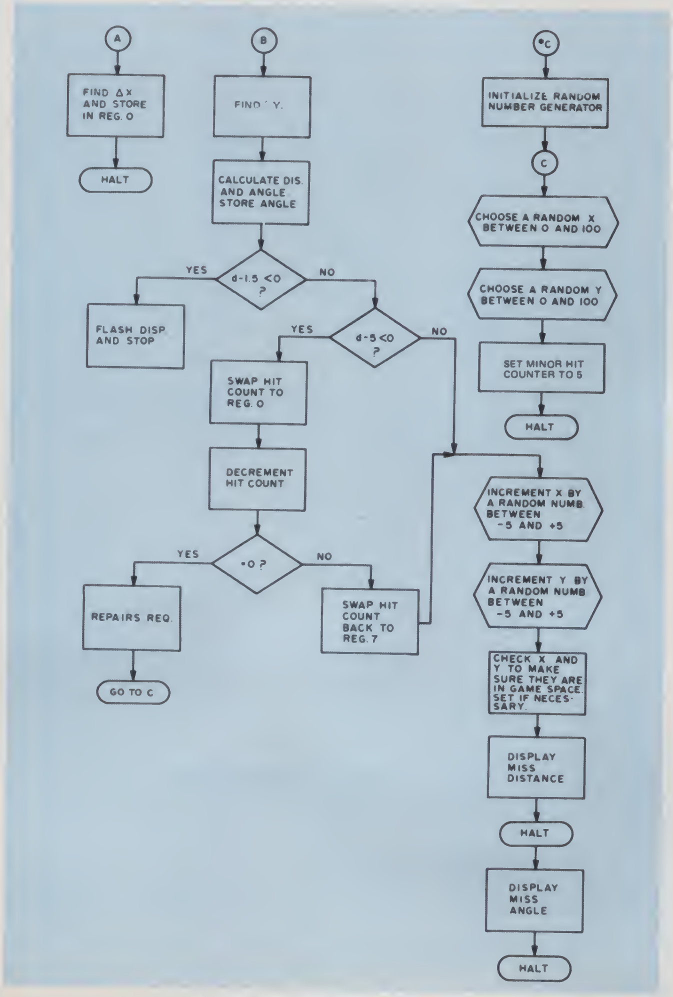


*Fig. 1. Flowchart of game.*

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nite locale that you have a fair chance for a minor hit on the fourth shot.

But before you get your hopes too high, note that after every shot the sub moves to a new location somewhere within a grid of 100 points centered on its previous position. However, you only have that previous position within a probable grid of maybe 16 points. This means that your fourth shot is aimed at a grid of approximately 196 points, including uncertainty. Now consider that there are only 69 points within the minor hit circle and that only one of them is a kill, and you will understand why I suggest that this game could easily lead to a severe case of frustration.

However, there is still one more gremlin lurking within Pete's game. You are playing the game with the impression that the sub is lying within a grid defined as $0 \leqslant X \leqslant 100$, and $0 \leqslant Y \leqslant 100$. It is not, and in fact you will probably be outside the allowed range during your first game. This is because Pete allows his random number generator to start with a seed of zero, which means that the first number generated is 100, which is precisely on the border. In addition, there is no routine included which will prevent the position jogging part of the program from generating a subsequent position between 100 and 105. The highest number that I saw before discovering this aspect of the problem was 108.

Therefore, in the interest of preserving the sanity of all SR-52 owners who would like to play Submarine, I submit the attached program which does the following:

1. Restricts the sub to the 0 to 100 grid.
2. Places 9 points within the kill zone.
3. Provides direction as well as range for the player who wants it.
4. Assures that the sub begins the game well inside the grid.

A comparison of the attached flowchart with Pete's will show the important differences. I have also used the Texas Instrument conventions in indicating keystrokes.

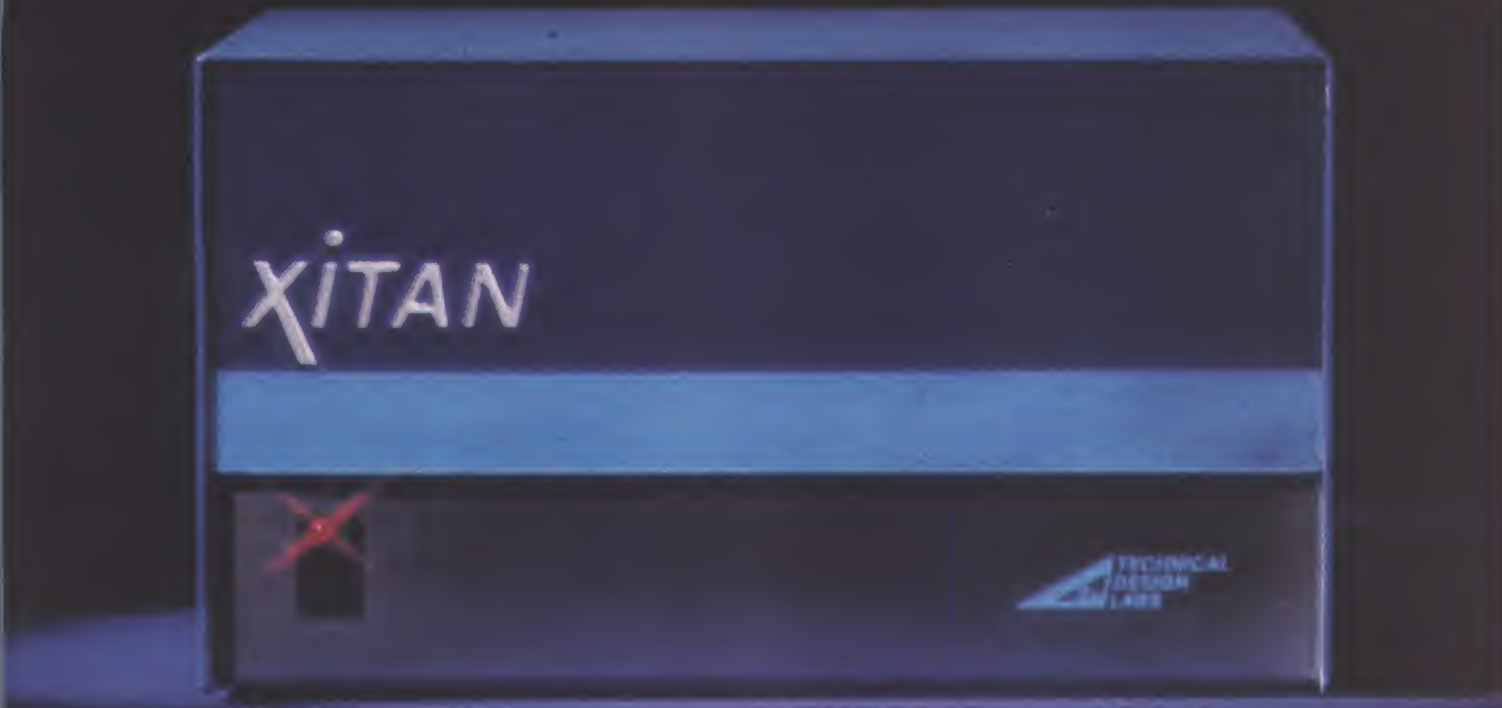
The new rules of play are as follows:

1. Start the first game by pressing *C
2. Enter your target x Press A
3. Enter your target y Press B
4. Flashing display indicates a kill. Begin a new game by pressing CLR, C
5. Steady display shows the distance by which you missed (same as Pete's version).
6. Press RUN to display the angle to the target in polar notation. Your target point is considered the origin. Skipping this step will not affect program operation.
7. Enter new target locations as above.

Good hunting! ■

| Location | Keystrokes | Comments |
|---|---|---|
| 000 | *LBL A | Enter x for depth charge |
| 002 | +/- + RCL 0 1 = | Calculate $\Delta$ x |
| 008 | *EXC 0 0 HLT | Store in register 0, wait for y value |
| 012 | *LBL B | Enter y value for depth charge |
| 014 | +/- + RCL 0 2 = | Calculate $\Delta$ y |
| 020 | INV *P/R | Calculate distance and angle |
| 022 | STO 0 4 | Store angle in register 4 |
| 025 | RCL 0 0 - 1.5 = | compare distance to 1.5 for kill |
| 033 | *if pos *4 | If greater, skip to *4 |
| 035 | 0 *1/x HLT | If less, Flash display and stop |
| 038 | *LBL *4 | |
| 040 | RCL 0 0 - 5 = | Compare distance to 5 for minor hit |
| 046 | *if pos *6 | If greater, skip to *6 |
| 048 | *EXC 0 7 | If less, swap hit counter from register 7 |
| 051 | *EXC 0 0 | to register 0 |
| 054 | INV *dsz C | Decrement hit counter, skip to C on zero |
| 057 | *EXC 0 0 | Put distance back in register 0, swap hit |
| 060 | *EXC 0 7 | counter back to register 7 |
| 063 | *LBL *6 | |
| 065 | SBR *1 | Get a small random number |
| 067 | SUM 0 1 | Move sub sideways |
| 070 | SBR *1 | Get another small random number |
| 072 | SUM 0 2 | Move sub vertically |
| 075 | RCL 0 1 | |
| 078 | INV *if pos *7 | If new x position is less than 0, go to *7 |
| 081 | - 1 0 1 = | |
| 086 | *if pos *9 | If new x is greater than 100, go to *9 |
| 088 | RCL 0 2 | |
| 091 | INV *if pos *3 | If new y is less than 0, go to *3 |
| 094 | - 1 0 1 = | |
| 099 | *if pos *5 | If new y is greater than 100, go to *5 |
| 101 | RCL 0 0 HLT | Display miss distance and stop |
| 105 | RCL 0 4 HLT | Display miss angle and stop |
| 109 | *LBL *C | |
| 111 | *CMs | |
| 112 | * $\pi$ *log | Initialize seed of random number generator |
| 114 | STO 0 3 | to be nonzero and store in register 3 |
| 117 | *LBL C | Reset |
| 119 | SBR *8 | Get a big random number |
| 121 | STO 0 1 | Store as subs x position |
| 124 | SBR *8 | Get another big random number |
| 126 | STO 0 2 | Store as subs y position |
| 129 | 5 STO 0 7 HLT | Set hit counter to 5 and stop |
| 134 | *LBL *1 | Start of subroutine to get a small |
| 136 | 5 +/- | random number |
| 138 | + .1 X | |
| 142 | *LBL *8 | Start of subroutine to get a big |
| 144 | 1 0 0 X ( ( 7 $y^x$ 9 | random number |
| 153 | X RCL 0 3 | |
| 157 | X 5 +/- INV *log ) | Shuffle numbers to make them |
| 163 | - ( RCL - .5 ) | seem random |
| 170 | *fix 0 *D.MS INV *fix ) | |
| 176 | STO 0 3 = | |
| 180 | *fix 0 *D.MS INV *fix | |
| 185 | *rtn | End of random number subroutines |
| 186 | *LBL *7 | |
| 188 | 0 STO 0 1 | Set x position to 0 |
| 192 | GTO 0 8 8 | Go test y position |
| 196 | *LBL *9 | |
| 198 | 1 0 0 STO 0 1 | Set x position to 100 |
| 204 | *rtn | Go test y position |
| 205 | *LBL *3 | |
| 207 | 0 STO 0 2 | Set y position to 0 |
| 211 | GTO 1 0 1 | Display miss distance |
| 215 | *LBL *5 | |
| 217 | 1 0 0 STO 0 2 | Set y position to 100 |
| 223 | *rtn | Display miss distance |

*Program.*

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01

# Build a Pulse Generator

## ... a useful hardware test aid

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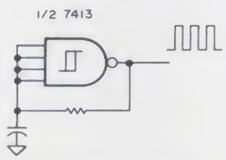



*Fig. 1. Basic circuit.*

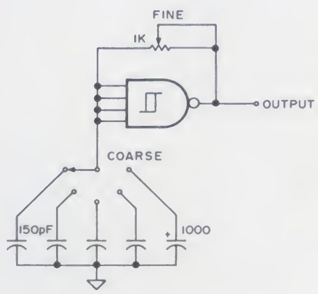



*Fig. 2. Pulse Generator.*

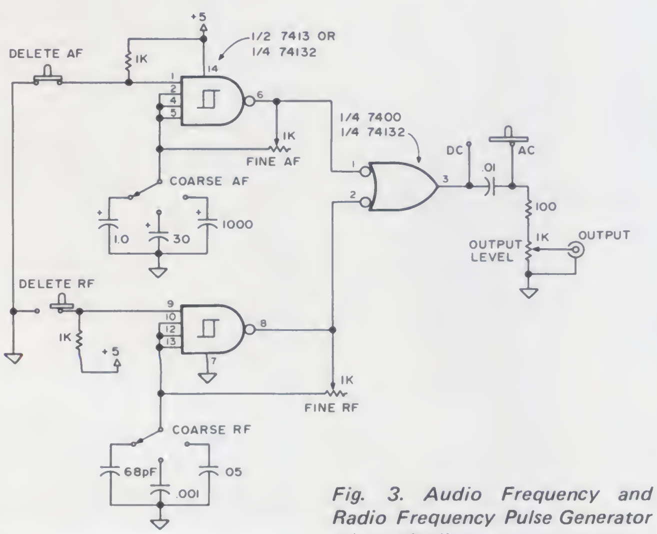



*Fig. 3. Audio Frequency and Radio Frequency Pulse Generator schematic diagram.*


*Enclosure and front panel for the pulse generator.*

What is it? Well it's a super simple, "super cycle," almost foolproof audio and radio frequency pulse generator, with a wide range of applications. What happened? Well Bob spotted the circuit in the design of a new telemetry test unit, sent it to George. George pounded and expounded on it, and hence this article. But why the "Super Cycle?" Some of us diehards love to plug cycles whenever we can, with all due respect to Mr. Hertz.

Fig. 1 shows the fundamental circuit. Any of the members of the Schmitt-Trigger family will work, the 7414, 7413, 74132, and 8T16. On the multiple input gates, all of the gate lines must be tied together, and since there are several individual gates in one package, one of the other gates may be used as a buffer if you wish. The Schmitt-Trigger uses a hysteresis, or backlash effect. To put it in simpler terms, the turn-on voltage for the gate is higher than the turn-off voltage, typically about 800 millivolts. This is what causes it to oscillate when the feedback resistor is put between the input and output.

In Fig. 2 George has whipped up a multiple range pulse generator that he has had operating from about 1/10 PPS to 15 MHz. In fact, a 68 pF capacitor was tried, and the circuit operated up to 30 MHz. You may select your own values of capacitance to allow for overlapping each range.

Now, Fig. 3 shows how to really complicate a simple circuit. What we have here is two separate Schmidt-Trigger oscillators. One operating at audio frequencies and one at rf frequencies. We can feed both of these frequencies into a NAND gate and come out with modulated rf. This might seem to some out of the realm of a computer oriented publication — not so! Remember those 1 MHz and 2 MHz clocks on your CPU board? Well, what comes out of this little bugger is a positive going square wave (well it's almost square) that is great for clocking all sorts of goodies. And if that gets boring, you can always jam your neighbors AM radio with it — playing different tones with the modulation should drive him right up the wall!

Referring again to Fig. 3: The entire circuit can be packaged in a 2 x 3 x 4 mini-box if miniature switches and controls are used. The photo shows the finalized version George came up with. If you use a 74132 Quad-NAND-Schmitt-Trigger (what a mouthful), you can do the whole thing with just one chip.

In any case, the basic circuit will provide a quick-and-dirty clock, with a fairly decent waveform in an emergency. ■

*Don Lancaster*
*SYNERGETICS*

# A TVT For Your KIM

## ... at a price you won't believe

Here is the great happening in TVT technology you have long been waiting for. Take a small, single-sided PC card with SIX integrated circuits on it, plug it into your KIM-1 or other microcomputer and display up to several thousand upper and lower case characters of your choice, all on an ordinary TV set with minimum modifications. Despite its "all the bells and whistles" performance, the cost of this new TVT approach is so ludicrously low that there's no comparing it with anything previously available. *If* you're a real dyed-in-the-wool scrounger (etch your own boards, steal sockets and connectors, burn your own PROMs, etc. . . .), you can put this together for around nine dollars plus the rapidly dropping cost of a character generator IC!

Complete kits and ready-to-go units are also available commercially, at somewhat higher but still unbelievable prices.

This new TVT development uses the microcomputer to do practically *all* of the system timing and control involved in a video display. This reduces the remaining interface circuitry to three hex inverters, two baby PROMs, and a character generator. Your computer alternates its compute and display modes, just as your KIM-1 now alternates between computer and keyboard modes. With fancy enough software, you can make this alteration nearly or completely transparent. More simply, you let the screen go blank when the computer is busy and doesn't want to talk to you anyway.

An entire book could be written on this whole new TVT ballgame. In fact . . . the book is called *Microprocessor Based Video Displays*, and Sams will print it. What we'll do here is lift just enough out of the book to show you how to build a video display for your KIM-1. The particular circuit is called a TVT-6L (L for lower case) and we'll show you how to build displays of 16 lines of 32 characters, 13 lines of 64 characters, and 25 lines of 64 characters, along with a fancy full-performance cursor that includes scrolling, erase to end of screen, full motions, and the usual goodies. The larger displays will take more memory than the bare bones KIM-1 has, so we'll show you one way to go with a KIM-1 and KIM-2 (4K add-on RAM) pair of cards.

### How It Works

The block diagram of the TVT-6L is shown in Fig. 1a. An area of your microcomputer's regular memory is reserved for your display. On the minimum KIM-1, a 512 character, 16 x 32 display on pages 02 and 03 is a good starting point, although the TVT-6L card can work with any contiguous memory block from 0000 to 0FFF. Since the KIM uses parts of page 00 and 01 for its operating system, these usually aren't available for alphanumeric display use. For the larger displays with added RAM, memory locations from pages four through seven or else four through ten (0400-07FF or 0400-0AFF) are a good choice.

Besides these display memory pages, you'll need a place to put the SCAN program that tricks the KIM-1 and a TV set into talking to each other compatibly. Usually your SCAN program is around ninety words long. On the KIM-1, this is easily stuffed into the leftover scratchpad RAM starting at 1780.

Our DECODE read only memory is the heart of our TVT circuit. This PROM is activated by sending it an address from 2000 to EFFF. When activated, the DECODE memory causes a companion SCAN memory to force the microcomputer into a *scan* mode that advances the CPU's program counter 32, 64, or some other number of selected steps, *advancing once each microsecond*, binary counter style.

During this active horizontal scan time of usually 32 or 64 microseconds, all the memory in the microcomputer is sequentially interrogated on a *one memory slot per microsecond* basis. A new *upstream tap* is added to the memory to be displayed that *always* outputs data to the TVT-6L circuit, even and particularly when the display memory does NOT have access to the data bus.

So, during a scan mode, the display memory outputs characters to the TVT even though it does not have control of the data bus. The characters have the format shown in Fig. 1b, with an ASCII character using up the lower seven bits of the memory word. An optional cursor bit is placed on bit eight if wanted or needed. A zero in bit eight does nothing; a one optionally displays a winking cursor under both software and hardware control.

The lower seven bits of a character that were sent from the upstream tap go to a character generator IC1. IC1 also receives some "what row of dots do we want?" information from the DECODE read only memory IC2. This particular character generator has an internal video shift register to directly output serial video in a 7 x 11 dot matrix with descenders format. The internal video shift register in IC1 derives its load and clock timing pulses from the KIM system clock Ø2 by way of gated oscillator IC6.

The serial output video goes now to a new, simple, and super-important circuit called a *bandwidth enhancer* in IC5. The bandwidth enhancer *predistorts* the output video to exactly cancel the way your TV set is going to try and mess it up. With this circuit, it's a simple matter to output several thousand characters per frame and still stay within the ordinary video bandwidth of a plain old TV set. Our bandwidth enhancer simply makes the dots longer than the undots, with the amount of lengthening set by a CLARITY control that is tuned to your TV for the sharpest and brightest display.

Meanwhile, two other outputs from the DECODE memory IC2 go to a position delay circuit in IC4 to provide horizontal and vertical positioning. The delayed sync signals are combined with the enhanced video in *video combiner* IC5.

IC5 gives us *two* outputs. One is the usual monitor output with grounded sync tips and +2 volt white level, used with monitors and completely preconverted TV sets. Our second *TV* output is translated upwards to put the white level at +4 volts, the usual bias level needed to go *directly* into the base of the first video amplifier transistor in a portable, transformer operated, solid state, black and white TV. Thus, our *TV* output greatly simplifies direct video interface. As Fig. 7 will show us later on, all you do is rip off the headphone jack and use it as an automatic video changeover switch, defeat the sound trap, and that's all you need — at least for the 16 x 32 display.

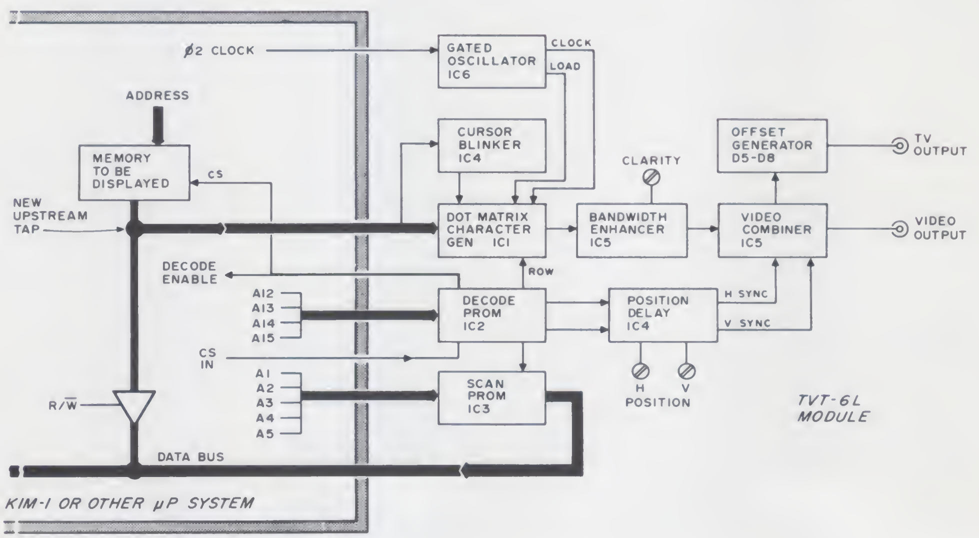




*Fig. 1a. TVT-6L Block Diagram. The CPU does all the work.*


*Fig. 1b. Data bus definitions.*

Three switches on the TVT-6L let you program the module to suit your particular needs. One switch picks 32 versus 64 character lines when used with suitable scan software. A second switch gives you a choice of no cursor or of a winking underline cursor under software control. The final switch is the neatest one to watch since it gives you a choice of all upper case or mixed upper and lower alphanumerics.

### Scanning

A SCAN program activates the DECODE memory once each horizontal line, which

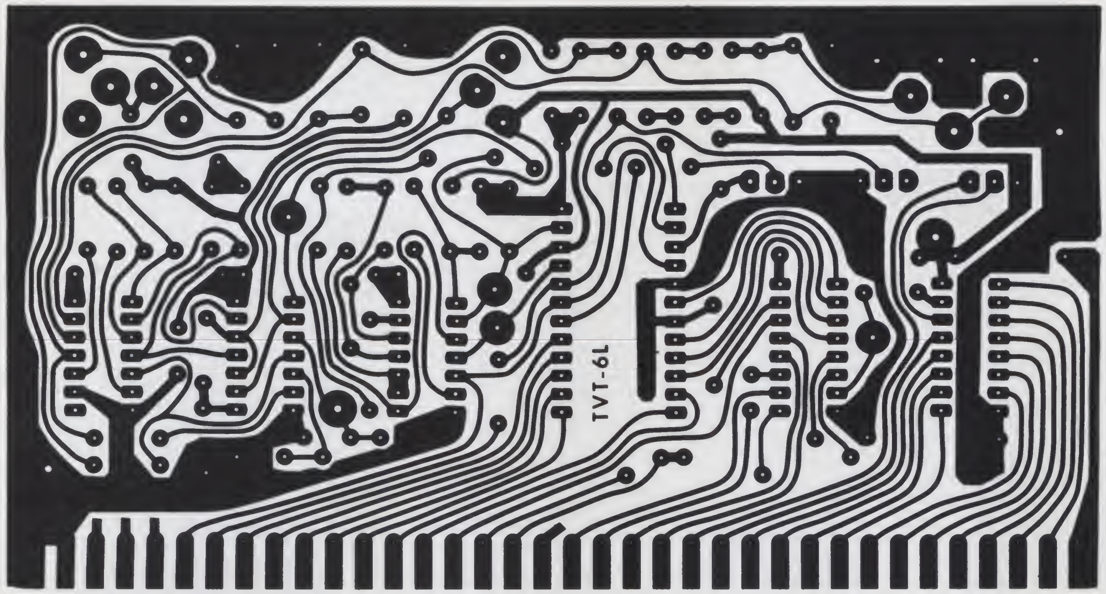



*Fig. 4. TVT-6L printed circuit board layout (full size).*

results in serial video being output for that particular line. If the program calls for a blank or retrace scan, all zeros are output, resulting in an all-black line. After a horizontal scan, the scan program computes the character and row information needed for the next line, and continues this way, on through one composite frame of fully interlaced video.

The design of a scan program is extra tricky since you have to control the exact number of microseconds everything takes to keep both the computer and the TV set happy. But once the scan program is designed and debugged, it's nothing but several dozen words of RAM or ROM available when needed to output the contents of the memory pages as video.

All our scan program does is cause the pages of memory reserved for characters to appear on the screen. *The SCAN program has absolutely nothing to do with how the characters get onto or off of that memory*, and couldn't care less. Your ordinary

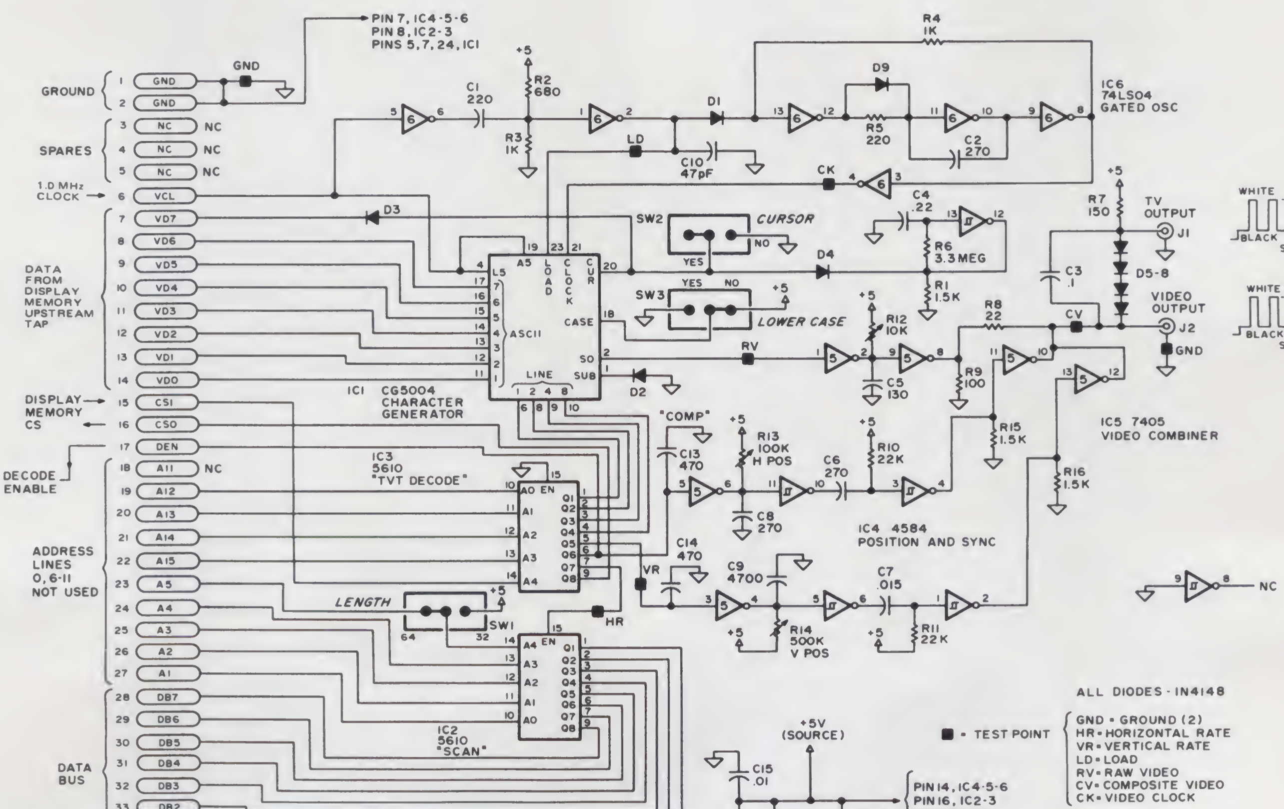



*Fig. 2. TVT-6L Schematic.*

| WORD | NOTES | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|
| 0 | LDY $240_8$ | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 1 | " " | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 2 | " " | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 3 | " " | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 4 | " " | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 5 | " " | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 6 | " " | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 7 | " " | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 8 | " " | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 9 | " " | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 10 | " " | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 11 | " " | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 12 | " " | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 13 | " " | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 14 | " " | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 15 | " " | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 16 | " " | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 17 | " " | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 18 | " " | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 19 | " " | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 20 | " " | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 21 | " " | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 22 | " " | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 23 | " " | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 24 | " " | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 25 | " " | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 26 | " " | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 27 | " " | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 28 | " " | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 29 | " " | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 30 | " " | ■ | □ | ■ | □ | □ | □ | □ | □ |
| 31 | RTS $140_8$ | □ | ■ | ■ | □ | □ | □ | □ | □ |

*Fig. 3a. Truth Table for SCAN PROM, IC2.*

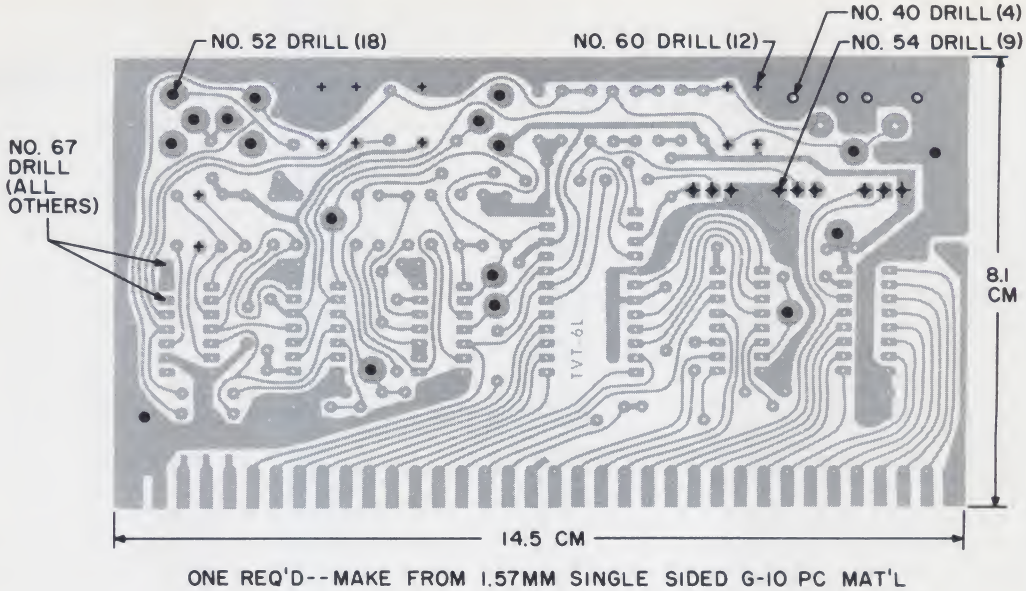



*Fig. 5. Mechanical and drilling details for PC board.*

| WORD | NOTES | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|
| 0 | NORMAL 100 | □ | ■ | □ | □ | □ | □ | □ | □ |
| 1 | NORMAL 100 | □ | ■ | □ | □ | □ | □ | □ | □ |
| 2 | BLANK 040 | □ | □ | ■ | □ | □ | □ | □ | □ |
| 3 | LINE 1 041 | □ | □ | ■ | □ | □ | □ | □ | ■ |
| 4 | LINE 2 042 | □ | □ | ■ | □ | □ | □ | ■ | □ |
| 5 | LINE 3 043 | □ | □ | ■ | □ | □ | □ | ■ | ■ |
| 6 | LINE 4 044 | □ | □ | ■ | □ | □ | ■ | □ | □ |
| 7 | LINE 5 045 | □ | □ | ■ | □ | □ | ■ | □ | ■ |
| 8 | LINE 6 046 | □ | □ | ■ | □ | □ | ■ | ■ | □ |
| 9 | LINE 7 047 | □ | □ | ■ | □ | □ | ■ | ■ | ■ |
| 10 | LINE 8 050 | □ | □ | ■ | □ | ■ | □ | □ | □ |
| 11 | LINE 9 051 | □ | □ | ■ | □ | ■ | □ | □ | ■ |
| 12 | LINE 10 052 | □ | □ | ■ | □ | ■ | □ | ■ | □ |
| 13 | LINE 11 053 | □ | □ | ■ | □ | ■ | □ | ■ | ■ |
| 14 | V SYNC 120 | □ | ■ | □ | ■ | □ | □ | □ | □ |
| 15 | NORMAL 100 | □ | ■ | □ | □ | □ | □ | □ | □ |
| 16 | NORMAL 300 | ■ | ■ | □ | □ | □ | □ | □ | □ |
| 17 | NORMAL 300 | ■ | ■ | □ | □ | □ | □ | □ | □ |
| 18 | BLANK 040 | □ | □ | ■ | □ | □ | □ | □ | □ |
| 19 | LINE 1 041 | □ | □ | ■ | □ | □ | □ | □ | ■ |
| 20 | LINE 2 042 | □ | □ | ■ | □ | □ | □ | ■ | □ |
| 21 | LINE 3 043 | □ | □ | ■ | □ | □ | □ | ■ | ■ |
| 22 | LINE 4 044 | □ | □ | ■ | □ | □ | ■ | □ | □ |
| 23 | LINE 5 045 | □ | □ | ■ | □ | □ | ■ | □ | ■ |
| 24 | LINE 6 046 | □ | □ | ■ | □ | □ | ■ | ■ | □ |
| 25 | LINE 7 047 | □ | □ | ■ | □ | □ | ■ | ■ | ■ |
| 26 | LINE 8 050 | □ | □ | ■ | □ | ■ | □ | □ | □ |
| 27 | LINE 9 051 | □ | □ | ■ | □ | ■ | □ | □ | ■ |
| 28 | LINE 10 052 | □ | □ | ■ | □ | ■ | □ | ■ | □ |
| 29 | LINE 11 053 | □ | □ | ■ | □ | ■ | □ | ■ | ■ |
| 30 | V SYNC 320 | ■ | ■ | □ | ■ | □ | □ | □ | □ |
| 31 | NORMAL 300 | ■ | ■ | □ | □ | □ | □ | □ | □ |

*Fig. 3b. Truth Table for DECODE PROM IC3.*

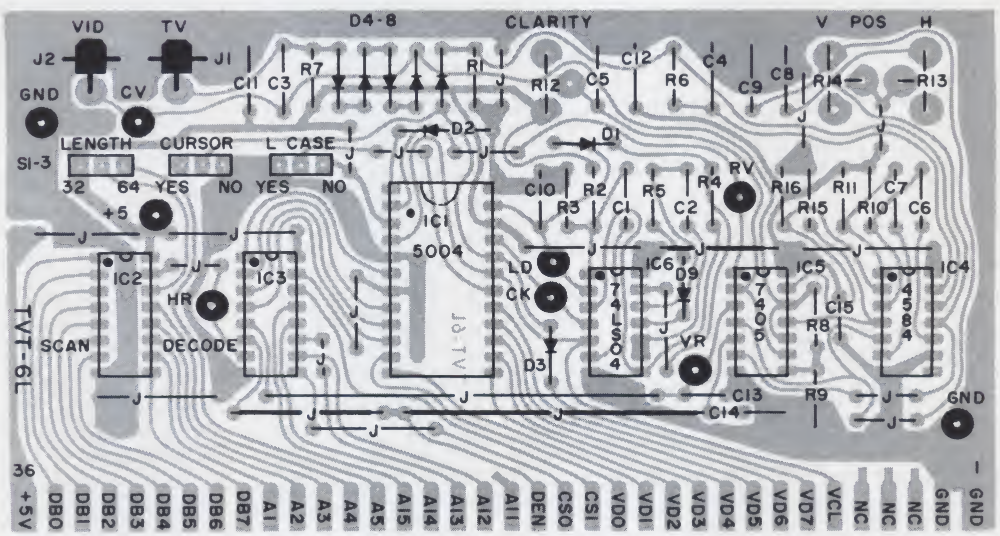



*Fig. 6. Components placement overlay.*

KIM-1 firmware can be used to load and dump memory to cassette tape. Your internal keypad can be used to put messages onto the screen by writing onto the memory pages. This trick gives you a zero cost ASCII keyboard and encoder, but at the hassle of having to write everything in hex rather than ASCII code.

For most uses, you'll want to add an external ASCII keyboard, entering on parallel A inputs and interrupting the Scan program every time you want to change a character. We'll be looking at a full scrolling cursor program later, but the important point now is that *you use whatever ordinary KIM-1 compatible programs you like to fill and empty the display memory pages*. Your separate Scan program simply puts the memory pages on the screen.

This way, you have total access to the screen memory at any time for any reason. Things like a displayed real time clock are trivial, and you can load and dump characters at a fantastic rate. With a simple Hex-to-ASCII adapter, you can also display op-code directly instead of alphanumeric characters. Note that this new TVT approach *isn't* DMA (Direct Memory Access) with its related drivers and access hassles. Your character memory is, looks, feels, and tastes just like any other memory in the microcomputer, since we've kept our upstream tap a secret from the CPU.

**Building It**

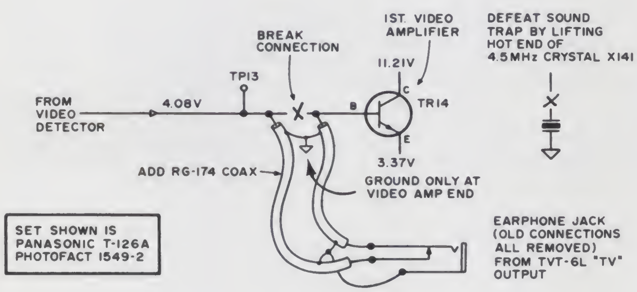
Fig. 2 shows you the schematic along with its parts list, while Fig. 3 gives you the truth tables for the DECODE and SCAN read only memories. Note that these are Tri-state 32 x 8 PROMs. Their programs obviously change if you use a system different from the KIM-1.

You'll find a full size printed circuit layout in Fig. 4, along with the mechanical and drilling details of Fig. 5. Components are located per the overlay of Fig. 6.

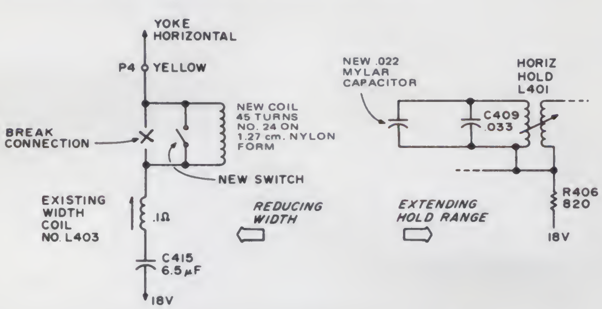
Start construction with the jumpers, using sleeving where shown. Follow this up with the nine test points and

| | |
|---|---|
| C1 | 220 pF polystyrene |
| C2, 6, 8 | 270 pF polystyrene |
| C4 | 0.22 uF mylar |
| C3, 11, 12 | 0.1 uF mylar (Disks OK for C11, 12) |
| C5 | 130 pF polystyrene |
| C7 | .015 uF mylar |
| C9 | .0047 uF mylar |
| C10 | 47 pF polystyrene |
| C13, 14 | 470 pF disk |
| C15 | .01 uF disk |
| D1-9 | 1N4148 or equivalent silicon computer diode. D1, D9 must be quality units. |
| IC1 | CG5004L-1 character Generator IC (STD Microsystems) |
| IC2 | IM5600 or equivalent 32 x 8 Bipolar Tri-state PROM "SCAN" |
| IC3 | IM5600 or equivalent 32 x 8 Bipolar Tri-state PROM "DECODE" |
| IC4 | 4584 CMOS Hex Schmitt Trigger (Motorola) |
| IC5 | 7405 TTL Hex open collector inverter |
| IC6 | 74LS04 LS TTL hex inverter |
| J1, 2 | PC Mount Phono Jack, Keystone 571 |
| R1, 15, 16 | 1.5k, 1/4 watt carbon film resistor |
| R2 | 680 ohm, " |
| R3, 4 | 1k, " |
| R5 | 220 ohm, " |
| R6 | 3.3 Megohm, " |
| R7 | 150 ohm, " |
| R8 | 22 ohm, " |
| R9 | 100 ohm, " |
| R10, 11 | 22k, " |
| R12 | 10k upright trimmer potentiometer CTS U201 "CLARITY" |
| R13 | 100k, " "H POS" |
| R14 | 500k, " "V POS" |
| S1-3 | SPDT miniature switch 3.17 mm pin centers |
| MISC: | PC Board, etched and drilled per Fig. 4; Test Point Terminals (9); PC Sockets, 24 pin (1), 16 pin (2), 14 pin (3): Matching connector (Amphenol 225 or equivalent); Sleeving; jumper material; solder. |
| NOTE: | The following are available from PAIA Electronics, Box 14539, Oklahoma City, OK, 37114:<br>PC Board, etched and drilled, #TVT-6LB, $4.00<br>Complete kit of all above parts #TVT-6LK, $59.95<br>Assembled and Tested TVT-6L, #TVT-6LAT, $75.00<br>KIM Coded Cassette, #TVT-6LC, $5.00 |

*Complete Parts List, TVT-6L.*




(a) DIRECT VIDEO MODS NEEDED FOR SHORTER LINE LENGTHS




(b) ADDITIONAL MODS THAT MAY BE NEEDED FOR 64 CHARACTER LINES

*Fig. 7. Mods to TV set are greatly simplified thanks to already offset "TV" output on TVT-6L. DO NOT ATTEMPT DIRECT VIDEO ON A HOT CHASSIS (NO POWER TRANSFORMER) SET!*

the low profile IC sockets, the switches, and the output phono jacks. Finally, add the resistors, pots, capacitors, and diodes. Be sure to note the polarity of each diode as it is added. Use fine solder and a small iron, and be sure to carefully double-check for any splashes or missed connections.

**Software**

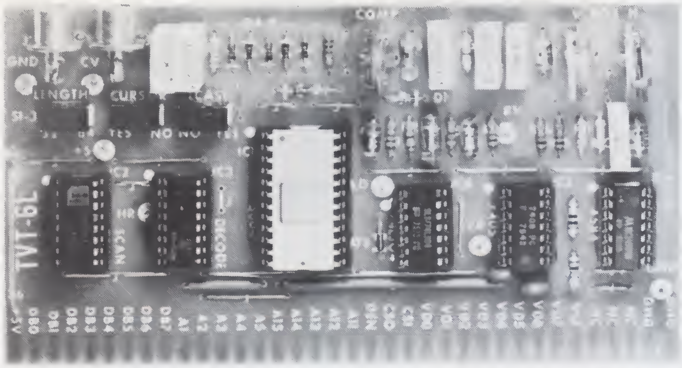
Table I shows us some tested and workable KIM software. Program 1-A is the scan program for a 16 x 32 fully interlaced 512 character display that can be moved around as needed. Program 1-B is a dual program that you can set up as 25 x 64 or 13 x 64 fully interlaced displays with larger characters. Finally, Program 1-C gives us a four-in-one full performance scrolling cursor. 1-C accepts an external ASCII keyboard on the parallel A inputs and works with any of the display formats by changing the key words as shown. This particular cursor system includes all the bells and whistles, such as full, rapid cursor motions in all directions, scrolling, erase to end of screen, and so on. It takes up most of page 01 in the KIM-1. You can easily make the cursor program longer for super fancy editing or shorter for a minimum sequential loading, per your choice.

