March 1983
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80micro

A WAYNE GREEN PUBLICATION

the magazine for TRS-80 users*

Build It Yourself

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From Prying Eyes

Your TRS-80 Meets
The Real World

Plus
How to Become
A Hardware Hacker

And an 80 Bonus
AIDS-III

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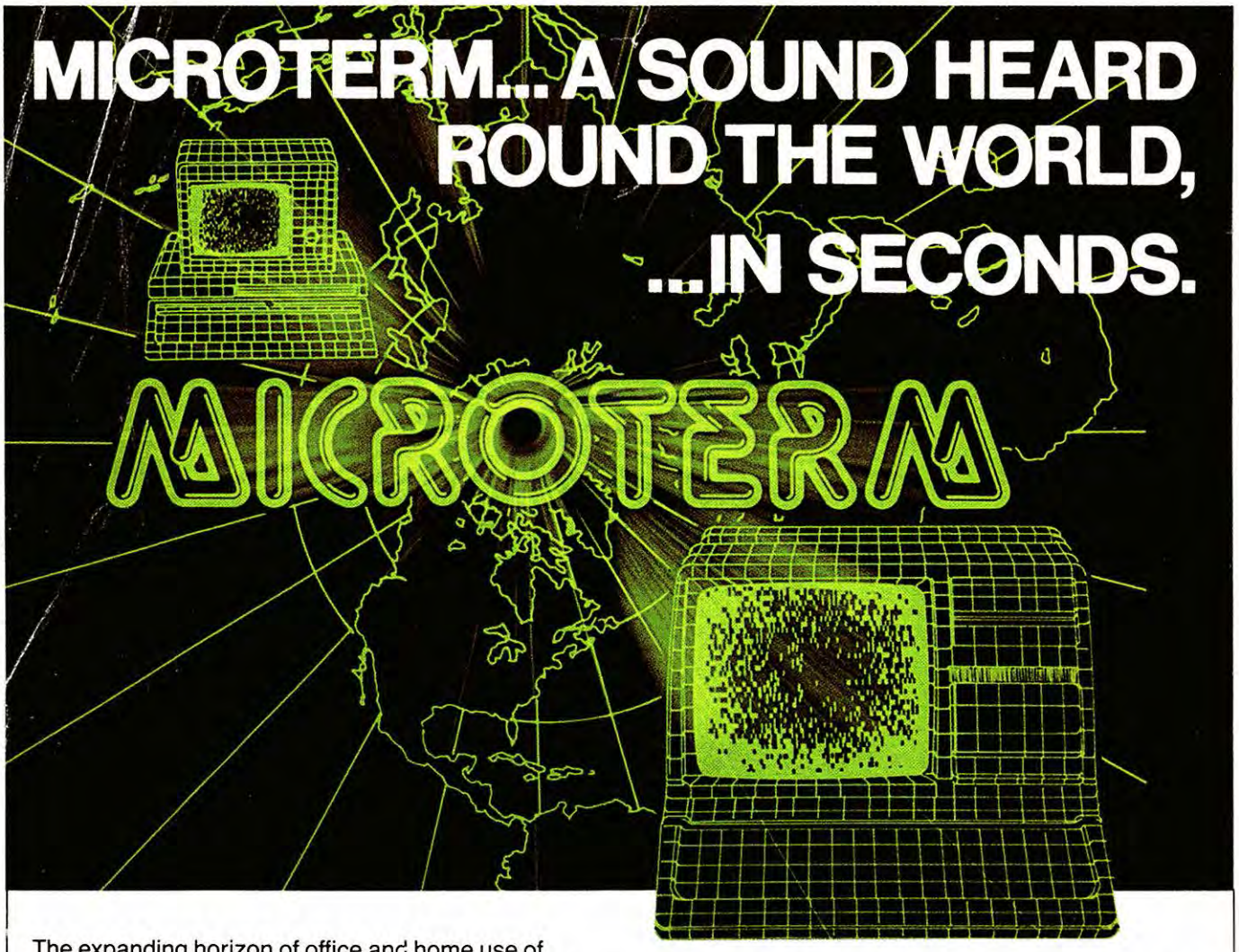
80micro 3/83 #38

MICROTERM... A SOUND HEARD ROUND THE WORLD, ...IN SECONDS.



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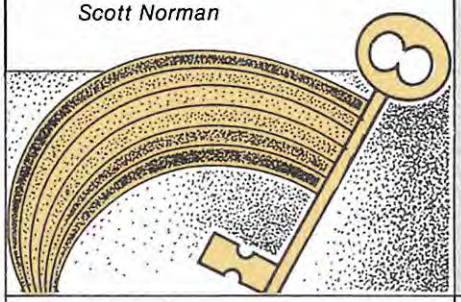

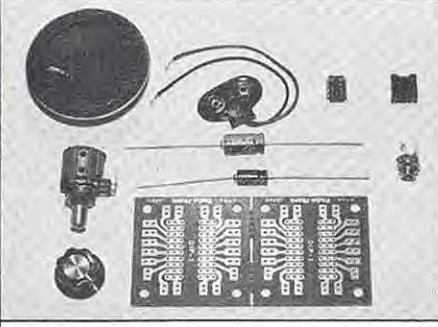

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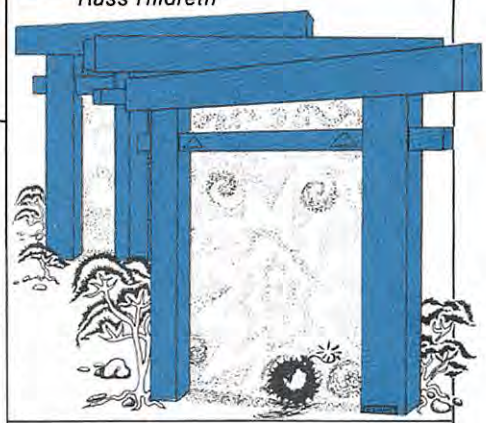

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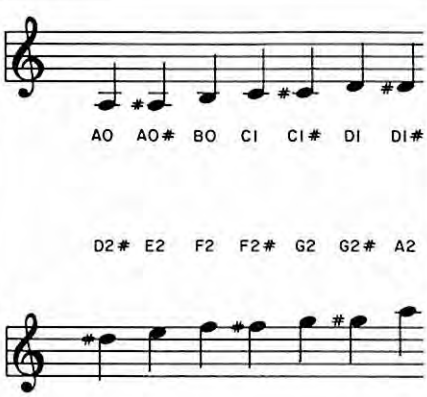

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80 formats its program listings to run 64-characters wide, the way they look on your video screen. This accounts for the occasional wrap-around you will notice in our program listings. Don't let it throw you, particularly when entering assembly listings.

Article submissions from our readers are welcomed and encouraged. Inquiries should be addressed to: Submissions Editor, 80 Pine Street, Peterborough, NH 03458. Include an SASE for a copy of our writers' guidelines. Payment for accepted articles is made at a rate of approximately $50 per printed page; all rights are purchased. Authors of reviews should contact the Review Editor, 80 Pine Street, Peterborough, NH 03458.

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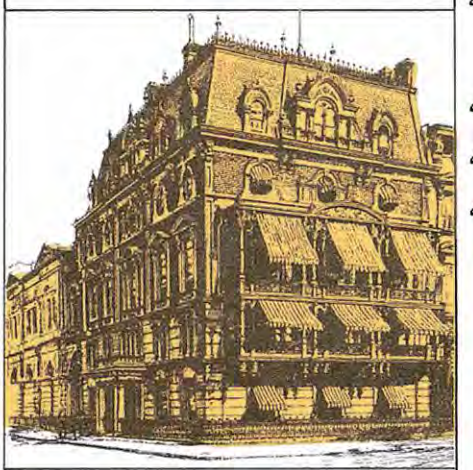

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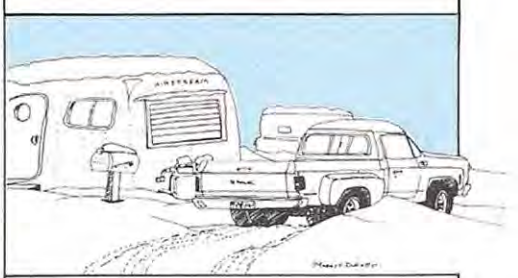

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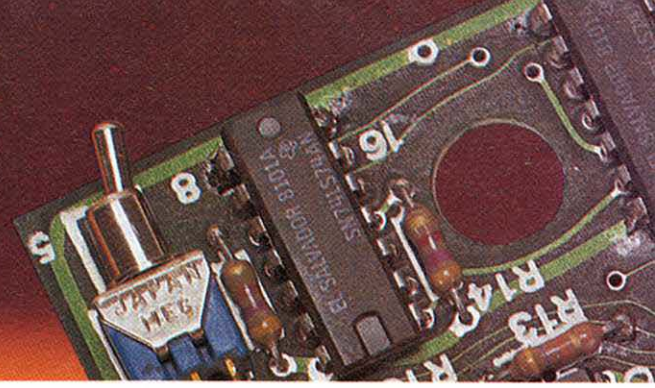

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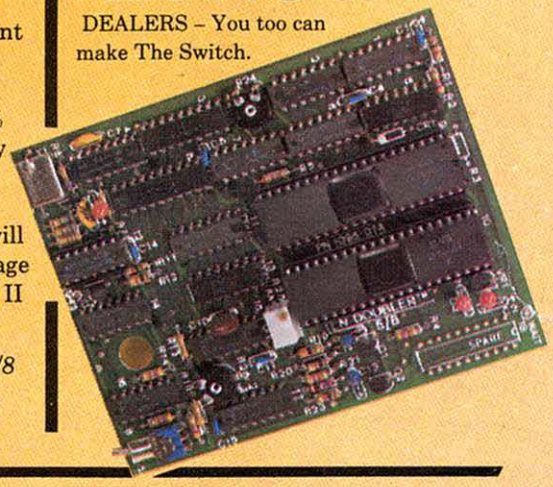

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*8" drive operation requires special cable, 8" double-density requires 3.55MHz CPU speed-up modification or LNW-80 4MHz computer.

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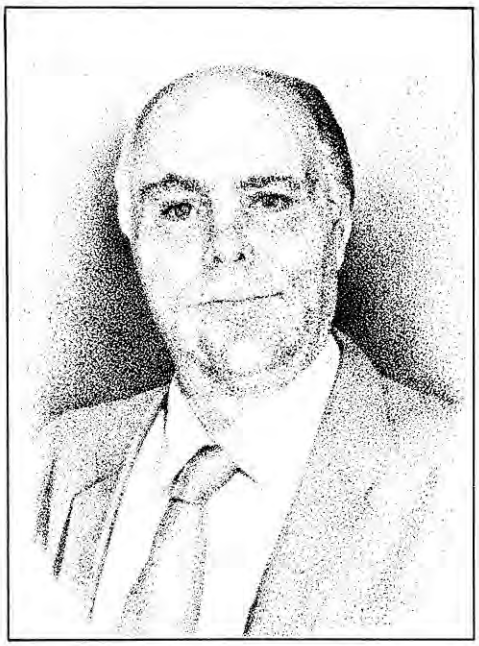
REMARKS

by Wayne Green



Why programs cost so much

On many occasions I get letters from TRS-80 owners who excuse making copies of commercially sold programs on the basis that, well, hell, the publisher of the program obviously is ripping everyone off with the high price of the program. Actually, there is much to be said on this subject... some of which may surprise you.

First, on the side of why programs are expensive to publish, let me write from my own considerable experience. My Instant Software division has put hundreds of programs on the market, so you can be sure that I have a darned good idea of the costs involved in that business.

Since the whole thing sounds easy and immensely profitable, it's no wonder so many small firms have started up in the field. It is also no wonder that 90 percent of them have gone broke.

Okay, the first little hooker in the chain of events that leads to a program being published is that simple one of evaluation. Hell, anyone should be able to tell if a program is good or not, right? Wrong! Long, frustrating experience has shown me that at best I can expect only about 5 percent of the submitted programs to be really worthy of publication and distribution. It has also shown me that there is no simple or inexpensive way of separating the wheat from the chaff. This turns out to be slow and expensive, no matter how you go about it... with programmers going into a blind fury over the delays involved.

By the time you get through sorting out 20 programs to find one that is salable, you have a substantial investment in that one program. Then comes the perfecting of the program, making changes suggested by reviewers and editors. Next comes a week or so of the documentation department writing up the instructions, and getting them okayed by the programmer, set into type, pasted up, and printed in generous quantities. Then comes designing the box, generally in four colors, taking or painting the picture for the box, the color separations (which alone can cost nearly $1,000), printing the boxes, making the master disk or tape, duplicating, quality checking, packaging the disk and instructions, writing the advertising and catalog copy, more color separations for the ad and catalog copy (another $1,000), brochures for dealer sales, and so on. It is an intricate process, taking, in all, about 225 steps from receipt of the program to its shipping to dealers.

There is no problem at all in having well over $10,000 wrapped up in a program before the first one is available for shipment. I'm talking about a relatively simple, inexpensive program, perhaps in the $10 to $15 range, not the $100 models. There the documentation takes many times longer and perfecting the program can take months beyond the day the programmer thinks he is done with it. Error trapping has to be added. Simplification of use has to be written in so the users won't have to consult the instructions as much. Bugs have to be found and cured... and some of them can be very elusive.

Another Frustration

The original idea I had for Instant Software was to produce a lot of relatively simple programs and charge the least possible for them. I wanted to make software available cheaply so that computers would sell better. This generous concept boomeranged, driving us crazy. It didn't take long before we found that no matter how great the programs we were producing, the customers refused to buy them... because they were too low-priced. Some of our early packages had five or more top-flight programs in them, all for $7.95. We could hardly give the damned things away with that price marked on them. We found, through cautious experimentation, that the way to sell the programs was to put one in a package, not five or 10, and to charge around $15, not $8 or $10. Priced any lower, the program was not perceived as being of any possible value.

Of course, no sooner did we increase the price to where the software would sell than we found that the programs were being copied to a fare-thee-well, with the rationalization being that they were too high-priced, and thus a rip-off. How's that for a no-win situation? You sell 'em cheap and no one will buy. You mark 'em up and they mostly get stolen. Say, who needs to be in such a stupid business?

Recent surveys of users indicate that roughly 5 percent of the users of our programs have actually paid for them, with the other 95 percent stealing them... at user's group meetings... schools... computer camps... via generous dealers... or just through a friend.

Copy Protection

When we put out the first programs from Instant Software, we made every effort to help the user make needed copies for protection. We even sent along a listing of the program in the instruction booklet. We believed that if software was low-priced, people would not bother to steal it. The idea was a nice one and I really got myself to believe it for a while. Naive. Copies proliferated.

Free copies of a program hurt in two ways. First there is the obvious loss of revenue to the publisher... and the programmer, who went to all that work in the hopes of getting some nice royalties. But the second chop is that when other computer owners come into the posses-

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sion of a program for free, their perception of the program is ruined and they have little feeling of any value...so, more often than not, they don't even bother to use it. Phooey.

As more and more software firms, tottering on the edge of bankruptcy, survey the ruins of their dreams, the move is toward copy protection of their programs. Few, if any, of the firms in the business want to have to do this, but when 90 percent or more of their sales are destroyed by illegal copying, the time for being a nice guy is long past.

That reminds me of what Hitler said recently, when approached in Argentina to come back to Germany and take over. "Well, okay, I'll come back, but remember this...no more Mr. Nice Guy!"

The only serious question now is what are the best methods for keeping programs from being copied, while still allowing the legitimate owner to back them up? It does appear that this is going to require some sort of hardware solution, since all known purely software solutions seem to be breakable. I'm open to any ideas along this line from you readers, so let's see what you can come up with. We're talking about a good deal of money here, since a successful system could conceivably be licensed for use by a wide range of software houses at so much per program.

The best solution I've seen to the hardware encryption problem was achieved by some lads in Bangkok, oddly enough. (Who says that micros aren't a world phenomenon?) I had a chance to sit and talk with the chaps during a recent visit to Bangkok for an international ham convention I attended and I was quite impressed by their proposed system. I think we'll be seeing more of it.

Software protection is an art that is really just beginning, so I'm interested in getting articles on the subject. While the software protection of software can't be ruled out completely, it appears at this time that this is an unproductive course to pursue. Almost all software fixes depend upon secrecy, while some hardware systems can use some sort of embedded key that, even if understood, can't be used.

If you've been doing any work along this line, perhaps it is time to come out of the closet and write it up. And if you haven't, perhaps the money awaiting a truly workable and relatively simple system will lure you. What would software firms pay to use a low-cost, yet effective, security system? Just about anything!

I'm working on plans for an official seminar on the subject of software protection for the National Computer Conference this May. I'll be the chairman of the session, so if you think you have anything serious to contribute, please let me hear from you. I'm hoping that the seminar will make it possible for the software industry to look over the protection systems that have been devised and perhaps come to a decision on one to use as a standard. This might put us into a situation much like ASCAP, where software would be protected and licensed, making it possible for both software publishers and programmers to reap the rewards of their work... and investments.■

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Who is the average *80* reader?

He owns a Model I. He's interested in construction projects, programming tutorials, and product reviews. He wants to learn Cobol as his second language. He's happy with his machine, and he would gladly recommend a TRS-80 to a friend.

In short, he's the average *80 Micro* reader.

We culled these interesting bits of information from our latest batch of reader service cards. Here's some more about you and your fellow computerists:

If you're a Model I owner, you're still in the plurality—42.9 percent. Some 31 percent of you own Model IIIs, 20 percent own Color Computers, and 5.4 percent own Model IIs. We suspect that many of you Color Computer owners also use a I or III.

If you're interested in articles on business or graphics, then you're in the majority. Almost as many of you want material on games, languages, or science. Music and robotics, on the other hand, don't seem to have piqued your curiosity yet.

Nearly 70 percent of you want to build things. Another 70 percent want to read about new products. And 66 percent want to learn how to be better programmers.

Some 74 percent of you are interested in learning and using Basic. The percentages for Cobol and Assembly language are 61.4 and 60.2 percent, respectively. Forth, Fortran, and Pascal still haven't caught on.

If you're like most readers, you bought your computer at a Radio Shack store. About 39 percent of you bought it at list price, but nearly half saved up to $600. Over half of you use a store as your primary source of computer equipment, although 34.5 percent of you prefer mail order. And a whopping 81.5 percent of you are satisfied with the repair service you've gotten for your TRS-80.

Interestingly, 28 percent of you own a second, non-TRS-80, computer. Leading the way is the Timex-Sinclair (5.3 percent), the Apple (4.9 percent), and the IBM PC (3.4 percent).

So what's the significance of all these numbers? Aside from their curiosity value, they give us a barometer by which to measure your interests and needs. They help to give us an idea of how well we've served you in the past, and how we might better serve you in the future.

Of course, our main source of feedback is still the many letters we get daily. Our surveys are useful, but we rely primarily on personal contact with you. So let us know what you want—even if the numbers say that you're in a minority.

* * * * *

News and notes from *80 Micro*: You'll be noticing a change in our masthead next month, as Mike Nadeau leaves his post as senior editor to take over our new Color Computer magazine. Mike has done a splendid job since he joined *80* in early 1981, and we have no doubt that he'll do the same in his new position...

Starting with this issue, we'll be publishing Model II conversions for a selected number of Model I/III programs. We're still not quite sure what kinds of programs you Model II owners want the most, so let us know whether you think we're picking the right programs to convert...

We've made some changes in our editorial calendar, and would like you to know about them. June's theme is going to be programming techniques. July's issue will be devoted to the Color Computer, and August will be our annual games extravaganza. September will focus on micros and the handicapped, October on data communications, November on business, and December on hobbies and crafts. If you want to contribute to any of these issues, get your material in at least four months in advance...

Finally, we're putting together a series of buyer's guides that will be running throughout the year. We'll start off in April with interpreters and compilers. May will feature two guides: one for printers and one for graphics packages. And June will cover disk drives and utility programs... ■

NEWCLOCK·80

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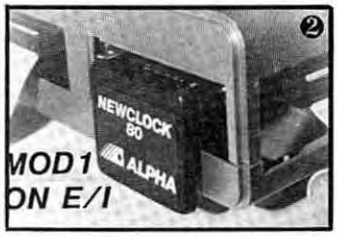

Wouldn't it be nice if your computer could always boot up with the right time and date and then stay accurate. Newclock-80 will enhance your Model I or III system with powerful clock/calendar/timer functions.

Using LSI (large scale integration) and custom circuits, Newclock-80 provides MO/DATE/YR, HR:MN:SEC plus AM/PM and day of week and even takes care of leap years! It continues to keep time and date with quartz accuracy when the computer is turned off or experiences a power failure. A single battery lasts over 2 years.

Compatibility: Newclock-80 is compatible with any operating system, including DOSPLUS, NEWDOS, LDOS. With its fully decoded circuitry it will work with any other hardware you may own. Bus expanders are available.

Installation is very simple, no tools, no disassembly, no soldering. Just plug it in, that's all. There is no power supply or messy cable. Newclock-80 plugs into the rear of the keyboard ❸ or side of the Exp. Int. ❷. Model III Newclock fits the 50 pin card edge (underneath) ❶

The Software: Newclock-80 is as easy to use as it is to install. -"SET", a Basic program, is used only once to set the time and date and select 12 or 24 hour format. -"TIMESTR", also in Basic, patches your computer "TIME$" function to read Newclock-80. It also adds "TIME$" to keyboard-only systems, a short routine is simply "poked" into low memory.

Newclock-80 uses 12 ports (176 to 188): 6 for the time, 6 for the date. The data is conveniently stored in decimal form, no conversion is needed. You can read or modify any digit using simple Basic "INP" and "OUT" statements.

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INPUT

A Ready Response

Thanks to those who replied to the problem I outlined in the December issue concerning high-level PEEK and POKE (Aid, p. 39). Within two weeks I had received close to 100 letters and nearly three dozen phone calls, most of them long distance. The letters came from as far away as Canada and Florida, and the calls from either coast, Florida, and Alaska! Most replies were pleasant, and a large number of the calls were from hackers who couldn't say "Hello" without saying "Ready" first. The letters came from a broad spectrum of people: M.D.s, Ph.D.s, and students like myself. One came written in crayon on Smurf stationery.

J. William McDonald
4206 Trio Lane, Apt. #3
Louisville, KY 40219

GOSMURF—RETURN.—Eds.

The Other Side

Someone must answer Mr. R.M. Sanford's letter (*80 Micro*, December 1982, p. 31) and clear up what appears to be a common misunderstanding about how floppy disks are made. I am a Process Engineer for a major producer of flexible media, and my specialty is the processing of the media that we put into our disks.

● Yes, the media is coated with the identical dispersion on both sides of the substrate.

● Yes, you could try to punch the additional index holes and write protect notches in the jacket to allow the drive to handle it as a flippy. If you are very careful, you will not scratch or dent the media while you are doing that. Remember, a scratch or other fault that you can barely see can cause a disastrous drop-out.

We punch our jackets to a tolerance of a few thousandths of an inch. You probably could allow a lot more variation than that and have it work in your own drive.

● The key fact that Mr. Sanford needs to know is that we—and all our competitors that I know of—test our products. For a double-sided product, both sides have to test good. For a single-sided product, only side 0 has to test good. This requires only half the time spent testing, and time is money. Some manufacturers test the media before the jacket is sealed, turn the media in the jacket, and test the reverse side of the rejects before scrapping the media.

This is the area that may give Mr. Sanford a problem. There is a fair chance that after he puts all that time and effort into carefully punching the additional holes in the jacket he may find that the reverse side of the disk is not reliable.

I strongly recommend that anyone who wants to try this do it as an experiment. Be sure to run some kind of certification program on the reverse side of the disk before trusting it with any important data.

If your time spent in modifying and certifying a single-sided disk into a flippy (remember as well those that fail) is worth less to you than the few cents extra that a flippy costs, have at it.

Wayne H. Thompson
711 North Custer St.
Weatherford, OK 73096

Graphics II

Program Listing 1 is Garrison's Color Computer graphics program (*80 Micro*, December 1982, p. 94) modified for the Model II. I didn't understand the description of the graphing subroutine, so I rewrote it as suggested by the way the graphs grew on the screen. Since the designs are interesting for only certain values of K and J, I display these values and allow the user to abort the display of a graph when he sees fit.

William A. McWorter, Jr.
8986 Mills Road
Ostrander, OH 43064

Scheduled Flight

During early November, I was deeply involved in the computerization of all the maintenance requirements on our eight assigned aircraft. This project, coupled with several other equally critical ones, placed heavy demands on my normally reliable equipment. Unfortunately, a failure point was reached.

The initial indication was that only the disk controller had failed. This did not prove to be the case; a failure in the computer had apparently induced a failure in the disk controller.

A visit to my local Radio Shack Computer Center produced astonishing results. On my initial visit the disk controller was replaced by a loaner to help me stay on schedule while my unit was being repaired. An attempted use

```
10 PI=3.14159265:RADIUS=59:XCTR=320:YCTR=120
20 CLS:PRINTCHR$(2);:LINE-(XCTR,YCTR),0
30 LINEINPUT"ENTER N,K<CR> OR N,C<CR> (CONTINUOUS RUN)";A$:N=VAL
(A$)
40 K=VAL(MID$(A$,INSTR(A$,",")+1)):C=INSTR(A$,"C")
50 CLS:PRINTCHR$(2);:IFC=0THENGOSUB70:GOTO30
60 FORS=NTO100:FORU=1TO(S-1)/2:N=S:K=U:FORI=1TO800:NEXTI:GOSUB70
:NEXTU,S:GOTO30
70 A=N:B=K:THETA=2*PI/N
80 R=AMODB:IFRTHENA=B:B=R:GOTO80
90 CLS1:PRINT@0,CHR$(17);"N=";N;"K=";K;:FORI=0TON-1
100 XPTL=XCTR+2*RADIUS*COS(I*THETA):YPTL=YCTR+RADIUS*SIN(I*THETA
)
110 FORJ=I+KTOI+N*K/BSTEPK
120 LINE-(INT(XPTL-2*RADIUS*COS(J*THETA)+.5),INT(YPTL-RADIUS*SIN
(J*THETA)+.5))
130 B$=INKEY$:IFB$<>""THENB$="":LINE-(XCTR,YCTR),0:RETURNELSENEX
TJ,I:RETURN
```

Program Listing 1

All photos are actual TRS-80 screens.

REAR GUARD

Deadly waves of enemy Cyborg craft attack your fleet from the rear. You are the Mothership's sole defender. You have unlimited firepower but the Cyborgs are swift, nimble attackers. Your abilities are tested hard in this game of lightening fast action and lively sound from Adventure International. Price: B

STRIKE FORCE

As the primary defender of a world of cities under deadly alien attack, your weaponry is the latest rapid fire missiles, long range radar, and incendiary "star shells." Your force field can absorb only a limited number of impacts. A complex game of strategy, skill and reflexes from Melbourne House. Price: A

PANIK

Trapped at an enemy building site, your fate seems certain. Your laser is empty and evil Mzors are closing in. You'll have to climb ladders and think one step ahead of the various monsters. A challenging game for agile minds. From Fantastic Software with voice (Disk has larger vocabulary). Price: B

SEA DRAGON

Your submarine, the U.S.S. Sea Dragon, penetrates a mined enemy channel. Armed with missiles and torpedos, you engage the enemy while navigating unknown waters. Succeed or come to a salty end in this game. 29 screens of horizontally scrolling sea-scrape and sound from Adventure International. Price: B

SAVE 10, 15, 20%

"If you purchase Alpha's Joystick you get the exquisite pleasure of enjoying (action games) to the limit of arcade-style realism."

–80 Microcomputing 80 Reviews, Jan '82

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Price includes Joystick + Alpha Interface + Instructions + Demo Program listing. Please specify Model I or III.

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14 DAY MONEY BACK GUARANTEE

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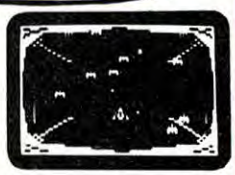
As you can see, all the best games from the top producers are joystick compatible. These games are fun without the joystick but we hope that you are one of the many thousands who enjoy the advantage of real joystick action.

Now you can deduct up to 20% on the price of games: buy any 2 games deduct 10%, buy any 3 games deduct 15%, buy any 4 games deduct 20% from game prices.

TOP TEN

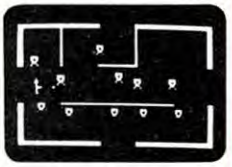
1. SCARFMAN - *All time favorite*
2. PANIK - *Remarkable Voices*
3. PENETRATOR - *Rave reviews*
4. ARMORED PATROL - *Super 3D graphics*
5. CATERPILLAR - *Good rendition*
6. CRAZY PAINTER - *Unique game concept*
7. DEFENSE COMMAND - *Tough struggle*
8. STELLAR ESCORT - *Fast and Challenging*
9. ROBOT ATTACK - *With voice*
10. SEA DRAGON - *Amazing "Seascape"*

STELLAR ESCORT



The latest super action game from Big Five. As the Federation's top space fighter you've been chosen to escort what is possibly the most important shipment in Federation history. The enemy will send many squadrons of their best fighters to intercept. With sound. Disk version has voices. Price: A

ROBOT ATTACK



Talks without a voice synthesizer, through the cassette port. With just a hand laser in a remote space station, you encounter armed robots. Some march towards you, more wait around corners. Careful: the walls are electrified. Zap as many robots as you dare before escaping to a new section. More robots await you. Price: A

LUNAR LANDER

As a vast panoramic moonscape scrolls by, select one of many landing sights. The more perilous the spot, the more points scored -- if you land safely. You control LEM main engines and side thrusters. One of the best uses of TRS-80 graphics we have ever seen. From Adventure International. With sound. Price: A

SUPER NOVA

Asteroids float ominously around the screen. You must destroy the asteroids before they destroy you! (Big asteroids break into little ones). Your ship will respond to thrust, rotate, hyperspace and fire. Watch out for that saucer with the laser! As reviewed in May 1981 Byte Magazine. Price: A

OUTHOUSE

You are the mighty protector of this small (but important) wooden structure. For reasons unknown, a bizarre gang of miscreants wish to vandalize, loot and otherwise destroy the little "half moon house." Your patrol craft has lasers and smart bombs to deal with this terror. From SSM with sound. Price: A

GALAXY INVASION

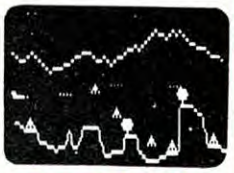
The sound of the klaxon is calling you! Invaders have been spotted warping toward Earth. You shift right and left as you fire your lasers. A few break formation and fly straight at you! You place your finger on the fire button knowing that this shot must connect! With sound effects! Price: A

LASER DEFENSE

In this game of ICBM's, high-energy lasers and particle beams, you control the U.S. strategic defense satellite system. From your viewpoint high above the globe, you intercept Soviet nuclear missiles in flight and attempt to destroy their scattered missile silos. With sound from MED Systems. Price: B

CHICKEN

Will the chicken cross the road? That's up to you. Can you guide these helpless little chicks across the perilous 10 lane super highway to safety? Or will you bumble, littering the blacktop with a storm of chicken feathers? A humourous yet challenging game of nerves from SSM with sound. Price: A



PENETRATOR

Soar swiftly over jagged landscape, swooping high and low to avoid obstacles and enemy missiles attacks. With miles of wild terrain and tunnels to penetrate, you're well armed with bombs and multiple forward missile capability. From Melbourne House. Features sound, trainer mode and customizing program. Price: C

DEFENSE COMMAND

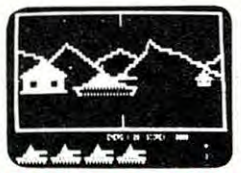
The invaders are back! Alone, you defend the all important nuclear fuel canisters from the repeated attacks of thieving aliens, repeatedly. An alien passes your guard, snatches a canister and flys straight off. Quick! You have one last chance to blast him from the sky! With sound and voice. Price: A

BOUNCEOIDS

Huge boulders careen off the walls. You're in the middle, in danger of being flattened. Keep your wits about you as you blast these "bounceoids" from the screen. Large ones break into many small ones. Clear a screen, and enter a fast-paced challenge stage with a chance for big bonus points. From the Cornsoft Group. Price: A

SCARFMAN

This incredibly popular game craze now runs on your TRS-80! It's eat or be eaten. You run Scarfman around the maze, gobbling up everything in your path. Try to eat it all before nasty monsters devour you. Excellent high speed machine language action game from the Cornsoft Group. With sound. Price: A



ARMORED PATROL

A realistic tank battle simulation. Your view is a 3-D perspective of an alien landscape. Maneuver your T-36 tank to locate and destroy enemy tanks and robots that lay hidden, ready to assault you. Clever graphics create the illusion of movement and dimension. From Adventure International. With sound. Price: B

CATERPILLAR

An arcade favorite! Stop these multi-sectioned crawlers before they creep down through the mushrooms. Zap one and it splits into two smaller bugs, each with its own sense of direction. There are moths and tumble bugs too. It all adds up to lots of fun for kids and adults alike. From Soft Sector Marketing. With sound. Price code: A

CRAZY PAINTER

You have to paint the floor white. We give you the paint and brush. Sounds easy? Hah! You'll be confounded by stray dogs, snakes, sloshing buckets of turpentine, even a ravenous "paint eater." A crazy, imaginative new game with ten selectable levels of skill for new or seasoned game players. Lot's of laughs. Price: A

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GAME PRICES

A: TAPE: $15.95 DISK: $19.95
B: TAPE: $19.95 DISK: $24.95
C: TAPE: $24.95 DISK: $24.95

TAPE: Model I&III, 16K Level 2
DISK: Model I&III, 32K, 1 Disk
All games are joystick compatible or may be played using arrow keys.

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of this controller rendered it inoperative, as well as my 32K computer.

An immediate trip to Radio Shack produced a circuit board change and the receipt of my newly repaired disk controller, all in less than one hour. As if the quick and thoughtful service were not enough, no one even whimpered when I returned their blown disk controller.

Since my computer was no longer under warranty, a one-time (and reasonable) charge was made for this service. The disk controller and my 32K unit are now under a 45-day warranty and I am back on schedule in my projects.

Radio Shack should be proud of their stores that go the extra mile for customers, as these establishments are the computer owner's and buyer's most direct link with the manufacturer.

John Fernald
255 Eagleview Place
Newbury Park, CA 91320

The Next in Line

You finally published a much-needed article by Mark Goodwin entitled "Memory Map—Level II" (*80 Micro*, December 1982, p. 298), but too late. I had been looking for such a map for a long time; now I have a Model III with Disk Basic III and the map is no good for me. I wonder if Mr. Goodwin or anyone else out there has compiled the same for the Model III.

Jim Palmer
1814 Buffalo Trail
Morristown, TN 37814

We're working on one.—Eds.

TRSDOS Recovery

I have heard many tales of woe from TRSDOS owners who accidentally kill a valuable disk file. Mr. Pennington's methods described in *TRS-80 Disks and Other Mysteries* are quite effective for file recovery.

The short program in Listing 2 eliminates its difficulties for TRSDOS. This program patches SYS3/SYS of TRSDOS 2.3 so that only the first byte of the file is converted to 00H during a kill, rather than all 32 bytes of the entry. This first byte, if 00H, tells DOS that the file is killed, and so is not checked further.

```
10 OPEN "R", 1, "SYS3/SYS.L0Y4"
20 FIELD 1, 31 AS A$, 2 AS B$
30 GET 1,3
40 LSET B$ = STRING$(2,0)
50 PUT 1,3
60 CLOSE
70 END
```

Program Listing 2

To recover such a file, using some form of zap utility, the user would then have to convert this first byte to 10H. The one-byte hash code for the hash index table sector must still be computed, but the need to dig through the disk to find the file's granules is eliminated since they are retained intact in its directory entry. From this information, the granule allocation table sector can easily be rebuilt.

David R. Goben
Lecoma Star Route
Box 30
Rolla, MO 65401

Ribbon Reload

Bill Grout's article "Open Cartridge Surgery" (*80 Micro*, December 1982, p. 343) describes a method for reloading the plastic ribbon cartridge used in the Daisy Wheel II printer. He mentions that he knows of no place to get replacement ribbons.

For at least two years, *80 Micro* has contained ads by several suppliers of ribbon reloads that eliminate the need for finding and purchasing ribbons packaged for another printer, then transferring them to the Daisy Wheel II cartridge. These reloads are much less expensive than the ribbon/cartridge assembly sold by Radio Shack.

Also, I have discovered that when a ribbon runs out, there is still a lot of life left in it. I've successfully rewound the used ribbons and reused them up to two additional times. The second and third times the impression is less intense and crisp than that left by a fresh ribbon, but is perfectly acceptable for drafts, program listings, and most data printouts.

A.J. Longhitano
26 Salem Road
Chappaqua, NY 10514

The Proof

As long-time advertisers in your publication, we were sorry that Mr. Grout (*80 Micro*, December 1982, p. 343) apparently missed our ad. We provide the type of ribbon (pancake) that is required for the Radio Shack Daisy Wheel II printer.

Now Mr. Grout no longer has to purchase a useless cartridge in order to get his replacement ribbon. We will provide him with 10 black ribbons for $24.95. We also have blue, brown, and red, though it should be pointed out that, while the black will stop the printer at the end of the ribbon, the colors will not.

Also, Radio Shack has switched the Daisy Wheel II ribbon cartridge from one that opens and reloads easily to one that is glued shut and cannot be reloaded. The purpose of this was to allow the same cartridge to fit both the Daisy Wheel II and the new Daisy Wheel 410 printer. Fortunately, we have the older type cartridge that easily reloads. The price is $48.95 for a six-pack including ribbon.

Finally, we would like to point out just how much money you could save. We have customers who will use one ribbon a day, and resulting calculations indicate that these people are saving over $1,500 a year in ribbon costs.

James M. Gibson
President
Creative Computer Center Inc.
1236 Colonial Drive
Orlando, FL 32803

Low-Priced Problems

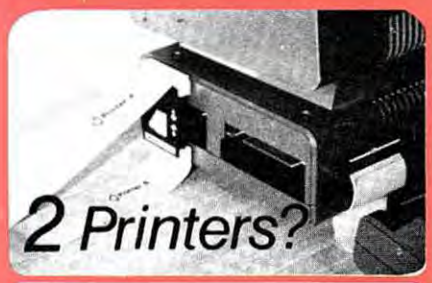
In the future, a collapsing price structure may make it very difficult for Radio Shack and others to compete in the low-priced end of the computer market.

The phenomenon of rapidly declining prices for high-technology electronic goods has made possible the $5 pocket calculator, the $10 digital watch, and the $99.95 Sinclair computer. The thought of a competitor marketing a $50 computer must make microcomputer executives shudder.

At low price levels a manufacturer's ability to provide customer support for its products would be severely impaired, and its stockholders would have very little interest in continuing

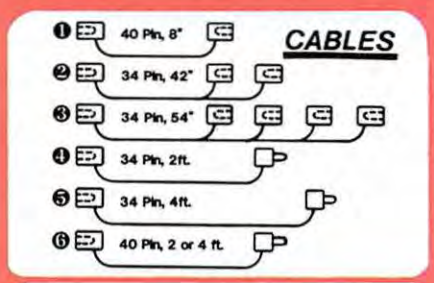
NOW MODEL I AND MODEL III!

Now Model III users can take advantage of the ALPHA I/O system too. Our new MOD III/I BUS CONVERTER allows most port based Model I accessories (such as our ANALOG-80, INTERFACER 2 and INTERFACER-80) to connect to the Model III bus. MOD III/I BUS CONVERTER, complete with all connectors, only $39.95.



PRINTSWITCH

Have 2 printers on line at all times and select printer 1 or 2 by means of a conveniently located switch. End the problem of constantly plugging and unplugging printer cables. PRINTSWITCH is a compact module that plugs onto the parellel printer port of your TRS-80 and provides an edge connector for each of your two printers. It works with any two types of printers: dot matrix, daisy wheel, plotters, TRS-80 converted selectrics, etc. Assembled, tested, ready to use with connector and instructions. For Model I or III (please specify). ONLY...$59.00



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Highest quality cable and high force, gold plated contacts ensure the utmost in connection reliability.

- ❶ KEYBOARD TO EXPANSION INTERFACE ..... $21.
- ❷ DISK DRIVE CABLE FOR 1 OR 2 DRIVES ..... $32.
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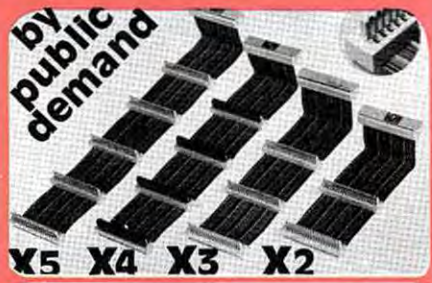
- ❹ DISK DRIVE CABLE EXTENDER ..... $22.
- ❺ PRINTER CABLE EXTENDER ..... $24.
- ❻ 40 PIN BUS EXTENDER — 2 ft. ... $22 4 ft. ... $24.

Custom cable configurations are also available. Call us.



YOU ASKED FOR IT: "EXPANDABUS" X1, X2, X3 AND X4.

CONNECT ALL YOUR TRS-80 DEVICES SIMULTANEOUSLY on the 40 pin TRS-80 bus. Any device that normally plugs into the keyboard edge connector will also plug into the "EXPANDABUS". The "X4" is shown with protective covers (included). The TRS-80 keyboard contains the bus drivers (74LS367) for up to 20 devices, more than you will ever need. Using the E/I, it plugs either between KB and E/I or in the Screen Printer port. Professional quality, gold plated contacts. Computer grade 40 conductor ribbon cable. X2...$29. X3...$44. X4...$59. X5...$74. Custom configurations are also available, call us.

ANALOG-80: A WORLD OF NEW APPLICATIONS POSSIBLE.

8 DIGITAL MULTIMETERS PLUGGED INTO YOUR TRS-80!!! Measure Temperature, Voltage, Current, Light, Pressure, etc. Very easy to use: for example, let's read input channel #4: 10 OUT 0,4 'Selects input #4 and also starts the conversion 20 A = INP(0) 'Puts the result in variable "A" Voila! Specifications: Input range: 0-5V to 0-500V. Each channel can be set to a different scale.
Resolution: 20mV (on 5V range). Accuracy: 8 bits (.5%). Port Address: jumper selectable. Plugs into keyboard bus or E/I (screen printer port). Assembled and tested. 90 day warranty. Complete with power supply, connector, manual ..... $139.

TIMEDATE 80: REAL-TIME CLOCK/CALENDAR MODULE

Keeps quartz accurate time for 3 years on 2 replaceable AAA batteries (not included). Gives MO/DATE/YR, DAY of WEEK, HR:MIN:SEC and AM/PM. Features INTELLIGENT CALENDAR and even provides for Leap Year. This compact module simply plugs into rear of Keyboard or side of Expansion Interface (may be slipped inside E/I). Includes cassette software for setting clock and patching to any DOS (including NEWDOS 80, 2.0). Optional "Y" connector allows for further expansion. For Model I. Fully assembled and tested. Complete with instructions and cassette. ONLY $95.00. "Y" option, add $12.00

GREEN SCREEN WARNING

IBM and all the "biggies" are using green screen monitors. Its advantages are now widely advertised. We feel that every TRS-80 user should enjoy the benefits it provides. But **WARNING:** all Green Screens are not created equal. Here is what we found:

- Several are just a flat piece of standard colored Lucite. The green tint was not made for this purpose and is judged by many to be too dark. Increasing the brightness control will result in a fuzzy display.
- Some are simply a piece of thin plastic film taped onto a cardboard frame. The color is satisfactory but the wobbly film gives it a poor appearance.
- One "optical filter" is in fact plain acrylic sheeting.
- False claim: A few pretend to "reduce glare". In fact, their flat and shiny surfaces (both film and Lucite type) ADD their own reflections to the screen.
- A few laughs: One ad claims to "reduce screen contrast". Sorry gentleman but it's just the opposite. One of the Green Screen's major benefits is to increase the contrast between the text and the background.
- Drawbacks: Most are using adhesive strips to fasten their screen to the monitor. This method makes it awkward to remove for necessary periodical cleaning. All (except ours) are flat. Light pens will not work reliably because of the big gap between the screen and the tube.

Many companies have been manufacturing video filters for years. We are not the first (some think they are), but we have done our homework and we think we manufacture the best Green Screen. Here is why:

- It fits right onto the picture tube like a skin because it is the only **CURVED** screen **MOLDED** exactly to the picture tube curvature. It is Cut precisely to cover the exposed area of the picture tube. The fit is such that the static electricity is sufficient to keep it in place! We also include some invisible reusable tape for a more secure fastening.
- The filter material that we use is just right, not too dark nor too light. The result is a really eye pleasing display.

We are so sure that you will never take your Green screen off that we offer an unconditional money-back guaranty. try our Green Screen for 14 days. If for any reason you are not delighted with it, return it for a prompt refund.

A last word: We think that companies, like ours, who are selling mainly by mail should •list their street address•have a phone number (for questions and orders)•accept CODs, not every one likes to send checks to a PO box•offer the convenience of charging their purchase to major credit cards. How come we are the only green screen people doing it?

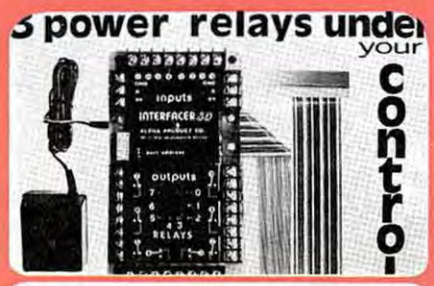
Order your **ALPHA GREEN SCREEN** today...$12.50

DISK DRIVE EXTENDER CABLE, FREE YOUR MINI-DRIVES.

End the daisy-chain mess once and for all. Fits all minidrives: Percom, Aerocomp, Shugart, Micropolis, MTI, Vista, Pertec, Siemens, BASF. East to install: just remove the drive cover, plug in the EXTENDER CABLE and replace the cover.

Now you can change and move your drives without disassembly. Keep the cover on and the dust out. High reliability gold plated contacts, computer grade 34 conductor cable. Tested and guaranteed.

Get one for each drive ... ONLY $8.95



INTERFACER-80: the most powerful Sense/Control module.

- 8 industrial grade relays, single pole double throw isolated contacts: 2 Amp. @ 125 Volts. TTL latched outputs are also accessible to drive external solid state relays.
- 8 convenient LEDs constantly display the relay states. Simple "OUT" commands (in basic) control the 8 relays.
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the product. Furthermore, brand identity will be lost. (Do you remember who made your $10 transistor radio? Do you care who made your $5 pocket calculator?)

A decision to compete on price could be disastrous. Value, service, quality, and the right product at the right place and time seem to be Radio Shack's best hope for survival in the low-priced computer market.

Ronald E. Gillilan
1955 Prince George Drive
Apt. G
Columbus, OH 43209

Subtitle Support

I am pleased with the new title of your magazine and with its content, but I feel a feature of the old edition should be incorporated. The subtitles that preceded each section were very helpful in finding the specific program I wanted.

Terry Tanski
Box 299
Boyle, Alberta
Canada, T0A 0M0

We agree, and we've returned to our old ways.—Eds.

CRT Update

The review of our new Soft-View Replacement CRTs was fantastic (*80 Micro*, December 1982, p. 51); we're pleased that you were so excited by the product. There were small errors, though, that I'd like to correct.

First, we're no longer referring to ourselves as LSI Systems. LSI is a registered trademark of Logical Systems Inc., the company that produces LDOS, and so we are having a new ad designed that doesn't make reference to that acronym.

Second, Dave Smith's only concern about the tubes—that they weren't quite as bright as the B&W tubes—has been in large part remedied by the introduction of a new phosphor into all tubes that we'll be shipping from the first of the year on.

Thom Hartmann
Langley-St. Clair Instrumentation Systems Inc.
5 Garland St.
Plymouth, NH 03264

Scripsit Switch

Table 1 is a collection of changes to Scripsit for occasional users like myself who don't want pasties on their keys and who cannot remember that "Z" = "Word." Using Craig Lindley's two articles on Scripsit (*80 Micro*, September 1982, p. 222; October 1982, p. 216), I found the memory locations for the commands I wanted to change. I also made sure there would be no conflict with using "W" for "Word" as well as for "Window"; these are at different locations and are called differently.

Table 1 shows both the key to be pressed and the machine code in memory to be changed. Any debug program can be used, and the "old" code should be checked before changing.

John P. Jones
17 Bel Manor Drive
Fairmont, WV 26554

	OLD		NEW			
Meaning	**Key**	**Code**	**Key**	**Code**	**Location**	**Called By**
Word	Z	1A	W	17	7A0D	Exchange
					79E4	Delete
Paragraph	C	03	P	10	79A5	Main
					7A0E	Exchange
					79E2	Delete
Line	X	18	L	0C	79A4	Main
					79E1	Delete
					568B	Insert
Blanks	F	06	B	02	79E0	Delete
Insert	S	13	I	09	79A1	Main
Exit to DOS		00		2D	6595	
without reboot		00		40	6596	

All numbers are hex.

Table 1. Changes to Scripsit

A New Source

In the recent past your magazine has run articles on programs that prepare tax returns on microcomputers. For some reason you did not include one of the best and least expensive tax systems available.

I would like to let your readers know that there is an excellent system available from Analytical Processes Corporation for only $600. It comes to the purchaser in source code, prints its own forms and schedules, and is well tested in our service bureau where several hundred returns are processed each year.

It is our opinion that in the future all good software will include source code and this belief is reinforced in articles that appear in your and other magazines. Consequently, we market all programs in source code, including our mail list system, post card billing system, and checkbook-driven general ledger.

Analytical Processes Corporation is a small company, but it is our feeling that the features we offer and the quality of our systems will not be ignored for long.

Michael K. Johnson
Analytical Processes Corporation
635 Main St.
P.O. Box 1313
Montrose, CO 81402

Color Code Update

I have improved my color Morse code program (*80 Micro*, December 1982, p. 200) to use RS-232 output for keying. Although I have experienced no problems using the computer relay, this new approach may be better. I will supply details and the required edits to any interested reader who sends a stamped, self-addressed envelope to

From Computer Plus to YOU . . .

PLUS after PLUS after PLUS

Model 16 128K
1 Drive $4199
2 Drive $4799

Color Computer 16K $235
w/16K Ext. Basic $305
w/32K Ext. Basic $420

Model III 16K $799
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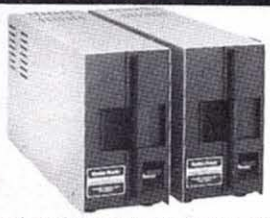

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Michael Chuck
567 Hamilton
Westmont, IL 60559

Memory Map Extended

Mark Goodwin's article, "Memory Map—Level II" (*80 Micro*, December 1982, p. 298), is good as far as it goes, but does not go far enough.

He shows the calls to 0013H and 001BH as keyboard and video routines respectively. While they can certainly be used for Mr. Goodwin's purposes, he fails to note that they are general-purpose read and write byte routines that are very effective for disk input/output under any DOS with which I am familiar. Since I use both of these calls in my Softcomm terminal program for all disk input/output, I know they work in these applications.

These calls make use of the device-control block defined during the Open or Init file routines. On entry, both have the DE register pair pointed to the DCB. The write routine at 001BH should also have the A register loaded with the byte to write to disk. The read routine will return with the byte from the disk in the A register.

In addition, the F register status flags will be set. On NZ status, an error has occurred. If the error from the read routine is 1CH, then the error is an end of file. Any other error can be handled by ORing 0C0H and jumping to 4409H. Using 001BH as the write routine also allows Close to properly set the end of file.

Error Trap

Personal Micro Computers Inc. was mentioned by David Heyman of Conway, PA (December 1982, p. 20) as having an expansion interface for the Model I. Actually, PMC sells its expander for the PMC-80 and PMC-81 computers, but it does not connect to the TRS-80 Model I.

The advantages of these one-byte read and write routines are enormous in terms of handling where the data goes in memory, and where it comes from. My Softcomm terminal program would be much larger and possibly less accurate without them.

Bill Stewart
Stewart Software Co.
P.O. Box 573
Memphis, TN 38101

Refutation

It is true that at one time I was employed by Radio Shack; however, at the time that I wrote the letter in question (*80 Micro*, September 1982, p. 24), I was unemployed. This fact seems to destroy Mr. Stephens' theory of a salesman seeking gratitude from his superiors (December 1982, p. 22). I wrote my letter as a sincere note of thanks to a company that has brought enjoyment to many people.

The time that I spent working for Radio Shack has made me quite familiar with its admittedly many shortcomings, but it has also made me aware of its good side.

Jon Von Tobel
2881 Augusta Drive
Las Vegas, NV 89109

Plea for a Look at Printers

Cheers for "Word Processing—An In-Depth Look" (*80 Micro*, September 1982, p. 88). The article inspired me to abandon my Selectric and to reevaluate the TRS-80, which until then had been my husband's toy.

I only wish you had published a more recent in-depth look at printers. After purchasing one of your recommended word processing systems, my husband agreed that out Centronic 737 printer was not comparable to my Selectric.

Since we have come to rely on your recommendations, we checked back issues for printer evaluations. We found printers were evaluated at least two years ago; much has happened in the world of printers in the intervening two years.

I can assure you that shopping for printers is a real adventure into never-never land. Salesmen are unfamiliar with the features of the printers they sell, and the specs are written in a foreign language without translators available. A simple query as to which machine offers the maximum choice of pitches and type styles is a question without answer.

On a by-guess-and-by-golly selection process, we finally chose a Diablo 630 API. After investing in excess of several thousand dollars and a month's time, we are still without answer to the simple questions with which we began.

The Diablo could work with serial or parallel, but the trick seems to be to find one that works at all. It comes with a manual written for another machine, and the cord needed to connect it to the TRS-80 is available somewhere else.

After endless phone calls, it turned out that our machine was pronounced dead on arrival, and inoperable the day we took delivery. It is now located in the machine hospital for an indefinite stay.

When you do get around to evaluating printers again, please check out the support services and warranties. We have learned to our dismay that the most expensive is not necessarily the best.

Nicky Wislocky
1208 E. Pine Ave.
El Segundo, CA 90245

Our buyer's guide for printers is slated for May 1983.—Eds.

Carolina Club

It appears that designers and manufacturers cannot agree on a common Basic language. At last count it seems there are over 250 dialects of Basic. This lack of standardization has restricted those of us at the novice level. We often rely on your magazine's specialty columns for any information on operation and applications.

A few of us here in Columbia feel that we could expand our proficiency with our equipment by forming a computer club. Interested users should contact me at the address below or by telephone at (803) 783-1255.

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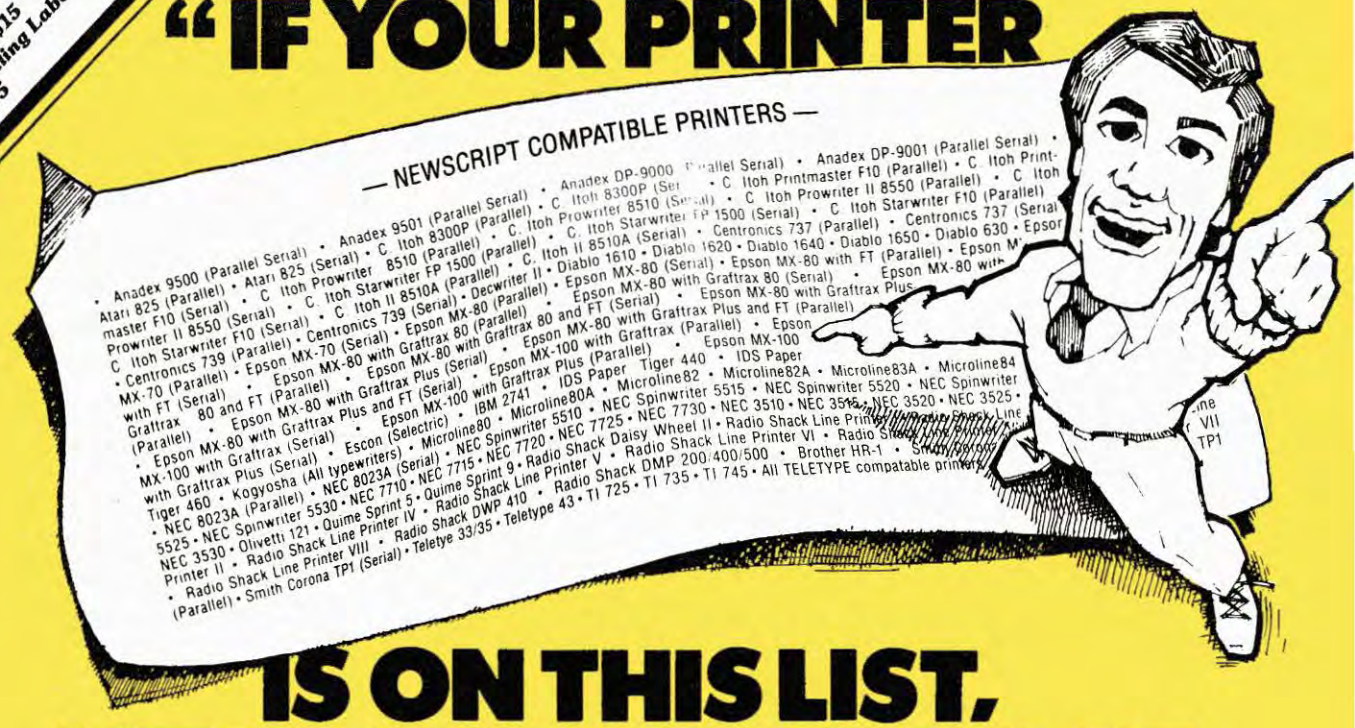

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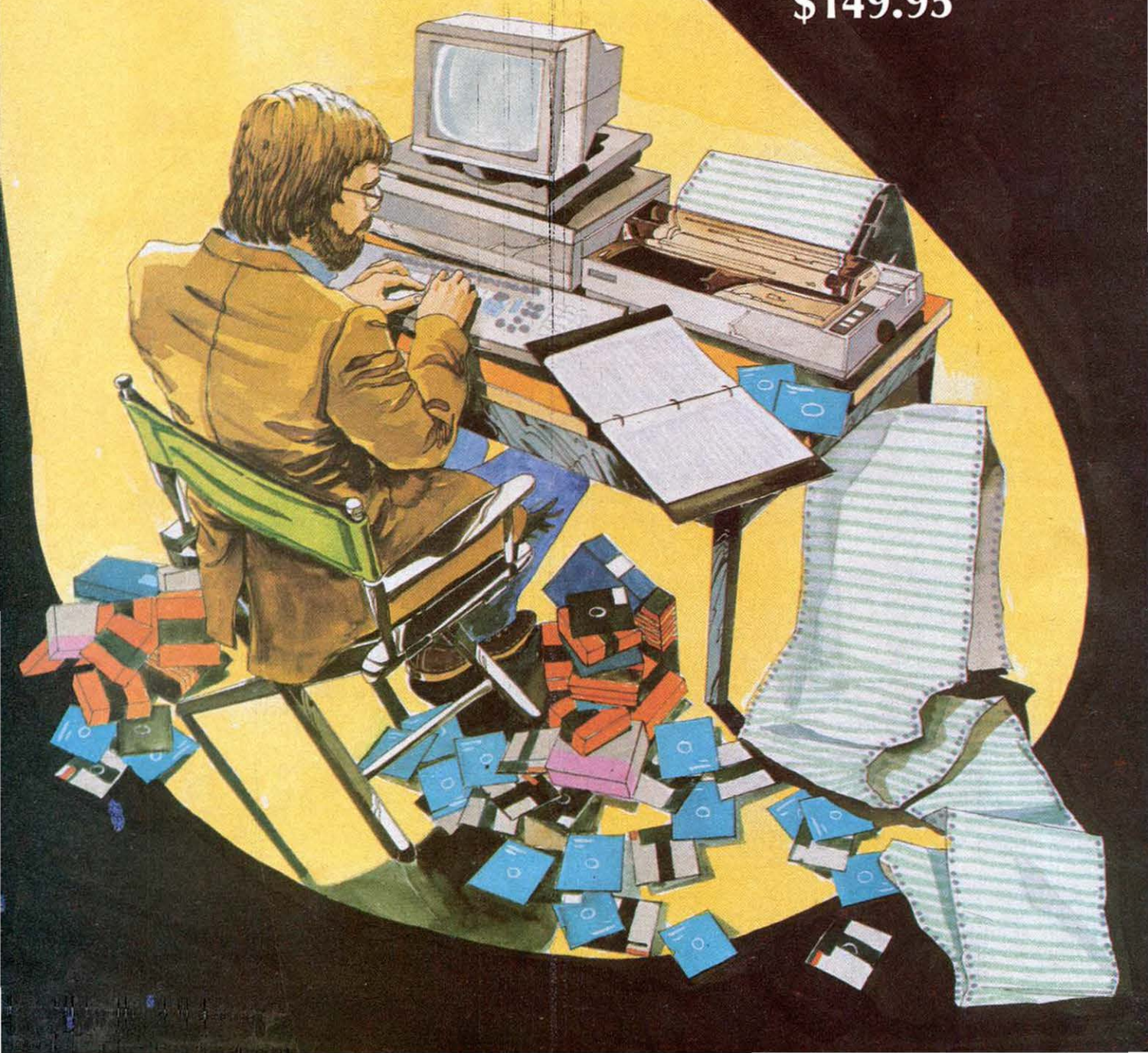

If BASIC somehow doesn't seem so basic, and your software has been getting you nowhere, then let me introduce myself. THE PRODUCER is my name. Writing programs is my game. If you're interested in an inexpensive way to quickly and easily write professional quality custom software programs, then read on.

Have you ever wasted money on software that didn't do what you thought it would? Are you burned out on high priced, canned programs that make big claims, but don't meet your needs. Has a lack of good software made your computer an expensive gadget that doesn't do what you hoped it would? If so, I'm here with good news. With my help you can put those problems behind you.

What is THE PRODUCER?

In short, I'm a Program Generator designed to write customized software programs. If you have a need to store and retrieve information, perform calculations on your data and get displayed or printed reports, I can help you develop a program to do just that, in just about any format you can imagine. That's why I'm called a program development system. I'm a powerful and sophisticated software package, born of vast technical knowledge and professional design experience. Yet, I'm the most simple, practical, easy to use and functionally versatile program generator ever put on the market.

What can THE PRODUCER do for you?

How can I help you? Just let me count the ways.

1. I make programming easy. I'm 'user friendly.' If you can answer simple English questions and push buttons, I'll do all the hard work. Let me worry about the BASIC language required to complete your program. Describe the program you want and I'll write it for you. The process is simple. First, I produce a printed planning sheet to help you get your ideas on paper. When you've finished planning, you're ready to draw your screen right on the monitor. The Screen design and appearance is completely at your command, including graphics. You have full editorial control. Make all the changes you like, until you're satisfied. After you're thru, I'll guide you thru some simple English questions about your Screen. Based on your answers, I'll write a complete BASIC program for you.

2. I can save you 100's of hours of time. I provide real short cuts to meet your needs by going direct from your idea to a 'ready to use' customized program. I write all the BASIC code for you. I'm simple, but I'm not shallow. The only limit to my capacity is your imagination.

3. I can save you big bucks. You may never need to buy another program to store and retrieve your data. With my help, you can design your own custom programs to get your job done.

4. I can help make you more productive. Having me as your partner will be like taking a smart pill. I'll pay for myself many times over by increasing your productivity and creativity. With my custom programs serving you, your computer will be the valuable friend you hoped it would be.

5. I can help make you a real pro. Based on your ideas, I write complete stand alone programs. I write in BASIC code, but you talk in English to me. And if you're an entrepreneur, you can sell the programs you and I create. As a licensed owner of THE PRODUCER, you may do so without paying royalties.

6. I can make good programmers much better. I produce fully commented BASIC code so you can use me as a building block to write your own specialized software. I have the best screen and input module available anywhere at any price.

What do you get with THE PRODUCER?

1. Two diskettes containing THE PRODUCER program development system, and a complete disk operating system. Also included is a free sample personal management program (value $59.95) useful to every computer owner.

2. Extensive documentation in a three ring binder, with index tabs, quick reference system, comprehensive index and sections for the novice and professional programmer.

3. Complete printed tutorial, walking through each step in THE PRODUCER process and resulting in a finalized sample program. An audio cassette tape ($14.95 value) of the tutorial session is also provided free for a limited time.

4. A toll free technical assistance number for PRODUCER owners.

5. A free one year subscription to THE PRODUCER's quarterly newsletter containing ideas, sample programs and update information related to THE PRODUCER.