**Modifying your KIM**

Table II gives you a complete listing of all pinouts on the TVT-6L along with the interface connections needed for either a KIM-1 or KIM-2 interface. The actual computer mods are outlined in Fig. 8. For the KIM-1, you add a connector along the top and make wiring pencil direct connections as shown. The foil is cut in ONE place along the 1K memory chip select line and a changeover switch is added. With the switch in the NORMAL position, the chip select is driven from K0 as usual. In the TVT position, the chip select line is driven from the TVT's CSO line, which is a *negative logic* OR of K0 and the TVT's scan access.

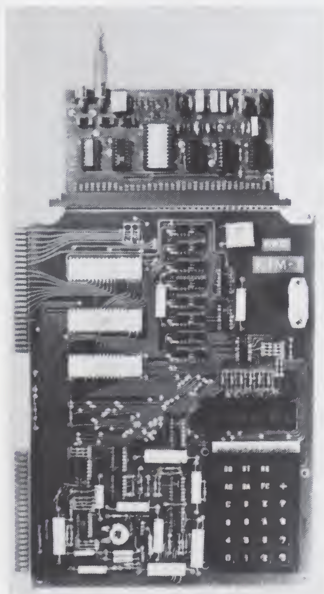
For larger displays, you'll need extra memory. Fig. 8b shows us the modifications for a KIM-2 memory. These mods first convert the KIM-2 decodings so that the KIM-2 works on the second, third, fourth, and fifth "K" of memory, or addresses 0400-13FF. Only addresses 0400 through 0FFF *may be* used for TVT page storage, although the remaining space is available for other computer use. The rest of the KIM-2 mods are similar to those on the KIM-1.

Even if you are going to use extra memory (who isn't?), convert the KIM-1 anyway as it is the simplest and best way to get started with your video displays. The changeover switch lets you run with the TVT-6L out of




*Closeup of TVT-6L module. Three of the six! ICs used are hex inverters. Switches give choice of line length, upper and lower case, cursor. Twin jacks give either monitor video or already-translated TV video. Both outputs are enhanced for minimum bandwidth needs. Module is adaptable to many popular microprocessors and microcomputers.*

the socket. In one position, the computer works normally; in the other, it will work as a TVT or transparently so long as the TVT is in the socket and so long as memory locations 2000 to EFFF are not called.




*The KIM-1 with a difference. Cable at top delivers enhanced video direct to your TV set or monitor.*

### TV Mods

The TV output with its +4 white bias level greatly simplifies your direct video interface. Fig. 7 shows how to "borrow" the headphone jack on a Panasonic T126A and convert it into an automatic video changeover switch. The only new parts needed are two short pieces of miniature coax. The sound trap is defeated by lifting the hot end of the 4.5 Megahertz crystal.

This type of conversion works on any small screen, solid state TRANSFORMER OPERATED portable B and W television set, so long as the set needs a bias voltage around +4 volts at the input to the first video stage.

In order to use the 64 character displays on an ordinary TV without extensive video bandwidth changes, the television's horizontal frequency is run much lower than normal, around 11 kHz. This means that you'll most likely need a width and hold modification for 64 or other long character lines. On the set shown, you can use a coil of 48 turns of #24 wire on a 1.27 cm diameter nylon form in series with the existing width coil. A new hold mylar capacitor of one third the normal value, or .022 uF, is added in parallel to C409 to extend the hold range downwards.

Note that the reduced horizontal frequency and reduced width are only needed on 64 character lines. The shorter 32 character lines run at normal horizontal speed. This tradeoff buys us a lot in the way of being able to scan characters with the CPU in the first place and eliminates any need for video bandwidth extension, so it is well worth the simple and reversible mods needed. Clip-on RF modulators can also be used as shown in the *TV Typewriter Cookbook* and *Microprocessor Based Video Displays*, again thanks to the reduced horizontal rate with long line lengths.

With any TV modification, be sure to have a SAMS photofact on hand and get expert help if you've never done a video input conversion before. NEVER ATTEMPT DIRECT VIDEO INTO A HOT CHASSIS OR TRANSFORMERLESS TELEVISION SET.

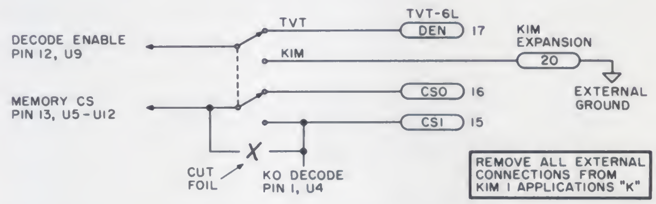
### Initial Checkout

*Always* have a good oscilloscope on hand for your initial checkout, and always do your first check on a KIM-1 in the 16 x 32 utility scan program 1A mode. Don't worry about doing anything initially except displaying code that already happens

1. Add a new 36 pin, single readout connector along the top of the KIM-1 above the crystal. Small "L" brackets can be added to use existing holes.
2. Make short and direct wire connections as shown in Table II. Use a wiring pencil for all connections *except* +5 and GND, which should be short lengths of #18 wire.

*Do not use ribbon cable or attempt extending the TVT-6L.*

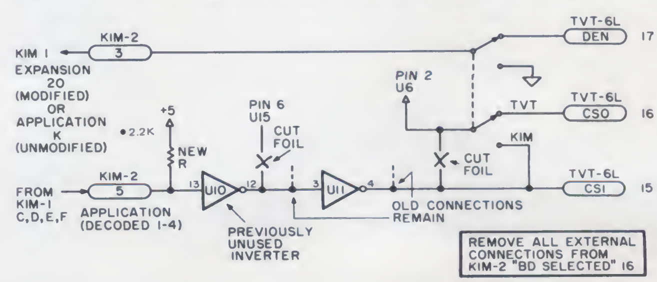
3. Break ONE foil run as shown, and add a DPDT changeover switch:




With the switch in the TVT position, operation is totally transparent so long as the TVT-6L is in its socket and addresses 2000-EFFF aren't called.

*Fig. 8a. Modifying your KIM-1 for the TVT-6L.*

1. Add a new 36 pin, single readout connector along the left edge of the card, the side away from the regulator. Small "L" brackets can use existing holes if one of the handle eyelets are replaced with a #6 screw.
2. Make short and direct wire connections as shown in Table II. Use a wiring pencil for all connections *except* +5 and GND.
3. Break TWO foil leads as shown, and add a DPDT changeover switch:




Note that we now have a new input pin on Connector 5 that is driven by KIM-1 decodings K1, 2, 3, and 4 in parallel from Application connector C, D, E, and F.

We also have a new output pin on Connector 3 that provides a ground for the KIM-1 Decode Enable. This is connected to Application Connector K on an *unmodified* KIM-1 and to Expansion Connector 20 or a KIM-1 modified per Fig. 8a.

Note further that BD SELECTED output Connector 16 is not used.

These modifications cause your KIM-2 to respond to addresses 0400-13FF. The program address switches are no longer used.

*Fig. 8b. Modifying your KIM-2 for the TVT-6L.*


# Print Your Heart Out.

## With help from the Digital Group, naturally.

Now, that small computer system you own or have been considering for personal or business use suddenly becomes a lot more usable—with the addition of a full-size *impact* printer from the Digital Group. A printer designed for small computers that need big output (like yours).

With the Digital Group printer, you can print your heart out...and it won't cost an arm and a leg. The Digital Group printer is available for less than $500. That's right—$500.

**Just look at these specifications:**

- Fast—120 characters per second
- 96 characters per line
- 12 characters per inch horizontal
- 6 lines per inch
- Makes up to 4 copies simultaneously
- Character set and pitch variable under software control—double width characters, etc.
- 5 x 7 character matrix
- Ribbon has built-in re-inkers for a life of 10,000,000 characters
- Paper can be either a standard 8½-inch roll, fanfold or cut page
- Interfaces to 8-bit parallel ports

There are lots of capabilities and outstanding features of the Digital Group printer...and (as always) the best news is our price. Kit prices start as low as $495 for the printer and interface card. It simply can't be beat.

Find out all the facts about the Digital Group printer now. Just fill in the coupon below or give us a call for the details. We think you'll find a place for our printer in your system ...and in your heart.

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**P.O. Box 6528**
**Denver, Colorado 80206**
**(303) 777-7133**

Quick. I want to print my heart out.
Send me all the details on your full-size impact printer.

Name ______________________________

Address ______________________________

City/State/Zip ______________________________

**D12** Please print.

to be on pages 02 and 03.

Center the three controls, switch to "32", cursor OFF and Lower Case OFF, plug the TVT-6L into your KIM-1, insert IC2 and IC3 *only*, and apply power. Go through the usual initialization, putting the KIM-1 in its binary mode with the interrupt returning you to keyboard operation. Then, try to operate the KIM-1 with a simple program on page zero to make sure the chip select and decode enable logic on the TVT-6L is passing things through properly and transparently.

Now, check address 2000 with your keyboard monitor. It should contain an A0. *If it doesn't, stop immediately and find out why*! Check the next 29 locations for more A0s followed by two 60s followed by another string of 30 A0s and so on. You should now be able to write and single step a simple program that will transfer control from KIM to TVT back to KIM again (see Example 1).

Your KIM-1 should start at 0000, jump to 2000, index sixteen times by twos to 201E, return to 0003 and stick there in the trap. *Don't go on till the KIM and TVT can pass control back and forth to each other.*

Next, add IC6 and check testpoints LD and CK with a decent scope. The waveforms should look exactly like Fig. 9. In particular, they should be clean and stable. The clock should have eight narrow positive clock pulses between load commands. *Do not omit checking these waveforms.*

Add the rest of the ICs,

| | | | | | | |
|---|---|---|---|---|---|---|
| 0000 | JSR | 20 | 00 | 20 | Go to TVT |
| 0003 | JMP | 4C | 03 | 00 | Trap |

*Example 1.*

*Table I. Some software.*

A. *Program for a 16 line, 32 character per line Interlaced TVT-6L Raster Scan:*

uP — 6502   Start — JMP 17A6   Displayed 0200-03FF
System — KIM-1   End — Interrupt   Program Space 1780-17d4

| Upper Address (178A0 | | | | | | | | Lower Address (1789) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| * | * | * | * | 0 | 0 | 1 | V8 | V4 | V2 | V1 | H16 | H8 | H4 | H2 | H1 |

0, 1, F — normal program (no tvt)
2 — blank scan
3 — scan row 1
4 — scan row 2
. (etc) . . . . . .
d — scan row 11
E — vertical sync pulse

Tape Ident — 6A
Program Length — 85 words + 1 word page zero (EC)

| | | | | | | |
|---|---|---|---|---|---|---|
| | 1780 | CLC | 18 | | | Clear Carry |
| | 1781 | STA | 8d | (8A) | (17) | Store Upper Address |
| | 1784 | PHA | 48 | | | Equalize 10 microseconds |
| | 1785 | PLA | 68 | | | continued |
| | 1786 | BNE | d0 | 00 | | continued |
| | 1788 | JSR | 20 | 00 | 20 | ///Character Scans 0-11/// |
| | 178b | ADC | 69 | 10 | | Increment Character Scan Counter |
| | 178d | CMP | C9 | E0 | | Character Scan Counter Overflow? |
| | 178F | BCC | 90 | F0* | | No, Scan next row of character |
| | 1791 | TAX | AA | | | Save Upper Address |
| | 1792 | LDA | Ad | (89) | (17) | Get Lower Address |
| | 1795 | ADC | 69 | 1F | | Increment Lower Address; Save carry |
| | 1797 | STA | 8d | (89) | (17) | Restore Lower Address; Save carry |
| | 179A | TXA | 8A | | | Get Upper Address |
| | 179b | ADC | 69 | 40 | | Reset Upper Address; add carry |
| | 179d | BNE | d0 | 00 | | Equalize 3 microseconds |
| | 179F | JSR | 20 | 04 | 20 | ///Blank Character Scan 12/// |
| | 17A2 | CMP | C9 | 24 | | Is it the "17th" row of characters? |
| | 17A4 | BCC | 90 | dA* | | No, start a new row of characters |
| START | 17A6 | LDA | A5 | (EC) | | Get Interlace Word |
| | 17A8 | ADC | 69 | 7F | | Change Field via Carry bit |
| | 17AA | BCS | B0 | 05* | | Jump if Even Field |
| | 17AC | STA | 8d | (EC) | E0 | Odd Field V Sync; Restore Interlace |
| | 17Af | LDX | A2 | 36 | | Load Odd (short) # of blank scans |
| | 17b1 | LDY | A0 | 05 | | Equalize 31 microseconds |
| | 17b3 | DEY | 88 | | | continued |
| | 17b4 | BPL | 10 | Fd* | | continued |
| | 17b6 | BCC | 90 | 05* | | Jump if odd field |
| | 17b8 | STA | 8d | (EC) | E0 | Even Field V Sync; Restore Interlace |
| | 17bb | LDX | A2 | 37 | | load Even (long) #of blank scans |
| | 17bd | JSR | 20 | 1E | 20 | ///1st V Blanking scan/// |
| | 17C0 | PHA | 48 | | | Equalize 9 Microseconds |
| | 17C1 | PLA | 68 | | | continued |
| | 17C2 | CLD | d8 | | | continued |
| | 17C3 | LDA | A9 | 00 | | Initialize Lower Address |
| | 17C5 | STA | 8d | (89) | (17) | continued |
| | 17C8 | LDA | A9 | 22 | | Initialize Upper Address |
| | 17CA | STA | 8d | (8A) | (17) | continued |
| | 17Cd | JSR | 20 | 00 | 20 | ///Rest of V Blanking scans/// |
| | 17d0 | DEX | CA | | | One less scan |
| | 17d1 | BMI | 30 | Ad* | | Start Character Scan |
| | 17d3 | BPL | 10 | Ed* | | Repeat V Blanking Scan |

NOTES: TVT-6L must be connected and both the SCAN and DECODE PROMs must be in circuit for program to run.

Both 17AC and 17b8 require that page 00 be enabled when page E0 is addressed. This is done automatically in the KIM-1 decode circuitry.

*Location 00EC on page zero is reserved as an interlace storage bit.*

Step 1788 goes to where the upper address stored in 178A and the lower address stored in 1789 tells it to. Values in these slots continuously change throughout the program.

For a 525 line system, use 17b0 34 and 17bC 35 and a KIM-1 crystal of 992.250 kHz. This is ONLY needed for a video superposition or tilting applications; the stock 1 MHz

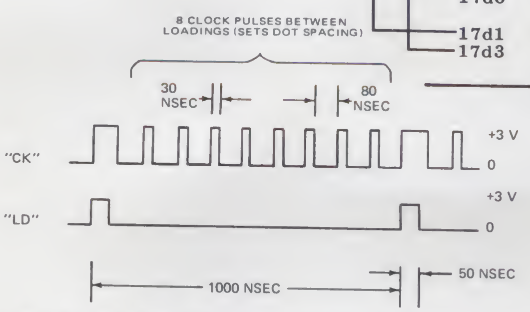



*Fig. 9. Key high frequency waveforms. Clock "CK" must be clean, jitter free, and have narrow positive duty cycle shown.*

crystal is used for ALL OTHER uses.

Normal program horizontal frequency is 15,873.015 kHz; Vertical 60.0114. 63 microseconds per line, 264.5 lines per field; 2 fields per frame 529 lines total.

*TVT-6L switch must be in the "32" position.*

( ) Denotes an absolute address that is program location sensitive.

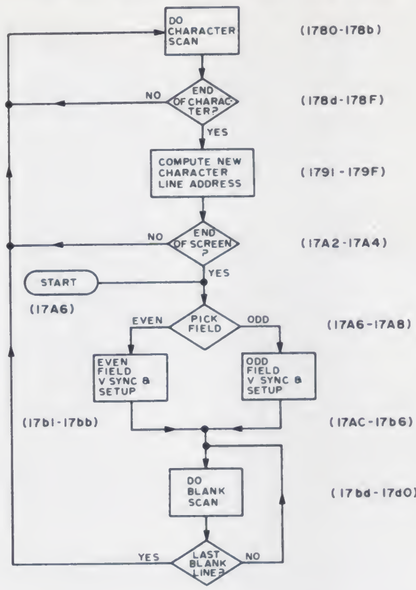
* Denotes a relative branch that is program length sensitive.

TO DISPLAY OTHER PAGES, USE:

| PAGES DISPLAYED | 17A3 | 17C9 | TVT CONNECTION |
|---|---|---|---|
| 0000-01FF | 22 | 20 | KIM-1 |
| 0200-03FF | 24 | 22 | KIM-1 |
| 0400-05FF | 26 | 24 | KIM-2 |
| 0600-07FF | 28 | 26 | KIM-2 |
| 0800-09FF | 2A | 28 | KIM-2 |
| 0A00-0BFF | 2C | 2A | KIM-2 |
| 0C00-0DFF | 2E | 2C | KIM-2 |
| 0E00-0FFF | 30 | 2E | KIM-2 |

FOR HIGHER PAGES, MOVE CONTENTS TO 0200-03FF or 0400-05FF

FLOWCHART 16X32 INTERLACED SCAN TVT-6L NO.6A

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B. *Program for a 13 line or a 25 line, 64 character per line interlaced TVT-6L Raster Scan:*

uP — 6502 Start — JMP 17bF Displayed 04C0-0AFF
System — KIM-1, 2 End — Interrupt Program Space 1780-17E2

Upper Address 1788

| * | * | * | * | PH | PL | V8 | V4 |
|---|---|---|---|---|---|---|---|

Lower Address 1787

| V2 | V1 | H32 | H16 | H8 | H4 | H2 | H1 |
|---|---|---|---|---|---|---|---|

- 0.1, F — normal program (no tvt)
- 2 — blank scan
- 3 — scan row 1
- 4 — scan row 2
- . . . etc . . . . . . . . . . . .
- d — scan row 11
- E — vertical sync pulse

Tape Ident — 6B
Program Length 99 words + 1 word page zero (EC)

| | | | | | |
|---|---|---|---|---|---|
| 1780 | LDA | A9 | (24) | | Initialize Upper Address |
| 1782 | STA | 8d | (88) | (17) | Store Upper Address |
| 1785 | NOP | EA | | | Equalize 2 |
| 1786 | JSR | 20 | 00 | 20 | ///Character Scans 0-11//// |
| 1789 | ADC | 69 | 20 | | Increment Character Gen by 2 |
| 178b | CMP | C9 | E0 | | Is it scan 12 or 13? |
| 178d | BCC | 90 | F3* | | No, Do next character scan |
| 178F | PHA | 48 | | | Save Upper Address |
| 1790 | LDA | AD | (87) | (17) | Get Lower Address |
| 1793 | ADC | 69 | 3F | | Increment L; Set C on V2 Overflow |
| 1795 | STA | 8d | (87) | (17) | Restore L; save carry |
| 1798 | PLA | 68 | | | Get Upper Word |
| 1799 | NOP | EA | | | Equalize 2 |
| 179A | JSR | 20 | 0C | 20 | ///Blank scans 12, 13/// |
| 179d | ADC | 69 | 40 | | Add Carry; Reset Upper Address |
| 179F | CMP | C9 | 2b | | Was this the last line of characters? |
| 17A1 | BCC | 90 | dF* | | No, Scan a new line of characters |
| 17A3 | LDA | A5 | (EC) | | Get Interlace Word |
| 17A5 | ADC | 69 | 7F | | Set Carry if Odd Field Finished |
| 17A7 | BCC | 90 | 0F* | | Start Even Field if Carry Set |
| 17A9 | STA | 8d | (EC) | E0 | Even V Sync + Replace Interlace |
| 17AC | LDX | A2 | 0E | | Load Even #VB Scans -2 |
| 17AE | LDA | A9 | 24 | | Initialize Even Upper Address |
| 17b0 | STA | 8d | (81) | (17) | continued |
| 17b3 | LDA | A9 | 2b | | Initialize Even Character End Compare |
| 17b5 | STA | 8d | (A0) | (17) | continued |
| 17b8 | LDY | A0 | 07 | | Equalize 41 microseconds |
| 17bA | DEY | 88 | | | continued |
| 17bb | BPL | 10 | Fd* | | continued |
| 17bd | BCS | b0 | 0F* | | Skip if Even Field |
| START 17bF | STA | 8d | (EC) | E0 | Odd V Sync + Replace Interlace |
| 17C2 | LDX | A2 | 0F | | Load Odd #VB Scans -2 |
| 17C4 | LDA | A9 | 34 | | Initialize Odd Upper Address |
| 17C6 | STA | 8d | (81) | (17) | continued |

```
17C9   LDA   A9   3b          Initialize Odd Character End Compare
17Cb   STA   8d   (A0)  (17)         continued

17CE   JSR   20   3F    20    ///1st V Blanking Scan/////
17d1   LDA   A9   C0          Initialize Lower Address
17d3   STA   8d   (87)  (17)         continued
17d6   BMI   30   00          Equalize 3 microseconds

17d8   CLD   d8               Equalize 4 microseconds
17d9   NOP   EA                      continued
17dA   JSR   20   00    20    ///Rest of V Blanking Scans///
17dd   DEX   CA               One Less Scan

17dE   BMI   30   A0*         Start Character Scan
17E0   CLC   18               Clear Carry
17E1   BPL   10   F5*         Repeat V Blanking Scan
```

NOTES:

TVT-6L must be connected and both the SCAN and DECODE PROMS must be in circuit for program to run.

Both 17A9 and 17bF require that page 00 be enabled when page E0 is addressed. This is done automatically in the KIM-1 decode circuitry.

*Location 00EC on page zero is reserved as an interlace storage bit.*

Step 1786 goes to where the upper address stored in 1788 and the lower address stored in 1787 tells it to. Values in these slots continuously change throughout the program.

Values in slots 1781 (Upper address start) and 17A0 (Character end compare) alternate with the field being scanned.

Horizontal Scan Frequency = 11.494 kHz. Vertical frequency = 60.0222 Hertz. 87 microseconds per line 191.5 lines per field; 2 fields per frame, 383 lines total.

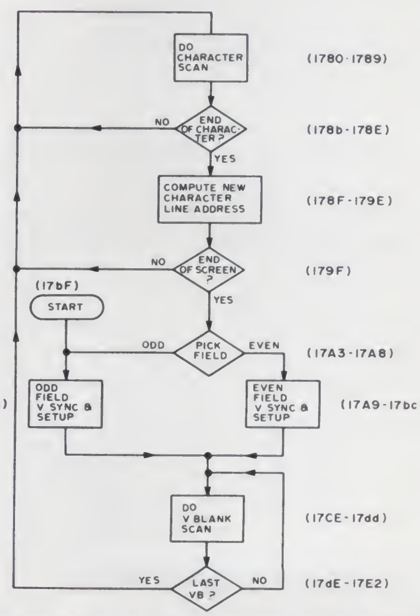
*TVT-6L switch must be in the "64" position.*

( ) Denotes an absolute address that is program location sensitive.

* Denotes a relative branch that is program length sensitive.

Program may be used for 13 x 64 large characters or 25 x 64 small characters by changing the following slots:

| | 13 x 64 | 25 x 64 |
|---|---|---|
| 178A | 10 | 20 |
| 17Ad | 14 | 0E |
| 17Af | 24 | 24 |
| 17b4 | 28 | 2b |
| 17C3 | 15 | 0F |
| 17C5 | 24 | 34 |
| 17CA | 28 | 3b |




FLOWCHART 13 X 64 OR 25 X 64 INTERLACED SCAN NO 6B

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C. *Program for a Four-in-One full performance Scrolling Cursor:*

uP — 6502    Start — $\overline{\text{IRQ}}$    Program Space 0100-01dF
System — Kim 1,2    End — RTI    + Two words page zero (ED,EF)

Input to parallel Word A

| 0 | A7 | A6 | A5 | A4 | A3 | A2 | A1 |
|---|---|---|---|---|---|---|---|

IRQ
10 usec.

Clear — CAN (18)
Carriage Return — CR (0d)
Cursor Up — VT (0b)
Cursor Down — LF (0A)
Cursor Left — BS (08)

Cursor Right — HT (09)
Cursor Home — SOH (0A)
Scroll Up — DC1 (11)
Erase To End —ETX (03)
Enter -- all characters and all *unused* CTRL commands

```
Enter via
IRQ
  |
  └──►0100   PHA   48             Save A
      0101   LDY   A0  00         Reset Y Index
      0103   LDA   A5  (EE)       Get Cursor and test for range
      0105   CMP   C9  04         Is cursor below maximum?

0147 ◄─0107  BCS   b0  3E*        No, Home Cursor
       0109  CMP   C9  02         Is cursor above minimum?
0147 ◄─010b  BCC   90  3A*        No, Home cursor
       010d  LDA   b1  (Ed)       Get Old Cursed character

       010F  AND   29  7F         Erase Old Cursor
       0111  STA   91  (Ed)       Replace character without cursor
       0113  LDA   Ad  00   17    Get New character from A parallel Int.
       0116  CMP   C9  20         Is it a character to be entered?

013E ◄─0118  BCS   b0  24*        Yes, go and enter character
       011A  CMP   C9  18         Clear Screen?
015E ◄─011C  BEQ   F0  30*        Yes, go clear screen
       011E  CMP   C9  0d         Return carriage?

0152 ◄─0120  BEQ   F0  30*        Yes, go return carriage
       0122  CMP   C9  0b         Move cursor up?
0194 ◄─0124  BEQ   F0  6E*        Yes, move cursor up
       0126  CMP   C9  0A         Move Cursor down?

0166 ◄─0128  BEQ   F0  3C*        Yes, move cursor down
       012A  CMP   C9  09         Move cursor right?
0158 ◄─012C  BEQ   F0  2A*        Yes, move cursor right
       012E  CMP   C9  08         Move Cursor left?

01A7 ◄─0130  BEQ   F0  75*        Yes, Move cursor to left
       0132  CMP   C9  01         Home Cursor?
0147 ◄─0134  BEQ   F0  11*        Yes, Home cursor
       0136  CMP   C9  11         Scroll Up?

0175 ◄─0138  BEQ   F0  3b*        Yes, Scroll Up
       013A  CMP   C9  03         Erase to End of Screen?
01b1 ◄─013C  BEQ   F0  73*        Yes, Erase to End of Screen
       013E  CLD   d8             Assure Hex arithmetic mode

       013F  JSR   20  (d3) (01)  ////Enter Character via Sub////
       0142  BNE   d0  06*        Did Screen Overflow?
       0144  JMP   4C  (75) (01)  Select Scroll or Wraparound
       0147  JSR   20  (C2) (01)  ////Home cursor via sub////

       014A  LDA   b1  (Ed)       ////Restore Cursor////
       014C  ORA   09  80         Add Cursor to cursed character
       014E  STA   91  (Ed)       Restore cursed character
       0150  PLA   68             Restore Accumulator

OUT  ◄─0151  RTI   40             Return to Scan
       0152  LDA   A5  (Ed)       ////Carriage Return///(get cursor)
       0154  ORA   09  1F         Move cursor all the way right
       0156  STA   85  (Ed)       Restore Cursor

       0158  JSR   20  (d5) (01)  Increment cursor
0142 ◄─015b  JMP   4C  (42) (01)  Scroll or wraparound if needed; finish
       015E  JSR   20  (C2) (01)  ////Clear///// (home cursor)
       0161  JSR   20  (Cb) (01)  clear screen via subroutine

0147 ◄─0164  BEQ   F0  E1*        Finish
       0166  LDA   A5  (Ed)       ////Cursor Down////(get cursor)
       0168  CLC   18             Clear Carry
       0169  ADC   69  20         Move cursor down one line

       016b  STA   85  (Ed)       Restore Cursor
     ┌─016d  BCC   90  03*        Overflow of page?
     │ 016F  JSR   20  (d9) (01)  Yes, increment next higher page
0142 ◄═0172  JMP   4C  (42) (01)  Scroll or wraparound if needed; finish

       0175  JSR   20  (C2) (01)  /////Scroll Up////(home cursor)
     ┌─0178  LDY   A0  20         Add offset to index
     │ 017A  LDA   b1  (Ed)       Get offset indexed character
     │ 017C  LDY   A0  00         Remove offset from index
     │
     │ 017E  JSR   20  (d3) (01)  Enter moved character and increment
     └─0181  BNE   d0  F5*        Repeat?
       0183  CLC   18             Clear Carry
       0184  LDA   A9  03         Set A to page of last line

       0186  STA   85  (EE)       Set Cursor to page of last line
       0188  LDA   A9  E0         Load A to start of last line
       018A  STA   85  (Ed)       Set Cursor to start of last line
014A ◄─018C  BCS   b0  bC*        Finish if carry set

       018E  JSR   20  (Cb) (01)  Clear last line
       0191  SEC   38             Set Carry
0184 ◄─0192  BCS   b0  F0*        Restore cursor to start of last line
       0194  LDA   A5  (Ed)       /////Cursor Up///(get cursor)

       0196  SEC   38             Set Carry
       0197  SBC   E9  20         Move Up one line
       0199  STA   85  (Ed)       Restore Cursor
014A ◄─019b  BCS   b0  Ad*        Underflow of page?

       019d  DEC   C6  (EE)       Yes, Decrement page
       019F  LDA   A9  01         Set A to page below home page
       01A1  CMP   C5  (EE)       Did screen underflow?
014A ◄─01A3  BNE   d0  A5*        No, Finish
```

load program 1A, switch to single step off, jump to 17A6 and hit GO. Your first check should be that the program *will* run, returning to the keyboard monitor when you hit stop and picking up on go again. Addresses should always be within the program bounds of being somewhere between 2000 and EFFF or somewhere between 1780 and 17d3.

Check test point VR for a one microsecond pulse every 16.7 milliseconds. If your scope has trouble with low duty cycle waveforms, you can try pin 6 of IC4, which should be a one millisecond or so pulse every 16.7 milliseconds. For the acid test, switch to *line* sync. This pulse is your vertical sync pulse. It should wander around *very* slowly with respect to the power line sync. This pulse is created both by the hardware and your SCAN program. *Stop right here till you have it there and stable.*

Now, plug in your fully modified TV or monitor to the VID output, or else a Fig. 8 modified TV to the TV output. You should have a random but stable display of characters, along with some weird control symbols. Position them and sharpen them with the controls. The CLARITY control makes the characters brighter in one direction and sharper in the other — pick what you like. At this point you should have a stable and attractive display. Use *minimum* contrast for sharpest characters.

The rest should be downhill all the way. Check the LCASE switch and the CURSOR switch. Around half the characters should wink cursors at you, since the cursor recognizes any bit eight set as a cursor and since you have a random page load, rather than a page of characters with a single cursor location.

If everything checks out so far, you can now go on to longer character lines, external keyboards, cursor loading (don't forget to load the $\overline{\text{IRQ}}$

```
0147 ◄-01A5   BEQ   F0   A0*          Yes, Home cursor
       01A7   DEC   C6   (Ed)         ///Cursor Left///(decrement cursor)
       01A9   LDA   A9   FF           Set A to page underflow
       01Ab   CMP   C5   (Ed)         Test for page underflow

019d ◄-01Ad   BEQ   F0   (EE)         Change page if off page
014A ◄-01AF   BNE   d0   99*          Finish if on page
       01b1   LDA   A5   (EE)         /////Erase to EOS///(get cursor)
       01b3   PHA   48                Save Upper Cursor location on stack

       01b4   LDA   A5   (Ed)         Get Lower Cursor location
       01b6   PHA   48                Save Lower Cursor location on stack
       01b7   JSR   20   (Cb)   (01)  Clear to End of Screen
       01bA   PLA   68                Get lower cursor location off stack

       01bb   STA   85   (Ed)         Restore lower cursor
       01bd   PLA   68                Get upper cursor location off stack
       01bE   STA   85   (EE)         Restore upper cursor
014A ◄-01C0   BNE   d0   88*          Finish

       01C2   LDA   A9   00           ///Subroutine-HOME CURSOR////
       01C4   STA   85   (Ed)         Set lower cursor to home value
       01C6   LDA   A9   02           Load A with home page value
       01C8   STA   85   (EE)         Set upper cursor to home page

       01CA   RTS   60                Return to main cursor program
       01Cb   LDA   A9   20           ///Subroutine-ENTER SPACES////
       01Cd   JSR   20   (d3)   (01)  Enter space via character entry sub
       01d0   BNE   d0   F9*          Repeat if not to end of screen

       01d2   RTS   60                Return to main cursor program
       01d3   STA   91   (Ed)         ///Subroutine-ENTER AND INCREMENT///
       01d5   INC   E6   (Ed)         Enter character and increment
       01d7   BNE   d0   06*          Overflow of page?

       01d9   INC   E6   (EE)         Yes, Increment cursor page
       01db   LDA   A9   04           Load A with page above display
       01dd   CMP   C5   (EE)         Test for Overflow
       01dF   RTS   60                Return to main cursor program
```

vector!), and so on, but don't try too much at once. *Always* get the utility 512 character basic display up on a KIM-1 before trying anything fancy. Thanks to the total software control, once you *are* up and working and confident, there's practically no limit to how fancy you get with your display.

More details on all this will appear in *Microprocessor Based Video Displays*, along with such options as a Hex-ASCII converter that displays *Super Front Panel* Op-Code (your whole program at once — how's that for a debug aide?); color graphics options, use of different character generators, different micro-processors, and so on. Watch for it. ■

NOTES: For auto-scrolling use 0145 75. For wraparound, use 0145 47.

*$\overline{IRQ}$ vector must be stored in 17FE 00 and 17FF 01.*

Total available stack length is 32 words. Approximately 16 are used by operating system, cursor, and scan program. Stack must be initialized to 01FF as is done in KIM operating system. For 30 additional stack locations, relocate subroutines starting at 01C2 elsewhere. For total stack availability, relocate entire program elsewhere.

To protect page, load 00F1 04. To enable entry, load 00F1 00

*Cursor address is stored at 00Ed low and 00EE high on page zero.*

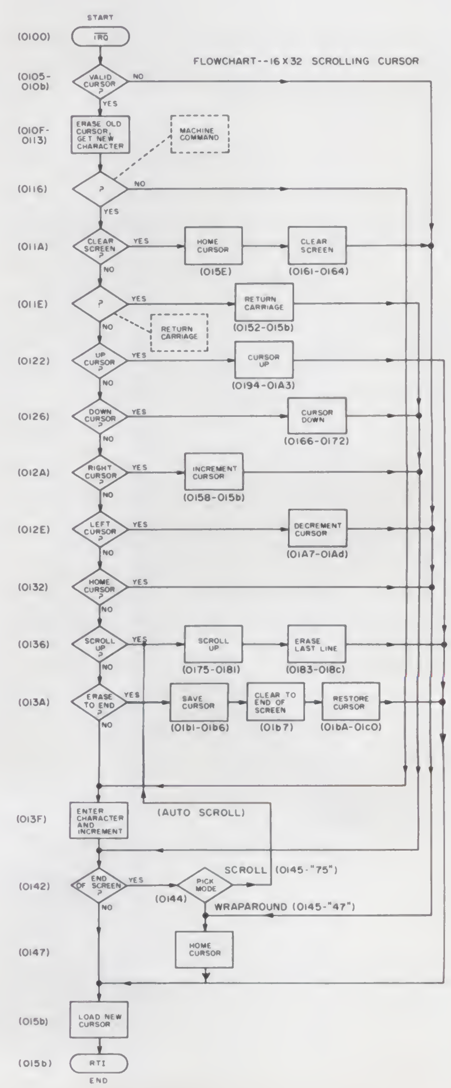
To display cursor, load 014d 80. To not display cursor, load 014d 00

* Denotes a relative branch that is program length sensitive

( ) Denotes an absolute address that is program location sensitive

To match this program to the scan program, change the following slots:

| | 16 x 32 KIM1 0200-03FF | 16 x 32 KIM2 0400-05FF | 13 x 64 KIM2 04C0-07FF | 25 x 64 KIM2 04C0-0AFF |
|---|---|---|---|---|
| 0106 | 04 | 06 | 08 | 0b |
| 010A | 02 | 04 | 04 | 04 |
| 0155 | 1F | 1F | 3F | 3F |
| 016A | 20 | 20 | 40 | 40 |
| 0179 | 20 | 20 | 40 | 40 |
| 0185 | 03 | 05 | 07 | 0A |
| 0189 | E0 | E0 | C0 | C0 |
| 0198 | 20 | 20 | 40 | 40 |
| 01A0 | 01 | 03 | 03 | 03 |
| 01C3 | 00 | 00 | C0 | C0 |
| 01C7 | 02 | 04 | 04 | 04 |
| 01dC | 04 | 06 | 08 | 0b |



| Pin | Ident | Function | Load | 8-A KIM-1 Connections | 8-B KIM-2 Connections |
|---|---|---|---|---|---|
| 1, 2* | GND | Ground Return — Heavy foil or wire | — | Expansion 22 | Connector 1 |
| 3, 4, 5 | NC | No Connection — reserved | — | — | — |
| 6* | VCL | Video Clock Ø2 | 1 LSTTL | Expansion U | Pin 4 of U10 |
| 7 | VD7 | Cursor from Display memory | 1 LSTTL | Pin 12 of U5 | Pin 2 of U3 |
| 8 | VD6 | ASCII Bit 7 from Display memory | 1 NMOS | Pin 12 of U6 | Pin 6 of U3 |
| 9 | VD5 | ASCII Bit 6 from Display memory | 1 NMOS | Pin 12 of U7 | Pin 10 of U2 |
| 10 | VD4 | ASCII Bit 5 from Display memory | 1 NMOS | Pin 12 of U8 | Pin 2 of U2 |
| 11 | VD3 | ASCII Bit 4 from Display memory | 1 NMOS | Pin 12 of U9 | Pin 6 of U2 |
| 12 | VD2 | ASCII Bit 3 from Display memory | 1 NMOS | Pin 12 of U10 | Pin 10 of U1 |
| 13 | VD1 | ASCII Bit 2 from Display memory | 1 NMOS | Pin 12 of U11 | Pin 2 of U1 |
| 14 | VD0 | ASCII Bit 1 from Display memory | 1 NMOS | Pin 12 of U12 | Pin 6 of U1 |
| 15* | CSI | Chip Select *from* Enable Decoding | 1 LSTTL | Pin 1 of U4 | Pin 4 of U11 |
| 16* | CSO | Chip Select *to* Display Memory | TTL Out | Pin 13 of U5-U12 | Pin 2 of U6 |
| 17* | DEN | Decode Enable *to* KIM | TTL Out | Pin 12 of U4 | Connector 3 |
| 18 | A11 | No Connection — reserved | — | — | — |
| 19 | A12 | Address Line 12 | 1 LSTTL | Expansion P | Connector R |
| 20 | A13 | Address Line 13 | 1 LSTTL | Expansion R | Connector S |
| 21 | A14 | Address Line 14 | 1 LSTTL | Expansion S | Connector T |
| 22 | AB15 | Address Line 15 | 1 LSTTL | Expansion T | Connector U |
| 23 | A5 | Address Line 5 | 1 LSTTL | Expansion F | Connector H |
| 24 | A4 | Address Line 4 | 1 LSTTL | Expansion E | Connector F |
| 25 | A3 | Address Line 3 | 1 LSTTL | Expansion D | Connector E |
| 26 | A2 | Address Line 2 | 1 LSTTL | Expansion C | Connector D |
| 27* | A1 | Address Line 1 | 1 LSTTL | Expansion B | Connector C |
| 28 | DB7 | Data Bus 7 | TTL TS Out | Expansion 8 | Connector 8 |
| 29 | DB6 | Data Bus 6 | TTL TS Out | Expansion 9 | Connector 9 |
| 30 | DB5 | Data Bus 5 | TTL TS Out | Expansion 10 | Connector 10 |
| 31 | DB4 | Data Bus 4 | TTL TS Out | Expansion 11 | Connector 11 |
| 32 | DB3 | Data Bus 3 | TTL TS Out | Expansion 12 | Connector 12 |
| 33 | DB2 | Data Bus 2 | TTL TS Out | Expansion 13 | Connector 13 |
| 34 | DB1 | Data Bus 1 | TTL TS Out | Expansion 14 | Connector 14 |
| 35 | DB0 | Data Bus 0 | TTL TS Out | Expansion 15 | Connector 15 |
| 36* | +5V | +5 Volt Supply | 200 ma | Expansion 21 | Connector Y |

NOTES: (See * Above)

Pins 1, 2 — Ground should be heavy foil or #18 wire — all other connections are wire pencil short leads. *Do not use ribbon cables or attempt extension.*

Pin 6 — Video clock must load character generator only when data output is stable and valid. Clock Ø2 on the KIM.

Pins 15, 16 — Chip select line from decoding to display memory is broken by cutting the foil and then replaced with a negative logic OR (positive AND) of the original chip select and the TVT chip select. *See Figure 8b.*

Pin 17 — Decode Enable output goes low when TVT is *not* scanning; goes high otherwise. Decoding must be disabled during active scans to allow SCAN memory access to data buss. *See Figure 8b.*

Pin 27 — Address line A0 is not used in the TVT module as the SCAN memory indexes every *second* microsecond. A0 is used in the display memory addressing.

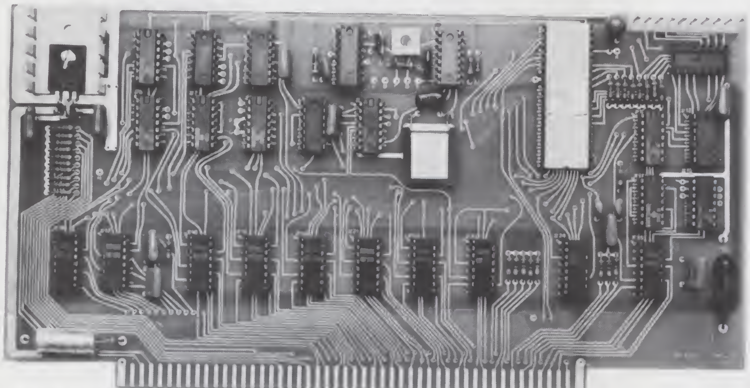
Pin 36 — +5 power borrowed from computer. Extra noise on the +5 line will cause skewed or akward characters; may be fixed usually with extra bypassing. Use heavy foil or #18 wire.

*Table II. TVT-6L Interface.*

# WHO OFFERS THE GREATEST VARIETY OF S-100 BUS-COMPATIBLE INTERFACES ???

## NOT MITS, NOT IMSAI, NOT PROCESSOR TECHNOLOGY—— BUT MINI MICRO MART!

### SUPER VALUE S100 Z80 CPU BOARD



Illustrated above is the Digital Innovations' S-100 Z-80 CPU board, functionally equivalent to the TDL ZPU ---- ONLY $169.95 in kit form.

Now you can trade your Altair or IMSAI CPU board for an S-100 bus-compatible Z-80 CPU board. Mini Micro Mart makes available both the ZPU board from TDL or a very similar CPU board from Digital Innovations. Ease the burden of updating your 8080 system ----trade with Mini Micro Mart. We will allow $70 for your Altair CPU or $90 for your IMSAI CPU (condition subject to inspection) towards the purchase price of $269.00 for the TDL ZPU or $169.95 for a Digital Innovations Z80-S100 CPU board. *Add $50 for assembled and tested Z-80 CPU Boards.*

**WE BUY AND SELL USED ALTAIRS AND IMSAI's.** Trade your Altair for an IMSAI or for a MINI MICRO MART system. Many like-new, assembled, tested systems available.

### YOUR CHOICE .......................................................... $ 49.95

1. **2708 PROM BOARD (10K)** -- Kit w/basic IC sockets. Any PROM addressable anywhere in memory map. Order as **C80-2708-2.**

   **NOTE:** Factory Prime 2708's, 1K x 8 erasable PROM's, **REG. $98** --------- **NOW ONLY $49.95**, with IC socket

2. **2K-1702A PROM BOARD** -- Kit w/basic IC sockets. Any PROM addressable anywhere in memory map. Order as **C80-1702-2.**

   FACTORY PRIME 1702A ............................................ **$ 8.95**

3. **2-PORT PARALLEL I/O BOARD** -- Latching inputs and outputs. Order as **C80-P I/O.**

4. **SERIAL I/O BOARD** -- Kit uses UART, software addressable baud rates. Order as **C80-S I/O.**

   **AUDIO CASSETTE INTERFACE ADAPTER** for above (Byte Standard) Add **$19.95.**

*Any of above boards only $49.95 in kit form; available assembled and tested at $40 additional per board.*

ALSO AVAILABLE: 4 styles of prototype boards, extender board, 2 backplanes, connectors, power transformers, scientific calculator board, audio cassette board, digital cassette interface board, adapter boards, and others.

### MEMORY BOARDS ALTAIR/IMSAI/SOL

C80-4K-300S Kit with 4K of 2102's ............................................ $ 79.95
C80-4K-300LP Kit w/4K of 91L02A's, LP 500ns, w/IC sockets........ $ 99.95
C80-4K-350LP Kit w/4K of 91L02C's, LP 300ns, w/IC sockets........ $129.95

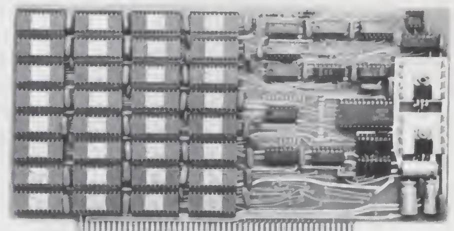
**16K STATIC MEMORY BOARD** --Kit uses EMM 4200's, 250ns, extreme LP, w/IC sockets (very similar to MITS board). Order **C80-16K-300** ..... **$479.95**

### SCIENTIFIC CALCULATOR S-100 BOARDS

MINI MICRO MART has introduced a completely new scientific calculator board for the S-100 system, using the MOS Technology 7529-103 calculator chip; greatly reduces software overhead for all mathematical computations. Complete with software, in kit form, order as **C80-SCI-300 at $ 99.95** or assembled and tested as **C80-SCI-500 at $ 149.95.**

### 16K S-100 MEMORY BOARD -----

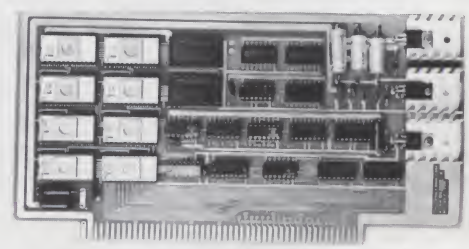
(from Digital Innovations) BEST VALUE ever Illustrated below is our SUPER SPECIAL 16K S-100 memory board, available in limited quantities, at **$ 399.95** in kit form or **$459.95** fully assembled and tested. Order as .............. **C80-16K SPECIAL.**



### EXPANDER/EXTENDER BOARDS

| | |
|---|---|
| **EXPA**, 4-position Expander Board | $ 10.95 |
| **EXPA-4** w/4 connectors " " | 34.95 |
| **EXPB**, 9-position " " | 17.95 |
| **EXPB-9**, w/4 connectors " " | 41.95 |
| **Extender Board**, w/connector | 24.95 |

NEW S-100 bus-compatible **VIDEO INTERFACE KIT**, 16x32 or 16x64, upper & lower case, and limited graphics; software includes cursor control, graphics and scrolling, etc. Uses low-power memory. Order as **C80-VBA** at **$149.95.** (Assembled & tested, add $50.00.)



Illustrated above is our 10K 2708 Board (C80-2708).

*New IMSAI and other S-100 kits and assembled units available from MINI MICRO MART. Write for price quotations; include stamped, self-addressed envelope.*

**Inquire about our special Boot Strap PROM Board for Altairs and IMSAI's for only $34.95, includes encoded PROM's. Send SASE.**

*Add $1.50 per board for shipping, handling & insurance. IC socket sets available – not included unless specified.*

*SURPLUS CATALOG -- send self-addressed, stamped envelope and specify SURPLUS CATALOG in lower left-hand corner of envelope.*

# MiniMicroMart

1618 James Street, Syracuse, N.Y. 13203, Phone: (315) 422-4467 M6

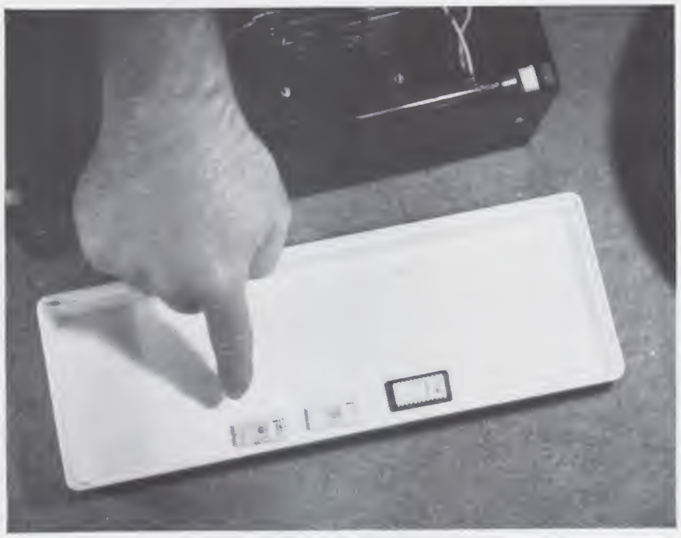
# The BYTEDESTROYER

## ... review of an EPROM eraser

The BYTEDESTROYER.

*Photos by R.P. (Bob) Jones*

*In a conversation with Ray Lyn, owner of the Byte Shop, whom Don mentions in the following article, I found out several facts which will be of interest to anyone reading it. First, Ray said that instructions certainly should have been included and apologizes for their omission. Second, he mentioned that a table of exposure time shouldn't be necessary because 30 minutes is adequate for any and all EPROMs. And last, but not least, his store is no longer in Campbell California (due to two too many burglaries!). The new address is 2626 Union Avenue, San Jose CA 95124. – John.*



*Put your EPROM in the bottom of the box.*

*A few parts in a two piece plastic box.*


*Don Parks*
*1039 Ivy Lane*
*Cary, NC 27511*


The BYTEDESTROYER is used for erasing ultraviolet Erasable Programmable Read-Only Memories (EPROM) and is sold by the BYTE Shop in Campbell, California. I ordered mine mail order from the BYTE Shop for $37.50 (plus postage). What you get for your money is a few parts in a two part plastic box. You put your EPROM (1702A, 5203, 5204, etc.) in the bottom part of the box (up to 48 EPROMs at a time), place the top part of the box over the EPROM, and switch on the ultraviolet light. Six to ten minutes later, your EPROM is erased. No instructions came with my unit – a table of exposure times for various EPROMs would be appreciated!

Looking into the top cover of the BYTEDESTROYER, you note there is a General Electric type G8T5 ultraviolet lamp, a switch, and a ballast transformer – really not much to it. In operating the unit, I have often had to operate the power switch several times to get the lamp to start (turn on). Just below the switch there is a label warning: "Protect your eyes from tube rays" (in other words – don't look at the lamp when it is on or you will get sunburn of the eyeballs!).

In conclusion, the BYTEDESTROYER erases EPROMs as advertised. I consider the unit overpriced even though it's the least expensive I've seen. If I had it to do over, I'd still buy it. ■

*Tom Rugg*
*1115 N. Beverly Glen Blvd.*
*Los Angeles CA 90024*

*Phil Feldman*
*1722 Brockton Ave. #10*
*Los Angeles CA 90025*

# BASIC Timing Comparisons

## ... information for speed freaks

*This is probably one of the most comprehensive execution speed comparisons of the various BASICs available to the hobbyists you've ever seen. Tom and Phil obviously put a lot of effort into the article and I'm sure you'll find their results as interesting as I did.*

*A side note concerning Imsai BASIC is in order. Imsai has recently released a new version of their 8K BASIC (Version 1.4) which will not only have additional features such as PEEK and POKE, and the ability to CALL assembly-language routines, but will also overcome the problems mentioned in this article. And in addition, they have a new Disk BASIC* compiler *which should be of interest to a lot of people. — John.*

* *Also note addendum following this article — Ed.*

If you hang around any gathering of computer hobbyists long enough, pretty soon the subject of relative speeds of different microprocessor chips will come up. How fast is the 8080 compared with the 6800 and 6502 (or whatever else is the favorite of someone there)? How much faster is the Z-80 than the 8080?

Sure, there will always be someone who will start rattling off the number of microseconds it takes to execute the fastest and slowest instructions, but how much does that really tell you? After all, which instructions will you really be using the most?

If you hang around a little longer, some people (maybe the same ones) will start making some very authoritative sounding statements about who has the "best" and "fastest" BASIC interpreter on their micro. They may even talk about how they've compared their own BASIC with another one and "proved" that theirs was "almost twice as fast."

Well, we've been curious about this ourselves, and we thought it was about time that someone came up with some comparisons of the speeds of the various BASICs that were a little bit more precise than this. We didn't hear any volunteers speak up, so we did it ourselves. Some of the results were *very* surprising.

### How Can You Compare BASIC Speeds?

We decided to write some simple "benchmark" programs in BASIC and then go around and run them on every microcomputer BASIC we could find. With the aid of a trusty stopwatch and an agile thumb, we timed each run to the nearest tenth of a second and then compiled and evaluated the results.

```
300 PRINT"START"
400 FOR K=1 TO 1000
500 NEXT K
700 PRINT"END"
800 END
```

*Fig. 1. Benchmark Program 1.*

```
300 PRINT"START"
400 K=0
500 K=K+1
600 IF K<1000 THEN 500
700 PRINT"END"
800 END
```

*Fig. 2. Benchmark Program 2.*

```
300 PRINT"START"
400 K=0
500 K=K+1
510 A=K/K*K+K-K
600 IF K<1000 THEN 500
700 PRINT"END"
800 END
```

*Fig. 3. Benchmark Program 3.*

```
300 PRINT"START"
400 K=0
500 K=K+1
510 A=K/2*3+4-5
600 IF K<1000 THEN 500
700 PRINT"END"
800 END
```

*Fig. 4. Benchmark Program 4.*

```
300 PRINT"START"
400 K=0
500 K=K+1
510 A=K/2*3+4-5
520 GOSUB 820
600 IF K<1000 THEN 500
700 PRINT"END"
800 END
820 RETURN
```

*Fig. 5. Benchmark Program 5.*

```
300 PRINT"START"
400 K=0
430 DIM M(5)
500 K=K+1
510 A=K/2*3+4-5
520 GOSUB 820
530 FOR L=1 TO 5
540 NEXT L
600 IF K<1000 THEN 500
700 PRINT"END"
800 END
820 RETURN
```

*Fig. 6. Benchmark Program 6.*

```
300 PRINT"START"
400 K=0
430 DIM M(5)
500 K=K+1
510 A=K/2*3+4-5
520 GOSUB 820
530 FOR L=1 TO 5
535 M(L)=A
540 NEXT L
600 IF K<1000 THEN 500
700 PRINT"END"
800 END
820 RETURN
```

*Fig. 7. Benchmark Program 7.*

Before we go any further, however, let's take a quick look at what a benchmark is, and what it can and can't tell us.

**What's a Benchmark?**

A benchmark to a computer person is obviously not quite the same thing as it is to a carpenter, who can make physical marks on his workbench for measurement purposes. But, just as a carpenter needs methods of measuring the lumber he's working with, the computer person needs ways of measuring the capacity of the computer hardware and software he's evaluating (and maybe even considering buying).

The way this is generally done is by running some carefully selected programs (benchmark programs) on each of the computer systems being considered. By comparing the amount of time it takes each system to run them, you can make a pretty good estimate of how much faster one system is over another *for the kind of work you tested.*

Notice that last qualification. If one guy runs his benchmark programs on system X and system Y, and concludes that system X is 23 per cent faster, that doesn't mean that system X is 23 per cent faster for *everything.* Maybe he was testing his set of statistical calculation programs, while some other guy would want to know how the two systems compare with some text-processing programs, for example. Maybe system X is great at "number crunching" (square roots, trig functions, etc.) but terrible at string manipulation.

The whole point of this is that you have to run benchmarks that reflect the kind of work that *you* plan to do if you expect the results to really tell you anything worthwhile. We tried to come up with some simple programs that would be somewhat representative of what a lot of computer hobbyists frequently do in the programs they write. If you do greatly different things in your programs, you'll need to run your own benchmarks, of course. But ours should give you a good general idea of how the different BASICs stack up, and you'll have a good starting point for coming up with your own benchmarks.

Another thing to keep in mind is that we're really testing the speed of the hardware and the software in conjunction with each other. If you have the fastest and most flexible CPU in the world, but you're running a badly written BASIC on it, it's not going to measure up too well. The same is true of a beautifully written BASIC on a poorly designed CPU. As a result, when our results show a certain BASIC on a certain

| | Software/Hardware | Benchmark Number 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| | 1. TRW Expanded BASIC/ Control Data Cyber 174 | .08 | .07 | .15 | .15 | .24 | .80 | 1.04 |
| | *2. 6K Integer BASIC/Apple | 1.3 | 3.1 | 7.2 | 7.2 | 8.8 | 18.5 | 28.0 |
| | 3. Zapple 8K BASIC (1.1)/ Altair 8800a, TDL ZPU @ 2 MHz | 1.7 | 9.5 | 20.6 | 21.7 | 23.7 | 36.2 | 51.8 |
| | 4. Altair 8K BASIC (4.0)/ Altair 8800b | 1.7 | 10.2 | 21.0 | 22.5 | 24.3 | 36.7 | 52.4 |
| | 5. Altair 8K BASIC (3.2)/ Altair 8800a | 1.7 | 10.3 | 21.4 | 23.1 | 24.8 | 37.3 | 52.8 |
| | 6. Altair 8K BASIC (3.0)/ Imsai 8080 | 1.6 | 10.6 | 22.0 | 23.7 | 25.4 | 38.3 | 57.1 |
| (tie) | 7. Digital Group Z-80 Maxi-BASIC (1.0)/Digital Z-80 @ 2.5 MHz | 1.8 | 7.5 | 21.2 | 25.1 | 26.9 | 40.3 | 58.5 |
| (tie) | 7. Altair 12K Extended BASIC (4.0)/Altair 8800b | 1.9 | 7.5 | 20.6 | 20.9 | 22.1 | 37.0 | 58.5 |
| (tie) | 7. Altair Disk Extended BASIC (4.0)/Altair 8800b | 1.9 | 7.5 | 20.6 | 20.9 | 22.1 | 36.9 | 58.5 |
| | 10. Altair 12K Extended BASIC (3.2)/Altair 8800a | 1.9 | 8.9 | 21.8 | 23.0 | 24.8 | 39.3 | 60.7 |
| | 11. Altair Disk Extended BASIC (3.4)/Altair 8800b | 1.9 | 8.8 | 21.7 | 22.8 | 24.7 | 39.6 | 61.6 |
| | 12. Altair 4K BASIC (4.0)/ Altair 8800b | 1.9 | 15.1 | 26.0 | 28.9 | 31.7 | 44.5 | 62.1 |
| | 13. Compal-80 10K BASIC/ Compal-80 | 2.0 | 9.3 | 23.4 | 24.6 | 26.3 | 42.1 | 65.7 |
| | 14. Process Technology BASIC 5/ Digital Group 8080 | 3.6 | 10.5 | 27.5 | 30.9 | 33.2 | 51.3 | 67.4 |
| | 15. Compucolor 8K BASIC/ Compucolor 8001 | 2.1 | 13.1 | 27.0 | 29.0 | 31.3 | 47.5 | 67.8 |
| | 16. Digital Group 8080 Maxi-BASIC (1.0)/Digital Group 8080 | 2.2 | 9.2 | 26.4 | 31.2 | 33.5 | 49.9 | 72.3 |
| | 17. Altair 680 8K BASIC (3.2)/ Altair 680b | 2.5 | 16.3 | 30.7 | 33.4 | 36.3 | 55.9 | 81.8 |
| | *18. Programma TBX (1.1)/ Sphere 330 | 2.9 | 34.8 | 55.6 | 60.5 | 73.5 | 101.1 | 159.8 |
| | 19. Imsai 8K BASIC (1.3)/ Imsai 8080** | 7.1 | ---- | 44.1 | 56.2 | ---- | 105.7 | 194.9 |
| | *20. Programma TBX (1.2)/ Sphere 330 | 3.1 | 41.2 | 68.3 | 72.2 | 85.3 | 115.3 | 202.8 |
| | 21. Southwest Tech 8K BASIC (1.0)/ SWTPC 6800 | 14.9 | 24.7 | 96.1 | 105.3 | 109.8 | 174.1 | 204.5 |
| | ***22. Imsai 8K BASIC (1.31) | 7.5 | 28.2 | 66.4 | 78.5 | 88.1 | 140.1 | 235.6 |

*Integer BASIC only.
**Some benchmarks could not be run. Others are incomplete.
***Results for Imsai 8K BASIC, Version 1.31, from tests conducted by Tom Rugg after article submitted for publication.

*Fig. 8. Benchmark timings (in seconds).*

CPU to be exceptionally fast (or slow), we don't really know how much of that is due to the hardware and how much to the software. We can draw some conclusions, though, by comparing how different versions of BASIC do on the same CPU.

One more thing. There are lots of factors that go into deciding which BASIC and which computer are *best* for you. We're just looking at the speed of some small programs. Large programs (with lots of variables to look up in internal tables) might come out different. You also have to consider cost, availability, reliability, support by the vendor, number of digits of accuracy, ease of use, compatibility with other hardware and software, loading time, special features, and other miscellaneous factors. Speed may not be important to you. But if it is, read on.

**The Benchmark Programs**

By now you've probably already sneaked a look at the table of benchmark timings, so we'd better explain each of the benchmark programs. Remember, there's nothing magic about these programs. They're just some that we made up so they would be short and simple and would test the speed of certain features of BASIC that we thought were important.

All the benchmark programs print "START" at the beginning and "END" at the end. The length of time between the two is what we measured.

The first benchmark is nothing but a simple FOR-NEXT loop. All it does is make the variable K go from one to a thousand. Ever wonder how long something like this would take? Depending on which micro's BASIC we used, it took anywhere from 1.3 seconds to 14.9 seconds. Quite a spread.

The second benchmark program does the same thing (logically), but in a different way. Instead of using a FOR-NEXT loop, we set K equal to zero, add one to it, and check to see if we've reached 1000 yet. If not, we go back and add one again. Since this does the same thing as the first benchmark, it should take about the same amount of time, right? Wrong! It takes an average of about five times as long. There's a lesson to be learned here.

The second benchmark is used as a basis for all the rest of the benchmarks. What we do is continually add more and more statements between lines 500 and 600. These statements will be executed 1000 times, and we can see how much time is added by adding each statement. That way we can figure out which BASICs are most efficient at each type of statement. In addition, the last benchmark will have a variety of types of statements in it, so we can use it as our measure of how fast each BASIC is overall.

The third benchmark adds statement 510 to the program. It does a divide, a multiply, an add, and a subtract — using variables only. We did this because some of the BASIC manuals tell you to use variables instead of constants to make your program run faster. If so, this benchmark should run faster than one that was doing these operations with constants, right?

The fourth benchmark provides the answer. It replaces statement 510 with one that does the same operations, but uses one-digit constants instead. Sure enough, the program runs longer this way on nearly all the micro BASICs.

Benchmark number 5 adds statements 520 and 820. All they accomplish are a simple GOSUB to a dummy subroutine that does nothing but RETURN. We were curious how long it took to do this, since it is a common programming technique (and a good one, we feel) to break up a program into a series of subroutines and GOSUB to them from a mainline routine.

The sixth benchmark has some interesting aspects, but it's mostly a preparation for the next one. It adds statements 430, 530 and 540. It creates the array M and does a five-time FOR-NEXT loop for each of the thousand times in outer loop. This tests a different condition than the first benchmark, which is also a FOR-NEXT loop, because this one executes a small inner loop a thousand different times. Initializing a small loop one thousand times is quite a bit different from initializing a large loop once (as Benchmark 1 did).

The last benchmark (number 7) adds statement 535. This tests the amount of time it takes to place a value in an array. Since arrays are so frequently used by so many programs, it's important to know how long it takes BASIC to figure out which element you're referring to (the "L-th" one here) and then put a value into it (A). Notice that we're executing this statement 5000 times.

**The BASICs That Were Tested**

We ran the benchmarks on just about every BASIC we could get our hands on for a few minutes. We went around to computer stores, hobbyist meetings, friends' houses — wherever new BASICs could be found. It seemed sort of like stamp collecting after a while. "Ah! Here's one we haven't found before!"

We even tried them on a *super computer*, a Control Data Cyber 174. We had to use its internal clock (our reflexes and stopwatch weren't quite good enough). It's interesting to see how the big guy compares with all the little guys. In addition, since it's a lot faster than all the micros, this will prevent anybody else from claiming he came out on top in our benchmark.

When possible, we tried to run somebody's BASIC on his own machine. We ran Altair BASIC on an Altair, Southwest Tech BASIC on a Southwest Tech machine, etc. In some cases, we couldn't do this, simply because we couldn't find anyone with the right machine, or the machine doesn't exist. So, we ran Processor Tech's "BASIC 5" on a Digital Group 8080 system, and Programma's TBX (Tiny BASIC Extended) was run on a Sphere 330 (a 6800-based machine). TDL's Zapple BASIC was run on an Altair 8800a with a TDL ZPU board in it. By the way, did you know that neither the TDL ZPU nor the Cromemco Z-80 board will work in an Altair 8800b? This fact hasn't been given too much publicity, as far as we've seen.

Note that some of the BASICs are marked with an asterisk in Fig. 8. These are the ones that only handled integers (no floating point). For a while we considered eliminating them from our results, since they obviously have an advantage in processing speed. But when we saw how some of them came out in the standings, it didn't look like it was necessarily as much of an advantage as we expected.

In glancing down the list of BASICs that were tested, a couple of things are quickly noticeable. First, we tested more versions of Altair BASIC than anything else. The reason for this is pretty simple. More people used it than any other BASIC we ran into, and more versions of it exist than any other.

The second thing is that we obviously didn't test every version of microcomputer BASIC that exists. Sorry, but we just couldn't arrange to test some of them. If you have one we didn't test (and you live in the Los Angeles area), let us know and we'll set up a test with you. If there's enough interest, we can publish an update in a later issue. That'll also give all the vendors a chance to come out with some new versions of BASIC that perform better. After all, isn't that what we really want to get out of all this?

### Imsai BASIC

A special explanation is required for Imsai BASIC, especially since so many people seem to have (and like) Imsai computers. Benchmark 1 was the only one that we could run the same way as on other versions of BASIC. Benchmarks 2 and 5 could not be run at all. The rest of them were run in an *incomplete* way.

Here's what happened. We went around to four different Imsai dealers to try to run the benchmarks with Imsai BASIC. One of them said, "It doesn't work." Another said his people had tried a couple of times without success and then gave up. The third worked with us to try to bring it up and partially succeeded. We could enter programs and run them, but they really didn't do anything. All variables were stuck at zero and couldn't be changed, and we were getting strange errors for no apparent reason.

The fourth dealer had more success. We were able to run our BASIC programs, but certain things didn't work. Specifically, any kind of branch instruction (GOTO, GOSUB, etc.) wouldn't work! He said the same thing had happened before. To say the least, this is a pretty severe programming restriction. As a result, we couldn't run benchmarks 2 and 5 at all. Benchmark 3 had to be done with a FOR-NEXT loop (like benchmark 1), as did all subsequent benchmarks. Benchmarks 6 and 7 didn't have the GOSUB-RETURN statements in them.

Imsai's documentation says that this version of 8K BASIC (1.3) is a "preliminary" one. Considering its extremely slow speed (it takes over twice as long as the next slowest 8080 BASIC) and the fact that many people are having problems getting it to work, we hope they can come out with a *final* version to replace it pretty fast.

### The Hardware That Was Tested

There were four microcomputer chips represented in the benchmarks. Apple (not Zapple) uses a 6502. Southwest Tech, the Altair 680b, and the Sphere use the 6800. The TDL ZPU and the Digital Group Z-80 use the Z-80. All others use the 8080.

We made sure that no *slow* memory was used. All machines were thought to be running at their full rated speeds by their owners. If you run these benchmarks on your machine and discover significant differences between your results and ours, we'd like to hear from you. Please be sure that you enter the programs exactly as they are shown (spacing is a factor in BASIC's speed, you know). We would hope that your results would be within one percent of ours.

### The Results

Now that we've talked about what we were trying to do and how we did it, let's finally take a look at the results to see what we can conclude. Remember, we're looking at the times for benchmark 7 as our overall measurement.

First of all, there's absolutely no question that BASIC on the Control Data Cyber 174 came out on top. If you have a few million dollars in loose change rattling around in your pocket, go out and get one.

To tell the truth, we were surprised that there wasn't a bigger difference between number one and the rest of the field. Apple BASIC only took 27 times as long as the CDC,and about half the field finished in less than 60 times as long. We expected a much larger gap here.

Speaking of Apple BASIC, look how far in front of the rest of the micros it came out. Sure, it's an integer BASIC, but that's still an awfully impressive performance. Some other integer BASICs finished down near the bottom. Apple expects to have a BASIC with floating point available by about July. It'll be interesting to see how much it slows down.

After Apple comes a cluster of Z-80 and 8080 BASICs. TDL's Zapple 8K BASIC just barely came out in front of Altair 8K BASIC (versions 4.0 and 3.2). TDL's ads claimed that it was "20% faster than Altair." Our benchmarks show that it's only a little over one per cent faster than the fastest Altair BASIC, and it's slower at some things (look at benchmark 2). It *is* nearly 20 per cent faster than the *slowest* Altair BASIC (4K, version 4.0). Keep in mind, though, that if we had run another set of benchmarks (maybe with a lot of string processing or square roots or something), it might have turned out that we agreed with TDL.

Most of the 8080 and Z-80 BASICs came out in the 50 to 70 second range. Digital Group's Z-80 Maxi-BASIC is an interesting case. Even though it uses the Z-80 and runs at 2.5 MHz, it still finished behind several others. (Zapple ran at 2 MHz, as do all the 8080 based computers.)

We were also sort of surprised that there wasn't more variation in the speeds of the 8080 and Z-80 BASICs. They all finished within about 20 seconds of each other (except Imsai's). All the Altair versions came out looking pretty good, but the others weren't really very far behind. By the way, you can observe that Altair 12K Extended BASIC (4.0) and Disk Extended BASIC (4.0) have almost identical timings right down the line. That tells us that they are probably similar. The 8K version is obviously quite a bit different.

All of the 6800-based BASICs are down at the bottom of the list. Here we see a wide variation in timings. Altair 680 8K BASIC took 81.8 seconds — about 30 to 40 per cent slower than the average 8080 BASIC (nearly 60 per cent slower than the fastest). But Altair's 680 BASIC looks great compared with the other 6800 BASICs. The two TBX versions (and both are integer BASICs, remember) took 2 to 2½ times as long!

The Southwest Tech BASIC was even slower (although not by much). We realize that SWTPC's BASIC handles nine significant digits and does BCD arithmetic, but 204 seconds compared with 81.8 seconds tells us that there's some work to be done to improve things. And when you compare it with 51.8 for Zapple and 52.4 for Altair 8K (on the 8080), well, there's a *lot* of work to be done.

Another thing that's interesting to look at is which BASICs are fastest at which things. For example, if you subtract the time for Benchmark 4 from the time for Benchmark 5, you can see how long it takes to do 1000 GOSUBs and RETURNs. You'll find that Altair Extended BASIC, version 4.0 (both Disk and 12K) took 1.2 seconds for this — the best of all the micros we tested.

### A Final Word

We hope you found this study interesting. You can bet that the computer store owners who were looking over our shoulders found it interesting. They were without exception very friendly and helpful, but they were also concerned about how their products were stacking up against the competition. So be fair to them and the manufacturers — remember that pure speed is only one of the factors you need to consider when buying a computer. At the same time, however, we hope this article has made you realize that there are some pretty good ways of comparing the power of different computer systems. Now if you'll excuse us, we're going to load BASIC on our new Cyber 174 so we can play Star Trek.

*During a phone conversation with Robert Uiterwyk, the man who developed SWTP's 8K BASIC, I happened to mention Tom and Phil's article and asked if he had any comments regarding the results of the benchmarks (in particular, of course, the fact SWTP's BASIC was so slow).*

*He wasn't even a little bit perturbed. His reaction was, "Of course it's slower than the others . . . it does more." He had three points to make regarding the speed:*

*1. It's going to be slower because it provides 50% more significant digits than other BASICs. SWTP BASIC generates* nine *significant digits whereas "everyone else uses six." This additional accuracy contributes to an overhead increase of about 50%.*

*2. The BCD arithmetic operations contribute approximately 20% in increased overhead but also provide increased accuracy for those operations.*

*3. The transcendental functions (sine, cosine, tangent, exponents, etc.) should execute twice as fast as before due to modifications found in Version 2. — John.*

---

*As a result of our submitting this article to several local computer stores, we were pleased to receive the following response from Microcomputers, Inc. We invite other stores to submit their own benchmark results. — Ed.*

Along with Imsai 8K BASIC, our store also has Polymorphic 11K BASIC and Northstar BASIC (on their disk system). Thus, our benchmark times for all three BASICs. First, a few words on how we did the testing:

*We used a watch with a sweep second hand, so we suspect our times to be accurate to only ½ second.

*The Imsai 8K BASIC is in 1702 EPROM using 1½ wait states per machine instruction access. It goes without saying that this alone slowed the programs way down.

*The Imsai 8K BASIC was run with an Imsai 8080 frame and CPU, using a Teletype as output device.

*The Poly-88 11K BASIC was run in a Polymorphic System 16 (16K RAM with no wait states, Poly video output).

*The Northstar Disk BASIC was run with an Imsai 8080 frame and CPU, using TTY again for output, and RAM needing no wait states.

*Each benchmark was run three times, with the average shown as our benchmark run time.

By the authors' charted results, Poly-88 11K BASIC and Northstar Disk BASIC performed midrange in speed, and the Imsai 8K BASIC performed by far the slowest; however, keep in mind the 1½ wait states per access on the 1702 EPROMs. I'm not sure how to bend the Imsai results to compare with the others, so I haven't. I hope you can use this additional information, and once again, my compliments on a very good effort.

**Stephen M. Pereira, Pres.**
**Microcomputers, Inc.**
**539 Amherst St.**
**Nashua NH 03060**

| BASIC/machine | BM1 | BM2 | BM3 | BM4 | BM5 | BM6 | BM7 |
|---|---|---|---|---|---|---|---|
| Imsai 8K ver 1.3 Imsai 8080 | 11.5 | 39 | 92 | 110 | 121.5 | 191 | 320 |
| Northstar ver 6 Imsai 8080 | 3.5 | 10.5 | 28 | 32.5 | 34.5 | 51 | 74.5 |
| Poly 11K ver 9V27 Poly-88 System 16 | 2.5 | 10.2 | 29 | 34 | 36.5 | 54 | 79 |

*Table of benchmark timings (in seconds).*

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# Solving Keyboard Interface Problems

## ... would you believe a UART?

A common need is for a device to convert the parallel ASCII output of a typical cheap keyboard into a serial Teletype-compatible output. A new UART (Universal Asynchronous Receiver-Transmitter) from Intersil makes the job very easy, and this article describes a simple circuit which easily adapts to a wide variety of uses.

The UART is a 40-pin integrated circuit made by several manufacturers under different numbers. It consists of two parts: The Receiver receives serial teleprinter data (in ASCII, Baudot, or any other code), one bit at a time, and converts it into a parallel form, eight bits at once. The Transmitter does the exact opposite, converting parallel data into serial format. Since UARTs are generally used for sending teleprinter characters, the parallel group of bits sent at once generally represents one character. Eight bits would be used in ASCII, five bits in the older Baudot code, and UARTs also can send six or seven bits at a time.

The word *asynchronous* means that these characters can appear at random intervals, either one right after another, or perhaps separated by unknown times. To indicate to the receiver when the next character is arriving, each serial group of bits is preceded by a start bit and followed by one or two stop bits. The UART transmitter automatically generates these bits, and the receiver also checks for them and uses them for timing. In addition, the transmitter can generate an optional parity bit, which is used by the receiver to check whether a possible error has occurred in character transmission. Although the UART can be used both as a transmitter and as a receiver (at the same time), in this circuit we use it only as a transmitter, converting parallel data such as might come out of a keyboard or computer output port into serial data which might be needed by a teleprinter.

The first UARTs needed two operating voltages, -12 volts and +5 volts, and consumed appreciable amounts of power. Later versions eliminated the need for the -12 volt supply and could therefore run on a single +5 volt supply such as might be needed in typical digital systems. Intersil's UART operates from a single +5 volt supply and has the further advantage that it requires less than one half milliampere of supply current. Four versions of the unit are available. The IM6402 is TTL compatible and operates on +5 volts. The IM6402A is CMOS compatible and operates on any voltage between +4 and +11 volts. The IM6403 and IM6403A are similar but have a built-in oscillator and divider circuit which makes them very easy to use. All of these ICs are second sourced by Harris under the numbers HM6402, etc.

In order to set the precise operating speed of a UART, a frequency oscillator is needed to generate a frequency exactly sixteen times the bit rate of the serial signal. For example, standard ASCII teleprinter signals send at 110 bits per second, and thus a frequency of 11 x 16 or 1760 Hz is needed. This frequency is often generated with a separate 555 timer, or more exactly with an external crystal oscillator and a frequency divider IC. The IM6403 and IM6403A are especially useful because they have that oscillator and divider built-in. Only one component is needed to generate a clock: an external crystal. For standard 110 bit-per-second speed a 3.58 MHz color TV crystal is needed. The crystal is simply connected between pins 17 and 40 of the UART as shown in Fig. 1. A built-in divider divides that frequency by 8192 to produce almost exactly 1760 Hz. This scheme tremendously simplifies any design and has only one disadvantage: Whereas in a standard UART the receiver and the transmitter can run at different speeds, in the IM6403 they must run at the same speed since they share the same crystal.

Fig. 1 shows the diagram of a simple circuit using the IM6403. The parallel ASCII input at Bit 1 through Bit 7 comes to the UART at the upper left; the serial output exits at the right. A "character present" strobe signal applied to either the A or the B input of a 74121 monostable provides the start pulse for the UART which tells the transmitter to start working. The only other components required are an RC network connected to pin 21 which provides a Master Reset when power is first applied. The following paragraphs describe some of the input and output characteristics; Fig. 2 shows some alternative wiring arrangements.

As shown in Fig. 1, the inputs are designed for a keyboard which provides a low voltage for a 1 and a high voltage for a 0. Two 7404 ICs are used to invert these logic voltages to a high for a 1, as required by the UART. If the 1 is a low voltage near 0 volts,

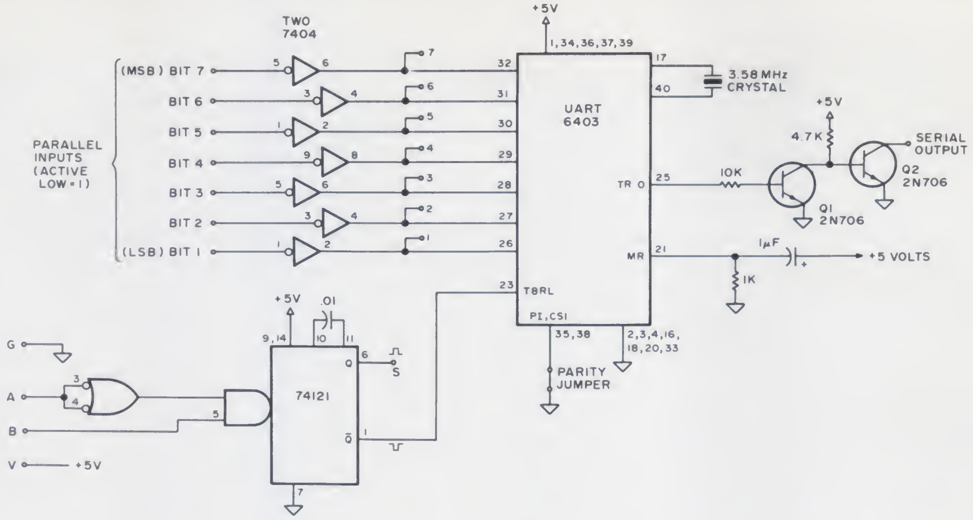
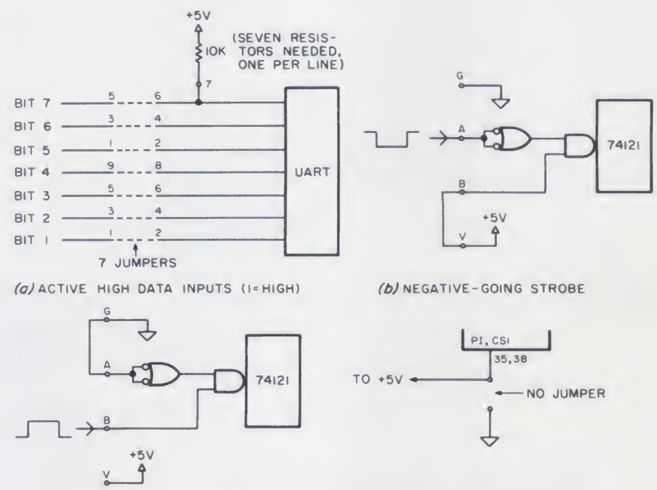



*Fig. 1. Schematic diagram.*




*(a)* ACTIVE HIGH DATA INPUTS (1=HIGH)

*(b)* NEGATIVE-GOING STROBE

*(c)* POSITIVE-GOING STROBE

*(d)* NO PARITY BIT (8TH BIT ALWAYS=0)

*Fig. 2. Optional connections.*

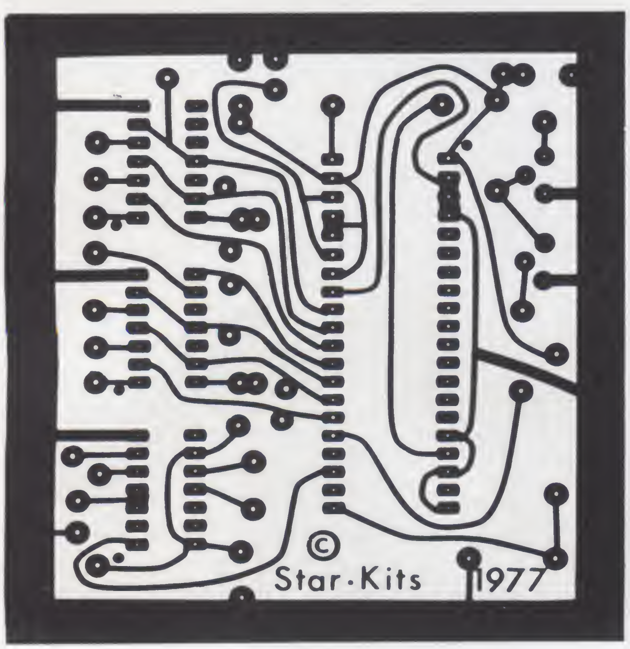



*Fig. 3. Printed circuit board (full size).*

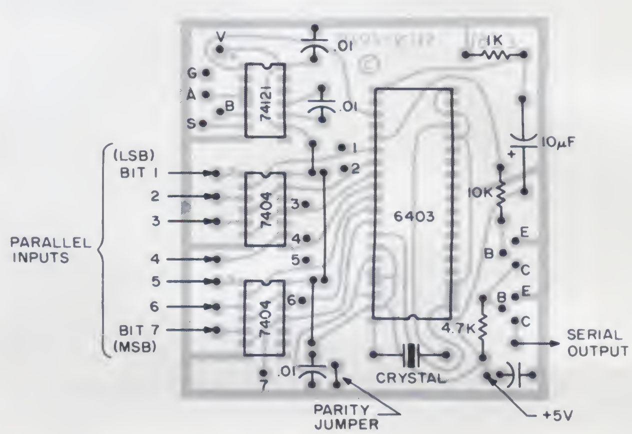



*Fig. 4. Parts placement.*

the keyboard is said to have an active low output; if the 1 is a high voltage of some 3 volts or so, then the keyboard has an active high output. Both types of keyboards are commonly available. The inverters are needed for active low keyboards. Tie points 1 through 7, connected to the outputs of the inverters, provide an inverted signal in case you need it somewhere else in your system.

For keyboards or computer output ports which provide active high outputs no inverters are needed; as shown in Fig. 2a they are simply left out and bypassed. But in this case the tiepoints should be used to provide seven 10k pullup protection resistors (only one is shown) to protect the seven UART inputs from possible static electricity damage.

The 74121 monostable can be activated either by an active low input or by an active high input, depending on how the points G, A, B, and V are jumpered; the correct jumpers for the two types of inputs are shown in Fig. 2b or 2c. The strobe pulse pulses the monostable, which then provides a short output pulse which starts the UART transmitter. The negative spike on pin 1 of the 74121 is needed by the UART, but the positive spike on pin 6 is also available on the S tiepoint in case you have a use for it elsewhere in your system.

Although the full ASCII code as sent over the serial line consists of eight bits, only seven of those are actual data. The eighth is generally used for parity. In many home-type systems this bit is intentionally made a 0, whereas in more professional systems it may be a 0 or 1 depending on the character. When used, it is called *even* parity when it is chosen such that the total number of ones in the character is even, or *odd* parity when the number of ones is odd. Even parity is probably more common, and the parity jumper shown in Fig. 1 is connected for even parity. If no parity is desired (always 0), then connect the jumper as shown in Fig. 2d.

The serial output on pin 25 of the UART is active high; that is a 1 or *mark* bit is a high voltage, and a 0 or *space* bit is a low voltage. If that is what your system needs, then the output from pin 25 can be used directly. If the opposite is what you need, then include Q1 and the two resistors (but not Q2); take the output from the collector of Q1.

Q2 is peculiar to my system because all serial lines in my system use an unusual convention: an open circuit is a 1 (mark), whereas a grounded circuit is a 0 (space). The collector of Q2 does just that — it is open for a mark and is grounded for a space. My Teletype machines have built-in control circuits which translate from this open-grounded configuration to a loop current basis. The advantage of such a setup is that this allows multiple inputs and outputs to be paralleled, as can a keyboard and an amateur radio-Teletype converter. Whichever input is active at the moment, generating spaces, provides an output. In the same way, this signal can be fed in parallel to a teleprinter, to my video display, and to my acoustic coupler. Simple phono plugs or phone plugs can be used for switching inputs and outputs around in any configuration.