TECHNICAL COMPARISON CHART

	PRODUCER	QUICKPRO	CREATOR
FEATURES OF THE FINISHED BASIC PROGRAM			
Full Screen Oriented Input of All Fields	YES	NO	NO
Edit without Retyping with insert & delete	YES	NO	NO
Restrict field Length automatically	YES	YES	NO
Unlimited Restriction choice for each field	YES	NO	NO
User defined Custom Prompts for each Field	YES	NO	NO
Full Speed Typing in ALL Fields	YES	NO	YES
Immediate Exit from Any Field to Menu	YES	NO	YES
Enter Fields from last Record automatically	YES	NO	NO
Fast BTREE File Structure (No Sort Needed)	YES	NO	NO
Find Record with Part of a Key	YES	NO	NO
Hi-Speed Global Search for ANY Field in a Record	YES	NO	NO
Duplicate Keys and Multiple Keys Supported	YES	limited	NO
Global Field Replacement Function	YES	NO	NO
Run Predefined Reports from Finished Program	YES	NO	NO
Select Reports from Menu in Finished Program	YES	NO	NO
Sort (machine language) ANY Field-Free	YES	NO	NO
Custom Mailing Labels Option (any Size)	YES	NO	NO
Do Calculations on fields in Program	YES	YES	NO
Sell Finished Program with No Royalty	YES	NO	NO
PRODUCER CAPABILITIES & FEATURES			
Toll Free Question Line	YES	NO	NO
Create PROFESSIONAL Finished Program	YES	NO	NO
Modify Program without Starting Over	YES	NO	NO
Ease of Use, including Complete TUTORIAL	YES	NO	NO
Number of Calculations allowed per field	8	1	0
Use Field Names for Calculations	YES	NO	NO
Use ALL Math Functions in Calculations	YES	NO	NO
Generates a BASIC Program	YES	YES	YES
Custom Design exact Screen YOU desire	YES	NO	NO
Full Feature Screen Generator (graphics)	YES	NO	NO
Easy Report Generation with Any Restrictions	YES	NO	NO
Complete & Thorough DOCUMENTATION	YES	limited	NO
Detailed Quick Reference Materials	YES	NO	NO
Audio Cassette Tutorial Available	YES	NO	NO
Program Planning Form Provided	YES	NO	NO
Sample Programs Available before Purchase	YES	NO	NO
FREE UTILITIES INCLUDED			
Free Menu Driven DOS Utility Package	YES	NO	NO
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AID

80 Micro In Demand

I have purchased all but five back issues of *80 Micro*. They are: #4 April 1980, #7 July 1980, #14 February 1981, #21 September 1981, and #24 December 1981. Can anyone help me acquire these issues?

Gary V. Van Dyke
Route 1, Box 6
Elburn, IL 60119

Borrowing Brother's Copy

My KBFIX/RELO tape for my Model I quit loading properly and I can't get a new one. I know there are other programs and hardware modifications available, but I haven't found any quite so easy and as efficient.

I'm borrowing my brother's copy (because he now uses a disk), but what happens when that quits working?

Jeff Cersonsky, M.D.
15741 S. Woodruff, Suite C
Bellflower, CA 90706

Bar-Code Reader Wanted

Help! I'm trying to computerize my high school's library and I need a bar-code reader to accomplish this. Does anyone know where I can find one that can be used with a Model III? And can the reader codes be printed by a printer with bit graphics?

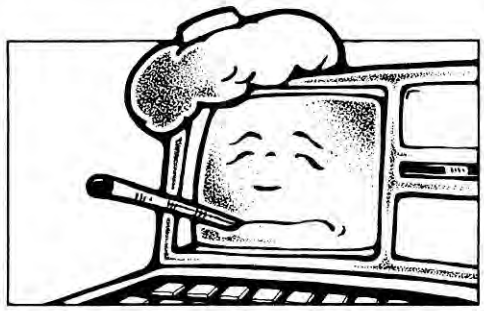
Steve Winokur
435 Norristown Road
Horsham, PA 19044

Looking For a Better Solution

I have a 16K Color Computer with a Radio Shack Line Printer VII, and I have been trying to no avail to find out how to set the right margin on my printer. My only solution so far has been to set double spacing on the printer and to never type more than one line on the screen without pressing enter.

Does anyone have a better solution?

Charles Cross
General Delivery
Pearlington, MS 39572



Education After School

Can someone help me locate educational programs written for a Model II system, or in Basic? I have a child who has learning disabilities and would like to use my computer to aid her after school.

Melvin Getlan
11 Leatherstocking Lane
Scarsdale, NY 10583

Adjustment Needed

In reference to Dr. Dimitri P. Bertsekas's article "A Basic Compiler in Basic" (October 1982, p. 122), has anyone been able to adjust this program for a Model I 16K Level II cassette system? If you have, please get in touch with me.

Bob Lockhart
604 N. 20th Ave.
Yakima, WA 98902

Interfacing a Typewriter

I would like to hear from anyone who has interfaced a Wang 701A IBM Selectric typewriter to a TRS-80 Model I.

John Cole
P.O. Box 519
Coloma, MI 49038

Changing Disk Size

Is there any method by which I can take Scripsit files from an 8-inch disk and transfer them to a 5¼-inch disk? If so, what hardware or software is needed, and would the new 5¼-inch disks be compatible with the IBM PC format?

Keith Cawer
4616 A Parkway
Sacramento, CA 95823

Can You Do It?

Does anyone have the facilities to transfer programs on an 8-inch CP/M disk to an Omikron Mapper I 5¼-inch CP/M disk?

I am also interested in hearing from people with programs for the Percom Electric Crayon.

Stephen Jenks
1711 Sherman Ave.
Canon City, CO 81212

Won't Print Proportionally

I have a Model III and a Qume Daisy Wheel printer. Under most circumstances this combination works well, but I have spent a great deal of time in frustration trying to find the correct printer command to make it print proportionally.

Would someone pass along the secret so that Scripsit, SuperScripsit, and so forth can be made to work on my printer?

Ward S. DeWitt, M.D., F.A.C.S.
2504 Harrison St., Suite B
Eureka, CA 95501

Any Okies Out There?

I would like to contact other Okidata 82A owners. I am having some difficulty understanding some of the control codes.

Terry E. Leckler
P.O. Box 652
Willernie, MN 55090

Has It Been Done?

I'm sure that someone must have put together the software for a Model III to drive the Telex Model 33 using a 20 ml. driver through the cassette port. This avoids tying up the RS-232 port and the parallel port, which can be used for other purposes.

If anyone has actually done this, I'd like to hear from you.

G.W.K. King, P.E.
105 Eagle Road, R.D. 2
Newtown, PA 18940

Convert to CP/M and Save.

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The Trouble with TRS-DOS.

Although TRS-DOS is an excellent operating system, it has one major disadvantage. When compared with CP/M, TRS-DOS locks you into a limited and possibly dead-end course. When you are ready to upgrade to a new computer, it is likely that none of your present software will run on the new machine. All of the time and money you have invested in TRS-DOS software will be lost.

CP/M for the TRS-80.

Converting to CP/M offers the TRS-80 owner many advantages. The TRS-80 immediately becomes capable of running twice the software of any other computer on the market. Perhaps more importantly, CP/M permits software portability. Unlike TRS-DOS programs, CP/M programs can be directly transferred to your next computer. The savings in time and software costs can be quite significant. CP/M conversion can easily pay for itself with the money saved on one or two software purchases. The sooner you convert to CP/M, the more you stand to save.

CP/M Acquires Unprecedented Support.

Over the past year, a number of powerful competitors have introduced new microcomputers. Most people will instantly recognize the names of Xerox, IBM, Hewlett-Packard, Digital Equipment and Zenith. The Japanese companies, Sony, NEC, Sanyo, Toshiba and Sharp, are equally well-known. Together, these companies have committed over a billion dollars to compete effectively in the micro market. TRS-80 owners should be aware that every one of these companies has chosen CP/M for their standard operating system. Over the next few years, these companies will sell millions of CP/M computers. Considering these facts, it is clear that CP/M is the operating system of the future.

Apple and Commodore Offer CP/M.

In a recent press conference, the Apple Computer Company stated, "The largest installed base CP/M system in the world today is the Apple II with the Z80 card from Microsoft." In a recent full page ad in the Wall Street Journal, Apple announced CP/M for the Apple III. Commodore, refusing to be left behind, has recently announced their "Emulator" series of computers that support CP/M. There are even rumors that the new Tandy 16 will support a version of CP/M.

Plan Ahead.

The Omikron "Mapper" offers the ideal step to upgrading to a newer, more powerful computer. With the "Mapper," your TRS-80 can run both CP/M programs and TRS-DOS. With CP/M, you can build a software library that's fully compatible with the newest CP/M business computers. All of the time and money you spend on selecting, purchasing, and learning CP/M software can be considered an investment in the future. In addition, your old TRS-80 can gain a new lease on life as a fully compatible back-up unit. Consider all these points carefully. The Omikron "Works" package offers the best solution for protecting your investment in the TRS-80. By choosing the "Works," you can purchase a "Mapper" and also receive over $1,000 worth of top-quality CP/M software. Value, Utility, performance — Omikron offers you more than ever before.

COUGAR . . . Omikron's Users Group.

CP/M has always been the standard for business and professional use. This market has always demanded high quality and high performance. The high prices for CP/M programs reflect the additional effort required to develop top-quality software products. To help our customers afford CP/M software, Omikron has formed Cougar, our official users group. Through Cougar, Omikron can purchase software products in large volume. This allows us to offer our customers some of the best CP/M software in the industry at greatly reduced prices.

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To See Bit 2 Set

This is in reference to my article "CC CQ" in the December 1982 issue (p. 200). It appears that there are some differences in Color Computers. The peripheral interface adapter (PIA) that reads RS-232 input is supposed to have the bit sound output #2 configured as an input on reset. The receive routine expects to see bit 2 set, but on many computers it isn't.

The solution is to add a line to the Hamshack program. The POKEs configure bit 2 as an output and set the bit. Line 11 should be: POKE 65315,51: POKE 65314,250: POKE 65315,55: POKE 65314,7.

There were also three printing problems on the Hamload listing: In line 110 the 31st data number is 62, in line 320 the 28th data number is 62, and in line 330 the 23rd data number is 3.

Mike J. Chuck
648 Longmeadow Drive
Severna Park, MD 21146

It's Compatible!

My article "POKE Graphics" (December 1982, p. 384) was originally written for a tape-based computer. To make the program compatible with all Model Is and IIIs, change line 310 to: AM = PEEK(293): AS = PEEK(16548) + PEEK(16549)*256:IF AM = 73 THEN AM$ = "MODEL III"ELSEAM$ = "MODEL I".

James S. Schaefer
33 Jackson Road
Berlin, NJ 08009

80 Debug Response to B.W. Bullock

A change is required for Leafstand's "Quickcalc" article (October 1982, p. 114). Line 3000 performs the printer test and should be modified for the Model III. A number of our readers have written saying that Model I programs that test for printer-ready status hang up when used on their Model III. Here are the two tests:

Model I

```
IF PEEK(14312) = 63 THENPRINT"PRINTER IS READY" ELSEPRINT "PRINTER IS NOT READY"
```

Model III

```
IF(PEEK(14312)AND240)<>48THENPRINT "PRINTER IS READY" ELSEPRINT "PRINTER IS NOT READY"
```

A Listing Correction

I found a minor error in the listings for "Voice-Controlled Typewriter" (December 1982, p. 72). Line 311 should be changed from B$ = "Q" to B$ = "V".

Greg Drake
3325 B Wood Valley Court
Lexington, KY 40502

Getting the Proper Reply

"Subterra" (Fun House, November 1982) appears to have a bug. The Grotto of Grief "S" choice gives a reply appropriate to an "N" choice. I corrected this by changing lines 520 and 530 as follows:

```
520 IF X$ = "N" AND IF Z = 1
THEN PRINT A$(42):END
530 IF X$ = "N" AND IF Z = 2
THEN PRINT A$(43): Z = 0: GOTO 470
```

Responses W, S, and E are then handled properly by lines 540, 550, and 560.

David H. Martin
820 East Adelaide Drive
Tucson, AZ 85719

Debugging Forms Maker

There is an error in line 12030 of the listing for "Forms Maker" (December 1982, p. 356). 4296 should be 4926. This single error prevents the printout of the screen from working properly.

To aid you in debugging the program, you should disable the ON ERROR GOTO at lines 2030 and 10220 until you are certain the program has been properly entered and debugged.

Charles R. Perelman
9777 Wilshire Blvd., Suite 700
Beverly Hills, CA 90212

Do a PCLEAR First!

To all who have been typing in the copy of "Alien Attack" (August 1982, p. 282): The game is correct as far as I've been able to check it. However, one thing that should have been mentioned in the article is that you need to do a PCLEAR 2 before running the program. If you don't, you will get either an OM or an FC error while running the program.

Larry F. Perry
Double Density Software
920 Baldwin St.
Denton, TX 76201

Adding a Mnemonic

There are two errors in my article "Color Assembler" (November 1982, p. 213). First, I left out the statement that dimensions the arrays that hold the labels so it will allow 10 labels as presented. To solve this problem, add the line: 25 DIM LB$(100),LB(100).

I also left out one mnemonic, ABX. Add it with the line: 13095 DATA ABX,3A

These additions will correct all the bugs encountered so far. I apologize for the errors.

John Heusinkveld
2161 East Cerrado Brio
Tucson, AZ 85718

Random Numbers and Kwikmaze

Dan Rollins' "Kwikmaze" game (November 1982, p. 318) has an error in its random-number-generating routine. Accessing the refresh register causes patterned number progressions. This in turn causes the maze generator to lock up soon after execution on a nondisk system because it fails to produce a number representing a legal direction.

```
100 REM * PEGLEGS / TRS-80 LEVEL II 4K *
110 CLS
120 Q=32
130 U$="JU"
140 D$="JD"
150 L$="JL"
160 R$="JR"
170 Y=3
180 FOR X=18 TO 36
190 SET(X,Y)
200 SET(X,Y+22)
210 NEXT X
220 X=6
230 FOR Y=9 TO 19
240 SET(X,Y)
250 SET(X+42,Y)
260 NEXT Y
270 X=18
280 FOR Y=3 TO 24
290 IF Y<9 OR Y>18 THEN SET(X,Y): SET(X+18,Y)
300 NEXT Y
310 Y=9
320 FOR X=6 TO 48
330 IF X<19 OR X>35 THEN SET(X,Y): SET(X,Y+10)
340 NEXT X
350 FOR Y=5 TO 24 STEP 3
360 FOR X=21 TO 36 STEP 6
370 SET(X,Y)
380 NEXT X
390 NEXT Y
400 FOR Y=11 TO 17 STEP 3
410 FOR X=9 TO 45 STEP 6
420 SET(X,Y)
430 NEXT X
440 NEXT Y
450 RESET(27,14)
460 A=27
470 B=5
480 A$=A$+INKEY$
485 PRINT @ 653,A$;"  ";
490 PRINT @ 480,"SCORE";Q;
500 IF Q=2 THEN PRINT @ 154,"WINNER";
510 IF Q=1 THEN PRINT @ 90,"DOUBLE";
520 IF Q=1 AND A=27 AND B=14 THEN PRINT @ 90,"TRIPLE";
530 IF POINT(A,B)=-1 THEN RESET(A,B): FOR T=1 TO 10: NEXT T: SET
(A,B)
540 IF POINT(A,B)=0 THEN SET(A,B):FOR T=1 TO 10: NEXT T: RESET(A
,B)
550 IF A$="U" AND POINT(A,B-2)<>-1 THEN B=B-3: A$=""
560 IF A$="D" AND POINT(A,B+2)<>-1 THEN B=B+3: A$=""
570 IF A$="L" AND POINT(A-3,B)<>-1 THEN A=A-6: A$=""
580 IF A$="R" AND POINT(A+3,B)<>-1 THEN A=A+6: A$=""
590 IF B-5<4 GOTO 610
600 IF A$=U$ AND POINT(A,B-5)=0 AND POINT(A,B-6)=0 AND POINT(A,B
-3)=-1 GOTO 690
610 IF B+5>24 GOTO 630
620 IF A$=D$ AND POINT(A,B+5)=0 AND POINT(A,B+6)=0 AND POINT(A,B
+3)=-1 GOTO 690
630 IF A-9<6 GOTO 650
640 IF A$=L$ AND POINT(A-9,B)=0 AND POINT(A-12,B)=0 AND POINT(A-
6,B)=-1 GOTO 690
650 IF A+9>49 GOTO 665
660 IF A$=R$ AND POINT(A+9,B)=0 AND POINT(A+12,B)=0 AND POINT(A+
6,B)=-1 GOTO 690
665 IF LEN(A$)>1 THEN A$=""
670 GOTO 480
690 RESET(A,B)
700 IF A$=U$ THEN RESET(A,B-3): B=B-6
710 IF A$=D$ THEN RESET(A,B+3): B=B+6
720 IF A$=L$ THEN RESET(A-6,B): A=A-12
730 IF A$=R$ THEN RESET(A+6,B): A=A+12
740 SET(A,B)
745 A$=""
750 Q=Q-1
760 GOTO480
770 END
```

Program Listing 1. Level II Version

The easiest fix is to use the RND function in Basic as follows: Delete lines 15200 and 15300 in Listing 1 and insert the following:

```
15200  RNDNUM  LD    HL,15
15220          PUSH  DE
15240          PUSH  BC
15260          CALL  14CCH
15280          POP   BC
15300          POP   DE
```

A random number between 1 and 15 is now in A.

If you have the program in data statements per Listing 2, delete ED,5F, E6,0F and replace it with CD,B5,7F,00 in line 1140. Then, in line 1270, add 21, 0F,00,D5,C5,CD,CC,14,C1,D1,C9.

This should take care of all your problems.

Robert D. Arthur
1315 16th Ave.
Grafton, WI 53024

The True Price Is...

In the Review Digest of the December 1982 *80 Micro*, I found part of a review I did of Stellar Escort for *80 U.S. Journal* in October.

If the price of this program is $95 as you so stated, then I'll have to revise my opinion of its worth. The true price of the disk version is $19.95 plus tax.

Jerry L. Latham
1409 Evergreen Circle
Midwest City, OK 73110

Our Fault

The December 1982 Fun House column listings for Peglegs and Color

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Mark Renne
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J. Kimble Rigney
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```
100 REM * PEG LEGS / TRS-80 COLOR BASIC 4K *
110 CLS(0)
120 Q=32
130 U$=CHR$(94)
140 D$=CHR$(10)
150 L$=CHR$(8)
160 R$=CHR$(9)
170 Y=3
180 FOR X=18 TO 36
190 SET(X,Y,5)
200 SET(X,Y+22,5)
210 NEXT X
220 X=6
230 FOR Y=9 TO 19
240 SET(X,Y,5)
250 SET(X+42,Y,5)
260 NEXT Y
270 X=18
280 FOR Y=3 TO 24
290 IF Y<9 OR Y>18 THEN SET(X,Y,5): SET(X+18,Y,5)
300 NEXT Y
310 Y=9
320 FOR X=6 TO 48
330 IF X<19 OR X>35 THEN SET(X,Y,5): SET(X,Y+10,5)
340 NEXT X
350 FOR Y=5 TO 24 STEP 3
360 FOR X=21 TO 36 STEP 6
370 SET(X,Y,8)
380 NEXT X
390 NEXT Y
400 FOR Y=11 TO 17 STEP 3
410 FOR X=9 TO 45 STEP 6
420 SET(X,Y,8)
430 NEXT X
440 NEXT Y
450 RESET(27,14)
460 A=27
470 B=5
480 A$=INKEY$
490 PRINT @ 502,"SCORE";Q;
500 IF Q=2 THEN PRINT @ 32,"WINNER";
510 IF Q=1 THEN PRINT @ 0,"DOUBLE";
520 IF Q=1 AND A=27 AND B=14 THEN PRINT @ 0,"TRIPLE";
530 IF POINT(A,B)=8 THEN RESET(A,B):FOR T=1 TO 10: NEXT T: SET(A
,B,8)
540 IF POINT(A,B)<>8 THEN SET(A,B,7): FOR T=1 TO 40: NEXT T: RES
ET(A,B)
550 IF A$="U" AND POINT(A,B-2)<>5 THEN B=B-3
560 IF A$="D" AND POINT(A,B+2)<>5 THEN B=B+3
570 IF A$="L" AND POINT(A-3,B)<>5 THEN A=A-6
580 IF A$="R" AND POINT(A+3,B)<>5 THEN A=A+6
590 IF B-5<4 GOTO 610
600 IF A$=U$ AND POINT(A,B-5)<>5 AND POINT(A,B-6)<>8 AND POINT(A
,B-3)=8 GOTO 690
610 IF B+5>24 GOTO 630
620 IF A$=D$ AND POINT(A,B+5)<>5 AND POINT(A,B+6)<>8 AND POINT(A
,B+3)=8 GOTO 690
630 IF A-9<6 GOTO 650
640 IF A$=L$ AND POINT(A-9,B)<>5 AND POINT(A-12,B)<>8 AND POINT(
A-6,B)=8 GOTO 690
650 IF A+9>49 GOTO 670
660 IF A$=R$ AND POINT(A+9,B)<>5 AND POINT(A+12,B)<>8 AND POINT(
A+6,B)=8 GOTO 690
670 GOTO 480
680 RETURN
690 RESET(A,B)
700 IF A$=U$ THEN RESET(A,B-3): B=B-6
710 IF A$=D$ THEN RESET(A,B+3): B=B+6
720 IF A$=L$ THEN RESET(A-6,B): A=A-12
730 IF A$=R$ THEN RESET(A+6,B): A=A+12
740 SET(A,B,8)
750 Q=Q-1
760 GOTO 480
770 END
```

Program Listing 2. Color Computer Version

Peglegs are incorrect. The problem: A printing production error. The end of the Level II version was appended to the Color version.

The following are the correct listings for both versions. We apologize for any inconvenience we may have caused.

—Eds.

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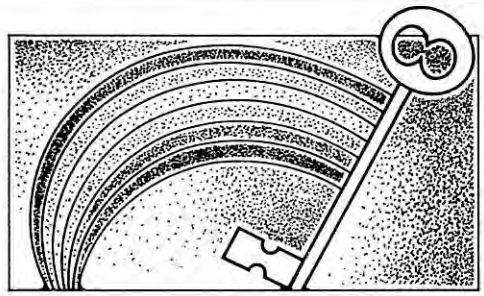
by Scott Norman



A new serial for CoCo buffs

Welcome to the first edition of The Color Key, a regular commentary on topics of interest to a personal-computer user. I will concentrate on the Color Computer, and I hope to provide a forum for discussing applications, products, and techniques.

My involvement with computers began about 21 years ago, making me one of those old buzzards who really does remember when a good-sized room was required to house a 64K machine. I used several generations of mainframes for scientific computation until six or seven years ago, when my interests switched to managerial applications. I first became aware of the personal computer a few years later, although I didn't acquire mine until late in 1980.

Ontogeny recapitulates Phylogeny, as the biologists say in their more whimsical moments; the development of an individual mimics the evolution of its species. My Color Computer started as a bare-bones 4K machine with a cassette recorder, and has gone through just about all the upgrades possible: 16K RAM plus Extended Color Basic, 32K via piggybacked 16Ks, 32K the Radio Shack way, and finally the modifications that allow access to the full 64K for running non-RS operating systems. A pair of disk drives and a printer joined up somewhere along the way, so by now it's a pretty full-bore system by Color Computer standards. The upgrades came along in stages, so I've had time to evaluate a lot of the hardware and software available for various configurations of the machine.

And that brings me at long last to something like a theme for this column. It's tough to find hard information about using commercial hardware and software to do real-world jobs with the modest little Color Computer.

Maybe I can help. I do use my machine: I write a lot with it, both as an avocation and professionally; I use it as an intelligent terminal to communicate with the mainframe at my place of business; and I use it to keep the family checkbook and calendar, as well as my personal data bases and address book. I do most of this with commercial software.

It's not that I dislike programming; in fact, I rather enjoy it. It's just that I would rather pick my spots and capitalize on the output of all the people who are already writing and selling useful software. Life is short.

One more thing—I think a thousand dollars is a lot of money. It's one thing to demand state-of-the-art everything in the personal computer with which you earn your livelihood, but there are plenty of people who would feel uneasy about selling the kids just to indulge their own passion for silicon, and others who aren't sure of the extent of their commitment to computation. I expect to keep the needs of that audience in mind in this column.

Those Software Availability Blues

Publishing lead times are substantial. I'm writing this in mid-November of 1982, a few days after my third annual visit to the Northeast Computer Show. This is a good-sized affair, held in Boston's Hynes Auditorium. This year's edition seemed to be more crowded than ever, although a few old-timers passed up the chance to exhibit.

Once again, the Color Computer enthusiast had to look long and hard for friendly faces. Radio Shack had their customary booth, actually one of the largest displays at the show, just inside the main entrance. Lots of Model IIs, IIIs, and 16s were out front, with a respectable cluster of Color Computers in the rear half of the display space.

What do you suppose was being shown by way of software? Right: Micro-bug, Poltergeist, and Clowns and Balloons. No Scripsit, no Spectaculator, no Colorfile. When I began writing software reviews, I was surprised at the number of letters I received from people who were totally unaware of the availability of anything serious for the Color Computer.

At this show, at least, the Shack seemed perfectly content to use the machine for babysitting. I was unable to find anyone who could even comment on the availability of Logo, which had been announced in the Shack's own newsletter. The response to my query was: "Our education rep was here, but he left. He's the only one who knows anything about the Color Computer. I don't know if he'll be back."

At least someone admitted to having heard of Logo. I failed to get any sort of response to questions concerning developments widely reputed to be in the works at this time: the "official" 64K upgrade and the sanctioning of OS-9 as the alternative Color Computer operating system.

A friend claims to have seen a new 64K motherboard with an E1 suffix, though. The jumpers needed to reconfigure the memory map to 64K of RAM were all installed, so that any software capable of tickling the SAM chip in the right way could do the job. I hope it's true. The Flex that I use now (Frank Hogg Labs' version) is a good operating system, but there are some attractive packages that only run under OS-9. I hope to treat them in future columns.

As for the rest of the show, I'm afraid the picture was the same. A few exhibitors were showing Color Computer games, but serious applications software was hard to find.

One machine was running a bar-graph and pie-chart demo, but all the other decent stuff was wrapped up in little plastic bags, when you could find it at all. Soft Sector Marketing trotted out the Master Control Programming aid for the second straight year, and there were a couple of terminal programs, but that was about it.

That's pretty much the story in the local computer stores, too. Even Computer Plus, a fairly busy Radio Shack-franchised discounter, has only a few nongame programs on display. The manager has told me that he just doesn't get enough inquiries to make it worth his while to invest in an inventory of non-Radio Shack word processors and other software for the Color Computer. I know that he does a brisk busi-

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ness in Color Computers, so what's the problem?

I have to assume that it's a lack of knowledge on the part of the consumer. It's a chicken-and-egg thing: There would be more demand for hardware and software if people knew that they existed, and there would be more stimulus to develop products if the market were larger.

I first learned of the existence of support material through advertisements in *80 Micro* and specialty magazines, but then I'm more of a sucker for magazines than most of humanity.

How do we ensure a continued supply of material for the Color Computer? By talking the machine up to people about to join the personal-computing contingent, and by patronizing those vendors who are already turning out quality material.

In this column, I will be discussing products that I've actually used long enough to evaluate; maybe that will help a little.

Word Processing for Real

I own two word-processing programs, and use both regularly. Why use two? I earn part of my living by writing; a professional carpenter wouldn't limit himself to just one hammer or saw for all jobs, would he? That sounds clever, but it's not good enough. For the real answer, we have to examine the state of Color Computer software.

Not too long after upgrading my computer to 16K, I bought a program called C.C. Writer from Transformation Technologies (now Trans Tek, 194 Lockwood, Bloomingdale, IL 60108). This was my first experience with personal computer word processing, and I fell for it. I bought the whole idea—the concept of editing right up to final print time, the ability to change print formats and run off a new copy, the works.

I wrote several articles and reviews with the program, too. Bill Dye, the author of C.C. Writer, proved to be very good about announcing upgrades and generally supporting his product. Apart from the Color Computer's keyboard, everything was fine—except that I gradually became aware of some deficiencies.

". . . there would be more stimulus to develop products if the market were larger."

C.C. Writer is line-oriented, meaning that each sentence in a block of text is a separate entry. There is a definite (if simple) sequence of operations to perform if you want to edit a line once it has been entered, and there are distinct operating modes for text entry and for changing, deleting, or inserting material.

You can't move whole blocks of text around, either. Finally, the C.C.'s reverse video lowercase display began to get to me after a while, although a new character-generator board eventually cured that.

About this time, a number of other word processors started to show up on the market. I went for Howard Cohen's Telewriter (Cognitec, 704 Nob Ave., Del Mar, CA 92014), and quickly found that it satisfied most of my needs. It is screen-oriented, meaning that if you have a screenful of text and want to do some editing, all you need do is move the cursor to the desired position and go to work.

There are no separate modes for the editing operations, which appeals to me because of my haphazard writing style; I correct on the fly, hopping back and forth between my current line and material I entered several lines back.

The screen format is fairly generous, too: 24 lines of 51 characters each—about as much as the TV sets typically used with the Color Computer can resolve. Telewriter also makes it pretty easy to do common editing chores such as moving or deleting blocks of text, or finding and changing strings. I have used it for perhaps two dozen reviews and articles, as well as for a lot of draft material for my job. The commands have become second nature by now.

So what was all the fuss about using two word processors? Well, the fact is that as happy as I am with Telewriter, it too has deficiencies in certain applications: correspondence, for example.

Telewriter's current edition (2.0) doesn't right-justify, and it lacks a convenient tabbing command. Telewriter

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also produces text files in a compressed binary format, rather than the conventional ASCII. This means that a conversion step is necessary before running the output through a spelling checker.

There's more. Bill Dye also produces C.C. Mailer and C.C. Merger, two other programs that I use, and they are compatible with C.C. Writer. They generate mailing lists and form letters, respectively. C.C. Merger actually uses text prepared by C.C. Writer, with special embedded commands to indicate where information from a mailing list is to be inserted.

The upshot is that while Telewriter carries most of my writing load, I still use C.C. Writer for my correspondence. I have gone along with all the upgrades for both programs, and now keep both on a single disk along with some utilities like the fast binary/ASCII conversion routine that Howard Cohen supplies.

I've also made C.C. Writer copies of the inside addresses and salutations that I use most often, such as those for letters to my editors. C.C. Writer's ability to right-justify guarantees that the right margins will all be squared, and most of my letters are short enough so that I don't mind the line-oriented editing procedure. I don't mind having to remember two sets of commands, either.

But aren't there other Color Computer word processors that combine the features of both? After all, many programs for other micros offer plenty of additional capabilities: WordStar, for instance. Indeed, there are lots of other Color Computer word processors—too many for me to have tried them all. I have used a few, though, and have to admit that most have specific advantages and most could be used for the kind of writing I do.

Tim Nelson's Super Color Writer (Nelson Software Systems, P.O. Box 19096, Minneapolis, MN 55419) seems pretty complete. It allows right-justification, produces ASCII files, and has separate commands for moving a block of text and for copying one without deleting the original; Telewriter lacks the former option. In many other respects, the two programs are quite similar, even if the commands differ in detail.

But I'm not likely to switch. Sometimes, knowing a piece of applications software thoroughly and feeling at home with it compensates for minor deficiencies, while the quirks of any potential replacement become fairly annoying.

For example, I find myself bothered by Super Color Writer's screen format and by its two distinct modes for inserting material into the middle of a block of text. It's not that they use especially awkward commands—just the clear key and one other. The point is that I'm accustomed to a still simpler system, and I like it.

That brings me to my last point. People sometimes ask if they should put off a software or hardware purchase for some indefinite period, in the hope that a better version will turn up.

If they have a genuine application in mind, I tell them to buy the most appropriate product now. There is hardly anything on the market that can't stand improvement; I'd try anything short of homicide for a decent keyboard, for example.

Just remember that in computing, as in anything having to do with high technology, you can drive yourself crazy waiting for the ultimate. Decide what's important to you, check out any reviews you can find, and take your best shot. Most products really do perform as advertised, so the differences tend to be in the details. ■

Scott Norman welcomes reader response to The Color Key. Write c/o 80 Micro, *80 Pine St., Peterborough, NH 03458.*

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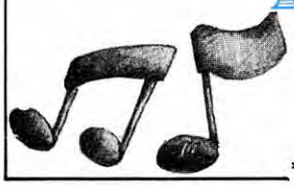

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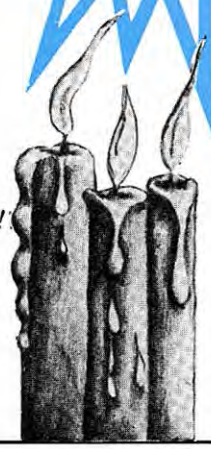

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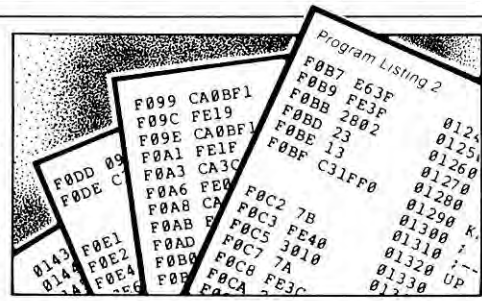

More about fixed-location routines

When you write a Basic program that uses a machine-language routine, you can either load the routine separately or as part of the Basic program itself. The first option is more valuable if you use the same routine with several different Basic programs, but it does have two major drawbacks.

First, the double-load process is often more trouble than it is worth, especially for tape systems. Second, if you want to share your programs with friends, you need to include detailed instructions for loading both programs and setting the memory size and HIMEM pointers.

The second option—including the machine-language routine inside your Basic program—overcomes these nuisances and is a better choice with short, unique routines.

This month, I will explore a method of adding fixed-location routines to Basic programs. Before beginning, however, two digressions are necessary.

Number Bases

One of the headaches of mixing Basic and machine-language is keeping various numbers and number bases straight. You will have to deal with three different types of numbers in two different ranges.

The two ranges are one-byte numbers (those the computer can store in a single byte) and two-byte numbers. One-byte numbers range from 00H–0FFH in hexadecimal and from 0–255 in decimal.

Converting from one to the other is simple using the chart in the back of your Level II or Model III manual. You can also find the decimal equivalent of any single-byte value stored in memory with the command: PRINT PEEK(addr).

The second range of numbers, two-byte values, can be more confusing. These numbers range from 0000H–0FFFFH in hexadecimal, from 0–65535 in decimal, and from −32768–32767 in the number mode that Basic knows as "integer." These numbers need some explanation.

When you use hex values, either in a machine-language program or with the &H function for Disk Basic, your computer stores the two bytes of the value in reverse order. That is, the value 789AH is stored in two contiguous bytes of memory as 9AH 78H.

The reverse order is the result of the Z80's mechanics, not the whim of a Fort Worth technician. If you forget about the reverse order, you can go nuts trying to debug a machine-language program.

The two-byte decimal values are straightforward but not used very often. You will use the decimal conversions of hex numbers (from 0–65535) to set memory size as well as with some system programs, but only occasionally inside a Basic program.

Integer values can be the most confusing, because you need to forget the definition of integer you learned in elementary school. An integer, to Basic, is any number that is stored in only two contiguous bytes (in reverse order, of course).

Basic looks at the most significant bit, bit 15, as a sign bit, interpreting the number as positive if the bit is a 0 and negative if the bit is a 1. The integer equivalents of 0000H–7FFFH are identical to the decimal equivalents of those values (0–32767), but then the fun begins.

The 32768 decimal, 8000H, is inter-

```
                ;*********************************
                ;*                               *
                ;*  Integer to Hexidecimal       *
                ;*    Converter                  *
                ;*                               *
                ;*********************************
                ;
                ; Receives integer value through
                ;   USR command
                ;   (for example: A=USR(23467)
                ; And prints Hex equivalent at
                ;   current cursor position
                ;
                ;This routine is NOT relocatable
                ;  though it may be assembled to
                ;  any convenient location in memory
                ;
                ;
7FCC            7FFFH-33H       ;TOP OF 16K ROM
7FCC CD7F0A     CALL    0A7FH   ;GET VALUE IN HL
7FCF 22FE7F     LD      (SAVE),HL ;PLACE IN POSITION
7FD2 21FF7F     LD      HL,SAVE+1 ;HL==>MSB
7FD5 CDE27F     CALL    BYTE    ;PRINT MSB
7FD8 2B         DEC     HL      ;HL==>LSB
7FD9 CDE27F     CALL    BYTE    ;PRINT LSB
7FDC 3E0D       LD      A,0DH   ;0DH=CARRIAGE RETURN
7FDE CD3300     CALL    033H    ;PRINT IT
7FE1 C9         RET             ;BACK TO BASIC
                ;
7FE2 AF         BYTE    XOR     A       ;A=0
7FE3 ED6F       RLD             ;HIGH NYBBLE IN A
7FE5 CDF07F     CALL    CONV    ;CONVERT & PRINT
7FE8 ED6F       RLD             ;LOW NYBBLE IN A
7FEA CDF07F     CALL    CONV    ;CONVERT & PRINT
7FED ED6F       RLD             ;RESTORE VALUE
7FEF C9         RET             ;RETURN FOR NEXT BYTE
                ;
7FF0 F5         CONV    PUSH    AF      ;SAVE VALUE
7FF1 C690       ADD     A,90H   ;THIS ROUTINE CONVERTS
7FF3 27         DAA             ;  BINARY TO
7FF4 CE40       ADC     A,40H   ;  ASCII HEX
7FF6 27         DAA             ;
7FF7 E5         PUSH    HL      ;SAVE REGISTER
7FF8 CD3300     CALL    033H    ;PUT ON SCREEN
7FFB E1         POP     HL      ;RESTORE REGISTER
7FFC F1         POP     AF      ;AND ORIGINAL VALUE
7FFD C9         RET             ;GO GET NEXT NYBBLE
                ;
7FFE 0000       SAVE    DEFW    0000H   ;SPACE FOR VALUE
0000            END
00000 TOTAL ERRORS
```

Program Listing 1

```
                00100 ;*********************************
                00110 ;*                               *
                00120 ;*  FLIP ROUTINE -- Relocate     *
                00130 ;*       to any convenient       *
                00140 ;*       address in memory       *
                00150 ;*                               *
                00160 ;*********************************
                00170 ;
7FE7            00180          ORG     7FFFH-18H
7FE7 21003C     00190          LD      HL,3C00H        ;HL==> TOP OF SCREEN
7FEA 010004     00200          LD      BC,400H         ;BC=SCREEN LENGTH
7FED 7E         00210 LOOP     LD      A,(HL)          ;GET BYTE FROM SCREEN
7FEE 17         00220          RLA                     ;SHIFT BIT 7 TO FLAG
7FEF 3008       00230          JR      NC,GO           ;GO IF NOT GRAPHICS
7FF1 17         00231          RLA                     ;SHIFT BIT 6 TO FLAG
7FF2 3805       00232          JR      C,GO            ;GO IF NOT GRAPHICS
7FF4 2F         00240          CPL                     ;ELSE COMPLEMENT BYTE
7FF5 1F         00250          RRA                     ;RESTORE BIT 6
7FF6 37         00251          SCF                     ;SET BIT 7
7FF7 1F         00252          RRA                     ;RESTORE BIT 7
7FF8 77         00260          LD      (HL),A          ;AND PUT ON SCREEN
7FF9 23         00270 GO       INC     HL              ;BUMP POINTER
7FFA 0B         00280          DEC     BC              ;DROP COUNT
7FFB 78         00290          LD      A,B             ;GET MSB
7FFC B1         00300          OR      C               ;MERGE WITH LSB
7FFD 20EE       00310          JR      NZ,LOOP         ;GO BACK UNTIL DONE
7FFF C9         00320          RET                     ;THEN BACK TO BASIC
0000            00330          END
00000 TOTAL ERRORS
```

Program Listing 2

preted as the integer -32768, and 8001H is interpreted as -32767. The largest possible value stored in two bytes, 0FFFFH, is interpreted as -1, because, when Basic sees the sign bit set, it interprets the number as both negative and in a form called "two's complement."

Although two's-complement values are useful for quick arithmetic routines, they can be confusing for other uses. However, you will need to use the resulting integer values inside Basic programs for addresses and PEEK and POKE instructions, among other situations.

Converting between number types can waste hours of programming and debugging time when you begin to mix Basic with machine-language routines. To convert the value in A from decimal to integer, include in your program:

```
IF A>32767 THEN A=A-65536
```

The process is reversed to go from integer to decimal notation:

```
IF A<0 THEN A=A+65536
```

To POKE a decimal value into memory, use:

```
POKE addr, A-INT(A/256)*256
POKE addr+1, INT(A/256)
```

and to read a decimal value from memory use:

```
A = PEEK(addr) + PEEK(addr+1)*256
```

The most troublesome conversions are those involving hex values. To convert from hex to integer values in Disk Basic, use the &H function:

```
A% = &H789A
```

In Level II Basic, it is easiest to write a short routine to evaluate and convert from hex to decimal. Converting from integer or decimal to hex presents new difficulties because Basic is not set up to print hex values.

Try using the short USR routine in Program Listing 1, especially while you are programming. The routine is called, after the USR pointers are set, by the command A=USR(int). The hex equivalent of the integer is then printed at the current cursor position. This is a handy routine to have in memory while you are writing mixed-language programs.

If your Disk Basic program requires a lot of base conversions, Jack Decker has published a terrific patch to the & function in the January/February 1982 issue of *The Alternate Source* (Volume III, Number 1). His program takes only 128 bytes and provides automatic conversions to and from decimal, hex, octal, and binary values.

The Flip Routine

This month's demonstration program is a short routine, called Flip, that instantly "complements" all graphics on the screen. It sets every reset pixel

```
10 '*************************************
20 '*                                   *
30 '*  Demonstration Program for        *
40 '*     FLIP Routine                  *
50 '*                                   *
60 '*************************************
70 '
80 ' First poke machine language routine into place
90 CLS
100 A=32743     'A=start address of machine language routine
110 FOR I=A TO A+24
120     READ B: POKE I,B
130 NEXT I
140 '
150 ' Here is the routine written into DATA statements
160 DATA 33, 0, 60, 1, 0, 4, 126
170 DATA 23, 48, 8, 23, 56, 5, 47
180 DATA 31, 63, 31, 119, 35, 11
190 DATA 120, 177, 32, 238, 201
200 '
210 ' Now reset Memory Size to protect program
220 A=A-1
230 POKE 16561,A-INT(A/256)*256: POKE 16562,A/256
240 CLEAR 200
250 '
260 ' Now set USR pointer
270 A=32743
280 DEFUSR0=A          'For tape system ==>
                         POKE 16526, A-INT(A/256)*256:
                         POKE 16527, A/256
290 '
300 ' The machine language routine is in place and ready
310 '   The following program demonstrates it
320 '
330 A$=CHR$(26)+STRING$(10,24)
340 B$=A$+CHR$(191)+STRING$(8,128)+CHR$(191)
350 C$=STRING$(10,143)+B$+B$+A$+STRING$(10,188)
360 FOR I=1 TO 10
370    PRINT@15,"FLIP Demonstration Program";
380    FOR J=1 TO 8
390       PRINT@ RND(11)*64+RND(53),C$;
400       A=USR(0)    'Call FLIP routine
410       FOR K=1 TO 100-10*I: NEXT
420    NEXT J
430    CLS
440 NEXT I
450 GOTO 360
460 END
```

Program Listing 3

```
                00100 ; This routine has different START
                00110 ; and TRANSFER addresses.
                00120 ; START address will be 4049H (4411H for Model III)
                00130 ; Set HIMEM (highest byte useable by operating system)
4049            00140         ORG     4049H   ;4411H for Model III.
4049 E77F       00150         DEFW    7FFFH-18H       ;One byte below start
                00160 ;The actual routine starts at 7FFFH-18H
                00170 ;This is the TRANSFER address
7FE7            00180         ORG     7FFFH-18H
0000            00190         END
00000 TOTAL ERRORS
```

Program Listing 3a

and resets every set pixel. Since it operates only on graphics, it leaves your screen text untouched.

One word of warning: Your TRS-80 can display different blank characters: CHR$(32), an ASCII space; and CHR$(128), a graphics space. They appear identical on the screen, but Flip only operates on a graphics space, not on an ASCII space.

Program Listing 2 is the Assembly-language source code for Flip. Program Listing 3 is a short Basic program that demonstrates Flip's speed and power.

The Interfacing Technique

With both digressions completed, I will explain this month's interfacing technique. Your finished program should look something like Listing 3.

The first step in this technique is to assemble the routine to the proper place in memory. Last month I presented one simple method that guarantees to put your routine at the top of available memory. Listing 2 uses that technique to place Flip at the top of 16K RAM.

As you assemble the program for the final time, be sure to note the starting, ending, and transfer addresses. As the names suggest, the starting address is the first byte of the routine, and the

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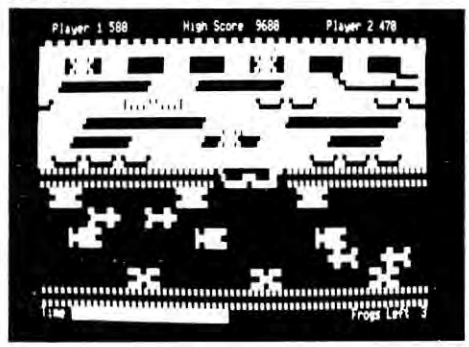

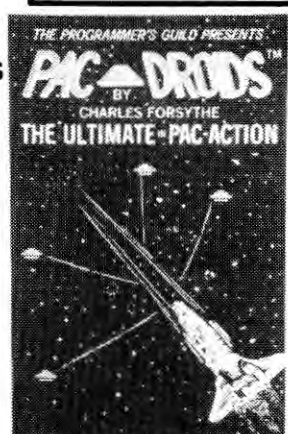

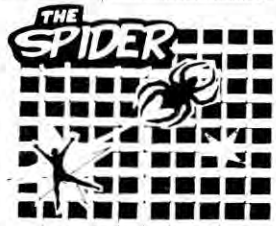

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```
10 '************************************
20 '*                                  *
30 '*  Utility to generate DATA        *
40 '*    values from pre-loaded        *
45 '*    machine-langauge routine      *
50 '*                                  *
60 '************************************
70 '
80 CLS
90 FIRST=32743        'Change these two values to
100 LAST=32767        'fit your machine language routine
110 FOR I=FIRST TO LAST
120     PRINT PEEK(I);"  ";
130 NEXT I
140 END
```

Program Listing 4

transfer address is the memory address at which execution should begin. These two can be different. For instance, Program Listing 3a automatically sets the high-memory pointer to prevent being overwritten by the operating system.

In this routine the start address is 4049H (4411H for Model III) and the transfer address is 7FFFH–18H, 18H bytes below the top of memory in a 16K machine. The latter address is the one that Basic should branch to.

You are going to be storing the machine-language routine in Basic as a series of data statements. This presents the first problem: Your assembler produces and displays the routine in hexadecimal values, but Basic data statements need decimal numbers. You must make a conversion before going any further.

If you like tedious jobs, you can do the base conversion by hand, one byte at a time, although using a utility such as the one in Listing 4 is much easier.

Load the machine-language program into memory, set memory size or high memory to protect it, and then go to Basic and run the short utility. The decimal values for your routine will be shown on the screen (or, by changing the PRINT in line 120 to LPRINT, you will get a printout of the values from your printer). Then write these values into data statements in your Basic program.

For long machine-language routines, there are some utilities that will write the data statements for you. See, for example, Dan and Cass Lewart's Datagen program in *80 Micro*, August 1981 (p. 168). Although the program as written will not work with Disk Basic, Program Listing 5 is a simple patch that avoids the incompatibility.

Write your Basic program in two parts. In the first part (lines 90–280 in Listing 3), use a For. . . Next loop to read each data value and POKE it into the appropriate place in memory. Then reset memory size to protect the routine by POKEing the appropriate values into 16561 and 16562 (40B1H and 40B2H). If you are using Disk Basic and plan to save your Basic program, use Merge or other disk-loading commands and reset high memory.

Use the Clear (or Run or New) command to force Basic to read the new memory size value and reset its own internal pointers. Finally, either use the DEFUSR command or POKE into 16526 and 16527 to point to the starting address of your routine. Your routine is now loaded, protected, and ready to use as part of your Basic program.

Although these four steps might seem more difficult than last month's separate load process, you have to think through them only once when you are writing the Basic program. After that, the computer does all the work for you. Neither you nor the operator of your program will have to worry about setting memory size or loading separate programs into the computer.

A few comments about resetting memory size in Basic. It is easy to do, but you have to be aware of two possible problems. First, all variables defined before the Clear statement will be lost. If your program needs to retain any variable values, redefine them after the Clear or else POKE them into memory and then retrieve them.

Second, do not use any string operations after POKEing in your machine-language routine and before the Clear command. Until Basic is forced to read the new memory size, the string storage and work area may overlap your machine-language routine, and your routine will be wiped out. When the routine is called, you will likely be faced with either a reboot or the cursed "silent hang" as your computer tries to execute a string as if it were machine instructions.

Fulfilling a Promise

Last month, I promised a short utility program for tape-system users. The object is to provide the same flexibility as Disk Basic users have when dealing with multiple machine-language routines. Program Listing 6 is that utility program, but before you rush off trying to use it, please read the following instructions and information.

First, the program expects your routines to be numbered from 0–9. It will not handle more than 10 routines—modifying it for more requires major surgery.

Second, you must include the trans-

```
                00100 ;*********************************
                00110 ;*                               *
                00120 ;*  PATCH for DATGEN              *
                00130 ;*    to make it compatible      *
                00140 ;*    with Disk Basic            *
                00150 ;*                               *
                00160 ;*  For original program, see    *
                00170 ;*  August, 1981, 80 Micro       *
                00180 ;*  page 168                     *
                00190 ;*                               *
                00200 ;*********************************
                00210 ;
                00220 ; CHANGE OR ADD THE FOLLOWING LINES
                00230 ;
2B75            00240 OUTSTR  EQU     2B75H           ;CHANGE LINE 220
0000 3EC9       00250         LD      A,0C9H          ;ADD LINE 242
0002 324C41     00260         LD      (414CH),A       ;ADD LINE 244
                00270 ;
                00280 ; To enter DATGEN --
                00290 ;   from Dos Ready LOAD both the CMD file
                00300 ;   and DATGEN
                00310 ;
                00320 ;   Then go to BASIC and enter DATGEN either
                00330 ;   with DEBUG or SYSTEM
                00340 ;
                00350 ;  Lines 350-370 added for correct assembly -
                00360 ;Do not print in magazine.
0000            00370         END
00000 TOTAL ERRORS
```

Program Listing 5

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```
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                00110 ;
                00120 ;  USR ROUTINE LOADER FOR LEVEL II & III
                00130 ;        TAPE SYSTEMS
                00140 ;
                00150 ;  ROUTINE USES THE FOLLOWING SYNTAX IN
                00160 ;        BASIC:
                00170 ;
                00180 ;        DEFn SETS POINTERS FOR USR ROUTINE
                00190 ;          NUMBER n TO BE CALLED NEXT
                00200 ;        0<=n<=9
                00210 ;
                00220 ;  TRANSFER ADDRESSES FOR ROUTINES MUST BE
                00230 ;        PLACED IN TABLE BEFORE USE
                00240 ;
                00250 ;****************************************
                00260 ;
                00270 ;  CHANGE THE ORG IN LINE 320 TO FIT YOUR MEMORY
                00280 ;  BUT DO NOT CHANGE LINE 620
                00290 ;
                00300 ;****************************************
                00310 ;
BFD3            00320           ORG     0BFFFH-2CH      ;TO FIT 32K RAM
BFD3 D29719     00330 START     JP      NC,1997H        ;REPORT SN ERROR
BFD6 E5         00340           PUSH    HL              ;SAVE THIS REGISTER
BFD7 D630       00350           SUB     30H             ;CHANGE ASCII TO HEX
BFD9 07         00360           RLCA                    ;MULT. BY 2
BFDA 5F         00370           LD      E,A             ;PUT IN E
BFDB 1600       00380           LD      D,0             ;  DE= n * 2
BFDD 21ECBF     00390           LD      HL,TABLE        ;POINT TO TABLE
BFE0 19         00400           ADD     HL,DE           ;HL==>ROUTINE ADDRESS
BFE1 118E40     00410           LD      DE,408EH        ;POINTER FOR USR ROUTINE
BFE4 7E         00420           LD      A,(HL)          ;GET LSB
BFE5 12         00430           LD      (DE),A          ;AND SAVE IT
BFE6 23         00440           INC     HL              ;BUMP BOTH
BFE7 13         00450           INC     DE              ;  POINTERS
BFE8 7E         00460           LD      A,(HL)          ;GET MSB
BFE9 12         00470           LD      (DE),A          ;AND SAVE IT
BFEA E1         00480           POP     HL              ;RESTORE REGISTER
BFEB C9         00490           RET                     ;AND RETURN
                00500 ;
BFEC 4A1E       00510 TABLE     DEFW    1E4AH           ;ADDRESS FOR ROUTINE 0
BFEE 4A1E       00520           DEFW    1E4AH           ;ADDRESS FOR ROUTINE 1
BFF0 4A1E       00530           DEFW    1E4AH           ;ROUTINE 2, ETC.
BFF2 4A1E       00540           DEFW    1E4AH
BFF4 4A1E       00550           DEFW    1E4AH           ;1E4AH IS ADDRESS FOR
BFF6 4A1E       00560           DEFW    1E4AH           ;FC ERROR IF NO ROUTINE
BFF8 4A1E       00570           DEFW    1E4AH           ;ADDRESS HAS BEEN PLACED
BFFA 4A1E       00580           DEFW    1E4AH           ;IN THE TABLE
BFFC 4A1E       00590           DEFW    1E4AH
BFFE 4A1E       00600           DEFW    1E4AH
                00610 ;
415C            00620           ORG     415CH           ;DON'T CHANGE THIS ADDR.
415C D3BF       00630           DEFW    START           ;PATCH IN OUR PROGRAM.
0000            00640           END
00000 TOTAL ERRORS
```

Program Listing 6

fer (or starting) address of each routine in the look-up table at the end of the program. You can either include it there when you assemble the program, or your Basic program can POKE the values there.

Third, before calling any routine, you must define it with the command DEFn, where n is the number of the routine you will use next (n must be a single digit between 0 and 9). For example, the following would call and run routine number 4:

```
150 DEF4 : A = USR(0)
```

Fourth, the routine will generate normal and expected messages on error conditions. If DEF is not followed by a single digit, a SN error (illegal syntax) will result. If the address of the DEFined program is not in the look-up table, a FC (illegal function call) error will result.

Finally, the program uses the Disk Basic exit at 415BH to patch into the DEF verb. If your Basic program or any of your routines also use that portion of memory, a conflict will result with unpredictable, probably dire, results. Although few programs will face this conflict, be warned.

The program can, of course, be assembled to any free area of memory, but do not change the ORG in line 620 for the DEF verb patch. Be sure to set memory size to protect this program, as well as all other machine-language routines in memory.

Next month, I'll discuss some of the ins and outs of relocatable routines. ■

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Dave Smith
Review in 80 Microcomputing

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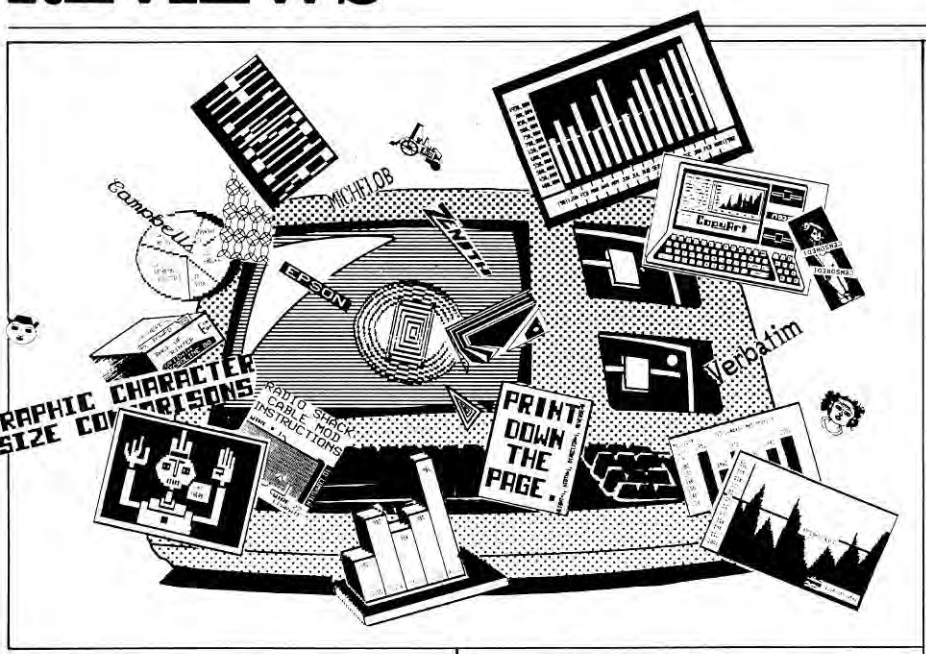

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★★★★

CopyArt II
Simutek Computer Products
4877 E. Speedway Blvd.
Tucson, AZ 85712
Models I & III
$149.95, disk

by Dan Robinson

CopyArt II is now on the market, with even more fantastic graphics capabilities than the first version. The program is a full-function word processor that features billboard characters, boxes, and computer-drawn artwork. CopyArt II adds dot-addressable graphics for printers such as the MX-80 with Graftrax, permitting you to draw a full screen and shrink it down to a high-resolution square inch.

For those of you not familiar with the word-processing features of the original CopyArt, the program is patterned after Scripsit, and uses the same text display above the command bar. Format commands in the text are typed in the same manner, and the familiar @ key is used for control. CopyArt has chosen more logical key combinations, however, and the D key is used for delete, the I for insert, and so on.

The break key is used in conjunction with letters to perform control functions, such as setting screen width, finding, replacing, loading, saving, or killing files, or determining free space. You can send control codes to your printer or program custom keys. A Help file is standing by for the needy.

Text can be centered and printed flush right, left, justified, or ragged. Underlining, boldface or emphasized printing are supported, as are italics, sub- and superscripts, if your printer can handle them. CopyArt supports proportional justification on a number of printers, and text files can be chained for printing.

CopyArt has a unique method of printing multiple columns so that printers incapable of reverse line feeds can produce an index or newsletter. A format code specifies the number of columns to be printed, and a page of data is formatted and written to a temporary disk file for each column.

Then a line from each column is read from the disk and printed in turn. Headers, footers, and page numbers will behave even if a half-dozen columns are used.

The Graphics Modes

CopyArt has two graphics modes. Both permit creating graphics that will be printed as integral parts of the completed text. Basic programs saved in ASCII can be edited with CopyArt, providing an easy alternative to string-packing graphics codes.

To print large block letters, a routine is called from the auxiliary editor that prompts text to be typed below the command bar. When it has been entered, a query is displayed for the height, width, direction (horizontal or vertical), and whether the letters are to be printed as positive or negative characters. You can even specify italics. In a moment, the letters commanded appear on the screen, ready to be sent to the printer exactly as they have been shown.

The screen width or window can be set up to 255 characters to accommodate wider graphics if desired. These can be printed in a dense-condensed mode on printers like the Epson MX-80 and the Okidata 82A. If you have Graftrax Plus on your Epson, CopyArt II will convert block graphics to dot graphics to produce the effect.

The second graphics mode uses the cursor as a computer paintbrush. In this mode, you move the cursor with the arrow keys leaving a string of graphics behind it. You can move the cursor without creating graphics or for erasing mistakes, also. This utility permits you to create bar charts, surround a block of text with a box, or draw detailed diagrams and illustrations.

You can also set points on the screen and then plot a line between them, draw circles, squares, or fill in the area between graphics markers. If you wish, you can reverse your drawing so that it

will be printed as blank spaces over a black background.

With dot-matrix printers, CopyArt changes type font with the Size command in a format line. On the MX-80, this produces condensed, regular, expanded-condensed, or expanded fonts. If the printer incorporates Graftrax, the command can be used to produce high-resolution dot graphics. This will convert a screen pixel to a single dot on the printer.

CopyArt II adds a number of new utilities to the word processor. It includes a Sort command that will order lines of data in ascending or descending order, using the column below the cursor as its sort key.

A math routine can perform add, subtract, multiply, or divide functions by row or column. The answer is presented in dollar-and-cents format or in high precision with up to 16 places behind the decimal point. In either case the answer will be neatly aligned by decimal point.

CopyArt has its own mail-list program that permits you to enter, edit, and sort a 9-field mailing list. The program is called from DOS, and the screen displays the CopyArt field names. These include the last and first names, company, address, city, state, and zip. A one-digit code represents Mr. or Ms., and Mail-List supports a two-character code of your own choosing. Data can be entered or edited, and searches or sorts can be performed on any field. Labels can be printed from Mail-List.

CopyArt can use the file created by Mail-List to produce form letters, inserting data from the mail list for each record wherever a field identifier is found. You have the option of printing only selected records that match the code you entered in the custom field of Mail-List.

This product has a unique bear trap to fend off predators: A coded key is supplied with each copy of the program and is inserted in the cassette port. Although unlimited back-ups of the software can be made, CopyArt II won't run unless the key is in place.

Scripsit fans will love the improvements that CopyArt has made. If you need graphics capabilities in your word-processing application, CopyArt II is still way out in front. ■

★★★★

Zorlof Word-Processing System
Anitek
P.O. Box 1136
Melbourne, FL 32935
Model I or III, disk
$70

by Mark E. Renne

Zorlof is a second-generation word processor. Like all second-generation products, it derives its basic functions from a first-generation industry standard, but is so radically different that it's in a class by itself.

Features

Zorlof has incredible features for its price. All the things we've come to expect from word processors—word wrap, full-screen editing, varied margins and page size, auto-page numbering, headers, and footers—Zorlof does. More importantly, Zorlof does those things *better* and adds features. For example, headers and footers can be different for odd and even pages. If you've ever written a manual or instruction book, you'll appreciate this feature. Even page numbering can be different for odd and even.

My favorite feature of Zorlof is its preview option. This feature allows you to preview your text in its near-final form on your screen before printing it. Obviously, your screen won't display underlines or superscripts and so on, but the preview does show centering, margins, spacing, and what the document will physically look like. The display is also free of any word-processing commands, i.e., end-of-line markers or print instructions. Justification either right, left, both, or center can also be displayed as you write the document.

Zorlof displays the following constantly-updated information at the top of the screen: name of document, width, words, lines, free memory, find variable, and replace variable. The word and line tallies are a handy reference for authors.

The Search and Find feature is excellent. Zorlof is not deferred by upper- or lowercase differences at all. This means that *any* occurrence of the particular word you are searching for will be found regardless of whether it's capitalized. In the manual mode of this command, Zorlof stops at the targeted word and gives you the option of replacing it. If you prefer, Zorlof will automatically replace words without your intervention.

You can get a directory of any drive at any time. Files can be loaded into any place in the document directly or from the directory listing. Files can also be killed from the directory listing, useful for the times when the disk is nearly full and you need to make room for a current document.

The cassette relay is used to provide a tactile feedback that a key has been pressed. This feature is easily disabled for those of us who are anti-IBM. Inserting in the text is quick and easy and accomplished by a special insert cursor. A document can consist of up to 27,152 characters on a 48K machine.

Printing

Zorlof allows you to selectively print sections of a document and to leave large areas of blank space. Up to 13 documents can be placed into a printing queue for printing at a later time. Paragraphs can be set off in the middle of the document by a command to indent the margins on the left and right sides by a number you specify.

Most printers are supported and the program incorporates special functions directly. On other printers special functions can be passed to the printer through control codes. Proportional spacing, on those printers that allow it, is fully supported by Zorlof. Bold face, underline, subscript, superscript, and even italics are directly available through the program. Even expanded or condensed characters are fully supported.

Editing Commands

There are a total of 58 editing commands all executed with one key and the control key. These commands include the standards (delete word, insert line, delete character) and also some unusual ones. Text can be scrolled up or down one line or a screenful at a time.

Basic or editor/assembler files can be edited by Zorlof and it even provides tabbing appropriate for each. Limited renumbering is also available; line num-

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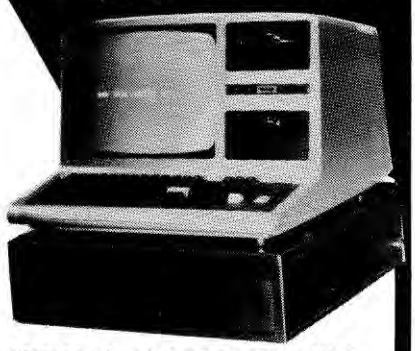

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bers change, but not references.

The Documentation

Documentation is above average, though it lacks an index and a complete table of contents. The 82-page manual is enclosed in a soft plastic binder and includes a full-size, hard reference card.

I found only one serious fault with Zorlof: the inability to set tab stops. Tabs are preset at intervals of seven across the screen. There is no way to change tabs to suit individual needs. Also, there is no way to generate less-than or greater-than symbols directly from the keyboard, as the program replaces them with curly brackets. This would seriously limit the ability to write Basic programs using Zorlof as a screen editor. They can be printed, however, by using the program's special-character feature.

Zorlof is an excellent value and works nicely with the new printers on the market. It operates under most DOSes and with over a dozen different printers. Anitek also offers a 30-day, "no questions asked" money-back guarantee—how can you go wrong? For well under $100, computer owners can have a complete disk-based, word-processing system with state-of-the-art features. ■

★★★

MDX-4
Micro-Design
6301 Manchaca Road, Suite J
Austin, TX 78745
Parts Kit $29.95 (Bare PC Board)
Computex
321 El Dorado
Webster, TX 77598
$39.95

by Mel Patrick

The MDX-4 is a direct-connect phone modem supplied as a bare printed circuit board.

If your requirements for a modem do not include all the frills and if you don't mind spending a few hours soldering a few parts, the MDX-4 is an economical alternative.

You can obtain all the parts independently through the many electronics parts suppliers listed in electronics magazines (a complete parts list is supplied with the board) or you can buy a parts kit (all in sealed plastic packages) available from Computex. You can also order the printed circuit board from Computex as well.

The MDX-4 double-sided printed circuit board is made of high-quality glass-epoxy. It measures approximately 6 by 6 inches. All components, with the exception of the power transformer, mount on the board. The kit contains three separate power supplies (+5, +12, −12 volts), all the active filtering for the frequencies involved, the modem chip (a Motorola MC14412 device), and even a fuse. Heat sinks are not required on the three power supplies because of the low current drain.

Although the advertisement claims that the modem is capable of 0–600 baud, the manual states that it is a standard 300 type. While this may seem like a major point, most computer information services (including the bulletin boards) usually only have 300 baud available. CompuServe does have a 1,200-baud option, but there is an extra charge for this. The modem also offers both Answer and Originate modes.

Since the MDX-4 is directly connected to the telephone line, it provides greater reliability for communication as it is more immune to noise than an acoustic modem (and more compact). A DB-25 standard connector provides a method of connecting the modem to the computer. There is also a pair of foil solder pads should you want to hard-wire it to your computer.

Construction

I completed my board in a little over one hour; I estimate that the novice builder would require about 2½ hours for completion.

The PC board is clearly silk-screened with the part numbers, and Micro-Design has thoughtfully duplicated this on the front cover of the manual to help with the ease of assembly.

The manual includes an assembly instruction section. It is not like a Heathkit manual (an industry standard for kit manuals), but it is clear and concise. Sockets are used for all of the ICs and facilitate repair should the need arise.

Nine ICs are installed first, followed by the resistors and capacitors. Next, the power supply regulators, diodes, crystal, and two switches are installed.

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These switches allow you to switch modes from answer to originate and to connect or disconnect the modem from the phone line.

Once all this is done, you wire the power transformer to deliver the proper operating voltages. This is a relatively simple job and takes only a few minutes.

After connecting the transformer to the PC board (which has none of the integrated circuits installed yet) there are three voltage checks to be made. This ensures that you haven't made any errors while assembling the power supply section. This test does require that you have (or have access to) a voltmeter capable of measuring from 0 to 15 volts dc.

These voltages (+5, +12, −12) may be out as much as 10 percent. This is not unusual, so don't worry if the reading you get from the +5-volt supply line is anywhere from 4.8 to 5.2, for example. Last, you install three jumpers to connect the power supply to the main circuitry.

The manual explains the operation of each of the individual sections of the board. It also supplies a self-test section, making calls to a local network for modem testing unnecessary.

Operation

Before you can use the MDX-4, you must install two telephone jacks. One of these will connect from the PC board to your wall jack and the other from the PC board to your telephone. Next, all you do is select the answer or originate modes, dial a network on the phone, listen for the modem's signal, and flip the switch that cuts off the phone and places the modem on line.

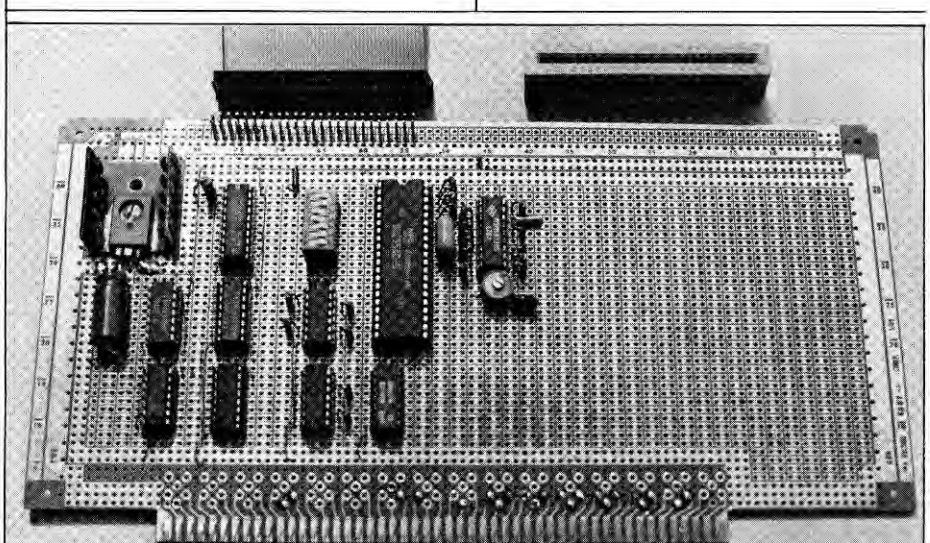
Since the MDX-4 works with any RS-232 port, I use it with my Color Computer. I had a little trouble finding the four-pin DIN plug that fits the Color's RS-232 port. Until I found a Radio Shack that had one of these connectors, I made a makeshift one out of a standard five-pin DIN plug. After connecting it to the computer, I tested it with ColorTerm (reviewed in the December 1982 issue) and a remote bulletin board, and it worked perfectly.

Comments

The printed circuit board is well designed and parts layout is not crowded. Most of the parts are easily obtainable except for the one-percent resistors (for the filters) and the MC14412 modem chip.

If you order the parts from Computex, you receive a complete set except for the line cord (which goes from the transformer to the wall for power), a female DB-25 connector (to connect the modem to your computer), and the telephone jacks. These parts are easy to come by at any Radio Shack store.

Don't use the Radio Shack cable they use for connecting their Modem I to the Color Computer. It is a male DB-25 connector. If you want to use this cable, buy a female DB-25 and install it on the PC board instead of the male (which is supplied by Computex in the parts package).



The completed MDX-4 board.

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By Roger Schrag

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Perhaps the only drawback to the MDX-4 is that there is no way to tell if you have a carrier locked on. The board has no provision, nor does the manual mention how you install a carrier-detect LED. This would be a very useful option and I hope that future revisions will have it.

Should you have any trouble or questions about the operation or assembly of the MDX-4, Micro-Design is more than willing to help. The PC board I received (revision C) had five empty places silk-screened where parts were obviously meant to go. I phoned Micro-Design (after business hours) and expected a recording. Instead, I got the president and designer of the Micro-Design products, Mike Shapiro.

He said that although these parts were silk-screened, they had found in testing the MDX-4 that they were not needed. These were capacitors (.1μF) that were used as filters on the power supply lines beside each IC. I have since tried my MDX-4 with and without these, and have noticed no change in operation.

I have used my MDX-4 for some time now, and have had no problems. I am quite satisfied both with the project and with Micro-Design's support. If you are thinking about buying a modem and can solder neatly and follow instructions carefully, I recommend an MDX-4 as an economical approach to computer-aided communication. ■

★★★½

Key Commander
Interpro Corporation
P.O. Box 4211
Manchester, NH 03108
Models I & III
$29.95, cassette
$34.95, disk

by Peter Ashley

Key Commander is a full-screen editor by Jake Commander, which provides a nondestructive cursor for screen editing. It claims to be self-relocating, self-modifying, and self-protecting. And most of this is true.

Capabilities

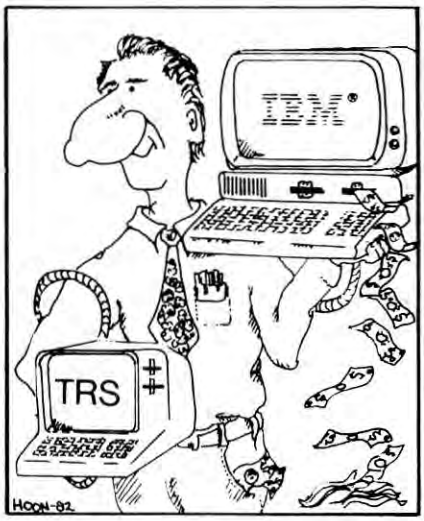
Key Commander allows you to assign keys A–Z, shifted or unshifted, with whole commands (List, GOTO, STRING$, and so on), similar to the old TSHORT program. This includes program lines and graphics pictures. You can save your own key assignments on disk or tape or use the preprogrammed key assignments. You can also assign graphics with this feature. Once a key is assigned (easily done from Basic), you call it by pressing the shift key along with the assigned key. You can unlock the key assignments to regain control of upper- and lowercase with a few simple control-key moves.

I have found special key-assignment utilities such as this very useful in the past, although I usually do not bother with them for such commands as For or Next, which are almost easier to type from the keyboard. This program's key-assignment feature let's you assign graphics to certain keys so that pressing an assigned key prints a picture on the screen. This feature is quite flexible, especially with the graphics capability, and also fast and easy to use. I give it an A.

Once you are in Basic with Key Commander loaded into high memory, a screen editor similar to word processors like Scripsit can be used by simultaneously pressing the shift, down arrow, and R keys. Zap, a new, larger, flashing cursor appears on the screen. You can move this cursor about the screen with the four arrow keys. Incorrect line numbers and text can be changed by typing over them. When you wish to exit the screen-edit mode, hit the enter key. When you List your program, all changes are shown.

You can access the Key Commander graphics mode with a few more keystrokes. Once there, six keys (Q, W, A, S, Z, X) control the six pixels found in each of the TRS-80's graphics blocks. By pressing these six keys, you can create all kinds of on-screen graphics. If you combine this with the screen editor, you can build them into numbered lines.

This graphics-print feature has great potential as you can draw pictures on the screen and at the same time easily build them into Basic programs using print statements. No more thumbing through manuals to locate the graphics code for a particular shape.



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There are a few other less spectacular, but helpful, features thrown in. All the keys repeat. I already had repeating keys built into my DOS, but it seems to work a bit faster with Key Commander. Also, the shift key homes the cursor.

The Disk Version

With the disk version you receive two key-assignment tables. The first table lists DOS commands callable with shift/key combinations, and the second lists those keys that are graphics.

For the $5 savings I purchased the tape version, which is the same for both the Model I and Model III, and converted it to disk with no problems. If you do have a disk system, the disk version is probably a wiser choice, because of the extra key-assignment files.

The Manual

The manual is complete, but not perfect. It contains detailed information on loading and running Key Commander as well as several demonstrations, a summary of special command keys, and preprogrammed shift/key assignments. There is also the customary warranty: free replacement if defective within 90 days.

There is even a registration form should you wish to register your purchase, assuming updates will be mailed. Unfortunately, this page must be torn from the manual to be mailed.

My copy of the manual seems to be a rough draft. It contains several updates and hand-written changes. Better use of space and separate headings in larger print would have been welcome.

I also wish that all documentation would come in a standardized size. I like an 8.5-by-11, three-ring binder format. Still, the manual (5.5 by 8.5 inches) is far better than early documentation attempts from much larger companies.

Reservations

Although I found the added features Key Commander gave my Model I of great value, I did have some problems. An "Important Update" on the third page of the manual states that Key Commander is not self-protecting under some DOSes, namely NEWDOS80 and DOSPLUS (those DOSes that do not honor high$). Of course I own DOSPLUS. An explanation and a solution to this bug is given and with the Do capability, Key Commander loads almost as if it were "self-protecting." The DOSPLUS update states that after loading the program, a message will appear informing you as to a guide number for setting the memory size. This number is called the "Warm Start."

"If you do have a disk system, the disk version is probably a wiser choice, because of the extra key-assignment files."

On my computer the warm start number equaled 63865—so far so good. However, just below that the instructions read: "Subtract 500 from this number and enter that as the memory size when going into Basic." When you subtract 500 from 63863, you get 63363. But whenever I set the memory size at 63363, I get an out-of-memory message. After some experimenting, I found that the highest memory size value I could use was 65294. This minor bug may be a peculiarity of DOSPLUS or a misprint in the manual.

In Conclusion

I recommend Key Commander. It takes a bit of reading and experimenting to master, but it is very flexible and increases the power of your computer considerably. Not only that, it's fun.

For the price, you get quite a bit. You can find shift-key programs for less, but not with a full-screen editor and those easy graphics in one nice, neat package. ■

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Kraft Joystick
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★★★
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Endicott Software
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★★★½
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Jarb Software Inc.
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$35.95 each

by Carlos Calle

Five of the six Color Computer joysticks reviewed here use a *potentiometer*, an input device that accepts directional information about two axes by the use of two potentiometers or variable resistors linked mechanically.

The variable resistors are employed as voltage dividers with a 5-volt potential difference applied to the ends of the resistance element and the output voltage taken from the slider (controlled by the stick) and one end of the element. Figure 1 illustrates this.

By mechanically linking both sliders on the potentiometers, the stick can control the horizontal and vertical positions of the screen cursor simultaneously, permitting diagonal motion.

The other kind of joystick uses switches instead of potentiometers. The switch joystick is less precise because it provides less information and allows motion in only eight fixed directions. This is the type of joystick used by the Atari computers and video games. The

potentiometer joystick is superior although more delicate.

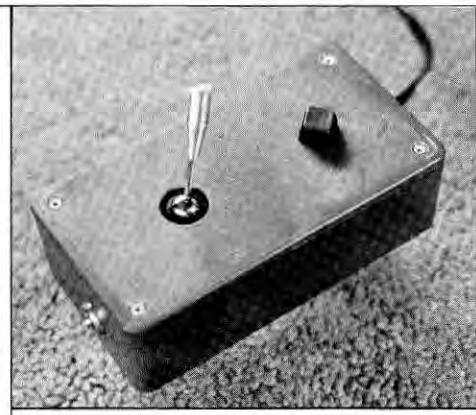
The Spectrum Joystick

This is a fairly large (6 by 3 by 2) joystick built in an experimenter's box of the kind sold at any Radio Shack or electronics supply store. However, the feeling of this joystick is superb. The actual stick is a large aluminum rod that provides for a good grasp; and the swivel ball friction gives a tight, precise control of the movement. The power on/off LED indicator in front of the unit is a very nice feature.

The fire button is on the top face of the unit and is a bit stiff. You can get tired when playing games where the button must be held down all the time. It seems natural to place this joystick on a tabletop as it is rather large. It comes with a nine-foot cable; although you might not need a cable this long, some people will find it handy.

Except for the light plastic box the components of this joystick are sturdy. The potentiometer assembly is larger and sturdier than the one in the Radio Shack unit. However, it is glued to the inside top face of the box, and in feverish playing it can come loose as it did in the first unit I tested. I cured this problem by drilling four holes and installing corresponding screws. The second unit I tested had a lighter potentiometer assembly, which accounted for a looser feel, and has withstood several hours of continuous heavy use. This is the current version of the Spectrum Stick.

In summary, the Spectrum Stick is an



The Spectrum Joystick

ugly-duckling unit that uses excellent components and performs beautifully, although it would be preferable to have the potentiometer assembly more securely attached. If appearance is not important to you and performance is what you are after, this joystick could be for you.

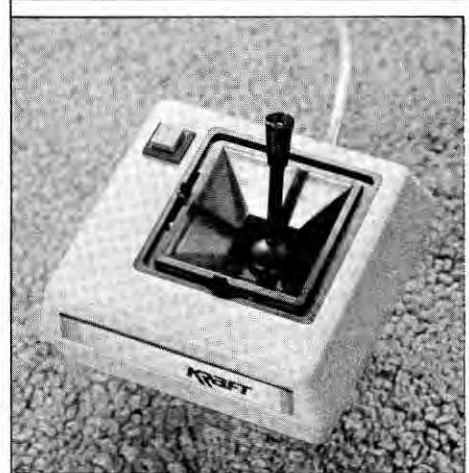
The Kraft Joystick

This is a feature-packed unit and the nicest looking joystick I have seen for any computer (Kraft makes similar units for Apple and the IBM personal computers as well). The Kraft joystick is color coordinated with the Color Computer and even has the same tilt and height as the computer keyboard.

Opening the unit reveals a professionally made precision instrument full of details that disclose fine craftsmanship. The plastic case has small guide pins that provide for a perfect fit; the connectors are bundled together and tied with nylon string; and the top side of the box has plastic rail-like rods that slide smoothly onto the potentiometer case. The gimbal design of this joystick, which is found only in radio-controlled model airplanes, provides a more accurate cursor control and faster motion.

The Kraft joystick has two modes of operation: a free-floating mode and a spring center return mode. Both are selectable from external switches at the bottom of the unit and are properly marked X and Y so that you can set either one or both directions. When only one axis is centered, the joystick acts very much like a paddle control with the added feature of allowing you to override the linear direction if desired.

On the top face of the unit there are two levers located perpendicular to each other, which allow fine adjustments to the joystick so that the center position can be redefined. The two trim tabs and the stick are located in the stick housing.



The Kraft Joystick

The fire button is positioned to the left of this housing for left-thumb operation.

The Kraft joystick feels pretty much like the Jarb Dual joystick, but is tighter than the original Radio Shack design. The free-floating mode feels similar to the Spectrum or the Dual units. However, you can get easily spoiled by the convenience of what I call the paddle mode, with only one axis locked for games that require motion in only one direction, as in the Space Invaders kind.

Of course you pay for the features and aesthetics of this joystick, and $130 is perhaps too much to pay for a pair of joysticks, unless you must have the best.

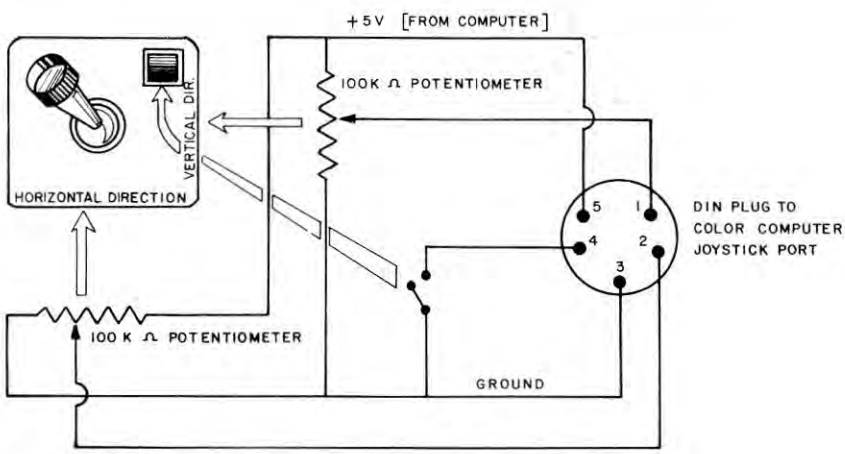


Fig. 1. Potentiometer Joystick

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- Optional second address line.
- Optional reversal of names about commas. This permits disk storage in last-name-first order to facilitate meaningful ordering while the printout will be in "natural" order.
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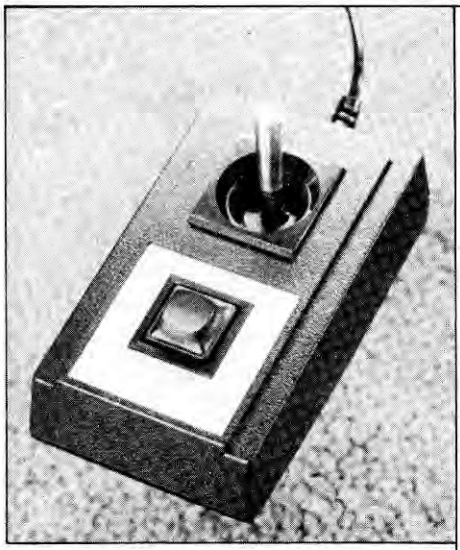


The Endicott Joystick

The Endicott Joystick

This new entry from Endicott Software is a hand-assembled unit that resembles the Radio Shack original design in feel and control capability. The shaft is short (about an inch and a half), but since it offers very little friction, it is easy to control with one finger. The fire button is on the top face of the joystick and requires very little pressure to be activated, although it travels about a quarter of an inch. It provided the best feel of all the joysticks tested.

Because the Endicott joystick uses similar components as the original Radio Shack design, it may fail to generate some of the points at the corners of the 64-by-64 grid. I couldn't reach points (62,63) and (63,63) in the model I tested. This, however, should not interfere with any of the graphics or games available for the color computer.

In short, the Endicott joystick is a pleasant-looking, rugged unit at an affordable price. However, the mechanical link of the potentiometer assembly provides for a loose feel that might lead to imprecision. The unit is nevertheless well made and is backed by a 90-day warranty on materials and labor. After the expiration of the warranty, Endicott Software will rebuild worn out joysticks for a small charge.

The Radio Shack Joystick

Radio Shack has once again changed the design of its joystick by restoring the longer shaft as in the original version. The current model features a lighter and smaller potentiometer assembly. The whole unit, however, seems sturdier, perhaps because of the small swivel-ball mechanism that accounts for a tighter feel with no backlash. The plastic box and fire button remain unchanged.

Their new design allows the joystick to generate all the points of a 64-by-64 grid, even though the instruction sheet still contains a diagram showing 18 points that were not attainable with the earlier design.

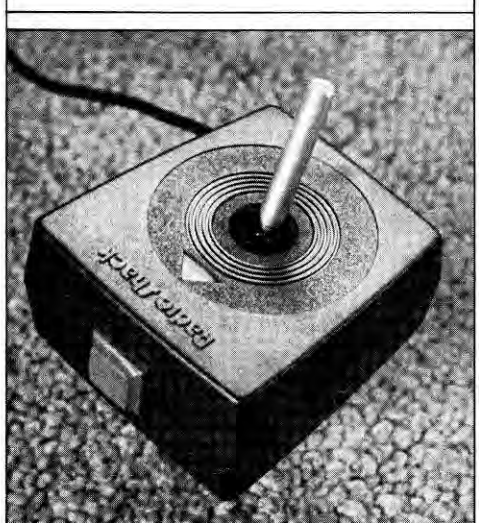
This improved joystick is still the least expensive of the joysticks available for the Color Computer and compares favorably to at least one of the more expensive units.

Jarb Dual Joystick

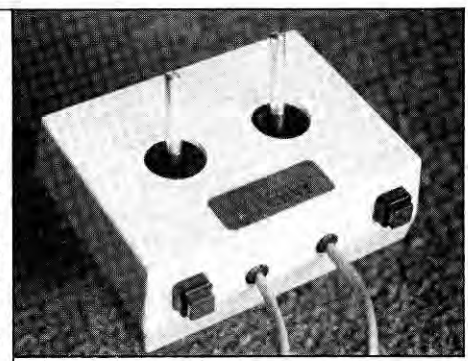
This joystick is different from all the other models for the Color Computer in that, as its name indicates, it has both units assembled into one box, with two cables, two fire buttons and, of course, two shafts.

Of all the potentiometer joysticks tested, the Jarb Dual joystick is the heaviest, due, in part, to the dual nature of its design. But the unit weighs more than twice the average of the other units, which gives an idea of its ruggedness. The two cables are the same heavy five-conductor cables used in the Kraft design. The two square fire buttons are mounted on the same front face and are identical to the ones used by the Spectrum Stick.

The two handles, located on the top face, are two aluminum rods two inches long and one-quarter of an inch thick, and present an average resistance to motion, about equal to the Spectrum and the Kraft joysticks.



The Radio Shack Joystick



The Jarb Dual Joystick

Opening the unit revealed a printed circuit board in lieu of the mesh of wires, which gives this design a very professional look. The two potentiometer assemblies are screwed to this board, which is attached to the housing with three screws.

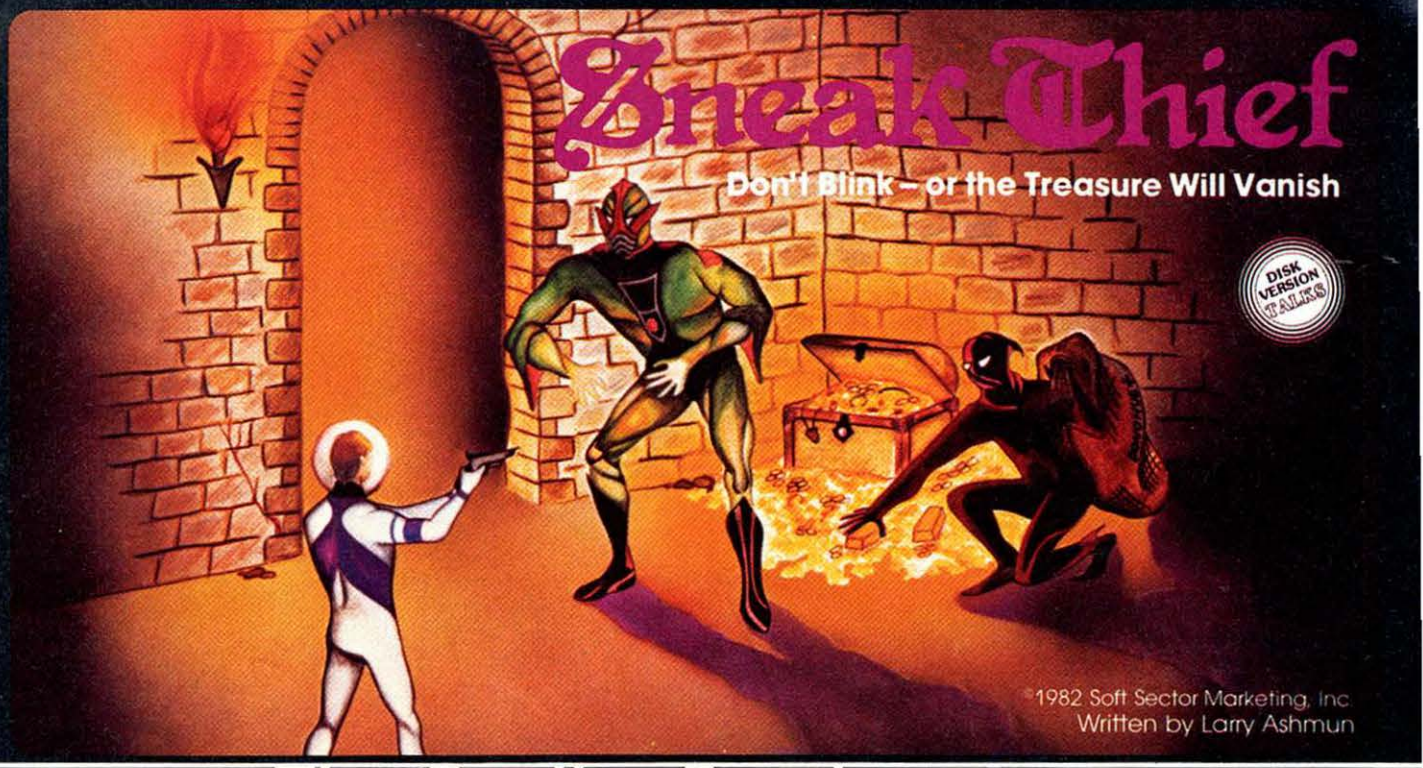
The unit I tested could not generate the (0,63) point with either control, but this is only a minor problem.

The Dual Joystick was designed for two-stick games played by one person. We tried it with several games and found it difficult at first to control two joysticks and fire two buttons that presumably perform different functions on the game. However, after some practice we could almost manage and if we had tried long enough we could probably have mastered it. We would have preferred the fire buttons be placed on top of the unit for easier maneuverability. If this were so, however, two players would interfere with each other's motions as the control shafts are only two inches apart.

The Dual Joystick comes with installation instructions (in case anybody needs them) and a useful test program. It is warranteed for 180 days. It is an excellent and attractive joystick, but for one player only.

Wico Command Control

This mammoth joystick is of the switch kind (like the Atari), meaning that only eight directions of motion are achieved by moving the handle forward, backward, left, right, and to each 45-degree angle in between. By moving the handle, contact is made with each one of the four leaf-type molded switches inside the housing or, for the 45-degree motion, with two switches simultaneously, thus providing the eight-way control.



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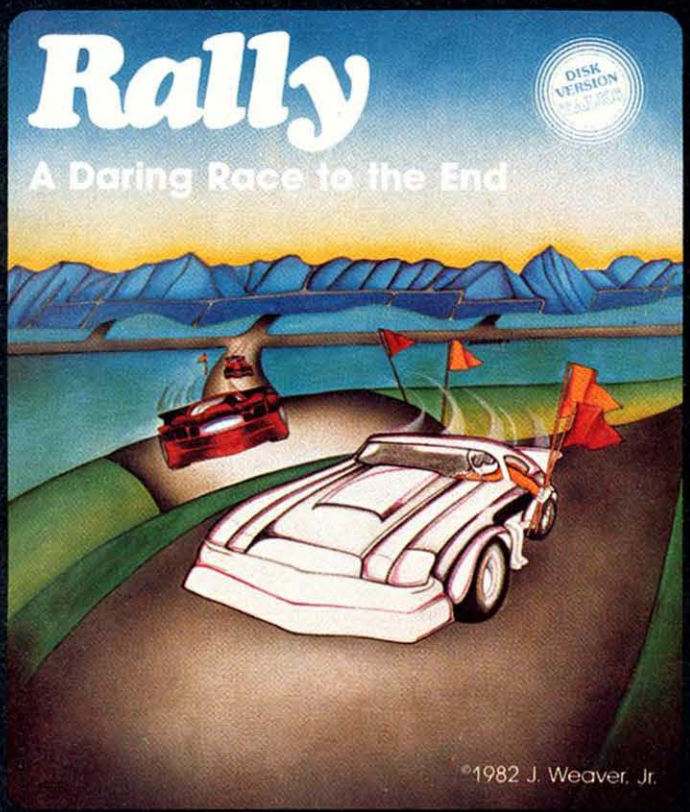
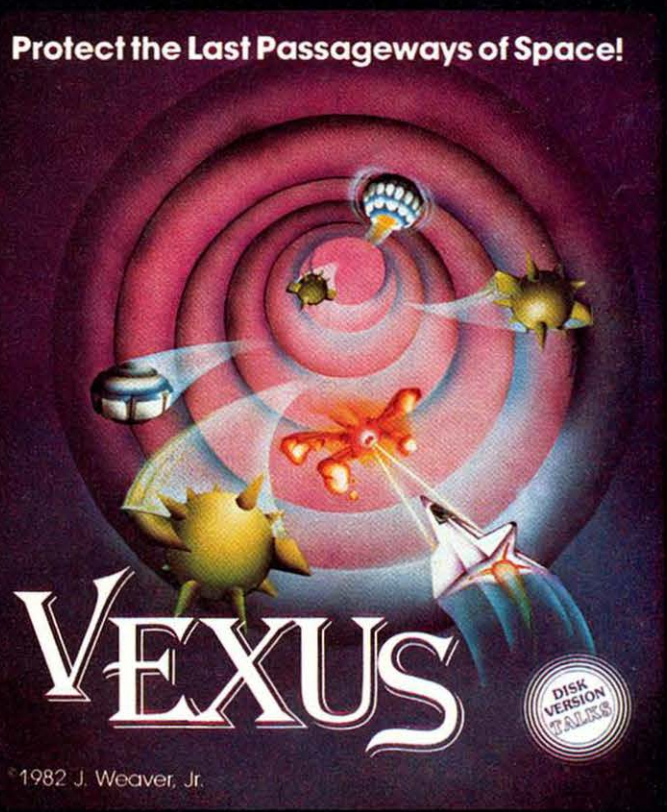




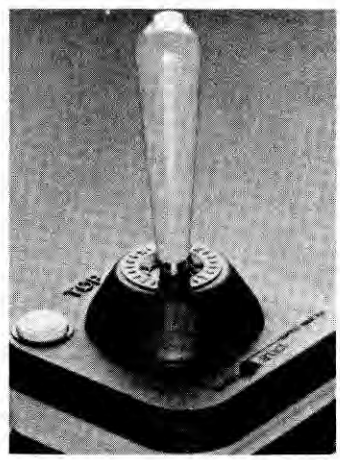
Model	Price per unit	Price per pair	Housing Dimensions (inches)	Shaft Dimensions (inches)	Weight (oz)	Force to move Shaft (grams)	Length of Cord	Color
Endicott	$19.95*	$37.95*	4×2 3/8×1 1/4	1 1/2×1/4	4	10	5′ 5″	Black
Jarb Dual	$35.95	—	5×3 3/4×2	2×1/4	14	30	5′ 5″	White & Gray
Kraft	$64.95	$129.90	4×4×2 1/4	2×3/8	8.5	30	5′	Silver
Radio Shack	—	$24.95	3×2 3/4×1 5/8	1 9/16×1/4	4	50	5′ 8″	Black
Spectrum	$39.95*	$79.90*	6×3×2	1 7/8×3/8	8.5	40	9′	Blue
Wico[1]	$29.95 +$7.95 for adapter	$59.90 +$7.95	4 1/2×4 1/2×1 1/2	4×1	13	N/A[2]	5′	Red & Black

* Plus $2.00 S/H
[1] Switch-type Joystick
[2] A switch-type joystick displaces only slightly and returns to the original position.

Table 1. A Comparison of Six Joysticks

Wico manufactures this joystick for the TRS-80 Color Computer, Atari, Texas Instruments, Apple II, and Commodore Computers, and sells an adapter separately to fit each one of these machines.

The housing of this joystick is a 4½-by-4½-by-1½-inch box with an elevation on the top face that raises it an extra inch to provide support for the huge red handle—a four-inch-long, one-inch-wide plastic shaft with a steel core meant to withstand just about any abuse. Two fire buttons are provided, selectable by means of a slide switch on the joystick base; one is at the top of the handle (I used this one the most for its convenient location) and the other, a big ¾-inch diameter red button, is placed at the upper left corner of the base for left-thumb control.



The Wico Command Control

The adapter is a black plastic box (4½ by 2½ by 1 inches) with connectors for two joysticks. The adapter itself has four trim potentiometers that permit readjustment of the center point to 31.

The Wico joystick, being switch-type, gives only directional readings and therefore can be used only with programs that use joysticks for direction. The Joystick gives output screen readings close to 0, 31, and 63 for both vertical and horizontal axes, for a total of nine points on the 64-by-64 grid. Thus they are limited to certain types of software and do not completely replace the potentiometer-type joysticks. Nevertheless, since they are not terribly expensive and are the most rugged units available for any computer, you might consider them as an alternative to your more delicate model. ■

★ ★ ★ ½

Data-Writer
Software Options Inc.
19 Rector St.
New York, NY 10006
Model I or Model III
$145 disk

by Dan Robinson

Data-Writer is an enhanced version of the popular Auto Writer database/form-letter system. It permits you to use whatever word processor you like to produce both a form letter and mailing list, or a data base. It combines all the familiar Auto Writer editing and scrolling features with the search and replace functions.

Data-Writer's Entry module will help build your data base while the Edit function creates your report or form letter. Other modules in the Data-Writer family support file management and math functions. The Model I Data-Writer package uses four disks, the Model III takes two.

A Data-Writer data base is limited in size only by the capacity of your disk. It supports 20 variable-length fields for each record, labeled as you choose. This information can be included in the form letter or report any place you wish by enclosing the field name within coded parentheses. Additional data can be entered from the keyboard at print time, with your own prompt appearing on the screen.

The program includes both Letter and Report utilities. The letter utility recognizes its own commands, since the word processor isn't active at the time letters are merged with the mailing list and printed. These commands set line and page length; top, bottom and left margins; and form feed, line spacing

You Are Being Attacked by a Raging . . .

Caterpillar

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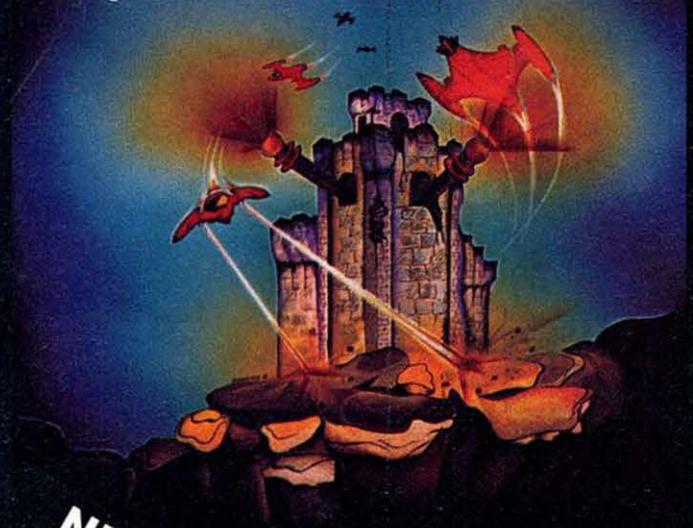

NEW!

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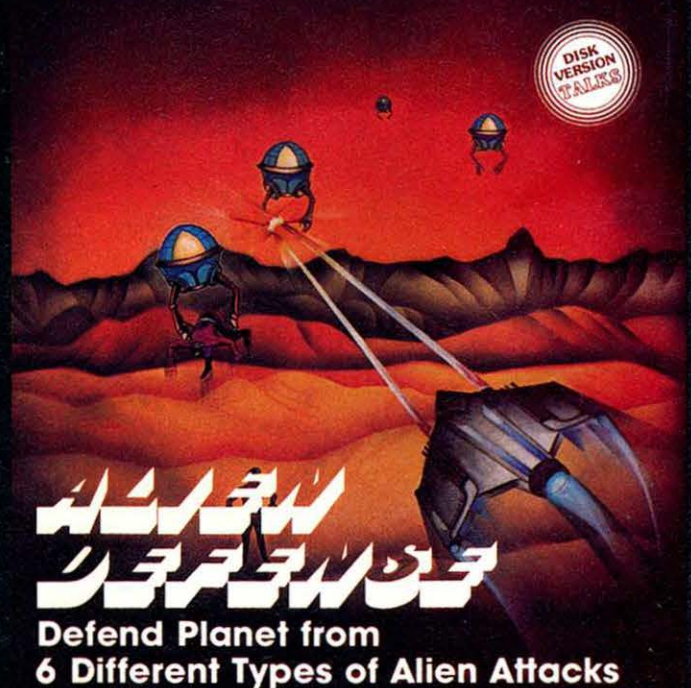

ALIEN DEFENSE

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Written by Larry Ashmun

and comment lines.

Control codes can be sent to your printer and a function is included to reduce both margins to outline a body of text. Also included is a page-end stop that enables single-sheet feeding. If none of these commands have been included within the form letter, default values are used that can be changed at print time.

If Data-Writer encounters an error during printing (such as a missing field), the program stops, identifies the error and gives you the opportunity to edit the text. This Edit routine can even be used to prepare a form letter, and it's commands are very much like Electric Pencil's.

The Report program is similar to the Letter program except that a header with page numbers is included. You can identify columns where information from the data base should be inserted, and select where to align the data in each column. Report also prints subtotals where indicated and has its own Edit routine.

Several other utilities are provided with Data-Writer. Stats checks for errors and gives the number of records in a file, the format, and the field labels and lengths. When sent to the screen, disk, or printer, Stats will show the record number containing errors together with the record's content and the nature of the mistake.

Select prepares a subset of your data base and creates a new file containing only those records that meet the specified criteria. It uses IF, AND, and OR with >, =, <, >=, <=, or < > to choose data that can consist of selected cities, customer names, or zip codes within a certain range. Select also supports elements that equal the right, left, or any part of a string, so that if you wanted to cull out the records dealing with California, a match could be found with CA or Calif. You can specify up to 30 criteria for making the selection.

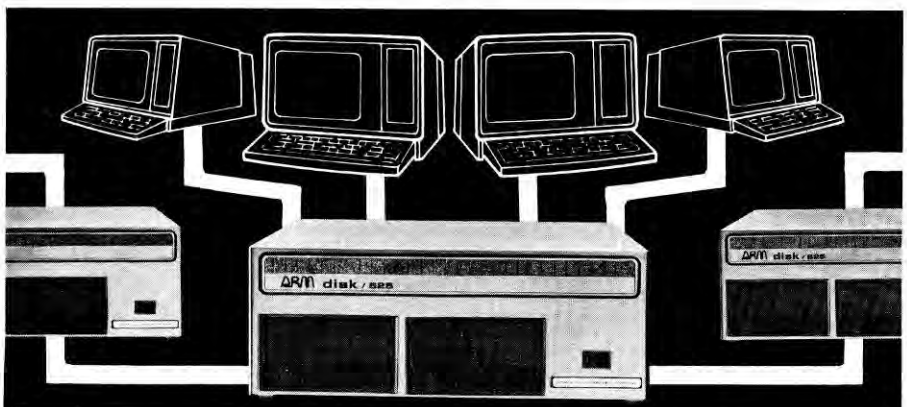
Sort organizes up to 4,500 records in ascending or descending order, alphabetically or numerically, using any field as its key. It can sort such items as a zip code that lies at the end of a city-state-zip field, or the last name included in a name field.

It supports a two-level sort in numerical or alphabetical order, so that files can be maintained alphabetically within a city or zip code. The reordered data is sent to a new output file.

If you use the Entry module for creating your data base instead of your word processor, Data-Writer provides tight validity checking to preclude entry errors. The program first prompts you through the creation of a control file where each field label and maximum length are stored.

You'll also be asked if the field is mandatory and whether it will repeat the entry from the previous field if no new entry is made. You can specify a validity check for the field to ensure that it conforms to zip-code standards, that the field is all numeric, or that the entry is of the proper length. The control file can also be instructed to place a field in a dollar/cents format, or to accept abbreviated entries. These are expanded to a full entry from a table that you provide at the end of the control file.

When using the Entry module to create the data base or add new records, the field label is displayed on the screen with a graphics arrow at the current field. The arrow keys let you move about the screen, and when shifted, per-



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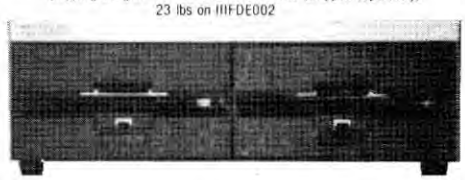

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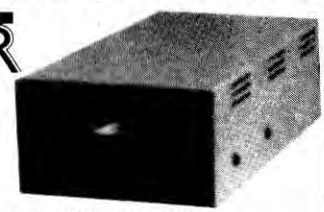

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mit deletions and insertions. Overwriting is the normal mode, just as in a word processor. Each record is written to disk after entry is completed, so that very long files can be created.

Edit is a separate module that permits you to view and alter information in your data base. Its controls are patterned after those of Electric Pencil, and its chief advantage is that it can edit the data base in sections, even if it covers an entire disk. Search and replace are supported for that portion of the data base currently in memory. If the file is too large to fit in memory, you must have enough disk capacity for an output file equal in size to the data base, and this may require some cautious disk swapping.

The Manage program lets Data-Writer restructure the data base, creating new fields, deleting old ones, or changing their order. A data base can be split or two bases can be merged with Manage. Like Edit, Manage creates a new output file.

If you choose Field Manipulation, a new menu offers to insert a new field, delete a field, swap the position of two fields, move a field to a different position, or append one field to another. When adding a field, Manage leads you through the entire data base, prompting you at each record for the new entry.

If your choice is to merge two data bases, Manage checks to make sure that the field names for the two bases are the same. If the two files are in alphabetic or numeric order, Manage integrates the files while maintaining that order.

The Math utility requires that both the input and output files be on line during operation. Math performs addition, subtraction, multiplication, division, or exponentiation on data contained in various fields of your base. It can use a standard formula contained in a file or you can supply it with up to 20 formulae when you run it. There are 10 scratchpad locations to serve as temporary parking places for data that you are computing. For example, you might specify: Cost = Price + Tax, or Total = Current + Balance.

Data-Writer contains a label-printing module that can handle up to four across. Your printing format can be input when the Labels module is run, or it can be taken from a disk file. A string can be specified to print on every label in addition to the data taken from the base, so that you can direct your mail to the "Marketing Director" or include your slogan to support National Bean Week.

The new Access module can be used as a shortcut to perform many of the functions found in the separate Data-Writer routines. It lets you add, delete, or edit records and has a rapid search capability. The update file it creates, containing your changes, can be merged with your data base integrating the corrections.

As compiled Basic programs, the Data-Writer series with DOS and the BRUN module uses a lot of disk space. Since many of the functions need both input and output files, two drives are minimum.

Data-Writer seems to have good speed and bug-free performance. It has a great deal of flexibility and capacity, and the ability to restructure an existing data base to meet changing needs gives it a big boost. For Electric Pencil or Scripsit fans, the capability of using an old favorite to maintain a mailing list or data base makes Data-Writer a winner. ■

★★★★
The Producer
Texas Computer Systems
P.O. Box 1327
Arlington, TX 76004-1327
Models I & III
$149

by Wynne Keller

A computer program that writes computer programs: The idea has a lot of appeal. Basic programming may seem easy at first, but sophisticated Basic programming is no simple task. The idea of having the computer do all the work is worth exploring.

The Producer is a Basic program generator. Specifically, it is great at generating data-base programs.

You can use programs created by The Producer as the file management core for complex programming tasks, thereby saving development time. In many applications, the program generated will be able to stand alone with no supplemental programming.

In addition to data-base programs, The Producer can also create programs to perform repetitive calculations.

Why spend $149 to buy a program that creates data bases when a little more will buy an excellent finished data base? If you write programs for profit, you can incorporate a Producer program in your effort, and market it without paying royalties.

You may want The Producer for its B-tree structure, which is not readily available in commercial data bases. You may want access to well-commented Basic code, or the ability, rare in data-base management programs, to reorganize a file if you decide you need another field, or find that a field previously defined is too short.

The Producer gives you the flexibility to change the data structure of the programs you create, and will reformat all previous files to fit the new structure.

A Producer-created program uses a B-tree structure for rapid access to the file. One advantage to B-tree is that the file does not need to be sorted (or an index built) before it can be accessed rapidly. In fact, B-tree functions best when the file is in random order. A module included in The Producer randomizes a file that has become too orderly.

Another advantage of the B-tree structure is that the key field (the field by which data will most often be accessed) does not have to be unique for each record in the data base. For example, if you wanted the last-name field in an address file to be the key field, you could do so, even though many last names would be the same. (Many other data-base programs require that a key field be unique for each record, which may require that some arbitrary code number be created.)

Creating a Program

Once you understand the procedure, you can create a program in about one hour. A special program planning form is built into The Producer and can be printed from the main menu.

As in all data-base applications, spend some time thinking about how to organize the data you wish to computerize. Using the worksheet, decide on field types, names, and lengths. Which field will be used most often for access? Are calculations needed? The first field in the data base will be the key field, so be certain to arrange the fields in the correct order.

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But that wouldn't have been nearly as impressive.

*Michael Tannenbaum, the "80 Accountant"

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Model II Systems are available in CP/M as well as TRSDOS at an additional cost. CP/M is a trademark of Digital Research Corporation. TRSDOS is a trademark of the Tandy Corporation.

↙See List of Advertisers on Page 403

When the worksheet is complete, begin setting up the screen that will accept the data input in the final program. (Only one screen is allowed, which may be insufficient for some uses.) Part of the screen must be reserved for error messages, and part can be reserved for special prompt messages to help the operator understand how to type the data. You can create your own custom prompts for this prompt area. Graphics can be included on the screen, and a clever routine allows you to draw with any combination of the TRS-80 graphics blocks.

The screen generator is quite flexible. You can move the cursor anywhere and type anything you wish, insert or delete characters or lines, draw with the arrow keys, using any character or graphics block, center titles, and define rectangles of any size and move them anywhere on the screen.

Up to nine screens can be defined and stored on disk for later reuse. You can type a letterset of large, graphics letters on the screen with single keystrokes. The screen generator will create a Basic program, if desired, to display your screen. More advanced programmers can use the screen generator to create screen and input sequences for their own programming efforts.

To create fields, simply type the field names and lengths where you wish them to appear in the final program. You can specify restrictions on what type of data can be entered in any field. Several predefined restrictions are provided, such as all uppercase letters and numbers, all numbers, and a Y or N answer.

You can also devise your own custom restrictions. For example, there is no choice that would allow the operator to enter lowercase characters. If you want to type data in lowercase, you may create your own special restriction field, which amounts to no restrictions at all, by carefully typing every letter and number on the keyboard in upper- and lowercase, as well as the space and special keys. However, all commands must be in uppercase, both in The Producer itself and in the finished program.

After designing the screen, use the second menu option to edit the screen definitions, if necessary. You can use this option for modifying an already-created program. Custom prompts and calculations are also created in this section. Up to 32 calculations can be performed, as many as eight on one field. You can specify when the calculation is performed (that is, as the program moves from which field) and in what order multiple calculations on the same field will be performed.

One calculation, addition, functions between records. It is possible to have a grand total, but not subtotals, for any numeric field on a printout. However, you can generate a report that will print a selection of records with totals for the records that match the restrictions that you use. This, in effect, would give subtotals for a subgroup of records.

Calculations can be edited later if necessary. An unusual feature of this program is the ability to calculate without saving the results to disk. This can conserve valuable disk space. Calculations can be performed for the printout as needed, but are not retained unless you desire it. A special feature in the finished program allows information to be globally inserted into a selected field of every record. This feature also allows all calculations to be performed if the inserted data would affect calculation results.

After the screen and calculations are complete, you can build the Basic lines for this part of the data base. Simply make the menu choice and the program is created, listed on screen, and saved to disk.

The next step is creating one or more custom reports. You begin by selecting the fields to be included, and indicate headings, if any. You can specify codes to place the printer in proper operational mode (such as sending the code for 132 characters/line). Printer codes can also be sent at the end of the report (you could ring the printer bell to tell that the report is done).

You can title the report, request totals of numeric fields, and indicate sorting order. Logical restrictions can be placed on records to be included, such as "name = Smith," or "cost greater than $1." Combination restrictions can also be used, such as: "name = Smith," "cost less than $2" or "date greater than March."

A special type of restriction lets the finished program ask for additional restriction information before printing the report. For example, suppose the user wants a report of all records in a file where a person owes more than a certain amount of money. The user could set up a restriction that would find all records greater than this amount and would query him for the selected amount at the time he used the report.

If the number of characters requested for the printout exceeds the line length, a multi-line report is created. The user can also specify the length of a page. The mailing-label option allows the user to specify what fields will appear on each line of the label. A special label set-up feature allows the user to test the proper alignment of labels, and to define the line length of the labels.

When the reports are done, Basic lines are created for this part of the program. Then the two halves are merged into one program. Again, this is simple and nearly automatic. Finally, the B-tree file is initialized, and the program is ready to use.

At this point in program development, The Producer itself is no longer needed, unless you detect errors or need modifications. In other words, the program you have created is completely self-contained.

The Producer

Extra effort has been taken to organize The Producer to simplify program creation. The main menu, for example, offers 12 choices, which you should select in order as development proceeds.

The manual is exceptionally clear. Each menu choice is a chapter, which begins by describing generally what the modules of that choice do, then gives a detailed explanation of each module.

Quick-reference cards are provided. Potentially confusing terms are carefully explained. The manual also deserves praise for its cosmetic appearance. The liberal use of underlining and various print sizes makes it very easy to pick out the information you need. The binding is a three-ring hardcover notebook with index tabs.

The author has made a real effort to always keep the user informed of what the computer is doing. A convenient feature is the log on, which enters the name of the program under development automatically whenever the program needs it for disk access. A fine editor module allows complete correction of any erroneous entries in the developing program.

Using the Program

A sample program included with The Producer illustrates the use of a finished data base. The main menu of

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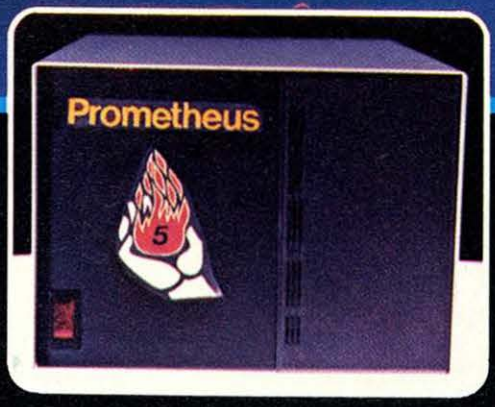

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any generated program displays the status of the program, and gives typical data-base choices to add, edit, display, or print records. The status area displays the number of the last record accessed, number of active records, number of available deleted slots, the name of the file, and any error messages.

The menu choices are selected by number, rather than the preferable (because it is easier to remember) A for add, and E for Edit. But a full description of each menu option is provided beside each of the five numbered selections. The add mode must be selected for each record. It is not possible to select the add mode and remain in it while you add a large number of records.

If you notice a mistake while adding records, the arrow keys move the cursor between fields so that corrections can be made. Letters can be inserted or deleted in a field without retyping the whole line. When you are through, the record can be saved to disk without stepping through any blank fields.

Selecting either edit or display brings in the search function. The search is performed on the key field. If necessary, you can also have a secondary search of the second field, which is useful if a large number of records in the first key field will meet the search criteria.

An interesting aspect of the B-tree structure is that the search data must be fairly complete to guarantee a match. If you are searching for a name, Edwards, and enter only an E as the search data, the record may or may not be found. However, if you type Ed it is more likely to be found, and if you type Edwards it absolutely will be found. Bear in mind that if you create the program to use lowercase, you must duplicate the correct uppercase/lowercase configuration to obtain a match.

In the sample data base I used, with about 800 records, a search took one or two seconds. The first record matching the search is displayed, and you can then automatically continue to search for other matches if you wish. It is not possible to scan forward or back through the file from any particular record. You can only look at records that match the search.

You can delete a record by typing the word "delete" in the first field. The delete functions best when used for only a few records. A massive delete would be very time consuming. However, a feature of the file-rebuild module provided with The Producer allows global deletion by a designated restriction entered by the user.

Reports are defined when the program is created, and requesting reports in the finished programs calls up a menu of the titles of these reports. The user creates his own report titles. If the report is to be in order on the key field, no sort will be necessary, because the B-tree maintains links to each record in proper order. If the records are to be organized on some other field, then a sort must be done first, to build an index.

The Producer comes with a special machine-language sort module automatically used if needed by the report module. There is no extra charge for this feature.

The Producer is an effective programming tool that will create excel-

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lent data-base programs in a fraction of the time required to write one from scratch. The novice user can produce any number of complete programs for his personal use. Experienced programmers may use the screens and reports generated as the foundation for integrated programs, thus saving many hours of work.

Programmers would have very little difficulty modifying aspects of a generated program that they did not like, since the finished program has many remarks. ■

★ ★ ½

Strike Force
Melbourne House Software Inc.
Dept. CS.
347 Reedwood Drive
Nashville, TN 37217
Models I & III
$15.95, cassette
$19.95 disk

by Michael E. Nadeau
***80 Micro* staff**

Strike Force is Melbourne House's second effort in the TRS-80 game market. Like its stablemate, Penetrator, it is a variation on the Defender arcade game. However, they are not much alike.

Penetrator played in a predictable, yet challenging manner and had some nifty features such as custom landscape design and a practice mode. Strike Force is also challenging, but often to the point of frustration. It foregoes the extra features found on Penetrator, as well.

The Game

In Strike Force, you have the customary cities to defend from a number of different alien craft. These aliens have a base on the other side of the planet. You get 5,000 points for destroying this base and 100 points for each alien craft. You can destroy the base only with incendiary shells you pick up from an underground store.

Wiping out the early waves of enemy fighters is easy, with a little practice; even hitting the enemy base is not hard at this stage. But after you hit the base a few times, the aliens attack with a vengeance; they crowd the screen with their numbers and fire awesome volleys, if you dare show yourself.

This is where it becomes very, very frustrating, and a few deficiencies of the game show up. Your craft has a slow reaction time to your keyboard input. (The game is joystick compatible.) After a while, you get the feeling you're fighting F-16s with a Sopwith Camel. At this point, you can give up all hope of collecting your bombs and hitting the alien base.

Melbourne House advertises Strike Force as "the fastest and most complex game you will ever see." Your ship does move pretty fast, once it gets around to it. However, the game's overall speed ranks no higher than average.

Strike Force is also no more complex than most TRS-80 arcade games I've

Gold Plug 80—E.A.P. Company
P.O. Box 14 Keller, TX 76248
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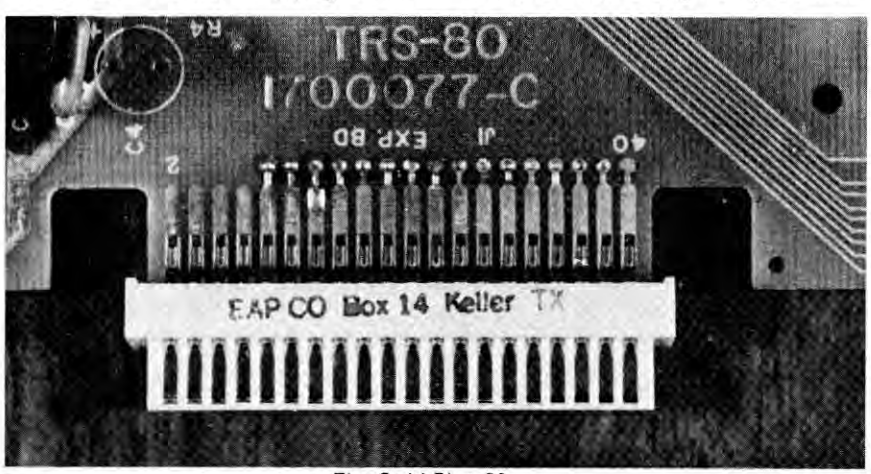
Ahhhh, instant relief! At last there is a permanent cure for contact oxidation on Model I edge connectors. Many TRS-80 users are familiar with the symptoms: untimely resets, spontaneous reboots, or the inability to get the computer started at all without a frustrating session with a pink eraser.

The Gold Plug 80 is a well made device consisting of an edge-card plug with gold plated contacts, available with either 34 or 40 contacts. The rear of the plug has terminal tabs which fit exactly over the existing foil fingers on the TRS-80's connectors. After installation, the original plugs have been extended about a half inch, meaning that the plastic door covers no longer fit. This did not trouble me, but you should take it into consideration. E.A.P.'s advertising leaflet, by the way, cautions you about the doors, which is refreshing. They also have the excellent policy of permitting you to return any plugs ordered for a refund if after seeing them you are unwilling to undertake the installation.



The Gold Plug 80

An excellent set of instructions accompany the plugs, and they are shipped promptly. I ordered mine by mail on a Monday and received my set of plugs by first class mail on Tuesday of the next week.

Installation

Installation requires a soldering iron (I use a 40-watt Weller), Rosin-core solder, a Phillips screwdriver, and your last Pink Pearl. The keyboard and Expansion Interface have to be disassembled to get at the connectors, which are then cleaned—the eraser's last fling. The Gold Plug 80 is fitted over the existing plug with the contacts centered, and then soldered to the board. I have some soldering experience, but it proved to be an easy, safe job. The contact is heated, a very small amount of solder applied, and then you go on to the next contact. It took about an hour to do all six plugs.

If you are a little nervous about this kind of work, note that all the contacts on the underside of the RS-232 output connector are grounded—that is, they are all connected. Start there; you can do no harm and the practice will be helpful.

The Gold Plug 80 set I bought included all six plugs. The plugs are available individually for $9.95, or you can get a pair for the keyboard to Expansion Interface cable for $18.95.

As I said earlier, I did resolder every connector on the machine, and I haven't had a single unwanted reset since. ■

ADVERTISEMENT

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seen recently. You have shields that you must use judiciously for your cities, but none for yourself. You have no hyperspace, no smart bombs, and the landscape is only a few screens long and not terribly varied. It's just another video shoot-em-up in slightly different clothing.

The program also has a bug: The documentation tells you to hit any key to drop your bombs on the enemy base. This works fine, but if, in the heat of the action, you hit more than one key, the game moves to the next player in the two-player mode.

This does not always happen, and you do not lose a ship when it occurs. But it is too easy to hit several keys while frantically maneuvering your craft. It is another annoyance that adds to the frustration level of the game.

Melbourne House claims that this is not a bug, because the proper strategy of the game is to defend your cities first.

"It's just another video shoot-em-up in slightly different clothing."

I don't see the logic in that argument, especially since the base is worth 50 times more than the alien fighters—it's just a case of insufficient error-trapping.

The documentation is good, though it fails to mention that hitting clear aborts the game. (Melbourne House said they will include this information in future mailings.) It gives some good advice on strategy and how each type of alien behaves.

There were times when I wanted to put my fist through the CRT because of the way the game played. I respect a game that is difficult to master; I get mad at the ones that put me at an impossible disadvantage.

Yet, in a perverse sort of way,I sometimes enjoyed playing Strike Force. That impossible aspect of it brought out a latent stubbornness in me; I was going to beat the damn thing in spite of its faults.

Well, I haven't—maybe I never will. ■

★★★★

TRS-80 Color Programs
Tom Rugg and Phil Feldman
Dilithium Press
Beaverton, OR 97005
$19.95, softcover
TAB Books, Inc.
Blue Ridge Summit, PA 17214
$25.95, hardcover

by Carlos Calle

TRS-80 Color Programs is not just a collection of 37 documented programs for a 16K Color Computer with Basic, but an entertaining textbook as well. Some programs run on a 4K machine and all run on 16K, 32K, or 64K Color Computers with Extended Color Basic.

The softcover and hardcover editions of this book seem to have appeared in reverse order. The original edition was published by Dilithium Press, which holds the copyright for a trade paperback, while TAB Books acquired the rights for the hardcover edition. Nevertheless, you can't go wrong with whichever edition you buy.

There are six sections in this book. The Home Applications section includes the ubiquitous check-balancing program. The version here is fairly good with options for service charges and a nice screen layout. A better home-application program is Loan, which calculates payments and interest for mortgages, car loans or any other loan. This program can be used with balloon loans, too.

No computer book would be complete without a math-drill program for children. This one allows you to choose between addition, subtraction, and multiplication (but not division) using up to two digits with answers up to three-digit numbers.

Other programs worth mentioning are: Hamcode, if you are interested in learning International Radio Code; Car Race, a fairly simple version of the pre-Space Invaders arcade favorite; and Walloons, an original graphics program.

A good collection of serious mathematics programs are provided and solve ordinary differential equations, perform least-squares fitting, solve simultaneous linear equations, and so on. This is the sort of thing I feel computers are meant to do well, and I am glad the authors included these programs. This helps dispel the Color Computer's image as a game machine.

The real value of this book, however, comes not in the ready-to-run programs but in the explanations of the programs themselves. Each program comes with an introduction on how to use it, a sample run with a picture of the actual screen display, the program listing, suggestions for changes, a detailed explanation of the main routines and variables used, and finally, a list of projects you can do to extensively modify the program. It is here where the book shines.

The only thing the book needs to receive a perfect score is a section on Extended Color Basic graphics. Nevertheless, Rugg and Feldman have written a very useful book that belongs on your bookshelf next to the *Getting Started with Color Basic* manual. ■

"The real value of this book, however, comes... in the explanation of the programs themselves."

★★★★½

Galaxy Invasion Plus
Big Five Software
P.O. Box 9078-185
Van Nuys, CA 91409
Models I & III
$15.95 cassette, 16K
$19.95 disk, 32K

by Eric Maloney
***80 Micro* staff**

With Galaxy Invasion Plus, Big Five gives an old standard some new tricks. They've added a permanent scoreboard, a pause feature, more sound, a faster pace, and an interesting twist to the action.

Fortunately, the people at Big Five knew enough to not tamper with a good

STOPPER!

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By Roxton Baker
Author of "TRAKCESS"

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* Trace a variable value to screen or printer
* Pause, slow-step and single step
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These examples will show how easily STOPPER is used:

Break when line 100 is hit for the 5th time	<100,5
Break when X! is equal to 10	<X=10
Break when ST$ in NOT equal to "YES"	<ST$<>"YES"
Execute next statement or full line	+ or >
Exact statement where program halted	P

With STOPPER you will know exactly where the error is and why it occurred. Program execution is under YOUR control! Stopper is self-relocating in high memory and respects any high memory utilities.

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This combination Z80/BASIC program has over 18 commands that allow you to effectively manipulate your mailing list using a cassette based Model I and III. All commands are described fully in an excellent manual. MAILing MANager supports mailing labels (your choice of formats), file sorting (in fast Z80), searching on your choice of fields (with output going to screen or printer), two types of cassette data input/output:

1. a faster cassette I/O on both Model I and III for minimum cassette saving and loading time, and
2. BASIC I/O routines for compatibility with other programs.

MAILing MANager also allows easy maintenance of file data with deletion and editing commands. The MAILing MANager manual also includes "Programming Notes" in case you want to modify the screen or printer output. Note that this is NOT required. MAILing MANager supports about 60 names on a 16K machine, 398 on a 48K machine. MAILing MANager respects high memory if you are using another high memory driver (for lower case, printer, etc.). MAILing MANager is available on cassette, complete with documentation for $29.95.

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thing. Despite the refinements, this is essentially the same Galaxy Invasion, one of the better of the many space invaders clones.

Through the first 50,000 points, GI + sticks close to the original. Waves of ships swoop down at you, and you move laterally to destroy them. Every once in a while, you get a flagship alert, and must destroy a flagship or be destroyed. Points are awarded on the basis of what kind of ship you hit and whether it's moving when you hit it.

The big surprise comes at 50,000, when the screen inverts—the invaders are suddenly falling up at you, and you're shooting down. The action thereafter does a back-flip at every 10,000 points.

If you're an experienced Galaxy Invasion player, you'll adjust to the upside-down screen without too much trouble. Nevertheless, it is disconcerting enough to increase the game's difficulty, especially after 200,000 points, when you are under a constant flagship alert.

Galaxy Invasion's other new features are, with one exception, welcome additions. The pause is a major improvement, since a typical game can extend to two or more hours. The scoreboard, too, is a nice feature. The exception is the extra sound—a voice that says, among other things, "oh, no" when you're shot. It's amusing the first time you hear it, but soon becomes annoying, and is likely to drive most players up the proverbial wall.

Is Galaxy Invasion Plus worth the expense? It depends. If you're a Galaxy Invasion die-hard, the answer is probably yes. If, on the other hand, you're an old Galaxy Invasion player who got bored with it, the differences and improvements are not significant enough to justify the purchase.

If you don't own the original, this is an essential addition to your game library. In the fast-changing world of microcomputer games, Galaxy Invasion is still a winner. ■

★ ★ ★

Jovian
Computer Shack
1691 Eason
Pontiac, MI 48054
Model I or III
Joystick-compatible
$19.95 cassette
$24.95 disk

by Michael E. Nadeau
***80 Micro* staff**

Jovian is a simple, yet somewhat original arcade game for the TRS-80. You don't need much strategy to play, just a quick eye and fast fingers.

The game is similar to Computer Shack's earlier release, Cyborg, in that both games feature "wrap-around graphics," which means that if you keep going in one direction, you'll eventually end up where you started.

The object of the game is to wipe out as many waves of enemy space stations as possible. While you do this, you also must avoid a number of odd little video critters and land (space?) mines.

As you progress to each new wave, the space stations, critters, and mines grow in number. Your craft also moves faster.

Jovian sports some nifty features that are finding their way into many new games. They include multiple speed settings (which can be changed during the game), an instruction screen (documentation is superfluous), a choice of three landscapes (or galaxies), and a save-score option that lets you put your name on the screen. It also has a status display throughout the game; this display is very useful during play.

I've come to expect similar features on arcade games; they indicate a well-thought-out program and add to the enjoyment of the game. The only thing I wish Jovian had is a pause command. All games of this quality should have this feature.

And Jovian is an enjoyable game to play. It's not a hard game to figure out; the only special tactics you need are to shoot and move fast.

Jovian may not be in the same league as such classics as Eliminator or Galaxy Invasion, but if you get tired of them, Jovian offers a pleasant alternative. ■

★ ★ ★

SPOOL/64
Apparat Inc.
4401 So. Tamarac Parkway
Denver, CO 80237
All models
$319.95

by Terry Kepner

One of the nuisances of a computer system is that when your printing out data, you have to wait for it to finish printing before you can use the system for anything else. In a home, waiting for the computer to stop printing is a minor inconvenience, but in a business it is a major problem, since you have to pay employees to stand around waiting for the printer to finish.

There are programs that set aside a section of your computer's memory as a print spooler buffer. But there are two problems with a spooler program. The first is obvious: memory availability. After you load in DOS, Basic, and your applications program, there isn't an awful lot of room left for the printer buffer (not to mention the spooler program itself).

The second problem is compatibility. There aren't any spooler programs that will work with every applications program. This is especially true of any programs that use machine-language modules in high memory.

Apparat has eliminated both of these problems with their SPOOL/64 hardware device. The SPOOL/64 is a tan box (2½ inches high by 6 inches wide by 10 inches deep) that you plug in place between your computer and your printer. It has two simple controls: an off/on switch and a reset button (with a metal ring guard around it to prevent accidental pressing), and a neon light to indicate the spooler's on/off status.

Because it is connected to the computer as an output device, it uses none of the computer's memory. In fact, it contains its own memory buffer of approximately 64K, more RAM than is available in the Model I or III, and the same amount as in the Model II.

The spooler control program takes up, at most, only 800 bytes of memory, leaving the rest for data storage.

When I started to connect it to my system, I promptly ran into my first difficulty: While I had a cable (Radio Shack's Model I-to-standard-parallel-

printer cable) that connected to the spooler, I didn't have a cable that went from the spooler to the printer. The manual (labeled "Preliminary") mentioned that a cable should be in the shipping box.

It turned out that Apparat had originally assumed that printers claiming to be Centronics parallel-printer compatible really were compatible, and they included a cable wired for that particular pinout. Unfortunately, this compatibility sometimes isn't and Apparat had more than one unhappy customer.

Apparat was about to lower the price of the SPOOL/64, and dropping the cable out of the package allowed them to lower the price a bit more (from $399 to $319). Customers ordering the unit are supposed to specify the printer they have and order the appropriate cable.

Since I knew my printer was standard, I ordered the standard cable. It cost only $29.95.

When the cable arrived, a scant week later, I LLISTed a 12K program. Less than five seconds later, my computer printed "READY" on the screen, and the cursor sat there blinking at me. Five minutes later, the printer finished printing (at a modest 50 cps)—quite a time difference!

Carefully reading the documentation revealed that the spooler could receive data at one of two rates: 1,000 or 3,000 cps. The higher speed is the default speed. A little arithmetic shows that although my program took only 12K of RAM, it actually printed out almost 16K of characters.

A moment's reflection gave me the reason why. In the computer's memory a program's commands are stored as 1-byte tokens, but when that program is sent to the printer the 1-byte tokens are expanded out to their full ASCII spellings, taking up about four bytes each.

"The spooler control program takes up, at most, 800 bytes of memory."

The actual amount of time a printer spooler can save you is dependent on many factors, not the least of which is the difference in speed between your printer and the spooler.

Another factor is the amount of text you send to the printer at a time. Like in the above example, sending many thousands of characters to the printer at one time will result in a significant time savings. If you have a fast (say 200 cps) printer and print under 100 characters at a time, the savings will be insignificant at first, taking a long period of time before any savings in processor time appear.

For example, I have a check-register accounting system that gives me a year-end summary of account activity, listing each account and all the activity in it. Since this requires searching through every entry for the entire year for each account, my data base is read off the disk 75 times, once for each account. The program is in Basic, which slows things down even more.

Running the program without the spooler takes four hours. Running with the spooler takes only three and a half hours. That's not much of a savings, but if this type of operation took place frequently, it wouldn't take long to save a substantial amount of time and money.

The SPOOL/64 has several different modes of operation, some software selectable, some hardware. The four hardware selections are for customizing the SPOOL/64 operation to the printer you have.

Switch number one can connect the printer's error line directly to the computer, if needed. This means that if the printer develops an error condition (paper jam, ribbon jam, head jam, and so on), the computer will halt operation until the problem is corrected.

The normal position is to let the computer continue sending data to the spooler, which stores it, while you fix the printer. When the printer removes the error-line condition, the spooler resumes sending data to the printer with the net result of no lost computer time.

The second switch controls repeating-character compression and control-code enabling. The compression option

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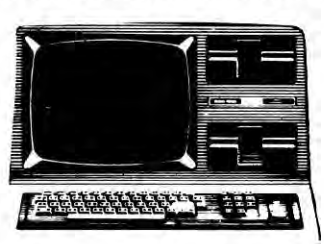

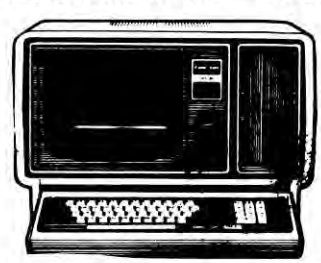

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Union, New Jersey
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"The tubes are not very expensive ($80 for green, $90 for amber, and more for the soon-to-be-released blue and red) and are shipped with excellent instructions. I installed my unit in less than a half hour. There is no soldering, only the removal and replacement of a few bolts and the tube socket..."

Dennis Kitsz
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80 Microcomputing

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stores any repetitious characters as two bytes (one byte is the character, the other is the number of time the character is repeated). The software control codes let you control the SPOOL/64 with software.

Switch three connects the paper-out line to the computer. If the printer runs out of paper, the computer will stop sending data and wait for the paper-out signal to halt. Normally it lets the computer continue sending data to the spooler while the spooler waits for the printer to be fixed, a more efficient use of the computer.

"The actual amount of time a spooler can save you is dependent on many factors. . ."

The last switch lets the computer know if the printer is selected or not. If the printer is deselected, or off, the computer will stop. I prefer the default setting that lets me operate the spooler whether or not the printer is actually on or off—a great time saver.

The software control codes are accessed by sending two escape characters (ASCII 27), followed by the ASCII numeric control code.

Typing LPRINT CHR$(27);CHR$(27);"0" enables the block mode of SPOOL/64. In this mode the spooler accepts data until it is full, then refuses to accept anymore data until the buffer is completely empty, effectively removing the burden of forcing the computer to send data to the buffer at printer rates.

Sending ASCII 1 after the two escape characters disables the block mode enabled by the ASCII 0.

ASCII 2 tells the spooler to stop receiving data until the buffer is empty, similar to the block command except that the spooler doesn't wait for a full buffer before refusing incoming data.

ASCII 3 turns off the spooler's buffer; whatever is sent to the buffer is immediately passed straight through to the printer and not stored. The computer is slowed down to the printer's print rate, as if SPOOL/64 weren't in place.

ASCII 4 initiates the spooler's self-test mode. The program ROM, buffer RAM, and spooler/printer interface are checked for errors. The addresses of any errors are printed on the printer.

The ASCII code 5 tells the spooler to stop printing until the printer is taken off-line and brought back on-line. This function may not work depending on how your printer's select line is set up.

ASCII 6 is the software version of the buffer reset button on the front panel of the SPOOL/64 unit.

ASCII 7 is the software equivalent of turning the unit off and then back on, all the software codes are reset to default (off) condition.

ASCII 8 lets you send two escape characters directly to the printer, rather than using them for its own control codes.

ASCII 9 turns off all the software control codes. The spooler will not act on any software codes until the unit is turned off and back on.

ASCII A is the multiple-copy code, letting you specify the number of times a certain document, up to 62,000 characters in length, can be repeatedly printed. Any number from one to 255 copies can be specified. Should zero be specified, the unit will print copies until it is either reset or turned off.

When this mode is selected, three additional codes are allowed. The first code is similar to the ASCII code 5; the other two are imbedded in your document and cause the spooler to half when they are reached and wait for new character input from the computer. These codes could easily be used to generate personalized batch form letters, pausing in each letter for you to type in the name, or other data, in selected places in the letters.

The final control code, ASCII B, lets you put your own machine-language programs into the spooler's memory and transfer control of the spooler to your program.

For anyone who has had to wait to use his computer because it was involved in printing, a spooler is a wise investment. For a business generating large amounts of printed reports, mailings, or inventory summaries, a spooler can pay for itself in a short period of time. The slower your printer, the faster SPOOL/64 will return your investment.

At only $319 (plus spooler/printer cable) the Apparat SPOOL/64 is a good buy. ■

REVIEW DIGEST

Space Castle: The Cornsoft Group, Indianapolis, IN 46220, Model I and III, $15.95 tape, $19.95 disk.

"The game plan is simple. Keep firing at the three force fields until you get a shot at the Space Castle of Yugdab in the center. But...you will soon find that the castle sends out intelligent mines which work their way through the force fields to get to you....If you enjoy arcade games then this is one you wouldn't want to leave out of your library." *80-U.S.,* January 1983, p. 122.

Astroball, Acorn Software Products, Vienna, VA 22180, Model I and III, $19.95 tape or disk.

"Not only is Astroball a fantastic pinball game, but its program also manages to include the destruction of deadly space debris....Instead of merely maneuvering between an array of bumpers and the like, the ball must annihilate meteors to score points before being consumed by enemy flying saucers and ball-thirsty black holes....The graphics are top-notch and the sound quality is suitably pinball-like and eerie." *Popular Computing,* February 1983, p. 132.

The Word Processor, Bible Research Systems, Austin, TX 78759, Model III, $160.

"Heaven knows, it couldn't have been easy cramming the entire King James Bible—both Old and New Testaments—onto just eight double-sided floppy disks....The Word Processor...lets you connect any single phrase or string of characters from the Bible to all its precise reference points....the package is very user-friendly....The Word Processor's indexing feature makes this system far superior to any printed concordance....It does have some drawbacks, but considering the amount of material that had to be stored, it's incredible just how complete the package really is." *Popular Computing*, February 1983, p. 128.

Profile, Tandy/Radio Shack, Model I and III, 32K disk, $79.95; **AUK's Computer Filing System**, AUK's, Sacramento, CA 95838, 32K disk, $69.95; **Filemate**, Datafile Systems, Palo Alto, CA 94304, Model I and III, 48K, two disks, $95.

"The hashed random keys used by Filemate are the fastest, followed closely by AUK. Profile is considerably slower because of its sequential file access, but is the capacity champ ....In ease of use, Profile comes out on top, AUK is a strong second, and Filemate is considerably harder to use....The choice is between an old, established, simple, slow, solid, and well-documented program (i.e., Profile) and a new, relatively untried, fast-changing, powerful, skimpily documented program (i.e., Filemate). AUK is positioned comfortably between the two." *InfoWorld*, December 27, 1982, p. 39.

TRS-80 Color Basic by Bob Albrecht, John Wiley and Sons, 1982, $9.95.

"Albrecht has not just written another book on Basic, but rather has caught the spirit of a very friendly microcomputer and has restructured his objectives to fit the audience of the machine....The programs presented are well structured and easy to follow, (with) emphasis on use of the color graphics features....If a Color Computer is available in your classroom and your goal is teaching beginning Basic, this book is highly recommended." *The Computing Teacher*, December 1982, p. 61.

Money Decisions, Vol. 1, Eagle Software Publishing, 993 Old Eagle School Road, Wayne, PA 19089, Model III, $199.

"Money Decisions, a financial toolkit from Eagle Software Publishing, doesn't do anything that a good financial calculator can't do, but it does it without having to master a complex calculation sequence or a convoluted notational system." *InfoWorld*, December 13, 1982, p. 36.

Platinum Worksaver, Platinum Software, P.O. Box 833, Plattsburg, NY 12901, Color Computer, $30.

"I had seen the ad for the Platinum Worksaver, but was somewhat unimpressed. As an operating system enhancement, its main claim-to-fame seemed to be automatic line numbering coupled with two-key entries of Basic commands. ...However, on closer reading a couple of other things sparked my interest. First of all, it claimed to provide full-screen editing...it also claimed to turn the right side of the keyboard to something akin to a calculator keyboard. To make a long story short ...this is undoubtedly the best program I have ever bought for my Color Computer." *Color Computer News*, January 1983, p. 41.

Upload, ML-US'R Software, 115 Rising Sun Circle, Ft. Mitchell, KY 41017, Color Computer, $9.95

"At $9.95, this gem of a communications package is a real steal. No home should be without one. I have already saved the price of the purchase in unused gasoline." *Color Computer News*, January 1983, p. 50.

Game Writer, Washington Computer Services, 3028 Silvern Lane, Bellingham, WA 98226, Color Computer, $129.

"Game Writer reminds us a great deal of the Logo Language. That is no surprise, as the author who developed it also developed Color Logo for Radio Shack. Game Writer has all the advantages of Logo, high speed, graphics orientation, and an easy-to-use language." *The Rainbow*, December 1982, p. 84.

Computer Security With A Credit Card

by Hardin Brothers & Jean Robert Durbin

Are you concerned about unauthorized persons using your computer? If you feel a need for security, this article will be of interest.

You can control access to your computer so that a special credit card is needed to operate it. Though the Computer Security Card Reader (CSCR) does not provide absolute computer security, it is an effective and inexpensive security device. You can build it with common electrical components and know that no one can use your programs without your pass card.

Theory of Operation

The CSCR is a port-addressed device and, as such, can be attached to either the keyboard or expansion port of the expansion interface. In its simplest form, only seven lines need to be run from the computer to the CSCR—six data lines and the IN* line.

As the schematic diagram in Fig. 1 shows, the CSCR is, in essence, a group of light-controlled switches that are activated by the computer's input strobe, line IN*. In its simplest form, the CSCR is not addressed to any particular port, and so can be read with any INP( ) or IN command. This "non-addressing" scheme has proven to be entirely satisfactory with a Model I disk system.

If you wish to use the security system with a tape-based system, you can install a single OR gate to address the CSCR to ports 00H through 7FH. This will keep the CSCR from interfering with the cassette recorder or an RS-232 board. More specific addressing schemes are possible if you are operating other port-addressed input devices simultaneously, but they will probably require an external power supply for the addressing gates.

CSCR is based on the normal operation of the computer's data bus during port input. Normally, during input, the data lines float high (logic "1"). To demonstrate this, enter from Basic "PRINT INP(0)." The computer will respond "255," which is equivalent to binary 11111111, which demonstrates that all data lines are high.

However, with the CSCR operating and your pass card inserted, from one to six of the data lines will be pulled low and "PRINT INP(0)" will return a

Photo 1. The system with the CSCR in place next to the cassette recorder.

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Of course, you may be able to "force-fit" an application into some existing canned program you have, but to really get results, you need a separate application program to run on your computer.

Until now, that meant you were forced to pay money for application software off the shelf, or if you could afford it, have it custom written for you, or, if you are qualified, do it yourself...spending endless hours figuring it out and writing it. Now, your computer can write individual application programs for you. These programs are each separate, unique software programs that run in standard Basic on your computer.

A company named FutureSoft has developed this exciting and long awaited remarkable working tool for you. There are two versions called *Quikpro+Plus* and standard *Quikpro*. Both of them create unique separate Basic programs for you...to do exactly, precisely, what you want to do. And listen to this...you create a new program in minutes instead of hours.

You can quickly generate a new program when you want it. You can generate thousands of different unique programs, each one standing alone as a complete program that runs in Basic. Best of all, *you* do not have to be a programmer to do it. The *Quikpro* software becomes your personal programmer, waiting to do your work for you any time of day or night you choose to use it.

The custom programs you generate from this software provide for: Data Entry, Additions, Changes, Record Locating & Searches, great variety of Computations, and Report Printing (if you have a printer). It lets you decide what data to manipulate and how to manipulate it. It lets you decide the formats you want to appear on your screen and/or to print out in a report. It lets you use differing formats on the same data base. It lets you make calculations from data within records without altering the data base. It lets you report results with or without including the base data from which results were calculated.

All this is included in the ability/power of the program you create. You do it by simply answering questions that appear on your screen. Instantly, the *Quikpro* software instructs the computer to perform complex and error free instructional sequences. You get the immediate benefits of professionally written software for your application.

The resulting custom program is truly a separate Basic program. You can list it, you can modify it, you can actually see what makes it tick. You can even ask it to print out its own operating instruction manual so others can run it for you. Finally, you can really tap the speed and power of your computer the way you really want. You can create new programs for every use you have in Business, Science, Education, and Hobby areas. And you can start now.

The software is available immediately from the creators. It comes in two versions. If you want to generate separate Basic programs with all the data handling plus Calculations and Report Printing features, you want *Quikpro+Plus*. Specify to run on TRS80 Model I and Model III at only $149; to run on TRS80 Model II at $189.

If you do not need Calculation ability or Report Printing in the separate Basic programs you will create from this program generating software, then standard *Quikpro* will do the job for you. Standard *Quikpro* to run on TRS80 Model I or Model III is $89; to run on TRS80 Model II is $129. (Later on you can always trade up to the Plus Versions for only the cost difference between the two).

Both programs are available to run on many other computers besides TRS80. Details are available by calling or writing.

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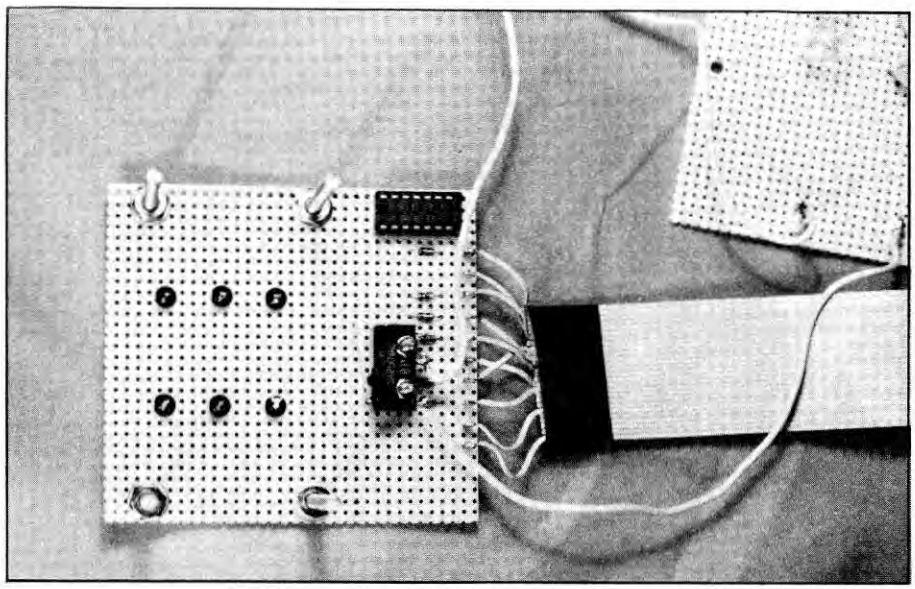

Photo 2. The fully wired phototransistor board. Notice the placement of the micro-switch and 74LS32 chip. The machine screws and nuts have been put in place, also.

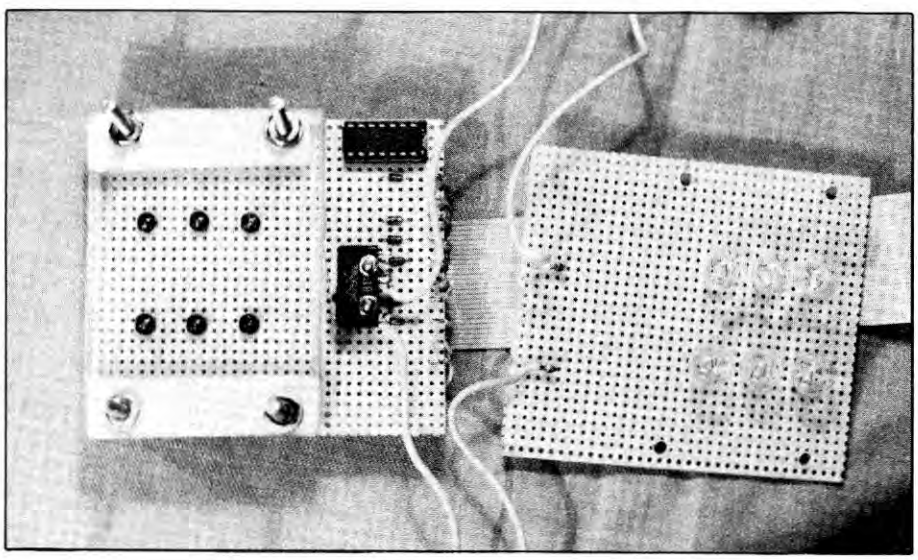

Photo 3. The plastic carriers have been added to the phototransistor board, and the six lamps mounted on another piece of perfboard. The lamp placement has been checked to ensure that the lamps will be directly over the phototransistors after final assembly.

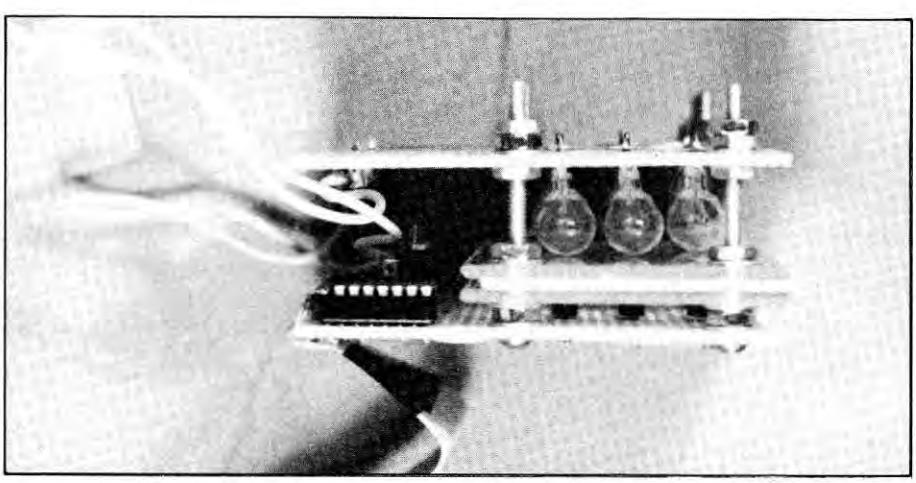

Photo 4. Side view of the CSCR after final assembly except for the box cover. Notice the spacer between the two plexiglass pieces and the placement of the power jack and ribbon cable.

unique value between 1 and 129. This unique value is the key to the software and your computer security.

When the Z80 processes an INP(0) instruction (or machine-language IN command), the IN* line is brought low to signal that a read is taking place. Each phototransistor that is receiving light in your CSCR will then allow the attached data line to be pulled low by the IN* line. When the Z80 reads the data lines, it will see those lines as 0.

Data lines not attached to phototransistors, or lines attached to transistors that are not receiving light, will remain high and equal to 1. This, by the way, is identical in theory of operation to the Alpha/Big 5 joystick for the Model 1, except that the CSCR uses phototransistors instead of contact switches to connect IN* and the data lines.

Construction

Unlike many projects, the electronics of the CSCR are relatively simple, while the mechanical construction can present problems. Therefore, we will describe the construction methods we used in detail. If you wish to make your CSCR differently, be sure you first understand our process before you begin your design.

Basic construction involves making a board for the phototransistors, a board for the lamps, and devising a method of holding the pass card between them that will allow light to shine only through selected holes in the card. Your pass card must be able to slide in and out freely, but it must also be held tightly enough that it will always be aligned correctly with a minimum of lateral and vertical movement.

Select a small cabinet to hold the CSCR—we used a metal cabinet sold by Radio Shack (#270-251). Cut two pieces of perfboard 3 1/8 by 3 3/8 inches to fit in the cabinet. Then cut two pieces of 1/8-inch thick plexiglass, 3 1/8 by 2 1/4 inches. The plexiglass will form the carrier for the pass card.

Tape the four pieces together so that they align with one flush edge, then mark and drill the four holes for the supporting bolts shown in Fig. 3. By drilling all four pieces at once, you know the holes will align themselves later.

Next, choose some opaque plastic to use for the pass card—we used the bottom of an inexpensive semi-flexible utility box—and cut two strips, each 1/2 by 2 1/4 inches. These strips will be bolted between the plexiglass to act as both spacers and as guides for your pass card.

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- **EVERY MICRO MAINFRAME CONTROLLER PRODUCED HAS INCLUDED GOLD PLATED CARD EDGE CONNECTORS FOR INCREASED RELIABILITY AT NO EXTRA COST.**
- **MICRO MAINFRAME IS FIRST TO USE THE STATE OF THE ART 9216 DATA SEPARATOR (FDC-3C ONLY).** We have proven this data separator for a full year and have used it beginning with the very first **FDC-3C** disk controller. Unlike other controllers, **NO ADJUSTMENTS ARE EVER REQUIRED TO OUR DATA SEPARATOR.**
- **MICRO MAINFRAME IS FIRST TO PROVIDE FOR 8" DISK OPERATION ON BOTH OUR FDC-3A and FDC-3C MODELS.**
- **MMF GIVES YOU A SYSTEM THAT CAN GROW WITH YOUR NEEDS,** from floppy disk systems to state of the art hard disk systems with full ECC and the industry's only SASI Multiplexer with our SASI-NET™†.
- **MMF's NEW 24 PAGE INSTALLATION MANUAL IS SECOND TO NONE.** Installing a disk upgrade kit from **MICRO MAINFRAME** is now easier than ever before.

WHO IS MICRO MAINFRAME?

MICRO MAINFRAME is the oldest and most respected after-market manufacturer of floppy disk controllers for the Model-III™*

MICRO MAINFRAME has more experience in floppy and hard disks than any other manufacturer, and we are producing our now-famous **FDC-3** series of disk controllers for the third year.

MICRO MAINFRAME has sold thousands of controllers to many OEM's who have marketed MMF controllers as their own unit.

HOW DO I ORDER?

In order to provide the lowest possible price to the end user, **MICRO MAINFRAME** does not accept credit cards. You may either pre-pay your shipment, or we will ship COD. All orders over $600 require a 10% deposit upon placement. All non-certified funds will be held a minimum of 3 weeks to allow them to clear. Shipping and handling charges are extra and are not included in the prices above. **MODEL-III™* COMPUTERS** are shipped by truck only. Please phone MMF to obtain shipping and handling fees to your location.

ACCEPT NOTHING LESS THAN THE BEST. INSIST UPON GENUINE MICRO MAINFRAME QUALITY PRODUCTS. Micro Mainframe has a complete line of products for the TRS-80™* computer system. Call or write for our descriptive flyer.

DEALER INQUIRIES SOLICITED ON YOUR PRINTED LETTERHEAD ONLY.

Phone orders are accepted only between 8:30 AM and 5:00 PM Pacific Time.

MICRO MAINFRAME ↙60
11325 Sunrise Gold Circle
Building E
Rancho Cordova, CA 95670
(916) 635-3997

* Model-III™ and **TRS-80™** are trademarks of Tandy.
† **SASI-NET™** is a trademark of Micro Mainframe.

Quantity	Item	Radio Shack Part No.
6	FPT-100 Phototransistor	276-130
6	IN914 Switching Diodes	
6	Type L-12 Lamps or Equiv.	
1	74LS32 Quad 2-Input OR Gate	276-1915
1	Submini Lever Switch	275-016
1	40-Position Card Edge Connector	
1	6.3V Transformer	

Miscellaneous: IC spaced perfboard, plastic for card and card guides, ribbon cable, cabinet, mounting hardware, IC socket, power jack and plug, plexiglass for card carrier, and push-in terminals.

Table 1. Parts List

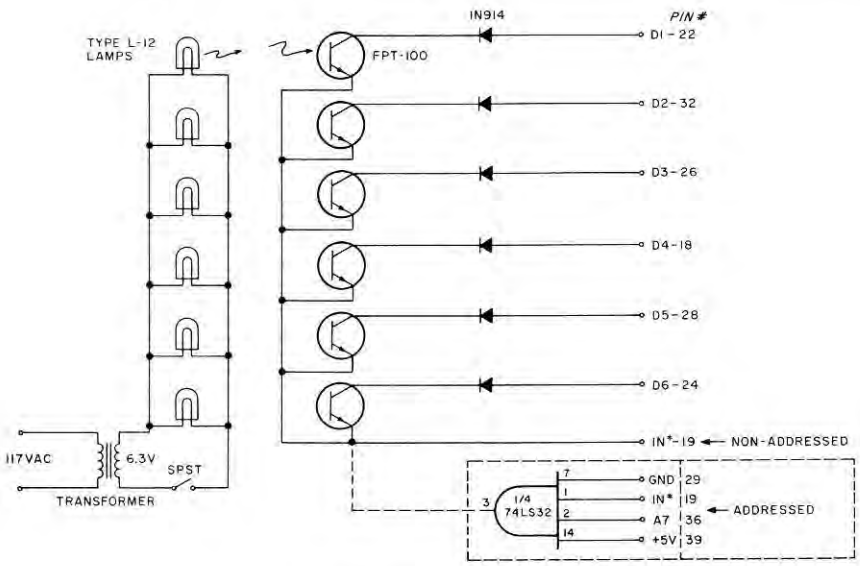


Fig. 1. Circuit Pictorial

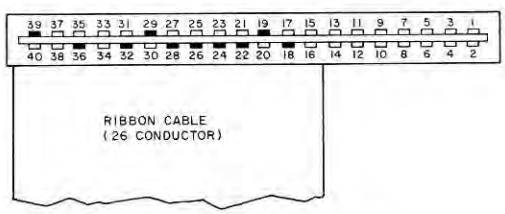


Fig. 2. 40-Position Card Edge Connector (Front View)

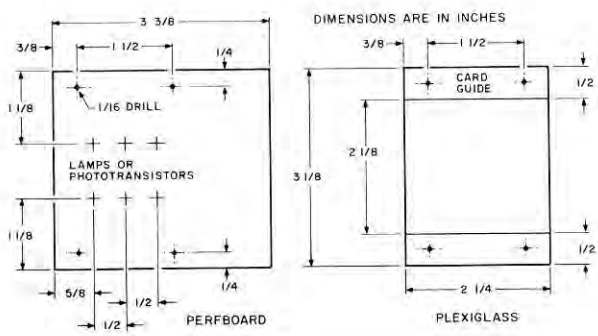


Fig. 3. Slot Dimensions

Using one of the plexiglass pieces as a template, drill two bolt holes through each strip. Also, use one of the perfboard pieces as a template for drilling four holes in the base of the CSCR cabinet. At the same time cut a pass card from the opaque plastic just wide enough to fit between the spacers and 3 1/2 inches long. Then, cut a piece of clear plastic (for example, from the lid of an old Christmas card box) the same size as your pass card.

Mark the lamp/phototransistor positions on each piece of perfboard by again referring to Fig. 3. Remember that the two boards will be facing each other and that the lamps and transistors must be in almost perfect alignment. Place the 6-volt lamps on one of the boards and solder their leads in parallel. The solder connections will hold the lamps in place on the board. Run the two common leads to the bottom of push-in terminals (such as Radio Shack #270-1392) near the rear of the board.

Place the phototransistors and diodes on the other piece of perfboard. If you are using the 74LS32 chip to semi-address the box, it must be placed on the board. Leave room for the microswitch and 10 push-in terminals. The final layout of this board is fairly tight; see Fig. 4. Then, when you are sure all pieces are correctly positioned, solder them all in place.

Mount the microswitch on the phototransistor board with two small (size #2) machine screws. The microswitch serves two uses: It turns on the lamps when the pass card is inserted into the CSCR, and it provides a secure and certain backstop so that the pass card is inserted the same depth every time.

Next, assemble the parts of the CSCR you have completed. Put the four machine screws through the wire side of the transistor board, using a washer and nut to hold each in place. Put a second washer on each machine screw; then add the two pieces of plexiglass with the plastic spacers between them. The plexiglass should be as close as possible to the phototransistors without actually touching them. Use additional washers as spacers if necessary.

After setting the plexiglass in place, add another washer and nut on each machine screw to hold the plexiglass pieces, and then another nut and washer (in that order) to support the lamp board. Put the lamp board on the screws and adjust its height from the plexiglass so that, again, it is as close as possible without actually touching. Then add another washer and nut set to hold the lamp board in place. Finally,

Telewriter-64™

the Color Computer Word Processor

- **3 display formats: 51/64/85 columns × 24 lines**
- **True lower case characters**
- **User-friendly full-screen editor**
- **Right justification**
- **Easy hyphenation**
- **Drives any printer**
- **Embedded format and control codes**
- **Runs in 16K, 32K, or 64K**
- **Menu-driven disk and cassette I/O**
- **No hardware modifications required**

THE ORIGINAL

Simply stated, Telewriter is the most powerful word processor you can buy for the TRS-80 Color Computer. The original Telewriter has received rave reviews in every major Color Computer and TRS-80 magazine, as well as enthusiastic praise from thousands of satisfied owners. And rightly so.

The standard Color Computer display of 32 characters by 16 lines without lower case is simply inadequate for serious word processing. The checkerboard letters and tiny lines give you no feel for how your writing looks or reads. Telewriter gives the Color Computer a 51 column by 24 line screen display with *true lower case characters*. So a Telewriter screen looks like a printed page, with a good chunk of text on screen at one time. In fact, more on screen text than you'd get with Apple II, Atari, TI, Vic or TRS-80 Model III.

On top of that, the sophisticated Telewriter full-screen editor is so simple to use, it makes writing fun. With single-letter mnemonic commands, and menu-driven I/O and formatting, Telewriter surpasses all others for user friendliness and pure power.

Telewriter's chain printing feature means that the size of your text is never limited by the amount of memory you have, and Telewriter's advanced cassette handler gives you a powerful word processor without the major additional cost of a disk.

...one of the best programs for the Color Computer I have seen...
— Color Computer News, Jan. 1982

TELEWRITER-64

But now we've added more power to Telewriter. Not just bells and whistles, but major features that give you total control over your writing. We call this new supercharged version Telewriter-64. For two reasons.

64K COMPATIBLE

Telewriter-64 runs fully in any Color Computer — 16K, 32K, or 64K, with or without Extended Basic, with disk or cassette or both. It automatically configures itself to take optimum advantage of all available memory. That means that when you upgrade your memory, the Telewriter-64 text buffer grows accordingly. In a 64K cassette based system, for example, you get about 40K of memory to store text. So you don't need disk or FLEX to put all your 64K to work immediately.

64 COLUMNS (AND 85!)

Besides the original 51 column screen, Telewriter-64 now gives you 2 additional high-density displays: 64 × 24 and 85 × 24!! Both high density modes provide all the standard Telewriter editing capabilities, and you can switch instantly to any of the 3 formats with a single control key command.

The 51 × 24 display is clear and crisp on the screen. The two high density modes are more crowded and less easily readable, but they are perfect for showing you the exact layout of your printed page, *all on the screen at one time*. Compare this with cumbersome "windows" that show you only fragments at a time and don't even allow editing.

RIGHT JUSTIFICATION & HYPHENATION

One outstanding advantage of the full-width screen display is that you can now set the screen width to match the width of your printed page, so that "what you see is what you get." This makes exact alignment of columns possible and it makes hyphenation simple.

Since short lines are the reason for the large spaces often found in standard right justified text, and since hyphenation is the most effective way to eliminate short lines, Telewriter-64 can now promise you some of the best looking right justification you can get on the Color Computer.

FEATURES & SPECIFICATIONS:

Printing and formatting: Drives any printer (LPVII/VIII, DMP-100/200, Epson, Okidata, Centronics, NEC, C. Itoh, Smith-Corona, Terminet, etc).

Embedded control codes give full dynamic access to intelligent printer features like: underlining, subscript, superscript, variable font and type size, dot-graphics, etc.

Dynamic (embedded) format controls for: top, bottom, and left margins; line length, lines per page, line spacing, new page, change page numbering, conditional new page, enable/disable justification.

Menu-driven control of these parameters, as well as: pause at page bottom, page numbering, baud rate (so you can run your printer at top speed), and Epson font. "Typewriter" feature sends typed lines directly to your printer, and Direct mode sends control codes right from the keyboard. Special Epson driver simplifies use with MX-80.

Supports single and multi-line headers and automatic centering. Print or save all or any section of the text buffer. Chain print any number of files from cassette or disk.

File and I/O Features: ASCII format files — create and edit BASIC, Assembly, Pascal, and C programs, Smart Terminal files (for uploading or downloading), even text files from other word processors. Compatible with spelling checkers (like Spell 'n Fix).

Cassette verify command for sure saves. Cassette auto-retry means you type a load command only once no matter where you are in the tape.

Read in, save, partial save, and append files with disk and/or cassette. For disk: print directory with free space to screen or printer, kill and rename files, set default drive. Easily customized to the number of drives in the system.

Editing features: Fast, full-screen editor with wordwrap, block copy, block move, block delete, line delete, global search and replace (or delete), wild card search, fast auto-repeat cursor, fast scrolling, cursor up, down, right, left, begin line, end line, top of text, bottom of text; page forward, page backward, align text, tabs, choice of buff or green background, complete error protection, line counter, word counter, space left, current file name, default drive in effect, set line length on screen.

Insert or delete text anywhere on the screen without changing "modes." This fast "free-form" editor provides maximum ease of use. Everything you do appears immediately on the screen in front of you. Commands require only a single key or a single key plus CLEAR.

...truly a state of the art word processor... outstanding in every respect.
— The RAINBOW, Jan. 1982

PROFESSIONAL WORD PROCESSING

You can no longer afford to be without the power and efficiency word processing brings to everything you write. The TRS-80 Color Computer is the lowest priced micro with the capability for serious word processing. And only Telewriter-64 fully unleashes that capability.

Telewriter-64 costs $49.95 on cassette, $59.95 on disk, and comes complete with over 70 pages of well-written documentation. (The step-by-step tutorial will have your writing with Telewriter-64 in a matter of minutes.)

To order, send check or money order to:

Cognitec
704 Nob Ave.
Del Mar, CA 92014 ↙ 121

Or check your local software store. If you have questions, or would like to order by Visa or Mastercard, call us at (619) 755-1258 (weekdays, 8AM-4PM PST). Dealer inquiries invited.

(Add $2 for shipping. Californians add 6% state tax. Allow 2 weeks for personal checks. Send self-addressed stamped envelope for Telewriter reviews from CCN, RAINBOW, 80-Micro, 80-U.S. Telewriter owners: send SASE or call for information on upgrading to Telewriter-64. Telewriter-compatible spelling checker (Spell 'n Fix) and Smart Terminal program (Colorcom/E) also available. Call or write for more information.)

Apple II is a trademark of Apple Computer, Inc.; Atari is a trademark of Atari, Inc.; TRS-80 is a trademark of Tandy Corp; MX-80 is a trademark of Epson America, Inc.

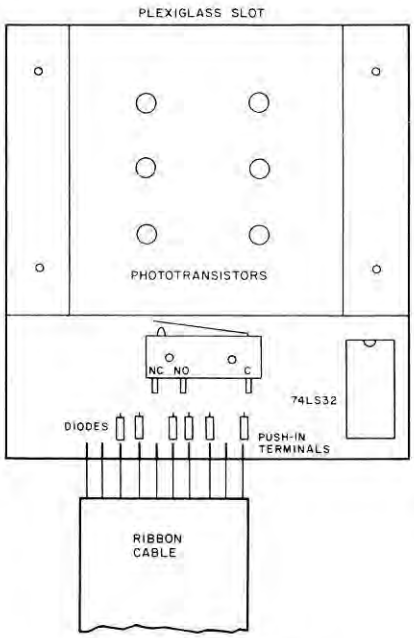


Fig. 4. Transistor Board

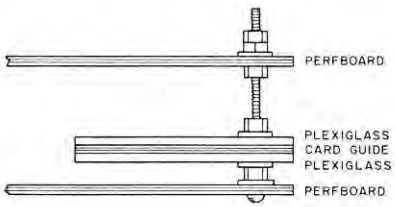


Fig. 5. Boards, Nuts, and Washers (Side View)

add one more nut to each screw to act as a spacer between the lamp board and the bottom of the assembly cabinet. See Fig. 5 for the proper arrangement of pieces.

You will have two cables running to the CSCR: a ribbon cable to carry signals from the computer and a small power cable to bring 6.3 volts from a transformer to the lamps. The ribbon cable can easily fit between the base and cover of the cabinet, but you will need a miniature plug and jack to carry the lamp power. Drill a hole for the jack in one end of the cabinet base, being sure that the jack will not interfere with either the plexiglass or the perfboard.

"... identify each of the ends of the ribbon cable you will need to connect."

The next step is to attach the ribbon cable that will run from your computer's expansion port (either from the keyboard or expansion interface). Press into a 40-pin edge connector a piece of ribbon cable at least 26 wires wide. If you do use 26-conductor ribbon cable, be sure that it is placed as far to the right (when viewed from behind) as possible inside the edge connector. Separate and strip each of the other ends of the ribbon cable; you won't be using them all, but having them all stripped will facilitate tracing the leads.

Refer to the edge-connector diagram in Fig. 2 and, using a continuity tester or ohmmeter, identify each of the ends of the ribbon cable you will need to connect. As you find each, solder it in place. When all ten necessary lines are connected, cut off the unnecessary lines, making sure that you have left no exposed wire on those ends to short out.

It is time to test your work so far. Connect, temporarily, your lamps to the power supply. If all six lamps do not light, check the solder connections on the lamp board. Disconnect the lamps, turn off your computer, connect the edge connector to your expansion port, and turn on the computer. Even if you have a disk system, use Level II Basic for this preliminary test.

If your computer does not turn on normally, immediately turn it off and then carefully check your wiring on the phototransistor board and recheck to be sure you connected the correct lines of the ribbon cable to the correct positions on the CSCR. Since nothing should be happening yet on the CSCR, your computer should perform normally.

Next, enter from the command mode, PRINT INP(0). If all is well, the computer will respond with the value 255. Then enter and run the following short program.