The circuit is easy to build; since no very high pulse rates are involved, almost any construction method can be used. If you wish, you can use the printed circuit board layout of Fig. 3, with the parts locations as shown in Fig. 4. Use the indicated layout to make your own board; alternatively, drilled and plated boards will be available from the author for $7 each. ■

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| 82S11 | 2.00 | 82S130 | 3.95 | 8574 | 5.50 |
| 82S12 | 2.00 | 82S131 | 3.95 | 8575 | 4.50 |
| 82S17 | 2.00 | 74S206 | 2.10 | 8576 | 4.50 |
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| 7404 | .18 | 7475 | .50 | 74165 | 1.10 |
| 7405 | .24 | 7476 | .30 | 74166 | 1.25 |
| 7406 | .20 | 7480 | .50 | 74170 | 2.10 |
| 7407 | .29 | 7483 | .70 | 74173 | 1.50 |
| 7408 | .25 | 7485 | .90 | 74174 | 1.95 |
| 7409 | .25 | 7486 | .40 | 74175 | .95 |
| 7410 | .18 | 7489 | 2.00 | 74176 | .90 |
| 7411 | .30 | 7490 | 45 | 74177 | .90 |
| 7413 | .45 | 7491 | .75 | 74179 | .90 |
| 7414 | .70 | 7492 | .50 | 74180 | .90 |
| 7416 | .35 | 7493 | .50 | 74181 | 2.50 |
| 7417 | .35 | 7494 | .80 | 74182 | .95 |
| 7420 | .20 | 7495 | .75 | 74184 | 1.95 |
| 7423 | .37 | 7496 | .90 | 74185 | 2.20 |
| 7425 | .30 | 74100 | 1.00 | 74190 | 1.15 |
| 7426 | .30 | 74107 | .40 | 74191 | 1.25 |
| 7427 | .35 | 74109 | .90 | 74192 | .90 |
| 7430 | .25 | 74121 | .40 | 74193 | .90 |
| 7432 | .30 | 74122 | .50 | 74194 | 1.25 |
| 7437 | .27 | 74123 | .70 | 74195 | .75 |
| 7438 | .27 | 74125 | .60 | 74196 | 1.25 |
| 7440 | .15 | 74126 | .60 | 74197 | .90 |
| 7441 | .85 | 74132 | 1.00 | 74198 | 1.75 |
| 7442 | .60 | 74141 | 1.15 | 74199 | 1.75 |
| 7443 | .75 | 74145 | 1.15 | 74200 | 4.95 |
| 7444 | .75 | 74147 | 2.35 | 74251 | 1.75 |
| 7445 | .75 | 74148 | 2.00 | 72284 | 4.95 |
| 7446 | .80 | 74150 | 1.00 | 74285 | 4.95 |
| 7447 | .70 | 74151 | .80 | 74365 | .90 |
| 7448 | .80 | 74153 | .90 | 74367 | .75 |
| 7450 | .25 | 74154 | 1.00 | 74368 | .90 |
| 7451 | .25 | 74155 | 1.00 | MH0025 | 2.50 |
| 7453 | .25 | 74156 | 1.00 | MH0026 | 2.95 |
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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MM5309 | 8.00 | 2501B | $1.25 | 1101 | .40 | 74LS00 | .40 | 74L00 | .25 | 74L78 | .90 |
| MM5312 | 4.00 | 2503V | 2.00 | 1103 | 1.25 | 74LS01 | .50 | 74L01 | .25 | 74L85 | 1.40 |
| MM5313 | 4.00 | 2504V | 2.00 | 2101 | 4.50 | 74LS02 | .40 | 74L02 | .25 | 74L86 | .75 |
| MM5320 | 4.95 | 2505KN | 2.00 | 2112 | 4.50 | 74LS03 | .40 | 74L03 | .25 | 74L89 | 3.50 |
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| MM5556 | 2.50 | 2509A | 2.00 | 4002-1 | 7.50 | 74LS05 | .45 | 74L05 | .40 | 74L91 | 1.50 |
| MM5055 | 1.90 | 2510A | 2.00 | 4002-2 | 7.50 | 74LS10 | .40 | 74L06 | .30 | 74L93 | 1.70 |
| DM8836 | .60 | 2511A | 2.80 | MM5262 | 1.00 | 74LS11 | .50 | 74L08 | .40 | 74L95 | 1.70 |
| DM8837 | 1.50 | 2517V | 1.25 | 7489 | 2.00 | 74LS12 | .55 | 74L09 | .40 | 74L98 | 2.80 |
| 80C95 | 1.10 | 2518B | 1.50 | 74200 | 4.95 | 74LS20 | .40 | 74L10 | .30 | 74L123 | 1.50 |
| 80C97 | 1.00 | 2519B | 2.80 | 74S89 | 3.50 | 74LS22 | .45 | 74L20 | .35 | 74L154 | 2.00 |
| 80L97 | 1.50 | 2521V | 1.50 | 74C89 | 3.50 | 74LS27 | .45 | 74L26 | .40 | 74L164 | 2.50 |
| 81L22 | 1.50 | 2522V | 2.00 | 74L89 | 3.50 | 74LS30 | .40 | 74L30 | .40 | 74L165 | 2.50 |
| 81L23 | 1.90 | 2525V | 2.80 | 8T80 | 2.50 | 74LS42 | 1.50 | 74L32 | .45 | 74L192 | 1.25 |
| 81L51 | 2.50 | 2527V | 2.80 | 8T97 | 2.00 | 74LS55 | .40 | 74L42 | 1.50 | 74L193 | 1.20 |
| 85L52 | 2.50 | 2528V | 2.80 | INTEL | | 74LS73 | .65 | 74L51 | .35 | MC4044 | 2.25 |
| 85L63 | 1.25 | 2529V | 2.80 | 8216 | 4.95 | 74LS74 | .65 | 74L54 | .45 | N8263 | 3.50 |
| 86L70 | 1.50 | 2532B | 2.80 | 8214 | 8.30 | 74LS76 | .65 | 74L55 | .35 | N8826 | 2.50 |
| 86L75 | 1.90 | 2533V | 2.80 | 8251 | 14.50 | 74LS151 | 1.55 | 75L71 | .30 | DM8131 | 2.50 |
| 86L99 | 3.50 | 91L02APC | 2.55 | 8255 | 14.50 | 74LS174 | 2.20 | 74L73 | .55 | 8T16 | 2.00 |
| 86L12 | .80 | 32 ea. | 2.40 | 1488 | 1.50 | 74LS175 | 1.95 | 74L74 | .55 | 8T20 | 2.00 |
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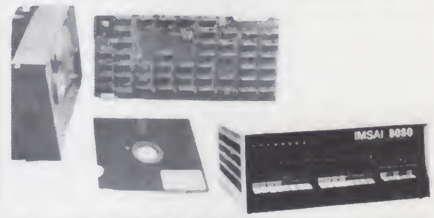


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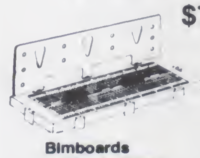

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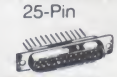

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# A Clean Cassette

## ... getting the most from inexpensive recorders

You say you have been having problems with the reliability of your Tarbell cassette interface? Stop looking at the interface and take a close look at your tape recorder.

Certainly many of us have had problems getting our Tarbell interface to work properly. Sometimes an IC is bad or perhaps a bad solder joint causes problems, but once these conditions have been cleared and record and playback problems will still exist, most of us get out the scope and start looking at the interface input and output waveforms. Well don't, unless you want to be more confused than ever.

After looking at several Tarbell interface boards, I have decided to take another approach which turns out to be much more rewarding.

Find a friend whose system (interface board and tape recorder) works reliably. Borrow the tape recorder and check it with your interface board. If there is significant improvement, then you are on the right track.

Before purchasing a tape recorder, I watched several individuals agonize over their inability to record and play back successfully on expensive (around $100) tape recorders; yet others with less expensive recorders were very successful, recording and playing back blocks as long as 24K bytes on inexpensive models. Not to say that all of the more expensive cassette recorders don't work, because some do.

So, initially I borrowed a friend's tape recorder, a J C Penney Model 6536 which sells for $39.95. This worked wonders. I was able to record and play back without one error. The J C Penney Model 6536, however, had several shortcomings for data recording. First, and most detrimental, was that the built-in microphone was always in the circuit, even when the cassette interface was plugged into the AUX jack, which meant any noises in the room were recorded along with the data. Naturally this caused a hiccup on playback, so the first mod was to fix this.

Since the most reliable playback is made with the TONE control rotated to treble (10 on the dial), and the MIC OFF switch is on the TONE control, but in the opposite rotation, the obvious answer is to reverse the pot, making the MIC OFF switch turn off the microphone at full treble. Fig. 1 shows the one foil cut and one jumper required. This has the added advantage of not completely disabling the internal microphone, so voice annotation may be made if desired. This modification simply makes full treble at position 0 and full bass at position 10, with the microphone off at 0.

The next modification was a boon to locating data on the tape and indicating when to start the software loader reading the data. This mod makes it possible to hear (via the cassette's built-in speaker) the tone leader and data while the interface is plugged into the EXT SP jack (plugging into the EXT SP jack normally disconnects the internal speaker). Fig. 1 shows where to install a 470 Ohm, 1/4 Watt resistor to allow the speaker to be in the output circuit. The value of the resistor may be varied to obtain different speaker output levels, but 470 Ohms is the best for me. Don't overload the output section; 100

Remove bottom cover.
Position unit with TONE and VOLUME controls toward you and PC foil up.

*Modifications at Locations Shown*
Add 470 Ohm, 1/4 Watt resistor
One foil cut
One jumper

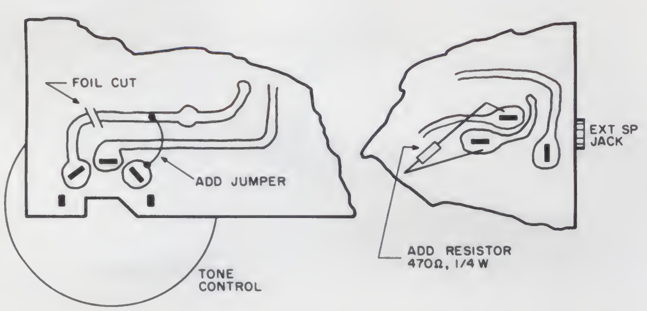
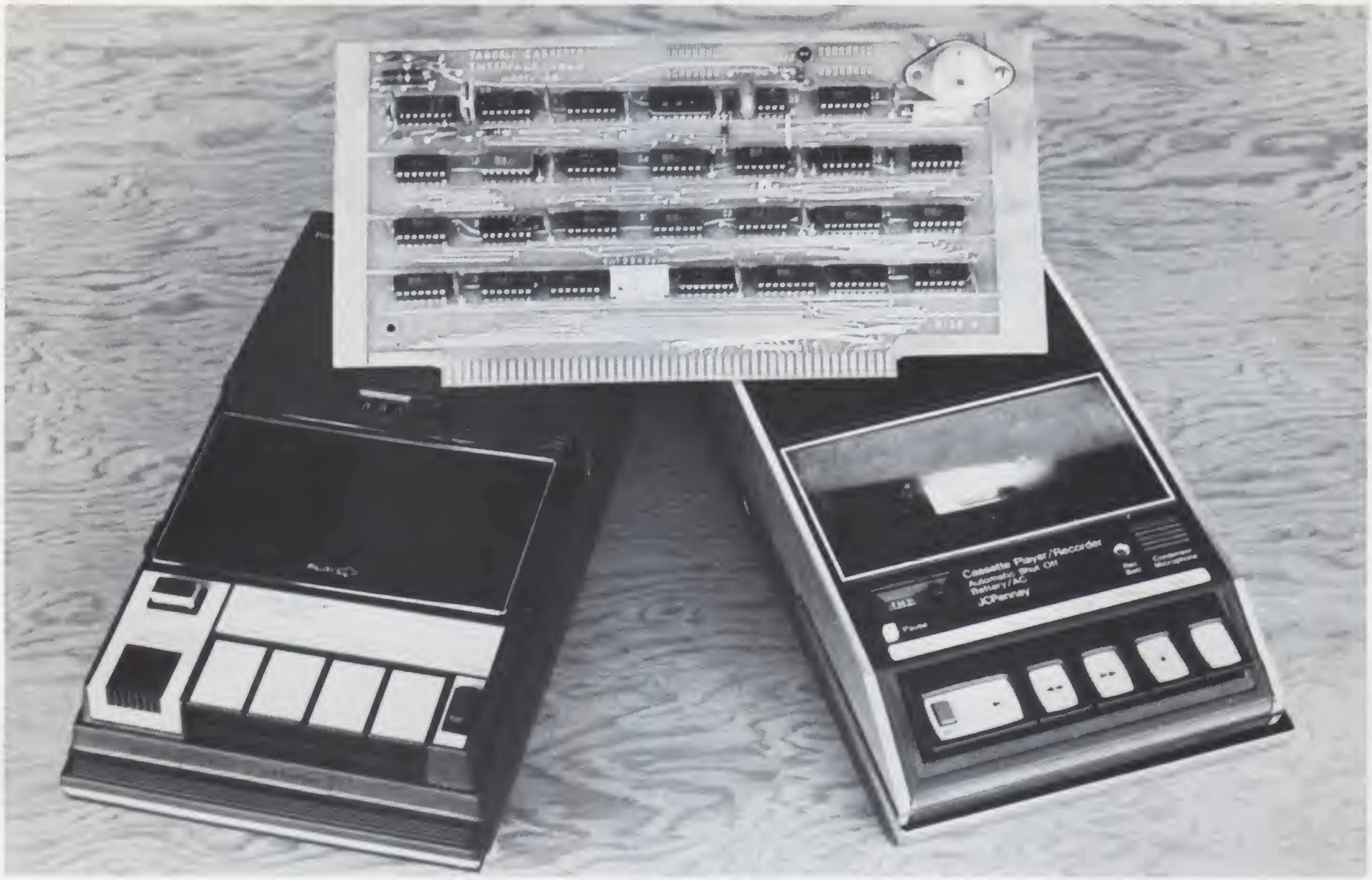



*Fig. 1. J C Penney Model 6536 Cassette Recorder modification.*



*J C Penney Cassette Recorder with Tarbell Cassette Interface.*

Ohms is recommended as a minimum value.

With these mods in and everything working better than ever, I returned the borrowed tape recorder.

The J C Penney Model 6536 had several additional shortcomings that made me want to investigate other machines. The biggest was that the FAST FWD button did not lock down and didn't provide a very fast forward. So, off to the marketplace I went. Now, since the borrowed Penney's recorder worked so well, I decided to try J C Penney again, this time for the next more expensive model. With the "satisfaction guarantee," which most big stores give, in mind, I purchased the J C Penney Model 6551 ($59.95).

Here is what I found. The J C Penney Model 6551 automatically disconnects the microphone when an external source is plugged into the AUX IN jack; so, no microphone mod was necessary. The fast forward locked down and provided a very fast forward. There were also the added features of REVIEW and CUE which allows fast reverse and forward while in the playback mode. This model also has auto stop on playback or record. I did, however, find a disadvantage that was soon overcome. The range of the volume control for data acquisition on playback was extremely limited (6.5 to 7.5 on the dial). It turns out that the 10 K VOLUME control is extremely nonlinear; so, I replaced the volume control with a miniature linear trimpot which now gives an acceptably large input range. While I was inside, I also removed the TONE control and replaced it with a 15 K, 1/4 Watt resistor (full treble). This precluded the chance of it accidentally moving from full treble. I also added a 470 Ohms, 1/4 Watt resistor to put the built-in speaker (quite muted) back in the circuit,

Remove bottom cover.
Position unit with TONE and VOLUME control toward you and PC foil up.

*Modifications at Locations Shown*

Remove VOLUME and TONE controls (remove two brass nuts and unsolder).
Add 10k Ohm miniature linear trimpot below board for access, through front when unit is closed. Orient as shown for volume increase with clockwise rotation.
ADD 15k Ohm ± 10%, 1/4 Watt resistor
ADD 470 Ohm ± 10%, 1/4 Watt resistor

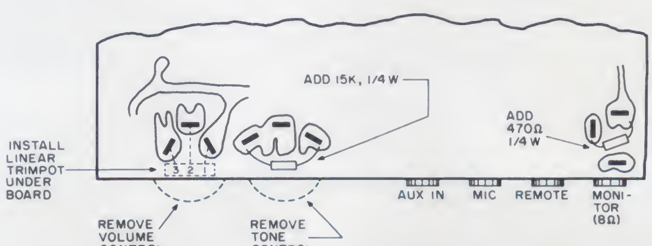



*Fig. 2. J C Penney Model 6551 Cassette Recorder modification.*

while the cassette interface was plugged into the MONITOR jack. Fig. 2 shows the modification. Now I have an extremely reliable peripheral for my system.

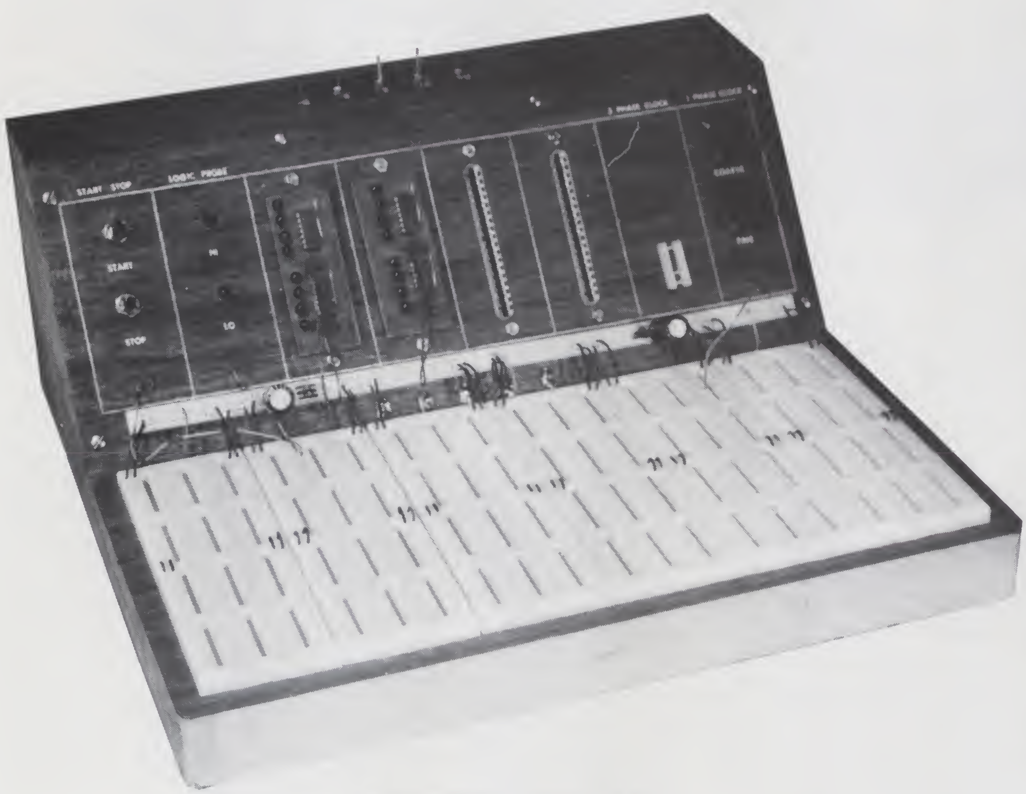
Both models may be run from ac power or batteries. I have been using ac power without problems. Both models have tape counters that count very closely to each other.

Either J C Penney model will give excellent results and perhaps other brand recorders may benefit from these modifications. ■

*George Young*
*Sierra High School*
*Tollhouse CA 93667*

# Try a Design Console

## ... for practical hardware prototyping



*Design Console — deluxe version.*

*For those of you planning to participate in the Kilobaud Klassroom series you'll be needing the construction plans provided here for the Student Console. As for the rest of you . . . if you don't have a design console on your workbench for breadboarding circuits, then now is the time to build one (it's really the only way to go!). — John.*

Need to test an IC? This will do it. You can test a 7400, or design an "automatic" circuit that will test 10,000 of them. Need to evaluate a circuit just published in your favorite magazine? This will do it. You can find out if the published circuit works as described or will suit your requirements within a few minutes after you get the parts required for the circuit. Need to modify the circuit a little? This will do it. Need to evaluate a microprocessor chip? This will do it. I've had a complete computer set up and running on the thing.

This construction article presents suggestions for an experimental tool. Solderless breadboards allow testing and evaluation and modification of circuits quickly and at very reasonable cost.

### History

The original version of this device was constructed more than two years ago with just one solderless breadboard, with a clock circuit and a logic probe built in for support circuits. A later revision used 4 solderless breadboards, a clock circuit, logic probe, 2 LED registers, a three phase clock circuit, and a 7 segment readout. It wasn't flexible enough still. The latest version of this design console has 6 solderless breadboards, two power distribution strips, a single and three phase clock circuit, a start-stop control, and a logic probe built-in. But in addition, it has 4 edge connectors built into the sloping control panel. Now it has the flexibility that I need for whatever I want to do.

### Construction

My framework is sugar pine, but any soft, easily workable wood will do. The framework is glued and nailed. A hot glue gun is rapidly becoming indispensible around the shack.

The wooden framework is then skinned with plastic laminate. For this project I busted one of my cardinal rules and broke down and bought some walnut grained plastic laminate to dress it up a bit. The two horizontal surfaces were glued in place, while the front panel was made removable. The Superstrips were bolted in place. Superstrips are available from AP Products, Inc., Box 110, Painesville, Ohio, 44077 or call them toll free for the name of your nearest AP Products distributor. (800-321-9668). The front panel was lined into rectangles with a white colored pencil (which wasn't entirely satisfactory) labeled with decal lettering (dry transfer lettering is also satisfactory) and then sealed with a coat of clear lacquer to protect the lettering and the lines. The slots were cut in the front panel with a router and a special jig made expressly for this purpose.

Bolts, nuts, and solder lugs make inexpensive, rugged, feed-through terminals to bring power in and out of the console. The previous two versions utilized nuts, bolts and solder lugs for both power and signal connections. In this version I have added a new twist which has proven faster for the signal connections. Subminiature tube sockets, transistor sockets, and IC sockets have been utilized to make plug-in provision for the signal lines. Again, the hot glue gun made quick work of mounting these components.


*Kilobaud Klassroom student console.*

Power at the moment is external to the console, entering the console at the top on five 4-40 bolts. There is sufficient room inside the console for a power supply to be built-in.

Superstrips are useable right out of the box. But anchoring them down and adding a few support circuits increases their versatility 1000 times. There is some additional space remaining along the top of the console. This could be used to mount controls, or switches, or both, but for now I plan on using the plug-in module approach with these components plugging into the edge connectors mounted in the front panel.

The console support circuits that I incorporated are shown in Fig. 1. The three phase clock circuit is not included since the demand for this circuit probably would not be very great. Anyone desiring a copy of this circuit can have one for a self-addressed envelope.

A simpler version of the console is also presented. This simplified version is the one that we will use in Kilobaud Klassroom (and is called the Student Console). The dimensions for both consoles are given in Fig. 2 and 3. The photographs show sufficient detail to allow you to whip up something similar. Nothing is critical. All that is really needed is a little Tender Loving Care (TLC).

**Construction Details**

The bulk of the following discussion deals with construction steps for the assembly of the Student Console. Almost every point considered is applicable to the Design Console as well. If you are already an experienced builder, then this section can be very rapidly perused and construction can begin. There is actually room on the working surface of the student console for four Superstrips. We will start with one, and more can be added as your own personal finances permit.

Start by cutting out the side, front, and back pieces of the console. File or sand down the saw cuts until the edges are reasonably smooth. The band saw in the high school wood shop (or junior college wood shop) will make very short work of the side panels. However, the home handsaw will also get the job done and very quickly if you have to drive any distance to get to the school. (Most schools run a night school class for adults in the community . . . check it out.)

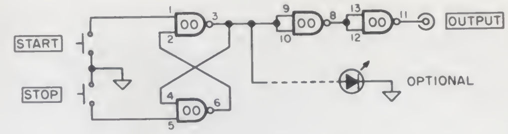
Place the front and rear panels so they are recessed about a millimeter (1/32 inch) or so. This is so that we can file or sand the framework smooth. Assemble the sides and end panels using glue and finishing nails. White glue or a hot glue gun works the best. If you don't have finishing nails, use whatever you do have on hand. The 4d finish nails are about right. Set the nail heads; it will ease the job of sanding. After the framework is assembled, we need to add the support strips for the support surfaces for the plastic laminate. I used 1cm x 1cm (½ x ½ inch) strips, but anything will do. Fit these very carefully, glue the ends, and drive one nail in each side to hold the strip while the glue dries. The upper support strip should be positioned so that it is flush on the top surface but protrudes past the slanting panel surface. After the glue has set, the protruding surface is planed off flush with the slanted panel sides to provide a flush surface to hold the plastic laminate. File or sand the console edges and surfaces to provide smooth surfaces to attach the plastic laminate. The wood can now be painted if you really want to have a show-off console, but the wood surfaces need not be treated any further for functionality. Next attach the two horizontal plastic laminate surfaces. The rear portion of the lower horizontal surface can be beveled slightly to fit more closely to the sloping section. When working with plastic laminates, leave a slight overlap, or overhang, on each edge. Here there will be three edges overhanging when this is done correctly. About 2mm (1/16 inch) is satisfactory. The purpose of the overhang is twofold: 1) it insures that the laminate will completely cover the area and, 2) it allows a slight chipping of the edges of the laminate during sawing so that the chipped edges will not show after finishing. (Some laminate workers leave as much as a ¼ inch overhang.) Affix the two horizontal surfaces to the frame with glue. The standard procedure is to use contact cement. However, this can be very tricky if you do not have previous experience with it; so try white glue. It will allow you to move things around a bit and get things lined up where you want them. Weight the two surfaces with something flat and set it out of the way until the glue cures.

After the glue has cured, file the edges of the laminate down flush with the wood. Angle the file slightly as you approach the final stages so as not to undercut the wood. Finish the last stages with sandpaper for a superior job. A very rough job here will be perfectly functional, but a little TLC (tender loving care) will give you something that you can show off with pride. No one says that HB (home brew) equipment has to look like it was HB.

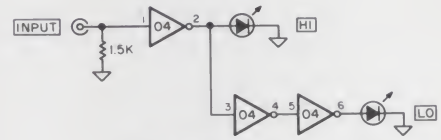
The front panel is done next. Here is the way I have my own high school students do it. Bevel the lower edge of the front panel so that you get a good snug fit with the lower surface that is already laminated. Now position the panel so that you have a slight overhang on three sides again. Drill a single hole through the panel about 2½ cm (1 inch) above the bottom of the panel and try to hit the wood dead center. Remove the panel and enlarge this hole to clear the screw that you will use to fasten the front panel to the wooden frame. A #6 woodscrew about 1 inch long will be satisfactory. Now fasten the panel in position with the screw. Move to the opposite side and repeat the process for the lower hole on that side. Refasten the panel in position. Now you can proceed with both upper holes locating them about 2½ cm below the top. The reason for all this is to assure that the holes, panel, and frame will all turn out in the right places. After the panel is fastened in position, it may be trimmed to the exact size of the support structure in a manner similar to that discussed earlier for the two horizontal surfaces. The reason for making the panel removable will become clear shortly.

## Dolling It Up

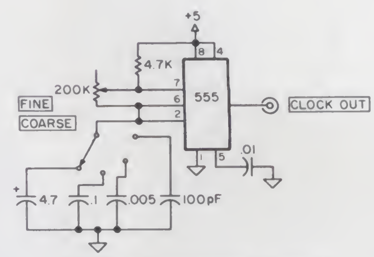
Nothing sets HB equip-




*(a) Start-stop control.*

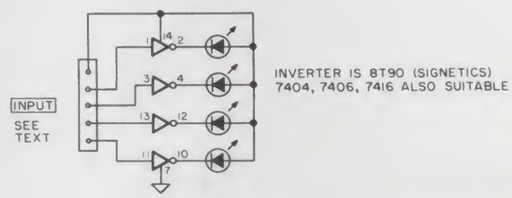



*(b) Logic probe.*



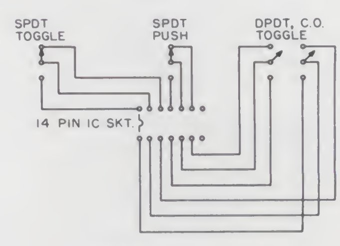

*(c) Single phase clock circuit.*

*(d) 3Ø clock circuit. See text.*

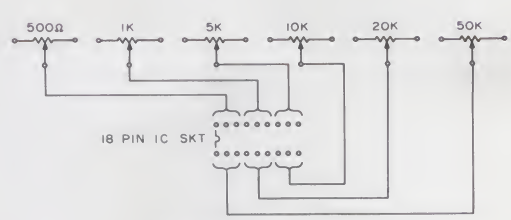



*(e) LED registers.*

*Group 2. Plug in modules.*




*(f) Plug in switch module.*




*(g) Plug in pot module.*

*Fig. 1. Console support circuits.*

*Wooden framework for deluxe console.*

*Student console framework.*

ment apart from commercial equipment as does the lettering. There are perhaps 20 different methods that can be used, but I am only going to tell you about a couple of practical ones. Dry transfer letters may be purchased at almost any stationery store. Select a contrasting color to the panel color, white if your panel is dark, black if your panel is light in color. Decals, which may be obtained at most electronic stores are another convenient method. Even if the precise label you need is missing from the set you buy, you can still cut apart words and syllables to form the label that you need. Both of these letters can be sealed in clear plastic by buying a can of clear lacquer spray at a paint store or supermarket and applying it to the panel while it is in a flat position.

If an india ink lettering set is available for your use, this can also be used to make a professional looking panel. India ink will not flow onto most plastic laminates. Try spraying a coat of clear lacquer on the surface and allowing it to dry thoroughly. Then letter directly on the lacquer layer. After the ink is dry, spray again so that the ink is sealed between two layers of plastic. I have even used this technique to label directly onto aluminum surfaces. The aluminum is first buffed on a wire buffing wheel, keeping the grain produced aligned. This is then sprayed with lacquer, inked with a Leroy lettering set, then sprayed again. The black letters on the silvery background are quite attractive.

Less professional looking labels can be produced with a Dymo labelmaker. Another trick is to use a typewriter and white paper. Type the labels with the typewriter. Cut them out with scissors into as perfect a rectangle as you can and affix it to the panel in the appropriate position with Magic Mending Tape.

The student panel shown in the photograph was labeled using a silk-screen process. This was produced by our graphic arts department since many of these panels had to be produced for our students. This is not a practical method for the HB constructor, but it is worthwhile if many identical panels are to be made.

There are many other methods that can be used, but these are some of the practical ones for the home brewer.

### Wiring It Up

Once the panel is completed, it can be attached to the front panel and we can proceed with the wiring of the console (see Fig. 4). Locate a toggle switch about 2½ cm in from the right-hand edge if you are right handed (left edge if left handed) and centered in the top horizontal surface. This may be any toggle switch; it will be used to remove power from the entire console. Position two 4-40 nuts and bolts, with a solder lug on each, about 3 cm apart and located centrally in the top surface. These will be used to bring power into the console. These may be about 1 cm long.

Position two more 4-40 x 1 inch bolts, this time with a solder lug inside and outside the console directly under the two upper 4-40 bolts, at the bottom of the front panel. Keep the spacing the same. These will bring power through the front panel to be available to the Superstrip. The bolts on top should point outward, those below inward.

Run the common - wire directly from the top -

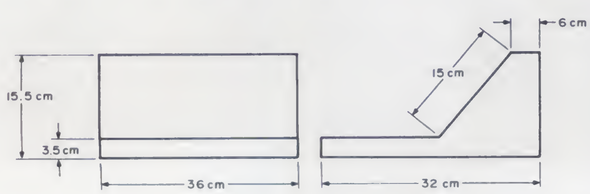



*Fig. 2. Design console dimensions.*

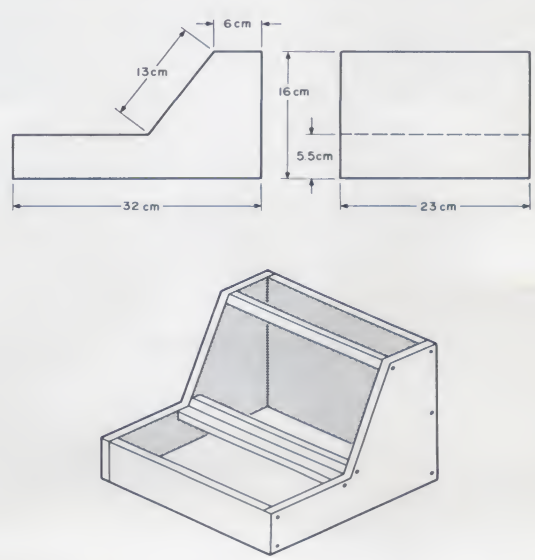



*Fig. 3. Kilobaud Klassroom student console.*

terminal to the lower - terminal but route the wire over near the switch, down the side, and back across to the - bolt. This is to keep the wire clear of the area back of the front panel. Run a wire from the + terminal on top, over to the switch, through the switch, then down to the center, and then across to the + bolt terminal at the bottom of the panel. The switch should interrupt the circuit path so that power to the console may be turned off with this switch.

Now, an option. The wire coming from the off-on switch may be connected to the + bolt. Or we can install another solder lug in the wooden frame near the + terminal and install a diode in series with the line. This diode will drop about 0.75 volts, but it will also give you a measure of protection for your ICs mounted on the Superstrip. It serves as a reverse polarity protector and prevents power from reaching the ICs if you inadvertently connect up the power source backwards. It is a very worthwhile addition to your console, but it is optional. Both circuits are shown in Fig. 4. If you install this protective diode, the diode connected in series with our 6 volt battery may then be eliminated. In fact, all you have to do is install it inside the console instead of on the battery pack.

At the bottom of the console, solder two red wires to the + terminal, and two black wires to the - terminal and then cut them to appropriate lengths and plug them into the buses on the Superstrip, + on the outside rails, - on the inside rails.

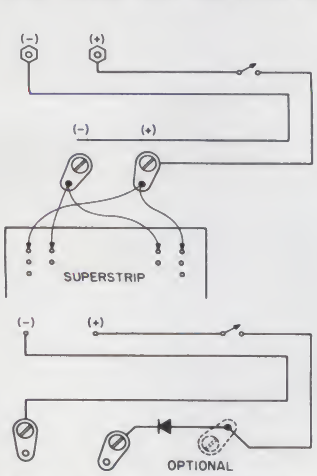



*Fig. 4. Student console wiring.*

**Mounting the Seven Segment Readout**

To mount the FND 70 in the front panel of the console, proceed as follows. Make a template of the pin spacing on the FND 70. Here is one way to do it. Place a sheet of paper over the Superstrip. Using a pencil, shade the area over ten triple pairs of pin holes on the Superstrip. Keep shading with the pencil until you can locate the 10 holes that match up with the 10 pins on the FND 70. Find a clear piece of plastic. Half a credit card holder from your wallet will do nicely. Place an issue of *Byte, Ham Radio,* or *QST* on the work table, then place the sheet of plastic on the magazine. Then place the shaded paper template over the plastic. With the scribe (probe) that I had you make in session one (or a straight pin or needle for you stubborn characters) poke the pattern through the plastic and into the surface of the magazine below. Discard the paper template and enlarge the holes in the plastic until you can get a pencil point through them. (Don't overdo it or you get to start all over.) Position the plastic template at the top right corner of the console front panel (see photograph of the front panel) and mark the locations of the 10 holes. The probe can also be used to do this instead of a pencil. The reason for the clear plastic is to enable us to see what we are doing, and if we miss one hole, we can place the plastic back in position to pick it up.

Now you are going to have to drill ten #60 holes in the front panel and exactly where the ten holes are marked. The probe can be used to center-punch these locations, but under no circumstances should a hammer and conventional center punch be used. The front panel will fracture.

*Console with plastic lamination "skin."*

I have not included any PC boards here with this article. It is my intention to teach you how to make simple circuit boards in the Kilobaud Klassroom sessions. We will need a PC board drill at that time, so you might as well buy one now. A #60 drill is fine for general purpose PC board work. Store the thing in a small plastic pill bottle so that it won't get lost.

**Haywiring In the Readout**

The FND 70 readout may be haywired into the console front panel at this time. Refer to KB Klassroom, Session 2, in this issue for this procedure.

The FND 70 readout is pushed through the ten holes very carefully (they do not appreciate having their pins bent back and forth at all!) and then haywired to the eight 4-40 x ½ inch bolts on the front panel. It is advisable to connect the current limiting resistor between pin 1 and the panel bolt marked common. This could be omitted and the current limiting resistor included each time the readout is connected for use in a circuit on the breadboard, but the first time you forget to include it in setting up a circuit, you will blow the readout and have to replace it. I'm reasonably sure that by the time you struggle through haywiring 8 pin connections up on the back of the front panel, that you will install the current limiting resistor here on the back of the front panel between pin 1 and the common bolt.

Hint: By unsoldering a couple of wires carrying power, etc., the entire front panel can be removed and laid flat on the workbench to greatly simplify the task of wiring in the readout.

**Display Functions of the Readout**

After completing the wiring of the FND 70 readout, you can connect wires from the bolts to + and form the following numbers and letters: 0,1,2,3,4,5,6,7,8,9 and A, b, c, d, E, F, G, H, J, L, o, P & U. And we now have a bank of 8 LEDs at our disposal that can be used in place of discrete LEDs.

**Conclusion**

I get a great deal out of my Design Console. I use it constantly. The power supply used to power my console will be written up in the Kilobaud Klassroom series. Look for it in KB Issue 8. For those of you that can't wait that long, send me a self-addressed stamped envelope and I'll get it to you. As additional support circuits are developed I'll send them on to John. ■

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## BOOKS

*from page 20*

in the software example) and a fair, if rather brief, survey of various MPU's strengths and weaknesses is offered.

The book assumes that the reader is already familiar with simple logic circuits (no explanation is offered for standard gate diagrams) but is completely unfamiliar with computer operation (a lengthy appendix is offered on computer arithmetic). The book also seems to assume that the reader is more interested in hardware than software, an assumption my experience in working with novices has not borne out. The book begins with the best introductory explanation of microprocessor concepts I have yet seen. After the first fifty pages, the beginner has been exposed to all the buzzwords we seem to love. He should now understand the various components of a microcomputer system, their uses, advantages, and shortcomings. Oddly, although the book is well illustrated, the authors never show an actual microcomputer (except for a KIM-1 which is used to illustrate the concept of a hex keypad). The authors never discuss how the novice might judge the merits of one system over another.

After this introductory material the authors plunge into a 84 page explanation of hardware, complete with schematics for power supplies, clock generators, a PROM programmer and a variety of keyboard and display circuits. For reasons known only to the authors, a PROM programmer, not a microcomputer, is featured on the cover! I think this emphasis on hardware is a mistake, one made by several other introductory books in this field. The reason microcomputers are so difficult to teach to a beginner is that hardware and software are so intimately bound together. There is not much point in telling the novice that a CPU contains an index register without explaining how that enhances the flexibility of the software. The concept of a hardware interrupt indirectly raises the question of how these interrupts are serviced in software.

Unfortunately, what is really needed is some of Ted Nelson's *HyperText*, where the reader can request further information on a point which puzzles or interests him. (Osbourne's *Introduction to Microcomputers* tries to do this with a bold face/light face type mixture.)

It has been my experience that most beginners want to know how to program a system before they are interested in circuit details, and so I think that the authors should have put their 45 page chapter on software first if they insist on splitting the two. A simple block-move program is used as the vehicle for explaining instruction types and operation. This is a good example to use (Osbourne uses it for his benchmark comparisons for processor instruction sets) since any program doing arithmetic or I/O usually ends up being processor dependent.

In summary, this is probably the best 180 pages of information available to the hardware oriented beginner. After reading this book, the novice will be able to read the articles in *Kilobaud* (or the manuals that come with his first system!) with some degree of confidence and understanding.

**Rick Simpson**
**Haddon Heights NJ**

### An Author's Complaint

*The following is a reply by Charles Sippl regarding the unfavorable review his book,* Microcomputer Dictionary and Guide, *received in Issue #4 of* Kilobaud. *He is also responding to and has some rather strong feelings about the comments I made in my editorial (in #4)* *indicating that I felt the book "was long overdue for a raking over the coals."*

*Charles indicated in his cover letter accompanying his reply that my comment might have been more appropriate if I had done the review.* That comment was my review. *I didn't feel there was any need for me to elaborate because the review expressed my feelings on the book. Charles* also suggested that my *negative feelings might have had an influence on the reviewer. Nothing could be further from the truth. The reviewer called me on the phone one day and asked if I would like a review of the* Microcomputer Dictionary *. . . a negative one. I said I would, and as we discussed it we brought up common points about the book which we both agreed on. I don't think that can be construed as exerting influence. One other comment in the cover letter should be mentioned and responded to. Charles suggested that due to my remark I have "requested (almost demanded) that the letters to come be derogatory or they won't be printed." Hey now, that's something I could take offense to! Anytime anyone gets the idea we only print certain letters in* Kilobaud *they've got another think coming! We print the good and the bad, whether they're directed at us* or a dictionary. *(As a matter of fact, we're thinking about starting a special section for printing the nasty letters which get sent to the #2 magazine but never get published. You know which one I mean . . . the one that used to be #1.)*

*Charles expressed a desire that his reponse be carried in its entirety (it has been) and that "some approach toward fairness" would be achieved if the response appeared in the Letters section . . . even though that section has "fewer readers (by far)" than the book review section. What the heck . . . in spite of the fact I wouldn't want people to start accusing me of being fair I'll be more than happy to put all of this in the book review section . . . which is why we're all here, right?*

*In conclusion, I have three comments to make. First, my feelings concerning the book haven't changed one bit. Second I wonder if Charles Sippl was as interested in responding to the book review as he was in getting in a plug for every book he ever wrote . . . or will write. Third, the editor* always *gets in the last word! – John Craig.*

Dear John,

Thank you for inviting comments regarding the recent review of a book representing a three-year effort to begin an organization of microcomputer terminology, *Microcomputer Dictionary and Guide.* Dave Winthrop, the reviewer, makes a number of important points, and he's right on many of them. His main points seem to be that the book contains too much information, that it is somewhat "encyclopedic" – a rare and rather odd complaint. His conclusion that the book is not well suited for the beginners and for regular microcomputer user's quick reference is totally at odds with a dozen or more other reviewers, principally the publisher of *Kilobaud* includes, ". . . A whopper . . . well over 700 pages and the price is right at $15.95 . . . definitions . . . are not brief . . . almost enough to learn about computers just from reading the book . . . a dictionary such as this is *invaluable* (italics mine)." *Datamation* found it to be ". . . A useful, comprehensive . . . Dictionary and Guide." (May, 1976, page 34) *Library Journal:* "Microcomputers, offering compact, effective and economical control systems, will be used more and more in the future. This book is *essential* (italics mine) for the reference collection." (as quoted on the Cahner's Books "Promotion" Post Card sent to all *EDN Maga-*

*zine* subscribers in February, 1977).

Perhaps some experts like Mr. Winthrop don't need a reference to approximately 5000 microcomputer definitions and a few thousand allied electronics "explanations," but evidently others do. The March 15, 1977 issue of the highly respected *Homebrew Computer Club Newsletter* in its review of the *Microcomputer Dictionary and Guide* stated: "Newcomers and old-timers alike can benefit from this book. It's a ready reference with definitions that are up to date. Newcomers should find extensive use . . ." Another publication developed by top people in the industry, *Microcomputer Digest*, had its review *republished* (italics mine) in *Compute* (May, 1976), the newsletter of the National Semiconductor User's Club, as follows: "After a careful detailed review of the dictionary, *Microcomputer Digest*, finds the definitions offered by the author to be clear, concise and consistent with industry usage. We recommend the book as an excellent reference tool."

We might examine some comments from some of *Kilobaud*'s competitors: *Interface* (March, 1976) states: ". . . An unbelievable compilation of 5000 terms, definitions and product procedure and applications explanations. This book is virtually indispensable and must become an integral part of every novice, amateur, experienced and professional in the microcomputer domain." *Personal Computing* magazine (March-April, 1977, p. 4) states ". . . 680 pages of very useful stuff . . . a book you might like to obtain . . . we plan to run a glossary . . . taking our definitions . . . from *Microcomputer Dictionary and Guide.*"

To add a little frosting one might consider the usually quite stiff and critical British and Canadians, especially their professional reviewers. The Information Processing Society of Canada: "This is an excellent little reference! . . . Barring a few such minor oversights, the author has produced a useful and worthwhile addition to and updating of the slowly growing list of computer and data processing dictionaries." (J. H. Toop, Book-Review Editor – *CIPS Review*, 4 August 1976.) And the British IPC Science and Technology Press Ltd. (Sept., 1976) stated, ". . . The number of new items, symbols and new techniques which lie in the wake of the microcomputer revolution make such a publication an essential *life-raft* (italics mine) for the engineer and designer." Copies of all *full reviews* are enclosed to be forwarded to Mr. Winthrop.

Now, no book is perfect – but is this the book that deserves "to be raked over the coals?" (or have some personal "grapes soured" a bit). Mr. Winthrop's review was really quite perceptive (even though a bit of the editor's "arm" might have affected his conclusion), and I should like to agree with him on several points. Reviewers have a right to "whack away" at books; that's their job, and most do so honestly and independently. Many of the definitions are indeed encyclopedic and reflect a particular "bent" I maintained when I began the project in 1974 after completing my article *Computers* as the main entry in the *Encyclopaedia Britannica* (1975-76 Editions). He is right, too, that some extra electronics definitions did creep in, possibly from a long range project I am doing to be published as *Concise Microelectronics Encyclopedia* in 1978 by Matrix Publishers, Inc.

Mr. Winthrop is accurate again by noting that the dictionary contains a large number of data communications terms. (I liked them so well I also produced a 10,000+ trim 1976 *Data Communications Dictionary*, Van Nostrand Reinhold.) But, every expert around is confirming that data communications and data processing are "merging" and a major scientific and governmental effort is underway to attempt to differentiate between the two. But, why does the reviewer complain about "too much" information? He suggests that too many terms makes some harder to find. Why? Has the alphabet changed? Mr. Winthrop doesn't seem to like to find "similar" definitions in two places – but this was done for the user's convenience. We defined the terms as we found them in the literature, manuals, and so on. If "data registers" in one place also appears as "registers, data" in another, with one defined a bit more at length, who got hurt? Certainly not the reader! The reviewer appears to become a bit "pique-ey" when he jumps on us for defining some terms by giving examples of specific products. Come now! This is one of the best tutorial techniques known and used by every teacher – and some of these terms, now representing commonplace products or techniques, were only just "invented" in 1974-5, and we chose to use the inventor's own words. The backs of pioneer dictionary writers are loaded with arrows – and even the umpteen editors of Webster and Funk & Wagnall are critized by Oxford and Random House on an almost annual basis.

But, Mr. Winthrop will have two of his wishes granted (1) "... a book one quarter this size" might contain a majority (not 99.5%, as the reviewer suggests) of the strictly microcomputer definitions needed for some. Such a book (*Microcomputer Glossary and Reference*) is presently "in press" by this author, has less than 200 pages (about $7) and has many hundreds of "new, 1977" terms and concepts defined, as published by dilithium Press. (2) The *Big Microcomputer Dictionary and Guide* 2nd edition is under way and may yet appear this year, or early 1978 – at about 500 pages with much culling and very careful editing and well over 2500 *new* definitions added to the "standards and basics" that have won significant praise from all but *Kilobaud.*

Again, we must challenge Mr. Winthrop's conclusion and John's desire to "rake" the book by advising that MITS thinks enough of it to include it with the sales of kits and systems computers. Many thousands of "beginners" appreciated this educational gift from MITS. (Several other suppliers also pack them with their systems, realizing that all of us need immediate lookup or reference [browsing] updating.) They are sold in all MITS stores, BYTE Shops, and most other stores. The book is being translated into some foreign languages – and Cramer Electronics (the second largest distributor) regularly runs full page ads displaying the book after making an early (1975) "five-figure" prepublication order.

We admit the book is not perfect, that Mr. Winthrop made some good points, but an editor's message asking readers to "rake" a particular book because of a personal peeve can be construed by some to be a bit of a "cheap shot." We all should be involved in doing everything we can to educate each other, to constantly continue to improve anything we do for personal computing, to support each other's efforts and to offer *constructive* criticism to each other. But, though a bit dismayed by "that" review, I appreciate your integrity for printing this letter in full.

And, I can find solace from those wonderful words from the "other" reviewers: "invaluable," "indispensable," "excellent," "essential," "life-raft for engineers and designers," "very useful stuff," "newcomers and old-timers alike benefit" ... and *Kilobaud* is becoming a great magazine ...

**Charles J. Sippl**

# Try Solar Energy

## ... computerized answer to the energy crisis

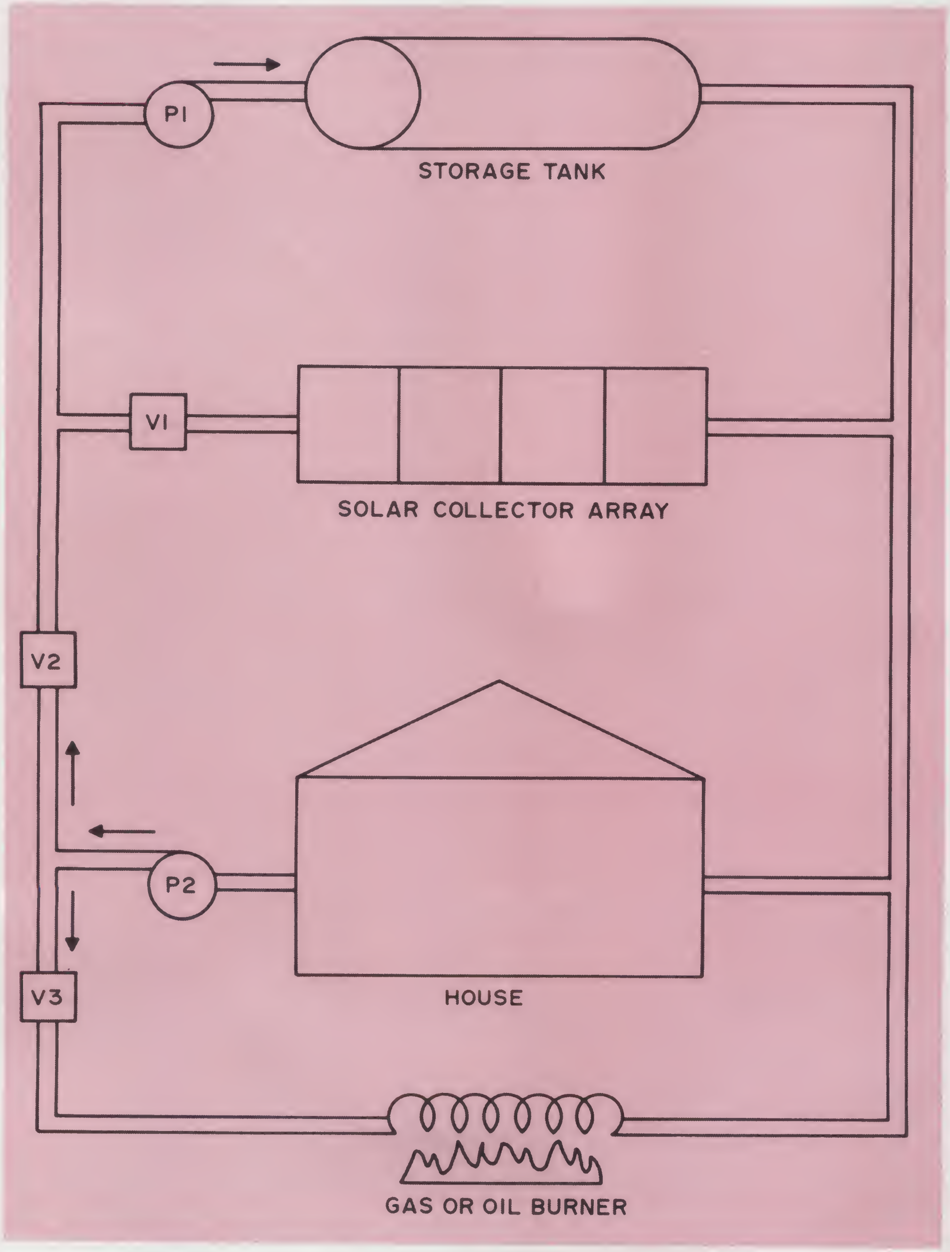


*Fig. 1. Simple solar heating system.*


*Hal Chamberlin*
*29 Mead St.*
*Manchester NH 03104*

*I've heard of using a microcomputer for solar heating control but before reading Hal's article I'm afraid I never gave it much thought (and as a result, didn't give much credit as a practical application). I can see now that it would really be the* only *way to implement such a system. Also, I've mentioned on several occasions how the hobbyist should be looking for dedicated controller applications as potential moneymaking opportunities. This is certainly one of them. (Oh, and don't miss Hal's idea for temperature sensing . . . minus the analog-to-digital conversion you would normally expect.)*

*Hopefully, Hal's fame has preceded him and he doesn't require an introduction because he is certainly a pioneer among computer hobbyists. Way back in ancient times (1974) Hal was busy developing and writing up a graphics display for the 8008 in one of the first computer hobbyist publications,* The Computer Hobbyist. *Since then he has gone on to develop some fascinating computer generated music, the first hobbyist cassette interface and a floppy disk interface, just to name a few. — John.*

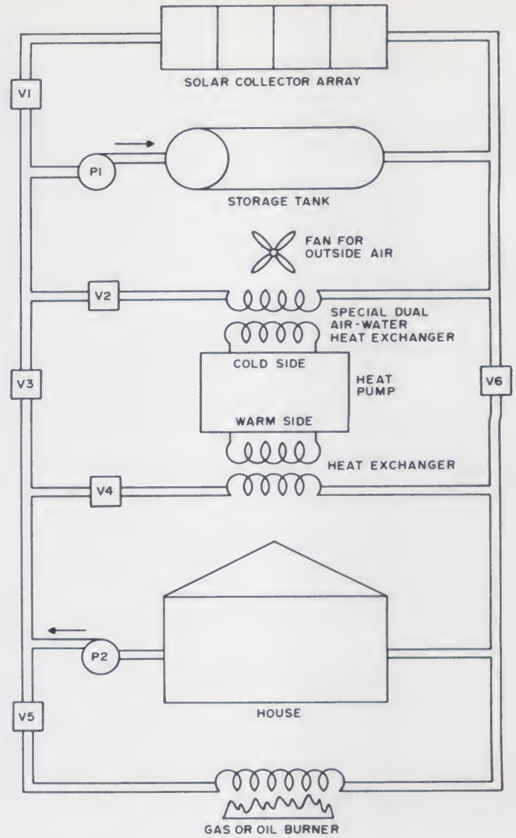


*Fig. 2. A more sophisticated solar heating system.*

The majority of hobby computer applications mentioned in these pages and elsewhere are of the general purpose type. That is, the hardware and software setup required for execution of the application in no way affects the system's ability to perform other functions as well. This article will be devoted to a dedicated application that requires continuous use of a small computer 24 hours a day.

During the winter it usually seems that the cold weather will never end and when the monthly fuel bill arrives you are reminded that winter is expensive as well as depressing. In many parts of the country the cost of heating a house has doubled or tripled in the last 5 years. Some people are investigating and implementing solar heating systems in an effort to cut heating costs as well as conserve our nation's resources without giving up the personal comfort afforded by a constant room temperature. But getting the maximum benefit from a solar system requires constant attention to the system controls and a little educated guesswork. This is where a dedicated computer comes in.

Unfortunately, solar heating systems are complicated by one inescapable fact: the sun does not shine all the time. A minimum system that works satisfactorily is illustrated in Fig. 1. Here we have four major components; the solar collectors which heat water with sunlight, an oil or gas fired water heater, a large storage tank, and a heat distribution system within the house. In addition, two pumps and three valves control the flow of water through these components.

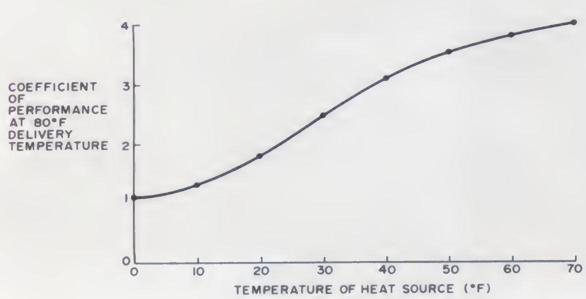


*Fig. 3. Hypothetical heat pump performance.*

The purpose of the storage tank is to save excess solar heat for use at night and on cloudy days. The fuel fired water heater is used only when there is insufficient solar heat and the stored heat has been depleted.

Two factors combine to determine the operating cost (proportion of time that fuel must be burned) of the system. One is the size of the storage tank and the other is the size of the solar array. A large tank is more likely to have sufficient capacity to tide over long cloudy periods and a large array will be able to recharge the storage system quickly while also heating the house. Unfortunately a high initial cost for oversize components must be borne to minimize the operating cost.

Control of the system in Fig. 1 is relatively simple. Inputs to the computer are the temperatures of the solar collector array, storage tank, and house, as well as the desired house temperature (thermostat setting). Controller outputs operate the two pumps and three valves. Several operating modes are possible. For example, when the sun is out and heat storage is low, the system would alternate between pump 2 on, valves 1 and 2 open (heated water from collectors warms the house) and pump 1 on, valve 1 open (heated water from collectors goes into storage tank). When the sun is not shining, water from storage would warm the house via both pumps and valve 3. If heat storage is exhausted, pump 2 and valve 3 allow the fuel burner to come into play.

With this simple system, the best control decision can always be made by examining only present conditions. A convenient method of programming the control function is by use of a decision table such as Table 1. First, all of the indicated temperature comparisons would be made and then the corresponding table row would be located. The action column would indicate which pumps and valves to actuate. Although using a computer to control this system would be challenging, it can also be done with standard logic.

### Enter the Heat Pump

A more interesting system with the potential of low operating cost without oversize components is illustrated in Fig. 2. A heat pump has been added which by appropriate valve actuation can transfer residual heat from either the outside air or the storage tank into the hot water system.

For those unfamiliar with heat pumps, they are essentially air conditioners turned backwards and optimized for producing heat. A heat pump literally pumps heat from a cold location to a warmer one using electrical energy. The advantage of a heat pump is that it requires less energy to *pump* a given amount of heat than would be required by a resistance heater to *create* the same amount of heat! For example, an ordinary electric heater will produce about 3400 BTU (857 K-cal) per killowatt hour of electrical energy, but a heat pump may produce 7000 to 14000 BTU (1765 to 3530 K-cal) with the same amount of energy. The ratio of pumped heat per KWH to 3400 BTU per KWH is termed the "coefficient of performance" or CP of the heat pump. The interesting part of all this is that the CP is greatly influenced by the temperature difference between the source of heat and its point of use as illustrated in Fig. 3. Thus depending on the temperature difference and the relative costs of electricity and oil, it sometimes will be more economical to use the heat pump instead of the oil burner during extended cloudy periods.

Another advantage of the heat pump is that it can extract additional heat from the water in the storage tank after it has cooled to room temperature and otherwise become useless. Doing this could almost double the effective heat capacity of the tank. Also when the sun did return, the solar collectors would be slightly more efficient in heating the colder water.

In order to better understand the many operating modes of the system and likely conditions that would suggest their use let us look at a few. Keep in mind that the relative costs of fuel and electricity as well as typical weather patterns in your area will affect the frequency and advantage of a particular operating mode. However energy costs are changing constantly, and while electricity may be so expensive that the heat pump would be seldom used now, it is likely that fuel costs, particularly natural gas, will rise more rapidly than electricity in the future.

The solar collector array, storage tank, fuel burner, and house, along with the two pumps and valves 1, 3, and 5, function in the same combinations as the simpler system in Fig. 1. This is assuming that valves 2 and 4 are closed and valve 6 is open to bypass the heat pump. Thus most of the entries in Table 1 are still valid. Differences generally occur when conditions call for burning fuel. At this point there are a number of possibilities. More heat may be extracted from the storage tank to tide over a brief additional cloudy spell by pumping storage tank water through the dual fluid heat exchanger on the cold side of the heat pump. The heat pump would extract additional heat from the storage water and transfer it to its warm side where it now heats a separate water circuit (created by closing valves 3 and 6) which includes the house. Electrical energy is, of course, consumed in doing this, but until the storage tank water gets very cold, it can be more economical than burning fuel.

If the outside air temperature temporarily rises to a reasonable level (as it often does just before a snow storm and following cold spell in New England), heat can be extracted from the outside air by running the fan on the dual heat exchanger. Now heat from the outside air is transferred to the warm side of the heat pump which can then flow into the house, and if cold weather is really on the way, the storage tank.

Optimum control of this system is considerably more involved than control of the previous one. Optimum operation can be defined as the least total cost (fuel plus electric bills) while maintaining the desired room temperature under all conditions. Besides an added fan and some more valves to operate, the computer/controller will need additional input data to achieve optimum control.

The outdoor temperature reading is now needed since it greatly affects the efficiency of the heat pump. If it is

T1 = Temperature of solar array
T2 = Temperature of storage tank
T3 = Actual temperature of the house
T4 = Desired temperature of the house

| Present Conditions | | | | Actions | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| T4 > T3 | T1 > T2 | T1 > T3 | T2 > T3 | P1 | P2 | V1 | V2 | V3 | Effect |
| NO | NO | NO | NO | OFF | OFF | OFF | OFF | OFF | IDLE |
| NO | NO | NO | YES | OFF | OFF | OFF | OFF | OFF | IDLE |
| NO | NO | YES | NO | OFF | OFF | OFF | OFF | OFF | IDLE |
| NO | NO | YES | YES | OFF | OFF | OFF | OFF | OFF | IDLE |
| NO | YES | NO | NO | ON | OFF | ON | OFF | OFF | SUN HEATS TANK |
| NO | YES | NO | YES | ON | OFF | ON | OFF | OFF | SUN HEATS TANK |
| NO | YES | YES | NO | ON | OFF | ON | OFF | OFF | SUN HEATS TANK |
| NO | YES | YES | YES | ON | OFF | ON | OFF | OFF | SUN HEATS TANK |
| YES | NO | NO | NO | OFF | ON | OFF | OFF | ON | BURN FUEL |
| YES | NO | NO | YES | ON | ON | OFF | ON | OFF | TANK HEATS HOUSE |
| YES | NO | YES | NO | OFF | ON | ON | ON | OFF | SUN HEATS HOUSE |
| YES | NO | YES | YES | OFF | ON | ON | ON | OFF | SUN HEATS HOUSE |
| YES | YES | NO | NO | ON | ON | ON | OFF | ON | BURN FUEL, SUN HEATS TANK |
| YES | YES | NO | YES | ON | ON | OFF | ON | OFF | TANK HEATS HOUSE |
| YES | YES | YES | NO | OFF | ON | ON | ON | OFF | SUN HEATS HOUSE |
| YES | YES | YES | YES | OFF | ON | ON | ON | OFF | SUN HEATS HOUSE |

*Table 1. Solar system decision table.*

quite cold outside and using residual heat in the storage tank is not appropriate, it may be best to go ahead and burn fuel. On the other hand, an unusually warm but cloudy spell might signal that outdoor heat should be pumped into the storage tank for use later. Input regarding the weather forecast is helpful in making such a decision. The system also needs to know what the electric rates and the cost of fuel are. Some electric utilities are considering rates that vary according to the time of day, with power being cheapest late at night. As a result, the time of day would be a useful input to the system. Also, if the user customarily reduces the termperature at night to conserve fuel, the system can be programmed to do that automatically.

**Hardware**

Besides all of the solar panels, heating equipment, pumps, and valves, what kind of computer hardware is necessary to get into sophisticated computer controlled solar heating systems? First it should be obvious that great computation speed is not needed, since input conditions change slowly and relatively few output devices need to be controlled at an equally slow rate. Some hobbyists could interpret this fact as a suggestion that their present computer could easily perform the control function as a background task without materially affecting execution speed of other applications running at the same time. While this is certainly true, solar system control is a full-time task. Invariably the time-shared computer will need to be turned off to install a new board or a program will run wild wiping out memory or some other minor disaster will happen. Consequently, a computer should be dedicated to the control task and not used for anything else.

Since speed is not a factor and the control program is not likely to get extremely large, one of the trainer kits should be ideal. Examples are the $99 SC/MP kit from National Semiconductor, the KIM-1 from MOS Technology, or the F-8 Survival Kit from Mostek. To the basic machine would be added some external memory as well as additional I/O capability. Besides low cost, another advantage of the trainer kit is that the power requirement is very low; after all, the goal is to cut energy consumption. For automatic recovery from power failures and long term permanence, the control program should be stored in ultraviolet erasable programmable read-only memories (EPROM).

Since a majority of the needed inputs are temperature readings, an inexpensive method of sensing temperature is needed. One possibility is to use a thermistor as the timing element in a 555 oscillator circuit. The outputs of up to 8 oscillators may be connected to a single 8-bit input port. A software routine would count the number of cycles from a particular oscillator in a fixed time period and thus compute the frequency. A calibration table would be stored in memory so that the corresponding temperature can be determined.

A time of day input can be accomplished in a number of ways. If the computer has an interrupt input (most do), it can be connected to a source of 60 Hz and the program would keep track of time by counting cycles. Some kits such as the KIM-1 and F-8 kit use crystal oscillators and already have programmable interval timers built-in that can be programmed for a time of day function. One could also interface a clock chip and reduce the amount of required software.

The remaining inputs are parameters set by the user such as the desired room temperature, weather forecast, and fuel cost tables. This data would be read and stored in RAM memory. Most of the trainer kits have a serial input which could be temporarily connected to a terminal or even another computer when updated information is required. Alternatively a calculator style keypad could be interfaced, or it may be standard equipment on some trainer kits.

All of the system outputs can probably be accomplished with a single 8-bit output port. Each bit would operate a relay which in turn would complete circuits to the various valves and pumps. A fancy control program might also be able to give a report on the solar system performance and an estimate of the fuel and power used. This would alert the user to possible equipment problems or wasteful living habits. The serial port and temporary hookup to a terminal would be a good way to output such a report.

As with most interesting applications, software is the key to a system that does all that is desired. Developing the software for a dedicated application is a little different from most software development. The reason is that the computer on which the software runs (called the *object* machine) is unlikely to be able to execute the usual software development aids such as an assembler or text editor. Also the object machine probably lacks effective debugging aids such as a monitor or front panel. One could use the pencil and paper method with additional careful checking to minimize the amount of debugging required. One could also utilize a full blown computer having the same microprocessor chip as the object machine to prepare the program and do the initial debugging. An example would be the use of National's Low-Cost Development System (LCDS) to develop a program to run on the $99 SC/MP Evaluation Kit.

Of course the control program itself is the interesting part of the whole project. A decision table routine for the first system is fairly simple and gives the best performance possible for that type of system. An optimum control program for the heat pump system is considerably more challenging however. First accurate data about the heating system components is required. For example, a CP curve for the chosen heat pump will be needed as well as data on the solar collector performance based on sunlight intensity and angle which changes throughout the year. A detailed analysis leading to absolute peak performance would also consider factors such as heat exchanger efficiency and power consumption of the pumps.

Next, some fairly simple but tedious calculations must be done to determine under what conditions a particular operating mode will be the most economical. These could be done once using a BASIC language program on another computer and the results translated into a decision table. Possible difficulties include the large size of the resulting table and that the calculations would have to be repeated whenever a factor which was assumed to be constant (such as fuel price) changes. These drawbacks can be overcome by building these calculations into the control program itself. Then it can adapt automatically as conditions change.

As you have probably gathered by now this is really a blue sky application (pun intended) that is not quite practical yet and would not appeal to the majority of hobbyists. However the same was said regarding computers in general only three years ago. Successful implementation of a computer controlled solar heating system would certainly quiet the skeptics who question the usefulness of a home computer. ■

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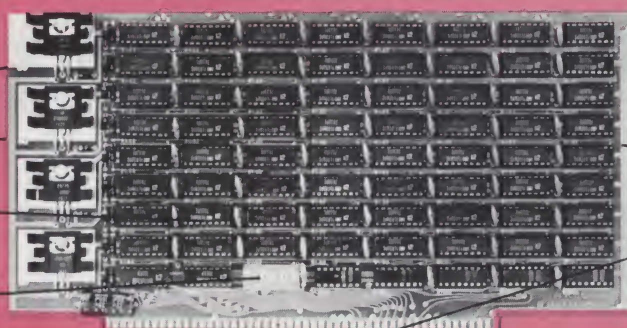


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0 001 11 001100 11 010 011 · 11 010 011

# Simplified Billing System

## ... in BASIC for the small business

```
                        BILLING COPY
QUICK FOX TRANSPORTATION SERVICE
8921 SOUTH SEPULVEDA BOULEVARD
LOS ANGELES, CALIFORNIA 90045

AIRLINE: UNITED             STATION: LAX

PERIOD: DEC 1 TO DEC 15

***********************************************************************

DATE   ORDER #   PICK-UP   DESTINATION   DELV   CHG$   CODE   BAGS
                 TIME                    TIME

***********************************************************************

1      127486    0700      TORRANCE      1100   5      R      1
1      127495    0800      GLENDALE      1200   5      R      1
3      326145    1500      VENTURA       2355   35     SP     1
4      347898    1100      VAN NUYS      1302   10     SC     3
6      347888    1300      INGLEWOOD     1645   0      COD    3
15     491876    2200      HYATT LAX     2245   4      SP     5

2  REGS +  2     SPLS    +   1    CODS   + 0    NO CHG    +  1    SVC CHG

TOTAL DELIVERIES = 6
TOTAL CHARGES = 59
TOTAL BAGS = 14

**********                    CUT                    **********
```

*Fig. 1. Sample run of program.*

*Carl Denver Warren II*
*2980 W. 235th Apt. 12*
*Torrance CA 90505*

Several months ago a small transportation company contacted me regarding a billing problem they had. They wanted a system that could take multiple entries, keep track of them, give a total of all, plus break down the totals of the different types of deliveries. There was no need to save data on tape or build data up over a period of time, as the data would be presented just prior to the billing date. They did need from 2 to 4 copies with the ability of making this change with little trouble.

After analyzing the problem, a set of specifications was drawn up and agreed upon before creating the actual program. (In application programming, this is a must and saves a lot of trouble later.) The actual program was written in MITS 8K 680 BASIC Version 1.0 Revision 3.2. The program was designed to run on the following system configuration.

a. MITS ALTAIR 680B with 17K memory.

b. SOUTHWEST AC 30 cassette interface.

c. SOUTHWEST CT 1024 terminal modified for 64 characters and scrolling.

d. AXION EX-800 electrosensitive printer, interfaced for RS-232C serial input and strapped for 1200 baud.

The program incorporates many cursor control functions to clean up the screen and prevent possible errors by displaying previously entered data. The print ASCII characters (PRINT CHR$), $29_{10}$ or $30_{10}$, is interpreted by the AXIOM printer and changes the size of type between 40 and 80 columns. This provides for maximum control of formating the output. Null is used to slow the execution time of BASIC as it is presented to the printer and prevents garbling.

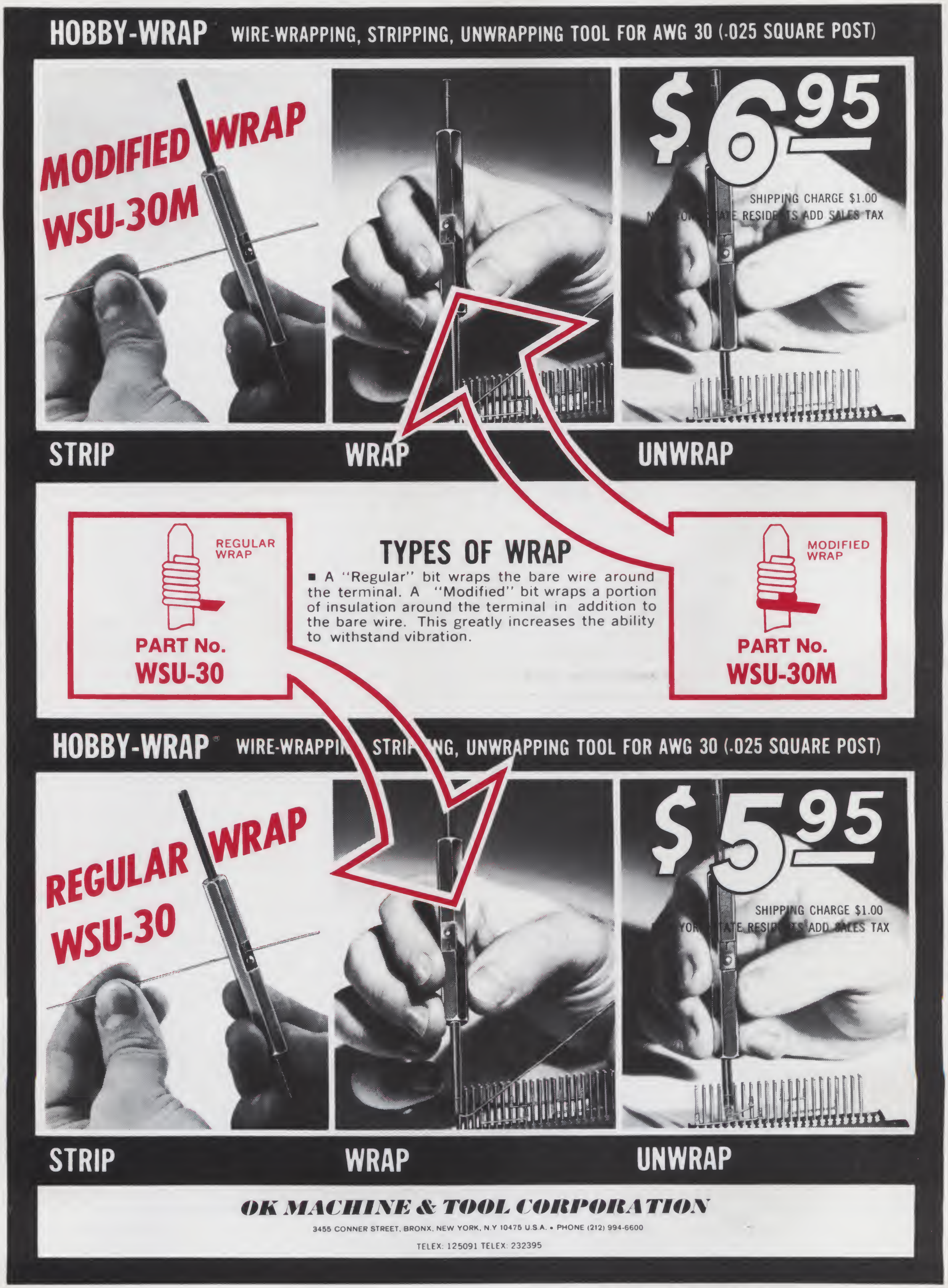
The application called for 13 separate variables which were to be stored then read to the output in a first in, first out manner. Therefore, each variable was dimensioned, and the initial value set to zero. Lines 66 through 140 are the input portion of the program and is the part of the program where the work of building the array is done. The array grows until terminated by the input of 99 for a date — this was done since the date could never be less than 1 or greater than 31 and provided a means of leaving the input loop.

Once 99 is input for the date, the output routine which starts at line 700 takes over. The work is done in lines 903 to 945. The array is decremented each time through. However, the data is not destroyed but remains intact. When the last piece of data is read the totals are printed, the values of which are saved in the array as specified in the input lines. Lines 1500 to 1520 are a subroutine that prints the totals in the specified order. In the program I have specified 2 copies. Therefore, after the totals are printed the program then tests the value of I in lines 1310 and 1320 (which determines the number of copies) to determine where to send the program next. When the required amount of copies is created, the program reinitializes itself by returning to line 9, which clears all variables.

Although this program may never be of any use to anyone other than a company doing similar work, it does demonstrate one method used to save data in an array and what I feel is an interesting method of printing the final output. ■

```
1 REM            MULTIPLE ITEM STATEMENT
2 REM                        BY
3 REM        CARL DENVER WARREN II / AUG 1976
5 REM CLEAR STRING SPACE AND DIMENSION ARRAY FOR NAMED VARIABLES
9 NULLO:CLEAR 4000:GOSUB62
11 DIMD(100),O$(100),P$(100),D$(100),L$(100),C(100),E$(100),B(100)
15 REM INPUT NONE MATRIXED ITEMS
20 INPUT"AIRLINE: ";A$:INPUT"STATION: ";S$
30 GOSUB 62
40 INPUT"MONTH ";M$:GOSUB62:INPUT"STARTING DATE: ";W:GOSUB 64
50 INPUT"END DATE: ";U:GOTO70
55 REM SCREEN CONTROL SUBROUTINES (62) HOME CLEAR SCREEN
56 REM (64) GENERATES A SPACE
62 PRINTCHR$(22):RETURN
64 PRINTCHR$(32):RETURN
65 REM SET VARIABLES TO 0
66 A=0:C=0:Z=0:X=0:M=0:Q=0:V=0:H=0
69 REM START OF MATRIXED VARIABLES
70 INPUT"DATE: ";D(A):GOSUB62
71 IF D(A)=99THEN 790
72 IF D(A))99THEN70
73 A=A+1
80 INPUT"ORDER # ";O$(C):GOSUB 62:C=C+1
90 INPUT"PICK-UP TIME: ";P$(Z):GOSUB62:Z=Z+1
100 INPUT"DESTINATION: ";D$(X):GOSUB62:X=X+1
110 INPUT"DELV TIME: ";L$(M):GOSUB62:M=M+1
120 INPUT"CHG: ";C(Q):GOSUB62:TC=TC+C(Q):Q=Q+1
130 INPUT"CODE: ";E$(V):GOSUB62
131 IFE$(V)="R"THEN R=R+1
132 IFE$(V)="SP"THENSP=SP+1
133 IFE$(V)="NC"THEN NC=NC+1
134 IFE$(V)="COD"THENCOD=COD+1
135 IFE$(V)="SC"THENSC=SC+1
139 V=V+1
140 INPUT" #OF BAGS: ";B(H):TB=TB+B(H):H=H+1:GOTO70
700 REM BEGIN OUTPUT ROUTINE
701 REM CONTROL CHR ARE FOR FORMATING OUTPUT OF AXIOM PRINTER
702 REM NULL PROVIDES SUFFICIENT TIME FOR FIFO OF PRINTER TO
703 REM CLEAR.
750 PRINTCHR$(29);TAB(32)"BILLING COPY":GOTO800
790 NULL20:PRINTTAB(36)"FILE COPY":GOTO800
800 PRINTCHR$(30);"QUICK FOX TRANSPORTATION SERVICE"
810 PRINT "8921 SOUTH SEPULVEDA BOULEVARD"
820 PRINT "LOS ANGELES, CALIFORNIA 90045":GOSUB64
830 PRINT"AIRLINE: ";A$;TAB(25)"STATION: ";S$:GOSUB64
832 PRINT"PERIOD: ";M$;" ";W;" ";"TO";" ";M$;" ";U;CHR$(29)
870 GOSUB1900:GOSUB64
880 PRINT"DATE     ORDER #     PICK-UP       DESTINATION     ";
890 PRINT"DELV   CHG$    CODE     BAGS":PRINTTAB(21)"TIME";TAB(50)"TIME"
900 GOSUB1900:GOSUB64
903 A=0:C=0:Z=0:X=0:M=0:Q=0:V=0:H=0
920 PRINTD(A);TAB(9);O$(C);TAB(21);P$(Z);TAB(34);D$(X);TAB(50);L$(M);
921 PRINTTAB(57);C(Q);TAB(65);E$(V);TAB(71);B(H)
930 A=A+1:C=C+1:Z=Z+1:X=X+1:M=M+1:Q=Q+1:V=V+1
935 H=H+1
940 IF D(A)=99 THEN 1100
945 GOTO 920
1100 GOSUB62:GOSUB64:GOSUB1500:PRINTCHR$(29)
1200 REM CUT LINE PROVIDES FOR DIVISION OF COPIES
1220 PRINT"**********";TAB(39)"CUT";TAB(70)"**********"
1221 GOSUB64
1290 REM THIS ROUTINE COUNTS THE NUMBER OF COPIES OUTPUT
1300 I=I+1
1310 IF I=1 THEN 750
1320 IF I=2 THEN 9
1400 GOSUB64
1490 REM THIS ROUTINE PROVIDES THE OUTPUT TOTALS OF ALL THE
1491 REM MATRIXED VARIABLES. EACH VARIABLE WAS INCREMENTED BY
1492 REM 1 DURING INPUT. WHEN THE OUTPUT ROUTINE IS BEGUN
1493 REM EACH ITEM IS DECREMENTED BY ONE.
1500 PRINTR;" REGS";" + ";SP;" SPLS";" + ";COD;" CODS";" + ";NC;
1501 PRINT" NO CHG";" + ";SC;" SVC CHG";GOSUB62
1510 PRINT"TOTAL DELIVERIES = ";A:PRINT"TOTAL CHARGES = ";TC
1520 PRINT"TOTAL BAGS = ";TB:RETURN
1900 FOR J=0TO79:PRINT"*";:NEXTJ:RETURN
```

*Program A. Listings for Multiple Item Statement Program.*


HOBBY-WRAP
WIRE-WRAPPING, STRIPPING, UNWRAPPING TOOL FOR AWG 30 (.025 SQUARE POST)
MODIFIED WRAP
WSU-30M
$6.95
SHIPPING CHARGE $1.00
STRIP
WRAP
UNWRAP
REGULAR WRAP
PART No.
WSU-30
TYPES OF WRAP
■ A "Regular" bit wraps the bare wire around the terminal. A "Modified" bit wraps a portion of insulation around the terminal in addition to the bare wire. This greatly increases the ability to withstand vibration.
MODIFIED WRAP
PART No.
WSU-30M
HOBBY-WRAP
REGULAR WRAP
WSU-30
$5.95
SHIPPING CHARGE $1.00
STRIP
WRAP
UNWRAP
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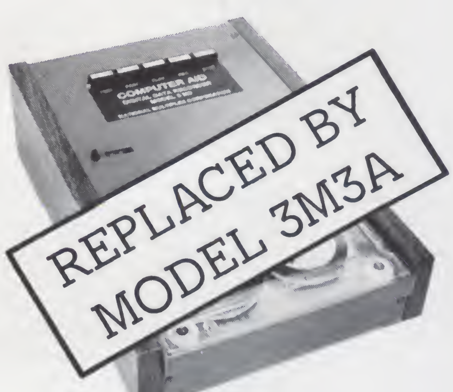
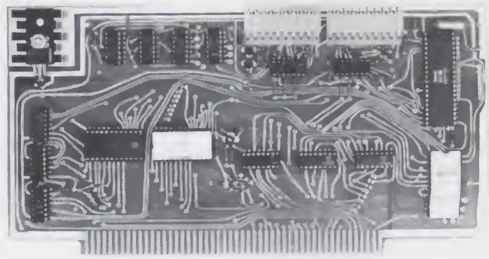
TELEX: 125091 TELEX: 232395

05

# DIGITAL DATA RECORDERS




USING 3M DATA CARTRIDGES



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2SIO (R) CONTROLLER – $190.00

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Featuring the radically new "Uniboard" method of construction for data cartridge drives. The major computer makers are changing to cartridges at a rapid pace because of the freedom from binding and greater data reliability. Operates in the phase encoded self-clocking mode which provides greatly enhanced freedom from speed variation problems and allows 100% tape interchangeability between units.

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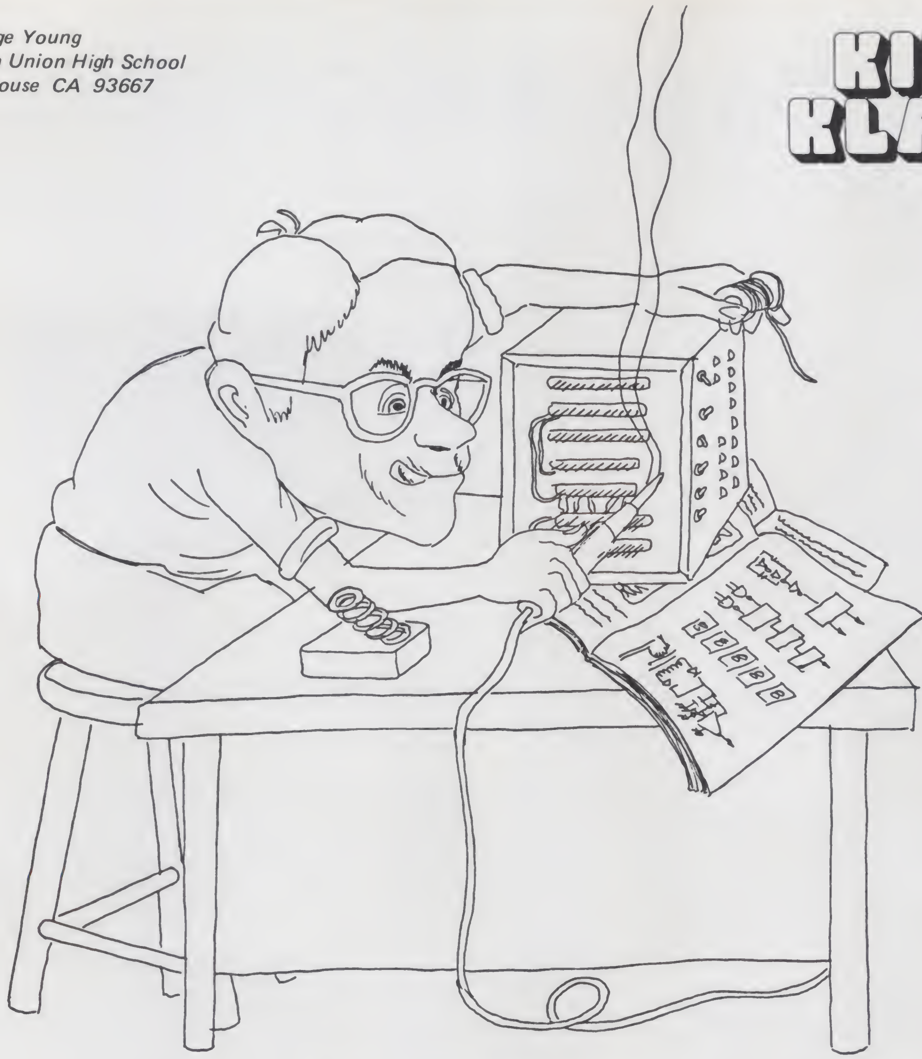
# KILOBAUD KLASSROOM NO. 2



# Gates and Flip-Flops Explained

A class meeting once a month is for the birds! The first thing we had better do each new class session is to have a quick review. Some newcomers to *Kilobaud* will have just started their subscription. Or worse yet, they will have picked up a copy off the newsstand and want to know what they have missed. Then they can subscribe and get the previously published class or classes.

## Review

Last time we listed what we would need to get started and had some tips on parts storage and on scrounging. We started to learn how to read schematics, pinouts on ICs, learned some symbols, wiring conventions, and met the Superstrip (a solderless breadboard). We learned how to test LEDs and ICs, and we had a little theory on inverters, NOT symbols, Boolean algebra, series and parallel connections of resistors and capacitors. It was a fair beginning.

## Preview

The Kilobaud Klassroom student console has been written up as a separate article and can be found elsewhere in this month's issue. Some nonstudents of Kilobaud Klassroom may want to build one without *taking the course*. This time we will introduce the 7400 gate, the NAND function, and the NAND truth table. We will construct a latch. We will show you a method of getting circuits into operation without using a PC board. We will construct a simple logic probe. We'll meet the 7-segment readout, and we'll meet the flip-flop.

## Experiment #5 The 7400 Gate

Purpose:

1. To investigate the 7400 IC.
2. To study the NAND logic function.
3. To explore the NAND Truth Table.

Equipment:

1. 7400 IC

New Symbols:

1. Fig. 1a shows the 7404 inverter (review).
2. Fig. 1b shows the NAND logic symbol.
3. Fig. 1c shows the 7400 NAND gate pin outs.

Circuit:

Figs. 2 and 3 contain the diagrams for this experiment.

## Procedure

Plug the 7400 into the Superstrip with the notch between pins 1 and 14 facing you. Connect pin 7 to the - rail of the Superstrip. Connect pin 14 to the + rail of the Superstrip. *Always connect ground and power connections first.*

Connect an LED and a 100 Ohm resistor as shown in Fig. 2 to pin 3 of the chip. The LED should be out. Now ground pin 1 with another piece of wire. The LED should turn on. Remove the wire from pin 1 and connect input pin 2 to ground. The LED should again turn on. Leave the wire connected to pin 2. Take another piece of wire and ground input pin 1 again. The LED should remain on. Repeat this test procedure for each of the remaining three gates in the DIP package.

## Theory

Fig. 3a shows the internal structure of just one gate section in the 7400 package. Hey, there are a whole bunch of goodies in there. Aren't you glad I don't have you build up a 7400 gate from discrete (discrete = indiv-

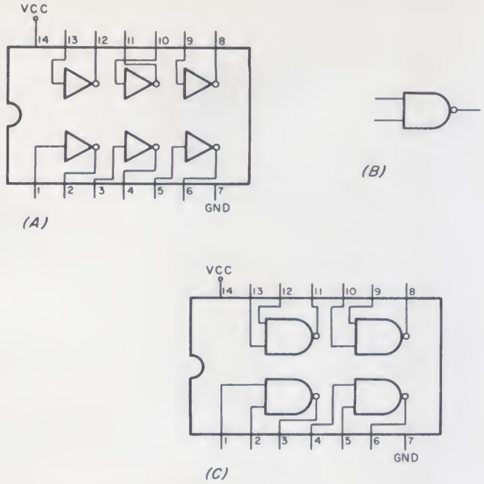



*Fig. 1. Symbols and pinouts for Experiment #5.*

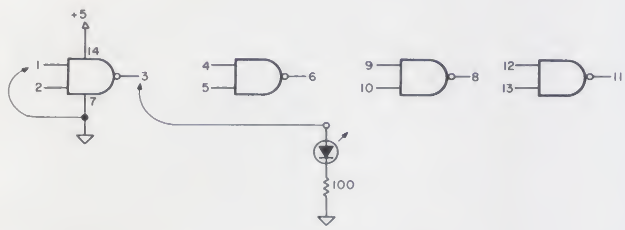
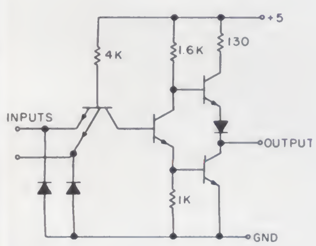
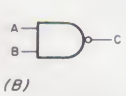



*Fig. 2. NAND gate test circuit.*




| A | B | C |
|---|---|---|
| HI | HI | LO |
| LO | HI | HI |
| HI | LO | HI |
| LO | LO | HI |

(C)

*Fig. 3. The NAND gate.*

idual) components?