```
10 CLS
20 PRINT INP(0),INP(254)
30 GOTO 20
```

You should see 255 printed in two columns on your screen. Now reconnect the lamps to their power supply. As the lamps come on, the first column on your screen should change to 129, but the second column will remain unchanged (if you are using the 74LS32; otherwise both numbers will change). Once your CSCR passes this test, you are ready for the final assembly.

Turn off the computer and disconnect the CSCR. You must now make your master card and pass card. Partially disassemble your CSCR and place the clear plastic between the two spacers over the transistor board. Using a sharp pin, make a small hole in the plastic directly over each phototransistor. Then use this piece of clear plastic to mark the six possible hole positions on your pass

Program Listing 1

```
                00100 ;****************************************
                00110 ;*                                      *
                00120 ;*   COMPUTER SECURITY CARD READER      *
                00130 ;*      INTERCEPT PROGRAM               *
                00135 ;*         VERSION 1.2                  *
                00140 ;*                                      *
                00150 ;*   WRITTEN BY                         *
                00160 ;*      HARDIN BROTHERS                 *
                00170 ;*           AND                        *
                00180 ;*      JEAN ROBERT DURBIN              *
                00190 ;*                                      *
                00200 ;****************************************
                00210 ;
7800            00220         ORG     7800H
                00230 ;
                00240 ;THIS SECTION INITIALIZES THE PROGRAM, RELOCATES IT TO
                00250 ;HIGHEST POSSIBLE MEMORY, AND PROTECTS IT THERE
                00260 ;
7800 2A1640     00270         LD      HL,(4016H)      ;GET ADD. OF KB DRIVER
7803 224378     00280         LD      (RETURN),HL     ;AND PUT IT IN PROGRAM
7806 2A4940     00290         LD      HL,(4049H)      ;GET CURRENT MEM TOP
                00300                 ;   *****       USE 40B1H FOR LEVEL II
7809 010E00     00310         LD      BC,000EH        ;LEN. OF MAIN PROGRAM
780C AF         00320         XOR     A               ;RESET CARRY FLAG
780D ED42       00330         SBC     HL,BC           ;HL=NEW ADDRESS FOR PROG.
780F 221640     00340         LD      (4016H),HL      ;NEW KB. DRIVER ADDRESS
7812 E5         00350         PUSH    HL              ;SAVE NEW PROG. ADDRESS
7813 2B         00360         DEC     HL              ;DROP BY ONE
7814 224940     00370         LD      (4049H),HL      ;NEW MEM TOP SET
                00380                 ;*****          USE 40B1H FOR LEVEL II
7817 11CEFF     00390         LD      DE,-50          ;SPACE FOR STRING STORAGE
781A 19         00400         ADD     HL,DE           ;SUBTRCT 50 FROM HL
781B 22A040     00410         LD      (40A0H),HL      ;SET STRING AREA POINTER
781E D1         00420         POP     DE              ;DE HAS NEW PROG. ADDR.
781F 213778     00430         LD      HL,START        ;GET PRESENT ADDRESS
7822 E5         00432         PUSH    HL              ;SAVE ADDRESS
7823 D5         00434         PUSH    DE              ;SAVE ADDRESS
7824 EB         00440         EX      DE,HL           ;CHANGE REGISTERS
7825 AF         00450         XOR     A               ;RESET CARRY FLAG
7826 ED52       00460         SBC     HL,DE           ;HL=AMT. TO OFFSET
7828 EB         00470         EX      DE,HL           ;NOW DE HAS THAT VALUE
7829 2A3978     00480         LD      HL,(START+2)    ;GET ADDRESS TO OFFSET
782C 19         00490         ADD     HL,DE           ;OFFSET IT
782D 223978     00500         LD      (START+2),HL    ;AND SAVE IT
7830 D1         00510         POP     DE              ;POP DESTINATION ADDR.
```

Listing 1 continues

ATARI

JOYSTICKS
JSA (2) . . . $6.95/pair

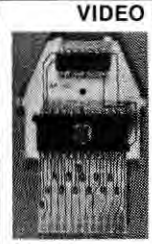
PADDLES
JSP (2) . . . $4.95/pair

TV GAME SWITCH

Switches TV to video game or computer operation. Used on Atari.

TGS-1 . . . $2.95 ea.

VIDEO GAME CHIPS



Pull-outs from hand-held video games. **AP2000** consists of one MM2716Q EPROM and one 74LS04. **AP2002** consists of two MM2716 EPROMs and one 74LS04. These EPROMs are mounted on a circuit board with a 12-pin edge card connection. EPROMs can be reprogrammed for other applications.

AP2000 . . . . . **$2.49 ea. or 2 for $3.95**
AP2002 . . . . . **$3.49 ea. or 2 for $6.49**

JOYSTICKS

JS-5K (Pictured)

JS-5K	5K Linear Taper Pots	$5.25
JS-100K	100K Linear Taper Pots	$4.95
JS-150K	150K Linear Taper Pots	$4.75
JVC-40	40K (2) Video Controller in Case	$4.95

JS KNOB Knob for JS5K,100K,150K . . . . . **$.99 ea.**
JVC KNOB Knob for JVC-40 . . . . . **$.99 ea.**

Jameco ELECTRONICS — Digital Thermometer Kit

Dual sensors — switch controls for indoor/outdoor or dual monitoring — can be extended to 500 feet. Continuous LED .8" ht. display. Range: -40°F to 199°F, -40°C to 100°C. Accuracy: ±1° nominal. Calibrate for Fahrenheit/Celsius. Simulated walnut case. AC wall adapter included. Size: 6¾"L x 3½"H x 1⅜"D.

JE300 . . . . . $39.95

BOOKS

NATIONAL SEMICONDUCTOR — INTERSIL — INTEL

30001	**National CMOS Data Book (1981)** (640 pages) 74C, CD4000, and A/D Converters	$6.95
30002	**National Interface Data Book (1980)** (704 pages) DP, DS8000, DS3600, DS5700, etc.	$6.95
30003	**National Linear Data Book (1982)** (1376 pages) LM, LF, ADC, DAC, LH Series	$11.95
30004	**National Series 80 — Board Level Computer (1980)** (224 pages)	$4.95
30005	**National TTL Logic Data Book (1981)** (624 pages) 7400,LS,L,H,S, and DM8000 Series	$9.95
	30006 Above (3) 30001,3,5 as set	**$24.95**
30008	**National Memory Data Book (1980)** (464 pages) RAMs, ROMs, PROMs, EPROMs Series	$6.95
30009	**Intersil Data Book (1983)** (1356 pages) Complete line.	$9.95
30010	**National Audio/Radio Handbook (1980)** (240 pages) Pre-Amps, AM, FM & FM Stereo, Power Amps	$5.95
30011	**National Linear Application Handbook (1980)** (736 pages) Application Notes, Linear Briefs, etc.	$15.95
30012	**National PAL Data Book (1982)** (176 pages) Data Sheet, PAL Design	$5.95
30013	**Zilog Data Book (1983)** (641 pages) Microprocessors and Support Chips	$7.95
010400	**Intel Component Data Book (1982)** (1405 pg.) Full data sheets for Intel's products incl. mem. devices, microproc., periph. & ind./mil. products	$14.95
205610	**Intel Peripheral Design Handbook (1981)** (828 pages) Full data sheets, application notes for Intel peripheral device components	$9.95

Universal Computer Keyboard Enclosures

"DTE" Blank Desk Top Enclosures are designed for easy modification. High strength epoxy molded end pieces in mocha brown finish. Sliding rear/bottom panel for service/component access. Top/bott. panels .080" thick alum. alodine type 1200 finish (gold tint color) for best paint adhesion after modification. Vented top & bottom panels for cooling efficiency. Rigid construction provides unlimited applications. Assembly instructions included.

DTE-8	**Panel Width 7.5"**	$24.95
DTE-11	**Panel Width 10.13"**	$27.95
DTE-14	**Panel Width 13.5"**	$29.95
DTE-20	**Panel Width 19.25"**	$34.95

Mostek DC/DC Converter +5 VOLTS TO -9 VOLTS

Input: +5V. Output: -9V (regulated) @ 30mA. Printed circuit mounting. Specifications incl.

DC10 . . . . . **$2.95 ea. or 2/$4.95**

Battery Checker

Easy-to-use hand-held battery checker tests AA, AAA, C, D, and 216 batteries. A multi-colored meter shows if battery is good, weak or needs replacing. Size: 6¼"L x 2¼"W x 1-7/8"H.

BC-1 . . . . . **$6.95 ea.**

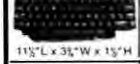
KEYBOARDS — POWER SUPPLIES

DATANETICS 73-KEY KEYBOARD *Apple Compatible*
Data Entry Keyboard uses MM5740 BEE/N encoder chip (included). 73-Key Keyboard features 11-key numeric keypad, SPST switching, 24-pin edge card connection. Includes pin-out.
17⅝"L x 6"W x 1⅜"H
Part No. KB261 (Fits DTE-20 Enclosure) . . . . . **$49.95 each**

MICRO SWITCH 69-KEY KEYBOARD
Data Entry Keyboard, Encoded Output: 8-bit Parallel EBC DIC. Switching: Hall Effect, 24-pin Edge Card Connection. Complete w/Pin Connection. Can easily be modified to ASCII code.
16¾"L x 5¼"W x 1⅝"H
Part No. KB69SD12-2 (Fits into DTE-20 Enclosure) . . . . . **$19.95 each**

MICRO SWITCH 85-KEY KEYBOARD
Word Processing Keyboard, 26 Pin Edge Card Connection. Supply Voltage +5VDC. Main Keyboard is DVERTY. Additional Key Pads for Cursor and word processing functions.
23"Lx5¾"Wx1-3/8"H
Part No. 85SD18-1 . . . . . **$29.95 each**

MICRO SWITCH 88-KEY KEYBOARD (PARALLEL
Data Entry Keyboard used in a Diablo 1640 Terminal. Supply Voltage: +5V, -12V. Switching: Hall Effect — 10-pin Edge Card Connection. Schematic included. Uses 8048 Encoder Chip.
18½"L x 5¾"W x 1⅝"H
Part No. 88SD22 (Fits into DTE-20 Enclosure) . . . . . **$49.95 each**



HI-TEK 58-KEY KEYBOARD
SPST switching, mechanical, monolithic housing, charcoal grey keycaps. Keyboard is not mounted on circuit board (each key is individually accessible). Used to replace touch-membrane found on Sinclair, Atari, and TRS-80 computers.
11⅞"L x 3⅝"W x 1⅜"H
Part No. K-58 (Fits DTE-14 Enclosure) . . . . . **$19.95 each**

ALPS 29-KEY CALCULATOR KEYBOARD
Features one 8-position decimal select switch, one 3-position switch, and two 2-position switches, mechanical SPST switching, 22-pin edge card connection. Pin-out included.
9⅝"L x 4⅝"W x 1⅜"H
Part No. KB297040 (Fits DTE-11 Enclosure) . . . . . **$4.95 each**

POWER SUPPLY +5VDC @ 1 AMP REGULATED *Transaction Tech*
Output +5VDC @ 1A (also +30VDC) reg. Input 115VAC 60Hz. 2-tone (black/beige) self-enclosed case. 6 ft., 3 cond. black power cord. 6½"W x 7"D x 2¼"H. Wt. 3 lbs. Data sheet incl.
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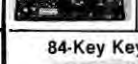

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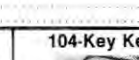

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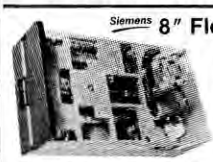

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JE665 — RS232C INTERFACE OPTION — The JE665 RS232C Interface Option implements computer access to the JE664's RAM. Sample software written in BASIC provided for TRS-80® Model I, Level II Computer. Baud rate: 9600. Word Lgth: 8 bits - odd parity. Stop bits: 2. Option may be adapted to other computers.

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Listing 1 continued

```
7831 E1       00520          POP     HL              ;AND CURRENT PROG. START
7832 EDB0     00530          LDIR                    ;THEN SHIFT PROGRAM
7834 C32D40   00540          JP      402DH           ;THIS IS FOR DOS
              00550 ;FOR LEVEL II MACHINE LANGUAGE, LINE 540 SHOULD BE
              00560 ;        JP      1A19H
              00570 ;FOR BASIC VERSION THAT WILL *NOT* BE SAVED AS
              00572 ;MACHINE LANGUAGE, LINE 540 SHOULD BE
              00580 ;        RET
              00590 ;
              00600 ;
              00610 ;**** THIS IS THE MAIN PROGRAM -- IT SCANS THE CSCR ON
              00620 ;        EVERY KEYBOARD SCAN AND RETURNS IF PASS CARD
              00630 ;        IS INSERTED
              00640 ;
7837 E5       00650 START    PUSH    HL              ;SAVE HL REGISTER
7838 2A4378   00660          LD      HL,(RETURN)     ;GET RETURN ADDRESS
783B E3       00670          EX      (SP),HL         ;AND PUT IT ON STACK
783C DB00     00680 LOOP     IN      A,(00H)         ;READ CSCR
783E FEFF     00690          CP      0FFH            ;**** CHANGE THIS VALUE
              00700                                  ; TO MATCH CARD ****
7840 C8       00710          RET     Z               ;GO IF OKAY
7841 18F9     00720          JR      LOOP            ;ELSE LOOK UNTIL OKAY
              00730 ;
7843 0000     00740 RETURN   DEFW    0000H           ;MEMORY FOR KB DRIV. ADDR.
              00750 ;
7000          00760          END     7000H
00000 TOTAL ERRORS
```

```
10 ' ****************************************
20 ' *****                                  *****
30 ' ***** COMPUTER SECURITY CARD READER    *****
40 ' *****       INTERCEPT PROGRAM          *****
50 ' *****                                  *****
60 ' *****        WRITTEN BY                *****
70 ' *****              HARDIN BROTHERS     *****
80 ' *****                    AND           *****
90 ' *****              JEAN ROBERT DURBIN  *****
100 '*****                                 *****
110 '****************************************
120 '
130 ' $$$$ SET CARD VALUE IN LINE 590 BEFORE RUNNING $$$$
140 '
150 'THIS PROGRAM MAY BE RUN IN THREE DIFFERENT MODES:
160 ' MODE 1 -- RUN IN DISK BASIC & DUMP M/L PROGRAM TO DISK
170 ' MODE 2 -- RUN IN LEVEL 2 BASIC & DUMP TO TAPE WITH T-BUG
180 ' MODE 3 -- RUN IN LEVEL 2 BASIC WITHOUT DUMP
190 '
200 ' SEE COMMENTS IN PROGRAM FOR NECESSARY MODIFICATIONS FOR
210 '     EACH MODE -- PROGRAM CURRENTLY WRITTEN FOR MODE 1
220 '
230 CLS : C = 0
240 FOR I = 30720 TO 30788
250   PRINT @ 0,I
260   READ A : POKE I,A
270 NEXT I
280 CMD"DUMP INTERCEP/CMD:1 (START=X'7800',END=X'7844',TRA=X'780
0')" : END : 'USE THIS LINE FOR MODE 1 ONLY
290 '
300 'FOR MODE 2:  300 END -- THEN GO TO T-BUG AND ENTER
310 '                        P7800 7844 7800 INTRCP
320 '
330 'FOR MODE 3:  300 POKE 16526,0 : POKE 16527,120 : A = USR(0)
 : END
340 '
350 '
360 DATA  42, 22, 64, 34, 67,120
370 DATA  42, 73, 64 : 'MODE 1 ONLY
380 '
390 '    MODE 2 & 3:  390  DATA  42,177, 64
400 '
410 DATA   1, 14,  0,175,237, 66, 34, 22, 64,229, 43
420 DATA  34, 73, 64 : 'MODE 1 ONLY
430 '
440 '    MODE 2 & 3:  440  DATA  34,177, 64
450 '
460 DATA  17,206,255, 25, 34,160, 64
470 DATA 209, 33, 55,120,229,213,235,175,237, 82
480 DATA 235, 42, 57,120, 25, 34, 57,120,209,225
490 DATA 237,176
500 DATA 195,45,64 : 'MODE 1 ONLY
510 '
520 '    MODE 2:  520 DATA 195, 25, 26
530 '    MODE 3:  520 DATA 201,  0,  0
540 '
550 DATA 229, 42, 67,120,227,219,  0,254
560 '
570 DATA 255 : 'SET THIS VALUE TO MATCH YOUR PASS CARD
580 '
590 DATA 200, 24,249,  0,  0
```

Program Listing 2

card. Select the positions (any number from 1 to 6) you wish to use, and, with a small drill-bit or nail, punch the final holes in the pass card. Be sure to mark the top of your pass card, as well.

Your next step is to cut a slot in the face of the cabinet to allow you to insert the pass card. Temporarily bolt the CSCR to the inside of the cabinet, mark its position on the inside of the face, and then remove the CSCR and cut the slot by drilling a row of small holes and smoothing out the cut with a file. You need to make the slot slightly wider and taller than the pass card, but small enough so that the pass card is forced to go between the plexiglass sheets instead of over or under them.

Next, run a short wire from one of the push-in terminals on the lamp board to the microswitch, from the other terminal to the power jack, and from the microswitch to the power jack. Bolt the CSCR back to the base of the cabinet, but don't attach the cover yet.

You are about to begin your last series of tests. Attach the CSCR to your computer, and the power transformer to the light circuit of your CSCR. Turn on the computer and again run the short program above. Insert your card (making sure it is right-side-up) into the slot. The number that appears in the first column on your screen is your card's code number. The first column on your screen should show this number constantly while the card is in the CSCR, and change back to 255 when your card is removed.

When you are convinced that all is working properly, turn everything off, disconnect the CSCR, and finish assembling it. You are now ready for the software and your computer's new life with some security.

Software

Your CSCR will do nothing without the appropriate software in your computer. Therefore, we have developed three programs that use the CSCR to provide security for your computer system.

Listing 1, CSCR Intercept program, is the simplest and probably most useful of the three programs. It is designed to allow the computer to run when your pass card is inserted into the CSCR. If you remove the pass card, the computer enters an endless loop and appears to hang up. If you reinsert the card, the computer will resume normal operation as if nothing had happened.

The theory behind this program is simple: The computer spends a large amount of its time scanning the key-

board to see if you are pressing any keys. Our intercept program is written so that the computer is forced to check the CSCR before every keyboard strobe. If your card is in place, control passes to the regular keyboard routine; if your card isn't there (or if the CSCR is disconnected), the computer waits for the card to be reinserted.

The first section of Listing 1, lines 270–540, moves the main program routine into the highest section of unprotected memory, protects it, and initializes the system. In line 270, the current keyboard driver address is found and saved for later use. Then the current top of free memory is found and adjusted to allow room for this program. Also, the pointer to the keyboard driver is changed to point to the Intercept program.

Lines 390–410 reset the 50 free bytes of string storage space. Then the program determines how far the main loop will be moved. This offset is then used to change the one necessary absolute address in the main loop. Finally, the main loop of the program is moved to high memory, and the initialization program is exited.

The method of exiting the program depends on its exact environment. Line 540, as it is currently written, returns control to DOS. If the change shown in line 560 is made, control will return to Level II Basic, if you are not using a disk system. Finally, if you wish to use this program as a USR call from Basic, line 540 should be a simple RET instruction.

"The method of exiting the program depends on its exact environment."

The initialization section is the most complicated part of this program; the main routine is much shorter. This routine is entered every time the computer scans the keyboard, so it must preserve all registers as they were with the exception of the A register. Therefore, in line 650, the HL register pair is pushed on the stack to save it. Then the address of the normal keyboard routine is found and placed in HL in line 660. In 670, the keyboard routine address is placed on the stack, and the previous HL value is restored.

Line 680 reads the CSCR through port 0. Line 690 is a test to see if the CSCR is reporting the correct value. Before you assemble this program, you must put your card's value into line 690, or the computer will hang up every time you run this program. Finally, the computer goes to the regular keyboard routine (its address was placed on the stack, so you get there with a RET) if the correct value was found. If the wrong value was reported by the CSCR, the program loops back until it finds the correct one.

Listing 2 presents the same program in Basic. As explained in the remarks in the program, you can use the listing either to generate the same machine-language code as Listing 1, or as a stand-alone Basic program. Listing 2 contains the necessary notes to assemble the machine language for a disk dump, a tape dump, or to create a USR routine. If you use this program as a USR call, you can delete the entire program after it has been called once, because a machine-

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```
1 REM**************

2 DEFINTA-Z
:A=PEEK(16548)+PEEK(16549)*256
:POKE16548,PEEK(A)
:POKE16549,PEEK(A+1)
:FORI=ATOA+18
:READD
:POKEI,D
:NEXTI
:POKEA+1,(A+7)-INT((A+7)/256)*256
:POKEA+2,INT((A+7)/256)
:POKEA+9,PEEK(16406)
:POKEA+10,PEEK(16407)

3 DATA 33,0,0,34,22,64,201,229,33,0,0,227,219,0,254
:'CHANGE NEXT DATAVALUE TO MATCH CARD

4 DATA 255,200,24,249

5 DEFUSR=A
:A=USR(0)
:FORI=1TO4
:A=PEEK(16548)+PEEK(16549)*256
:POKE16548,PEEK(A)
:POKE16549,PEEK(A+1)
:NEXTI
:RUN
```

Program Listing 3

```
1 REM**************
2 DEFINTA-Z:A=PEEK(16548)+PEEK(16549)*256:POKE16548,PEEK(A):POKE
16549,PEEK(A+1):FORI=ATOA+18:READD:POKEI,D:NEXTI:POKEA+1,(A+7)-I
NT((A+7)/256)*256:POKEA+2,INT((A+7)/256):POKEA+9,PEEK(16406):POK
EA+10,PEEK(16407)
3 DATA 33,0,0,34,22,64,201,229,33,0,0,227,219,0,254,255,200,24,2
49
4 DEFUSR=A:A=USR(0):FORI=1TO3:A=PEEK(16548)+PEEK(16549)*256:POKE
16548,PEEK(A):POKE16549,PEEK(A+1):NEXTI:RUN
```

Program Listing 4

```
                00100 ;****************************************
                00110 ;*                                      *
                00120 ;*   COMPUTER SECURITY CARD READER      *
                00130 ;*    SOURCE CODE FOR HIDDEN            *
                00140 ;*        BASIC PROGRAM                 *
                00150 ;*        VER. 1.0                      *
                00160 ;*                                      *
                00170 ;*      WRITTEN BY                      *
                00180 ;*         HARDIN BROTHERS              *
                00190 ;*              AND                     *
                00200 ;*         JEAN ROBERT DURBIN           *
                00210 ;*                                      *
                00220 ;****************************************
                00230 ;
0000            00240           ORG     0000H           ;WILL BE LOCATED BY BASIC
                00250 ;
                00260 ;**** FIRST INITIALIZE THE KEYBOARD DCB
                00270 ;
0000 210000     00280           LD      HL,0000H        ;BASIC WILL SUPPLY VALUE
0003 221640     00290           LD      (4016H),HL      ;PLACE IN KB D.C.B.
0006 C9         00300           RET                     ;RETURN FROM USR CALL
                00310 ;
                00320 ;**** NOW THE CARD-READER SCAN
                00330 ;
0007 E5         00340           PUSH    HL              ;SAVE REGISTER
0008 210000     00350           LD      HL,0000H        ;BASIC WILL SUPPLY VALUE
000B E3         00360           EX      (SP),HL         ;AND PLACE ON STACK
000C DB00       00370 LOOP      IN      A,(00H)         ;STROBE CARD READER
000E FEFF       00380           CP      0FFH            ;**** CHANGE THIS VALUE
                00390                                   ; TO MATCH CARD ****
0010 C8         00400           RET     Z               ;GO TO KB SCAN IF OKAY
0011 18F9       00410           JR      LOOP            ;ELSE TRY AGAIN
                00420 ;
000C            00430           END                     ;DOESN'T NEED A T.R.A.
00000 TOTAL ERRORS
```

Program Listing 5

language routine will then be running in high memory.