What I am trying to emphasize here is that electronics changes. We used to build up a NAND gate in this fashion several years ago, but we don't do it that way any more. We don't even bother to draw the innards any more; we only concern ourselves with what goes in and what comes out.

The rule for the operation of a NAND gate is that *the output is low only when both inputs are high.* If either input goes low, then the output will go high. When we test a 7400 gate element, this is exactly what we look for. If each section in the DIP package does not obey the instructions that we give it, then: a) we're doing our testing wrong, or b) the chip has a defective section. If one of the four sections of a chip tests bad, then you can be reasonably certain that you are testing correctly. If all sections of two or more chips test out bad, then you can be reasonably certain that you are doing something wrong in your testing procedure.

Refer to Fig. 3b. We have redrawn the NAND logic symbol and labeled the inputs A and B and the output C. Fig. 3c shows a table called a Truth Table. Recall from class session one that TTL logic input pins go high as soon as power and ground are connected. And also recall that a high is any voltage near +5 volts. A low is any voltage near ground. Line one of the Truth Table reflects this. If both the inputs are high, the output will be low. If either input goes low, or both the inputs go low, the output will go high. The remaining lines of the Truth Table indicate this and this Truth Table is for the NAND logic function. Note that for a two input gate, there are $2^2$ or 4 combinations of inputs, so there are 4 lines in the Truth Table.

Now examine the Truth Table carefully. Notice that only one line in the Truth Table is different from the other lines. (The only Lo output is in the top line; all the other lines have Hi outputs.) Generally speaking, once you find the *different* line in a truth table, you have found the line that identifies the logic function.

**Chip Testing**

A vacuum tube tested in a tube tester doesn't always work in a TV set. Likewise, a chip tested in a chip testing circuit of some kind doesn't always work in a solid state circuit. The opposite, however, is always true: a chip proven bad in a chip tester will not work in a circuit.

What we are doing again is *playing the odds.* If a tester says the chip is good we can be reasonably certain that the chip will function in a circuit. The *proof is in the pudding,* so to speak: *a chip which is tested in a functioning circuit is the best test that you can give that chip.*

To illustrate this point, once you have the *squawker* of experiment #1 up and running (functioning), you have a nifty 7404 chip tester. And it is a much better and faster 7404 tester than the LED test that we used in experiment #1 to test the 7404. Not only is the circuit a 7404 tester, but it will test speakers, resistors, LEDs and capacitors as well! (There is, however, one slight flaw in what I've just told you. Can you find the flaw? Hint: Three sections of the 7404 are inparallel in the booster section. What would happen if one of these sections had an open pin? Two parallel clock circuits made from each 3 pairs of inverters would make a simple and quick 7404 tester that would test *all input* and *all output* pins.)

**The Set/Reset Flip-Flop**

When a mechanical switch is closed, the contacts bounce several times before they finally remain closed. TTL logic inputs interpret this bouncing as several highs and lows on the input and respond accordingly. A circuit widely used to debounce a mechanical switch is shown in Fig. 4a. This circuit uses a normally open, normally closed push-button switch to produce the equivalent of two switch actions operated from one button. By cross-coupling two sections of a 7400 NAND gate we can debounce the mechanical switch (we get only one closure, one opening). The cross-coupled configuration in Fig. 4a is called a latch. In Fig. 4b two cross-coupled NAND gates are used to debounce *two* normally open, push-button switches. The remaining two NAND gates are connected as inverters, and this portion of the circuit shows two different ways to make an inverter out of 2-input NAND gate. *Note:* Any time you see a control or switch or an LED inside a rectangular box it means that the device is a front panel mounted control or switch or LED.

Here's how Fig. 4b works: Both switches are shown in the open position. Assume that pin 2 and pin 1 are both Hi. (Why is pin 1 Hi?) Pin 3 therefore is Lo (see the NAND truth table). Pin 3 goes into pin 4 of the bottom gate. If Pin 4 is Lo pin 6 is Hi. If Pin 3 is Lo, Pin 10 is Lo, and the LED is off. With Pin 10 Lo, pin 8 is Hi, Pins 12 and 13 are Hi, and Pin 11 is

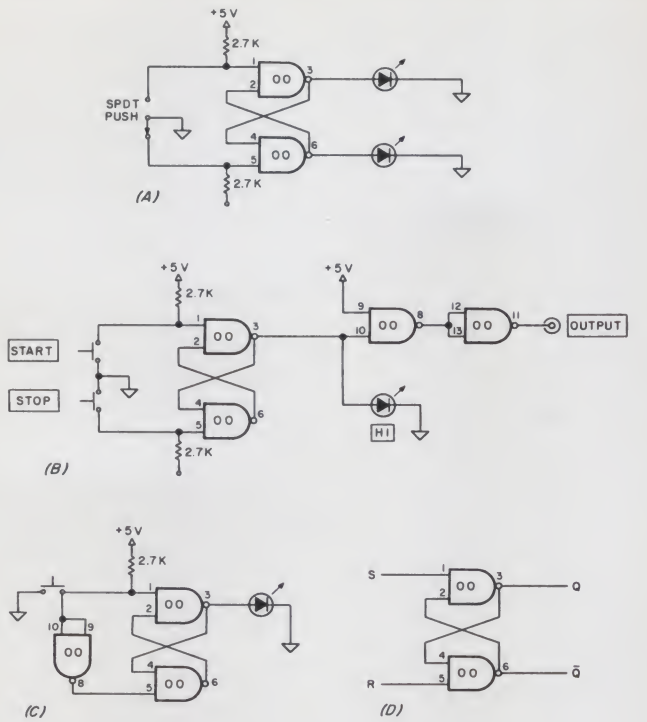



*Fig. 4. Latch circuits for Experiment #5.*

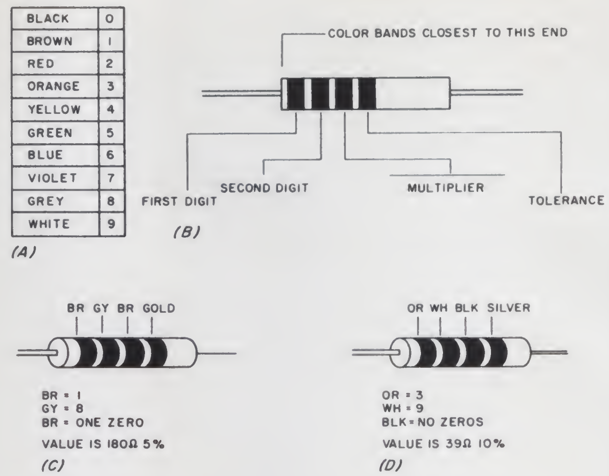



*Fig. 5. Electronic color code.*

Lo and the output is a voltage near ground. Now press the start switch. Pin 1 goes Lo, forcing Pin 3 Hi, Pin 10 Hi, and the LED on. With 10 Hi, 8 is Lo, 12 and 13 are Lo, and Pin 11 goes Hi. The output is now a voltage near 5 volts. When Pin 3 went Hi, so did Pin 4. Now with a Hi on Pin 4 and 5, Pin 6 is Lo. Pin 6 Lo means Pin 2 is Lo and Pin 3 therefore is latched Hi. To make the circuit relatch back the way it started, you will have to press the Stop push-button switch. This will force Pin 6 Hi, Pin 3 will go Lo, and Pin 6 will be latched in the Hi position by the Lo placed on Pin 4 by Pin 3.

The 2.7k resistors connected to the 5 volt supply in Fig. 4a, 4b and 4c are known as *pull-up* resistors. In digital circuits it is unwise to leave an input to a gate unconnected, or *floating*. If this is done, noise may cause a circuit to respond incorrectly. The pull-up resistors insure that the floating gate inputs assume a Hi, or logic 1 state. Thus, in Fig. 4a, the input not connected to ground by the SPDT switch is forced Hi by current through the resistor. It will assume a low state only when the switch is thrown, connecting the input to ground.

Set up this circuit on the Superstrip and make it work. Be sure to leave your ground and power hooked up as before. If you have a single push-button with both normally closed and normally open contacts, then the circuit of Fig. 4a can also be set up and tested. If you don't have either switches yet, you can still do the experiment. The switches simply connect either Pin 1 or Pin 5 momentarily to ground. Two wires can be used to momentarily ground these pins and simulate the switches. This circuit allows us to generate one pulse at a time and we are going to incorporate it into our console as one of the permanent support circuits for working with the Superstrip. The LED Hi indicator is optional, but my own students need it to reassure themselves that the Start-Stop (SS) control on their console is functioning.

Fig. 4c will not latch. It will debounce a switch and produce one pulse out for each button depression. It shows a way to use the 7400 to effect the same results as in Fig. 1a, but utilizing only a normally open push-button.

In the circuit of 4b Pin 1, the Start input, is called the Set input. Pin 3 is called the Q output. Pin 5 is the Reset input, and Pin 6 is called the "not Q" output. This is because when a circuit is Set, the Q output is the output that goes Hi. When a circuit is RESET, the Q output goes Lo. This cross-coupled configuration (latch) is also called a flip-flop. A flip-flop is a device which has two outputs, one of which is the opposite of the other. If one output is called Q, then the other output is $\overline{Q}$. Since the cross-coupled 7400 NAND gates have two inputs (Set and Reset) and two outputs (Q and $\overline{Q}$) we have what is called a Set/Reset flip-flop. These conventions are illustrated in Fig. 4d.

One final point: a handy way to identify IC sections is to write the last two digits of the IC inside the symbol. This is illustrated in Fig. 4. We will assume that the first two digits are 74 unless somebody tells us otherwise.

**Experiment #6**
**The Electronic Color Code**

Purpose:

1. To learn to use the electronic color code.
2. To get some helpful pointers on how to remember the color code.

Equipment:

1. No new parts or equipment as such is needed.
2. We will need several resistors from your junk box to evaluate.

Symbols:

1. No new symbols will be introduced.

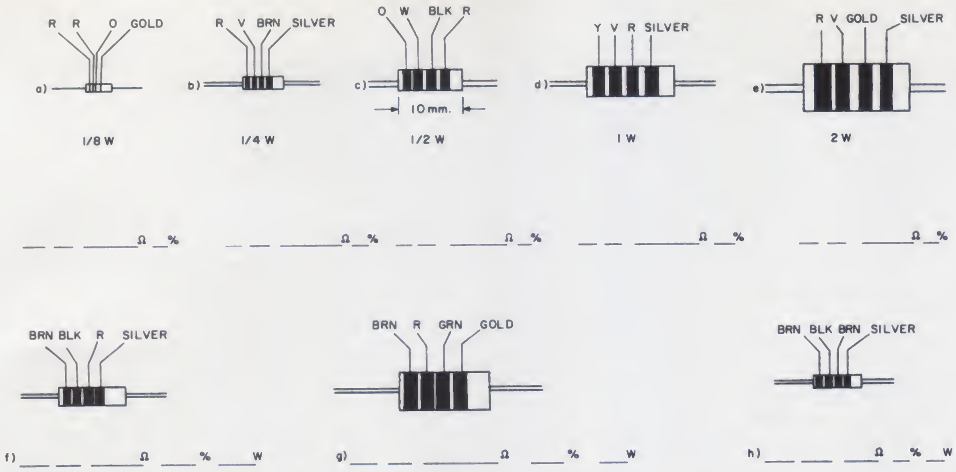
Circuit:

1. We will not be using a circuit as such.

**Procedure**

Refer to Fig. 5a. The colors used in the color code are those colors that are produced by white light which has been split up into its spectrum. The names given to each of these colors are: red, orange, yellow, green, blue, and indigo or violet. If you count these, there are only 6 different colors. So we add black and brown before the list and grey and white at the end to make the ten different colors that we need for the ten numerals of our number system.

Refer to Fig. 5b. Pick up any resistor from your junk box. Turn it around so that you are holding the resistor with the end with a color band facing the left. The bands of color should be




| | COLOR BANDS | | | | VALUE | % TOLERANCE | LENGTH (mm.) | WATTAGE |
|---|---|---|---|---|---|---|---|---|
| | 1ST | 2ND | 3RD | 4TH | ••••••••• | •••••••• | 4 | |
| i | BRN | RED | YEL | G | | | 7 | |
| j | GRY | RED | RED | S | | | 10 | |
| k | BRN | BLK | ORG | S | | | 15 | |
| l | GRN | BLU | RED | G | | | 19 | |
| m | RED | RED | RED | R | | | 4 | |
| n | GRY | RED | ORG | G | | | 7 | |
| o | BLU | RED | GOLD | O | | | 15 | |
| p | BRN | GRN | RED | NONE | | | 10 | |
| q | GRN | BLK | GOLD | S | | | 19 | |
| r | YEL | VIO | GRN | S | | | 7 | |
| s | VIO | GRN | BLK | G | | | 10 | |
| t | BRN | RED | BRN | Y | | | 10 | |

*Fig. 6. Resistor wattage and quiz.*

nearer one end of the resistor than the other end, but this may not always be true. If the resistor has a gold or a silver band, it will end up on the right, or at least toward the right-hand end of the resistor.

The leftmost color band is the first digit, the second color band is the second digit. The third color band is *not* a digit. It is called the multiplier. The simplest way to treat the multiplier is to consider it as the number of zeros that are to be added after the first two digits. Years ago, this statement was entirely valid, but when solid state devices appeared on the scene, we began to find resistors with gold and silver for the third color band, and a third color band of gold or silver cannot be treated as the number of zeros to be added. A gold third color band means that you divide the first two digits obtained from the first two color bands by 10 to get the resistance value. A silver third color band means that you divide by 100 to get the value of resistance. Dividing by 10 is the same as multiplying by 1/10 or .1 which means that you stick in one decimal place. Dividing by 100 means that you have two decimal places.

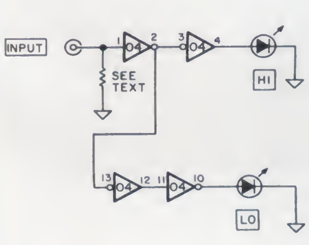



*Fig. 7. Console logic probe.*

I will give you a sentence, cleaned up slightly for publication, that you can use to help remember the color sequence: "Bad Boys Race Our Young Girls But Violet Gives Willingly." Translated, it produces: Black, brown, red, orange, yellow, green, blue, violet, grey, white. And if you then go through the list of colors and assign numerals to each color in sequence, you can come up with Fig. 5a from memory.

The fourth color band on resistors: The 4th color band gives the tolerance of the resistor. Gold means 5% tolerance, silver means 10% tolerance, and no fourth color band means 20% tolerance. It is very rare these days to find a resistor without a 4th color band. What you will find is a color band again used for the tolerance. Red designates 2%, orange 3%, yellow 4%, but gold is used for 5%. All 1% resistors could be marked with a brown color band, but usually the 1% is *written* on the resistor.

Power: The power a resistor will dissipate is measured in Watts and is generally directly related to the physical size of the resistor, and as a generalized rule of thumb, the bigger the physical size of the resistor, the more power it will dissipate.

About the only way I can handle the wattage rating of resistors on a printed page is to draw some resistors to actual scale to indicate the wattage. Since I would also like to give you a quiz on this section, here is what we are going to do: Fig. 6a shows several resistors with color bands indicated and the wattage given. Fill in the blanks as you *read* the values of the resistors. We'll publish the answers in the next class session.

If this is your first try at reading resistances, then try this:

1. From memory, reproduce Fig. 5a and write it down on the test page.

2. Write down the first two digits.

3. Now add the number of zeros to obtain the value. (If I see anything after two digits but zeros, I'm going to get very upset! Black means: do *not* add any zeros after the first two digits. And there is no such thing as a 271 Ohm resistor read from the color code.)

Now electronics nuts are basically very lazy. They do not even like to write zeros if they can write a letter instead. So we can use some metric prefixes to eliminate zeros. Three zeros can be replaced by a k (k = kilo) and 6 zeros can be replaced with an M (M = mega). So 1000 Ohms can be written as 1k, and 1,000,000 Ohms can be written as 1M. Since kilo actually means X 1000, the k really *replaces* 3 decimal points. For example, 1200 Ohms can be written as 1.2k, and 2,200,000 Ohms can be written as 2.2M. We'll have to do some more work with the metric system and prefixes, but this will suffice for now.

**Experiment #7**
**A Simple Logic Probe**

Purpose:

1. To construct a simple logic probe on the breadboard.

2. To verify its operation.

Equipment:

1. 7404

2. Two LEDs

3. A resistor between 1000 Ohms and 2400 Ohms.

Symbols:

1. No new symbols will be introduced.

Circuit: Refer to Fig. 7 for the circuit diagram for the simple probe that we will construct.

**Procedure**

Set up the circuit of Fig. 7 on your breadboard. The input resistor may range from 1000 Ohms to 2400 Ohms. Try what you have on hand and evaluate the performance. (Hey, you won't forget the power and ground connections on the 7404, will you?)

**Theory**

Repeating something that was stated earlier; the inputs of TTL logic chips go high as soon as you connect power and ground. If you have a voltmeter available, and you know how to use it, measure the voltage between Pin 1 and common on the 7404. If the meter is not available, then you'll have to trust me until such time as you are able to verify this. The input resistor from Pin 1 to common pulls the input of the first inverter Lo. This resistor must be small enough to accomplish this. A resistance value of 2400 Ohms (2.4k) is on the edge of doing this. Sometimes a 2.4k resistor will pull an input down, sometimes not. What we want here is the largest value of resistance that we can use that will be interpreted as a Lo by the 7404.

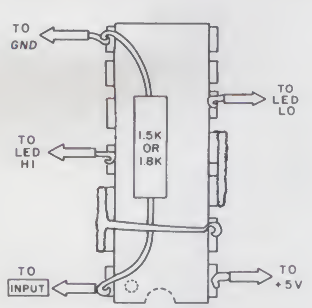



*Fig. 8. Haywiring of console logic probe (bottom view of 7404 IC).*

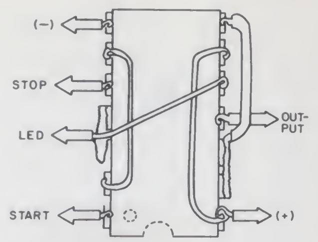



*Fig. 9. Haywiring of Start-Stop control.*

However, we do not want this value to be lower than about 1000 Ohms. A resistor of around 1500 Ohms or 1800 Ohms should do the trick. The author's console (breadboard) uses a 1500 Ohm resistor. When this resistor is correct, the Lo LED will be on.

The Lo on Pin 1 is inverted, appearing as a Hi on Pins 2 and 3. Pin 2 is connected to Pin 13, so 13 is also Hi. If 13 is Hi, 12 is Lo and so is 11. With 11 Lo, Pin 10 is Hi and the Lo LED is on. With Pin 3 Hi, Pin 4 is Lo and the Hi LED is off. Now, if we take the input Hi, Pin 2 will go Lo along with Pin 3, causing Pin 4 to go Hi, lighting the Hi LED. With Pin 2 Lo, 13 is Lo, 12 and 11 are Hi, and 10 is Lo and the Lo LED goes out. Once the probe is operational, connect the probe input (Pin 1) to Pins 5 and 6 on the 7404 chip. Pin 5 should indicate a Hi, Pin 6 a Lo.

**Troubleshooting**

It's a simple circuit, but things can go wrong. Always assume that the chip is good at the start. This is usually the way it will turn out. The first thing to check if it doesn't work is, of course, power and ground. Does the chip feel warm? It will if it is getting power. Are the LEDs correctly polarized? Remember that these are diodes, and if they are reverse biased by being connected into the circuit backwards, they will not light up. If one or both don't light, try turning them around in the circuit. You won't hurt anything. If they then light up, you had them in backwards.

If you still have an inoperative circuit, then we'll have to test the chip. Return to Experiment 3 and test out the LED first, then the 7404. If it doesn't *play* after the chip is proven, then you'll have to get some help.

Any member of the 7404 family may be used. The 74H04, the 74S04, the 74L04, and the 74SL04 will all work here, just as all would have functioned in the clock circuit of Experiment #1.

**Experiment #8**
**Haywiring**

Purpose:

1. To find out what haywiring is.

2. To get the logic probe and the start-stop control incorporated into the console.

Equipment:

1. All the parts used to construct the logic probe on the breadboard, and the start/stop control.

2. The 7400 IC, LEDs, 7400 IC and two SPST PB switches (single pole-single throw push button).

3. LED, optional for the start-stop control.

4. A resistor — from 1.5 to 1.8k Ohms.

Symbols:

1. No new symbols will be introduced as such. However, we will reintroduce the pictorial drawing again, this time using an IC.

**Procedure**

Fig. 8 is a pictorial drawing of the haywired logic probe. The resistor is soldered directly to the pins of the IC. Wires are soldered directly to the pins of the IC. Leave all wires about 10 cm (4 inches) long. This procedure is called haywiring by hams. While not very pretty, it *is* an acceptable way of getting things done without the fuss of a printed circuit board. Note: The wire shown connecting Pins 2 and 3 to Pin 13 is positioned above the resistor lead and may not touch it. Once the circuit is wired, it is again tested on the breadboard before hanging it behind the panel. If the haywired circuit functions, then install it behind the panel. Install the LEDs in the Hi and Lo hole positions in the logic probe area and connect the wires from the chip to the designated destinations as diagramed on the pictorial.

Upon applying panel power, the Lo LED should be on. The Hi LED should be off. Connect a wire to the 4-40 X ½ inch bolt used for the logic probe input (see article on constructing student console). Touching this wire to +5 volts should turn off the Lo LED and turn on the Hi LED. If it doesn't work, then check your wiring. The purpose of having you test it before installing it was to prevent inoperation when it is placed behind the panel. If it worked *out front*, then it will work *out back* as soon as you eliminate the errors in wiring. The entire circuit hangs from the wires used to haywire it up, and it will function satisfactorily in this fashion. Later after we teach you how to make a PC (printed circuit) board, you can redo this to improve its looks. But for now it gets our console in operation, and that is the most important thing now. Besides, it's buried and you don't have to show anyone the underside of the console. *Pin positions get reversed when reading ICs from the bottom.*

Fig. 9 shows the haywiring circuit of the start-stop control. Follow the same procedure in haywiring the start-stop control as you followed in wiring up the logic probe. Test the circuit before you hang it behind the front panel. Solder two wires on the push-button switches and plug them into the circuit so that all components of the circuits are tested and functioning before you place things behind the panel. Again the chip simply hangs on the wires for support.

The LED used for Hi indicator is optional. Pushing the start push-button makes the

output Hi. However, my students are reassured if they see this LED turn on when they push the start button, so we will make it optional for you as we did for them.

And before we proceed, I need to mention one other thing: *soldering*.

**Soldering**

It is not possible to teach you how to solder via a magazine. In teaching soldering, it is a do it yourself thing. You have to do it, and then have someone look at it and tell you what you did right and what you did wrong. The best that I can do is give you some pointers.

1. Everything must be clean. The tip of the iron, the parts to be joined, the solder, everything must be clean.

2. Use the best electronic solder that you can afford. 50/50 or 60/40 in something around 20 gauge is preferred. It must be resin core for electronic work, no acid core allowed.

3. The solder must flow. This means that enough heat must be transferred to the components that are to be joined so that the solder flows over their surface. About 1 second (or less) after the solder flows, remove the heat. Too much heat is as bad for the connection as insufficient heat. This is the hardest single thing for the beginner to learn. And, of course, using the proper wattage (heat rating) iron for the job is very important (not over 47 Watts for ICs).

4. No movement allowed while the solder is turning back to a solid. This implies that some form of device be used to keep things from moving.

A good solder joint is bright and shiny upon completion of the connection. Any grey color to the solder means that something was done incorrectly.

Practice making soldering connections before you tackle the actual circuit. Take a piece of hook-up wire, strip the ends back, and twist the two ends together so that they don't unravel. Place any reasonably heavy device, such as the front edge of the console, over the wires to hold them stationary. Now solder the wires together. If you do the job correctly, a) the joint will be stronger than the wire itself, b) it will be bright and shiny with no trace of grey showing, the entire surface of the wire will be covered with solder, but the outline of the two twisted wires will still be easily visible. Now pull on the two wire ends until something gives. The wire should break before the two wires unravel. When you have this mastered, then proceed to solder up the circuits. You will only learn to solder by soldering.

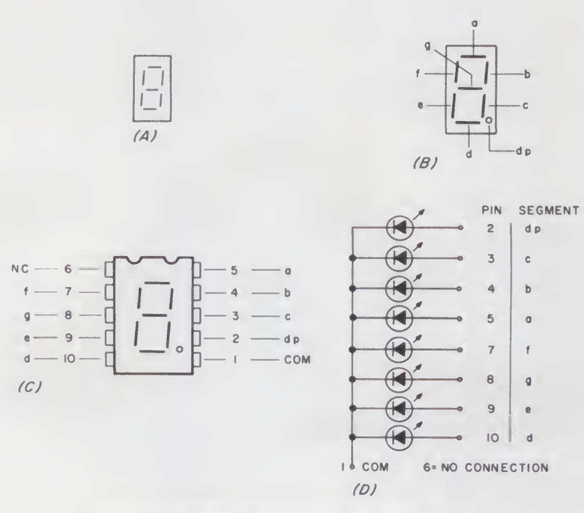



*Fig. 10. Seven Segment display diagrams.*

**Experiment #9**
**The Seven Segment Display**

Purpose:

1. To introduce the 7 segment display.

2. To determine how to test 7 segment display.

Equipment:

1. 7 segment display

**New Symbols**

Refer to Fig. 10a. This figure shows a generalized 7 segment display as many authors draw them in their schematic diagrams. Fig. 10b identifies the seven segments and the decimal point. Fig. 10c shows a pictorial top view of the FND 70 display and identifies the pinouts. Please note that this is not an IC and the identification is not between the first and last pins as it is on integrated circuits.

**Circuit**

Refer to Fig. 10d. This diagram shows 8 LEDs inside the FND 70 package.

**Procedure**

Examine the FND 70 closely. Insert it in the Superstrip along one side of the strip only. The pin spacing is not wide enough to straddle the channel. The row of pins containing Pin 1 on the display should be the pins plugged in. The other 5 pins will drop into the channel between the plug in rows. Connect a resistor from Pin 1 (common) to ground. *Do not omit this resistor or the readout will be ruined.* This resistor may be any value between 47 and 220 Ohms. Start with Pin 2. Connect a wire to the plus rail from Pin 2. The decimal point (dp) LED inside the display should light. Connect Pin 3 to +. The c segment should light. Pin 4 to + should light b, Pin 5 to + should light a. To test the other segments, we will have to place a wire in the + rail on the other side and then reach under the FND 70 and touch each pin in turn to test the other segments. Pin 6 has no connection, Pin 7 is f, Pin 8 is g, Pin 9 is e and Pin 10 is d. Each segment should light up in turn as you connect each pin to the + rail. Pretty neat, huh? What good is it, though? Well, we've got 8 LEDs at our disposal instead of having to use discrete LEDs.

**Preview**

Hopefully, there will be fewer pages but more experiments in future sessions of KB Klassroom. We will teach you how to count in binary. We will teach you how to decode numbers in binary and binary coded decimal. We will learn how to change from the binary number system to the decimal number system. We will study the decade counter and the 7 segment decoder. We will learn how to build a device called an LED register. And we will construct the console clock circuit on the breadboard, but we still won't get it into the console until the 4th class session when we will learn how to make PC boards.

We are going to need some more ICs and more parts. For the next session we will need a 7448, an 8T90 (or a 7406 or 7416), a 7490, and a 555. And we will need handful of LEDs, at least 4 more. (Sierra Electronics package price to Kilobaud Klassroom students is $4.)

And in the 4th session we will need, a) some copper clad circuit board, b) some etchant, some resist material, and the probe I keep telling you to make. Suntronix Company which published a catalog in *Kilobaud*, Issue 2, has a nifty kit for this purpose for $14.95. This will satisfy our requirements very nicely. I have contacted them about a 10% discount for you and you've got it by mentioning Kilobaud Klassroom.

When you reach this point in the course, you can consider yourself as out of the beginner class in electronics. You'll never learn it all, but you now know a whale of a lot more than you did when you started and we've got a solid foundation laid. ■

# Computerized Typesetting

## ... an introduction to word processing

*Lee Wilkinson*
*2308 New Walland Hiway*
*Maryville TN 37801*

*One of our biggest objectives in starting* Kilobaud *was to provide a media to the world of personal computers for good practical applications people have been developing. When Lee Wilkinson writes something for us you can bet it's going to be a very practical application. He's one of the few examples I've seen of a small businessman getting a computer system and really putting it to use as a tool in running his business. — John.*

```
THIS  IS  ONE SAMPLE OF A 40 COLUMN LINE
USING  AN ALTAIR 8800 AND A KSR 33 TELE-
TYPE  TO 'SET' JUSTIFIED COPY.  THE TYPE
HAS BEEN REDUCED 20% WHICH IS OUR NORMAL
REDUCTION  OF  THE BODY TYPE WE USE.   A
CARBON  RIBBON  WAS USED ON THE TELETYPE
AND  THE  PAPER  IS HAMMERMILL FOUR-BOND


WOULD YOU LIKE IT AGAIN? NO

OK
```

In our business of photography we have an occasional need for justified (even right-hand margins) type in order to make plates to run on our offset press. This need includes biographies for entertainers, descriptive information for models' portfolios, body type for church pictorial directories, and body type for our own advertising brochures.

**The Problem and the Solution**

Prior to writing this program in MITS 8K BASIC, our usual method of obtaining body type was with our office typewriter. There are no *type houses* in our area and the only other solution was to have a local printer set the type. The cost of the type set by a local printer is prohibitive for some of our low budget jobs. Printers in the area have charged, for typesetting alone, within a few dollars of what they would charge for a complete job. Our office typewriter was suitable but an attempt to justify several paragraphs of type was slow, time-consuming and required typing each line at least twice. If we were lucky we ended up with almost all the lines even on the right-hand side of the page. With this program we can now type in our copy, observing a few rules for input, edit any mistakes we might have made while typing, and then get justified copy on command with the KSR 33 Teletype.

Admittedly, the KSR 33 does not have the prettiest typeface and, of course, is limited to upper case letters, but the type is attractive enough for our limited need. We have found that the type looks very nice if you insert a sheet of quality paper and use a carbon ribbon. Carbon ribbons were not available locally for the Underwood and Underwood portable typewriters which use the same style spools as the KSR 33, but it was a simple matter to respool a carbon ribbon from another style of spool as long as the ribbon is ½ inch wide. Our method of respooling is to save a couple of the spools from *used up* cloth ribbons, then use a variable speed drill with a bit that fits loosely in the center of one of the TTY spools and wind on as much of the carbon ribbon as will fit comfortably on the TTY spool. A slight amount of tension on the ribbon will make a very neat winding. You will probably have some carbon ribbon left over for future use since it seems impossible to keep as much tension on the ribbon as the manufacturer when winding the original spool or the brand spool you may have to buy will often be larger than the TTY spool. When the spool is holding as much ribbon as you feel will stay on without spiraling off, cut the ribbon and fold a piece of masking tape over the end for connection to the sharp pin on the TTY spool. The carbon ribbon is a *one-time* use ribbon and you will have to watch as the ribbon approaches the end, since there are no eyelets for reversing, which you don't want anyway. You will use this ribbon only for your final justified copy, so it will last for quite a few paragraphs.

The paper we use for the justified copy is clay-based IBM paper made for their composing machines, but very good results are obtained

```
RUN

HOW MANY LINES? 48
IF YOU FINISH BEFORE TYPING 48 LINES, TYPE 'DONE'
LENGTH OF LINE? 40
IF YOUR LINE IS A SHORT LINE AT THE END OF THE PARAGRAPH
TYPE SPACES TO THE END.
(ENCLOSED IN QUOTES) LINE LENGTH OF 40 IS HERE . . .
                                          I
? "THIE IS ONE SAMPLE OF A 40 COLUMB ←N LINE"
? "USING AN ALTAIR 8800 AND A KSR 33 TELE-"
? "TYPE TO 'SET' JUSTIFIED COPY. THE TYPE"
? "HAS BEEN REDUCED 20% WHICH IS OUR NORMAL"
? "REDUCTION OF THE BODY TYPE WE USE. A"
? "CARBON RIBBON WAS USED ON THE TELETYPE"
? "AND THE PAPER IS HAMMERMILL FOUR-BOND"
                                          I
? DONE

THIE IS ONE SAMPLE OF A 40 COLUMN LINE
USING AN ALTAIR 8800 AND A KSR 33 TELE-
TYPE TO 'SET' JUSTIFIED COPY. THE TYPE
HAS BEEN REDUCED 20% WHICH IS OUR NORMAL
REDUCTION OF THE BODY TYPE WE USE. A
CARBON RIBBON WAS USED ON THE TELETYPE
AND THE PAPER IS HAMMERMILL FOUR-BOND

IS THERE A LINE YOU WISH TO CHANGE? YES
WHEN TYPING A NEW LINE, ENCLOSE IN QUOTES AND ADD A SPACE AT END
WHICH LINE? 1

THIE IS ONE SAMPLE OF A 40 COLUMN LINE
CORRECT LINE? YES
TYPE YOUR NEW LINE

? "THIS IS ONE SAMPLE OF A 40 COLUMN LINE "
IS THERE ANOTHER LINE? NO

PRESS SPACE BAR FOR JUSTIFIED COPY
THIS IS ONE SAMPLE OF A 40 COLUMN LINE
USING AN ALTAIR 8800 AND A KSR 33 TELE-
TYPE TO 'SET' JUSTIFIED COPY. THE TYPE HAS
BEEN REDUCED 20% WHICH IS OUR NORMAL
REDUCTION OF THE BODY TYPE WE USE. A
CARBON RIBBON WAS USED ON THE TELETYPE
AND THE PAPER IS HAMMERMILL FOUR-BOND

WOULD YOU LIKE IT AGAIN? YES
PRESS SPACE BAR FOR JUSTIFIED COPY
```

*Sample of program run.*

```
LIST
100 REM *** JUSTIFICATION *** BY LEE WILKINSON, WB6DKI/WA4QXC
110 CLEAR 4000
120 INPUT "HOW MANY LINES";N
130 PRINT "IF YOU FINISH BEFORE TYPING";N;"LINES, TYPE 'DONE' "
140 INPUT "LENGTH OF LINE";LL
145 PRINT "IF YOUR LINE IS A SHORT LINE AT THE END OF THE PARAGRAPH"
147 PRINT "TYPE SPACES TO THE END."
150 L=LL+2
160 DIM A$(N)
170 PRINT "(ENCLOSED IN QUOTES) LINE LENGTH OF";LL;"IS HERE . . . "
180 PRINT TAB(L)"I"
190 FOR I=1 TO N
200 INPUT A$(I)
210 X=X+1:Q=Q+1
220 IF A$(I)="DONE" THEN I=N:N=X-1:GOTO 500
230 A$(I)=A$(I)+CHR$(32)
240 IF Q=7 THEN GOSUB 430:Q=0
250 NEXT I
255 GOTO 500
260 PRINT:PRINT
270 PRINT "PRESS SPACE BAR FOR JUSTIFIED COPY":WAIT 0,1,1
280 PRINT:PRINT
290 FOR J=1 TO N
300 K=0
310 A=LEN(A$(J))
320 IF A<LL/1.3 THEN PRINT A$(J):GOTO 400
330 B=(LL+1)-A
340 FOR I=1 TO A
350 T=T+1
360 IF T+K=LL+1 THEN T=0: GOTO 400
370 IF MID$(A$(J),I,1)=" " AND K<B THEN PRINT " ";:K=K+1
380 PRINT MID$(A$(J),I,1);
390 NEXT I
400 PRINT
410 NEXT J
411 PRINT:PRINT:PRINT
```

*Program listing (cont'd next page).*

```
412 INPUT"WOULD YOU LIKE IT AGAIN";Z$
414 IF LEFT$(Z$,1)="Y" THEN GOTO 270
420 END
430 PRINT TAB(L)"I"
440 RETURN
500 PRINT:PRINT:PRINT
510 FOR I=1 TO N
520 PRINT A$(I)
530 NEXT I
535 PRINT:PRINT:PRINT
540 INPUT "IS THERE A LINE YOU WISH TO CHANGE";Z$
550 IF LEFT$(Z$,1)="Y" THEN 595
560 GOTO 260
595 PRINT"WHEN TYPING A NEW LINE, ENCLOSE IN QUOTES AND ADD A SPACE AT END"
600 INPUT "WHICH LINE";I
610 PRINT:PRINT A$(I)
620 INPUT "CORRECT LINE";Z$
630 IF LEFT$(Z$,1)="Y" THEN GOTO 650
640 GOTO 600
650 PRINT"TYPE YOUR NEW LINE"
652 PRINT
655 INPUT A$(I)
660 INPUT "IS THERE ANOTHER LINE";Z$
670 IF LEFT$(Z$,1)="Y" THEN GOTO 600
680 GOTO 260
690 END
```

*Program listing (cont'd).*

using 20 lb Hammermill four-bond. Most of our copy is reduced 20% before printing and this enhances the esthetic value of the type even more.

**The Program**

When you run the program it first asks "HOW MANY LINES?". If you do not know how many lines you will be typing, then answer with a greater number than you know there will be. A handy feature of this function is: If, for example, you want only 48 lines on an 8½ x 11 page you will answer "48" and the computer will automatically end your input and put you in the edit mode when you finish typing the 48th line. You can, as the program instructs, type DONE and go into the edit mode after having typed any number of lines less then the number originally specified. Next comes the question "LENGTH OF LINE?" This feature enables you to *set* the length of the line you wish justified. It is especially handy for narrow paragraphs or columns. The computer then tells you that if a line is a short line, such as the last line of a paragraph, you must type spaces to the end of the line. The line length guide (an "I") is spaced to the length to which you should type your line (as close to as possible) but not over this length. Longer words should be hyphenated in order to get close to the end of the line. The fewer spaces you leave at the line's end, the fewer spaces the computer has to compensate for. On the initial typing, your lines must be enclosed in quotation marks since commas are delimiters without being within the quotes. If you get to the end of a line and accidentally go past the "I" you can backspace using your "shift 0" and then hyphenate the word. Each seven lines the line length guide ("I") is typed out to help keep you in bounds of your line length. At first, starting and ending each line with quotation marks is a bit confusing but after a few lines you will get the feel of it. You cannot use quotation marks in your lines but we have found an apostrophe to be just as effective.

You may wish to change the number of string bytes at line 110 to better conform with your available memory. The WAIT instructions will need to be changed at line 270 if your terminal is addressed to a different I/O port. This WAIT statement allows you the time you need to switch ribbons and to insert a sheet of quality paper. The two PRINT statements at line 280 are included because after inserting a sheet of paper my TTY does not always line feed correctly for a line or two and this gives the TTY a chance to "catch up." Lines 412 and 414 are included because there are occasions when a possibility of damaging the first copy can occur, especially when pasting up and cutting. Line 430 is the Line Length Indicator to keep you in bounds. As mentioned, it repeats every seven lines and can be changed if you need it less often.

**Conclusion**

The program can be easily adapted to your specific needs if they are different from ours. An ideal adaptation would be to interface an IBM Selectric to the computer so that different type styles would be available as well as upper and lower case letters. An added convenience of the Selectric interface would be a permanent carbon ribbon source without having to spool your own. In my limited inquiries of Selectric interfaces the least expensive modification kit runs between $1000 and $1500 plus the typewriter. This in itself puts it out of my price range. I would be interested in hearing from you regarding adaptations of this program or other systems interfaced to print justified copy. ■


*"Gentlemen, and Gentleladies, I'd like to introduce you to our new model EX 3000 Vectored Priority Interrupt, Direct Memory Access, Multidimensional Arrays computer. Or, as it is known by those who work with it, the little GizzWhizz II."*

## DIODES/ZENERS

| | | | |
|---|---|---|---|
| 1N914 | 100v | 10mA | .05 |
| 1N4004 | 400v | 1A | .08 |
| 1N4005 | 600v | 1A | .08 |
| 1N4007 | 1000v | 1A | .15 |
| 1N4148 | 75v | 10mA | .03 |
| 1N753A | 6.2v | z | .25 |
| 1N758A | 10v | z | .25 |
| 1N759A | 12v | z | .25 |
| 1N4733 | 5.1v | z | .25 |
| 1N5243 | 13v | z | .25 |
| 1N5244B | 14v | z | .25 |
| 1N5245B | 15v | z | .25 |

## SOCKETS/BRIDGES

| | | | | |
|---|---|---|---|---|
| 8-pin | pcb | .25 | ww | .45 |
| 14-pin | pcb | .25 | ww | .40 |
| 16-pin | pcb | .25 | ww | .40 |
| 18-pin | pcb | .25 | ww | .75 |
| 22-pin | pcb | .45 | ww | 1.25 |
| 24-pin | pcb | .35 | ww | 1.25 |
| 28-pin | pcb | .35 | ww | 1.45 |
| 40-pin | pcb | .50 | ww | 1.95 |

Molex pins .01 To-3 Sockets .25
2 Amp Bridge 100-prv 1.20
25 Amp Bridge 200-prv 1.95

## TRANSISTORS, LEDS, etc.

| | | |
|---|---|---|
| 2N2222 | NPN | .15 |
| 2N2907 | PNP | .15 |
| 2N3740 | PNP 1A 60v | .25 |
| 2N3906 | PNP | .10 |
| 2N3054 | NPN | .35 |
| 2N3055 | NPN 15A 60v | .50 |
| T1P125 | PNP Darlington | .35 |
| LED Green, Red, Clear | | .15 |
| D.L.747 | 7 seg 5/8" high com-anode | 1.95 |
| XAN72 | 7 seg com-anode | 1.50 |
| FND 359 | Red 7 seg com-cathode | 1.25 |
| HP276 | com-cathode | 1.25 |

## C MOS

| | |
|---|---|
| 4000 | .15 |
| 4001 | .20 |
| 4002 | .20 |
| 4004 | 3.95 |
| 4006 | 1.20 |
| 4007 | .35 |
| 4008 | 1.20 |
| 4009 | .30 |
| 4010 | .45 |
| 4011 | .20 |
| 4012 | .20 |
| 4013 | .40 |
| 4014 | 1.10 |
| 4015 | .95 |
| 4016 | .35 |
| 4017 | 1.10 |
| 4018 | 1.10 |
| 4019 | .70 |
| 4020 | .85 |
| 4021 | 1.35 |
| 4022 | .95 |
| 4023 | .25 |
| 4024 | .75 |
| 4025 | .35 |
| 4026 | 1.95 |
| 4027 | .50 |
| 4028 | .95 |
| 4030 | .35 |
| 4033 | 1.95 |
| 4034 | 2.45 |
| 4035 | 1.25 |
| 4040 | 1.35 |
| 4041 | .69 |
| 4042 | .95 |
| 4043 | 1.25 |
| 4044 | .95 |
| 4046 | 1.50 |
| 4049 | .80 |
| 4050 | .60 |
| 4066 | 1.35 |
| 4069 | .40 |
| 4071 | .35 |
| 4082 | .45 |

## — T T L —

| | |
|---|---|
| 7400 | .15 |
| 7401 | .15 |
| 7402 | .20 |
| 7403 | .20 |
| 7404 | .15 |
| 7405 | .25 |
| 7406 | .35 |
| 7407 | .55 |
| 7408 | .25 |
| 7409 | .15 |
| 7410 | .10 |
| 7411 | .25 |
| 7412 | .30 |
| 7413 | .45 |
| 7414 | 1.10 |
| 7416 | .25 |
| 7417 | .40 |
| 7420 | .15 |
| 7426 | .30 |
| 7427 | .45 |
| 7430 | .15 |
| 7432 | .30 |
| 7437 | .35 |
| 7438 | .35 |
| 7440 | .25 |
| 7441 | 1.15 |
| 7442 | .55 |
| 7443 | .85 |
| 7444 | .45 |
| 7445 | .80 |
| 7446 | .95 |
| 7447 | .95 |
| 7448 | .95 |
| 7450 | .25 |
| 7451 | .25 |
| 7453 | .20 |
| 7454 | .25 |
| 7460 | .40 |
| 7470 | .45 |
| 7472 | .45 |

| | |
|---|---|
| 7473 | .25 |
| 7474 | .35 |
| 7475 | .35 |
| 7476 | .30 |
| 7480 | .55 |
| 7481 | .75 |
| 7483 | .95 |
| 7485 | .95 |
| 7486 | .30 |
| 7489 | 1.35 |
| 7490 | .55 |
| 7491 | .95 |
| 7492 | .95 |
| 7493 | .40 |
| 7494 | 1.25 |
| 7495 | .60 |
| 7496 | .80 |
| 74100 | 1.85 |
| 74107 | .35 |
| 74121 | .35 |
| 74122 | .55 |
| 74123 | .55 |
| 74125 | .45 |
| 74126 | .35 |
| 74132 | 1.35 |
| 74141 | 1.00 |
| 74150 | 1.00 |
| 74151 | .75 |
| 74153 | .95 |
| 74154 | .75 |
| 74156 | 1.15 |
| 74157 | .65 |
| 74161 | .85 |
| 74163 | .95 |
| 74164 | .60 |
| 74165 | 1.50 |
| 74166 | 1.35 |
| 74175 | .80 |

| | |
|---|---|
| 74176 | 1.25 |
| 74180 | .85 |
| 74181 | 2.75 |
| 74182 | .95 |
| 74190 | 1.75 |
| 74191 | .35 |
| 74192 | 1.65 |
| 74193 | .85 |
| 74194 | 1.25 |
| 74195 | .95 |
| 74196 | 1.25 |
| 74197 | 1.25 |
| 74198 | 2.35 |
| 74221 | 1.00 |
| 74367 | .85 |
| 75108A | .35 |
| 75110 | .35 |
| 75491 | .50 |
| 75492 | .50 |
| 74H00 | .25 |
| 74H01 | .25 |
| 74H04 | .25 |
| 74H05 | .25 |
| 74H08 | .35 |
| 74H10 | .35 |
| 74H11 | .25 |
| 74H15 | .30 |
| 74H20 | .30 |
| 74H21 | .25 |
| 74H22 | .40 |
| 74H30 | .25 |
| 74H40 | .25 |
| 74H50 | .25 |
| 74H51 | .25 |
| 74H52 | .15 |
| 74H53J | .25 |
| 74H55 | .25 |

| | |
|---|---|
| 74H72 | .55 |
| 74H101 | .75 |
| 74H103 | .75 |
| 74H106 | .95 |
| 74L00 | .35 |
| 74L02 | .35 |
| 74L03 | .30 |
| 74L04 | .35 |
| 74L10 | .35 |
| 74L20 | .35 |
| 74L30 | .45 |
| 74L47 | 1.95 |
| 74L51 | .45 |
| 74L55 | .65 |
| 74L72 | .45 |
| 74L73 | .40 |
| 74L74 | .45 |
| 74L75 | .55 |
| 74L93 | .55 |
| 74L123 | .55 |
| 74S00 | .55 |
| 74S02 | .55 |
| 74S03 | .40 |
| 74S04 | .35 |
| 74S05 | .35 |
| 74S08 | .35 |
| 74S10 | .35 |
| 74S11 | .35 |
| 74S20 | .35 |
| 74S40 | .25 |
| 74S50 | .25 |
| 74S51 | .45 |
| 74S64 | .25 |
| 74S74 | .40 |
| 74S112 | .90 |
| 74S114 | 1.30 |

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|---|---|
| 74S133 | .45 |
| 74S140 | .75 |
| 74S151 | .35 |
| 74S153 | .35 |
| 74S157 | .80 |
| 74S158 | .35 |
| 74S194 | 1.05 |
| 74S257(8123) | .25 |
| 74LS00 | .45 |
| 74LS01 | .45 |
| 74LS02 | .45 |
| 74LS04 | .45 |
| 74LS05 | .55 |
| 74LS08 | .45 |
| 74LS09 | .45 |
| 74LS10 | .45 |
| 74LS11 | .45 |
| 74LS20 | .40 |
| 74LS21 | .25 |
| 74LS22 | .25 |
| 74LS32 | .40 |
| 74LS37 | .40 |
| 74LS40 | .55 |
| 74LS42 | 1.75 |
| 74LS51 | .65 |
| 74LS74 | .75 |
| 74LS86 | .75 |
| 74LS90 | 1.30 |
| 74LS93 | 1.00 |
| 74LS107 | .95 |
| 74LS123 | 1.00 |
| 74LS151 | .75 |
| 74LS153 | 1.20 |
| 74LS157 | .85 |
| 74LS164 | 1.90 |
| 74LS367 | .85 |
| 74LS368 | .70 |

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| 9309 | .35 |
| 9322 | .85 |
| 95H03 | .55 |
| 9601 | .75 |
| 9602 | .50 |

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| 1702A | 7.95 |
| MM5314 | 3.00 |
| MM5316 | 3.50 |
| 2102-1 | 1.75 |
| 2102L-1 | 1.95 |
| TMS6011NC | 6.95 |
| 8080AD | 15.00 |
| 8T13 | 1.50 |
| 8T23 | 1.50 |
| 8T24 | 2.00 |
| 2107B-4 | 4.95 |

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| 8266 | .35 |
| 8836 | .95 |
| MCT2 | .95 |
| 8038 | 3.95 |
| LM201 | .75 |
| LM301 | .25 |
| LM308 (Mini) | .75 |
| LM309H | .65 |
| LM309K(340K-5) | .85 |
| LM310 | 1.15 |
| LM311D(Mini) | .75 |
| LM318 (Mini) | .65 |

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|---|---|
| LM320K5 | 1.65 |
| LM320K12 | 1.65 |
| LM320T12 | 1.25 |
| LM320T15 | 1.65 |
| LM339 | .95 |
| 7805 (340T-5) | .95 |
| LM340T-12 | 1.00 |
| LM340T-15 | 1.00 |
| LM340T-18 | 1.00 |

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|---|---|
| LM340T-24 | .95 |
| LM340K-12 | 2.15 |
| LM340K-15 | 1.25 |
| LM340K-18 | 1.25 |
| LM340K-24 | .95 |
| LM373 | 2.95 |
| LM380 | .95 |
| LM709(8,14 PIN) | .25 |
| LM711 | .45 |

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|---|---|
| LM723 | .45 |
| LM725 | 1.75 |
| LM739 | 1.50 |
| LM741 8-14 | .20 |
| LM747 | 1.10 |
| LM1307 | 1.25 |
| LM1458 | .95 |
| LM3900 | .50 |
| LM75451 | .65 |
| NE555 | .50 |
| NE556 | .95 |
| NE565 | .95 |
| NE566 | 1.75 |
| NE567 | 1.35 |
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# Kilobaud Sweepstakes Winners

Twenty people won life subscriptions to **Kilobaud.** If they were already subscribers they got double their original subscription money back. The winners were:

E. DeConingh, Temple City CA
J. A. Weber, Berthoud CO
J. MacDonald, Virginia Beach VA
A. Gutierrez, Hialeah FL
B. Hamerski, Winona MN
R. Fisher, Spokane WA
Jeremy Nichols, Minneapolis MN
L. Tekheira, Chico CA
S. A. McCall, Decatur GA
D. Digiacomo, Glendora NJ
D. Digiacomo, Glendora NJ
Jonathan Griffitts, Boulder CO
G. Oldenburg, Rancho Palos Verdes C
D. Willson, Omaha NB
L. Macknik, Lexington MA
B. Fuller, Grand Prairie TX
T. Hughes, Ventura CA
E. Silterra, Urbana IL
R. French, San Francisco CA
E. Frankenberry, Mt. Lebanon PA

Over $7500 in prizes have been awarded to winners of the **Kilobaud Sweepstakes.** This contest was started before **Kilobaud**'s first issue last January and continued until March 25th when D. Kim Simpson of Chicago IL won the Altair 8800b, completely assembled and ready to go. Troy Beloťe of Fayetteville AR won an Ohio Scientific CPU Expander for second prize. R. Friedman of Piscataway NJ won a set of 15 game programs for a 6800 by Technical Systems Consultants. Fourth prizes of **Hobby Computers Are Here** were awarded to the following individuals:

Travis Good, Hillsboro OR
J. Adams, Jerome ID
J. Dowdy, San Diego CA
J. Waldyke, Chelsea MI
R. Downs, Saraland AL
Maj. J. Beard, APO NY
D. Uchitil, Franklin WI
M. Stock, Kansas City MO
R. Deliban, Palo Alto CA
G. Constantine, Poughkeepsie NY
E. Berlett, Melbourne FL
K. Saunders, Las Vegas NV
J. Williams, Oklahoma City OK
A. Voss, Grand Forks AFB ND
C. Myhre, Stacy MN
K. Goen, Oklahoma City OK
C. Shimbo, Detroit MI
C. Brinkley, Ft. Myers FL
D. O'Brien, Stockton CA
M. Smith, Milwaukie OR
H. Smith, Uncasville CT
J. Wilson, Kenn. WA
M. Warren, North Wilkesboro NC
E. McWhiney, Redondo Beach CA
J. Newton, McDonald IN
J. Wells, Santa Ana CA
H. Flank, Wheaton MD
K. Brown, Sherman Oaks CA
M. Furguson, El Paso TX
R. Alleger, Mount Holly NJ
A. Sclawy, Brooklyn NY
C. Vaughn, Chelan WA
D. Torres, Fraser MI
N. Corison, Anaheim CA
B. Hill, Amherst TX
R. Pullen, Fountain Valley CA
A. Hoke, Brooklyn NY
S. Scharf, Hackensack NJ
S. Wolf, Bronx NY
G. Gresfeld, Olney MD
S. Devlin, Warren NJ
M. Goldstein, Tempe AZ
W. Leopold, Troy MI
J. Langdon, Austin TX
H. Havlik, River Forest IL
S. Judd, APO NY
R. Jones, Washington DC
J. Gehrke, Fredericksburg VA
M. Zarembski, Scarsdale NY
J. Anglin, Rochester MN
D. Hartman, Mission Viejo CA
N. Weber, Burnside LA
J. Smirl, Kansas City MO
R. Moell, Raleigh NC
J. Culvahouse, Lawrence KS
W. Peters, Beaumont TX
C. Harris, Potomac MD
C. Cowan, Jr., Louisville KY
R. Rasor, San Antonio TX
L. Shoemaker, St. Petersburg FL
T. Foster, N. Hollywood CA
W. Stewart, Atlanta GA
C. Benward, Citrus Heights CA
G. Darwin, Louisville KY
K. Klages, Orlando FL
H. Hankins, Jr., APO NY
Major R. T. Flora, APO SF CA
L. Stevick, FPO Seattle WA
R. Kobayakawa, Honolulu HI
G. Yama, Mesa AZ
J. C. Weaver, Midland TX
John Alston, Virginia Beach VA
A. Larsen, Los Altos CA
J. Keesling, Woodland Hills CA
M. King, Ridgecrest CA
L. Pironka, Pullman WA
F. Simoneau, Los Gatos CA
R. Colantonj, Los Angeles CA
D. Booth, Portland OR
D. Metal, Commack NY
E. Monahan, Lisle IL
A. Kranok, Jr., Mission Viejo CA
D. V. Gassie, Lajolla CA
G. Pennini, Birmingham AL
D. Burke, Bremerton WA
B. Adler, Brooklyn NY
D. Parker, Davis CA
E. Lovick, Jr., Northridge CA
J. O'Leary, Redondo Beach CA
DeCoffey, Sheffied Lake OH
F. N. Henderson, Santa Maria CA
J. Celko, Atlanta GA
D. Coleman, Norridgewock ME
G. Cosimini, St. Paul MN
J. Wilkendorf, Ft. Worth TX
J. Chinn, College Place WA

Sixth prize, a Southwest Technical Products 6800 kit with 8K of memory and a BASIC compiler was awarded to R. W. Mikel of Fort Worth TX.

S. Chenoweth of Bryan TX and S. North of Newfoundland NJ won Seals 8K "never forget" memory boards with a keep-alive circuit to protect the memory in case of a power failure.

G. Crockett, Riverside CA
A. Griffin, APO San Francisco CA
M. Johnson, Kettering OH
D. Moody, W. Covina CA
F. Lowe, Riverside CA
T. Rodeheffer, Pittsburgh PA
B. Cronenberger, Buffalo NY
J. Hegseth, Spanaway WA
H. Stuck, Chapel Hill NC
W. Tanoue, Hilo HI
M. Yamada, Chicago IL
M. Terrell, Middletown OH
R. Wier, College Station TX
W. Farrey, FPO NY
C. Green, San Francisco CA
D. Weber, Eureka CA
R. Formeister, Phoenix AZ
Frank Tinius, Vandenberg AFB CA
J. Muir, Livermore CA
G. Twait, Cylinder IA
J. Salmon, Fenton MO
J. Tyler, Troy MI
S. Mikkelsen, Glendora CA
A. Helpinstine, Anoka MN
J. Wood, San Jose CA
D. Stoenner, Tustin CA
L. Burbey, Green Bay WI
R. Schaeneman, Stockton CA
D. McGuire, Longmont CO
T. Speer, Syracuse NY
J. Merritt, Torrance CA
J. Hood, New Haven CT
K. M. Barbier, Socorro NM
E. Wilczak, Howell MI
D. Hallberg, Molino IL
Q. Jensen, Brigham City UT
M. Ito, Casper WY
W. Nichparenko, Santa Cruz CA
C. McCain, Syracuse NY
J. Morris, Dedham MA
P. Rekieta, Houston TX
J. Dumas III, Oxford MI
P. Burke, Red Bank TN
J. Trachtman, St. Louis MO
G. Edmundson, Elizabeth PA
K. Stauffer, Madison Hts MI
F. Stukey, Goshen NY
G. Beecher, Duncombe IA
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C. Carlson, N. Las Vegas NV
J. Bowman, Phoenix AZ
R. Johnston, Woodstock NY
M. Spurgat, Houston TX
P. McHarque, Sacramento CA
Psycholinguistic Research, Menlo Park
D. Repsher, Bakersfield CA
M. Fenton, Los Angeles
M. Williams, Northridge CA
R. Marshall, Lemon Grove CA
K. Kiser, Pullman WA
B. Freeland, Olympia WA
L. Dossett, San Diego CA
E. Walsh, Santa Maria CA
B. McLendon, Sacramento CA
J. Mealing, Jr., El Paso TX
M. Sweet, Austin TX
K. Newcomer, Corvallis OR
F. Yates, Saratoga CA
R. Lopez, Santa Barbara CA
J. Fotts, 1000 Oaks CA
C. Pearce, Berwyn IL
P. Hutchison, Ames IA
W. Spear, Tulsa OK
K. Jackson, Livonia MI
J. Wise, Houston TX
P. Roberts, Richmond CA
R. Browning, Kenmore NY
D. Hatton, Angwin CA
J. Edelman, Baton Rouge LA
R. Taylor, Des Moines IA
N. Crawford, Plano TX
A. Amaro, Fremont CA
E. Gardner, Troy NY
W. Kirsch, III, Annandale VA
R. Hoolko, Canoga Park CA
B. Bong, Cedar Rapids IA
R. Romero, APO NY
D. Norlander, Sunnyside CA
C. Hill, Ft. Wayne IN
T. Lennon, Albany NY
S. Mitteldorf, Belle Harbor NY

# GLOSSARY

Tim Barry

**ADDRESS:** Addresses are used to identify individual locations within the computer's memory. Every time the computer needs to transfer data to or from a memory location it sends the address to the memory. The memory system then decodes the address and performs the data transfer with the selected location.

**BENCHMARK:** Benchmark programs are used to compare the performance of computer or language processors. The normal procedure for computer benchmarking is to define a set of problems representative of the proposed application and implement them in the test computer's assembly language. Program execution times can then be compared and the most effective processor selected. For language processor benchmarks, the procedure is again to define test problems, this time implementing them in the various versions of the same language and testing for the best execution times.

Benchmarking is very easy to describe and very difficult to do in a meaningful way. Almost any company can devise benchmark which "prove" their computer and/or language processors are best. The program and its interaction with the computer is a complex operation, and to be meaningful any attempt at benchmarking must test a wide variety of applications programs and take into account the variations in the overall systems being compared.

**BUFFER:** 1. A buffer is a memory area used to store data for use at a later time. Buffers are often used to store I/O data prior to or after processing. For example, a BASIC interpreter will usually accept user input characters into a line buffer. Then, after the last character of the line is entered, the characters in the buffer are processed and the command executed. 2. An electronic buffer is a gate/driver IC, or discrete circuit, used to isolate one section of a system from another. Buffers help reduce device loading and improve the noise tolerance of the system. Normally (in good design practices) all devices which communicate via a common bus have all signals buffered.

**BYTE:** A byte is an eight-bit data element. Many computers use the byte as the basic size element of their memory. In this case the computer's instruction set will be composed of instructions which are stored in one or more single byte memory locations. The Intel 8080, for example, executes instructions which are 1, 2 or 3 bytes long.

**DATA BASE:** A data base is the collection of all data used and produced by a computer program. In large systems, data base analysis is usually concerned with large quantities of data stored in disk and tape files. Smaller hobbyist systems are more frequently concerned with data base allocations of available memory locations between program and data storage areas.

**DISCRETE:** 1. A discrete circuit is built up from individual circuit components (transistors, resistors, capacitors, etc.). This usage is common when the user wishes to make clear that a circuit was constructed without integrated circuits, e.g., a discrete amplifier. 2. Events occurring at distinct and separate instants in timing. The pulses were detected at discrete intervals.

**EFFECTIVE ADDRESS:** The effective address is the address of the memory location which is actually used in a program operation. For example, in an indexed address operation the effective address is formed by adding the displacement included with the instruction to the base address held in an index register.

**KILOBYTE:** 1. A kilobyte is $2^{10}$ x 1024 bytes. It is commonly abbreviated to "K" and used as a suffix when describing memory size. 32K really means a 32 * 1024 = 32,768 byte memory system. 2. Shortest lived computer magazine title on record.

**LOCATION:** A location is a single storage address, or position, in a computer memory.

**MODULO:** Modulo is a mathematics term which means the same as *base*. It is normally used when referring to counters or adders. For example, a modulo 10 counter would go through 10 distinct states before returning to its initial state. A number evaluated modulo N (N is called the *modulus*) gives the integer remainder of the division of that number by the modulus. Thus 300 evaluated modulo 256 equals the remainder of 300/256 = 44.

**NIBBLE:** A nibble is one half of a byte, namely a four-bit data element.

**PHI-DECK (Trademark):** The Phi-Deck is a computer-controlled magnetic tape transport manufactured by Triple I, a division of the Economy Company, Oklahoma City, Oklahoma.

**SEED:** A seed is a constant used to initiate a pseudo-random number generator. The seed is used to generate the first number, and all subsequent numbers are based on previous results. If you start the sequence with the same seed, you will, of course, get the same "random" number sequence. To avoid this, a good way to generate a reasonably random seed is to sum up a block of memory which is known to be used for variable program data. This sum can then be used to seed the random number generator.

**VOLATILE:** A volatile memory is one which loses its content when power is removed. All currently available semiconductor memories are volatile. Special external circuitry must be added to maintain data in the event of power interruption.

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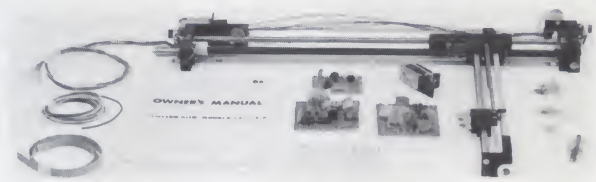

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# Authors

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- **Simple Programming**—Simply punch in on the keyboard the frequency you wish to monitor.
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- **Manual Scan Control**—Scan all 10 channels at your own pace.
- **3-Inch Speaker**—Front mounted speaker for more sound with less distortion.
- **Squelch**—Allows user to effectively block out unwanted noise.
- **AC/DC**—Operates at home or in the car.

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| | 512 x 8 Bit 1 us TS Erasable | 12.00 |
| 5 | 256 x 4 Bit 60 ns TS | 3.25 |
| | 256 x 4 Bit 65 ns TS | 9.00 |
| | 256 x 4 Bit 65 ns OC | 9.00 |
| | 32 x 8 Bit 50 ns OC | 4.00 |
| | 256 x 4 Bit 50 ns TS | 4.25 |
| | 32 x 8 Bit 50 ns OC | 4.50 |

EFORM GENERATOR

| | | |
|---|---|---|
| 8 | VCO | 4.50 |
| 024 | Dual VCO | 2.75 |
| | VCO Function | 2.00 |

CTER GENERATORS

| | | |
|---|---|---|
| | 5x7 5 line CM2140 Upper case | 6.75 |
| 1 | 7x9 7 line | 12.00 |
| 1 | CN3421 (Signetics) | 5.00 |

REGISTERS — DYNAMIC

| | | |
|---|---|---|
| N | 1024 x 1 Bit 2.5 MHz | 3.00 |
| | 512 x 1 Bit 2.5 MHz | 3.00 |

STATIC

| | | |
|---|---|---|
| | 100 x 2 Bit | .89 |
| | 50 x 2 Bit 1.5 MHz | 1.00 |
| | 32 x 6 Bit 2.0 MHz | 3.95 |
| | 1024 x 1 Bit 1.5 MHz | 2.00 |
| 02 | 50 x 2 Bit 1.0 MHz | 1.00 |
| 12 | 32 x 6 Bit 2.0 MHz | 3.95 |
| 8 | 1024 x b Bit 1.5 MHz (8 pin) | 2.00 |

HER COMPONENTS

| | | |
|---|---|---|
| N | Dual Low Cost MOS Clock Driver | 1.75 |
| N | 5 MHz Dual MOS Clock Driver | 3.00 |
| | Bi-Directional One Shot | 4.00 |
| | Quad Bus Driver/Receiver | 3.25 |
| | Tri State Hex Buffer | 1.15 |
| | Tri State Hex Inverter | 1.00 |
| | RS232 Quad Line Driver | 1.95 |
| | RS232 Quad Line Receiver | 1.95 |
| | Quad NAND to MOS Driver | 2.50 |
| | 6 Bit Latch 12 ns O/P Delay | 3.95 |
| | Tri State Hex MOS Sense Amp | 6.75 |
| | Clock Generator | 4.95 |
| | T V Camera Sync Generator | 6.00 |
| | Oscillator Pre Scaler | 2.00 |
| | Ten Bit Comparator | 2.25 |
| | 6 Bit Comparator | 2.00 |
| | 4 Input AND NAND Tri State | 2.50 |
| | Quad Tri State Transceiver (True) | 2.50 |
| | Quad Tri State Transceiver (Inv) | 2.50 |

R T S

| | | |
|---|---|---|
| 1013 | (TR1602A) 30 KHz | 6.95 |

C.P.U. 'S

| | | |
|---|---|---|
| 8008 1 | 8 Bit CPU | 18.75 |
| 8080 | Improved 8008 | 22.95 |
| 8080A | Super 8008 | 24.95 |
| Z80 | CPU (3880) | 39.95 |
| F8 | CPU (3850) | 29.95 |

Support Devices

| | | |
|---|---|---|
| 3851 | Program Storage Unit (F 8) | 19.95 |
| 3853 | Static Memory Interface (F 8) | 19.95 |
| 3881 | Parallel I/O Controller (Z 80) | 19.95 |
| 3882 | Counter Timer Circuit (Z 80) | 19.95 |
| 8212 | 8 Bit I/O Port | 4.25 |
| 8214 | PriorityInterrupt Control | 12.95 |
| 8216 | Bi Directional Bus Driver | 5.25 |
| 8224 | Clock, Generator & Driver | 6.00 |
| 8228 | System Controller & Bus Driver | 9.25 |
| 8251 | Programmable Communication Int | 12.00 |
| 8255 | Programmable Peripheral Interface | 12.00 |
| 8257 | Progr Direct Mem Access Control | 23.00 |

DYNAMIC RAMS

| | | |
|---|---|---|
| 1103 | 1024 x 1 Bit 300 ns | 1.50 |
| 2107A | 4096 x 1 Bit 300 ns | 6.00 |
| 2107B | 4096 x 1 Bit 200 ns | 6.50 |
| 2107B 4 | 4096 x 1 Bit 270 ns | 5.00 |
| 2107B 6 | 4096 x 1 Bit 350 ns | 4.50 |
| 4008P 6 | 1024 x 1 Bit 500 ns | 2.75 |
| 4050NL | 4096 x 1 Bit 300 ns | 4.00 |
| MM5261 | 1024 x 1 Bit 400 ns | 3.00 |
| MM5262 | 2048 x 1 Bit 365 ns | 3.00 |
| MM5270 | 4096 x 1 Bit 200 ns (18 pin) | 4.00 |
| MM5280 | 4096 x 1 Bit 200 ns (22 pin) | 6.00 |

STATIC RAMS

| | | |
|---|---|---|
| 2101 1 | 1024 x 1 Bit [illegible] ns TS | [illegible] |
| 31101 | 16 x 4 Bit [illegible] ns OC | [illegible] |
| 1101A | 256 x 1 Bit 2 us TS | 1.00 |
| 2101 | 256 x 1 Bit 1 us TS | 3.00 |
| 2102 | 1024 x 1 Bit 1 us TS | 1.50 |
| 2102 1 | 1024 x 1 Bit 500 ns TS | 1.75 |
| 2111A 4 | 256 x 1 Bit 450 ns TS (18 pin) | 1.15 |
| 2112A 4 | 256 x 4 Bit 450 ns TS (16 pin) | 2.45 |
| 25018 | 256 x 1 Bit 1 us | 1.45 |
| 3107 | 256 x 1 Bit 80 ns OC | 2.95 |
| 7489 | 16 x 4 Bit 280 ns TS | 3.00 |
| 74S201 | 256 x 1 Bit 50 ns TS | 4.75 |
| 91L02A | 1024 x 1 Bit 500 ns TS | 2.00 |
| 7489 | 16 x 4 Bit 60 ns OC | 2.25 |
| 8225 | 16 x 4 Bit 50 ns OC | 1.50 |
| 8599 | 16 x 4 Bit 50 ns TS | 1.50 |

FIFO

| | | |
|---|---|---|
| 3341A | 64 x 4 Bit 1.0 MHz | 6.75 |

# JADE CO. OFFERS

**THE ITEMS SHOWN IN THIS AD FOR IMMEDIATE SHIPMENT FROM STOCK. IN ADDITION WE STOCK OVER 4,000 OTHER ITEMS. INCLUDING:**

1. All Standard, Hi-Speed, Low Power, Schottky TTL Product
2. All Linear Devices
3. Transistors—Diodes
4. Clock Kits & Modules
5. Vectors & AP Products
6. Resistors-Capacitors
7. Video Games & Chips
8. PROM Setters [E-Prom]
9. Wire & Wire Wrap Tools

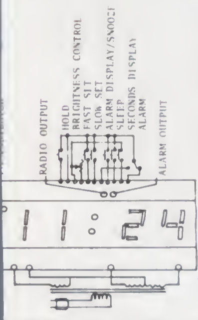
## SPECIAL OF THE MONTH

## 2708 E-PROM
## Price $35.00 ea.

master charge

your BANKAMERICARD welcome

## Digital Clock Module

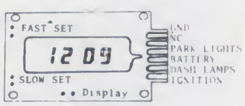



FEATURES
- *4 digit 0 5 display
- *Complete,needs only transformer & switches
- *Clock Radio Alarm
- *12 hr & 60Hz
- *Power Failure Indicator
- *Direct Drive No RFI

APPLICATIONS
- *Clock radio timers
- *Desk Clocks
- *Instrument panel clocks

MA 1002 A
$10.95

TRANSFORMER,14 VCT AC SCHEMATIC TO POWER MA 1002A $1.75

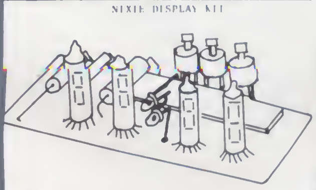



FEATURES
- * Operates on 9 12 V DC
- * 0.3" green display
- * Internal time base
- * Display color filterable to blue, green & yellow
- * Lock out of time set when display is "OFF"

APPLICATIONS
- * In dash autoclocks
- * Recreation vehicles
- * Aircraft/Marine clocks
- * Portable battery operated instruments

MA 1003
$24.95

NIXIE DISPLAY KIT



FEATURES
- * MM5316 Clock Chip
- *Needs only case & 12 V AC @ 200 ma
- *Blanking control
- *AM PM Option
- *24 hr Capability
- *59 minute timer
- *Power Failure indicator
- *24 hr clock radio

NIXIE CLOCK KIT
$12.95
Transformer 110 14V AC 200ma $1.50

## TIME BASE CHIP

| | | |
|---|---|---|
| MM 5369 | 17 Stage Osc/Divider | [illegible] |

# CLOCK CHIPS

| | | |
|---|---|---|
| MM5312N | 4 Digit w/BED 7 Seg 12/24 hr 50/60 Hz | 4.50 |
| MM5316N | 4 Digit Alarm Snooze, 12/24 59 min timer,50/60 Hz,AM/PM | 4.00 |
| MM5318N | TV Display Digital Clock | 8.95 |
| MM5370N | Gas Discharge Display 12 24 60 Hz, 59 min timer, AM/PM | 4.00 |
| MM5375NAC | 4/6 digit, date counter, 50Hz | 2.00 |
| 7001 | 6 digit calender, alarm, 12/24 hr | 5.95 |

# 74LS00

| Low Power | Schottky |
|---|---|
| 74LS00 | .40 |
| 74LS02 | .40 |
| 74LS03 | .40 |
| 74LS04 | .40 |
| 74LS05 | .40 |
| 74LS08 | .40 |
| 74LS10 | .40 |
| 74LS11 | .40 |
| 74LS12 | .50 |
| 74LS20 | .40 |
| 74LS21 | .40 |
| 74LS30 | .40 |
| 74LS32 | .40 |
| 74LS37 | .50 |
| 74LS42 | .90 |
| 74LS51 | .40 |
| 74LS73 | .60 |
| 74LS74 | .65 |
| 74LS76 | .60 |
| 74LS78 | .80 |
| 74LS85 | 2.00 |
| 74LS86 | .55 |
| 74LS95 | 2.00 |
| 74LS107 | .55 |
| 74LS109 | .60 |
| 74LS112 | .60 |
| 74LS113 | .60 |
| 74LS122 | .60 |
| 74LS139 | 1.30 |
| 74LS151 | 1.50 |
| 74LS153 | 1.60 |
| 74LS155 | 1.60 |
| 74LS157 | 1.30 |
| 74LS161 | 1.50 |
| 74LS169 | 2.00 |
| 74LS174 | 1.25 |
| 74LS175 | 1.30 |
| 74LS191 | 2.45 |
| 74LS192 | 1.95 |
| 74LS193 | 2.45 |
| 74LS196 | 2.60 |
| 74LS248 | 1.35 |
| 74LS251 | 2.00 |
| 74LS266 | .75 |
| 74LS363 | .70 |
| 74LS367 | 1.00 |
| 74LS368 | 1.00 |
| 74LS386 | .75 |

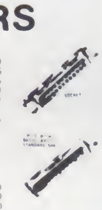
# CMOS

| | | |
|---|---|---|
| 34001 | Quad 2 Input NOR Gate | .40 |
| 4000 | Dual 3 Input NOR Gate/Inver | .25 |
| 4001 | Quad 2 Input NOR Gate | .25 |
| 4002 | Dual 4 Input NOR Gate | .25 |
| 4004 | 7 Stage RPl Ctr/hz Div | 3.50 |
| 4006 | 18 Bit St. Shift Register | 1.40 |
| 4007 | Dual Comp Pair + Inverter | .25 |
| 4008 | 4 Bit Full Adder | 1.25 |
| 4009 | Hex Buffer Inverter | .70 |
| 4010 | Hex Buffer Converter | .70 |
| 4011 | Quad 2 Input NAND Gate | .25 |
| 4012 | Dual 4 Input NAND Gate | .25 |
| 4013 | Dual Type D Flip Flop | .60 |
| 4014 | 8 Bit St. Shift Register | 1.25 |
| 4015 | Dual 4 Bit Static Shift Reg | 1.25 |
| 4016 | Quad Analog Sw/Quad Multi | .60 |
| 4017 | Decade Counter Divider | 1.25 |
| 4018 | Divide By N Counter | 1.25 |
| 4019 | Quad AND OR select Gate | .70 |
| 4020 | 14 Bit Binary Counter | 1.25 |
| 4021 | 8 Bit St. Shift Register | 1.25 |
| 4022 | Octal Counter/Divider | 1.25 |
| 4023 | Triple 3 Input NAND Gate | .35 |
| 4024 | 7 Stage Ripple Counter | 1.00 |
| 4025 | Triple 3 Input NOR Gate | .35 |
| 4026 | Decade Ctr/Div 7 Seg Output | 2.75 |
| 4027 | Dual J-K Flip Flop | .60 |
| 4028 | BCD to Dec Bi Octal Dec | 1.25 |
| 4029 | 4 Bit BIN/BCD UP/DN CTR | 1.90 |
| 4030 | Quad Exclusive OR Gate | .60 |
| 4032 | Triple Serial Adder (POS) | 1.60 |
| 4033 | Decade Ctr/Div 7 Seg Out W/B | 2.00 |
| 4034 | 8 Bit Universal Bus Register | 3.50 |
| 4035 | 4 Bit Shift Register | 1.60 |
| 4038 | Triple Serial Adder (Neg) | 1.60 |
| 4040 | 12 Bit Binary Counter | 1.50 |
| 4041 | Quad True/Comp Buffer | 1.45 |
| 4042 | Quad Latch | 1.25 |
| 4043 | Quad 3 State NOR R/S Latch | 1.20 |
| 4044 | Quad 3 State NAND R/S Latch | 1.25 |
| 4046 | Phase Locked Loop | 1.95 |
| 4047 | Mono Astable Mltvbr | 2.50 |
| 4049 | Hex Inverter/Buffer | .75 |
| 4050 | Hex Non Inverting Buffer | .75 |
| 4051 | 8 Channel Analog Multiplexer | 1.10 |
| [illegible] | Dual 4 Channel Analog Mx | 1.10 |
| [illegible] | Triple 2 Channel Mltplx | 1.10 |
| 4060 | 14 Stage Binary Ctr/Osc | 3.25 |
| 4061 | 256 x 1 Static RAM | 7.00 |
| 4063 | 4 Bit Magnitude Comparator | 2.50 |
| 4066 | Quad Bilateral Sw | .85 |
| 4068 | 8 Input NAND Gate | .38 |
| 4069 | Hex Inverter | .40 |
| 4070 | Quad Excl OR Gate | .38 |
| 4071 | Quad 2 Input OR Gate | .38 |
| 4072 | Dual 4 Input OR Gate | .38 |
| 4073 | Triple 3 Input AND Gate | .38 |
| 4075 | Triple 3 Input OR Gate | .38 |
| 4076 | Quad D Type Register | 1.85 |
| 4078 | 8 Input NOR Gate | .38 |
| 4081 | Quad 2 Input AND Gate | .38 |
| 4082 | Dual 4 Input AND Gate | .38 |
| 4093 | Quad 2 1 NAND Schmitt Trigger | .75 |
| 4098 | Dual Retrig/Reset M S Multi | 2.50 |
| 4160 | Decade Counter | 1.75 |
| 4161 | Binary Counter | 1.75 |
| 4162 | Decade Counter | 1.75 |
| 4163 | Binary Counter | 1.75 |
| 4174 | Hex D Flip Flop | 1.75 |
| 4175 | Quad D Flip Flop | 1.60 |
| 4194 | 4 Bit Univ Shift Register | 1.80 |
| 4501 | Triple Gate | .38 |
| 4502 | Strobed Hex Inverter/Buffer | 1.75 |
| 4503 | Hex Three State Buffer | 1.15 |
| 4506 | Dual Expandable AOI Gate | .70 |
| 4507 | Quad Exclusive OR Gate | 1.00 |
| 4508 | Dual 4 Bit Latch | 4.00 |
| 4510 | BCD Up/Down Counter | 1.75 |
| 4511 | BCD to 7 Seg Latch/Decdr/Dr | 2.00 |
| 4512 | 8 Channel data selector | 1.50 |
| 4514 | 4/16 line decoder (hi) | 4.75 |
| 4515 | 4/16 line decoder (lo) | 4.75 |
| 4516 | Binary up down counter | 1.75 |
| 4517 | Dual 64 Bit Static Shift Reg | 8.50 |
| 4518 | Dual 4 Bit Decade Counter | 1.65 |
| 4519 | 4 Bit AND/OR Selector | .90 |
| 4520 | Dual 4 Bit Binary Counter | 1.65 |
| 4521 | 24 State Frequency Divider | 3.25 |
| 4522 | BCD Divide by N Counter | 1.75 |
| 4527 | BCD Rate Multiplier | 3.00 |
| 4528 | Dual Monostable Mltvbr | 1.75 |

# ONNECTORS

EDGE CONNECTORS

| | |
|---|---|
| Dual .156 W W Gold | .50 |
| Dual .156 W W Gold | .75 |
| Dual .156 Solder Gold | 2.25 |
| Dual .125 Solder Gold | 5.00 |
| Dual .125 Solder Gold (No Bolt Down Ears) | 3.50 |
| Molex type w/edge clip female & male (solder) | 10/1.25 |



SUBMINITURE

| | |
|---|---|
| Solder type (25-S) (Female) | 3.90 |
| Solder type (25-P) (Male) | 3.50 |
| Male & female (25-P & 25 S) | 6.50 |
| Cover each | 1.50 |


# JADE CO

*Electronics for the Hobbiest and Experimenter*

5351 WEST 144th STREET
LAWNDALE, CALIFORNIA 90260
(213) 679-3313


J6

# SOCKETS

I C SOCKETS

| Pins | Description | Price |
|---|---|---|
| 8 | Lo Pro Tin | .20 |
| 10 | Transistor (C-10) Gold | .25 |
| 14 | Lo Pro Tin | .25 |
| 14 | Wire Wrap Gold | .30 |
| 16 | Lo Pro Tin | .25 |
| 16 | Standard P C Tin | .30 |
| 16 | Wire Wrap Tin | .30 |
| 18 | Lo Pro Tin | .25 |
| 22 | Lo Pro Open Frame Tin | .50 |
| 22 | Wire Wrap Tin | .95 |
| 24 | Standard P C Tin | .50 |
| 24 | Wire Wrap Tin | .85 |
| 28 | Lo Pro (Open Frame) Tin | .40 |
| 28 | Standard P C Tin | .60 |
| 28 | Wire Wrap Tin | .95 |
| 40 | Lo Pro (Open Frame) Tin | .50 |
| 40 | Wire Wrap Tin | 1.45 |

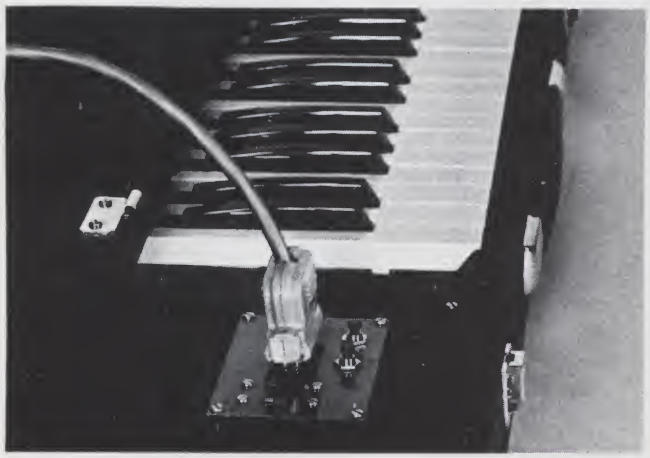
# COMPUTER MUSIC WITH OR WITHOUT THE COMPUTER !

## EQUALLY TEMPERED DIGITAL TO ANALOG CONVERTER

Unlike more conventional R-2R ladder type digital to analog converters, the PAIA 8780 kit is based on a multiplying principle that allows the module to generate the exact exponential stair-step function required to make even the simplest linear response oscillators and filters produce equally tempered musical intervals. The 8780 uses only six bits of data to generate over 5 octaves of control voltage. In an 8 bit system, the remaining 2 bits are ordinarily reserved for trigger flags, but may be used to extend the range of the converter or provide micro-tonal tunings.

The module is physically and electrically compatible with the complete line of PAIA music synthesizer modules and is easily interfaced to any micro-processor with or without hand-shaking logic.

#8780 D/A CONVERTER Kit..$34.95 (plus $1.00 postage)

## THE PAIA HIGH LEVEL LANGUAGE FOR COMPUTER MUSIC DATA ENTRY (We call it a keyboard)

An n key roll-over scanning matrix encoder tied to a 37 note AGO keyboard provides 6 bits of data and both STROBE and $\overline{\text{STROBE}}$ control outputs. Input control lines to the encoder include $\overline{\text{SCAN}}$ (starts and stops encoder clock), RESET, START and RANDOM making the keyboard universally applicable to all computer/processors from the very largest to the very smallest.

NO COMPUTER? The encoded keyboard can be directly interfaced to the PAIA 8780 Equally Tempered Digital to Analog converter to provide an infinite hold Sample and Hold device. The keyboard contains its own power supply for stand-alone applications.

Housed in a trim and sturdy vinyl covered road case, the kit consists of all parts including keyboard, power supply and detailed assembly instructions; software overview for computer applications and detailed instructions for Digital Sample and Hold.

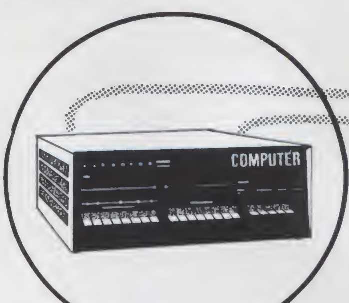
#8782 ENCODED KEYBOARD ... $109.95 .............. 20 lbs.
(shipped freight collect)


## WITH A COMPUTER......

Both the 8780 D/A and the 8782 Encoded Keyboard easily interface to any processor providing capabilities and control never before possible with music synthesizers.

## WITHOUT A COMPUTER......

An infinite hold, DIGITAL Sample and Hold and the heart of an entire system of modules that will be introduced over the next few months including: Memories, Polytonic output modules and others.




**DETAILS ON THESE & MORE IN OUR FREE CATALOG**

PAiA

ELECTRONICS, INC. - DEPT. 6-K - 1020 WEST WILSHIRE BLVD. - OKLAHOMA CITY, OK 73116 P9

# computer display terminal

*This display terminal has an integral controller B/W cathode ray rube and keyboard. The system has a serial I/O interface for communication and I/O interface for a printer.*

**External logic & power pack not shown.**

DISPLAY (P/N 4802-1095-501) FEATURES:
- 17" B/W CRT
- 41 lines of data
- 52 characters per line
- Characters are generated by a diode matrix "graphic" technique
- 21 special push-buttons wired for a program call up
- Brightness Control
- Self-contained power supply

KEYBOARD (P/N 4802-1115-501) FEATURES:
- Reed switch technology
- 54 data keys
- 28 special keys detachable with cable

LOGIC UNIT (P/N 4802-1157-502) FEATURES:
- 1024 by 6 bit core memory
- Printer I/O interface
- Communication I/O interface

POWER: 115V, 50/60 Hz, 500 Watts

WEIGHT: 210 lbs. (including logic unit, keyboard, display and cables.)

FOB LYNN MASS (you pay shipping)
Check with order please.

**$ 180.00**

4 way cursor control, graphics display.

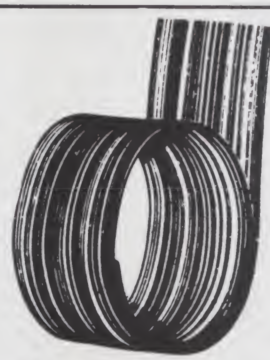
The story: These are unused terminals made for airport ticketing & seat assignment. After several years of storage they require tinkering to make operable. We have some hints printed such as cleaning PC fingers. One of our customers has this tied into his KIM-1, another has his running with his IMSAI. We have data on this. Should be useable on most common computers. A hell of a deal and all for a paltry $180.00. Don't be left out as many were on our past VIATRON deal. Sold "as is" all sales final.