Listings 1 and 2, along with a CSCR, provide you with a great deal of protection. They provide complete compatibility with other keyboard routines (a debounce or lowercase driver, for example) as long as those routines are loaded before the CSCR Intercept routine.

All Basic programs strobe the keyboard after each command, looking for the break key or shift @; most machine-language programs also necessitate frequent keyboard entry. Therefore, removing your pass card from the CSCR will seem to freeze the computer in its tracks. Until you reinsert your card, the computer will appear to be lifeless except that the real-time clock will continue to update.

The only way to defeat the CSCR Intercept is to reboot the system using the reset button with disks or by turning it off and then back on with Level II. If someone does reset the system, your program will no longer be running.

If you are truly serious about protecting your programs, you will probably have to disable the reset and power switches, move them away from the CPU, and make them accessible only with keys. But for most micro users, the direct simplicity of the CSCR will provide adequate protection. Think of the CSCR as a locked door, not a bank vault, guarding your programs and software.

Hidden Basic

Listings 3, 4, and 5 present another method of protecting individual Basic programs. Listings 3 and 4 are short headers that you can attach to any Basic program. As soon as the program is run, the header will disappear, but the CSCR will operate exactly the same as under the Intercept program. Anyone trying to list your program (which they won't be able to do unless your pass card is in the CSCR) will not be able to see or reprogram your protection scheme.

Listing 3 presents the header in readable form, though you will probably want to use Listing 4 to save space in actual practice. The first line, although it seems meaningless, is the most important in the program. The asterisks save space for the machine-language code stored as data statements in lines 3 and 4. (If you wish to examine the actual machine instructions, the assembly source code is presented in Listing 5.) Be sure you enter the first line exactly as shown. If you do not, your computer

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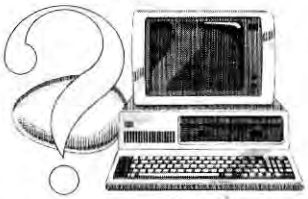

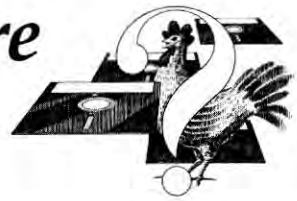

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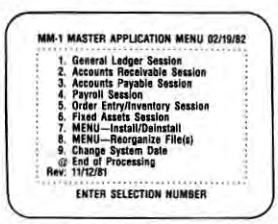

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Program Listing 6

```
                00100 ;****************************************
                00110 ;*                                      *
                00120 ;*   CARD-READER /COMPUTER SAFETY        *
                00130 ;*      TIME ROUTINE -- VER. 1.3        *
                00140 ;*                                      *
                00150 ;*   WRITTEN BY                         *
                00160 ;*      HARDIN BROTHERS                 *
                00170 ;*            AND                       *
                00180 ;*      JEAN ROBERT DURBIN              *
                00190 ;*                                      *
                00200 ;****************************************
                00210 ;
                00220 ;
7800            00230           ORG     7800H
                00240 ;
                00250 ;*****  THIS SECTION SETS TIME DURATION
                00260 ;       ACCORDING TO KEYBOARD INPUT
                00270 ;
7800 CDC901     00280 ASK       CALL    01C9H           ;ROM CLEAR SCREEN ROUTINE
7803 213678     00290           LD      HL,ASKQ         ;POINT TO QUESTION
7806 11843C     00300           LD      DE,3C84H        ;POINT TO SCREEN
7809 011000     00310           LD      BC,0010H        ;QUESTION LENGTH
780C EDB0       00320           LDIR                    ;PUT QUESTION ON SCREEN
780E 13         00330           INC     DE              ;BUMP ONCE
780F ED532040   00340           LD      (4020H),DE      ;AND SET CURSOR POSITION
7813 213278     00350           LD      HL,ASKBUF       ;POINT TO TEMP. BUFFER
7816 E5         00360           PUSH    HL              ;AND SAVE
7817 0603       00370           LD      B,03H           ;MAX. LENGTH OF ANSWER
7819 CDD905     00380           CALL    05D9H           ;ROM INPUT STRING ROUTINE
781C E1         00390           POP     HL              ;RECOVER REGISTER
781D 38E1       00400           JR      C,ASK           ;GO BACK IF BREAK HIT
781F CD5A1E     00410           CALL    1E5AH           ;CONVERT TO INTEGER
7822 AF         00420           XOR     A               ;A=0
7823 BA         00430           CP      D               ;D SHOULD BE ZERO
7824 20DA       00440           JR      NZ,ASK          ;GO BACK IF NOT
7826 BB         00450           CP      E               ;E SHOULD BE >0
7827 28D7       00460           JR      Z,ASK           ;GO BACK IF NOT
7829 7B         00470           LD      A,E             ;GET VALUE
782A 32AF78     00480           LD      (TIME+1),A      ;PUT IN PLACE
782D CDC901     00490           CALL    01C9H           ;CLEAR SCREEN AGAIN
7830 1814       00500           JR      INIT            ;AND GO
                00510 ;
0004            00520 ASKBUF    DEFS    4               ;BUFFER FOR INPUT
7836 4D         00530 ASKQ      DEFM    'MINUTES (1-255)?' ;INPUT PROMPT
     49 4E 55 54 45 53 20 28
     31 2D 32 35 35 29 3F
                00540 ;
                00550 ;*****  THIS ROUTINE MOVES AND PROTECTS MAIN LOOP
                00560 ;       AND INITIALIZES THE PROGRAM
                00570 ;
7846 F3         00580 INIT      DI                      ;STOP INTERRUPTS FOR NOW
7847 2A4940     00590           LD      HL,(4049H)      ;GET MEMTOP
784A 017400     00600           LD      BC,0074H        ;LENGTH OF MAIN PROGRAM
784D AF         00610           XOR     A               ;RESET CARRY FLAG
784E ED42       00620           SBC     HL,BC           ;HL=NEW ADDR. FOR PROG.
7850 225B40     00630           LD      (405BH),HL      ;SET INTERRUPT POINTER
7853 E5         00640           PUSH    HL              ;SAVE BEG. OF PROG. ADDR.
7854 2B         00650           DEC     HL              ;DROP BY ONE
7855 224940     00660           LD      (4049H),HL      ;AND PROTECT PROGRAM
7858 11CEFF     00670           LD      DE,-32H         ;SPACE FOR STRING STORAGE
785B 19         00680           ADD     HL,DE           ;SUBTRACT 50 FROM HL
785C 22A040     00690           LD      (40A0H),HL      ;SET STRING AREA POINTER
785F D1         00700           POP     DE              ;DE HAS NEW PROG. ADDR.
7860 219278     00710           LD      HL,START        ;POINT TO BEGIN. OF PROG.
7863 E5         00720           PUSH    HL              ;AND SAVE
7864 D5         00730           PUSH    DE              ;  BOTH REGISTERS
7865 EB         00740           EX      DE,HL           ;SWAP REGISTERS
7866 AF         00750           XOR     A               ;CLEAR CARRY FLAG
7867 ED52       00760           SBC     HL,DE           ;HL=AMT. TO OFFSET
7869 EB         00770           EX      DE,HL           ;  OFFSET INTO DE
786A 2AC878     00780           LD      HL,(W1+9)       ;FIRST ABSOLUTE ADDRESS
786D 19         00790           ADD     HL,DE           ;OFFSET IT
786E 22C878     00800           LD      (W1+9),HL       ;AND SAVE IT
7871 2ADB78     00810           LD      HL,(STOP+8)     ;SECOND ABSOLUTE ADDRESS
7874 19         00820           ADD     HL,DE           ;OFFSET IT
7875 22DB78     00830           LD      (STOP+8),HL     ;AND SAVE IT
7878 2AE378     00840           LD      HL,(STOP+16)    ;LAST ABSOLUTE ADDRESS
787B 19         00850           ADD     HL,DE           ;OFFSET IT
787C 22E378     00860           LD      (STOP+16),HL    ;AND SAVE IT
787F D1         00870           POP     DE              ;RECOVER DESTINATION ADDR.
7880 E1         00880           POP     HL              ;AND CURRENT PROG. ADDR.
7881 EDB0       00890           LDIR                    ;MOVE PROGRAM
7883 AF         00900           XOR     A               ;CLEAR A REGISTER
7884 0606       00910           LD      B,6             ;SET COUNTER
7886 214040     00920           LD      HL,4040H        ;POINT TO CLOCK TABLE
7889 77         00930 LOOP      LD      (HL),A          ;SET POSITION TO 0
788A 23         00940           INC     HL              ;BUMP POINTER
788B 10FC       00950           DJNZ    LOOP            ;CLEAR WHOLE TABLE
788D ED56       00960           IM      1               ;SET INTERRUPT MODE
788F C32D40     00970           JP      402DH           ;AND RETURN TO DOS
                00980 ;
                00990 ;***** THIS IS THE MAIN ROUTINE *****
                01000 ;
                01010 ; DOS ENTERS THIS ROUTINE WITH REGISTERS SAVED
                01020 ; AND WITH INTERRUPTS DISABLED -- RET WILL GO BACK TO
                01030 ; DOS ROUTINE TO RESTORE REGS AND ENABLE INTERRUPTS
                01040 ;
7892 214440     01050 START     LD      HL,4044H        ;STORAGE FOR BYTE FLAG
7895 7E         01060           LD      A,(HL)          ;GET BYTE IN A
7896 B7         01070           OR      A               ;SET FLAGS
7897 281A       01080           JR      Z,WAIT          ;GO IF NOT SET
7899 214040     01090           LD      HL,4040H        ;ELSE POINT TO BEAT COUNT
789C 34         01100           INC     (HL)            ;AND BUMP
789D 7E         01110           LD      A,(HL)          ;NOW GET COUNT
789E FE28       01120           CP      40              ;HAS ONE SECOND PASSED?
```

Listing 6 continues

may wander off into deep space when you try to run the program.

Line 2 defines all variables as integers. Then it PEEKs at 16548 and 16549 to find the beginning of Basic pointer. If this pointer is changed, Basic will look to a new address to find the beginning of any program. As soon as the first two POKEs are completed in line 2, the pointer is changed, and as far as Basic is concerned, the first line no longer exists. Then it's time for the For... Next loop to put the machine code into the space that the first line has reserved in low memory. Finally, in line 2, a series of POKEs and PEEKs are performed to set the unspecified values in the machine-language portion of the program.

"...change the 255 value to match the unique value of your pass card."

Lines 3 and 4 in Listing 3 (which are a single line in Listing 4) are merely the decimal equivalents of the machine-language routines. Be sure, though, that you change the 255 value to match the unique value of your pass card.

The last line serves several purposes. First, it runs the short initialization portion of the machine-language program, which changes the keyboard-driver-address pointer. If you are using Level II Basic, you must change the first instruction of this line to:

```
POKE 16526,A - INT(A/256)*256:POKE
16527,INT(A/256)
```

As soon as the USR call is run, the CSCR routine is up and running, and your card must be in the reader for the rest of the program to work.

The For...Next loop in the last line then increments the beginning of the program pointer at 16548 and 16549 to hide all signs of the header. By the time the loop is completed, the header will no longer list, and Basic will not even know that it existed. As far as your computer is concerned, the header has disappeared and taken about 350 bytes of low memory with it. The line ends with the instruction Run, so that all variables will be cleared and your main Basic program will perform exactly as expected.

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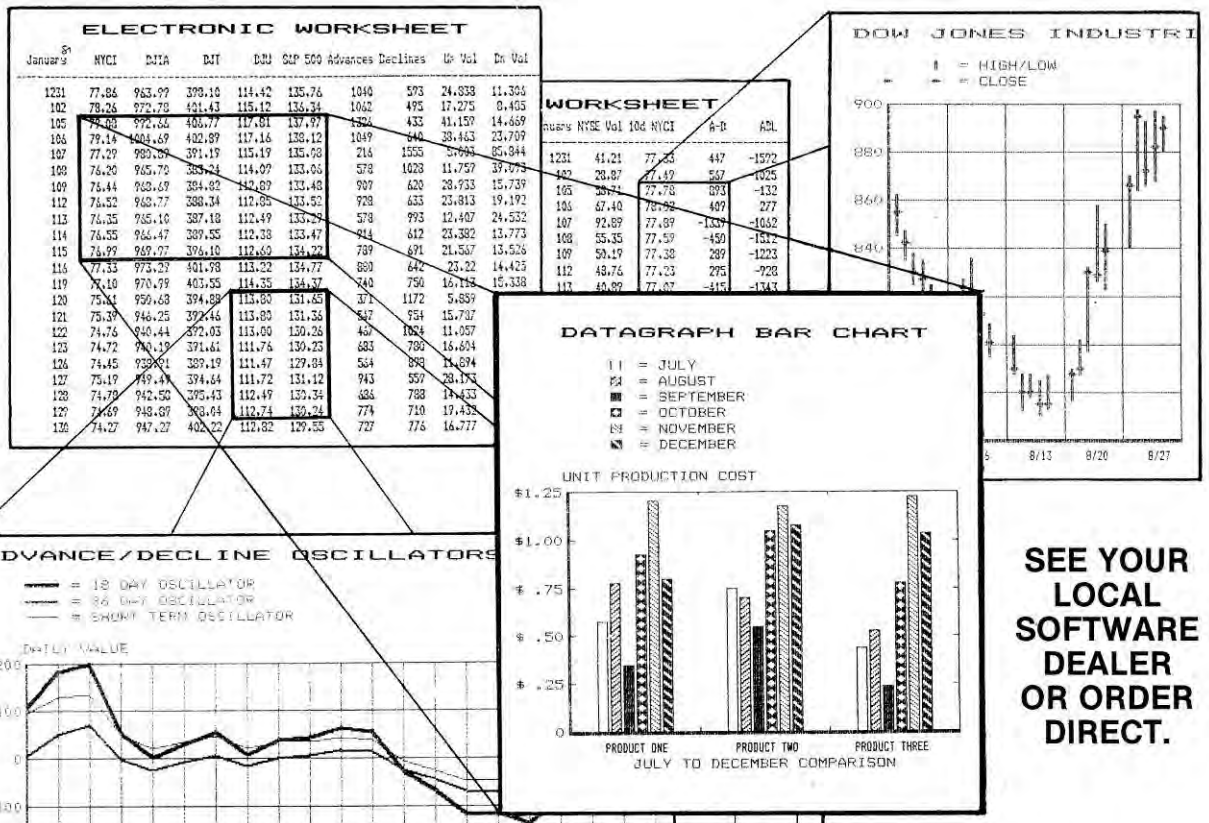

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Listing 6 continued

```
78A0 D8       01130          RET     C               ;GO IF NOT
78A1 AF       01140          XOR     A               ;ELSE CLEAR A
78A2 77       01150          LD      (HL),A          ;AND RESET BEAT COUNT
78A3 2C       01160          INC     L               ;POINT TO SECOND COUNT
78A4 34       01170          INC     (HL)            ;AND BUMP
78A5 7E       01180          LD      A,(HL)          ;GET COUNT
78A6 FE3C     01190          CP      60              ;ONE MINUTE?
78A8 D8       01200          RET     C               ;GO IF NOT
78A9 AF       01210          XOR     A               ;ELSE CLEAR A
78AA 77       01220          LD      (HL),A          ;RESET SECOND COUNT
78AB 2C       01230          INC     L               ;POINT TO MINUTE COUNT
78AC 34       01240          INC     (HL)            ;AND BUMP
78AD 7E       01250          LD      A,(HL)          ;GET COUNT
78AE FE00     01260 TIME     CP      00H             ;*** TIME VALUE SET AT
              01270                                  ;INITIALIZATION
78B0 3021     01280          JR      NC,STOP         ;LOOK FOR CARD AGAIN
78B2 C9       01290          RET                     ;ELSE RETURN
              01300 ;
              01310 ;***** THIS ROUTINE LOOKS FOR CARD AND THEN SETS FLAGS
              01320 ;      AND STORGE AREA
              01330 ;
78B3 DB00     01340 WAIT     IN      A,(00H)         ;READ PORT
78B5 FEFF     01350          CP      0FFH            ;***** SET THIS VALUE
              01360 ;                                  TO MATCH CARD
78B7 20FA     01370          JR      NZ,WAIT         ;STAY UNTIL READY
78B9 AF       01380          XOR     A               ;SET A TO 0
78BA 214040   01390          LD      HL,4040H        ;POINT TO BEAT COUNT
78BD 0606     01400          LD      B,6             ;SET COUNTER
78BF 77       01410 W1       LD      (HL),A          ;LOAD 0
78C0 23       01420          INC     HL              ;BUMP COUNTER
78C1 10FC     01430          DJNZ    W1              ;CLEAR ENTIRE TABLE
78C3 3C       01440          INC     A               ; NOW A=1
78C4 324440   01450          LD      (4044H),A       ;SET CARD FLAG
78C7 21FA78   01460          LD      HL,BUFF         ;POINT TO BUFFER
78CA 11DA3D   01470          LD      DE,3DDAH        ;POINT TO SCREEN
78CD 010C00   01480          LD      BC,000CH        ;BYTE COUNT
78D0 EDB0     01490          LDIR                    ;BUFFER TO SCREEN
78D2 C9       01500          RET                     ;AND EXIT PROGRAM
              01510 ;
              01520 ;*****  THIS ROUTINE HALTS EVERYTHING BY RESETING CARD
              01530 ;       FLAG, PRINTING MESSAGE, AND RETURNING.
              01540 ;       ENDLESS LOOP WILL BE PICKED UP ON NEXT INTERRUPT
              01550 ;
78D3 AF       01560 STOP     XOR     A               ; A=0
78D4 324440   01570          LD      (4044H),A       ; RESET FLAG
78D7 21DA3D   01580          LD      HL,3DDAH        ;POINT TO SCREEN
78DA 11FA78   01590          LD      DE,BUFF         ;POINT TO BUFFER
78DD 010C00   01600          LD      BC,000CH        ;BYTE COUNT
78E0 EDB0     01610          LDIR                    ;SCREEN TO BUFFER
78E2 21EE78   01620          LD      HL,MSG          ;POINT TO MESSAGE
78E5 11DA3D   01630          LD      DE,3DDAH        ;POINT TO SCREEN
78E8 010C00   01640          LD      BC,000CH        ;LENGTH OF MESSAGE
78EB EDB0     01650          LDIR                    ;MESSAGE ON SCREEN
78ED C9       01660          RET
              01670 ;
78EE 4E       01680 MSG      DEFM    'NO MORE TIME'
     4F 20 4D 4F 52 45 20 54
     49 4D 45
78FA 20       01690 BUFF     DEFM    '           '   ;12 ASCII SPACES
     20 20 20 20 20 20 20 20
     20 20 20
              01700 ;
7800          01710          END     ASK
```

Program Listing 7

```
10 ' ****************************************
20 ' *****                              *****
30 ' ***** COMPUTER SECURITY CARD READER *****
40 ' *****       TIME DELAY PROGRAM     *****
50 ' *****                              *****
60 ' *****         WRITTEN BY           *****
70 ' *****            HARDIN BROTHERS   *****
80 ' *****                 AND          *****
90 ' *****           JEAN ROBERT DURBIN  *****
100 '*****                              *****
110 '****************************************
120 '
130 ' ** WORKS ONLY WITH DISK BASIC **
140 '
150 ' $$$$ SET CARD VALUE IN LINE 440 BEFORE RUNNING $$$$
160 '
170 CLS : C = 0
180 FOR I = (&H7800) TO (&H7905)
190   PRINT @ 0,I
200   READ A : POKE I,A
210   IF I<>(&H78B6) THEN C = C + A
220 NEXT I
230 IF C <> 25486 THEN PRINT "DATA ERROR" : END
240 CMD "DUMP TIMECTRL/CMD (START=X'7800',END=X'7905',TRA=X'7800')
250 END
260 DATA 205,201,  1, 33, 54,120, 17,132, 60,  1
270 DATA  16,  0,237,176, 19,237, 83, 32, 64, 33
280 DATA  50,120,229,  6,  3,205,217,  5,225, 56
290 DATA 225,205, 90, 30,175,186, 32,218,187, 40
```

Listing 7 continues

This header program, because it hides itself in low memory, can provide special protection for your Basic programs, especially if you use them with the NEWDOS80 run-only mode or something similar. On a tape-based system, you can provide even greater protection by adding the special auto-loader shown on p. 71 of Dennis Kitsz's *The Custom TRS-80 and Other Mysteries.* Then only a power down could escape the CSCR, but as soon as the program was reloaded, it would again be protected.

The CSCR as a Timer

The last set of programs, Listings 6 and 7, allow your CSCR to work as a security timer. With them, you can preset a duration between 1 and 255 minutes, use your card once to start the system, then remove the card and allow someone else to use your computer for a specified period of time. If your card is not in the CSCR at the end of that time period, a message is displayed on the screen and the computer locks up. As soon as your card is reinserted, the screen is restored and the program will continue for the same amount of time again.

The first section (lines 280–530) of Listing 6 is a short data-entry routine to request and set the timing loop. After clearing the screen, it asks the operator for the number of minutes (between 1 and 255) to be delayed between every CSCR scan. This number is converted into binary, tested to see if it is within limits, and stored in the appropriate place in the main section of the program. As soon as a correct entry has been made, the screen is again cleared and the next section of the program is entered.

The second section of the program (lines 580–970) is an initialization, move, and protect routine similar to the one used in Listing 1. The major differences are that the main program is patched, not to the keyboard driver, but to the interrupt processor in DOS. In TRSDOS-compatible DOSes, 405BH points to a routine that handles clock functions. Our program merely replaces DOS's clock updating and display routines.

Lines 1050–1700 are the three main program routines that are actually protected in high memory. The first, from 1050 to 1290, updates a counter every time the 25 msec heartbeat interrupts the CPU. Each 40 beats (or one second), the heartbeat counter is reset to zero and a seconds counter is incremented. Each 60 seconds, the seconds

counter is reset and a minutes counter is incremented. Whenever the minutes counter is incremented, it is compared to the time value the operator entered during initialization. When the specified number of minutes have passed, control is passed to the stop routine at line 1560.

In the stop routine, a flag is first reset to show that no valid card has been inserted. Then a section of the screen is saved and replaced by the message "NO MORE TIME." However, this routine does not actually stop processing; instead it merely returns control to the interrupted program.

Finally, the wait routine in lines 1340–1500 is used whenever there is an interrupt and the flag in 4044H has been reset to indicate that no valid CSCR card has been read. This routine first attempts to read the CSCR and loops until a successful match has been found. Then it clears the beats, seconds, and minutes counters, sets the card flag, and restores the screen. Finally, control is again returned to the interrupted program.

Listing 6 will not work as written with NEWDOS80 version 2. There are two ways the program can be made compatible with that operating system. Either change line 630 to "LD (45FEH), HL" or add code after line 960 that will add the main routine to NEWDOS's interrupt queue. The first method is simpler, but the second retains all of the interrupt-driven features of NEWDOS80.

Listing 7 presents the same program in Basic data statements so that it can be read into your computer without using an assembler. There is nothing unusual about it except perhaps line 240, which will not operate with TRSDOS. If you use TRSDOS, you will have to return to DOS Ready to enter the Dump command.

Both Listings 6 and 7 are interrupt driven and both replace the real-time clock functions of the operating system. Therefore, they will not work with any program that requires the clock for its operation. They will also not work with any program that disables interrupts. If you plan to use the time delay with Basic programs, you must remove any CMD"T" in the program or follow it with a CMD"R". Otherwise, as soon as CMD"T" is executed, the interrupts will cease and your program security will be gone.

Machine-language programs are a little more difficult to deal with. The Assembly-language command to disable interrupts is DI, which turns into 0F3H in machine code. Some utilities and

Listing 7 continued

```
300 DATA 215,123, 50,175,120,205,201,  1, 24, 20
310 DATA  29,  9, 76, 68, 77, 73, 78, 85, 84, 69
320 DATA  83, 32, 40, 49, 45, 50, 53, 53, 41, 63
330 DATA 243, 42, 73, 64,  1,116,  0,175,237, 66
340 DATA  34, 91, 64,229, 43, 34, 73, 64, 17,206
350 DATA 255, 25, 34,160, 64,209, 33,146,120,229
360 DATA 213,235,175,237, 82,235, 42,200,120, 25
370 DATA  34,200,120, 42,219,120, 25, 34,219,120
380 DATA  42,227,120, 25, 34,227,120,209,225,237
390 DATA 176,175,  6,  6, 33, 64, 64,119, 35, 16
400 DATA 252,237, 86,195, 45, 64, 33, 68, 64,126
410 DATA 183, 40, 26, 33, 64, 64, 52,126,254, 40
420 DATA 216,175,119, 44, 52,126,254, 60,216,175
430 DATA 119, 44, 52,126,254,  0, 48, 33,201,219
440 DATA   0,254,255, 32,250,175, 33, 64, 64,  6
450 'CHANGE THIS [[[ VALUE TO MATCH YOUR CARD **********
460 DATA   6,119, 35, 16,252, 60, 50, 68, 64, 33
470 DATA 250,120, 17, 51, 60,  1, 12,  0,237,176
480 DATA 201,175, 50, 68, 64, 33, 51, 60, 17,250
490 DATA 120,  1, 12,  0,237,176, 33,238,120, 17
500 DATA  51, 60,  1, 12,  0,237,176,201, 78, 79
510 DATA  32, 77, 79, 82, 69, 32, 84, 73, 77, 69
520 DATA  32, 32, 32, 32, 32, 32, 32, 32, 32, 32
530 DATA  32, 32
```


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many games start with a DI at or near the beginning of the program flow to increase speed and provide a small measure of program security. Any machine-language program that shuts off the real-time clock and the trace function includes a DI. Also, the disk operating system performs a DI before every disk access, but reenables the interrupts after the disk routines have been completed.

To use the CSCR time delay with machine-language programs requires a bit of detective work. For some programs, you need only find the entry point of the program using LMOFFSET, TASMON, or a similar utility. Then use a zap utility to search the program's disk file for the data that is loaded to that address.

Finally, disassemble the code beginning at the entry point and, when you find a DI, change it to EI (0FBH). Your program may then work successfully (be sure to do all of this on a back-up disk, not an original).

If your program still does not allow the CSCR time delay to operate, you need to search further. A good disk search utility, such as Super Utility Plus, will let you know where every 0F3H byte is in the program. You will need to look at each and the code surrounding it to determine if it is a DI instruction or part of an address, data, or another machine-language instruction. Sometimes this is relatively easy to decide, sometimes it is difficult. Practice will certainly help. Just be sure that you don't remove the DI instruction just before any program-controlled disk access—if you do, the program's disk routines will not be able to keep up with the data flow from the disk and will produce nothing but errors.

Keep a written record of the bytes you change and test the program after each change. Eventually, you will have a program that will seem to operate normally, albeit slightly slower, but that will not disable interrupts. To test the program, try running it with the real-time clock or trace function on. If either of those functions continues to operate, you have found all the DI instructions and your new version of the program will operate with your CSCR timer. ■

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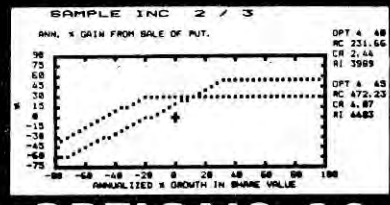

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Quic-N-Easi Pro

by Thomas L. Quindry

★★

Quic-N-Easi Pro
Standard MicroSystems, Inc.
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Model III, two disks recommended
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$395

Not a program generator, but an applications-development language, Quic-N-Easi Pro frees you from learning detailed programming skills.

Over the past two years, a new type of programming aid for microcomputers has been introduced—program generators. The idea is not new; program generators have been around for mainframe computers for the last 15 years or so. Quic-N-Easi Pro, hereafter referred to as Quic-N-Easi, is one of the latest entries in this field for the TRS-80.

Quic-N-Easi is not a program generator per se but, as stated in the manual, an applications development language. Its purpose is to reduce the programming knowledge needed to develop programmed tasks and provide more professional, clearer screen presentations. It is a complete programming language with a specific orientation to entering data from the keyboard and storing that data on a disk. Once the data is on disk, it can be accessed by other Quic-N-Easi programs, or by programs in other languages.

You are freed from learning disk input/output and file-management techniques when using Quic-N-Easi. It is also not necessary to learn detailed programming. You must, however, learn the problem-oriented Quic-N-Easi language.

The program manual is in the form of a looseleaf notebook. It is an extensive manual divided into four parts: self-teaching guide, programmer's manual, system commands, and appendices and supplements.

The self-teaching guide leads you through sample programs to give you a feel for Quic-N-Easi programming and to demonstrate some of the software's power. The section also teaches simple Quic-N-Easi program procedures and explains the different capabilities for file handling and computations.

The programmer's manual and system commands sections provide more detail on using the commands and file-handling capabilities of Quic-N-Easi.

The appendices and supplements section gives, among other things, a list of the error messages, operational techniques, and instructions for using certain utility programs included with Quic-N-Easi.

One such utility is a Quic-N-Easi Report Writer/Generator. This utility takes a file that you've created with Quic-N-Easi and allows you to manipulate and output the data by your specified format. Limited mathematical calculations can also be made by the Report Writer.

The Program

Quic-N-Easi comes on four disks. The distribution disk is in a specially sealed package, so you can use the supplied evaluation disk for the first 15 days to determine whether Quic-N-Easi is the program for you. The evaluation disk is the same as the distribution disk, except that it allows only 50 accesses to the disk before returning to the operating system. This limits your ability to evaluate a complicated program, but it does let you decide whether you want to buy the program. If you decide within the 15 days that you don't want the program, you can return all materials as long as the distribution disk has the original seal intact.

The other three disks contain the Quic-N-Easi run-time program, a format builder, sample format files to be used with the self-teaching guide, the Report Writer, a couple of other utilities, and a demo program. The demo program takes up one full disk and consists of files to be run by the Quic-N-Easi run-time program. All disks contain a modified version of DOSPLUS as an operating system.

The Quic-N-Easi system is comprised of two programs. A format builder, FB/CMD, is essentially an editor that prepares programs (formats) for execution by the run-time system, QNE/CMD. As stated in the programmer's manual, the specific features of the Quic-N-Easi system include:

- Intelligently formatted screens, with alphabetic, numeric, and combined type fields. All field editing and cursor control is performed implicitly by the system.
- Sequential, random, and indexed sequential file structures. A full, flexible

set of file manipulation commands is available.

- A flexible programming language oriented to handling data, including data formatting, math functions, string manipulation, a buffered keyboard, and error-trapping.
- Rapid application development time, due to the high-level nature of the entire system.
- English-text error messages.

I interpret the above to mean that Quic-N-Easi should be useful for just about any business application.

Some Instruction Pitfalls

The self-teaching guide will familiarize you with the features of Quic-N-Easi, but there are some traps that you must overcome. First, Quic-N-Easi is available for a multitude of microcomputers. The manual is not microcomputer specific. It is written mostly for CP/M-based systems and contains a few footnotes that refer to the Model III.

Some of the utilities discussed are only available for the CP/M versions of Quic-N-Easi and this is not clear from reading the manual. One thing you must remember when reading the manual is that the run-time program, QNE/CMD, and the format builder, FB/CMD, have the extension /CMD rather than the extension .COM as specified throughout the manual for CP/M systems.

Also, all other files supplied that are generated by the format builder and intended to be used by QNE/CMD have the extension /QNE rather than the extension .QNE as specified. In some cases, the manual shows no extension, but it should still be /QNE. Of course, on the files you create, you can use any extension name you want.

The other pitfall that isn't explained in the manual is that you must have the disk containing the lessons in your second disk drive. The self-teaching guide is unclear that you are trying to load preprogrammed formats that Quic-N-Easi has already provided.

The red herring here is that the manual *recommends* at least two disk drives. To me this means that the program should work on a one-drive system, though two are better. The way the disks are distributed, with QNE/CMD and FB/CMD on one disk and the lessons on another, makes two disks mandatory.

The format builder can be loaded and then disks changed to read the preprogrammed files and manipulate them according to the manual. But the edited file must be saved to the same disk it is read from. For a one-disk-drive system, QNE/CMD, the run-time program, must be on the same disk as the first formatted program read. Though a copy utility is provided to make the transfer to another disk, this is not always practical. Since the run-time program is quite long, this can present a problem with disk capacity and is the reason for their recommendation for two disk drives.

I got around this by writing a small program using the format builder, which allows QNE/CMD to request the program to be run. This short program (Listing 1) was put on the disk with QNE/CMD and allowed me to change disks to get the formatted program in place for easy access. In my opinion, unless your data files to be generated are very long, this allows efficient one-drive operation.

In addition to going through the exercises of the self-teaching guide, it is important to run the demo program. Program Listing 1 is helpful here for one-drive systems since QNE/CMD is on a different disk than any of the programs that are to be run with it.

The programs supplied as lessons, the

```
ENTER FILENAME (######################)
```

Program Listing 1a. Field definition. User fields marked by # signs.

OFFSET	FIELD	LEN	R	C	DESC	JUST	FILL	MY-EN	MU-EN	MU-FL	MU-TB	PROC
0	FILE	22	2	29	X	L	#	Y	Y	N	N	FILEP

Program Listing 1b. Field Descriptors.

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demo programs, and the Report Writer programs are masterful. They really show you the capabilities of Quic-N-Easi. One of the features of the format builder is to be able to list files to the printer.

```
100: PROC FILEP
100:        CHAIN FILE
100:        END
```

Program Listing 1c. Field Program Procedures/Table Definitions.

I suggest that you call all the /QNE files on the three disks and print them out. This will give you about a ¾-inch notebook of printouts; about the same thickness as the Quic-N-Easi manual. Most of the techniques available in the Quic-N-Easi system can be seen here. All you must do is decipher them.

You must read the entire manual to fully understand Quic-N-Easi programming. I read the manual three times before I was comfortable with its concepts. I still did not feel that I could be an expert programmer with Quic-N-Easi.

The manual says that Quic-N-Easi is usable by beginning and advanced programmers alike. A letter from Standard MicroSystems Inc., in response to a number of questions I had, stated that Quic-N-Easi is targeted for the professional developer. I have to agree with their later statement. The beginning programmer would not fare too well using Quic-N-Easi. He would, however, be able to easily use the programs created for him by an advanced programmer.

Standard MicroSystems will be introducing a new package, Quic-N-Easi AG, which is designed for the first-time user. The initial release will be for CP/M machines only and the price will be $295. In addition, a new release of Quic-N-Easi Pro is forthcoming that includes an automatic file re-sort capability for the report generator. This will probably be available for the Model III by the time this review is published.

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	###############	#
	Date (MO/DA/YR):	#########
	Item Description:	###################
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	Articles:	######
Expenses –	Cost of Goods:	######
	Depreciation:	######
	Office Supplies:	######
	Postage:	######
	Dues and Publications:	######

Program Listing 2a. Field definition. User fields marked by # signs.

One Drawback

One of the main drawbacks of Quic-N-Easi is the inability to alphabetically sort on fields that are not the key field. The key field is used for implied sorting when using an index sequential file. It can be alphanumeric. A mail-list program to prepare mailing labels could not be easily done, for example. It would be necessary to sort on the entire zip code, the first three digits of the zip code, and on city and state.

The only method to sort on fields that is now available is with a cross-reference file using Quic-N-Easi. This means manually entering numbers or names in the order you want them sorted. With the new release mentioned above, a cross-reference file can be generated automatically by the report generator if requested. This added capability might allow programming the above application.

Program Evaluation

To evaluate the effectiveness of Quic-N-Easi, I wrote a program to keep track of the income and expenses of my home-computer business. I wrote a short program to allow me to enter up to nine data fields (Listing 2). They included the date that I used as the sorting key, a description of the transaction, two income categories, and five expense categories. The idea behind the program was to use the Report Writer to manipulate the data and print out the nine fields plus a total-income and total-expenses column for each entry.

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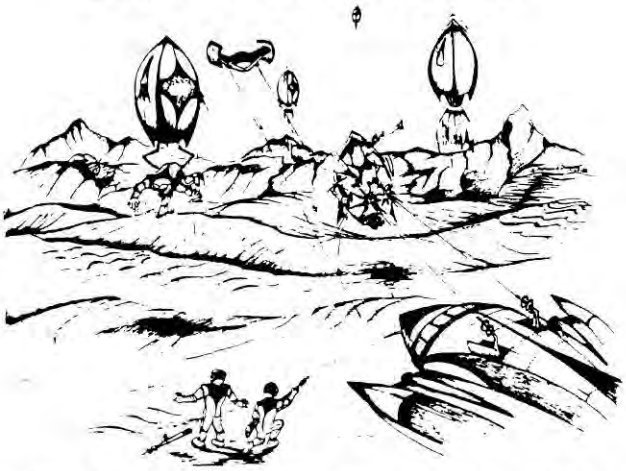

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Specifying an index sequential file, the data would be sorted by date. For more than one entry on a given date, I used an A, B, C, and so on, at the tag end of the date. The program would search through the file to see if I had made an entry for the particular date or sorting key.

If I had made an entry, it would display all information that I had previously entered for that date. I then had the option of correcting it, deleting it, or leaving it as it was. Since my books didn't always have the dates in correct order, this alerted me to add a different letter to the tag end of the date to create another data point for the same day. The letters could be stripped off by the report generator for the final tally, but then every date would be in order due to the implied sorting of an index sequential file.

Here is where the inefficiencies of Quic-N-Easi became apparent. My program was a simple one. For each entry, Quic-N-Easi had to access the disk, first to find out if I had made an entry for that date, and second to enter the new data in the proper place in the output file that was created for data.

This is not an unreasonable task. In fact, it is very similar to the tasks illustrated by the lessons supplied by Quic-N-Easi. The disk access time for each entry was 30 seconds. This included both reading and writing as described above. For my data, which included 100 different dated entries, this meant that close to an hour of the time to enter data was just waiting for the disks to run.

For a large business, where more than 100 transactions take place each day, this would be intolerable. Consider just 100 entries a day for a small business; assuming one hour of data entry

OFFSET	FIELD	LEN	R	C	DESC	JUST	FILL	MY-EN	MU-EN	MU-FL	MU-TB	PROC
0	FILENA	12	4	37	X	L		Y	Y	N	Y	FILENAP
1	CHECK	15	5	20	X	L		Y	N	N	N	
2	ANS	1	5	37	A	L	#	Y	Y	N	N	ANSP
3	DATE	9	6	37	x	R	0	Y	Y	Y	N	DATEP
4	DESCRIP	20	7	37		R	#	Y	Y	N	N	
5	RECEIPT	6	9	37	N	R		Y	N	N	N	
6	ARTICLE	6	10	37	N	R		Y	N	N	N	
7	COSTGOOD	6	11	37	N	R		Y	N	N	N	
8	DEPREC	6	12	37	N	R		Y	N	N	N	
9	SUPPLIES	6	13	37	N	R		Y	N	N	N	
10	POSTAGE	6	14	37	N	R		Y	N	N	N	
11	PUBL	6	15	37	N	R		Y	N	N	N	

Program Listing 2b. Field Descriptors.

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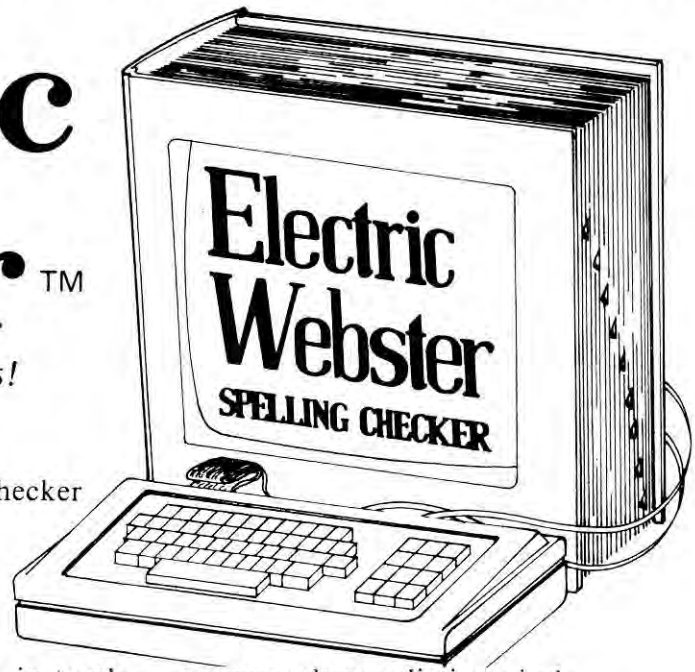

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plus one hour of waiting for disk access, over one fourth of the day is spent entering data—not too efficient.

After I had finished entering data, I became aware of two small problems. There was a discrepancy in the manual and an error in the Report Writer. The manual states that up to 20 data columns can be output using the Report Writer. When defining the report to be generated using the self-prompting Report Definition part of the Report Writer, only 10 columns could be defined. I needed 11 columns for what I wanted to do. Undaunted, I decided to write the best report I could using 10 columns to check out the other capabilities.

Now I became aware of the second problem. I wanted to add the seven columns of data that I had entered. The Report Writer would only add four columns horizontally. Knowing this, I could have written my data-gathering program to perform these calculations and put them in my data file, but still, with the 10-column limitation, I couldn't have printed all them out using the Report Writer as I had planned. I could still get a vertical total of all columns, though.

A programmer writing his own reporting program could specify all seven columns being totaled horizontally, but I was looking for the ability to use this report-writing utility and it fell short.

The only error in programming from the Quic-N-Easi folks now appeared. When 10 columns are printed out, an error occurs after the first page is printed. Going to nine columns of printout eliminated this error and an entire report was printed, though it did not include all the information I had hoped for.

The biggest disappointment of all was the time it took to print out my small report. Total time for two and one-half pages of printout was 21 minutes. I remembered reading in the appendix about a utility called REORG/CMD to reorganize indexed files. It explained that indexed files in Quic-N-Easi were based on a tree structure. Sometimes the manner in which data is entered into indexed files results in a nonoptimal internal tree structure for the file.

The Indexed File Reorganization utility was available to optimally restructure the file so that more efficient output was possible. I used this utility to create an optimal file. Now the total time for the two and one-half pages of output of printout was 20 minutes—not much improvement.

Quic-N-Easi is a very well-programmed piece of software. An expert programmer could make Quic-N-Easi jump through hoops and do whatever he wants it to do.

But just good programming does not make it useful or practical. I can't tolerate the slow input or output of data. The Report Writer, though an excellently programmed utility (if the error was corrected and more columns of data printout permitted), is limited in what it can do. Much of its limitations can be overcome by the data-input program that the user would write with Quic-N-Easi.

I prefer Basic and would rather program from scratch. Quic-N-Easi may free one from some of the chores of Basic, but unless one is fairly expert in programming, Quic-N-Easi can be more limiting. An expert programmer, though, probably doesn't need Quic-N-Easi to program for him. ■

```
100:  PROC FILENAP
100:  OPEN FILENA,3,80,1 :1010
100:  GOTO1020
100:  1010 MOVE "NEW FILE?" TO CHECK
100:  NEXT ANS
100:  1020 MOVE "CORRECT FILE?" TO CHECK
100:  NEXT ANS
100:  1030 ERROR "Error on creating file"
100:  SYSTEM
100:  END

200:  PROC ANSP
200:  IF ANS EQ "Y" THEN GOTO 1530
200:  IF CHECK = "NEW FILE?          "THEN GOTO 1531
200:  CLOSE 1
200:  1531 HOMECLEAR
200:  1530IF CHECK = "NEW FILE?          " THEN GOTO 1600
200:  1540 CLEAR CHECK
200:  CLEAR ANS
200:  LOCK FILENA
200:  LOCK CHECK
200:  LOCK ANS
200:  NEXT DATE
200:  1600 MAKE FILENA,3,80,10,9,1 : 1030
200:  GOTO1540
200:  END

300:  PROC DATEP
300:  POSN 1 TO DATE :2010
300:  READ 1 :2020
300:  GET * FROM 1
300:  NEXT DESCRIP
300:  2010 ERROR "Error on position. Please re-key"
300:  NEXT DATE
300:  2020 MOVE "NEW RECORD" TO CHECK
300:  NEXT DESCRIP
300:  END

400:  PROC ENTER
400:  CLEAR CHECK
400:  RESTART 1
400:  PUT * TO 1
400:  WRITE 1 : 3010
400:  SECURE 1
400:  END
400:  3010 ERROR "Error on write of file"
400:  NEXT DATE
400:  END

500:  PROC KEY1
500:  * PROCEDURE TO DELETE A RECORD
500:  FREE 1 :5050
500:  HOMECLEAR
500:  END
500:  5050 ERROR "No record to delete"
500:  HOMECLEAR
500:  END
```

Program Listing 2c. Field Program Procedures/Table Definitions.

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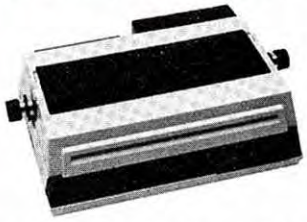

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I'll take a look at two implementations of Technical Systems Consultants' FLEX. Other operating systems are available for the Color Computer, but FLEX should remain a major contender because of its large software base and its ease of use.

There are two very different approaches to the business of bringing FLEX to the Color Computer. Hogg Lab's specialized CC-FLEX makes use of the standard Radio Shack disk controller, while Atomic City Electronics' contribution is its own disk controller board, which is intended to interface with a variety of drives to run standard FLEX.

Hogg Laboratory's CC-FLEX

The Frank Hogg Laboratory (FHL) has been supplying FLEX-compatible material since 1979. CC-FLEX is a modified version of the standard TSC system, but the modifications are pretty much confined to interrupts and console I/O drivers. A lot of the software already written for Gimix, Smoke Signal Broadcasting, and SWTP machines will therefore run on the Color Computer, and vice versa.

Frank Hogg and his people have taken a fairly conservative approach to bringing FLEX to the Color Computer by using the Radio Shack disk controller and paying heed to the requirements of the single-drive system user.

The documentation consists of a three-part volume containing the *TSC FLEX User's Manual* and a more advanced *Programmer's Manual*, and an FHL CC-FLEX supplement. The system disk contains all of CC-FLEX plus FLEX/BAS, a short Disk Color Basic program that calls in a machine-language loader to perform the actual memory reconfiguration.

There is also a FLEX file called PUTBOOT.LDR, used to copy the Radio Shack format loader onto subsequent generations of disks, so that CC-FLEX will boot up from the copies. PUTBOOT.LDR itself cannot be readily duplicated, so the master disk must always be used when making a new copy.

The procedure for beginning a session with CC-FLEX is simply to type RUN "FLEX". The disk drive clunks a few times, and in about 15 seconds you receive the FLEX logo and a request to enter the date (the system keeps track of the dates on which disk files were created). Once you have done so, you receive the standard FLEX prompt, + + + , and are ready to go.

C-FLEX is still evolving. I've worked with version 5.0, 5.0:1 and 5.0:2, which is currently being shipped.

Unlike standard FLEX, the Color Computer version can be used with single-drive systems. However, to do so you must be prepared to make frequent copies of the system disk; that way, each major application program can coreside with the necessary portions of the operating system.

FLEX actually consists of three parts: the DOS, the file management system, and the utility command set.

The disk operating system (DOS) accepts user commands and carries out such chores as the parsing of command arguments and file specifications, terminal I/O, and error reporting. The file-management system (FMS) forms the communications link between the DOS and the disk hardware and performs the dynamic file space allocation, a hallmark of FLEX. The utility command set (UCS) is the user-callable commands. The UCS can be customized.

The high-quality *FLEX Programmer's Manual* contains complete memory maps and other details of the DOS and FMS. The experienced Assembly-language programmer can use this information to capitalize on the system functions and routines. Be aware that FLEX minimizes wasted disk capacity by recording files as linked lists of 256-byte sectors.

The Programmer's Environment

The complete UCS consists of nearly 40 commands, many of which are concerned with disk-file manipulations: Append, Delete, Rename, Save, and so

on. Others (Setup, TTYSET) are used to control your environment by defining various characteristics of the terminal, the printer, and the FLEX operating system itself.

Of particular interest is that FLEX lets you change parameters in the drive-configuration table, a section of memory used to control disk operations. You can mix single- and double-density drives of various track-stepping rates, and inform the system as to the characteristics of each.

This is a major boon to the Color Computer community. It offers the possibility of using, say, 80-track double-sided drives for large storage capacity. It is also possible to specify the "system" and "working" drives in a multi-drive environment.

The former is used by FLEX as the default for command specifications, while the latter is used as the default for all other file specifications. When CC-FLEX is booted up, it defaults to drive zero for both system and working drives, in keeping with its single-drive orientation.

There are also UCS commands for changing the parameters of the video display. The current version of CC-FLEX uses a software-defined upper-and lowercase character set, like Telewriter and Colorterm; default parameters are 24 lines of 51 characters, black on white. The contrast can be reversed, and the text density can be changed to 16 by 32, 24 by 64, or even 32 by 64 for those with video monitors.

Another CC-FLEX feature usually associated with large time-sharing systems is the Help command. This is used to obtain a screen listing of information about any specified UCS command by entering Help and the command name. Sometimes the listing just reminds the user of syntax, but sometimes there is more information. I have found this to be very useful.

The utility commands reside on the system disk and are loaded into RAM when called by name. The documentation does a good job of presenting the syntax of each command: which arguments are required, what the defaults are, and so on.

In most cases, the arguments are file specifications. These differ from the ones used in Disk Color Basic. In FLEX, the field separator between file name and extension must be a period. The drive number specification must also be set off by a period, and can appear either before the name or after the extension. All UCS files have .CMD extensions.

Your first concern after booting CC-FLEX is to make a copy of the system disk using the Newdisk command. The procedure is rather lengthy. Noteworthy points are the opportunities that the system gives you to specify the disk configuration (number of sides and tracks, and density) during formatting, and the fact that the procedure checks itself to some degree. Newdisk uses a larger gap between disk sectors than does Disk Color Basic, in order to secure more reliable operation.

As a result of variations in track length, the desired number of sectors may not fit on disks prepared with some drives; in such cases the system reduces the number of sectors accordingly. That's what happens with my system. The enlarged guard bands of CC-FLEX prevent the normal 18 sectors from fitting around a track. The system generates the message "Trimming Track Size Double D" during formatting.

I find that a newly formatted disk holds 578 sectors, in contrast to the theoretical maximum of 680. The increased reliability of disk operation is worth it. If you insist on pushing your luck, there is an alternative command, NEWDISKA, which reduces the inter-sector gap to boost storage capacity.

Once a blank disk has been formatted, the Radio Shack-compatible files and directory are copied so that CC-FLEX can be bootstrapped. The FLEX

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FLEX and the Color Computer

Color Computer owners can use their machines for a good long while without ever coming across the term operating system: the Radio Shack Disk System manual, for example, doesn't ever mention it. An explanation, therefore, is in order to detail FLEX as it applies to the Color Computer.

In general, an operating system is nothing more mysterious than a program or group of programs intended to help a computer run more efficiently.

For a single-user setup, the operating system is simply the master control program that manages all sorts of I/O operations. By handling these in a consistent fashion, it permits files to be swapped between applications programs and provides the user with a convenient means of specifying the tasks to be accomplished by the system.

By controlling the interpretation of signals from the outside world, it gives the operator some leeway in defining the personality of a computer in software. All in all, the operating system governs the real power of the host machine.

Since much of a micro's operating system has to be devoted to controlling disk I/O operations, it has become common to use the acronym DOS (disk operating system) to refer to the whole package. Be aware, however, that strictly speaking the DOS is just one part of any complete operating system. FLEX, for example, has three major constituents.

Extended Color Basic

Every standard disk-equipped Color Computer has an operating system contained in the ROMs of the disk controller, which plugs into the car-

Continues on p. 104

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system file itself is then copied and linked to the boot loader. Finally, you are ready to copy the rest of the files on the system disk.

In a two-drive system you can use a copy command to do this in a convenient manner. For single-drive installations, the process is a busy one. CC-FLEX has an SDC (single-drive copy) command that works on one file until it is completely copied, rather than duplicating a fixed portion of the source disk's surface. Thus, you can expect to do a lot of swapping in the course of copying a complete disk.

This is probably unavoidable, given FLEX's method of organizing files as a series of sectors forming a linked list (the sectors making up a given file need not be in physical proximity on the source disk). One result, though, is that fatigue sets in and you become very selective about which UCS files are needed on system copies.

Utility Commands

I have already mentioned the Append command as an example of the disk-file manipulation suite. This is used to concatenate two files into a third, with a different name. The originals are left intact. In general, all the files can be on separate drives, as they can for most of the commands that I will discuss.

As I have tried to indicate, though, one of the attractions of CC-FLEX is its suitability for single-drive systems, so rest assured that these same commands can be used in that fashion as well.

Basic programs can be spliced together with Append. Since the command doesn't perform any tests on the files

Continued from p. 102

tridge port. When you add the Radio Shack disk system it just seems as though Extended Color Basic acquires some new commands and becomes Disk Extended Color Basic.

There are a few problems, however. The computer still "wakes up" in Basic, and no matter what you do the Basic compilers always occupy some of the machine's address space. You can load another compiler or interpreter, but those Basic ROMs continue to limit the amount of memory available for your programs.

In contrast, a true DOS controls all of a computer's memory resources and gives the user the maximum freedom to explore different languages.

Next, there is the matter of compatibility between applications programs. I frequently use Radio Shack's Spectaculator to prepare tables for my articles, but with the Shack's DOS there is no easy way to incorporate the tables into text composed with my word processors; I have to print them separately.

On the other hand, a full-fledged DOS can impose a common format on output files, as well as offering all sorts of options for appending and merging them. It can make all the difference in the world as far as the user's ability to manipulate data is concerned.

Owners of the Models I, II, III, or 16 computers can choose from a variety of operating systems: TRS-DOS, LDOS, NEWDOS, and so on. The Color Computer's possibilities are more limited, since the 6809 microprocessor is supported by a relatively small number of systems. FLEX, from Technical Systems Consultants of Lafayette, IN, is probably the most widespread.

FLEX actually predates the 6809, having originated as a 6800 operating system about six years ago. It has achieved a high level of portability between machines, and supports a wide range of applications software.

Users can choose data-base-management systems, financial programs, word processors, spelling checkers, spreadsheet calculators, and high-level language packages for Pascal, Forth, C, and several Basic dialects. What's more, FLEX is easy to learn and to use. Its command syntax is simpler than that of CP/M, the de facto standard system for the Z80.

Silver linings tend to be surrounded by black clouds, though. In the case of FLEX, the cloud is 20 kilobytes in size, that being the amount of RAM required for the system itself. In particular, standard FLEX requires the 12K between addresses 0000 and $2FFF and the 8K between $C000 and $DFFF.

This puts it squarely into conflict with the location of Radio Shack Disk Basic; even if you could stuff FLEX into a stock 32K Color Computer it wouldn't leave enough RAM for serious applications programs. Clearly, something has to give, and in this case the something is the Color Computer's memory map.

Stock 32K Color Computers actually employ 64K RAMs containing two banks of 32K each. Only one

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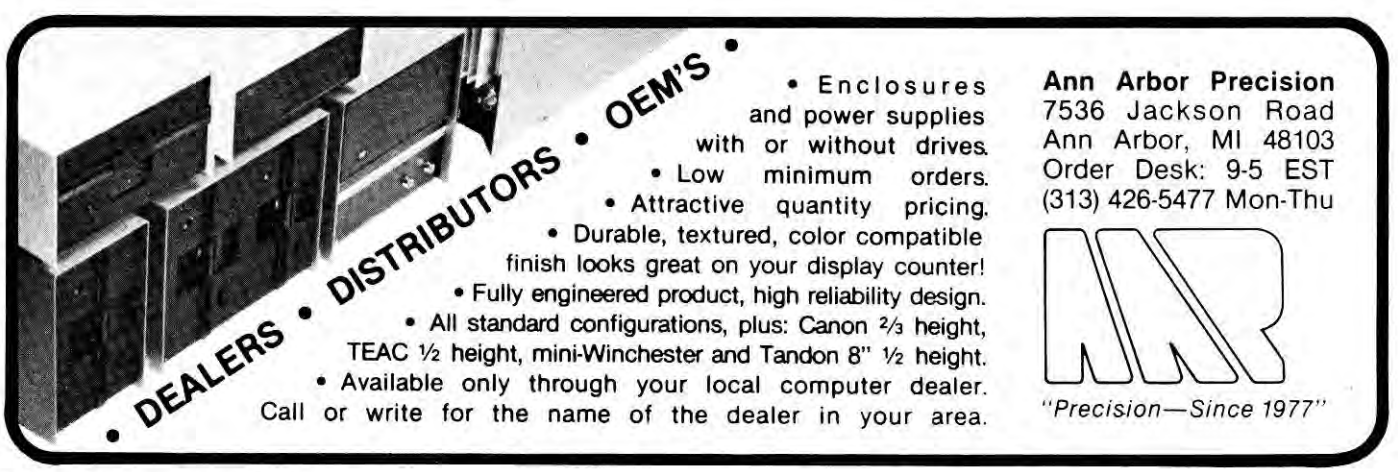

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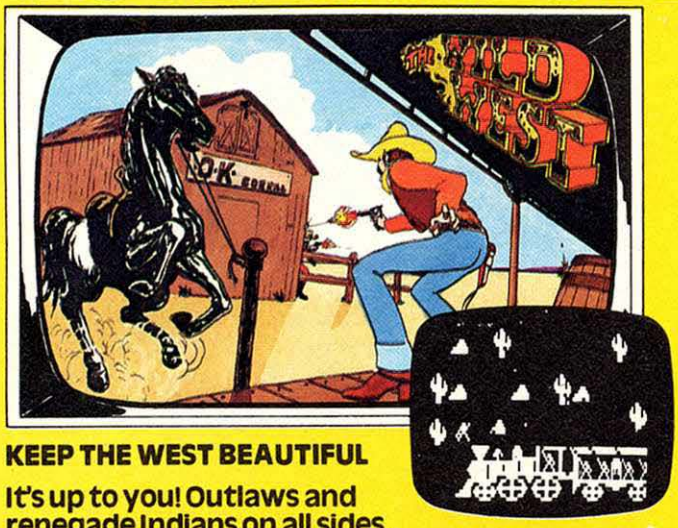

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used for its arguments, it is up to you to guarantee that the lower Basic statement numbers appear in the first file in such applications. To do otherwise is to invite disaster at run time.

Several other UCS commands perform functions common to all operating systems: Delete, List, Rename, and Save. These are much more powerful and flexible than their Disk Color Basic analogs, however. For example, List displays a listing of either text (ASCII) or Basic files on the terminal without the use of an editor program. Line numbers (if any) can be suppressed, and the output can be formatted into pages.

Rename can change either a file name, an extension, or both. Why would anyone want to change an extension? Well, in general, the extensions assigned to FLEX files govern the ways in which they can be used. One might wish to redesignate a binary file produced by an assembler (BIN extension) as a command file (CMD extension). When renamed in this way, the file could be executed immediately whenever called.

CAT, the FLEX command that lists the disk directory, offers considerable flexibility allowing you to specify a "match list" to produce a selective catalog. For example, the form CAT,.CMD generates a listing of just those files having the CMD extension; either a comma or a space could have been used as a field separator.

By the way, a FLEX directory listing is fairly elaborate. There is a header consisting of the drive number and disk name (assigned during the Newdisk procedure), and titled columns for file name, type (extension), size (in sectors, not grans), and protection code.

This last parameter can be set by another command, PROT, to protect a file against deletion, renaming, or the writing of additional information. In fact, there is even a code to protect a file against being listed by CAT.

Build is used to create small text files without first loading a FLEX editor. Such files can serve a very specific purpose in a FLEX environment: They can be interpreted as commands and used to automatically perform a sequence of frequently needed operations.

There is another UCS command, EXEC, which processes text files in this way. The FLEX manual gives as an example the list of commands needed to make a copy of the system disk in a two-drive system. In this case, Build is used to create a file, MAKEDISK.TXT, which can subsequently be invoked as a command sequence by typing EXEC MAKEDISK.

A FLEX feature called Startup performs a similar function during the bootstrap loading process. Immediately after initialization, FLEX checks the system disk directory for a text file called STARTUP.TXT. If none is found, the FLEX prompt is generated as usual; if there is such a file, it is first interpreted as a single command line and executed.

This can be useful for defining system environment parameters you wish to change from the default values assigned by CC-FLEX. Concrete examples of such parameters might include the number of lines on a printed page and the terminal escape character used to stop and restart output (the default is the C.C.'s break key, by the way).

Another useful job for Startup might be to load a high-level language package every time FLEX is booted, assuming you consistently wanted to work with that language.

Keyboard Control Functions

Under CC-FLEX, the Color Computer is capable of generating every ASCII code with some fancy shift

work. As I noted above, the break key is normally used as the escape character (ASCII 27). The control key (ASCII 0) is actually the combination of shift and up-arrow, which means that three keys often have to be pressed simultaneously to perform common control functions. FHL might designate the single down-arrow key as control in CC-FLEX 5.1, however.

Many other common functions are supported: Control/E erases text from the cursor position to the end of the current line; control/J is the line feed; and so on.

There is also a super-shift mode, for which the control key is the three-stroke combination: shift/up-arrow/break. The most likely use I expect to have for this mode is the generation of the curly brackets required by the C programming language. Square brackets can also be generated.

Unfortunately, operating system versions 5.0:1 and 5.0:2 do not support display scrolling. Release 5.0 did, at least in its default display mode of 16 32-character lines per screen. When the new version was being prepared, it was felt that the video memory required for the storage of hi-res text would have been excessive. This is probably true, but I think it was a step backward.

The manual does a complete job of covering the keyboard commands, but some of the material is spread between Appendix E (the CC-FLEX supplement) and the first part of the *TSC FLEX User's Manual*.

My advice is to just sit at the keyboard, manual in hand, and experiment. You might find it useful to capitalize on the wide spacing of the Color Computer's keys and make a thin plastic overlay defining the control functions of major keys.

I've touched on just a few high points of the utility command set; there are others, such as the routines for routing output to a printer or directly onto a disk. My purpose has been to introduce some of the aspects of CC-FLEX that clearly distinguish it from the more elementary operating system in the Radio Shack disk controller. Before moving on, however, there is one more command unique to CC-FLEX 5.0:1 that deserves highlighting: EXT, the external terminal utility.

The EXT command allows a standard serial terminal to be connected to the Color Computer's RS-232 port so that the Color Computer owner can enjoy a high-quality keyboard and video display. A printer can then be hooked to the terminal.

The arguments of EXT are a series of hex numbers, most of which are concerned with setting various delays in the computer-terminal-printer chain. You must experiment with these because the lack of hardware handshaking between computer and printer in this configuration can cause the printer buffer to overflow, resulting in lost characters.

The default values of the arguments have been chosen for the combination of a Televideo 910 terminal and Microline 82A printer; the documentation indicates that other combinations should be workable, and contains some hints for the setup procedure.

When EXT is invoked, it moves the 2K of RAM used by FLEX between $B7FF and $BFFF to screen memory; the internal command, INT, is used to move it back and to reset FLEX vectors so that the Color Computer keyboard regains control of the system.

Basic with FLEX

The various Basics already resident in the machine are also usable in a CC-FLEX environment as the system disk contains two utilities that move portions of the Radio Shack ROMs to RAM so

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that either bare-bones Color Basic or Extended Color Basic can be run. The calling commands are Basic and CBasic, respectively.

What good are these utilities? Well, they allow you to start a long terminal session in FLEX, break away to do some cassette Basic work, and then return to the operating system with simple keyboard commands. No rebooting of the system disk is required.

There's another benefit, too: increased memory availability. When you call Extended Color Basic with CBasic, 24,871 bytes of RAM are made available—just as though the disk controller were removed from its slot. For regular Color Basic, the Basic command frees up a generous 39,207 bytes. I have found one quirk, because of the Color Computer's limited range for integers, the PRINT MEM command returns −26329 for freshly called Color Basic.

To return to CC-FLEX from Basic, just enter EXEC. This also works from CBasic, unless you have reset the EXEC pointer by loading a machine-language cassette program. If you have, then EXEC &HC100 does the job.

The Atomtronics Approach

If the Frank Hogg Laboratory CC-FLEX is a fairly conservative approach, then Atomic City Electronics (Atomtronics) have opted for a frontal assault. They have produced an elaborate disk-controller board that perches atop the RF shield inside the Color Computer's case, and handles all interfacing between the computer and disk drives, printer, and video monitor. If that sounds just like an enumeration of everything an operating system is supposed to do, you're on the right track.