**WITH COMPLETE DOCUMENTATION**

## SPECTRA FLAT TWIST

50 conductor, 28 gauge, 7 strands/conductor made by Spectra. Two conductors are paired & twisted and the flat ribbon made up of 25 pairs to give total of 50 conductor. May be peeled off in pairs if desired. Made twisted to cut down on "cross talk." Ideal for sandwiching PC boards allowing flexibility and working on both sides of the boards. Cost originally $13.00/ft

SP-324-A $1.00/ft. 10 ft/$9.00



SP-234-A $1.00 ft 50 cond. 10 ft/$9.00
SP-234-B .90 ft 32 cond. 10 ft/$8.00

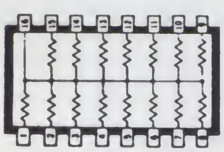
## WIRE WRAP WIRE

TEFZEL blue #30 Reg. price $13.28/100 ft. Our price 100 ft $2.00; 500 ft $7.50.

## MULTI COLORED SPECTRA WIRE

| Footage | | 10' | 50' | 100' |
|---|---|---|---|---|
| 8 Cond. | #24 | $2.50 | 9.00 | 15.00 |
| 12 " | 22 | 3.00 | 11.00 | 18.00 |
| 14 " | 22 | 3.50 | 13.00 | 21.00 |
| 29 " | 22 | 7.50 | 28.00 | 45.00 |

Great savings as these are about 1/4 book prices. All fresh & new.



Precision 16 pin DIP network as shown. Each resistor 1K. For pull-up/pull-down interface networks. Value over $1.00 each; New, CTS or Beckman

SP-320 pack of 6 $1.00

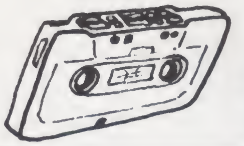
**TINY SWITCH TELEDYNE**

In tall TO-5 can
DPDT, 24 volts. Brand new.
cost $16.00 each
SP-134 $3.00 each 2/$5.00

Meshna

*Please add shipping cost on above.* Minimum order $10
*FREE CATALOG SP-9 NOW READY*
P.O. Box 62K, E. Lynn, Massachusetts 01904

M-2



## COMPUTER GRADE CASSETTES

These cassettes were custom made for one of the leading manufacturers of computers and calculators, and are excess to his present needs.(Their name is moulded on each cassette), They run about 5 minutes per side, which is ideal for most programming.

STOCK NO.5504K .75 ea. 3/2.00 10/6.00 100/55.00

## VIDEOCUBE TV INTERFACE

The VIDEOCUBE is a fully self contained RF oscillator, modulator, and selection switch, which allows easy interface with any video device to the RF input of a standard T.V. receiver.

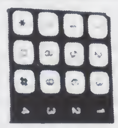
The drive to the VIDEOCUBE can be any type of standard digital logic (CMOS TTL' Etc.) or any linear device. The VIDEOCUBE meets FCC requirements for this type of device. Thus it is possible to use your TV set as a video monitor for your computer output, or camera output. The VIDEOCUBE is available in complete and kit form. All required data for use and assembly are provided. Also finds use in TV games.

STOCK NO.5499K TESTED VIDEOCUBE 13.95 2/26.00
STOCK NO.5500K VIDEOCUBE kit. 9.95 2/18.00

## TONE GENERATOR CHIPS

MICROELECTRONIC TONE GENERATORS, are hybrid chips which generate 4 high frequency tones, and 4 low frequency tones, which are the frequencies used in telephone systems to generate the tone on the touch tone keyboard.( 1 high and 1 low frequency for each tone). Operates from 4.5 to 35 volts. We provide 4 pages of data and applications. Usefull for touch tone applications in phone systems, repeater control, computer input etc. We provide MOLEX socket with this chip. Distributor price is in excess of $12.00

STOCK NO.1010K $6.95 ea. 2/13.00



## 16 KEY TOUCH TONE PAD

TOUCHTONE pad made for RAYTHEON. 16 SPST switches, with one common terminal.Terminals fit MOLEX strip. 3" square. Individually packed. with data. Computer, telephone and repeater use.

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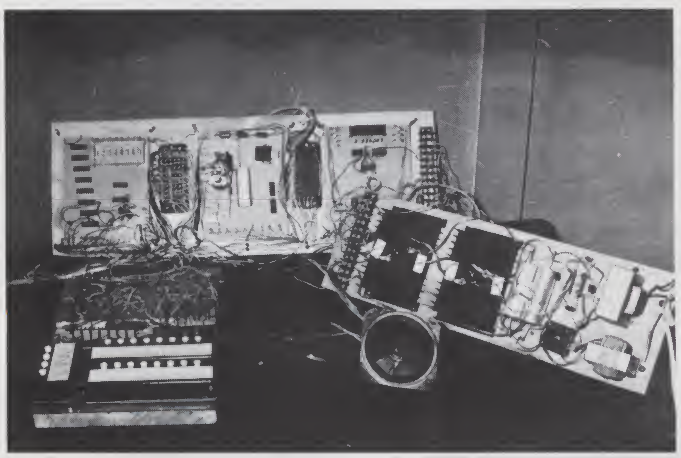
# Introducing! The World's Cheapest Computer

## . . . a $60 SC/MP

*Photos by Bob Fitch*



*The complete $60 computer. In the background is the mainframe with memory board and display LEDs on the left, a terminal strip, CPU board with SCAMP chip next to a circuit added for music production in the center, another terminal strip, and on the right an extra perf board with a seven-segment calculator readout assembly which we never hooked up. On the right side of the picture is the power supply, including two voltage regulators mounted on heat sinks (which probably are not needed) and the output peripheral device for music production. In the left foreground is the keyboard — control circuit (version two) with 20 pushbuttons and mass of surplus relays. Your version doesn't have to look this messy.*

*Although Rich and his family built their SC/MP for the purpose of getting familar with computer hardware and programming, I think it would be a good idea to also look at what they've done with an eye toward an inexpensive microprocessor controller. (And to get any lower than $60 is going to take some doing!) — John.*

There are many different levels of cost at which you can enter the computing hobby. If you have lots of money and enjoy spending it, you can buy an Altair, Imsai or et cetera system and interface it with, say, the Intecolor terminal, floppy disks and so on, run in a BASIC compiler and then have a lot of fun with it. If your wallet is a little bit tighter, you can buy a one-board system such as an MOS Technology 6502 processor and have just as much fun with that. If even that is not within your budget (or you're like me, trying to do everything absolutely as inexpensively as possible) then there is still an alternative for you — a complete computing system that you can build for very close to $60.00.

This article describes the computer which my father and I have built at a cost of less than sixty dollars. It is based on National Semiconductor's SC/MP microprocessor chip, which I chose for its low cost and ease of interfacing. You should realize that you only get what you pay for; the SC/MP is at least ten times slower than an

8080 and is less efficient in terms of memory space by virtue of its smaller instruction set. I have kept in mind that my SC/MP will still be useful if and when I *move up* to a better computer system; the SCAMP would make a dandy I/O controller, interrupt handler, keyboard decoder or whatever. Right now, though, it has proven to be an excellent low-cost method to get into the home computing hobby.

**Objectives**

Our objectives were to put together a small, but *complete* computer system which could run small programs and interface to simple input/output devices, all without spending nonessential dollars. We are using a set of pushbuttons to enter programs and data into the memory, with eight discrete LEDs for verification of input and data output. This summer I had a BAUDOT Teletype interfaced with the system; it now plays tunes through a three-inch speaker. I think that we have met our objectives and have had a lot of fun in the process.

**Construction**

Before we get deep into schematics and waveforms, let me present a price list for you so you can see what you will need and what it costs; see Table 1. This includes everything that we could see except the wire to hook it together and the scraps of pine board to mount it on.

Some general construction notes: We wired everything on three perf boards, using perf board pins for all board-edge terminations. We used a socket for the SCAMP; all other ICs were soldered right in. The version we put together uses a double handful of reed-type relays instead of the DM7400s for the keyboard control circuit; I have provided the solid-state "version three," using more standard parts, for this article.

We decided that it would be impractical to describe the workings of every little circuit; if you are seriously interested in building one of these, you should acquire an *SC/MP Technical Description* from National (publication number 4200079A; National Semiconductor Corporation, 2900 Semiconductor Drive, Santa Clara, California 95051). This explains how the chip operates as well as the program instruction set. They also have other worthwhile literature.

You can probably do better with a different memory chip; 2102-1s are 300% larger and only 25% more expensive from PolyPaks. Your memory interface circuit is likely to be somewhat different in this case. If you're not a whiz at reading memory data sheets get a friend to help.

You might want to throw in some extra despiking capacitors on each power supply connection on each board. My original version, running with the Teletype this summer, did not have these. When I left for school in September, my father rewired the system a little bit and added the capacitors.

OK, now let's discuss the schematics and go over brief descriptions of each of the circuit boards as we built them.

The CPU Board (see Fig. 1) contains the SC/MP chip and two ICs (one 7400 and one 7404) to control it and interface it to the memory. Table 2 contains a description of each of the most important pins on the SC/MP. It wouldn't be a bad idea to provide a perfboard pin for each pin of the SCAMP chip in case you want to do some experimenting with the inputs and outputs not used here. Again, we used a 40-pin socket for the SCAMP chip itself.

The Memory Board (see Fig. 2) is somewhat more

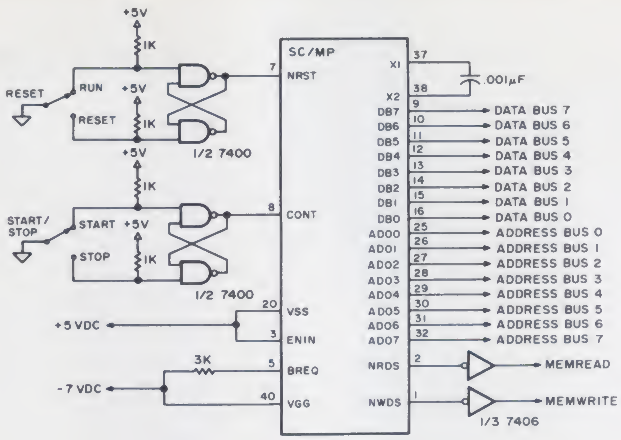



*Fig. 1. CPU Board. Pins which are not shown are unused but they may be brought out to perf board pins for experimentation.*

| Quantity | Item | Source | Unit Price | |
|---|---|---|---|---|
| 1 | SC/MP chip | Order #ISP-8A-500D from a National dealer | $17.76 | |
| | | + shipping | 2.00 | $19.76 |
| 8 | MM1101 memory | PolyPaks | 95¢ | 7.60 |
| 9 | DM7400 | PolyPaks | 14¢ | 1.26 |
| 6 | DM7403 | PolyPaks | 14¢ | .84 |
| 2 | DM7406 | PolyPaks | 20¢ | .40 |
| 8 | MV-50 LEDs | PolyPaks | 8¢ | .64 |
| 1 | 7805 3-terminal regulator | Radio Shack | $1.59 | 1.59 |
| 1 | 7812 regulator | Radio Shack | $1.59 | 1.59 |
| 2 | bridge rectifier | Radio Shack | $1.39 | 2.78 |
| 10 | 1N914 diodes | Radio Shack | 10/$1.00 | 1.00 |
| 1 | 6.3 V 1.2 A transformer | Radio Shack | | 1.99 |
| 1 | 12.6 V 1.2 A transformer | Radio Shack | | 2.69 |
| 17 | assrt'd resistors | | | 1.66 |
| 2 | 1000 uF 35 V cap. | Radio Shack | $1.19 | 2.38 |
| 2 | .022 uF disc cap. | Radio Shack | 2/49¢ | .49 |
| 1 | .001 uF disc cap. | Radio Shack | 2/25¢ | .25 |
| 20 | SPST pushbuttons | Radio Shack | 5/$1.89 | 7.56 |
| 3 | SPDT switches | Radio Shack | $1.19 | 3.57 |
| 1 | 40-pin socket | Radio Shack | | 1.69 |
| 3 | perfboards | Radio Shack | $1.29 | 3.87 |
| 100 | perfboard pins | Radio Shack | | 1.89 |
| | | | Total Price | $65.50 |

*Table 1. Parts list with prices.*

complex. Since I purchased the memory over the summer, I bought MM1101s which were fairly cheap at the time. You can do better presently using larger 1K static chips. The circuit should be basically the same, but watch out for slightly different control methods, such as on the Read/Write pin. Also check Output Sink Current: for the 1101 it is 8 mA, which is just enough to drive the LEDs. For another memory you may need to buffer the LEDs with an extra pair of 7400s. (Doing this has another advantage: in my circuit, a 0 is an ON LED, and a 1 is an OFF LED. A set of inverting buffers would correct this, but remember — extra dollars.) If the memory you use is larger, you will also have to wire a few more address lines and control buttons.

The purpose of the DM7403s in this circuit is to disable data from the memory output leads during WRITE cycles. When the SC/MP wants to read data from memory, it sends a low out on its NRDS pin which is inverted to a high and enables the 7403 gates. This allows read data to transfer from the memory to the SCAMP. At other times (when the SCAMP is writing data to memory) the NRDS line is high and the 7403s are turned off.

The SC/MP requires +5 and -7 volts; the 1101s require +5 and -9 volts. I skimped a little and used -7 for both; the circuit is shown in Fig. 3. The easiest way to get the necessary voltages was to build what amounted to two separate supplies, one for 5V dc and the other for 12V dc. The positive leads of the two supplies are wired together; the negative side of the 5V supply is ground and the negative side of the 12V supply is -7V. Both supplies take advantage of the 3-terminal regulators that are available (and have done a lot toward making power supply design easier).

The Keyboard and Control Circuit was originally constructed using 16 SPDT center-off switches for entering data and addresses into my machine. Those switches were expensive and tiresome though, so my Dad replaced the circuit with a configuration of surplus reed relays. Fig. 4 is the solid state answer to the "problem." (The price list in Table 1 is based on using Fig. 4.) R/S flip-flops are used to hold data *ones* set by the pushbuttons; the *release* button resets them all back to zero.

The purpose of the DM7403s in Fig. 4 is about the same as on the memory board. They allow the keyboard to send out data when the keyboard is turned *on*, and they lock out the data from the keyboard when it is turned *off* so the computer can send data back and forth without *interference* from the keyboard.

### Operation

Operating the SC/MP system is about as simple as the circuit itself. The sequence for keying in a program and running it looks like this:

1. Turn the "start/stop" switch to "stop" and the "reset" switch to "reset."
2. Flip the "keyboard" switch to "on."
3. Push the "release" button.
4. Key in your first address and the data or program instruction you wish to put there, pushing a button wherever you want a "one."

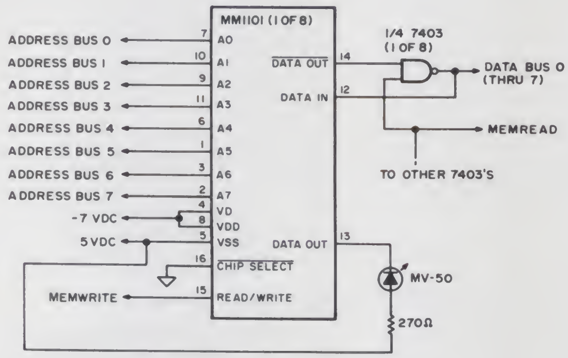



*Fig. 2. Memory Board. One eighth of the circuit is shown for simplicity. The pins drawn on the lefthand side of the 1101 are wired identically for each chip. The ones on the right must be wired separately for Data Bus 0 through Data Bus 7.*

| Pin No. | Name | Function |
|---|---|---|
| 20 | Vss | +5V |
| 40 | Vgg | -7V |
| 2 | NRDS | The SC/MP sends out a zero on NRDS when it wants to read data from memory. |
| 1 | NWDS | The SC/MP sends out a zero on NWDS when it wants to write data into memory. |
| 9-16 | DB0-DB7 | The data bus. When NRDS is low, these lines handle read data and act as inputs. When NWDS is low, they send data and act as outputs. At most other times, they are in a high-impedance "off" state. |
| 25-36 | AD00-AD11 | The address bus. The address tells the memory where to send data from or where to store data. When not in use these too are in a high-impedance "off" state. |
| 8 | CONT | When this input is high, the computer runs normally. When it is low, it stops and "holds everything." |
| 7 | NRST | When this input is high the computer runs normally. When it is low, the computer stops and resets all its internal registers to zero. |
| 37,38 | X1,X2 | These are provided to hook a frequency-determining element (a crystal or a capacitor) to. |
| 3 | ENIN | |
| 5 | BREQ | ENIN and BREQ are used for running two or more SC/MPs together. When using only one SC/MP, they should be hooked up as shown in Fig. 1. See the SC/MP Technical Description for details. |

*Table 2. Descriptions of the pins of the SC/MP chip used in the system described in this article. For more details and other pins, see SC/MP Technical Description.*

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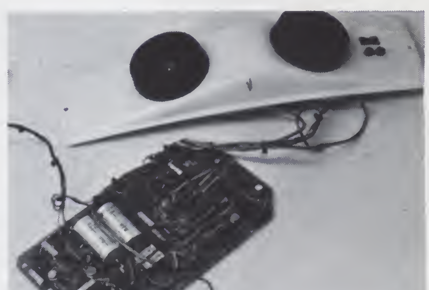

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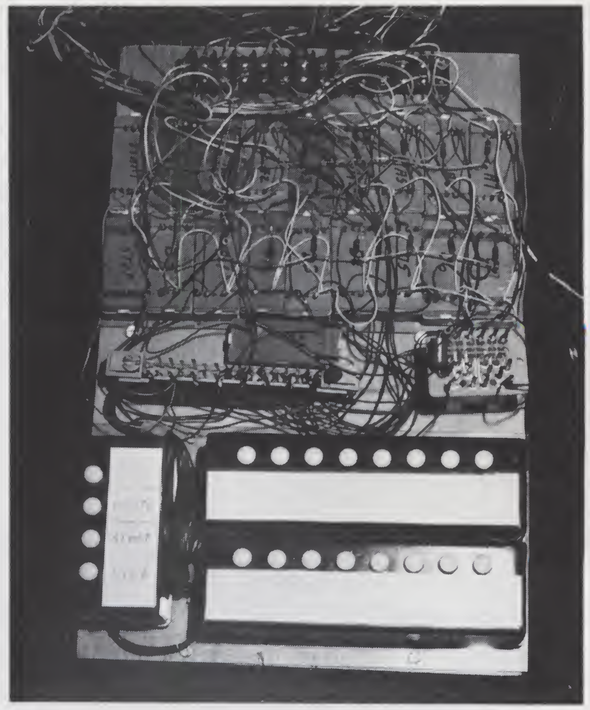
R-7

*The author does a little programming, entering data in binary form. The author does this as little as possible (Please don't unplug my computer!).*



*Detail of keyboard — control circuit, version two. Buttons on left are labeled "Release," "Write," "Start," and "Stop." Buttons on right are labeled "Address 0-7" and "Data 0-7." See text for details.*

5. Push the "write" button.
6. Repeat steps 3, 4, and 5, moving on to the next address each time until you are finished.
7. Flip the keyboard switch to "off."
8. Flip the "reset" switch to "run."
9. Flip the "start/stop" switch to "start."

And that's it. If you wish to stop in the middle of a program and check something, just flip the "start/stop" switch to "stop." If you want to go back to address one, clear all registers and start over, flip the "reset" switch to "reset" and back to "run."

By the way, we leave the computer turned on when we have a program in it. It's been on for a few weeks now. The power plug is the on/off switch.

**Programming**

The degree of difficulty you will have programming the SC/MP depends on your level of experience. (I had no experience; therefore I had no difficulty!) In any case, don't be afraid to try it. For details on the instruction set see National's literature. Here are a few hints:

1. If you add or subtract anything, *watch out for the carry link*! If you forget about it, you will find (or possibly you won't — I almost didn't, and it nearly drove me crazy) extra "ones" being added to your result that were left over from previous additions. Use the CCL (clear carry link) instruction.
2. If you use more than 4K of memory you will have to get fancy with your addressing (not to mention your hardware.) National's literature explains it.
3. Figuring out address displacements is not too hard after you do it a few times. the SC/MP figures out an address according to the formula:

Address=Contents of Pointer +Address Displacement

Therefore, you can figure out your displacement by the formula:

Displacement=Address-Pointer

In the case of a Jump-type instruction, the SC/MP will compute the address and execute the next instruction *after* that. To compensate for this, subtract an extra 1 from your displacement.

Remember too that the displacement can be negative: the SC/MP works in *two's complement* binary notation. This means, to find the negative of a number, complement it (switch ones and zeroes) and add an extra one (see Example 1).

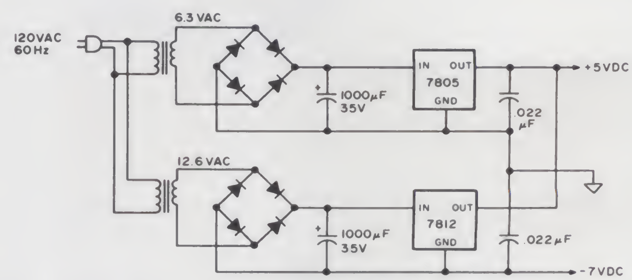



*Fig. 3. Power Supply. Provides +5V dc and -7V dc. See Fig. 4 for simplified block diagram.*

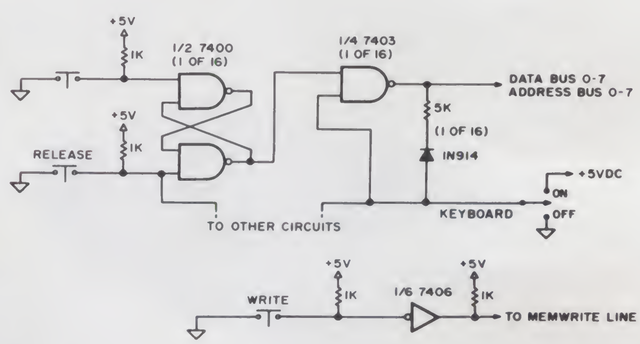



*Fig. 4. Keyboard Control Circuit, version 3. This diagram shows one of sixteen identical circuits. This version was used in the price list.*

Example: 47 = $00101111_{two}$
the complement is $11010000_{two}$
adding one, the two's complement is $11010001_{two}$
-47 = $11010001_{two}$

*Example 1.*

A number is negative if it has a 1 in the first bit position.

If the displacement equals -128 ($10000000_{two}$) the contents of the extension register will be substituted for the displacement.

4. Figuring out delay cycles can be difficult. I will explain my method for figuring out a delay cycle, step by step.

a. Figure out your machine cycle time. If you know the clock frequency, you can use the formula shown in Example 2.

b. Take your desired delay time and divide it by the machine cycle time to find out the number of machine cycles you want to delay.

c. Subtract 13 from this figure.

d. Divide that figure by 514, with remainder. The quotient is the figure that must be in the displacement (the byte following the Delay instruction).

e. Divide the remainder by two and round off. This value must be in the accumulator when the Delay instruction is processed.

Note that the two values above must be translated into straight (positive) binary instead of two's complement.

5. The SC/MP has the ability to execute a Halt instruction. It doesn't do that automatically though; an external circuit is required. This is omitted here (extra dollars) but you can add it from information given in the National literature. Or you can just program the computer to run around in an endless loop instead of stopping; add a Delay and the lights will blink.

$$\text{machine cycle time} = \frac{2}{\text{clock frequency}}$$

Example: if clock frequency is 400,000 Hz

$$\text{machine cycle time} = \frac{2}{0.4\ \text{MHz}} = 5\ \text{usec.}$$

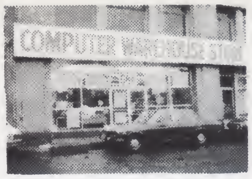
*Example 2.*

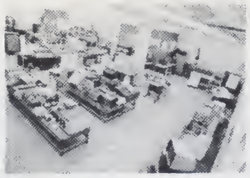
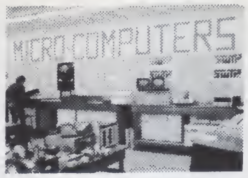
Well, that about wraps it up. I will do my best to answer any reasonable inquiry accompanied by an SASE. Please allow for some delay as your letter may have to be forwarded to my address at college. First, get your hands on one of those SC/MP Technical Descriptions; that contains a lot of information, including circuit and programming examples.

The only other thing I can tell you about is some of the things we have done with our system and some application ideas. Over the summer we were using a Baudot five-level Teletype machine. I didn't use a UART or anything to interface it; I just programmed the SCAMP with two subroutines that performed the same function. The machine is now programmed to play music through a little speaker; if you walk around shuffling your feet enough to build up static and then walk over and touch the keyboard you get to hear Jingle Bells.

My father is building another SCAMP computer which I think he plans to use to remote control his ham shack. (We already have another SC/MP chip.) I would like to develop a better system (perhaps based on a Z-80) and using a few SCAMPs for various purposes. Incidentally, I read somewhere that National is coming out with the SC/MP II — twice as fast, one fourth the power, single five-volt supply, and *cheaper*!

Well, there it is. I have told you how we built our computer, what it cost, some programming hints, and what we have done with it. Now you know what you can do with an SC/MP. So if you're interested in *cheap* computing, Good Luck! ■

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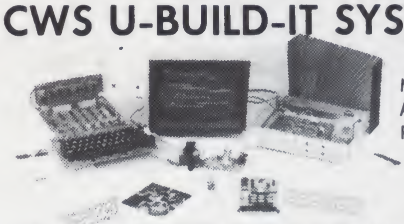

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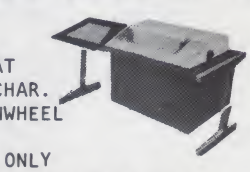

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# My Friend is

**"He remains unaware as he gropes in desperate haste for needed diskettes, or paper tapes, or cassettes, . . . "**

*Sheila Clarke*
*Cybergrafix*
*PO Box 430*
*Glendale CA 91206*

*Gather around, girls, and see if there aren't portions of Sheila's tale that you can relate to. I say "portions" because it's doubtful that your man could be anywhere near as hooked (or hopeless?) as the one in this article. — John.*

I remember him as a really nice guy. Lots of fun to be with. We spent hours talking late into the night, or sunny days sailing off the California coast, or weekends partying with friends. Our friendship was warm and close.

One Saturday afternoon we were sitting on the sofa just chatting quietly like friends will, about how to spend a vacation, or the next hundred bucks extra. Then he startled me with his current pipe dream . . . this was the first I'd heard it. I guess, thinking back now, it was only natural to want such a thing. After all, he was a computer programmer and really into it. Among his interests were stock investment predictions that he'd like to write programs for. As I said, it was probably natural, though it took me by surprise when he told me wistfully that what he really wanted was a computer of his very own. The little I knew about computers conjured up an image of the living room space consumed with metal boxes standing 6 feet high, banked along the wall, spouting flashes of blinking lights. So I said, "You gotta be kidding." "No," he said thoughtfully, "that's what I really want."

# a Computer Junkie

Thinking he possessed the impossible dream, I promptly dismissed the notion. So I don't quite know when it all started happening. I think he'd met someone who shared his pipe dream and invited him to a meeting of a small group called the Southern California Computer Society. He returned from that meeting wired for computers. But I still didn't give it much credence. Shortly after that, he ran across a magazine that advertised "a computer kit" and sent off a check for the beginning of *his* dream's realization and for what would become *my* nightmare.

The computer needed a room to grow in. We moved.

As the year rolled along, computer stuff started to arrive by United Parcel. With the arrival of each new package I felt vague fadings of someone I'd known and loved. He disappeared into his computer cave for days, coming out only for food and water. On occasion, I'd pop my head into the sanctuary to discover him, buried in stacks of circuit boards, rolls of solder wire, and flying ICs, grumbling and cursing.

I became lonely and terrified of what might be happening in there. And I said so. But my friend didn't hear me. So I consoled myself, hoping that the madness would soon end, at least for a time, until the next parcel arrived.

But my friend had troubles of his own and solicited outside help. The incredible response to his pleas for aid astonished me. I couldn't believe there were more like him. I found myself jostled about in a traffic jam — in my own home. They came and went at all hours of the day or night. The telephone rang continually. In desperation for contact with the real world, I ordered another phone for my own use.

Cowering into the corner of my sofa, I turned up the volume of the television set. And gnashed my teeth.

Packages continued to come. He went down into the cave. Strangers arrived, then left. Sometimes he stuck his head out to holler, "It works!" or something like that. I think he was talking to me. At that point I'd have listened to him say *anything*.

Little did I know that once all this madness ended and the computer was working, it would truly be the beginning of a different sort of life for him. I no longer recognized him. It's really sad, though he thinks he's pretty happy. Dream fulfilled, and all that, you know. When he gets home from work, all strung out, he goes straight to the computer cave for a fix. I can tell he's hooked — after he gets down there I see the room lights go on, hear a rat-a-tat-tat of switches, and that now familiar "ahhhhh" of relief emanating from the room.

So? you say . . . he seems to be happy, and no one has been hurt. Hah! You oughta see what he goes through to support his habit. Why, he'll do programming for absolutely anybody, just to earn extra money for new computer goodies. He programs and flicks switches *any* time of the day or night. He hasn't opened his mail in so long that his mother called the other day to find out if he's still living. People are really worried about him. They can't help noticing his glazed look. His usual response to their attempts at conversation is an effort at recruiting their interest in computers. So conversations fade. He hasn't noticed that they've walked away, their heads shaking.

He isn't aware of the number of bill collectors who've called. He doesn't even know who they are, because he forgets to open his mail. It just sits there in big stacks on his desk. There's no more room, so the stuff is starting to collect around his desk on the floor. He remains unaware as he gropes in desperate haste for needed diskettes, or paper tapes, or cassettes, through those nasty stacks of paper.

I'd thought of moving to an environment more suitable, but alas, staying here is like living aone. So why bother. It's just that he now talks to me in hexadecimal . . . I think he's talking to me . . . and I am grateful for the company. Occasionally I stick my head in the entrance of the computer cave. You know, just to see if he's still with us, so to speak. What I find is a rambling stream of conversation already in progress — with the computer. He doesn't even know I've been there.

It isn't only that our relationship has faded to merely existing in the same house. His face has become drawn and pasty. His eyes look like ones and zeros, and his hands have gone completely digital. One would naturally want to help a friend who's become hooked on a habit to the point that his erstwhile energetic way of life has gone on without him. I've been searching my conscience lately, wondering if sometime back I could have averted this disaster. No, I've concluded, there was no way for me to know. I've never known a computer junkie before, so didn't recognize the danger signs.

Continuing to explore my conscience, I hope to help him, even now. There are all those debtors, the IRS, the neglected friends and relatives. Should I make excuses for him socially? Should I open his mail and take care of its demands? Should I threaten to leave him? Would it matter?

I can hear him now. Screams coming from the cave. Sounds something like, "I hate octal . . . why would anyone program in octal?"

If any of you who read this recognize symptoms similar in your own friends, please be warned early. There is danger. Contact me so we can talk about it. Maybe we victims of computer junkies could get together and find solutions . . . to help ourselves. Surely my friend, the computer junkie, is beyond help. He seems so happy. ■

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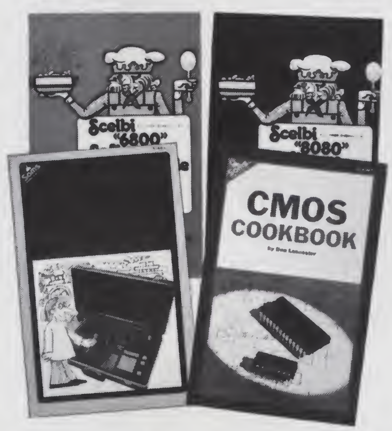


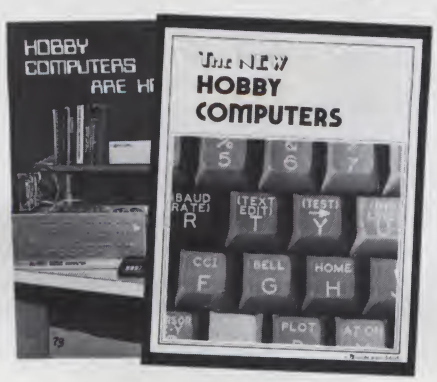


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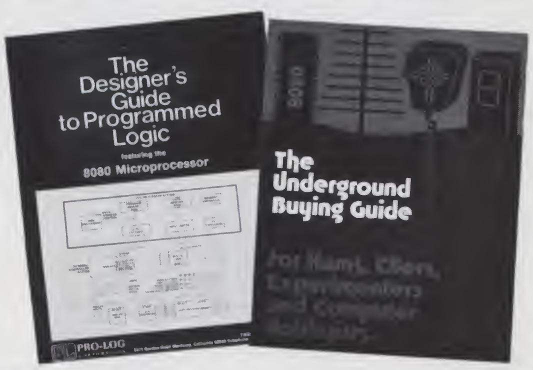


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*" Time to go home. I've just computed that the Cowboys will win by 6 points."*



# CORRECTIONS

There are three errors in my article, "Welcome to Assembly Language Programming," (January). One is a simple typo. The seventh instruction in Program G should be SBB H. The other two errors are the same. DCX H does not set any flags! If the fifth instruction in Program F is changed to JMP LOOP that program will run as advertised. In Program G the 12th instruction should be changed to DCR E but now the program can clear no more than #129 bytes.

Mike Aronson
Oregon City OR

In "Beware the Wumpus" (February) the following corrections to the program listing: Line 20 should be ---- IFLEFT$(I$,1)="Y" ----; Line 2050 should end ---- 2100,2100 ---- deleting the 00 that follows; Line 2440 should delete the T at the end of the line; Line 4280 should be ---- ORL=L(6) ----.

Please note also that another Wumpus (Greg Yob's) was originally published in the *PCC Newspaper* (Vol. 2, #2, Nov 73 and Vol. 3, #3, Jan 74). Our apology for omitting this credit.

In "A Useful Loan Payment Program" (February, page 68), line 16 of the program listing in Fig. 1 should be 200 C=(1+R)↑M.

In "A 6800 Single Stepper" (February, page 132), the IC1 in Fig. 1 is a 7400 Quad NAND gate and the resistor is a 1k Ohm ¼ Watt resistor.

# We Just Can't CRAM it ALL in Kilobaud!


Yes, there are computer articles in *73* . . . a lot of them. There are also a lot of articles that computer hobbyists will be needing to read which are not exactly computer articles such as on regulated power supplies . . . on making printed circuit boards . . . on how various circuits work . . . things like that which hardware men in particular need to read . . . and which software people need even more, since they are a bit behind on hardware.

*73* is written for the average ham . . . and that means that the level is not PhD by any means. The level of articles in *73* is quite parallel to the level of computer articles in *Kilobaud* . . . and that means that you will be able to understand them and profit from them.

There are computer application articles . . . oriented towards hams, of course. Hams also need to understand the basics of computers, so these are also being covered.

During the last year or so there have been over 300 pages of computer articles and nearly as many which are of interest to the average computerist.

Take the March 1977 issue of *73* just as an example. The big feature was a high quality video display with complete cursor control and video control. This was by Don Alexander, the winner of the WACC exhibition last year. This generates upper and lower case, and even Greek letters! 6800 users will be excited about the operating system described in this issue . . . complete with the hex listing . . . which is used right along with Mikbug and greatly increases the flexibility of the system.

There's an article on using ICs . . . one on a fantastic low voltage power supply with overcurrent protection . . . a capacitor comparator . . . the 79MG and 78MG new breed of voltage regulators . . . a PROM message generator for RTTY . . . how counter ICs works . . . a speedy audio counter . . . making your own PC boards . . . things like that.

In other recent issues there have been articles on computerized satellite tracking (with software), RTTY using a uP, using old (inexpensive) Teletypes, building a Polymorphice video board, making instant PC boards using the new color-key technique, the TTL one-shot, what computers can and can't do, a hamshack file handler (software), the bit explosion — 8-12-16?, backward branch the easy way with the 6800, the hexadecimal . . . etc.

Any one of these articles could easily be worth the cost of a full year of *73*. One good program could save you days of work. One good interface project could make an enormous difference. In general, *73* tries to present not too complicated construction projects . . . things you can make in a day or two.

### HAM MAGAZINES

There are a number of ham magazines and they all have one thing in common . . . hardly anything for the computer hobbyist . . . except for *73*. *73* has been running an I/O section since early 1976 . . . computer articles . . . and they are still coming.

One of the fundamental policies is that no articles will be published in both *73* and *Kilobaud*. This is, in a way, unfair because it keeps some great computer articles away from computerists. But since about 20% of the readership of the two magazines overlaps, it would be unfair to those getting both magazines to duplicate. You really must get both magazines to keep up to date with what is going on. When you subscribe to both you will not be getting duplication.

## BIGGEST–BEST

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*Kilobaud* has been outstanding because it is so filled with articles of interest. You've probably noticed that you don't finish *Kilobaud* very quickly . . . and that it takes a lot longer than most other hobby magazines. You'll find the same thing with *73*. Sure, it is ham oriented . . . but remember that ham radio is about 30 different hobbies . . . and today that includes computers.

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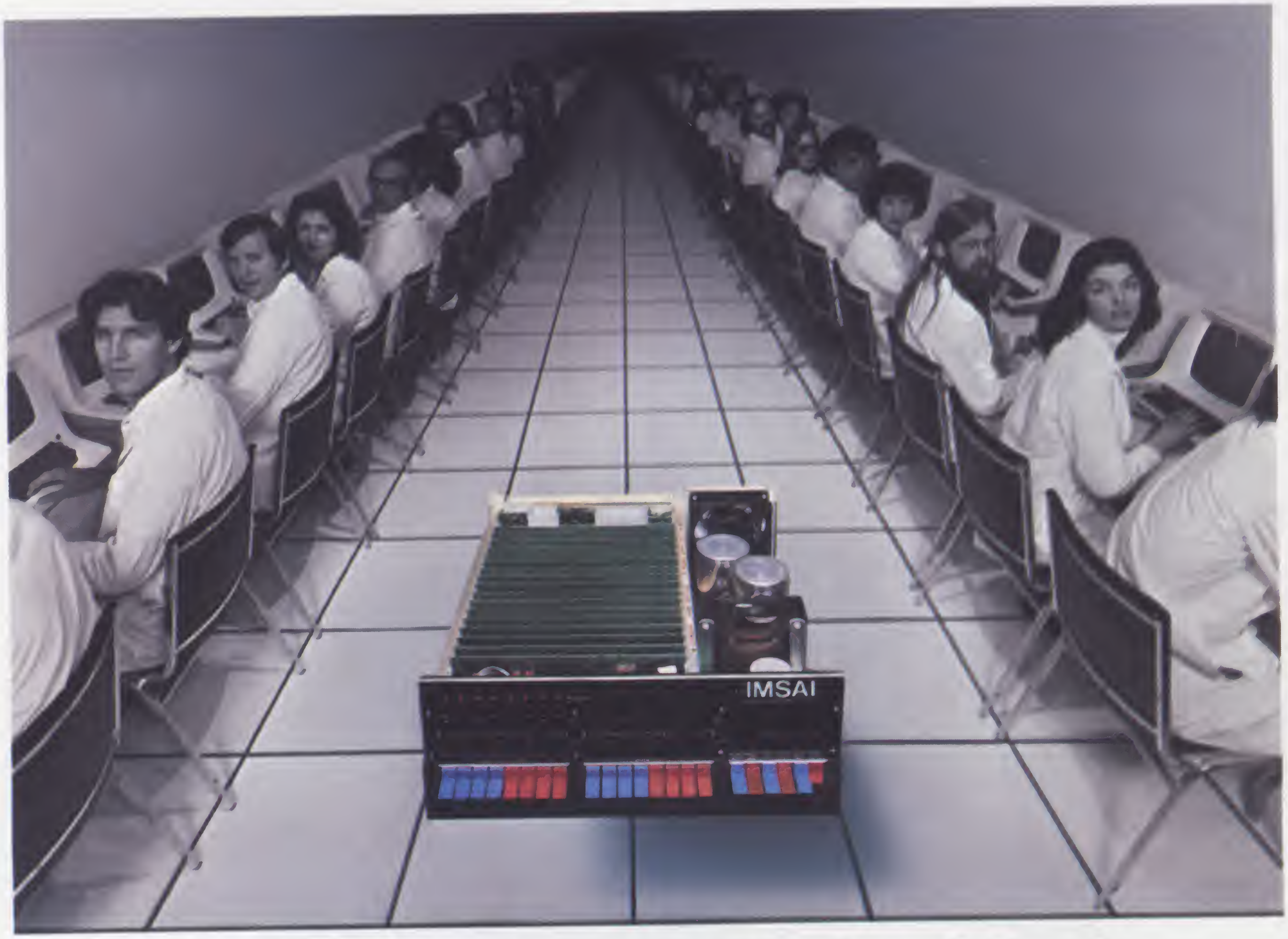


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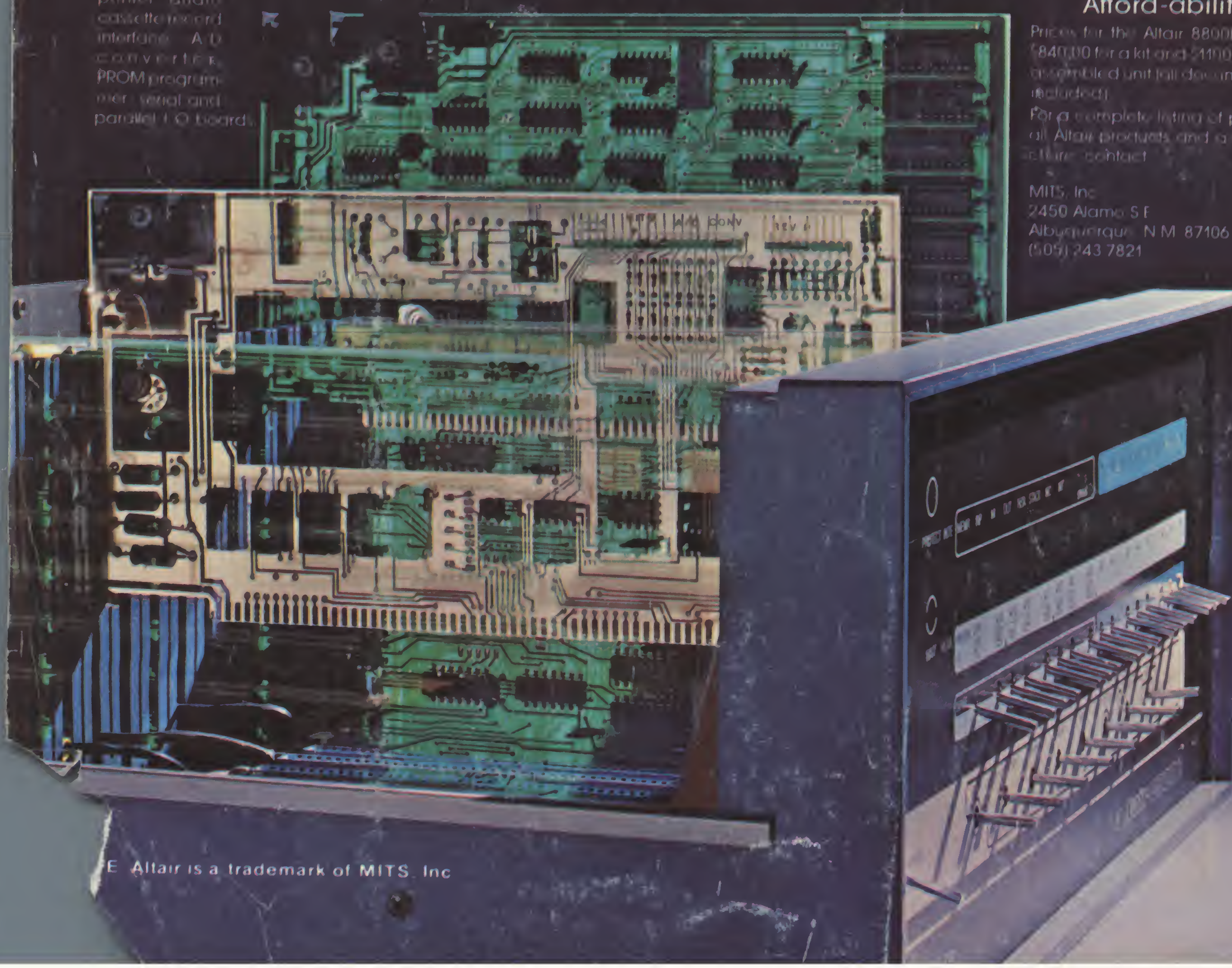

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