The Atomtronics controller is intended for the Color Computer user who wants to emulate the operation of larger, more sophisticated 6809-based computer systems. Of course, it requires 64K of RAM. The modifications described by Hogg Labs will work, or you can purchase a 64K adapter board from Atomtronics; the latter was reviewed in the December 1982 issue of this magazine (p. 41).

With the Atomtronics board installed, a Color Computer behaves much like a Gimix or SWTP mainframe/terminal combination. FLEX becomes the primary operating system. At present, the various Radio Shack/Microsoft Color Basics cannot be used, but TSC's Basic, Extended Basic, and Pascal are all supported.

The disk-controller hardware handles all 5¼-inch configurations: single or double density, single or double sided, 35–80 tracks. A Centronics-standard parallel printer driver is included, as is a cable for Epson printers. A baseband video-driver output provides a nice clean signal for standard monitors, an absolute necessity if the 80-column-by-24-line display option is installed.

Finally, the board includes a real-time CMOS clock with battery back-up and a ROM monitor program called Wolfbug, which was also reviewed in last December's issue.

As you can imagine, the installation of this board brings about a major change in the Color Computer and a corresponding change in the way you use the system. It makes you wish that Atomtronics had included a high-class keyboard while they were at it!

This installation, however, is not a trivial job; to do it properly requires significant alterations to the Color Computer's case, which are unlikely to escape the attention of your local Shack service personnel should the need for their services ever arise.

With the disk controller in place,

Continued from p. 104

bank of each chip is used in any given machine. Of the other 32K of addressable memory space, 24K are devoted to the Basic ROMs, 256 bytes are used for I/O, and 7.75K are unused.

If the version 1.1 Color Basic (not Extended Color Basic) ROM is in place, as it should be for machines upgraded by the Shack, it is possible to reprogram the Color Computer's synchronous address multiplexer chip (SAM) to ignore the ROMs and recognize both banks of the 64K RAMs.

This leaves the machine with a full 64K of user-accessible memory, less the 256 I/O bytes at the top. The Basic ROMs will simply be ignored, so that FLEX can be loaded and used to load any of the compilers, interpreters, or other programs mentioned earlier.

The hardware modifications are simple, and are well described in several places of literature available for an SASE from the Frank Hogg Laboratory.

An unused NOR gate must be made available to reconfigure the memory map. To do this, two ICs must be modified by having a total of four pins bent up to avoid contact with their sockets. Three pieces of wire are used to connect the ICs to one another and to a test point on the Color Computer's printed circuit board. That's all there is to it.

The faint of heart will be glad to learn that the ICs requiring modification are both inexpensive and readily available. They are U11, a 74LS138; and U29, a 74LS02. To avoid any future problems with Radio Shack's service policy, I removed the circuits from my computer and modified a pair of replacements. The total cost was only about $2, and my machine can always be easily demodified.

Once the wiring changes are made, the actual reprogramming of the SAM is carried out by software and is completely reversible. When a modified Color Computer is turned on, the Disk Color Basic message comes up as usual. A short loader program can then be used to change the system configuration for FLEX.

Of course, none of this will work for a machine with 32K obtained by piggybacking two sets of 16K RAMs; you must have the 64K chips and Color Basic version 1.1 ROM used in the official 32K upgrade. Both 32K banks must be fully operational, as well, and the Hogg Labs literature contains a Basic program to test everything. ■

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power and signals are brought in through a short length of 40-conductor cable that connects the controller board to the Color Computer's program-pack connector. This connection must be made with the case open; the cable is just long enough to drape over the top of the pack connector and plug in.

The documentation recommends securing the cable connector to the bottom of the channel in which a program pack would normally slide. This requires that a pair of screw holes be drilled into the case.

Reading from left to right as you face it, the rear apron of the new board contains an RCA jack for the video cable and 34-pin connector areas for the printer and disk drives. A little detective work was necessary to identify the multi-pin connectors, since they are unidentified on the board and in the manual (although pinouts are given).

Openings for all three of the new connectors must be made in the rear of the Color Computer case. This calls for a fair amount of drilling and filing.

The final step in the installation is the insertion of a pair of AA batteries into a holder mounted on the board, for clock back-up power.

It's probably a good idea to wait until your warranty is up before attempting the conversion.

The controller draws a significant amount of current, about 600 ma, from the Color Computer's 5-volt supply. This is in excess of Radio Shack specifications for add-ons such as ROM cartridges but within the total power consumption specs.

The machine does run noticeably warmer than an unmodified computer, however, and it may become necessary to install a cooling fan or add an auxiliary power supply to the board itself. Atomtronics sells a suitable fan, and space has been provided on the board for any necessary power supply.

The Disk Controller

Because the Atomtronics board is meant to be used with a variety of peripherals, there are quite a few setup options to be considered. First, there's the matter of the disk drives. At present, both single- and double-sided, single-density, 40-track drives are fully supported, although it's a pretty simple matter to specify double density; just write 34 to address FF4D.

It is still necessary to pay some attention to the matter of drive and side selection, though. To accommodate as many options as possible, the Atomtronics controller provides four outputs for drive select and another for side select. The documentation describes how jumpers should be wired on the board to deal with some of the most common configurations. It is also possible to write your own disk-driver routines and have them executed up at start-up time.

The stock Atomtronics printer cables work with an Epson MX-80. Parallel printer interfaces are not exactly standardized, though, so it may be necessary to customize the cable for any given system.

Some fiddling may also be in order to get the best display quality. The vendor recommends an NEC Green Screen monitor for the high-density option. It is claimed that other monitors will work, but may have horizontal-sync problems because the Atomtronics setup routines use a horizontal sweep rate that is slightly higher than normal.

This can be changed with the aid of DISET, a routine on the utility disk supplied with the board; the tradeoff is that lowering the sweep rate reduces the spacing between text lines on the display.

The on-board character generator is a

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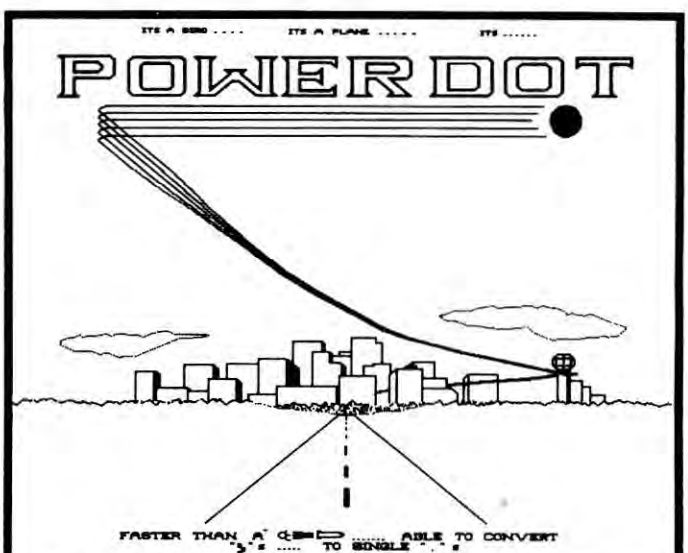

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2716 EPROM that provides the 96 ASCII characters plus a set of superscript and subscript numbers. For even more versatility, a 2732 EPROM can be installed. If two jumpers are moved, a total of 256 different characters can be displayed.

The real-time clock is set and read with two other utility routines: Clockset and Clock. It can be read from within programs, and the documentation gives the addresses at which everything from the seconds' count to the current year are located.

Comparisons and Conclusions

Most of my previous comments about CC-FLEX naturally apply to the standard FLEX supported by the Atomtronics board, with the obvious exception of the utilities for single-drive copy and for running the Color Computer's cassette Basics.

Otherwise, the majority of the utility command set is common to the two embodiments of the operating system. Likewise, the file-management system and disk operating system are very similar. The routines available for disk access and file management under either version give the skilled Assembly-language programmer a high degree of control over information storage and retrieval.

But what of the less-experienced user? Does either version of FLEX have much to offer, and are there significant differences between them? Yes to both. Hogg Labs' CC-FLEX can be brought up with much less effort, and at considerably lower cost.

Let's assume a 64K Color Computer as a baseline system. If the user were to buy Radio Shack's disk controller and drive 0 at list price, a CC-FLEX system could be up and running for about $700; careful shopping for the controller, plus an independent's drive, could bring this down to about $550. On the other hand, a minimum Atomtronics configuration—two drives, TSC FLEX, and a controller board without hi-res video—would cost about $900.

There's more to this story, however, than price. The Hogg Labs package is less intimidating than Atomtronics' to those whose primary interests lie in applications programming and high-level languages. The fact that it will run on single-drive systems, and the defaults to Radio Shack drive parameters, are big factors.

Offsetting this is the total flexibility of the Atomtronics package; you can change everything about the way it handles I/O, if you wish. The standard parallel printer interface and baseband video drive are plusses, as well.

Both products have fine documentation, although Atomtronics' is a little terse. This is probably acceptable, given the degree of sophistication I would expect of its users. The complete ROM code for the disk drivers, machine-language monitor, and 64K memory-mapping routine is included, a commendable feature.

I think CC-FLEX offers the most painless way of trying one's hand at an advanced operating system for the Color Computer. It offers quite a few "big machine" features, and opens the door for a lot of applications software.

The Atomtronics disk controller board, however, seems much more appropriate to the user who has already decided to go after maximum performance from the 6809 microprocessor, and is prepared to dig into the details of an operating system to do so. ■

Eds. Note: Color FLEX version 5.0:2 is now on the market, unfortunately too late to be tested for this review.

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CP/M Cheap

by Bill Brewer

A CP/M mod for $5? That's what author Brewer describes how to build. It's easy to do, and an Assembly bootstrap-loader is included.

Your Model III cannot run all those CP/M programs as it comes from Radio Shack. But I'm going to show you how to build a simple, two-chip CP/M mod for just $5.

The ROM in the Model III uses memory addresses ranging from 0000 to 37FF hexadecimal. In addition, the memory-addressed keyboard switch matrix and video-display memory use addresses from 37FF to 3FFF. Locations from 4000 to the top of memory (FFFF) are the only ones that Model III hardware design permits to be used for read/write RAM. The Model III memory map is shown in detail in Fig. 1.

Model III memory design, unfortunately, places ROM at exactly the same addresses used by programs written to run under CP/M. CP/M must store data in memory locations that are taken up by Model III ROM at address 0000, and CP/M loads all the programs that run under it into memory beginning at 100 hexadecimal. CP/M and all programs that run under it must have a continuous segment of RAM available from address 0000 through the top of the memory used by the operating system.

Other than these limitations of its memory map, the Model III I/O hardware is standard enough to permit use of slightly modified versions of any 8080 or Z80 operating system, including CP/M.

The hardware limitation in the Model III involves very little of the unit's circuitry. An examination of the circuitry almost immediately reveals a simple and inexpensive way to remove the limitation.

The Model III CPU addresses signals over 16 lines of its address bus. An off-the-shelf Model III routes its two highest-order address lines into a decoder circuit that composes one half of a 74LS139 multiplexer (U58). This decoder circuit outputs signals to enable one of four 16K memory banks (Fig. 2).

With both highest-order address lines (A15 and A14) at a low logic level, the decoder chip enables the 16K bank, which contains the Model III ROM and the keyboard and video circuitry. Depending on the binary values of these two address lines, one of the four 16K

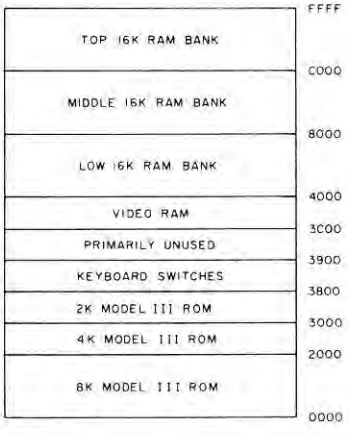

Fig. 1. Model III Memory Map

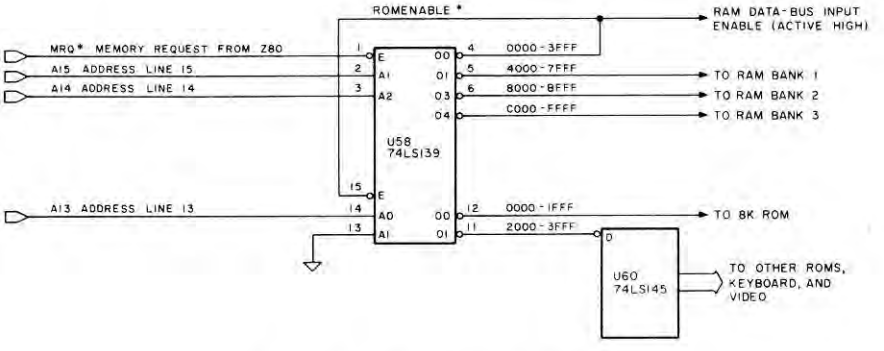

Fig. 2. Model III Address Decoder Circuit

The Key Box

Model III
48K RAM
Assembly Language
One Disk Drive
CP/M Operating System

SIXTEEN KILOBYTE ADDRESS BANK SELECTED BY MRQ*, A16, AND A15

MRQ*	A16	A15	BANK SELECTED
HIGH	EITHER	EITHER	NONE
LOW	LOW	LOW	0000-3FFF
LOW	LOW	HIGH	4000-7FFF
LOW	HIGH	LOW	8000-BFFF
LOW	HIGH	HIGH	C000-FFFF

Table 1. 16K Bank Selection by U58

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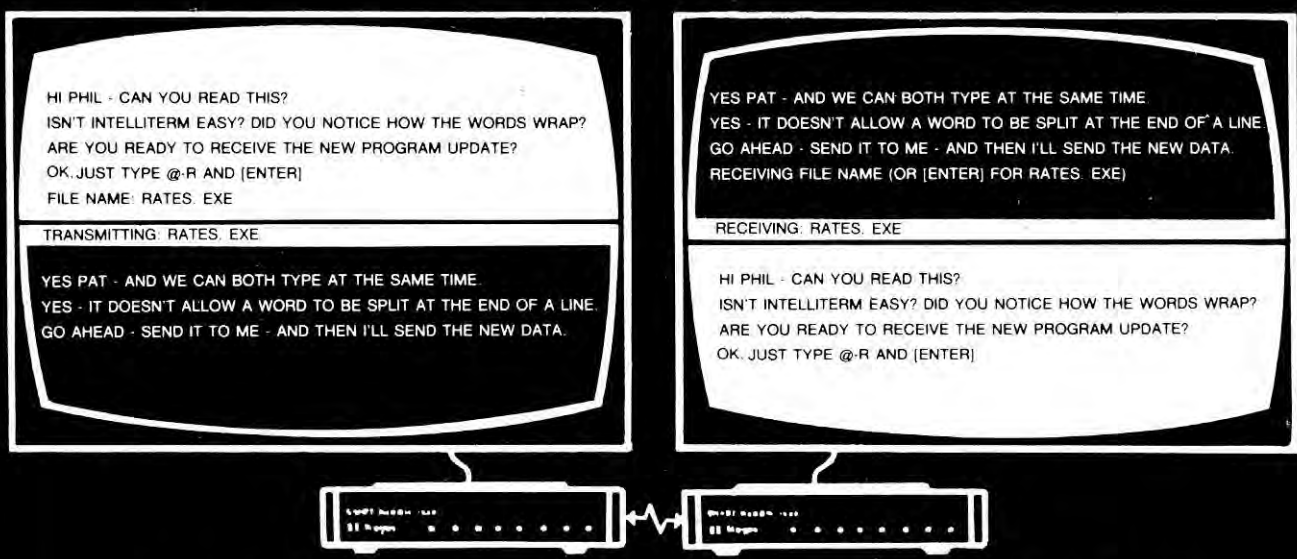

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EIGHT KILOBYTE DEVICE SELECT BY ROM ENABLE* AND A14

ROM ENABLE*	A14	DEVICE SELECTED
HIGH	EITHER	NONE
LOW	LOW	8 KILOBYTE PROM
LOW	HIGH	PROM, KBD, VIDEO

Table 2. Segment Selection in Bank Containing ROM

banks of memory in the Model III address space is selected (Table 1).

A second decoder circuit, which uses the bottom half of the same multiplexer, produces enable signals within the single 16K bank, which contains Model III ROM. Using address line A14 and the 0000-3FFF enable (ROMENABLE*), this decoder enables either the 8K ROM chip, which contains most of Model III Basic, or another group of circuits, including a 4K ROM, a 2K ROM, the keyboard, and the video display. This segment decoder selects or enables these devices for use in their respective memory space as shown in Table 2.

A Hardware Solution

The simplest solution to making the Model III a more capable machine lies in switching the ROM out of the address range used by most programs that are not designed specifically for the Model III, and switching in RAM in its place.

This task looks very simple at first. You might be able to accomplish it by exchanging the printed circuit board (PCB) traces that route the signals labeled 0000-3FFF and C000-CFFF in Fig. 2. That way, the ROM, keyboard matrix, and video circuits would be addressed from C000 to FFFF and the 16K bank of RAM designated as bank 3 would be addressed from 0000 to 3FFF.

This simple approach, however, has two drawbacks. First, the Model III would no longer be capable of running programs specifically written for it, because the ROM, keyboard, and video RAM would be permanently switched out of the memory addresses where they must be run.

Second, when you reset or turn on the computer, the Z80 processor—without additional hardware modifications to its control circuitry—would invariably attempt to execute a program beginning at address 0000 in RAM; there would be no chance to load a program into the RAM before the processor would begin to fetch instructions from it.

You can keep the original capabilities if electronic switching is used. Electronic switching can change the addressing so that 0000 is the beginning address of ROM when you run programs under TRSDOS or similar operating systems, and 0000 is the beginning address of RAM when you run programs under CP/M.

Electronic switching also takes care of the program-loading problem: With an electronic switch, you can load programs by routines already stored in ROM before the switch exchanges the ROM and RAM addresses. Thus, an electronic switch provides for program control by the processor at all times.

An Electronic Switch

One way to achieve electronic memory-map switching is to preprocess the address signals from the Z80 processor before they arrive at the decoders. While the memory map is in standard Model III configuration, the Z80 can execute instructions within the 4000-BFFF address range to invert signals on lines A15 and A14, if they are both true or both false. Thus, the decoder will be fooled into thinking that a processor-provided address within the 0000-3FFF range is actually in the C000-FFFF range, and the processor will have RAM to access at 0000.

Some commercial modifications are designed to remap the memory in this manner. The design has a significant advantage and a significant drawback. Address signal preprocessing is mechanically convenient; it can be provided by a single piggyback board that plugs into the Model III Z80 socket and, in turn, accepts the Z80 in an on-board socket.

The advantage is that the Model III does not have to be physically altered; because the Z80 is one of the few socketed chips on the Model III CPU, the piggyback board does not change the unit in any permanent way.

The drawback is that preprocessing the address lines necessarily introduces a delay in the signals reaching the decoders and the RAM banks, which can make RAM operation unreliable. This delay is more critical in the Model III than in the Model I, because the memory-cycle time for the Model III is approximately 20 percent shorter than it is for the Model I.

A New Bank-Select Decoder

A better solution is to replace the multiplexer circuit, U58, with new decoder circuitry that can switch the address assignments for ROM and RAM and is no slower in setting up addresses than the original Model III circuitry.

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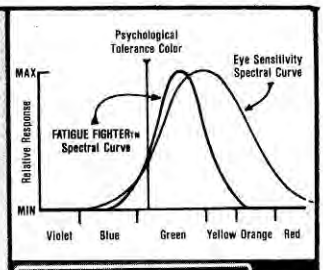

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16K bank-select decoder in the top half of circuit U58 actually consists of two selectable decoders inside one 74LS156 open collector demultiplexer. One of the new decoders can enable the ROM, keyboard, and video display at addresses 0000–3FFF and RAM bank 3 at C000–FFFF (just as in the original Model III decoder). The other new decoder can enable the ROM, keyboard, and video memory at C000–FFFF and RAM bank 3 at 0000–3FFF. This circuit, built up around the 74LS156 demultiplexer (labeled U58-1), is shown in Fig. 3.

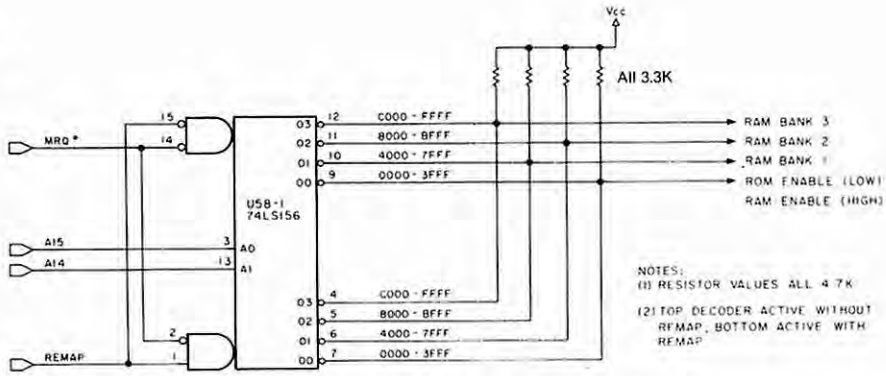


Fig. 3. Bank Decoder with External Request Line

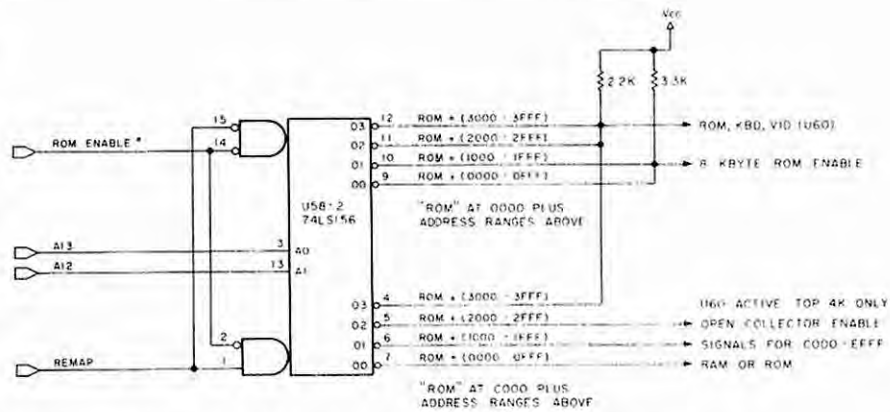


Fig. 4. Decoder for Bank Containing ROM, Keyboard, and Video

At any time, only one of these new decoders is active. An active-high signal, REMAP, external to the decoders, determines which of the two decoders controls memory-bank selection. Because the active-low outputs of the decoders are "wire ORed" and the deselected decoder has high (inactive) outputs for all four banks, only the selected decoder can provide an active-low enable to the bank-select lines.

With REMAP at a logic low (inactive) level, the decoder shown at the top in Fig. 4 is enabled; it puts out enable signals in accordance with the original Model III memory map. With REMAP at a logic high (active) level, the bottom decoder is enabled; it puts out enable signals which map the ROM, keyboard, and video display in the top 16K of memory. It also maps RAM bank 3 into the lowest 16K of memory.

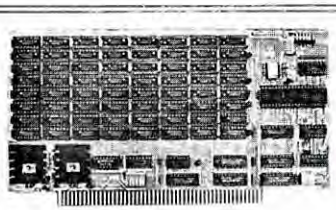
The Additional Decoder

An additional decoder circuit external to U58-1 must be used to perform the 8K segment-select functions which have previously been performed by the lower half of U58. As shown in Fig. 4, the top decoder inside of a second 74LS156 chip, labeled U58-2, provides the 8K enable for the standard-map 16K memory segments devoted to ROM, keyboard, and video display. The other decoder provides four 4K enables in the address range C000–DFFF under remapped conditions.

The segment decoders are selected by REMAP in the following way. With REMAP low, the ROMs, keyboard, and video display are enabled as in the original decoder. With REMAP high, however, the lower decoder produces four enable signals in accordance with address line A12. One of these enables is active whenever the processor addresses C000–FFFF.

The line labeled "ROM + (3000–3FFF)," when active, enables U60 to select the 4K segment that contains the 2K ROM, the keyboard matrix, and the video memory. The three additional signals are the spares, and they are active for the three other 4K segments within the C000–FFFF bank. They can be used together to enable on outboard 12K of RAM (bringing the total to 60K). The original 8K and 4K ROMs, which are useless when they are switched from 0000, no longer appear in the memory map. The space is available for memory expansion.

Replacement of U58 by the two



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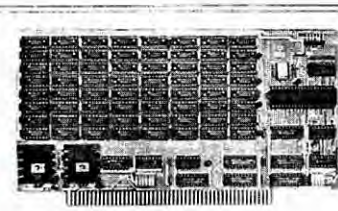

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74LS156 demultiplexer chips provides the Model III with its original memory map and a memory map usable by CP/M (Fig. 5). In addition, the new decoders provide no address-setup delay in excess of the decoders they replace in either mapping condition. Rather than providing for memory unreliability, they provide for memory expansion.

The Signal to REMAP Memory

The REMAP signal for selecting the pair of decoders for each memory-map configuration could come from a toggle switch mounted outside of the Model III cabinet. But such a switch can be thrown only when the Z80 is running a program loaded into memory (or present in ROM) inside the 4000–BFFF address range. Otherwise, the program counter inside the Z80 would lose track of the instructions it is executing.

This restriction requires that you produce REMAP under the control of a program that is loaded into the required address range.

The signal is easily provided by unused output (port) components already present on the Model III logic board. Latch U98, primarily used to output cassette-recorder levels and a video character-width signal, has an unused D-type flip-flop.

Providing the input to this latch with bit 0 of the data bus results in the output of the flip-flop being controlled by the low-order bit output to port EC. With this bit low (inactive), a low REMAP* signal is output from bit 0 of the latch, and the memory map of the Model III is set up for TRSDOS. With the bit high (active), Remap is output, and the memory is mapped for CP/M.

The RESET* signal to latch U98 is, however, originally tied to Vcc (+5 volts). The latch will not necessarily be cleared when you turn on the computer, and it will never be cleared by a reset

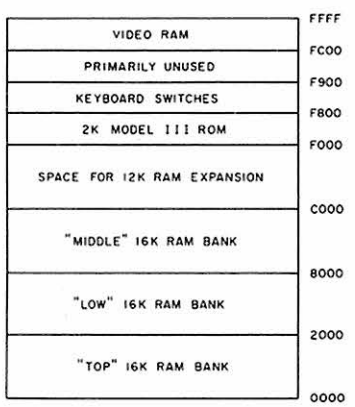

Fig. 5. CP/M-Compatible Model III Memory Map.

Program Listing. Assembly Listing of Bootstrap Loader

```
                00001 ;
                00002 ;BOOTSTRAP LOADER FOR MODEL III WITH MEMORY MAP
                00003 ;MODIFICATIONS
                00004 ;
4300            00005         ORG     4300H
                00006 ;
                00007 ;CUSTOMIZATION EQUATES:
5000            00008 RAMORG  EQU     5000H   ;BEGINNING OF RAM TO LOAD
53FF            00009 RAMEND  EQU     53FFH   ;END OF RAM TO LOAD
0002            00010 DSKORG  EQU     2       ;TRACK (MSB) & SECT (LSB) TO LOAD
5000            00011 PGNTRY  EQU     5000H   ;ENTRY POINT FOR EXECUTION IN RAM
9000            00012 STACK   EQU     9000H   ;AN OUT-OF-THE-WAY STACK
                00013 ;
                00014 ;MODEL III ADDRESS AND PORT EQUATES:
021B            00015 LINOUT  EQU     21BH    ;$VDLINE
01C9            00016 CLRSCN  EQU     1C9H    ;$VDCLS
0066            00017 NMIADR  EQU     66H     ;Z80 NMI VECTOR LOCATION
                00018 ;
00E0            00019 CNMIPT  EQU     0E0H    ;NMI ENABLE PORT FOR CLOCK, CAS
00E4            00020 DNMIPT  EQU     0E4H    ;NMI ENABLE PORT: DISK CONTROLLER
00EC            00021 CASPRT  EQU     0ECH    ;CASSETTE AND MEMORY-MAP PORT
00F0            00022 CSTPRT  EQU     0F0H    ;DISK CONTROL AND STATUS PORT
00F2            00023 SCTPRT  EQU     0F2H    ;SECTOR PORT
00F3            00024 DTAPRT  EQU     0F3H    ;DATA PORT
00F4            00025 DRVPRT  EQU     0F4H    ;DRIVE SELECT PORT
                00026 ;
                00027 ;INITIALIZATION INSTRUCTIONS
                00028 ;
4300 310090     00029         LD      SP,STACK
4303 F3         00030         DI
4304 AF         00031         XOR     A
4305 D3E0       00032         OUT     (CNMIPT),A
4307 D3E4       00033         OUT     (DNMIPT),A      ;INTERRUPTS DISABLED
                00034 ;
4309 3E09       00035         LD      A,9
430B D3EC       00036         OUT     (CASPRT),A      ;MEM MAP SWITCHED
                00037 ;
430D 3EC3       00038         LD      A,0C3H
430F 326600     00039         LD      (NMIADR),A      ;RETURN VECTOR FOR READ
4312 217543     00040         LD      HL,INTRTN
4315 226700     00041         LD      (NMIADR+1),HL
                00042 ;
4318 210050     00043         LD      HL,RAMORG       ;RAM POINTER FOR LOAD
431B 210200     00044         LD      HL,DSKORG       ;DISK POINTER FOR READ
                00045 ;
                00046 ;PROGRAM FLOW FOR MULTIPLE-SECTOR LOADS AND DISPATCH
                00047 ;TO CODE LOADED
                00048 ;
431E CD3743     00049 MSECLP: CALL    RDSCTR          ;CONTROL LOOP
4321 01FF53     00050         LD      BC,RAMEND
4324 B7         00051         OR      A
4325 E5         00052         PUSH    HL              ;SAVE RAM POINTER
4326 ED42       00053         SBC     HL,BC           ;TEST FOR PAST RAM END
4328 E1         00054         POP     HL
4329 D20050     00055         JP      NC,PGNTRY       ;EXIT IF DONE
432C 7B         00056         LD      A,E             ;ELSE NEXT DISK ADR
432D FE12       00057         CP      18
432F 3803       00058         JR      C,NXTSCT        ;SAME TRACK
4331 14         00059         INC     D               ;NEXT TRACK
4332 1E00       00060         LD      E,0             ;PRIME FOR SECTOR 1
4334 1C         00061 NXTSCT: INC     E
4335 18E7       00062         JR      MSECLP
                00063 ;
                00064 ;
                00065 ; SECTOR READ ROUTINE WITH ERROR DETECTION:
                00066 ;
4337 3E0A       00067 RDSCTR: LD      A,10            ;SECTOR READ:  TRIES
4339 32D643     00068         LD      (ERRCNT),A
                00069 ;
                00070 ;
433C 3E81       00071 RDSTR1: LD      A,81H           ;SELECT,START DRIVE 0
433E D3F4       00072         OUT     (DRVPRT),A
                00073 ;
4340 7A         00074         LD      A,D             ;SELECT TRACK
4341 D3F3       00075         OUT     (DTAPRT),A
                00076 ;
4343 3E1C       00077         LD      A,1CH           ;SEEK COMMAND
4345 D3F0       00078         OUT     (CSTPRT),A
                00079 ;
4347 CDCF43     00080         CALL    SDELAY          ;DELAY FOR LATCH
                00081 ;
434A DBF0       00082 BSYLP:  IN      A,(CSTPRT)      ;LOOP UNTIL READY
434C 0F         00083         RRCA
434D 38FB       00084         JR      C,BSYLP
                00085 ;
434F 7B         00086         LD      A,E             ;SELECT SECTOR
4350 D3F2       00087         OUT     (SCTPRT),A
                00088 ;
                00089 ;
4352 0EF3       00090         LD      C,DTAPRT        ;READ SECTOR: INPUT PORT
                00091 ;
4354 3E81       00092         LD      A,81H           ;AVOID TWO-SECOND TIMEOUT
4356 D3F4       00093         OUT     (DRVPRT),A
                00094 ;
4358 DBF3       00095         IN      A,(DTAPRT)      ;DISCARD SPURIOUS INPUT
                00096 ;
435A 3E84       00097         LD      A,84H           ;OUTPUT READ COMMAND
435C D3F0       00098         OUT     (CSTPRT),A
                00099 ;
435E CDCB43     00100         CALL    LDELAY
                00101 ;
4361 3EC0       00102         LD      A,0C0H          ;ENABLE DISK NMI
4363 D3E4       00103         OUT     (DNMIPT),A
```

Listing continues

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Listing continued

```
                        00104 ;
4365 DBF0               00105 DRQLP:    IN      A,(CSTPRT)      ;LOOP UNTIL DATA READY
4367 E602               00106           AND     2
4369 28FA               00107           JR      Z,DRQLP
                        00108 ;
436B EDA2               00109           INI                     ;DO FIRST BYTE
                        00110 ;
436D 3EC1               00111           LD      A,0C1H          ;WAIT BETWEEN BYTES
                        00112 ;
436F D3F4               00113 DATALP:   OUT     (DRVPRT),A      ;AWAIT SECTOR INTERRUPT
4371 EDA2               00114           INI
4373 18FA               00115           JR      DATALP
                        00116 ;
4375 AF                 00117 INTRTN:   XOR     A               ;HERE AFTER INTERRUPT
4376 D3E4               00118           OUT     (DNMIPT),A      ;DISABLE INTERRUPTS
                        00119 ;
4378 2B                 00120           DEC     HL              ;PRIME RAM POINTER
                        00121 ;
4379 DBF0               00122           IN      A,(CSTPRT)      ;TEST CONTROLLER STATUS
437B E61D               00123           AND     1DH
                        00124 ;
437D C1                 00125 REREAD:   POP     BC              ;EVEN STACK
                        00126 ;
437E C8                 00127           RET     Z               ;DONE OF NO ERROR
                        00128 ;
                        00129 ;
                        00130 ; ERROR CONTROL ROUTINES:
                        00131 ;
437F 21D643             00132           LD      HL,ERRCNT       ;ERROR CONTROL
4382 35                 00133           DEC     (HL)
4383 2809               00134           JR      Z,ERROR         ;MESSAGE IF RETRIES DONE
                        00135 ;
                        00136
4385 2AD443             00137           LD      HL,(DMADR)      ;REREAD ADRESSES
4388 ED5BD243           00138           LD      DE,(SECTOR)
438C 18AE               00139           JR      RDSTR1          ;LOOP TO READ AGAIN
                        00140 ;
438E 21E643             00141 ERROR:    LD      HL,ERNUM-1      ;COMPOSE ERROR MESSAGE
4391 CDB143             00142           CALL    OUTNUM          ;ERROR ID FOR MESSAGE
4394 7A                 00143           LD      A,D
4395 21F543             00144           LD      HL,TRKNM-1
4398 CDB143             00145           CALL    OUTNUM          ;AND TRACK NUMBER
439B 7B                 00146           LD      A,E
439C 21EE43             00147           LD      HL,SECNM-1
439F CDB143             00148           CALL    OUTNUM          ;AND SECTOR NUMBER
43A2 3E00               00149           LD      A,0
43A4 D3EC               00150           OUT     (CASPRT),A      ;BACK TO OLD MEM MAP
43A6 CDC901             00151           CALL    CLRSCN          ;CLEAR SWREEN
43A9 21D743             00152           LD      HL,ERMSG
43AC CD1B02             00153           CALL    LINOUT          ;OUTPUT MESSAGE
                        00154 ;
43AF 18FE               00155 WLOOP:    JR      WLOOP           ;AWAIT RESET KEY
                        00156 ;
43B1 F5                 00157 OUTNUM:   PUSH    AF              ;TRANSLATE BYTE TO HEX
43B2 0F                 00158           RRCA
43B3 0F                 00159           RRCA
43B4 0F                 00160           RRCA
43B5 0F                 00161           RRCA
43B6 CDBE43             00162           CALL    OUTHEX
43B9 F1                 00163           POP     AF
43BA CDBE43             00164           CALL    OUTHEX
43BD C9                 00165           RET
                        00166 ;
43BE 23                 00167 OUTHEX:   INC     HL              ;STORE ASCII FOR NIBBLE
43BF E60F               00168           AND     0FH
43C1 C630               00169           ADD     A,'0'
43C3 FE3A               00170           CP      '9'+1
43C5 3802               00171           JR      C,NUMBER
43C7 C607               00172           ADD     A,7
43C9 77                 00173 NUMBER:   LD      (HL),A
43CA C9                 00174           RET
                        00175 ;
43CB E3                 00176 LDELAY:   EX      (SP),HL         ;LONG, SHORT DELAYS
43CC E3                 00177           EX      (SP),HL
43CD E3                 00178           EX      (SP),HL
43CE E3                 00179           EX      (SP),HL
43CF C5                 00180 SDELAY:   PUSH    BC
43D0 C1                 00181           POP     BC
43D1 C9                 00182           RET
                        00183 ;
                        00184 ;RESERVED RAM
43D2 0200               00185 SECTOR:   DEFW    DSKORG
43D4 0050               00186 DMADR:    DEFW    RAMORG
0001                    00187 ERRCNT:   DEFS    1
                        00188 ;
                        00189 ;COMPOSITE ERROR MESSAGE
                        00190 ;
43D7 44                 00191 ERMSG:    DEFM    'DISK READ ERROR '
     49 53 4B 20 52 45 41 44
     20 45 52 52 4F 52 20
43E7 41                 00192 ERNUM:    DEFM    'AA SCTR '
     41 20 53 43 54 52 20
43EF 42                 00193 SECNM:    DEFM    'BB TRK '
     42 20 54 52 4B 20
43F6 43                 00194 TRKNM:    DEFM    'CC',0DH
     43
                        00195 ;
                        00196 ;ERROR BYTE ("ERNUM") SIGNIFICANCE
                        00197 ;
                        00198 ;BIT 0: CONTROLLER BUSY FROM PREVIOUS COMMAND
                        00199 ;BIT 1: NO SIGNIFICANCE (MASKED OUT)
                        00200 ;BIT 2: LOST DATA (Z80 DIDN'T READ DATA BYTE)
                        00201 ;BIT 3: CRC ERROR (BAD DISKETTE, FAULTY READ)
```

Listing continues

signal from the switch on the keyboard. To ensure that the computer comes up with ROM mapped at 0000 (the processor starting address), the RESET* signal to the latch must be provided by processor support circuitry, specifically from U57 pin 13.

Physical Modifications

Replacing the decoders in the Model III is slightly more complex than piggybacking a board in the Z80 socket, although no major changes are made to the CPU. The new decoder circuitry is mounted on a separate board, which plugs into a socket installed in place of the original decoder (U56) on the logic board (Photos 1a and 1b).

Parts for the decoder, consisting of IC58-1, IC58-2, two 16-pin sockets, various resistors, and a dual in-line package (DIP) header, are mounted on a cut-to-size piece of solder-tail prototyping (Vector) board. Sockets for the chips are inserted into the component side of the board, and wiring is done on the solder side with 30-gauge (wire-wrap) leads. The DIP header is soldered to the printed-circuit pads on the solder side of the board. Photos 2a and 2b show the component and solder sides of the board.

The most bothersome modification is the removal of the original decoder chip (U58) and the installation of a DIP socket. Clipping each lead of the chip and removing the leads one at a time with low-heat soldering equipment is the least risky. A socket that accepts the decoder-board header plug is then soldered in place of IC51. This socket can be a conventional type, but a socket composed of individual Augat pins, as shown in the photographs, provides a snugger fit for the DIP header and eliminates any need for complete removal of solder remaining in the Model III logic board after the removal of U58.

The reset lead of the output latch (U98) must be clipped near the surface of the logic board. Wire-wrap leads, tacked with solder directly to the leads of IC chips, are used to provide the following connections:

- Data-bus line 0 from U100, pin 14, to the spare port EC latch input at U98, pin 4.
- Port EC latch output from U100, pin 5, to a terminal on the decoder board which provides REMAP to U58-1 and U58-2.
- /RESET (RESET*) from U57, pin 13, to the port EC latch reset at U98, pin 1.
- Address line U12 from U60, pin 13, to the decoder board.

I've tested the remapping modifica-

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tions described above for more than 100 hours and no failure has occurred. The 8K and 4K Model III ROMs are disabled, and three 4K memory-expansion enable signals function as designed.

Preliminary Design for Adding Memory

No tests, however, have been performed on the Model III with additional memory added. The memory-expansion enables are a cost-free result of chip selection for the remapping modification.

Additional modifications to add 12K of RAM can be most easily made through the same construction techniques used for the remapping modification. Plug a board constructed of 8 DIP headers and 16 sockets into the sockets for one of the 16K RAM banks. Wire eight of the sockets in parallel with corresponding headers, and insert the 4116 RAM chips into them. They function exactly as in an off-the-shelf Model III.

Wire all pins but one (CAS*—the column address strobe pin) of the eight remaining sockets (for the eight additional 4116s) in parallel with corresponding headers. A column address strobe line connected to the CAS* pins of all the new RAM chips can be obtained from wire ORing the three 4K enable lines from U58-2 and ORing the resulting signal with the Model III CAS* to produce a new RAM bank-select signal, CAS4*. (See Fig. 6.)

Only further construction and testing can verify that the memory-expansion modification is adequate for long-term performance. However, the power supply, which can operate from a 50-Hertz line, should be capable of providing power to the additional RAM chips. Also, no excessive heat buildup should occur in this well-ventilated part of the cabinet, but Murphy's law is in effect: *caveat constructor.*

Extreme care is the only guarantee of success in working with the CPU board. All the connecting cables and connectors that plug into the board are tin-plated, and they are all fragile. Do not attempt this mod if you are a novice with a soldering iron.

Software Control

The software that switches the memory map is simple. To remap memory, put the following pair of instructions in your bootstrap loader program:

```
LD      A,9
OUT     (OECH),A
```

Similarly, to switch back to the off-the-shelf memory mapping, use the

Listing continued

```
                00202 ;
                00203 ;BIT 4: RECORD NOT FOUND (ADR FIELD MISSING)
                00204 ;BIT 5: NO SIGNIFICANCE (MASKED OUT)
                00205 ;BIT 6: NO SIGNIFICANCE (MASKED OUT)
                00206 ;BIT 7: DRIVE NOT READY (DOOR OPEN, NO DISKETTE)
                00207 ;
0000            00208           END
00000 TOTAL ERRORS
```

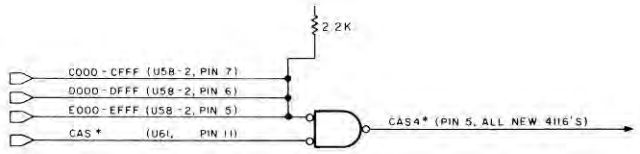


Fig. 6. Preliminary Logic for a New RAM Bank-Select Signal

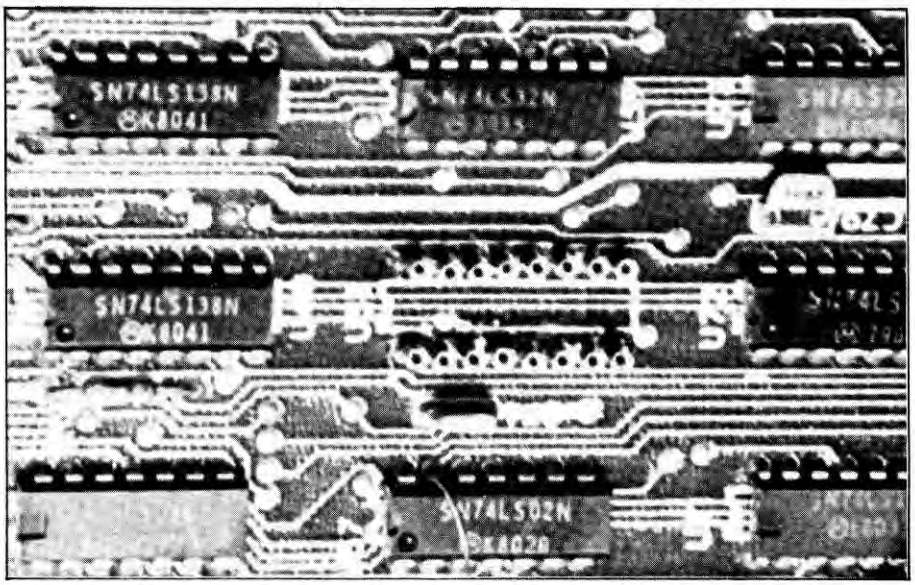


Photo 1a. Socket for New Decoder

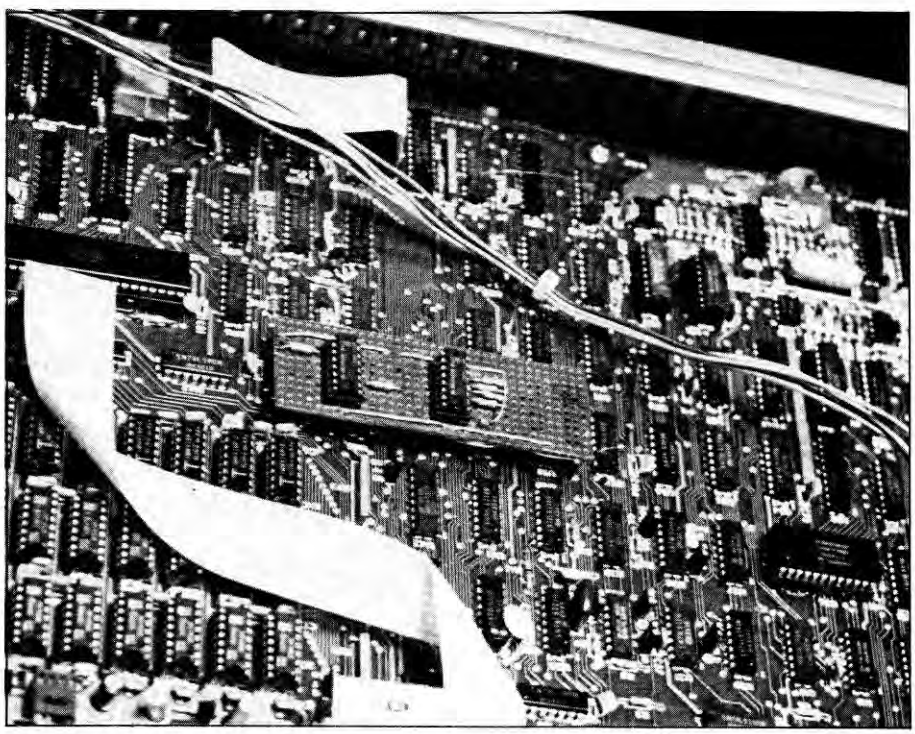
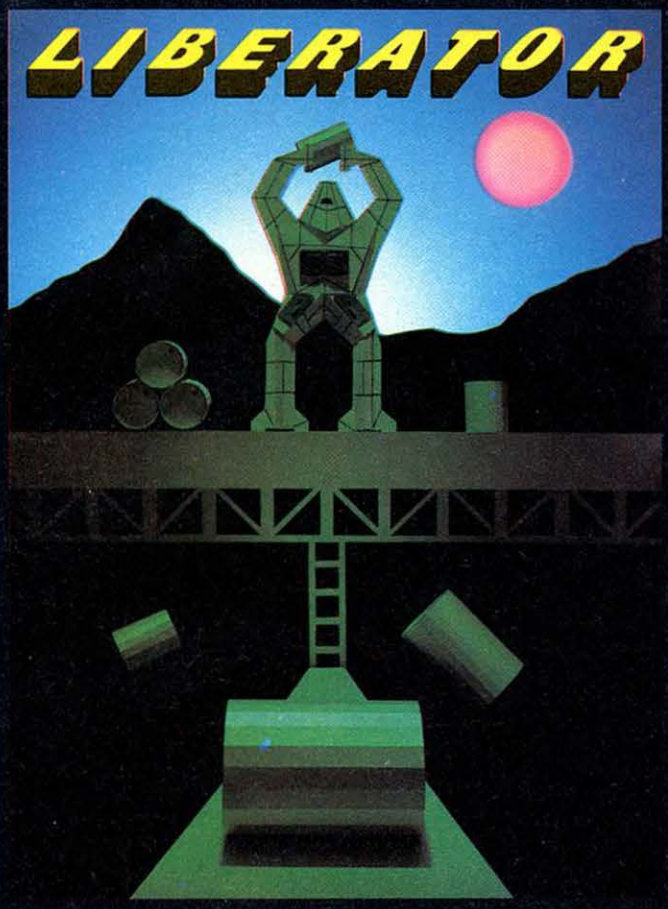


Photo 1b. New Decoder Installed



ASSAULT

Once again, two of the industries greatest programmers have teamed up to bring you a game like you've never seen before, anywhere. Bill Dunlevy and Doug Frayer have combined their talents in order to bring you a fantastic new game, ASSAULT. By taking the best parts of the top arcade games, combining them and adding a little touch of their own, they've insured the success of this new creation. Stationed inside a hollow mountain, you must protect your gold from the hideous creatures and the indestructible spider, while digging caverns and dodging the numerous poisonous mushrooms. Not only is the concept of ASSAULT great, but it also has intricate, wrap around graphics and stupendous sound.

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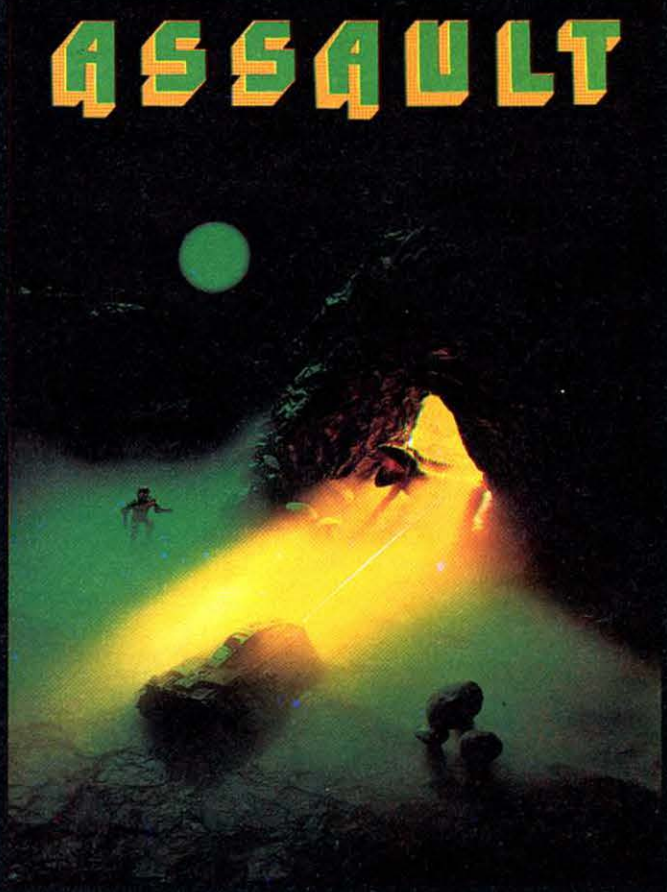

LIBERATOR

It has happened, somebody finally went and topped DONKEY KONG! John Crane, an ambitious young programmer has created a great new game for the TRS-80, LIBERATOR. Written after the DONKEY KONG tradition, it'll not only meet your expectations, but exceed them with original stages that combine fantastic graphics and wonderful sound. you're a brilliant scientist, with many great past achievements, but nobody's perfect. While you and your four beautiful assistants are working on a automated robot, something goes wrong! The robot goes bezerk, destroying your lab and capturing your four young helpers. Fleeing into an industrial park, he hides each of the girls in a different place. In order to save them, you must make your way through the hazardous park, while avoiding the crushing grip of the robot gone mad. With its five fast moving, original stages and twenty different levels, LIBERATOR's not only different from DONKEY KONG, but it's better. So try LIBERATOR, it'll become a favorite in your house too.

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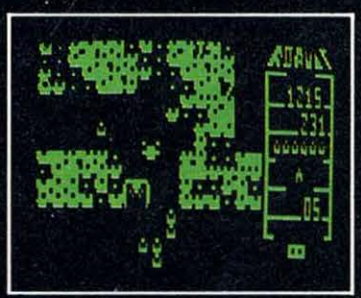
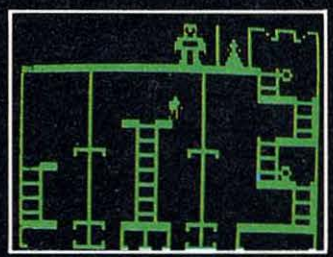
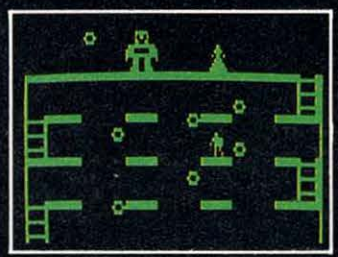
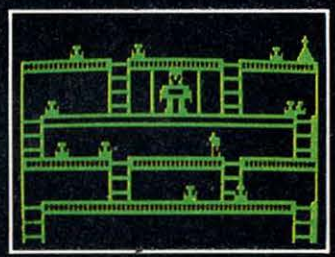


ASSAULT







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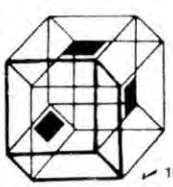

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following pair of instructions:

```
LD      A,8
OUT     (OECH),A
```

The least-significant bit of the output byte switches the memory. Other bits in the byte affect video line length and character set, video wait states, cassette-motor switching, and external I/O bus operation. With these bits off, the Model III is set up for a 64-character video line, the Japanese kana special-character set, no video wait states, and the cassette motor and I/O bus off. With bit 3 on, as above, the Greek character set is selected.

Most versions of CP/M used with commercial remapping modifications are easy to patch for use with this modification. Just search through the code of the bootstrap loader and the Basic input/ouput system (BIOS, the machine-particular module in CP/M) for the remapping instructions particular to the modification, and replace them with the instructions listed above.

As an alternative, a new boot (see below) and BIOS can be written for the standard version of CP/M. The sector read and write primitives in the BIOS can be modeled on the sector-read primitive in the bootstrap loader listed below.

A bootstrap loader for CP/M or any other program that you have placed on disk is shown in the program listing. The loader must be present on track 0, sector 1, of a disk with the Model III standard format of 18 256-byte sectors per track. The program to be loaded must be present on the disk beginning at track 0, sector 2.

The memory addresses into which the program is to be loaded are set by equate statements at the first of the program listing, and they can easily be changed to suit your program. With your disk inserted, in response to power-on or reset, Model III ROM will bring the loader into RAM at 4300 hexadecimal and transfer control to it. It loads your program, and your program gives you the computing power you didn't have before. ■

Bill Brewer can be reached at 5236 17th St., Lubbock, TX 79416.

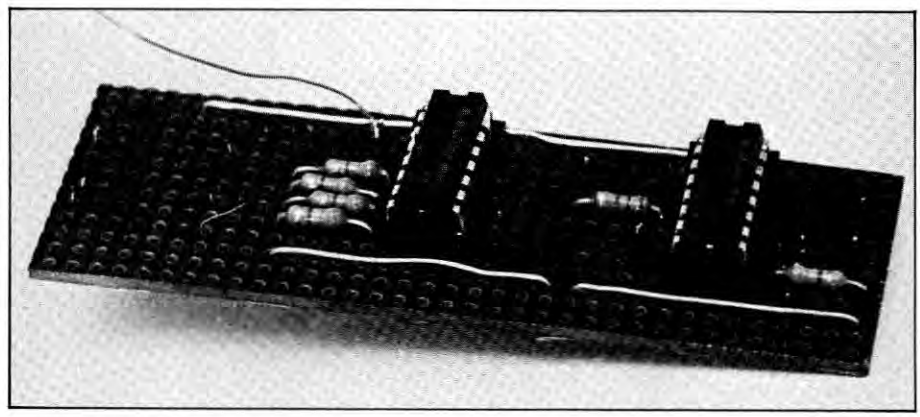

Photo 2a. Component Side of Decoder Board

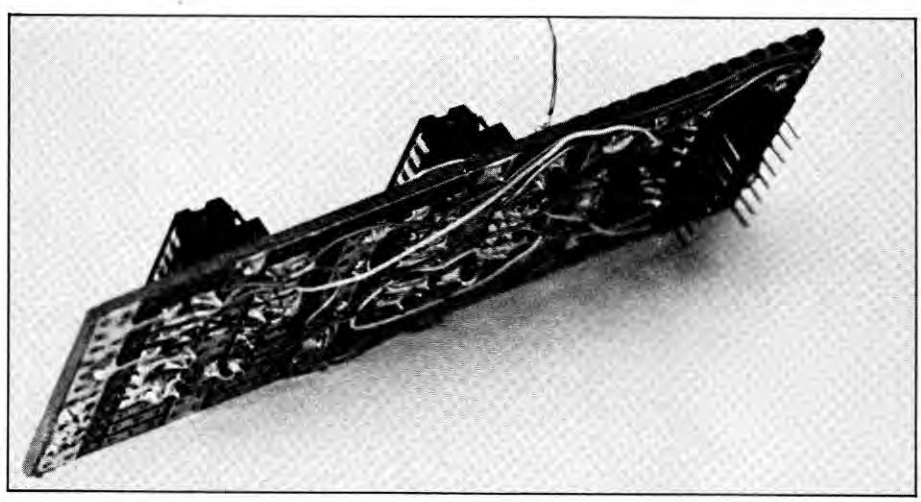

Photo 2b. Solder Side of Controller Board

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Your First Hardware Project

by Jeff DeTray

There was a time when people built their own computers. But the wide variety of ready-made machines available today has lessened the ranks of the hardware hackers.

Therefore, many of today's computerists haven't experienced that rewarding feeling that comes with building a useful project.

Want to get your hands dirty with some hardware construction? Here's an easy starter project.

Photos by the author

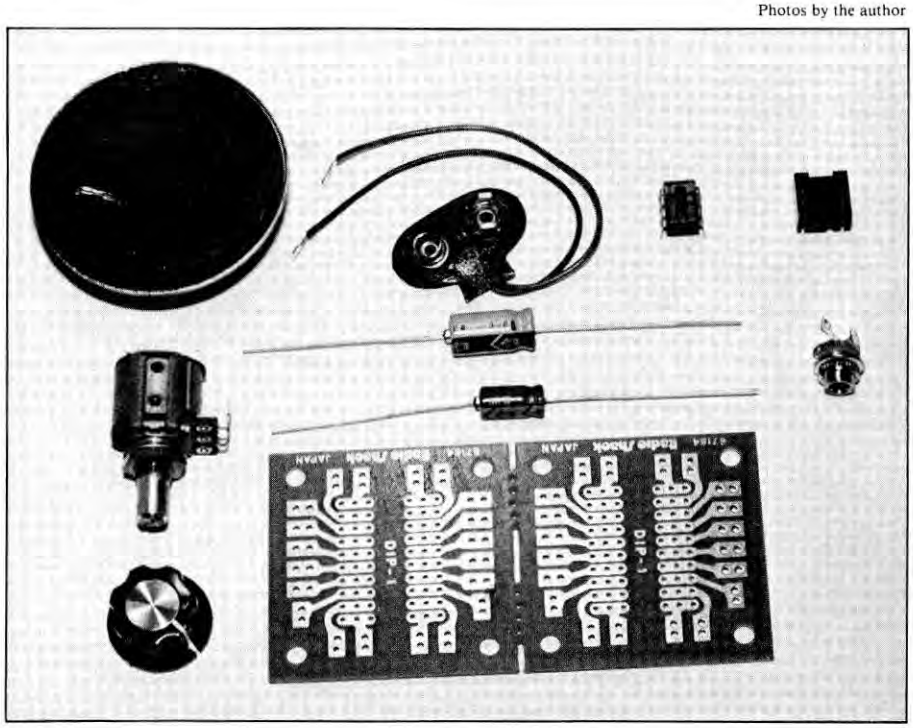

Photo 1. These 10 components, plus a battery and some hookup wire, are all you need to make an audio amplifier for your Model I/III. Note that only half of the circuit board is used in the project (see text).

Here's a simple do-it-yourself project that almost anyone can build. It's an audio amplifier that will allow your Model I or III to take advantage of the many programs on the market that have sound effects, and this includes the most popular games.

This project is not foolproof, but is about as simple as one can be and remain useful. The entire project contains fewer than 30 solder joints and costs less than $20. It's my hope that, after building this little amplifier, you'll have the confidence to attempt other, more complex projects in the future.

Let's get on with it.

Schematic Diagrams

Electronics hobbyists, indeed the entire electronics industry, have adopted some conventions that facilitate the written presentation of hardware projects. The most important of these is the schematic diagram or, simply, schematic. Such a diagram of our amplifier circuit is shown in Fig. 1.

In a schematic, the components of a circuit and their interconnections are shown in a stylized form. Each type of component has a distinctive symbol, and an abbreviated designation is printed next to the symbol. Often, the actual value of the component is printed near its symbol, although the value may be printed in a separate parts list.

Although a schematic shows all the interconnections in a circuit, it does not necessarily show the actual layout of the

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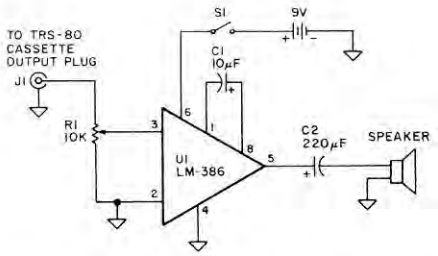

Fig. 1. Schematic diagram of audio amplifier—S1 is a switch that is part of R1, the volume control.

parts. There are often many equally suitable arrangements, and the one you choose may depend on such factors as the space available and the physical size of the components.

Also note that two parts that appear quite close together in the schematic may be some distance apart in the finished project, connected by a long wire.

Parts Availability

All parts used in this project can be found in a well-stocked Radio Shack store. The parts list gives the appropriate Shack part number for each component. The store manager can order any parts not in stock.

There are many other sources for the components used in the project. A number of them advertise in this magazine. Look for their ads and write for catalogs—you'll save money over the Shack's prices.

The Circuit

It would require many pages to explain in detail the workings of each and every component in even this simple circuit. However, I will mention at least briefly the functions of the main components. Photo 1 shows the parts used in this project.

Referring to Fig. 1, J1 is a miniature phone jack, which mates with the larger of the two gray plugs at the end of the TRS-80's cassette cable. It's through this jack that the very low-level audio from the computer is delivered to the amplifier.

R1 is a 10k (10,000) Ohm variable resistor or potentiometer. It serves as the volume control. On the rear of R1, and part of it, is S1, a switch used to turn the amplifier on and off.

Most of the work of this circuit is performed by U1, an LM386 audio power-amplifier integrated circuit (IC). The IC

Component	Description	R.S. Part#	Price
U1	LM386 audio amp. IC	276-1731	$1.09
R1	10k control w/switch	271-215	1.69
C1	10 μF capacitor	272-1013	.59
C2	220 μF capacitor	272-1006	.79
J1	Mini phone jack	274-251	3/1.29
	Circuit board	276-159	1.49
	Speaker, 2-inch	40-245	2.49
	Eight-pin IC socket	276-1995	2/.59
	Battery clip	270-325	5/.99
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Table 1. Parts List

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is a small plastic package with eight protruding legs or pins. Pin 3 is the audio input from the computer (through R1). The positive terminal of a 9-volt battery is connected to pin 6, with the negative battery terminal going to pin 4.

The LM386 has two levels of amplification available and capacitor C1 selects the higher of the two. C1 can be omitted altogether if you can get by with a lower volume level. Pin 5 is the output of the LM386. Pin 7 is not used.

The sound from our amplifier would be rather ragged were it not for C2. This capacitor smooths the audio from the LM386 before it goes to the speaker, a small, 2-inch-diameter model.

Construction

Many different construction methods can be used to build this project. I've selected one that offers a good chance for success even if you've never before attempted to construct a piece of hardware. A step-by-step procedure using this method appears below.

One of the most enjoyable aspects of being a hardware hacker, though, is deviating from the well-marked path into unexplored territory. So, if you have a favorite construction method or wish to experiment, be my guest.

My version of the amplifier was built on one-half of a Radio Shack dual IC board, part #276-159. This is a universal-type printed circuit board, designed specifically for homemade projects involving ICs. It is made to be cut or broken in half at the center, yielding a pair of single IC boards.

One surface of the board is covered by a foil pattern, which gives easy access to the pins of the IC that you will mount in the center of the board. The flip side of the board contains no foil. This is the side on which the components are mounted, with their leads running through the holes in the board where they are soldered to the foil. All components are mounted on the nonfoil side of the board, but all soldering is done on the foil side.

In the steps that follow, you'll notice that you do your soldering to an IC socket and not to the IC itself. An IC can be damaged by overheating. It is a simple matter to make all connections to the socket, and when soldering is completed, simply plug in the IC.

Whenever a step calls for you to make a connection to a particular socket pin, you can make the connection to any part of the foil leading to that pin. For instance, four different wires are connected to pin 4 of the socket, each to a different hole in the foil to which pin 4 is soldered.

To make a circuit-board connection, just insert the wire or component lead from the nonfoil side of the board, through one of the holes that goes through the appropriate foil, and solder it in place. The pin numbers of the IC socket (and the IC, for that matter) are shown in Fig. 2.

You will need 30–36 inches of insulated hookup wire for this project. Number 20 or 22 wire is recommended. Be sure to remove ¼ inch of insulation from both ends of every wire before attempting to solder it.

Step-by-Step Instructions

Build this project using the following steps in order:

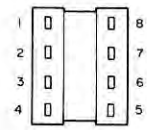

Fig. 2. The Eight-Pin IC Socket, Top View, Showing Pin Numbers.

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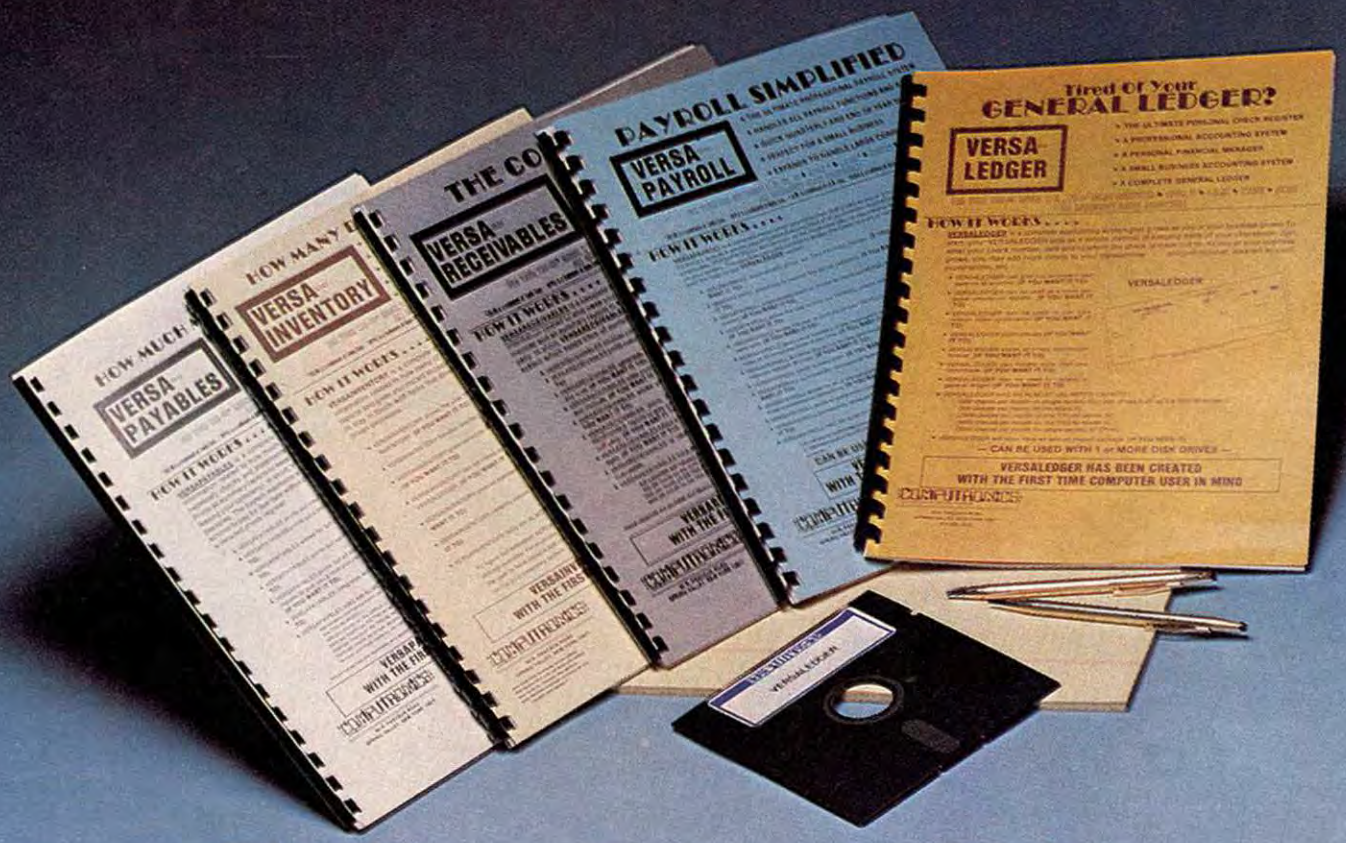

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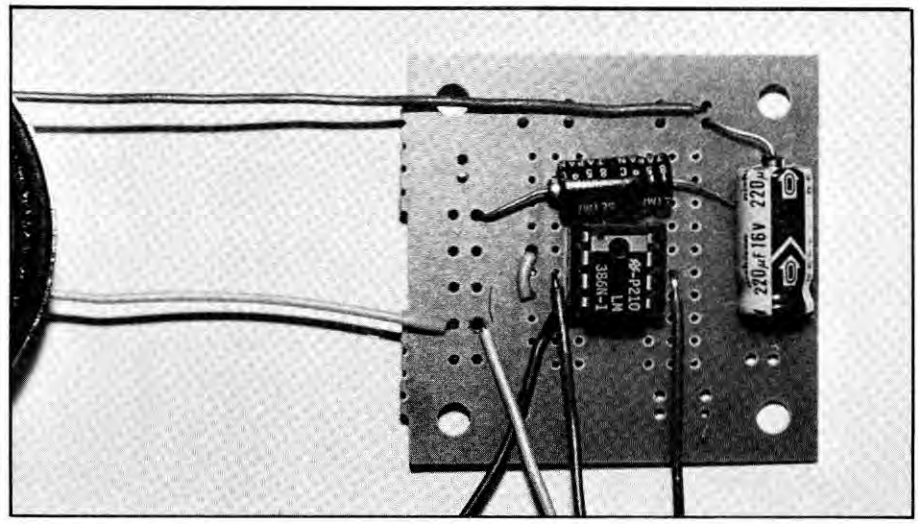

Photo 2. The finished circuit board. U1, the LM386 amplifier IC, is in the center. Above it is C1, and to the right is C2.

- Separate the two halves of the circuit board and set one half aside for use in some future project.
- From the nonfoil side of the board, insert the eight pins of the IC socket, locating it as near as possible to the center of the board. Turn the board over and solder all eight pins to their respective foils, keeping the socket flat against the circuit board.
- Solder one lead of capacitor C1 to the foil leading to IC pin 1. Solder the other lead of C1 to pin 8.
- Solder the black lead of the 9-volt battery clip to pin 4 of the socket. Remember that all wires are inserted from the nonfoil side.
- Refer to Fig. 3, a view of the switch lugs on the rear of volume control R1. Solder the red lead of the battery clip to the "C", or common, lug.
- Solder one end of a 3½-inch length of hookup wire to lug 1 of the switch on the rear of R1 and the other end to pin 6 of the socket.
- Solder one end of a 4-inch wire to the center lug on the main part of R1. Solder the other end to pin 3 of the socket.
- Cut two lengths of hookup wire, one 4 and the other 5½ inches long. Solder one end of each to the right (when viewed from the shaft end) lug of R1. Solder the other end of the 4-inch wire to pin 4 of the socket. The remaining end of the 5½-inch wire will be connected later.

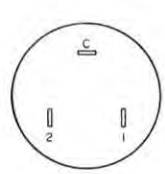

Fig. 3. Rear of R1, Showing Identification of Switch Lugs.

- Solder a ½-inch wire between pins 2 and 4 of the socket.
- Examine C2, the 220 μF capacitor. Note the minus sign with an arrow pointing to one end of the capacitor. Solder the lead coming from this end of the capacitor to any of the previously unused foils on the circuit board. Select a foil that has nothing connected to any of its holes.
- Solder the remaining lead of C2 to pin 5 of the socket.
- Cut 2½- and 3-inch lengths of hookup wire. Solder one wire to each terminal on the rear of the speaker. It does not matter which wire goes to which terminal.
- Solder the other end of the 2½-inch wire to pin 4 of the socket. Solder the remaining end of the 3½-inch wire to the same foil to which you connected the minus (−) lead of C2 (installed above).
- Locate J1, the miniature phone jack, and note which of its two solder terminals is connected to the threaded barrel of the jack. Solder the free end of the 5½-inch wire from R1 to this terminal.
- Solder one end of a 5-inch wire to the left (when viewed from the shaft end) lug of R1. Solder the other end to the remaining lug on J1.
- Slide the knob onto the shaft of R1 and tighten the set screw with a small screwdriver.
- Carefully inspect your work. Look for unsoldered connections and for accidental bridges of solder between adjacent connections. Be sure that all component leads touch only those parts of the circuit they are meant to touch. Doublecheck the previous steps to make certain all components are connected as specified in the previous steps.
- Install U1, the LM386 IC, into its

Continues on p. 134

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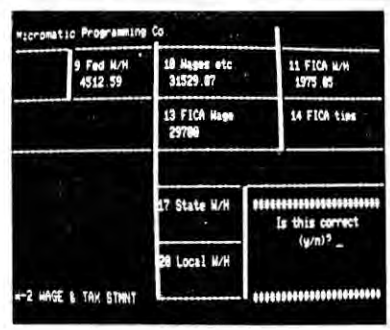

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● ● ● EVERYTHING FOR YOUR TRS-80* ● ● ●
MODEL I, MODEL II & MODEL III

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*** ESSENTIAL UTILITY PROGRAMS FOR EVERY TRS-80 OWNER ***

Facts About Racet Computes Utility Programs

*** ALL PROGRAMS ARE WRITTEN IN MACHINE LANGUAGE
*** ABSOLUTELY NO KNOWLEDGE OF MACHINE LANGUAGE IS NECESSARY TO USE ANY OF THE UTILITY PROGRAMS
*** EACH UTILITY PROGRAM IS CALLED UP FROM **BASIC** USING THE SIMPLE BASIC COMMANDS PROVIDED
*** EACH UTILITY PROGRAM COMES WITH A **RACET COMPUTES** INSTRUCTION MANUAL
*** EACH INSTRUCTION MANUAL INCLUDES SEVERAL EXAMPLES OF UTILITY USAGE
*** EACH UTILITY ALLOWS THE USER TO PERFORM CERTAIN BASIC OPERATIONS TEN, TWENTY OR MORE TIMES FASTER THAN THE EQUIVALENT BASIC ROUTINE (FOR EXAMPLE, **GSF** CAN SORT AN ARRAY OF 1000 RANDOM NAMES INTO ALPHABETICAL ORDER IN UNDER 9 SECONDS!!)

GSF (GENERALIZED SUBROUTINE FACILITY)

- SORTS 1000-ELEMENT ARRAYS IN 9 SECONDS
- SORTS UP TO 15 ARRAYS SIMULTANEOUSLY (MIXED STRING, FLOATING POINT AND INTEGER)
- SORTS SINGLE OR MULTIPLE SUBSTRINGS AS ASCENDING OR DESCENDING SORT KEYS
- READ AND WRITE ARRAYS TO CASSETTE
- COMPRESS AND UNCOMPRESS DATA IN MEMORY
- MOVE ARRAYS IN MEMORY
- DUPLICATE MEMORY
- FAST HORIZONTAL AND VERTICAL LINES
- SCREEN CONTROLS FOR SCROLLING THE SCREEN UP, DOWN, LEFT, RIGHT AND FOR GENERATING INVERSE GRAPHIC DISPLAYS
- ADDS PEEKS AND POKES (MOD-II VERSION ONLY)

MODEL-I VERSION $25.00
MODEL-II VERSION $50.00
MODEL-III VERSION $30.00

KFS-80 (KEYED FILE SYSTEM)

- CREATE ISAM FILES (INDEX SEQUENTIAL ACCESS METHOD)
- ALLOWS INSTANT ACCESS TO ANY RECORD ON YOUR DISKETTE
- INSTANTLY RETRIEVE RECORDS FROM MAILING LISTS, INVENTORY, ACCOUNTS RECEIVABLE OR VIRTUALLY ANY APPLICATION WHERE RAPID ACCESS IS REQUIRED TO NAMED RECORDS
- PROVIDES THE BASIC PROGRAMMER THE ABILITY TO RAPIDLY INSERT OR ACCESS KEYED RECORDS IN ONE OR MORE DATA FILES
- RECORDS ARE MAINTAINED IN SORTED ORDER BY A SPECIFIED KEY
- RECORDS MAY BE INSERTED OR RETRIEVED BY SUPPLYING THE KEY
- RECORDS MAY BE RETRIEVED SEQUENTIALLY IN SORTED ORDER
- RAPID ACCESS TO ANY FILE REGARDLESS OF THE NUMBER OF RECORDS
- MULTIPLE INDEX FILES CAN BE EASILY CREATED WHICH ALLOWS ACCESS OF A SINGLE DATABASE BY MULTIPLE KEYS (FOR EXAMPLE, BY BOTH NAME AND ZIP-CODE)

MODEL-I VERSION $100.00
MODEL-II VERSION $175.00
MODEL-III VERSION $100.00

DSM (DISK SORT MERGE)

- SORT AN 85K DISKETTE IN LESS THAN THREE MINUTES!
- SORTS LARGE MULTIPLE DISKETTE FILES ON A MINIMUM ONE DRIVE SYSTEM
- ALL RECORDS ARE PHYSICALLY REARRANGED-NO KEY FILES ARE REQUIRED
- SORTS RANDOM FILES CREATED BY **BASIC**, INCLUDING FILES CONTAINING SUB-RECORDS SPANNING SECTORS
- SORTS ON ONE OR MORE FIELDS IN ASCENDING OR DESCENDING ORDER
- FIELDS MAY BE STIRNGS, INTEGER, BINARY INTEGER OR FLOATING POINT
- THE SORTED OUTPUT FILE MAY OPTIONALLY HAVE FIELDS DELETED, REARRANGED OR PADDED
- SORT COMMANDS CAN BE SAVED FOR REUSE
- SINGLE SORT. MERGE. OR MIXED SORT/MERGE OPERATIONS MAY BE PERFORMED
- SORTED OUTPUT MAY BE WRITTEN TO A NEW FILE, OR REPLACE THE ORIGINAL INPUT FILE.

MODEL-I VERSION $75.00
MODEL-II VERSION $150.00
MODEL-III VERSION $90.00

MAILLIST (A MAILING LIST DATABASE SYSTEM)

- IDEALLY SUITED FOR ORGANIZATION MAILING LISTS, PERSONAL ADDRESSBOOK, OR MAILING LISTS BASED ON DATES SUCH AS REMINDERS FOR BIRTHDATES OR DUES PAYABLE
- USED ISAM (INDEX SEQUENTIAL ACCESS METHOD) FOR RAPID ACCESS TIMES
- YOUR **MAILLIST** CAN ALWAYS BE SORTED AND MAINTAINED BY UP TO FOUR INDEX FILES (FOR EXAMPLE, NAME, ZIPCODE, DATE AND NUMBER)
- **MAILLIST** ALLOWS UP TO 30 ATTRIBUTES TO BE SPECIFIED (TO BE USED IN SELECTION OF SPECIFIED RECORDS WHEN GENERATING REPORTS OR MAILING LABELS
- **MAILLIST** SUPPORTS BOTH 5 OR 9-DIGIT ZIPCODES
- PRINTING MAY BE STARTED OR ENDED AT ANY POINT IN THE LIST...THE USER CAN SPECIFY FIELDS OR CODES TO BE PRINTED
- CAPACITY IS 600 NAMES FOR MODEL-I, 3500 NAMES FOR MODEL II, 38,000 NAMES FOR MODEL II WITH HARD DISK DRIVE. 1200 NAMES FOR MODEL III

MODEL-I VERSION $75.00
MODEL-II VERSION $150.00
MODEL-III VERSION $75.00

HSDS HARD DISK DRIVE SOFTWARE

- MAKES TRSDOS COMPATIBLE WITH MOST HARD DISK DRIVES
- ADDS MANY EXTRA FEATURES TO TRSDOS $400.00

COMPROC (COMMAND PROCESSOR)

- AUTO YOUR DISK TO PERFORM ANY SEQUENCE OF INSTRUCTIONS THAT YOU NORMALLY GIVE FROM THE KEYBOARD (FOR EXAMPLE, INSERT THE DISKETTE, PRESS THE RESET BUTTON, YOUR COMMAND FILE COULD AUTOMATICALLY SHOW YOU THE DIRECTORY, SHOW THE FREE SPACE ON THE DIKSETTE, LOAD A MACHINE LANGUAGE SUBROUTINE, LOAD BASIC, LOAD AND RUN A BASIC PROGRAM, AND SELECT A GIVEN ITEM ON YOUR MENU...ALL WITHOUT TOUCHING THE KEYBOARD!)

MODEL-I VERSION $20.00
MODEL-III VERSION $30.00
NOT AVAILABLE FOR MODEL-II

DISCAT (DISKETTE CATALOG SYSTEM)

- THIS COMPREHENSIVE DISKETTE CATALOGUING/INDEXING UTILITY ALLOWS THE USER TO KEEP TRACK OF THOUSANDS OF PROGRAMS IN A CATEGORIZED LIBRARY...FILE INCLUDES PROGRAM NAMES AND EXTENSIONS, PROGRAM LENGTH, DISKETTE NUMBERS AND FREE SPACE ON EACH DISKETTE...KEEP A COMPLETE CATALOG OF THE DIRECTORIES ON ALL YOUR DISKETTES IN ALPHABETICAL ORDER (SORTED ON EACH DISKETTE...OR COMPLETE ALPHABETICAL LIST OF PROGRAMS ON ALL YOUR DISKETTES)

MODEL-I VERSION $50.00
MODEL-III VERSION $50.00
MODEL-II VERSION (SEE MODEL-II UTILITY PACKAGE)

BLINK (BASIC LINK FACILITY)

- LINK FROM **BASIC** PROGRAM TO ANOTHER SAVING ALL VARIABLES
- THE CHAINED PROGRAM MAY EITHER REPLACE THE ORIGINAL PROGRAM OR CAN BE MERGED BY STATEMENT NUMBER

MODEL-I VERSION $25.00
MODEL-III VERSION $30.00
MODEL-II VERSION (SEE MODEL-II UTILITY PACKAGE) $50.00

INFINITE BASIC

- ADDS OVER 80 COMMANDS TO BASIC
- SORTING...STRING CENTERING/ROTATION/TRUNCATION...JUSTIFICATION...DATA COMPRESSION...STRING TRANSLATION/COPYING...SCREEN DISPLAY...SCROLLING...MATRIX OPERATIONS...SIMULTANEOUS EQUATIONS (THROUGH MATRIX INVERSION)...DYNAMIC ARRAY RESHAPING

MODEL-I VERSION $50.00
MODEL-III VERSION $60.00
NOT AVAILABLE ON MODEL-II

INFINITE BUSINESS

- ADD ON PACKAGE TO **INFINITE BASIC** (REQUIRES INFINITE BASIC)
- ADDS PACKED DECIMAL ARITHMETIC WITH 127 DIGIT ACCURACY (+,0,*,/)
- COMPLETE PRINTER PAGINATION CONTROLS...AUTO HEADERS, FOOTERS AND PAGE NUMBERS
- BINARY SEARCH OF SORTED AND UNSORTED ARRAYS (INSTANT SEARCH OF AN ELEMENT WITHIN AN ARRAY)
- HASH CODES

MODEL-I VERSION $30.00
MODEL-III VERSION $30.00
NOT AVAILABLE ON MODEL-II

REMODEL-PROLOAD

- THE ULTIMATE RENUMBERING PROGRAM...RENUMBERS ALL OR PART OF A PROGRAM (ALLOWS PARTIAL RENUMBERING IN MIDDLE OF PROGRAMS)
- PARTIAL OR COMPLETE MERGE OF TWO CASSETTE PROGRAMS

MODEL-I VERSION $35.00
MODEL-III VERSION $35.00
NOT AVAILABLE ON MODEL-II

COPSYS

- COPY AND VERIFY ALL MACHINE LANGUAGE (SYSTEM) TAPES WRITTEN IN STANDARD FORMAT...IF YOU BUY A MACHINE LANGUAGE PROGRAM, **COPSYS** ALLOWS YOU TO EASILY COPY THE PROGRAM ONTO ANOTHER CASSETTE AS A BACKUP

MODEL-I VERSION $15.00
MODEL-III VERSION $20.00
NOT AVAILABLE ON MODEL-II

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THIS IS AN ENHANCEMENT FOR TRSDOS 2.0 THAT WILL RADICALLY DECREASE DISK ACCESS TIME.

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- IMPROVE DISK I/O UNDER BASIC

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MODEL II ONLY $99.95

MODEL II FASTBACK — FULL DISK BACKUP IN 55 SECONDS

IN BUSINESS TIME IS MONEY, AND ONE BACKUP IS WORTH A THOUSAND TEARS.

- WORKS ON SYSTEMS WITH 2 OR MORE DRIVES
- CAN REPLACE YOUR EXISTING TRSDOS 1.2 or 2.0 BACKUP UTILITY

NEW

MODEL II ONLY $75.00

MODEL-II UTILITY PACKAGE

- ESSENTIAL FOR EVERY MOD-II OWNER
- RECOVER AND REPAIR FILES AND DIRECTORIES (BY JUST ENTERING A SINGLE COMMAND)
- XCOPY...SIMILAR TO COPY BUT CAN COPY ANY NUMBER OF FILES AT ONE TIME FASTER AND MORE ACCURATE THAN COPY SINCE RECORDS ARE COPIED IN GROUPS RATHER THAN ONE RECORDS AT A TIME...USING XCOPY YOU CAN COPY FILES THAT CAN NOT BE COPIED USING THE COPY COMMAND
- SZAP...PROVIDES THE CAPABILITY TO READ AND MODIFY ANY SECTOR ON A DISKETTE
- XHIT...CAN BE USED TO REPAIR A DISKETTE DIRECTORY
- DCS...DIRECTOR CATALOG SYSTEM IS A UTILITY FOR THE MANAGEMENT OF USER DISKETTES...SETS OF A MULTIPLE DISKETTE DIRECTORY FILE (WITH UP TO 1200 INDIVIDUAL FILE NAMES)...ALLOWS SELECTIVELY LISTED OR PRINTED LISTS OF DIRECTORY FILES IN COMBINED SORTED ORDER (FOR EXAMPLE, LISTED ALPHABETICALLY BY DISKETTE...OR A COMPOSITE ALPHABETICAL LIST OF ALL YOUR DISKETTES!)
- DEBUG-II...ADDS SEVERAL FEATURES TO THE PRESENT TRSDOS DEBUG UTILITY INCLUDING SINGLE INSTRUCTION CYCLE, AUTO (LOOP) BREAKPOINTS, SUBROUTINE CALLING, BREAK-KEY DETECTION AND MANY OTHERS

MODEL-II ONLY $150.00

MODEL-II DEVELOPMENT SYSTEM

- THIS PACKAGE IS A MUST FOR ASSEMBLY LANGUAGE PROGRAMMERS
- INCLUDES THE **MICROSOFT EDITOR ASSEMBLER PLUS** WITH ENHANCEMENTS FOR THE MODEL-II
- A COMPLETE DISASSEMBLER
- SUPERZAP FOR READING AND MODIFY ANY SELECTOR ON A DISKETTE

MODEL-II ONLY $125.00

MOD-II BASIC CROSS REFERENCE UTILITY

- LIST OR PRINT A SORTED CROSS REFERENCE TO ALL NUMBERS OR VARIABLES WITHIN A PROGRAM
- LIST OF PRINT ALL LINE NUMBERS CONTAINING A SPECIFIED STRING OF CHARACTERS

MODEL-II ONLY $50.00

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P&T CP/M®2 is GROWING

TRS-80 MODEL II
$185
Still the best CP/M for the Mod II with features like 596 Kb per diskette, type ahead, full serial port support, and more.

TRS-80 MODEL 16
$220
Includes full support for thinline drives; gives 1.2 Mb per diskette for the Mod 16 (Z-80 mode) and Mod II's with double sided drives.

RADIO SHACK HARD DISK
$250
Includes all the features of P&T CP/M 2 plus 8.7 Mb per hard disk drive.

CAMEO HARD DISK
Support for the standard Cameo hard disk system ($250) or the multiplexer (for multiple computers) system $400.

CORVUS HARD DISK
$250
Support for a 5, 10, or 20 Mb Corvus hard disk system.

Start with a Model II floppy system and grow into a hard disk. Since all P&T CP/M 2 systems are fully compatible, you will have no conversion worries.

Special note: P&T hard disk systems allow you the user to configure logical drive assignments to your specifications. Write for more details.

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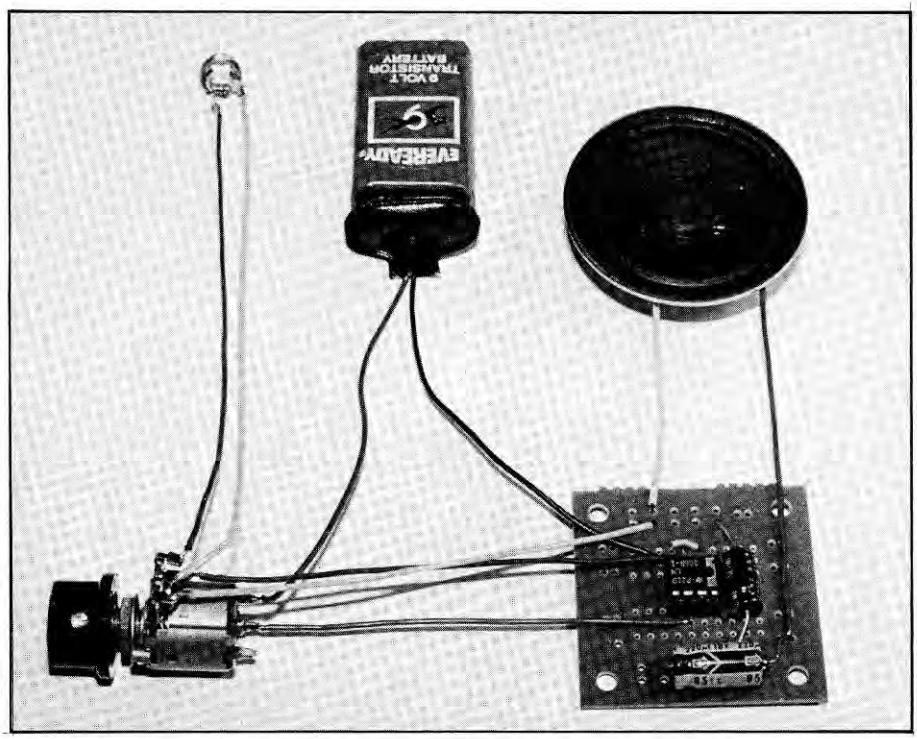

Photo 3. Here's the complete amplifier, ready to give voice to your TRS-80. The miniature phone jack at upper left accepts the cassette output plug (the large gray one) from your computer. To the right of the jack is the 9-volt battery, and to the right of the battery, the 2-inch speaker.

Continued from p. 130

socket. The IC will have a small dot, depression, or notch in its plastic case near pin 1 or between pins 1 and 8. Carefully push the IC pins into the corresponding slots in the socket. You will have to bend the pins slightly inward to fit them into the socket.

Check carefully that all pins are in their appropriate holes and that none of the pins are accidentally bent under the IC.

- Turn the knob on R1 fully counterclockwise to the off position.
- Connect the battery to the battery clip.

This completes construction of the amplifier. See? I knew you could do it! Photos 2 and 3 show a close-up of the finished circuit board and an overall view of the entire amplifier, respectively.

Using the Amplifier

To get sound out of the amplifier, you must run a program that contains a routine that sends audio to the cassette output plug on the cassette cable. If you have some commercial game programs in your personal library, the chances are quite good that many of them have such routines built in.

80 Micro has published articles on writing your own sound routines. Two of the simplest appeared in January 1980 (p. 36), and in November 1980 (p. 230). You'll want to customize the programs for your own applications, but these are an excellent start.

Troubleshooting

If you have difficulty getting the amplifier to work properly, check the following:

- Faulty wiring—check especially the switch wiring. You may be turning the amplifier off instead of on.
- Dead battery—try a new one.
- IC installed backward—fix it!
- Defective speaker—it happens occasionally.
- Defective IC—try a new one as a last resort.

If you're stumped, ask the help of a friend who knows his way around hardware. If all else fails, send me a list of any symptoms and I'll respond as time allows. No guarantees, however; hardware troubleshooting by remote control is almost impossible.

This project will not save you money. Radio Shack sells a perfectly adequate audio amplifier for $11.95, and that's less than this project costs to build. The value in building this amplifier comes in the knowledge and skills you acquire while doing so. It also gives you a taste of those early days of microcomputing, when everyone was a hardware hacker. Ah, nostalgia! ■

(For more construction tips, see "Hardware Hacker's Tool Kit" elsewhere in this issue.—Eds.)

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VERSION 3.0

The finest disk utility and repair program available now reassembled in a major revision. A necessity for the serious disk user it now supports all known operating systems. TRSDOS, NEWDOS, LDOS MULTIDOS and DOSPLUS, and another all new feature—limited AUTODOS recognition, AUTODOUBLER recognition, and AUTODENSITY recognition. Both MOD III and MOD I boot the same 3.0 disk. The program now adds support for all doublers including RADIO SHACK, and also supports any double density MOD I or III DOS. All new DOS specifiers by first letter of DOS name. A second disk with a complete backup copy is now included. Hobbyists rave about it... serious users can't be without it.

- Now In Hard Cover
- Loose Leaf 3 Ring Binder

SPECIALS

PROGRAM NAME	RETAIL	SPECIAL
LDOS 5.1 MOD I/MOD III	129.00	109.95
DOSPLUS 3.4 MOD I/MOD III	149.95	129.95
DOSPLUS II MOD II	249.95	199.95
BASIC/S SYSTEM MOD I/MOD III	89.95	65.95
MZAL MOD I/MOD III	149.95	129.95
POWERDRAW MOD I/MOD III	39.95	34.95
JOVIAN MOD I/MOD III	21.95	18.95
MAKE 80 MOD I	14.95	12.95
MAKE 80 MOD III	29.95	24.95
MICROTERM MOD I/MOD III	79.95	69.95
POWERMAIL MOD I/MOD III	99.95	74.95
MICROCASH MOD I/MOD III	199.95	149.95
SUPER DIRECTORY MOD I/MOD III	39.95	34.95
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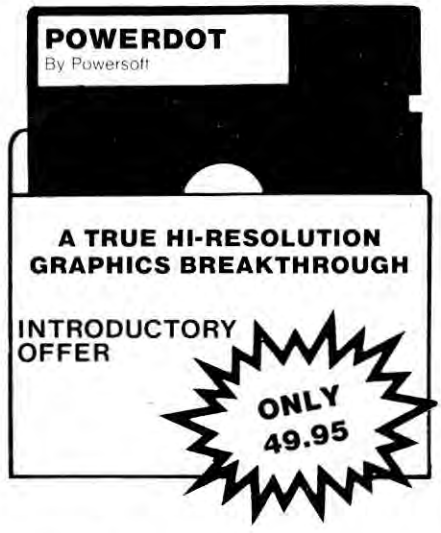
HI-RES GRAPHICS

A brand new concept, POWERDOT allows you to create hi-resolution screen prints on EPSON (GRAFTRAX & GRAFTRAX+), C.ITOH, PROWRITER, and RADIO SHACK LP8 printers without any hardware additions or modifications to your TRS-80. You can draw directly on your screen which is a "picture window" of a much larger drawing area and move the window to other areas of the drawing. Your only limitations are imagination and memory size. The completed drawing is dumped to the above printers by reducing and transforming the complete graphic pixels to single hi-res dots.
Use the same disk for booting on MOD I, or MOD III. Designers, architects, engineers and artists will love this unique drawing program.



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Inside AIDS-III

by Robert A. Fiorelli

AIDS-III won three Reader's Choice Awards in January. Now you'll be able to see for yourself why it has become such a popular program.

(This is the first of a two-part series. Part 2, which will discuss MAPS-III and CALCS-III, will appear next month.)

AIDS-III has sold thousands of copies. All around the world it's at work in major brokerages, insurance firms, universities, and computer companies. A southern airline uses it for maintenance records. One gentleman maintains a 22,000-name mailing list with it. Government and military intelligence agencies routinely exercise its capabilities. AIDS-III is even used in the space program.

But the most gratifying aspect of having authored AIDS has been winning three *80 Micro* Reader's Choice Awards. This, and Bruce Tonkin's article "The Creator" (*80 Micro*, January 1982), has led to our decision to make AIDS' original source code available to the readers of *80 Micro*.

AIDS-III is a data-management system. This is different than a data-*base* management system. The former is generally faster, more flexible, and is suited for selecting and ordering information in a highly dynamic fashion. By contrast, the latter has larger capacity, is slower and more cumbersome, and is suited for easily accessing individual items of data. Think of it as the difference between driving a station wagon and a bus.

Data-base management implies structure and rigidity. A data base is similar to an apartment building. A key accesses a record in the data base, much like a key opens the door to a specific apartment. Fields make up an individual record just as a living room, bathroom, bedroom, and kitchen make up an individual apartment. A field is the smallest unit of information in a data base. A field could be an account number, an expiration date, the name of an applicant, a zip code, a shipping weight—almost anything.

Like an apartment building, a data base has a physical structure. It is this relatively rigid structure that permits the computer to quickly process and analyze information. To change this structure involves considerable effort.

A classic example can be found on page 6-8 of the user manual of Adventure International's Maxi Manager. Under the heading "Yawn." (I kid you not!) is the following warning: "Sorting a couple thousand records can easily

Program Listing. AIDS-III

```
1 '(C)1980 BY META TECHNOLOGIES CORP.,(C)1982 BY SOFTRENDS,INC.
10 CLS:PRINT@284,"AIDS-III":PRINT@410,"VERSION 1.5":PRINT@599,"C
OPYRIGHT(C)1982":PRINT@670,"BY":PRINT@728,"SOFTRENDS, INC.":PRIN
T:PRINT
20 GOTO 1820
40 '    KEY IN K$( 1 CHAR.) @ Q, IC IS ACTIVE, VC$=VALID CHARS.,
 RETURN VK CHAR. IN VC$
60 PRINT@Q,CHR$(14);:K$=INKEY$:PRINT@Q,CHR$(15);CE$;:IFK$="" THE
N60 ELSE IC=INSTR(CC$,K$)
80 IF IC THEN VK=0:RETURN ELSE VK=INSTR(VC$,K$):IF VK THEN PRINT
@Q,K$;:RETURN ELSE 60
100 '    Q=CSR.PST:FL=FLD.LEN:ML=MIN.LEN(0):FV$=FLD.VAL:CL=CHR.L
OW:CH=CHR.HI:CC$=CTRL.CHR:CE=ASC(ENTRY.CHR):RJ=RIGHT JUST.(RESET
 ON RETURN)
120 S$=FV$:GOSUB340:LS=LEN(S$)
140 PRINT@Q,STRING$(FL,CE);:PRINT@Q,S$;
160 PRINTCHR$(14);:K$=INKEY$:PRINTCHR$(15);:IFK$="" GOTO160ELSEI
C=ASC(K$)
180 IFIC<CLORIC>CHTHEN200ELSEIFLS<FLTHENS$=S$+K$:PRINTK$;:LS=LS+
1:GOTO160ELSE160
200 IFIC=K3ANDLS>0THENLS=LS-1:S$=LEFT$(S$,LS):GOTO140
220 IFIC=K0AND(LS>=MLORML=0)THENFV$=S$:IC=0:GOTO290
240 IFIC=K7THENLS=0:S$="":GOTO140
260 IFIC=K8THEN120 ELSE IF IC=K4 AND RJ THEN S$=STRING$(FL-LEN(S
```

Listing continues

The Key Box

Model I, II, and III
32K and 48K RAM
Disk Basic
One Disk Drive

Listing continued

```
$),32)+S$:LS=FL:GOTO140 ELSE IF IC=KD AND DC THEN S$=S$+DC$:PRIN
TDC$;:LS=LS+1:GOTO160
280 IC=INSTR(CC$,K$):IFIC=0THEN160ELSE 300
290 IF NE AND  LEFT$(FV$,1)<>"E" THEN FV#=VAL(FV$):FV$=FNVS$(ABS
(FV#),FD):FV$=LEFT$(LEFT$("E",(LEN(FV$)<FL)+1)+LEFT$("-",(FV#>=0
)+1)+STRING$((LEN(FV$)<FL)*(LEN(FV$)-FL-(FV#<0)),32)+FV$,FL)
300 PRINT@Q,FV$;STRING$(FL-LEN(FV$),32);:RJ=0:DC=0:NE=0:RETURN
320 '     TRIM TRAILING BLANKS FROM S$
340 LS=LEN(S$):IFS$=STRING$(LS,32)THENS$="":RETURNELSESB=0
360 IFMID$(S$,LS-SB,1)=" "THEN SB=SB+1:GOTO360ELSES$=LEFT$(S$,LS
-SB):RETURN
380 '     DISPLAY FIELD NAMES
420 FORI=NFTO1STEP-1:PRINT@2*HS+FNMD(I-1,L)*HS+INT((I-1)/L)*(NS+
3),CHR$(64+I);"-";NF$(I);:NEXTI:RETURN
440 '     SELECT RECORD ( RC +/- SR ) BY FIELD ( SF ), FIELD VALU
E CONDTL. RELTN.(SC) SELECT VALUE ( SV$ )
460 IF SC=7 OR SC=3 OR SC=4 OR NOT(FNNM(SF)) THEN DR$(0)=SV$:VP(
0)=RC:VP(1)=SR:VP(2)=RU:VP(3)=SC:VP(4)=VARPTR(DR$(0)):VP(5)=FP(S
F)-1:DEFUSR1=VARPTR(MC(MR(1)+1)):RC=USR1(VARPTR(VP(0))):RETURN
470 FP=FP(SF):FL=LEN(SV$)
480 RC=RC+SR:IF RC<1 OR RC>RU THEN RC=0:RETURN ELSE IF SC=7 THEN
 RETURN ELSE IF FNVM(DR$(RC)) THEN RETURN ELSE 480
499 '     COMPOUND RECORD SELECTION
500 SF=SF(1):SC=SC(1):SV$=SV$(1):GOSUB 460: IF RC=0 THEN SF=SF(S
K):SC=SC(SK):SV$=SV$(SK):RETURN ELSE X=1
505 X=X+1:IF X>SK THEN RETURN ELSE SF=SF(X):SC=SC(X):SV$=SV$(X)
520 FP=FP(SF):FL=LEN(SV$):CR=0:IF FNNM(SF) THEN IF FNVM(DR$(RC))
 THEN CR=-1
525 IF NOT(FNNM(SF)) THEN IF FNFM(DR$(RC)) THEN CR=-1
528 IF CR THEN 505 ELSE 500
540 '     COUNT/DISPLAY MATCHES
560 RC=0:SR=1:CT=0
570 GOSUB500:IF RC<>0 THEN CT=CT+1
580 PRINT@115,USING"COUNT:####";CT;:IF RC>0 THEN570 ELSE RETURN
600 '     DISPLAY/INPUT VALUES FROM DR$
620 FOR I=1 TO NF: PRINT@PS(I)-LEN(NF$(I)),NF$(I);": ";MID$(DR$,
FP(I),FNLF(I));CL$;:NEXT I
640 I=1:ML=0:CL=32:CH=90
660 Q=PS(I)+2:FP=FP(I):FL=FNLF(I):FV$=MID$(DR$,FP,FL):RJ=(FL(I)>
0):NE=NOTRJ:FD=FD(I):GOSUB120:IF IC=0 THEN MID$(DR$,FP,FL)=FV$+S
TRING$(FL-LEN(FV$),32)
680 IF IC>2 OR (IC=0 AND I=NF) THEN RETURN
700 IF IC=0 OR IC=2 THEN I=I+1
720 IF IC=1 THEN I=I-1
740 IF I>NF THEN I=NF:GOTO660
760 IF I<1 THEN I=1
780 GOTO660
800 '     CLEAR SCREEN & DISPLAY SYSTEM NAME
810 PRINT BS$;
815 '     DISPLAY SYSTEM NAME
820 PRINT@0,TAB(INT((HS-LEN(SN$))/2));SN$
840 '     DISPLAY REC.COUNT
860 RR=NR-RU:PRINT@64,"* RECORD(S)":PRINT@77,USING"USED:####";RU
:PRINT@89,USING"REMAINING:####";RR;:PRINTCL$;:RETURN
880 '     ASSEMBLER ALPHA-SORT STR.ARRAY(N+1), ELEMENTS 1-N...
SP=START POSTN: SL=MIDSTRING LEN: SO=(1:ASC. 2:DESC.): XX!=VARPT
R( STR.ARRAY(0) ): GOSUB 'ASORT'  *
900 MC(26)=FNMB(MC(26),SP-1):MC(29)=FNLB(MC(29),-235*(AD=2)):MC(
30)=FNLB(MC(30),SL):DEFUSR9=VARPTR(MC(0)):VP=USR9(VP):RETURN
980 '     SELECT & XXX SCREEN
1000 SK=1
1010 GOSUB810:GOSUB420
1020 PRINT@512,CS$;"SELECT & ";OP$;" RECORDS BY (A-";CH$;"):";
1040 Q=540+LEN(OP$):VC$=FC$:GOSUB60
1060 SF=0:IF IC=4 THEN SC=7:SC(1)=7:SK=1:RETURN ELSE IF IC=2 THE
N 1040 ELSE IF IC THEN 1400 ELSE SF=VK
1080 PRINT@512,CS$;"SELECT & ";OP$;" RECORDS BY ";DQ$;NF$(SF);DQ
$;
1100 PRINT@640,CS$;"= EQUAL";TAB(15);"< LESS THAN";TAB(30);"- LE
SS OR EQUAL"
1120 PRINT@704,"# NOT EQUAL";TAB(15);"> GTR THAN";TAB(30);"+ GTR
 OR EQUAL"
1140 PRINT@832,"CHOOSE RELATION:";
1160 Q=849:VC$=SC$:GOSUB60
1180 ON IC GOTO 1020,1160,1400,1160,1400
1200 SC=VK
1220 PRINT@533+LEN(OP$),CS$
1240 PRINT@576,NF$(SF);MID$(SC$,SC,1);
1260 Q=578+LEN(NF$(SF)):FL=FNLF(SF):ML=1:FV$="":RJ=(FL(SF)>0):NE
=NOT RJ:FD=FD(SF):CL=32:CH=90:GOSUB120:SV$=FV$
1280 IF IC=2 THEN SV$=STRING$(FL,32) ELSE ON IC GOTO 1080,1,1400
,1260,1400
1300 IF SK>1 THEN FOR J=SK-1 TO 1 STEP -1:PRINT@576+(64*(SK-J)),
NF$(SF(J));MID$(SC$,SC(J),1);" ";SV$(J);:NEXT J
1320 PRINT@SK*64+640,"<C>OUNT, <N>EXT OR <";LEFT$(OP$,1);">";MID
$(OP$,2);":";
1340 Q=SK*64+663+LEN(OP$):VC$="CN"+LEFT$(OP$,1):GOSUB60
```

Listing continues

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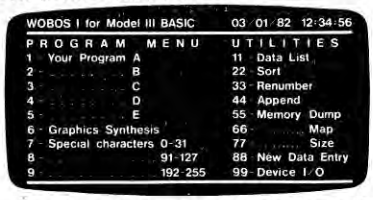

Illustrated above is the Primary Menu of WOBOS I for Model III. In addition to the features shown, the DEVICE I/O generates a separate 9-choice menu that will allow you to compile, update, sort and output your data files. It also includes a utility that will save both the DATA and WOBOS I on tape and/or disk. With controllable SOUND!

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Listing continued

```
1360 ON IC GOTO 1220,1340,1400,1340,1400
1362 SF(SK)=SF:SC(SK)=SC:SV$(SK)=SV$
1365 IF VK=3 THEN RETURN ELSE IF VK=1 AND OP<>1 THEN GOSUB560Ø EL
SE IF VK=2 AND SK<DS THEN SK=SK+1:GOTO1Ø1Ø
1370 GOTO 1340
1400 SC=Ø:RETURN
1420 '    CLOSE FILE(FT), SET FL$(FT)="" & RESET 'ON ERROR'
1440 CLOSE FT:FL$(FT)="":ON ERROR GOTO Ø:RETURN
1460 '    GET FILENAME( FL$(FT) ) OF TYPE(FT$) & OPEN (IF REQ'D.
)
1480 GOSUB 820:PRINT@192,"NAME OF ";FT$;" FILE:";
1500 IF FL$(FT)<>"" THEN PRINT@320,"ACTIVE ";FT$;" FILE=";MID$(L
C$,FT);FL$(FT);
1520 Q=207+LEN(FT$):FL=14-(FT=1):ML=1:FV$="":CL=42:CH=90:GOSUB12
Ø:PRINT@320,CS$
1540 IF IC=2 OR (IC=4 AND (FL$(FT)="" OR FT=3)) THEN 1500 ELSE I
F IC=1 OR IC=3 OR IC=5 THEN RETURN
1560 IF FV$="*" THEN 1680
1580 IF IC=4 AND FT<3 THEN PRINT@Q,MID$(LC$,FT);FL$(FT);:RETURN
ELSE IF FT=1 THEN LC=INSTR("-+",LEFT$(FV$,1)):LC$=MID$("+-",3-LC
,1):IF LC THEN FV$=MID$(FV$,2)
1590 FL$(FT)=FV$
1600 IF (FT<3 AND FL$(1)=FL$(2)) OR (FT=3 AND (FL$(3)=FL$(1) OR
FL$(3)=FL$(2))) THEN PRINT@384,">>> FILE=";FL$(FT);" IN USE";:FL
$(FT)="":GOTO1500
1620 ON ERROR GOTO 1640:CLOSE FT:OPEN MID$("IOO",FT,1),FT,FL$(FT
):RETURN
1640 IF ERR/2+1<21 THEN ON ERROR GOTO Ø ELSE RESUME 1660
1660 PRINT@384,CS$;">>> BAD FILE=";FL$(FT);
1680 GOSUB1440:GOTO1500
1689 '    PRINTER TEST...RETURNS (PR) "TRUE" IF ON...IF PRINTER
UNIT (PU$) IS 'STANDARD', NO QUERY IS USED.
1690 IF PU$="S" THEN PR=PEEK(14312)<128:RETURN ELSE PRINT"IS THE
 PRINTER ON? ( <Y>ES OR <N>O )"
1692 K$=INKEY$: IF K$="Y" THEN PR=-1:RETURN ELSE IF K$="N" THEN
PR=Ø:RETURN ELSE 1692
1699 '    READ MACHINE CODE
1700 RESTORE: GOSUB 1770
1701 '    READ <KEY> DEFINITIONS
1702 READ K0,K1,K2,K3,K4,K5,K6,K7,K8,K9,KD
1703 '    READ 'ENTRY' & 'DONT CARE' DISPLAY CHARACTERS
1704 READ CE,D1
1705 '    READ SYS. CONFIG. DATA( FIELD CNT., HORZ.SCREEN SIZE,V
ERT.SCREEN SIZE,DEPTH OF SELECTION, PRINTER USED)
1707 READ FC,HS,VS,DS,PU$
1709 '    COMPUTE NO. OF FIELDS DISPLAYED ON A LINE & SIZE OF FI
ELD NAMES
1710 HN=INT((FC+3)/4): NS=INT((HS+1)/HN)-3
1715 '    READ SYSTEM DESCRIPTORS
1720 READ SN$,NF:IF NF>FC THEN PRINT">>> FIELD COUNT EXCEEDS";FC
:END ELSE DIM NF$(FC),FL(FC),FD(FC),FP(FC),PS(FC),PV(FC): FP(Ø)=
1: L=INT((NF-1)/HN)+1
1725 DEF FNLF(V)=ABS(FL(V))
1730 DEF FNST$(V#)=MID$(STR$(V#),2-(V#<Ø)):' CONVERT NON-NEGATIV
E V# INTO A CHAR. STRING
1735 DEF FNVS$(V#,RD)=FNST$(INT(V#+.5*10[-RD))+LEFT$(".",SGN(RD)
)+RIGHT$("ØØØØØØØØØ"+FNST$(INT((V#-INT(V#))*10[RD+.5)),RD):' CON
VERT NON-NEGATIVE V# INTO CHAR.STRING WITH RD DIGITS TO RIGHT OF
 DECIMAL PT.
1740 MF=Ø:FOR I=1TONF: READ NF$(I),FL!:FD(I)=-1*(FL!<Ø)*INT((ABS
(FL!)-INT(ABS(FL!)))*10+.5):FL(I)=SGN(FL!)*(INT(ABS(FL!))+1+FD(I
)-(FD(I)<>Ø))+(FL!>Ø)-SGN(FL!)*(INT(ABS(FL!))=Ø)
1745 FP(I)=FP(I-1)+FNLF(I-1):NF$(I)=LEFT$(NF$(I),NS)
1750 IF LEN(NF$(I))>MF THEN MF=LEN(NF$(I))
1755 NEXTI:RZ=FP(NF)+FNLF(NF):RS=RZ-1
1760 IF RS>254 THEN PRINT BS$;">>> RECORD SIZE EXCEEDS 254 CHARS
.":END ELSE RETURN
1765 '    INITIALIZE MACHINE CODE ROUTINES
1770 READ MR: DIM MR(MR): MR(Ø)=-1:FOR I=1 TO MR: READ MC: MR(I)
=MR(I-1)+MC: NEXT I: DIM MC(MR(MR))
1775 FOR I=Ø TO MR(MR): READ MC(I):NEXT I
1790 DEF FNLB(V,B)=CVI(CHR$(B)+MID$(MKI$(V),2,1)):DEF FNMB(V,B)=
CVI(MID$(MKI$(V),1,1)+CHR$(B)):RETURN
1800 '    START/INIT.
1820 CLOSE:CLEAR300:GOSUB1700:NR=INT((MEM-1200)/(RS+4)):M=NR*RZ+
900:IFM>32767 THEN CLEAR32767 ELSE CLEAR M
1840 DEFINTA-Z:GOSUB1700:NR=INT((FRE(K$)-900)/RZ)
1850 DEF FNNM(V)=FL(V)<Ø
1860 DEF FNFM(S$)=(SC AND (1-3*(MID$(S$,FP,FL)=SV$)-(MID$(S$,FP,
FL)>SV$)))<>Ø
1870 DEF FNVM(S$)=(SC AND (1-3*(VAL(MID$(S$,FP,FL))=VAL(SV$))-(V
AL(MID$(S$,FP,FL))>VAL(SV$))))<>Ø
1875 DIM SF(DS),SC(DS),SV$(DS)
1880 DEF FNMD(V,B)=V-INT(V/B)*B
1920 DIM DR$(NR+1):BR$=STRING$(RZ,32)
1940 FC$=LEFT$("ABCDEFGHIJKLMNOPQRST",NF):CH$=CHR$(64+NF)
1980 CL$=CHR$(30):CS$=CHR$(31):DQ$=CHR$(34):BS$=CHR$(28)+CHR$(31
)
```

Listing continues

Listing continued

```
2000 U$=CHR$(K1):CC$=U$+CHR$(K2)+CHR$(K5)+CHR$(K6)+CHR$(K9)
2030 CE$=CHR$(CE):DC$=CHR$(D1)
2040 SC$="<>#=-+"
2050 DIM VP(5)
2080 DIM FL$(3)
2084 '    COMPUTE SCREEN POSITIONS FOR FIELDS
2085 IF NF<VS-2 THEN FOR I=1 TO NF: PS(I)=I*64+128+MF: NEXTI: GO
TO 2120
2090 I=1: FOR J=192 TO 960 STEP 64: IF I>NF THEN 2120 ELSE PS(I)
=J+LEN(NF$(I)):I=I+1: IF I>NF THEN 2120
2093 PS=PS(I-1)+7+FNLF(I-1)+LEN(NF$(I)): IF (PS-J+2+FNLF(I))<HS
THEN PS(I)=PS:I=I+1
2096 NEXT J
2100 '    MAIN MENU SELECTION
2120 GOSUB810:GOSUB420
2160 PRINT@384,;:TB=INT((HS-24)/2)
2180 PRINTTAB(TB);"1 - SELECT & LOAD RECORDS";
2200 IF FL$(1)<>"" THEN PRINT " (";FL$(1);")" ELSE PRINT
2220 PRINTTAB(TB);"2 - ADD RECORDS"
2240 PRINTTAB(TB);"3 - SORT RECORDS"
2260 PRINTTAB(TB);"4 - SELECT & UPDATE RECORDS"
2280 PRINTTAB(TB);"5 - SELECT & DELETE RECORDS"
2300 PRINTTAB(TB);"6 - SELECT & PRINT RECORDS"
2320 PRINTTAB(TB);"7 - SELECT & SAVE RECORDS";
2340 IF FL$(2)<>"" THEN PRINT " (";FL$(2);")" ELSE PRINT
2360 PRINTTAB(TB);"8 - WRITE DESCRIPTOR FILE"
2370 PRINTTAB(TB);"9 - QUIT, ALL DONE"
2380 PRINT@945+TB,"CHOOSE OPTION:";
2400 Q=960+TB:VC$="123456789":GOSUB60
2420 IF VK=9 OR IC=4 THEN CLOSE:CLEAR500:END ELSE IF IC THEN 240
0
2440 OP=VK: IF (RU<1 AND OP>2 AND OP<8) OR (RU=NR AND OP<3) THEN
 2400
2460 ON OP GOTO 2500,2860,2700,3400,2940,3100,3520,3260
2480 '    LOAD FILE
2500 OP$="LOAD":GOSUB1000:IF SC=0 THEN 2120 ELSE PRINTBS$;:FT=1:
FT$=OP$
2520 GOSUB1480
2540 ON ERROR GOTO 0: IF IC=3 OR IC=5 THEN 2120 ELSE IF IC=1 THE
N 2500 ELSE ON ERROR GOTO 2660
2580 IF RU=NR THEN ON ERROR GOTO 0:GOTO 2120 ELSE IF INKEY$=U$ T
HEN ON ERROR GOTO 0:GOTO 2520
2600 IF EOF(1) THEN GOSUB1440:GOTO2520 ELSE LINE INPUT#1,DR$:LR=
LEN(DR$)
2610 IF LR<>RS AND LC=0 THEN GOSUB1660:GOTO2540 ELSE IF LR<>RS A
ND LC=1 THEN 2580
2620 DR$=LEFT$(DR$+STRING$((LR<RZ)*(LR-RZ),32),RZ)
2635 IF SC(1)=7 THEN 2655
2640 FOR X=1 TO SK: SC=SC(X):SF=SF(X):SV$=SV$(X):FP=FP(SF):FL=LE
N(SV$)
2643 IF FNNM(SF) THEN 2647
2645 IF FNFM(DR$) THEN 2650 ELSE 2580
2647 IF NOT(FNVM(DR$)) THEN 2580
2650 NEXT X
2655 RU=RU+1:DR$(RU)=DR$:GOSUB860:GOTO2580
2660 GOSUB1640:GOTO2540
2680 '    SORT RECORDS
2700 GOSUB810:GOSUB420
2720 PRINT@512,CS$;"SORT RECORDS BY (A-";CH$;"):";
2740 Q=535:FL=2*NF:ML=1:FV$="":CL=43:CH=64+NF:GOSUB120
2760 ON IC GOTO2120,2740,2120,2740,2120:SO=1:' DEFAULT TO ASCEND
ING SORT ORDER
2780 FORI=LEN(FV$) TO1STEP-1:K$=MID$(FV$,I,1)
2783 AD=INSTR("+-",K$):IF AD THEN SO=AD:GOTO 2830
2786 IF K$<"A" OR K$>CH$ THEN 2830 ELSE SF=ASC(K$)-64
2800 PRINT@512,CL$;:IF SO=1 THEN PRINT"ASCENDING"; ELSE PRINT"DE
SCENDING";
2810 PRINT" SORT BY ";DQ$;NF$(SF);DQ$
2820 SL=FL(SF): IF SL>0 THEN SP=FP(SF):AD=SO:VP=VARPTR(DR$(0)):G
OSUB900:GOTO 2830
2821 '    NUMERIC SORT STARTS HERE
2822 SL=FNLF(SF):SP=FP(SF):AD=2:VP=VARPTR(DR$(0)):GOSUB900
2823 IF SO=2 THEN SL=1:AD=1:VP=VARPTR(DR$(0)):GOSUB900
2824 RC=0:SR=1:SC=4:SV$=MID$(" -",SO,1):GOSUB460:IF RC=0 THEN 28
30 ELSE RC=RC-1
2826 MID$(DR$,1,RZ)=DR$(RC):SL=FNLF(SF):AD=1:VP=VARPTR(DR$(RC)):
GOSUB900: DR$(RC)=DR$
2830 NEXT I: GOTO 2120
2840 '    ADD RECORDS
2860 GOSUB810:DR$=BR$:GOSUB620:IF IC=3 OR IC=5 THEN 2120
2880 IF DR$<>BR$ THEN RU=RU+1:DR$(RU)=DR$
2900 IF RU<NR THEN 2860 ELSE 2120
2920 '    SELECT AND DELETE
2940 OP$="DELETE":GOSUB1000:IF SC=0 THEN2120
2960 IF SC=7 THEN UR=0:GOTO3040 ELSE RC=0:SR=1:UR=RU
2980 GOSUB500:IF RC=0 THEN3000 ELSE MID$(DR$(RC),RZ,1)="*":UR=UR
```

Listing continues

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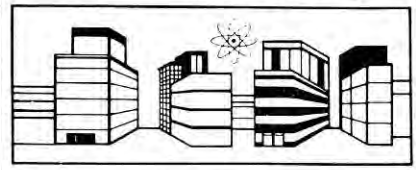

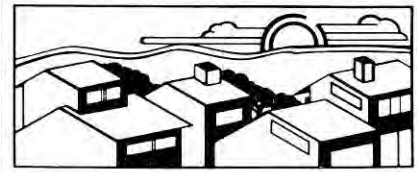

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```
-1:GOTO2980
3000 IF UR=0 THEN3040 ELSE IF UR=RU THEN 2940
3020 SP=RZ:SL=1:AD=1:VP=VARPTR(DR$(0)):GOSUB900
3040 FORI=UR+1TORU:DR$(I)="":NEXTI:RU=UR
3060 IF RU=0 THEN2120 ELSE2940
3080 '    SELECT & PRINT
3100 GOSUB810: GOSUB420: PRINT@512,CS$;"SPECIFY FIELDS (A-";CH$;
") TO BE PRINTED:";
3105 Q=548:FL=NF:ML=1:FV$="":CL=65:CH=64+NF:GOSUB120:IF IC=4 THE
N FV$=FC$ ELSE ON IC GOTO2120,3105,2120,0,2120
3110 PV=LEN(FV$):FOR I=1 TO PV:PV(I)=ASC(MID$(FV$,I,1))-64:NEXT
I
3115 OP$="PRINT":GOSUB1000:IFSC=0 AND IC=1 THEN3100 ELSE IF SC=0
 AND (IC=3 OR IC=5) THEN 2120
3120 RC=0:SR=1:PRINTBS$;:GOSUB1690:PRINTBS$;
3135 GOSUB500:IFRC=0ORINKEY$=U$THENFORI=1TO1500:NEXTI:GOTO3115
3140 MID$(DR$,1,RZ)=DR$(RC)
3145 FOR I=1 TO PV: PRINT MID$(DR$,FP(PV(I)),FNLF(PV(I)));" ";
3150 IF PR THEN LPRINT MID$(DR$,FP(PV(I)),FNLF(PV(I)));" ";
3155 NEXT I:PRINT: IF PR THEN LPRINT " "
3160 GOTO 3135
3240 '    WRITE SYSTEM DESCR. FILE
3260 PRINTBS$;:FT=3:FT$="DESCRIPTOR"
3280 GOSUB1480
3300 ON ERROR GOTO 0: IF IC THEN 2120 ELSE ON ERROR GOTO 3360
3320 PRINT#3,"MTCAIDS2":PRINT#3,SN$:PRINT#3,RS:PRINT#3,NF
3340 FORI=1TONF:PRINT#3,NF$(I):PRINT#3,FL(I);:IF FL(I)<0 THEN PR
INT#3,FD(I);
3350 PRINT#3,FP(I):NEXTI:GOSUB1440:GOTO2120
3360 GOSUB1640:GOTO3300
3380 '    SELECT & UPDATE
3400 OP$="UPDATE":GOSUB1000:IF SC=0 THEN2120 ELSE PRINT@128,CS$:
RC=0:SR=1
3420 GOSUB500:IF RC=0 THEN3400
3440 MID$(DR$,1,RZ)=DR$(RC):GOSUB620:IF IC=5 THEN 3400 ELSE MID$
(DR$(RC),1,RZ)=DR$
3460 IF IC=3 THEN SR=-1 ELSE SR=1
3480 GOTO3420
3500 '    SELECT & SAVE
3520 OP$="SAVE":GOSUB1000:IF SC=0THEN2120
3540 PRINTBS$;:FT=2:FT$=OP$
3560 GOSUB1480
3580 ON ERROR GOTO 0:IF IC=3 OR IC=5 THEN 2120 ELSE IF IC=1 THEN
 3520 ELSE ON ERROR GOTO 3640
3600 RC=0:SR=1
3620 GOSUB500:IF RC<>0 THEN PRINT#2,LEFT$(DR$(RC),RS):GOTO3620 E
LSE 3560
3640 GOSUB1640:GOTO3580
3649 '    NO. OF MACHINE CODE ROUTINES, SIZE.1, SIZE.2, ...
3650 DATA 2,61,68
3660 '    SORT MACHINE CODE
3670 DATA 32717,-6902,8995,-6877,-7715,-6691,-7683,9181,9181,918
1,32477,-18688,-14111,30693,32477,8961,-8841,638,30499
3680 DATA -6687,-539,598,24317,8961,9086,28518,1,2304,2539,1536,
6661,8382,8964,4115,-7688,8752,32509,-768,887,32509,-767
3690 DATA 1143,32509,-766,1399,11261,11261,11261,-6659,-20543,17
133,-16864,-6687,-642,887,32291,30717,8964,-642,1399,-28648
3700 '    DATA STATEMENTS FOR MACHINE CODE SELECT
3710 DATA 32717,-6902,-7715,26333,-8959,110,22237,-8957,606,-468
9,-5286,33,-1536,2714,29405,-8959,115,26333,-8955,1134
3720 DATA -4689,8530,0,-25862,-8950,1662,2046,26333,-8959,110,-2
5910,-8950,2406,28381,17928,1733,-8960,2638,9189,9086,28518
3730 DATA -7701,-8747,342,24285,6400,6425,9169,9086,28518,-16119
,-16870,2080,4899,-2032,1086,1560,318,560,574,-22819,10246
3740 DATA -8823,358,28381,-15616,2714,-6877
3742 '    <KEY> DEFINITIONS
3744 DATA 13,91,10,8,9,27,26,24,25,31,31
3746 '    DISPLAY CHARACTERS
3748 DATA 136,130
3749 '    FIELD CNT.,HORIZ.SCREEN SIZE,VERT.SCREEN SIZE,SELECTIO
N DEPTH
3750 DATA 20,64,16,4
3760 '    PRINTER ( <S>TANDARD / <N>ON-STANDARD ) USED
3770 DATA S
4990 '    SYSTEM DESCRIPTORS ( IN "DATA" STATEMENTS )
5000 DATA "SAMPLE CHECK MANAGEMENT SYSTEM": ' <== SYSTEM NAME
5010 DATA 4: '    <== NUMBER OF FIELDS IN EACH RECORD
5020 DATA "CHECK NO.": '      <== NAME OF 1ST FIELD
5030 DATA -3: '   <== NUMERIC FIELD HAVING 3 DIGITS (EX: 104)
5040 DATA "DATE": '           <== NAME OF 2ND FIELD
5050 DATA 5: '    <== CHARACTER FIELD OF LENGTH 5 (EX: 03/22)
5060 DATA "PAY TO": '         <== NAME OF 3RD FIELD
5070 DATA 24: '               <== CHARACTER FIELD OF LENGTH 24
5080 '                            (EX: SOFTRENDS, INC.)
5090 DATA "AMOUNT": '         <== NAME OF 4TH FIELD
5100 DATA -5.2: ' <== NUMERIC FIELD HAVING 5 DIGITS TO THE
5110 '                LEFT OF THE DECIMAL POINT & 2 DIGITS TO
5120 '                THE RIGHT OF THE DECIMAL (EX: 13045.78)
```

take a couple of hours." The source of a data-base system's power is also its greatest limitation.

Data-management systems, on the other hand, are characterized by a much less rigid structure. In general, such a system has no predefined keys. The emphasis in a based system is the individual record; for example, an individual invoice, a credit memo, a specific check. The emphasis in a non-based system are the relationships represented by the fields; for example, a list of names, a list of overdue accounts, a list of zip codes.

The difference in the operation of these systems can be quite striking. A checkbook is a type of data base. The key field is the check number. You can find a check quickly using its number. But suppose you wanted to find all the checks representing a car payment? Unless you had anticipated this need, finding all those checks could take some time. (In all fairness, finding an individual record using a data (non-base) management system can be an involved process. This generally isn't a major consideration, as most uses involve the production of reports or lists of related information.)

As a Basic program, AIDS-III is certainly among the most complex, and convoluted, ever created. Careful study of the listing, subroutine index, and variable index should allow a moderately skilled programmer to understand, and perhaps modify, its inner workings. I have tried to provide a brief outline of its concepts and operation in the following sections.

Defining a New System

To define an AIDS system, locate

Enter	—Entry complete, accept data
Up arrow	—Skip back to previous entry line
Down arrow	—Skip forward to next entry line
Left arrow	—Backspace, erase last character
Right arrow	—Right-justify entry data
Shift/Up arrow	—Skip back to previous entry screen
Shift/Down arrow	—Skip forward to next entry screen
Shift/Left arrow	—Erase entire contents of entry line
Shift/Right arrow	—Restore line to original contents
Clear	—Cancel action, exit to previous action

Table 1. Control keys and their functions

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```
MTCAIDS2 ..... An AIDS descriptor file
SAMPLE CHECK MANAGEMENT SYSTEM ..... Name of system
  42 ..... 42 characters per record
  4 ..... 4 fields per record
CHECK NO. ..... 1st field name
  -401 ..... Format: -999, Position = 1
DATE ..... 2nd field name
  55 ..... Length = 5, Position = 5
PAY TO ..... 3rd field name
  2410 ..... Length = 24, Position = 10
AMOUNT ..... 4th field name
  -9234 ..... Format = -9999.99, Position = 34
```

Table 2

lines 4990–5120 in the program. You'll need to delete lines 5000–5120, and type in a set of new data statements to define a system. The example given should be studied. It is important to save the newly defined AIDS system immediately after defining the system. AIDS-III will configure itself to use all available memory in the system. When invoking Basic, make sure three file buffers are specified.

Entering Data

Entering data and answering queries in AIDS-III is straightforward and relatively self-explanatory. However, a knowledge of the following control keys in Table 1 is important for any serious use.

Selecting Records

You select records by specifying one or more criteria that must be met for a record to be included in an operation. The selection process is machine-code assisted for all operations except the Load. Specifying the Count option will display a count of all records meeting the specified criteria. Using the next option lets you specify more than one criterion.

Sorting Records

The AIDS-III sort is machine-code assisted and will sort 200 records in less than five seconds. One or more fields are specified to control how the records are ordered; for example, sorting by zip code. It will sort records by each field into either ascending (lowest-to-highest) or descending (highest-to-lowest) order. Here's an example of the Ascending Sort option: SORT RECORDS BY (A–G): B+. Records will be sorted by field B into ascending (lowest-to-highest) order.

The following is an example of the Descending Sort option: SORT RECORDS BY (A–G): F–. Records will be sorted by Field F into descending (highest-to-lowest) order. If neither a "+" nor "–" is supplied, an ascending sort will be performed.

The following is an example of the Ascending and Descending Sort options: SORT RECORDS BY (A–G): A+DB–CEF+. Records will be sorted by Field A into ascending order, by Fields D and B into descending order, and by Fields C, E, and F into ascending order.

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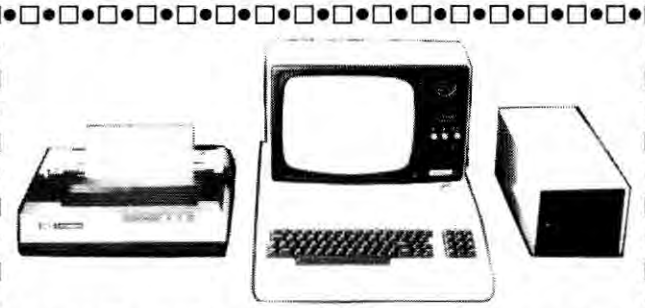

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The Printer

AIDS-III uses the standard printer-driver for Basic. If a printer is attached and ready, AIDS will automatically direct its output to the printer. If your printer does not print when expected, it is probably a non-standard printer, at least as far as AIDS is concerned. You'll need to change line 3770 to 3770 DATA N. AIDS will then ask whether the printer is ready before sending output to it.

Writing a Descriptor File

A descriptor file is used to communicate with other programs. Programs that are designed to work specifically with AIDS-III are called subsystems. MAPS, CALCS-III and IV, and MERGE-III are subsystems designed to give added function to AIDS. I'll discuss these further in Part 2 next month. You should create a descriptor file if you want to use a subsystem to manipulate your data. These programs expect the data describing the system to be in the form shown in Table 2. Each field's name is followed immediately by its size, in characters. If the size is a negative number, the field is numeric. Numeric field sizes are followed by the number

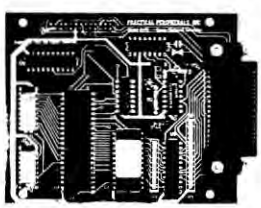
About AIDS-III

In 1978 MTC was a fledgling software company, founded on the premise that Radio Shack had just introduced sliced bread—the TRS-80 Model I. A group of us had recently quit our jobs on the corporate staff of a Fortune-100 corporation. Our new corporate headquarters consisted of two converted parts rooms above a motorcycle dealership. I still have the cardboard sign that hung on the door—"World-Wide Headquarters of a Company called Meta Technologies Corporation—Deliveries, Use Rear Entrance." There was no rear entrance. Only stifling heat, noxious gases, and the deafening sound of revving engines.

We had been working with the TRS-80 for the best part of a year, while still "gainfully" employed. We had trained 50 Radio Shack store managers to sell the new micro, and had even negotiated (unsuccessfully) a software contract with Tandy Corporation. Our primary source of income was from consulting and custom programs.

With 50 man-years of computer experience between us, we decided in August of 1978 to produce a program generator to ease the growing burden of programming. What was produced in the late summer and early fall of that year was to serve MTC into 1980. It was never released for fear of adversely affecting the packaged software market, a market we intended to enter. The power of the generator is substantial. I remember generating a full-blown, customized inventory system in less than 90 minutes. Subsequent research produced a prototype system named MIRIAD. MIRIAD was designed to be a high-performance, user-friendly, data-base management system.

Continues on p. 144



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Continued from p. 143

In August of 1979 I was asked by the Northern Ohio TRS-80 Business Users Group (NOBUG) to make a presentation on information management. With the help of my associates, Alan Becker and Wendy Sayer (who are still at SofTrends), and Robert Schneider (now Chairman of the Board of Meta Technologies), I wrote a crude data-management program named AIDS (Automated Information Directory System), about a half-hour before the meeting. We passed out more than 50 copies of the program listing at the meeting.

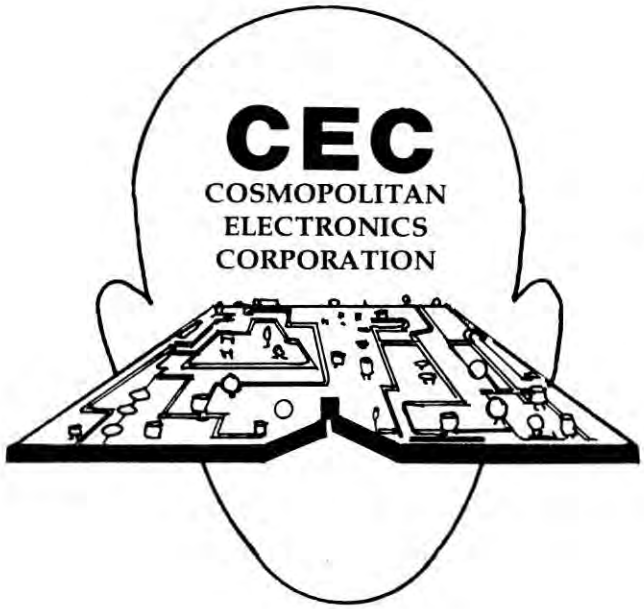
We were inundated with requests for an improved version, which we produced almost immediately. It was named AIDSPLUS and was designed to offer an alternative to a mailing list program sold by Radio Shack.

AIDSPLUS could select records for printing or display by any of 12 fields. It was an in-memory system, meaning that records are loaded from the disk into the computer's

Continues on p. 146

AD—Sort order (1 = ascending, 2 = descending)
BR$—Blank record
BS$—Home cursor and blank screen
CC$—Control character string for input
CE—Entry character value
CE$—Entry character display block
CH—Valid characters high limit for input
CH$—Field specifier character for display
CL—Valid characters low limit for input
CL$—Clear to end of line
CR—Current record selected, compound selection
CS$—Clear to end of screen
CT—Selected record count
D1,DC$—Don't care character value
DC—Don't care switch (−1 = enabled, 0 = disabled)
DQ$—Double quote character (")
DR$—Current data record
DR$(*)—Array of data records
DS—Maximum depth of selection
FC—Maximum number of fields
FC$—Valid field specifiers
FD—Right digit count
FD(*)—Array of right digit counts for fields
FL—Field length in characters
FL$(*)—Array of file names
FL(*)—Array of field length/type specifiers
FNFM(*)—Function returning alpha selection (−1 = selected)
FNLB(K,J)—Function: stores J in the left byte of integer K
FNLF(*)—Function returning length of field in characters
FNMB(K,J)—Function: Stores J in the right byte of integer K
FNMD(V,B)—Function returning remainder of V divided by B
FNNM(*)—Function indicating numeric field (0 = no, −1 = yes)
FNST$(*)—Function to convert positive value to string
FNVM(*)—Function returning numeric selection (−1 = selected)
FNVS$(*)—Function to convert numeric to string
FP—Field position
FP(*)—Array of field positions in data record
FT—File type, file# (1 = load, 2 = save, 3 = descriptor)
FT$—File type string
FV#—Field value (numeric)
FV$—Field value (string)
HN—Number of fields horizontally displayed
HS—Horizontal screen size in columns
IC—Control key index (from input)
K$—Key character
K0—Key, enter
K1—Key, up arrow
K2—Key, down arrow
K3—Key, left arrow
K4—Key, right arrow
K5—Key, shift/up arrow
K6—Key, shift/down arrow
K7—Key, shift/left arrow
K8—Key, shift/right arrow
K9—Key, clear
KD—Key, "don't-care" entry
L—Used in display of field names
LC—Load character index (1 = "−", 2 = "+")
LC$—Load character
LR—Length in characters of input data record
LS—Length of string in characters
M—"Clear" size, used in memory initialization
MC(*)—Integer array containing machine code
MF—Maximum field name length
ML—Minimum allowed input length in characters
MR—Number of machine code support routines
MR(*)—Array of machine code routine entry offsets
NE—Numeric entry switch (−1 = numeric, 0 = alpha)
NF—Number of fields
NF$(*)—Array of field names
NR—Maximum number of records available
NS—Size of field names displayed in characters
OP—Main screen option number
OP$—Character string representing option
PR—Printer available switch (−1 = available, 0 = not)
PS(*)—Array of positions on screen for fields
PU$—Printer used (S = standard, N = nonstandard)
PV—Number of fields to print
PV(*)—Array of fields to print
Q—Absolute screen position
RC—Current record number
RJ—Right-justify flag (0 = no, −1 = yes)
RR—Number of records remaining
RS—Record size in characters
RU—Number of records used
RZ—Record size + 1 in characters
S$—Character string
SB—Count of trailing string blanks
SC—Selection condition mask
SC$—Seelction relations characters
SC(*)—Array of selection masks for compound selection
SF—Selected field
SF(*)—Array of selection field numbers
SK—Number of relations in compound selection
SL—Sort field length
SN$—System name
SO—Sort order (1 = ascending, 2 = descending)
SP—Sort field position
SR—Selection scan direction (1 = up, −1 = down)
SV$—Selection value
SV$(*)—Array of selection values
TB—Tab value for common positioning
U$—Key, <up-arrow>
UR—Record count, used in delete operation
VC$—String of valid characters for input
VK—Valid character index from single key input
VP—Sort array variable pointer
VP(*)—Array of values passed to machine code
VS—Vertical screen size in lines

Table 3. Variables List



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Continued from p. 144

memory. Records were sorted into order using any field. At the time, this feature was unusual, especially for a program of less than 2400 bytes.

In the fall of 1979, Wayne Green announced the introduction of 80 Micro, *a magazine to be dedicated solely to the TRS-80. We saw this as a prime opportunity to enter the national market and signed up as a charter advertiser. We also made the decision to produce a more advanced data manager, AIDS-II. The design goals were quite ambitious. It had to be small, fast and easy to use. AIDS-II is capable of producing a file that describes its records. This file, called a system descriptor file, is used to communicate with other programs. One of these programs, named MAPS, was designed to print labels, reports and provide for user-defined output. AIDS-II was released early in 1980. Our customers liked it, but wanted even more capability. So we wrote a more sophisticated version with numeric capability, improved sorting and selection, and extended record management—AIDS-III, released in May of 1980.*

In June of 1982, SofTrends was founded as a software development and publishing firm. One of the first actions of the company was to acquire the rights to the original AIDS products, copyrights and trademarks. In late 1982, SofTrends released a greatly enhanced, machine-code version of AIDS-III. The new version is up to 10 times faster and three times as powerful as the original. Its record capacity is that of a medium-sized data base, 1,000 to 10,000 records. Advanced hybrid data/data base systems are planned in the near future. ■

—R.A.F.

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```
 60—Get key pressed (K$) and validate against VC$ ——>VK
120—Enter line @ Q,LEN. = FL,MIN.LEN. = ML,CTRL.CHRS. = CC$
340—Trim trailing blanks from string S$
420—Display field names and respective specifiers
460—Select record(RC) by field(SF) using comparison SC
500—Select record using combination comparison
560—Display selection count
620—Display field values and enter new field values
810—Clear screen, display system name and record count
820—Display system name and record count
860—Display record count
900—Sort records using machine code routine
1000—Select and "(load,save,print,etc.)" sequence
1440—Close file(FT) and reset file error handler
1480—Input file name, open file if required
1640—Test for file error
1660—Display bad file message, close file and get entry
1690—Check for printer "ready"
1700—Initialize variables, functions, records, etc.
1770—Load machine code routines into integer array
```

Table 4. Subroutines

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of digits to the right of the decimal point. The last number indicates the starting position of the file within each record.

Record Formats

The records are stored as ASCII, sequential-format disk records. The fields appear within the record in the order they were defined. Here are some records as defined by our sample system, above:

```
35604/13WEEWAUKAN LIGHT & POWER      54.66
35704/24GREELY MEATS                 34.21
35805/02GEORGE JONES                345.21
35905/24ACME TRANSMISSION REPAIR     357.88
```

Part 2

In Part 2, I'll present MAPS-III and CALCS-III in their entirety as usable examples of AIDS-III subsystems. Feel free to use any or all of the information in this series for any noncommercial use (SofTrends has enough competition, thank you!). For those of you without nimble fingers, the entire source code is available in machine-readable form from SofTrends for $15 (shipping prepaid) within the continental United States, and for $20 for other areas. We will accept VISA and MasterCard orders. The source is also available on Load 80. For those of you with nimble fingers, good luck! ■

Robert A. Fiorelli is the president of SofTrends Inc., 26111 Brush Ave., Euclid, OH 44132 (214-289-2002).

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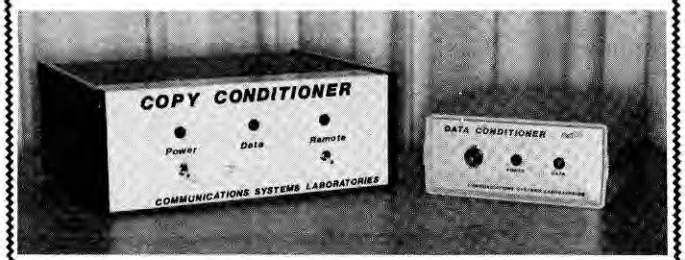

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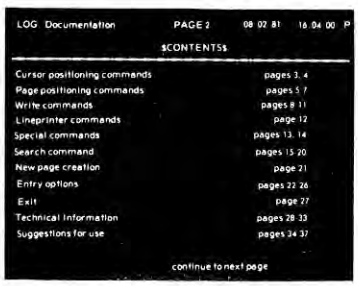
PROGRAM BY **KSoft**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continue to next page

One year old and a proven success! LOG for the TRS-80 (R) is still the only program on the market that addresses one very obvious problem: Despite data-base managers, word processors, and a dozen brands of spreadsheets, the fact is that most of the information people handle on a day-to-day basis just won't fit into fields, files, and codes.

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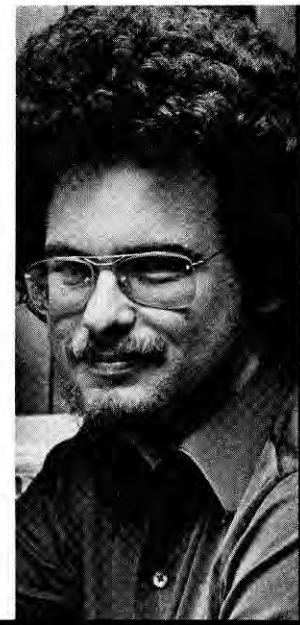

The Snappware College Educated Garbage Collector (SNAPP-VI) is an intelligent processing function which greatly improves performance of typical BASIC applications. And here's why.

Microsoft uses a 'variable length string' in the BASIC interpreter. Each time the string is assigned a new value, it is relocated in a string pool. Periodically the string pool must be reorganized and condensed into a single contiguous area. Performing this string space reclamation is time consuming and inefficient because this approach evaluates and collects each string individually. The time required is roughly proportional to the square of the number of active strings in the resident program. During reclamation the system seems to 'lock-up' and does not respond to the operator until the process is completed.

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Testing Your New RAM

by Dennis Weide

Are you confused because the memory you have added to your Color Computer doesn't work? This program will help locate the problem.

Program Listing

```
10 '   ADDITIONAL RAM TEST
20 '(C) 1982 BY DENNIS WEIDE
30 CLS:PRINT
50 PRINTTAB(12)"RAM TEST":PRINT
70 PRINTTAB(8)"BY DENNIS WEIDE"
80 FOR X=1 TO 500:NEXT X:CLS
120 PRINT:PRINT STRING$(32,"#");
140 PRINT:PRINTTAB(6 )"ADDITIONAL RAM TEST"
160 PRINT:PRINT STRING$(32,"#")
170 CLEAR 100,13000
180 PRINTTAB(3)"ENTER 1 FOR SHORT TEST"
200 PRINT:PRINTTAB(3)"ENTER 2 FOR LONG TEST"
220 PRINT:PRINTTAB(3)"ENTER 3 FOR WORST CASE TEST"
240 PRINT:PRINTTAB(9)"YOUR CHOICE";
250 INPUT W:CLS:PRINT:PRINT
290 PRINTTAB(2)"ENTER START AND END ADDRESS"
300 PRINTTAB(8)"";:INPUT R1,R2
320 ON W GOTO 830,340,340
340 GOSUB 700
350 IF W=3 THEN GOSUB 1170
360 FOR A=R1 TO R2:B=1:RZ=0
380 PRINT@480,A;:G=PEEK(A):POKEA,B
420 K=PEEK(A):IF K<>B THEN GOSUB 590
430 IF W=3 THEN GOSUB 1220
440 B=B*2:RZ=RZ+1
450 IF B<128 THEN 380
460 POKE A,0
470 IF PEEK(A)<>0 THEN GOSUB 590
480 NEXT A
490 IF Z<1 THEN 560 ELSE 500
500 PRINTTAB(8)"END OF RAM TEST":PRINT
520 PRINTTAB(8)"ANOTHER TEST (Y/N)";:INPUT A$
540 IF A$="Y" THEN 180 ELSE END
560 PRINT:PRINTTAB(5)"ADDITIONAL RAM IS GOOD"
580 GOTO 500
590 X=X+1:Z=1
600 PRINT@A1,"";:PRINTUSING"#####";A;
610 PRINT@A2,"";:PRINTUSING"###";G;
620 PRINT@A3,"";:PRINTUSING"###";K;
630 PRINT@A4,"";:PRINTUSING"###";B
640 A1=A1+32:A2=A2+32:A3=A3+32:A4=A4+32
680 IF X=10 THEN GOSUB 800
690 RETURN
700 CLS:X=0
720 PRINTTAB(8)"MEMORY FAILURES"
730 A1=129:A2=139:A3=146:A4=155:PRINT
```

Listing continues

Most microcomputer magazines have had articles on how to add memory to the Color Computer. However, most articles fall short when it comes to testing the additional memory.

This program tests the additional 16K of RAM. Its three separate tests allow the user to select a short test, long test or a worst-case test. It displays the address being tested and allows you to select the address range you wish to test. It will print up to 10 failures on the screen and then halt until you press enter. The program can be *modified* to allow for an output to the printer, allowing the program to run without pressing enter.

New RAM chips have about a 10-percent failure rate.

The four common types of RAM failures are:

- RAS or CAS failures, where the same bit fails in a large number of addresses.
- Bit set or reset failures that indicate the inability to set a bit to zero or one.
- Adjacent bit failures that involve the setting or resetting of adjacent bits in the address being tested.
- Adjacent address failures that involve the setting or resetting of bits at an address adjacent to the one being tested.

RAS or CAS failures can also be caused by the SAM (6883) or PIA (6821) chips. These cause each bit of every address tested to fail and are likely to render the RAM useless since you can't access the memory.

The Tests

Test 1, the short test, POKEs a zero

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By Tim Nelson

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System Size	4K	16K	32K	4K	16K	32K
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ROMPAK: Text space	2.5K	16K	31K	N/A	N/A	N/A
DISK: Text space	N/A	5.5K	21.5K	N/A	0.5K	16.5K
Right Justify		YES			NO	
Video Window		YES			NO	
Edit any ASCII File		YES			NO	
Programmable Function		YES			NO	

The figures speak for themselves and with professional features like PROGRAMMABLE function string commands to perform up to 28 commands automatically. PROGRAMMABLE text file chaining, PROGRAMMABLE column insert & delete, and right hand JUSTIFICATION with punctuation precedence, the choice is clear but there's still more! In their September '82 issue, "80 MICRO" says, "The Color Computer has finally come of age. Nothing illustrates that coming of age better than this offering (SUPER "COLOR" WRITER) by Nelson Software". The **Super "Color" Writer** takes full advantage of the new breed of "smart printers" with Control codes 1-31, 20 Programmable control codes 0-255 for special needs. Works perfectly with all Epson, Radio Shack, Okidata, NEC, IDS, Centronics, Citoh, Smith Corona, Diablo Etc., Matrix, or Letter Quality Printers.

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Listing continued

```
780 PRINT"ADDRESS----OLD----NEW----EXPECT":RETURN
800 INPUT"   PRESS <ENTER> TO CONTINUE";Q
810 GOSUB 700
820 RETURN
830 GOSUB 950
840 FOR A=R1 TO R2
850 B=0:PRINT@480,A;:POKE A,0:C=PEEK(A)
880 IF C<>B THEN GOSUB 1040
890 B=255:POKE A,255:C=PEEK(A)
920 IF C<>255 THEN GOSUB 1040
930 NEXT A:GOTO 490
950 X=0:CLS:PRINTTAB(8)"MEMORY FAILURES"
980 PRINT:PRINT"ADDRESS----CONTENT----EXPECT"
1000 A1=129:A2=141:A3=152:RETURN
1040 PRINT@A1,"";:PRINTUSING"#####";A;
1050 PRINT@A2,"";:PRINTUSING"###";C;
1060 PRINT@A3,"";:PRINTUSING"###";B
1070 X=X+1:Z=1:A1=A1+32:A2=A2+32:A3=A3+32:A4=A4+32
1120 IF X=10 THEN 1130 ELSE 1160
1130 INPUT"   PRESS <ENTER> TO CONTINUE";Q
1140 CLS:GOSUB 950
1160 RETURN
1170 FOR A=16384 TO 32767
1180 PRINT@490,A;:POKE A,0:NEXT A:RETURN
1220 FOR H=16384 TO 32767
1230 PRINT@480,A;:PRINT@490,H;:PRINT@500,RZ;
1240 IF H=A THEN 1270
1250 Z=PEEK(H):IF Z<>0 THEN GOSUB 1290
1270 NEXT H:RETURN
1290 A5=A1+8:X=X+1
1310 PRINT@A1,"";:PRINTUSING"#####";H;
1320 PRINT@A5,"%";
1330 PRINT@A2,"";:PRINTUSING"###";QQ;
1340 PRINT@A3,"";:PRINTUSING"###";Z;
1350 PRINT@A4,"";:PRINTUSING"###";QQ
1360 A1=A1+32:A2=A2+32:A3=A3+32:A4=A4+32
1400 IF X=10 THEN GOSUB 800
1410 RETURN
```

into the address being tested, and then PEEKs it to ensure that all bits are reset. It then POKEs the same address with 255 and PEEKs it again to ensure that all bits are set. This process is repeated until all the specified addresses have been tested.

If an error occurs, its address and the contents of that address will be displayed. The expected results will also be displayed. This is a good test for RAS and CAS troubles as well as bit set and reset failures.

Test 2, the long test, POKEs each address in the specified range with a one. The address is then PEEKed to ensure that bit 0 is set (equal to one) and all other bits (1 through 7) are reset (equal to zero). This process is repeated, POKEing the address with 2, 4, 8, 16, 32, 64, and 128 until all bit positions have been tested. The address is then POKEd to zero and PEEKed again.

This will detect RAS, CAS, individual-bit, and adjacent-bit failures.

It takes about two hours to test 16K of RAM. Failing addresses are listed on the screen showing the address, the old data (before first POKE), the new data, and the expected results.

Test 3, the worst-case test, POKEs all addresses in the specified range to zero. Then it walks a one through a field of zeroes as in test 2. However, after setting each bit in the address being tested, it PEEKs all other addresses to ensure that they still contain zero.

The address being tested is displayed in the lower left corner of the screen as in test 2. In addition, the address being PEEKed for a zero is displayed to the right of the address under test. Next to this is the bit position being tested (bits 0–7).

Failures are displayed the same as in test 2. A percent sign after the failing address indicates that the address had a bit set when it should have been a zero. This is the best possible RAM test you can run; if your RAM passes this test, you can be sure that it is good.

"It takes about two hours to test 16K of RAM."

Testing the Program

Test the program by deleting line 170. It protects the memory above address 13000 and allows it to be POKEd and PEEKed. Deleting this line will leave the addresses above 13000 unprotected. Since the last 200 bytes of RAM are used by the system, you will see address failures starting at about address 32520.

Analyzing Test Failures

If a failure occurs, retest the failing addresses to see if the same failing data is printed out. Since each RAM chip contains 16,384 addresses of one bit each, determining the bad bit will tell you which chip is faulty.

A test where a large number of addresses fail or where all addresses are failing may indicate a bad RAS or CAS lead. The leads are the row-address strobe and the column-address strobe. They are the only way an address can be accessed in a RAM chip. This type of failure can be caused by a RAM chip, but is not limited to them. If several addresses with the same bit or bits fails, it is probably the fault of the RAM chip associated with that bit. Replace the RAM chip or swap it with another to double check.

If, during test 3, an address other than the one being tested fails, replace the chip associated with the failing bit.

This program will test addresses above 16384 as effectively as any program available. Also, by POKEing various pointers, RAM addresses 1536 to 16383 can also be tested. Do not try to test addresses below 1537, since they are used by the system for pointers and text screen and testing them will cause the system to go insane. ■

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  LD (HL),E
  LD (HL),C
  DEF
  DM tw,$+5 ", etc.?
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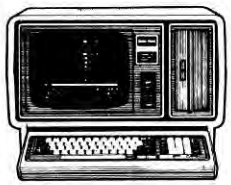

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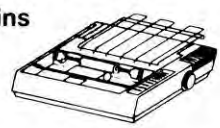

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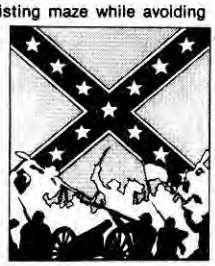

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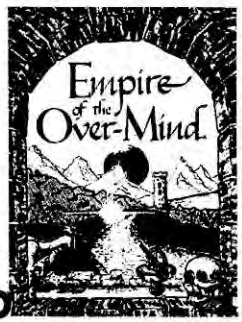

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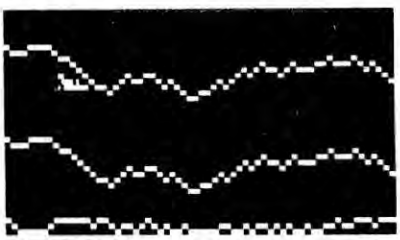

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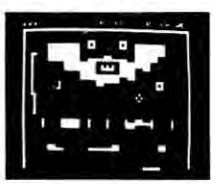

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Hardware Hacker's Tool Kit

by Jeff DeTray

Compile the essential tools to start your career as a TRS-80 hacker with this helpful advice.

We TRS-80 users have become quite comfortable creating, modifying, and otherwise fiddling with the software we run on our machines. Software tinkering is fun and productive if you have the right tools and the know-how to use them.

So it is with hardware.

Compared to a sophisticated utility program, the tools of the hardware hacker may seem simple and plain, but they are no less important. It is a tremendous frustration to attempt the construction of any electronics project without a few essential implements. I will examine the contents of a good, basic tool kit, with a brief explanation of how each item is used and a rough idea of its price range.

A Word About Quality

How do you tell a good tool from a poor one? For the most part, you get what you pay for. This does not mean that every inexpensive tool is inferior to every costly one, but if you apply a dash of common sense to your selection, price is a surprisingly good yardstick.

This does not imply that every would-be builder should purchase high-priced tools. The main advantage of such tools is that they tend to last longer under frequent and heavy use. So, if you expect your interest in hardware projects to be intense and enduring, it is probably wise to spend a little extra for the good stuff.

On the other hand, an infrequent hacker can do just fine with bargain tools, especially at the start. Pay your money and take your choice.

Which Tools?

There are whole catalogs devoted to hand tools—literally hundreds of tools from which to choose. Fortunately for your pocketbook, you will need only a few of these to begin your hardware adventures. Let's look at the basics.

● Soldering Iron: The essence of hardware construction is the interconnection of electronic components. The most commonly used method of making these connections is soldering.

Soldering irons come in many shapes and sizes, but you should narrow your selection to a pencil-type iron rated between 25 and 40 watts. (Watts are a measure of the iron's heating capacity.) Irons with a higher rating are too powerful, and can damage delicate electronic components.

Choose an iron with a slender tip ending in either a point or a small, flat blade. Irons more than 1/8 inch wide at the tip are too large. Be sure the tip is replaceable, as it will eventually wear out.

You can expect to pay between $3.50 and $20 for a pencil-type iron. I used a $5 soldering iron with great success for years before retiring it not long ago.

(For more about the important skills of soldering and desoldering, see the sidebars that accompany this article.)

● Long-Nosed Pliers: Few tools are

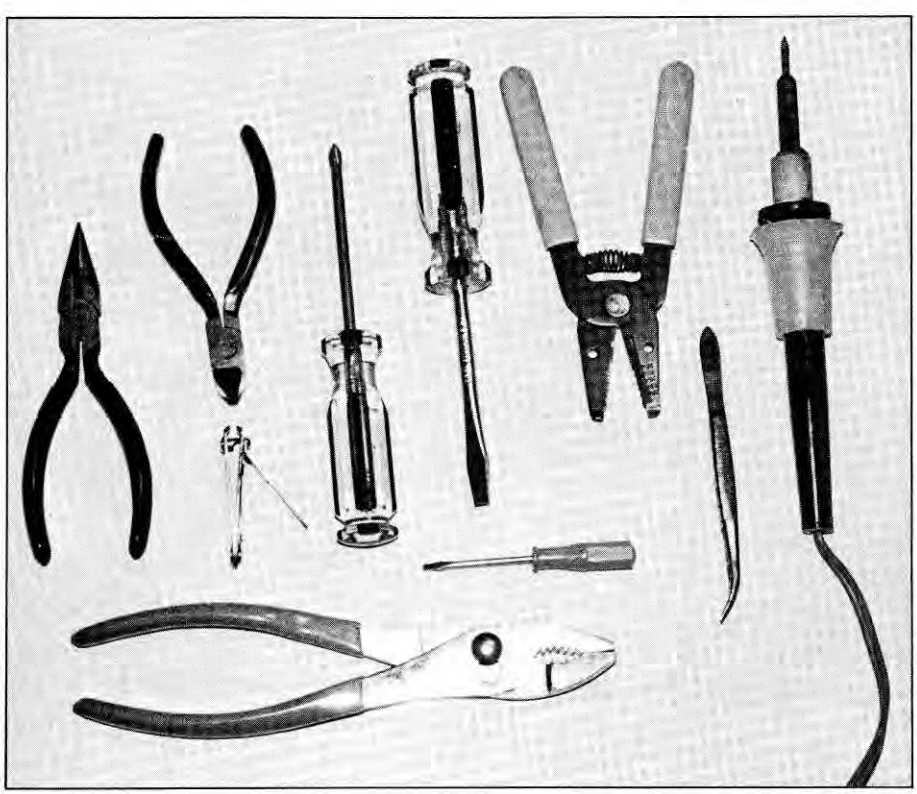

Photo 1. The Hardware Hacker's Tool Kit (left to right). Long-Nosed Pliers; Diagonal Cutters and Nail Clippers; Phillips, ¼-inch and 1/8-inch Screwdrivers; Wire Strippers; Tweezers; Soldering Iron. Below, Slip-Joint Pliers.

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handier than these hard workers, which are also known as needle-nosed pliers. They are an absolute must for your tool kit. Long-nosed pliers are usually available in 5- and 6½-inch sizes; either will do.

You'll use these pliers constantly, no matter what the project. They are the tool of choice for grasping components, making wire leads fast to their attachment points, holding items to be soldered, and much more. This most-used tool is a bargain at $3 to $9.

For truly delicate work, even long-nosed pliers may prove too clumsy. Some time back, I added a pair of tweezers to my tool kit. The choice was a good one, as the tweezers have paid for themselves a dozen times over. The larger-than-normal kind found in any high-school biology lab are superb.

● Diagonal Cutters: Popularly known as dikes, these are used to cut wire and component leads to the desired length and to nip off excess wire after soldering. You'll find dikes in many sizes, but the 4½-inch type is probably best for electronic work. The price range is the same as for long-nosed pliers.

If you work with very small diameter wire, a pair of ordinary fingernail clippers makes an inexpensive alternative to dikes. Once used to cut wire, however, the clippers are useless for their intended purpose.

● Wire Strippers: If you do much work

The Art of Soldering

So you want to be a hardware hacker, eh? Then sooner or later (preferably sooner), you'll have to learn to solder. Soldering is the quintessential skill of the do-it-yourself electronics enthusiast.

Basic Principles

Soldering is a simple concept. The goal is to make secure electrical connections between the different components making up an electronic circuit. You do this by bringing the parts to be joined into physical contact, heating the parts with a soldering iron, melting solder over the junction of the parts, and allowing the resulting joint to solidify as the solder cools and hardens.

Only metallic parts can be joined by ordinary soldering techniques, and even some metals, such as aluminum, are difficult to solder. In small electronics projects, you're usually concerned with connecting the metal leads of small components to printed-circuit (PC) boards and the lugs found on larger components, such as switches and volume controls. Components of this type are among the very easiest to solder.

The solder most commonly used in electronics work is an alloy of 60 percent tin and 40 percent lead. This mixture melts at a temperature of about 370 degrees Fahrenheit, low enough that the connections can be completed without any damage to components.

Electronics solder looks like fine wire, but it's really a hollow tube with a material known as "flux" at its core. The flux flows onto the joint with the solder to create the proper chemical environment for a good connection. Although there are different types of flux, resin-core solder is usually used; avoid acid-core solder like the plague; it will damage the components. Small-diameter solder (.030–.050 inches) is preferred for most of the jobs you'll encounter.

Technique

There is nothing magical about creating a good solder joint. In fact, by following a few simple procedures, you can make a good one virtually every time. First the preliminaries:

● First, preheat the iron. Most pencil-type irons have no on/off switch, so plug in the iron and let it warm up for at least five minutes before using it.

● Keep the tip of the iron clean. Have a damp cloth or sponge at your side and frequently wipe debris and excess solder from the tip. A clean iron is a happy iron.

● Be sure the tip is covered with a thin, even coat of solder. This is called "tinning" the iron. Just apply a small amount of solder to the clean iron and let it flow over the tip. If it does not flow, the iron is probably not hot enough. Never allow large blobs of solder to cling to the tip.

● Make a secure mechanical connection between the items you are about to solder. This cannot be done when you are soldering a component lead to a circuit board, but do try to support the part so that it will not move while you're soldering it.

With that out of the way, you're ready to do the deed. Here's all it takes, in five easy steps. The accompanying diagrams show how these steps apply to a circuit-board connection.

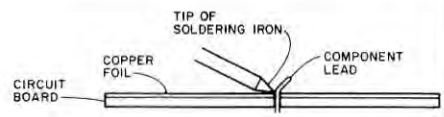


Fig. 1. Step 1—heat the connection.

● First, place the tip of the hot iron in simultaneous contact with the two parts to be soldered (the work). Let the work heat up for a couple of seconds.

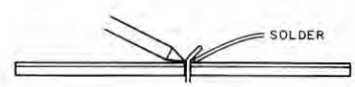


Fig. 2. Step 2—add the solder.

● Second, without removing the iron, bring the solder into contact with the hot work.

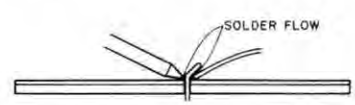


Fig. 3. Step 3—let the solder flow, enveloping the connection.

● Third, as the solder melts, apply just enough of it to completely envelope the connection. Avoid the mistake of applying too much solder. The solder should never run or drip, but flow smoothly around the connection.

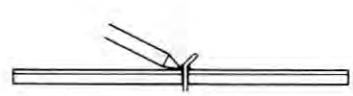
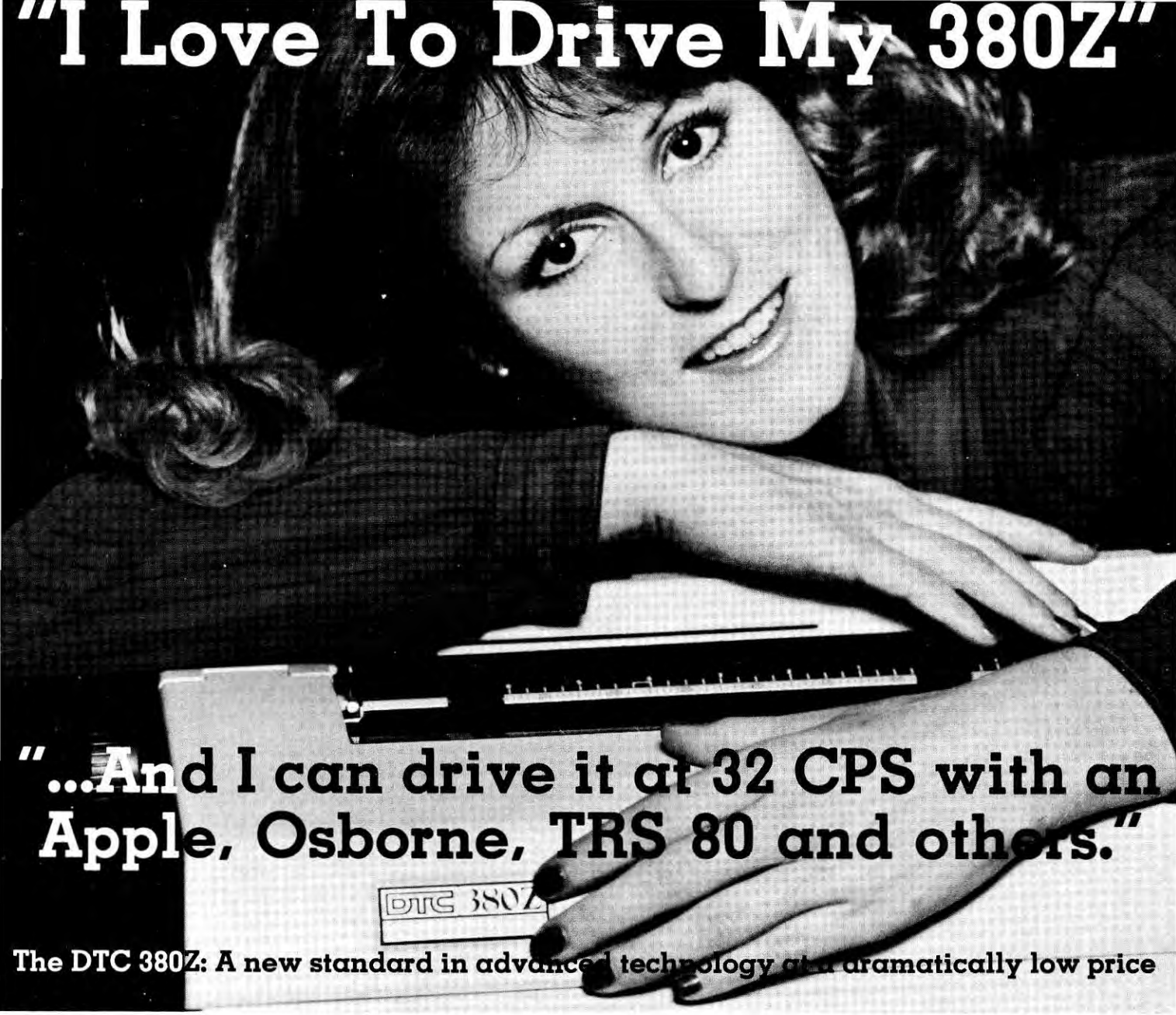


Fig. 4. Step 4—withdraw the solder first.

● Fourth, withdraw the solder from the work, followed a couple of seconds later by the iron.



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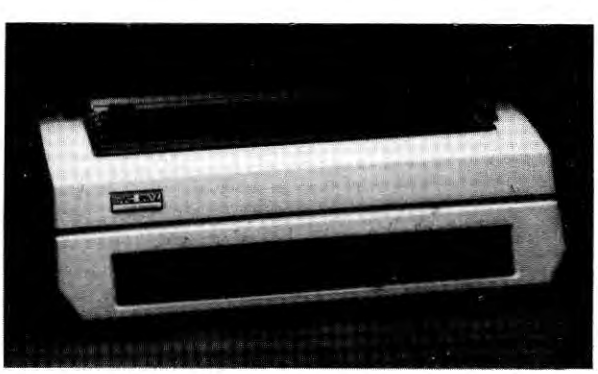

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Fig. 5. Step 5—let the connection solidify.

● Finally, let the joint cool and solidify before moving any of the parts.

Voila! Another perfect solder joint, ready to carry any electrical signals that come its way. This five-step process should take only 10 seconds from start to finish.

Pitfalls

A finished solder joint should appear clean and bright. The solder should look "wet" even after it has hardened. It should seem to flow smoothly from one component to the other.

If the solder beads up or appears granular, watch out! You may have a bad joint. When in doubt, always take the time to reheat the joint, applying a bit more solder if necessary. You'll soon know the look of a good solder joint; don't accept anything less.

When soldering components to printed circuit boards, be careful not to overheat the connection. The thin copper foil that forms the conductors on PC boards has been known to detach itself from the board during prolonged overheating.

In contrast, when one of the parts you are soldering is connected directly to a piece of metal with a large surface area, it may be necessary to use a more powerful iron to get enough heat to make a good connection. The metal will tend to disperse the heat, and your usual small iron simply won't supply heat fast enough.

Avoid breathing the fumes that result from soldering. Your lungs and eyes will thank you.

Finally, remember that the iron is very hot! Don't place it near items made of plastic, rubber, or any flammable material. The shaft of the iron is nearly as hot as the tip, so take care not to let the shaft come into unintentional contact with anything.

As with most skills, soldering is best learned by doing. If you follow the guidelines presented here, you'll be a full-fledged hacker before you know it. ■

with insulated (as opposed to bare) wire, then the convenience of a stripper can't be overstated. The sole purpose of this tool is to quickly and easily remove a selected amount of insulation from one end of a wire. This must be done before you can solder the wire to anything else.

A sharp knife can also be used for this chore, but the stripper is much easier and a whole lot safer. With wire-stripper prices starting at $2.50, it's a luxury you can afford, although fancy, automatic models can cost in excess of $40.

● Screwdrivers: You probably have these around the house already. If not, many hardware stores carry sets of five or six that perform admirably. Just be sure you have at least one small (1/8-blade), one medium (¼-inch blade) and one Phillips type. Plan to spend a dollar apiece if you buy them individually, less in sets.

● Slip-Joint Pliers: These common, ordinary pliers are useful for tasks that are too hefty to tackle with your long-nosed pliers. Like screwdrivers, they aren't really electronic tools, but are handy for assembling homemade enclosures for your projects, removing stubborn nuts and other mechanical jobs. An expenditure of $3 to $10 should get you suitable pliers.

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Desoldering

by Ron Hands

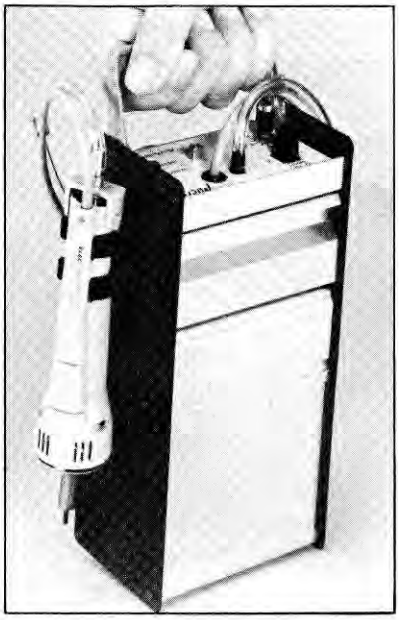
Everybody knows how to solder, but what about desoldering? What about extracting dead integrated circuits from printed circuit boards without destroying the foil on the board, the plated-through holes, nearby components, and your patience?

This isn't meant to be an exhaustive survey of desoldering methods. It may give you a few ideas for the next time you have a repair job, and even provide a bit of confidence that you can indeed tackle a replacement project instead of sending a piece of equipment out to the repair shop.

First, do not use a blow torch if you plan to reuse the circuit board. Use of a torch is a legitimate technique only for salvaging components and sockets from scrap boards.

The Cadillac among desoldering methods is the desoldering station, as marketed by companies like Pace and Weller (9893 Brewers Court, Laurel, MD 20707). It consists of a hollow-tipped, temperature-controlled, low-voltage iron connected to a vacuum pump. To use this method, the hot iron is placed over the pin of the IC where it projects through to the foil side of the board. The pin is heated until it can be gently pushed to the center of the hole; then a button on the soldering iron handle triggers the vacuum pump that sucks all the solder out of the hole, cools the tip, and leaves a bare pin. Do this with the other pins on the IC, and you should be able to remove it, leaving a clean set of holes for the replacement.

These stations are expensive; they are better suited for a commercial enterprise, not a hobbyist.



Pace Inc.'s Micro Portable Soldering and Desoldering System.

Continues on p. 162

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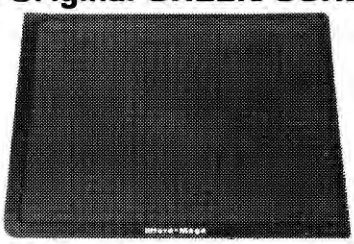

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And that, friends, is it! A soldering iron, long-nosed pliers, diagonal cutters, wire strippers, three screwdrivers and an ordinary pliers (with tweezers and nail clippers optional) make up the essential items in your tool box.

As time goes by, you'll no doubt begin to accumulate other tools that you find useful. For instance, an integrated-circuit inserter is a handy gadget for placing ICs into their sockets.

Then there are electric drills, nut drivers, desoldering tools, wrenches—the list of useful items goes on and on. For building most of the projects you'll encounter in *80 Micro*, however, the hardware hacker's tool kit is all you need. ■

Continued from p. 161

Somewhat more economical methods divide into three variations: desoldering braid, oversize soldering iron tips that heat all pins simultaneously, and the spring-actuated vacuum pump used in conjunction with a standard soldering iron (Radio Shack has one for about $11; most electronic suppliers will have something similar).

To use desoldering braid, usually called solder-wick, place the braid against the solder connection, then place your soldering iron against the braid. The braid gobbles up all the solder and you're left with a naked pin in a solder-free hole.

The super soldering-iron tip is big enough to make contact with all the pins of a 16-pin DIP at once. After they're all hot enough, the IC can be extracted without any problems. This method requires excellent coordination.

The remaining method uses the vacuum desoldering tool. This works best for me. It's a technique that assumes the IC is defunct; at today's prices it's not worth trying to salvage many of them. The first step is to use a fine pair of cutters to clip off the pins and remove the body of the IC. One technician I know prefers to clip the pins as close to the circuit board as possible. Another says he likes to clip the pins off at the top, near the IC body.

The long-pin method requires long-nose pliers to remove each pin; heat the connection on the foil side and draw the pin out from the component side. Make a second pass over each connection, heating them and using the vacuum desoldering tool to suck the solder out of the hole.

The short-pin method is a one-step process. The desoldering tool is used on the component side and the soldering iron on the foil side. When the connection is at the right heat, a flick of the trigger pulls both the solder and the remnant of the pin out of the hole, leaving a clean hole.

Both methods seem to work well. Sometimes it's so difficult to get at the lower portion of the IC pin when you're clipping it off that the long-pin method is used by default. If the soldering iron is at the right temperature, the short-pin technique seems to clean out the hole equally well. The only drawback is that it accumulates debris in the vacuum tool. When removing a lot of ICs, you will have to clean out the pump barrel periodically.

Mounting the circuit board vertically in a Workmate vise or any sturdy holder so that both sides are readily accessible is almost a necessity. A temperature-controlled soldering iron also helps immensely.

By the time you've removed a few ICs, you'll probably decide that it's best to install a socket for the replacement. Sockets are cheap and they make troubleshooting easier in the future.

By all means, find a scrap circuit board to practice on so that you can perfect your techniques before tackling a vital piece of equipment.

When you do operate on a board that you want to use again, there's one final step you should take after all the ICs or pins have been removed. Examine the board with a large magnifying glass. You will no doubt discover tiny solder splashes or hairs that must be removed. You can clean the board with a toothbrush and rubbing alcohol, scrubbing each set of holes to remove flux remnants and any other foreign material. Every precaution at this stage pays off in freedom from trouble later. ■

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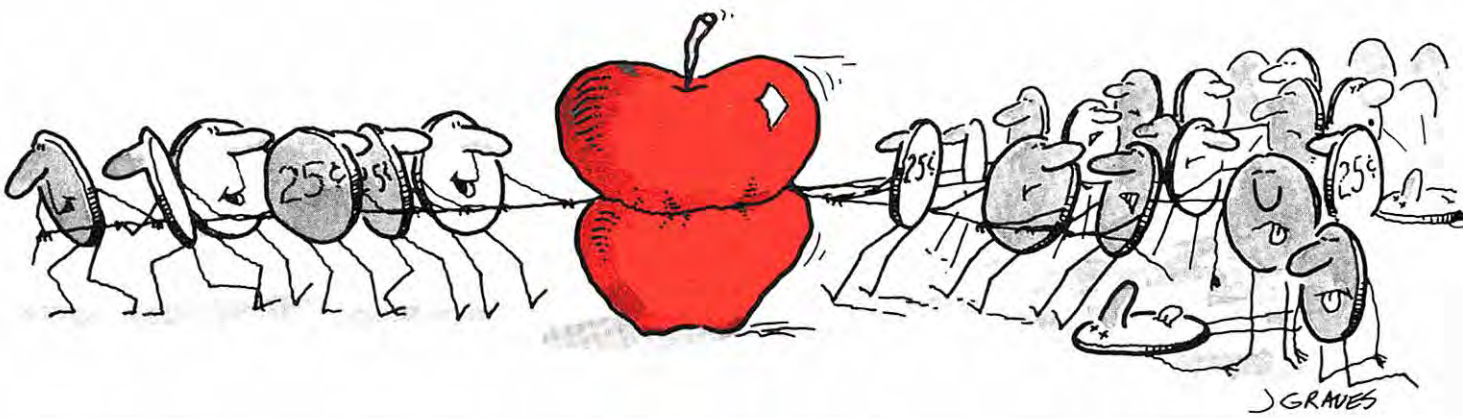

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PRINT@ Graphics

by Francis S. Kalinowski

Are you still puzzled about graphics, still deciphering the user's manual and analyzing published programs for hints and clues? Key in PRINT@ Graphics (Program Listing 1) and study its demonstration programs. They simultaneously show various graphic actions and the statements that produce them. Accompanying remarks tell you exactly what does what, where, when, and how.

Use these demonstration listings to produce graphics and improve your programming skills.

Listing 1 is printed in 64-character-per-line format for easier key-in and debug. Your keyed-in statements should look exactly as they appear in Listing 1; you must include all spaces used in the statements to ensure faultless displays. The short demo programs and remark statements appear on the screen. Graphic actions occur in spaces above, between, or at the side of the statements and remarks.

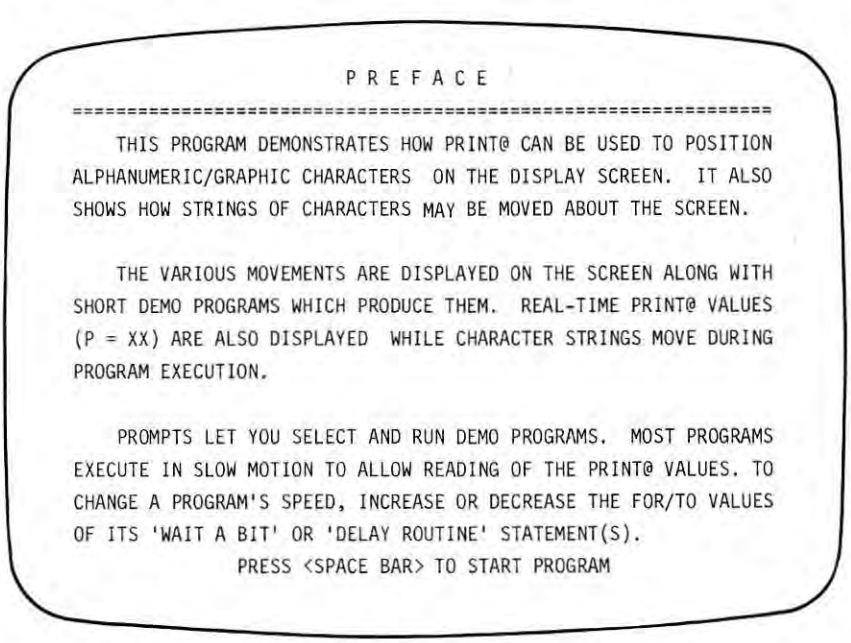

Fig. 1. Preface Display

Program Features

The program starts with a preface display (Fig. 1) that generally describes program operation. Pressing the space bar erases the preface and starts a graphic title.

Real-time PRINT@ values appear on the display screen's bottom line as the title develops. Incrementing and decrementing values identify screen locations of graphic blocks as they appear in the title display.

Pressing the space bar erases the title and prints a demonstration program menu (Fig. 2). The menu lets you exit

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the program or select any one of nine graphic displays.

Select 1 (and enter) to see a character-display map. The map shows all line-start and end-PRINT@ values and briefly describes the TRS-80 Model I and III video-display worksheet. You must thoroughly know the display map to do PRINT@ graphics.

Demonstration Programs

Demo programs 2–9 illustrate basic concepts for producing various graphic actions on the TRS-80's display screen. They progress from basic movement of alphanumeric characters to smooth movement of graphic shapes. CHR$ with ASCII codes are used to form graphic shapes.

You can speed up, slow down, or repeat a demo program until you know exactly how it works. You can step through the demo programs at your own pace and gradually gain the PRINT@ know-how for developing your own graphic-action routines.

Moving Characters

Program 2 (statements 145–170) and program 3 (statements 220–240) move a four-letter word laterally. The programs are similar except for their second statement values. Program 2's statement 150 FOR P=128 TO 187: starts the word MARY at the screen's left side and increments PRINT@ one position at a time. This action moves MARY rightward.

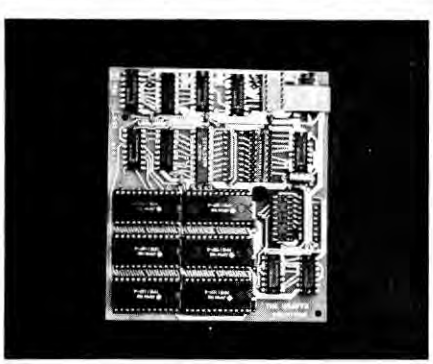
Program 3's statement 225 FOR P=187 TO 128 STEP−1: reverses word movement. It starts JOHN at the screen's right side and decrements PRINT@ one position at a time. This action moves JOHN leftward.

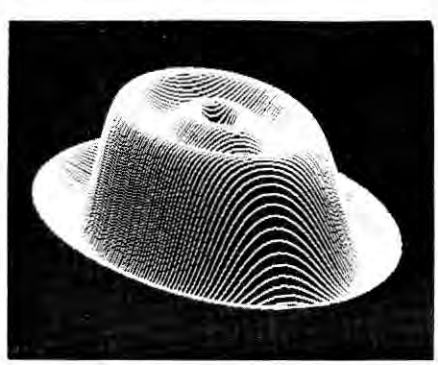
MARY in statement 155 and JOHN

Program Listing 1

```
0 CLS:CLEAR75:GOSUB10:GOSUB970:GOSUB5:GOTO35:
  REM *** PROMPT ROUTINES ***
1 PRINT@909,CHR$(230);
2 PRINT@974,"PRESS <M> KEY FOR DEMO PROGRAM MENU      ";
3 IFINKEY$="M"THEN35ELSE3
4 PRINT@909,"PRESS <SPACE BAR> TO RUN THIS PROGRAM";:
5 IFINKEY$<>" "THEN5ELSERETURN
6 REM *  @ @ @ @ @ @ @ @ @ @ @ @ @ @ @ @ @ @ @ @ @ @
         @     PRINT@ DEMONSTRATION PROGRAMS     @
         @   FOR TRS-80  MODEL I AND MODEL III   @
         @       BY: FRANCIS S. KALINOWSKI       @
         @           ORLANDO,  FLORIDA           @
7 REM *  @ @ @ @ @ @ @ @ @ @ @ @ @ @ @ @ @ @ @ @ @ @
9 REM *** PROGRAM DESCRIPTION ***
10 PRINT@25,"P R E F A C E":PRINTSTRING$(64,61);
15 PRINT"    THIS PROGRAM DEMONSTRATES HOW PRINT@ CAN BE USED TO
 POSITION";:PRINT"ALPHANUMERIC/GRAPHIC CHARACTERS  ON THE DISPLA
Y SCREEN.  IT ALSO";:PRINT"SHOWS HOW STRINGS OF CHARACTERS MAY B
E MOVED ABOUT THE SCREEN.":PRINT
20 PRINT"    THE VARIOUS MOVEMENTS ARE DISPLAYED ON THE SCREEN A
LONG WITH";:PRINT"SHORT DEMO PROGRAMS WHICH PRODUCE THEM.  REAL-
TIME PRINT@ VALUES";:PRINT"(P = XX) ARE ALSO DISPLAYED  WHILE CH
ARACTER STRINGS MOVE DURING";:PRINT"PROGRAM EXECUTION.
25 PRINT:PRINT"    PROMPTS LET YOU SELECT AND RUN DEMO PROGRAMS.
  MOST PROGRAMS";:PRINT"EXECUTE IN SLOW MOTION TO ALLOW READING
OF THE PRINT@ VALUES. TO";:PRINT"CHANGE A PROGRAM'S SPEED, INCRE
```

Listing 1 continues





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in statement 230 must have trailing blanks as shown. These blanks erase M and N respectively, as MARY and JOHN move across the screen. PRINT @29,"P ="P ;: in both demo programs merely displays real-time printing locations as MARY and JOHN move.

Program 4 (statements 315–360) and program 5 (statements 435–480) move stacked characters vertically. The programs are similar except for their start, stop, and step values.

Program 4's statement 320 specifies a PRINT@ range and step increment for displaying a bomb shape in statements 335–345. STEP 64 moves the bomb downward, one line at a time. Statement 330 erases above the falling bomb.

Program 5's statement 440 specifies a PRINT@ range and step decrement for displaying a missile in statements 455–465. STEP –64 moves the missile upward, one line at a time. Statement 450 erases below the rising missile.

Program 6 (Fig. 3) shows how a string of characters can be moved diagonally. As in all demo programs except 9, displayed remarks define the functions of all statements. Statement 535 (Listing 1) prints a flying saucer

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Listing 1 continued

```
ASE OR DECREASE THE FOR/TO VALUES";
30 PRINT"OF ITS 'WAIT A BIT' OR 'DELAY ROUTINE' STATEMENT(S).":P
RINT@975,"PRESS <SPACE BAR> TO START PROGRAM";:GOSUB5:CLS:RETURN

34 REM *** DEMO PROGRAM MENU ***
35 CLS:PRINT@17,"DEMONSTRATION  PROGRAM  MENU
40 PRINT@80,STRING$(30,61)
45 PRINT@144,"1. SHOW CHARACTER DISPLAY MAP.
50 PRINT@208,"2. MOVE CHARACTERS RIGHTWARD.
55 PRINT@272,"3. MOVE CHARACTERS LEFTWARD.
60 PRINT@336,"4. MOVE CHARACTERS DOWNWARD.
65 PRINT@400,"5. MOVE CHARACTERS UPWARD.
70 PRINT@464,"6. MOVE CHARACTERS DIAGONALLY.
75 PRINT@528,"7. MOVE GRAPHIC SHAPE RIGHTWARD.
80 PRINT@592,"8. MOVE GRAPHIC SHAPE LEFTWARD.
85 PRINT@656,"9. MOVE GRAPHIC SHAPE UPWARD.
90 PRINT@719,"10. EXIT PROGRAM.
95 PRINT@911,"";
100 INPUT"WHICH DEMO PROGRAM DO YOU WANT";MS
105 IFMS<1ORMS>10THEN35
110 CLS:ONMSGOTO935,120,185,250,380,490,590,710,835,925
115 FORD=1TO99:NEXTD:RETURN
119 REM *** 2. MOVE CHARACTERS RIGHTWARD. (DISPLAY) ***
120 PRINT@260,"P R O G R A M": PRINT@290,"R E M A R K S":PRINT"1
45 CLS:                    ' CLEAR SCREEN"
125 PRINT"150 FOR P=128 TO 187"CHR$(34)":     ' SET START / STOP
 RANGE"
130 PRINT"155 PRINT@P,"CHR$(34)" MARY"CHR$(34)";:      ' PRINT '
MARY' AT POSITION 'P'"
135 PRINT"165 FOR D=1 TO 49: NEXT D: ' WAIT A LITTLE BIT"
140 PRINT"170 NEXT P:                ' INCREMENT 'P' ONE POSITIO
N";:PRINT@128," MARY";:PRINT@29,"P = 128";:GOSUB4:GOTO150
144 REM *** 2. MOVE CHARACTERS RIGHTWARD. (PROGRAM) ***
145 CLS:
150 FOR P=128 TO 187:
155 PRINT@P," MARY";:
160 PRINT@29,"P ="P ;:
165 FOR D=1 TO 49: NEXT D:
170 NEXT P:
175 GOTO1
184 REM *** 3. MOVE CHARACTERS LEFTWARD. (DISPLAY) ***
185 PRINT@260,"P R O G R A M": PRINT@290,"R E M A R K S
190 PRINT"220 CLS:"CHR$(213)"' CLEAR SCREEN"
195 PRINT"225 FOR P=187 TO 128 STEP-1: ' SET RANGE AND DECREMENT
 STEP"
200 PRINT"230 PRINT@P,"CHR$(34)"JOHN "CHR$(34)":          ' PRINT
 'JOHN ' AT POSITION 'P'"
205 PRINT"235 FOR D=1 TO 50: NEXT D:   ' WAIT A LITTLE BIT"
210 PRINT"240 NEXT P:"CHR$(210)"' DECREMENT 'P' ONE POSITION";:P
RINT@187,"JOHN";
215 PRINT@29,"P = 187";:GOSUB4:GOTO225
219 REM *** 3. MOVE CHARACTERS LEFTWARD. (PROGRAM) ***
220 CLS:
225 FOR P=187 TO 128 STEP-1:
230 PRINT@P,"JOHN ";: PRINT@29,"P ="P ;:
235 FOR D=1 TO 50: NEXT D:
240 NEXT P:
245 GOTO1
250 PRINT@29,"VWV":PRINT@94,"H":PRINT@158,"V
255 PRINT@132,"P R O G R A M";: PRINT@168,"R E M A R K S
259 REM *** 4. MOVE CHARACTERS DOWNWARD. (DISPLAY) ***
260 PRINT"315 CLS:"CHR$(217)"' CLEAR SCREEN"
265 PRINT"320 FOR P=29 TO 861 STEP 64:     ' SET RANGE AND INCRE
MENT STEP"
270 PRINT"325 IF P<93 THEN 335:            ' SKIP FIRST ERASURE"

275 PRINT"330 PRINT@P-64,"CHR$(34)"   "CHR$(34)";              ' E
RASE ABOVE FALLING BOMB"
280 PRINT"335 PRINT@P,"CHR$(34)"VWV"CHR$(34)";:"CHR$(206)"' PRIN
T 'VWV' (FINS) AT P"
285 PRINT"340 PRINT@P+65,"CHR$(34)"H"CHR$(34)";:"CHR$(205)"' PRI
NT 'H' (BODY) AT P+65"
290 PRINT"345 PRINT@P+129,"CHR$(34)"V"CHR$(34)";:"CHR$(204)"' PR
INT 'V' (NOSE) AT P+129"
295 PRINT"355 FOR D=1 TO 50: NEXT D        ' WAIT A LITTLE BIT"
300 PRINT"360 NEXT P:"CHR$(214)"' INCREMENT P BY 64 (ONE LINE)"
305 PRINT"365 AND 370 EXPLODE BOMB         ' (SEE 365 AND 370 IN
 LISTING)";:PRINT@18,"P = 29";
310 GOSUB4:PRINT@909,CHR$(230);:FORD=1TO50:NEXTD:GOTO320
314 REM *** 4. MOVE CHARACTERS DOWNWARD. (PROGRAM) ***
315 CLS:
320 FOR P=29 TO 861 STEP 64:
325 IF P<93 THEN 335:
330 PRINT@P-64,"   ";:
335 PRINT@P,"VWV";:
340 PRINT@P+65,"H";:
345 PRINT@P+129,"V";:
350 PRINT@18,"P ="P  ;:
355 FOR D=1 TO 50: NEXT D:
```

Listing 1 continues

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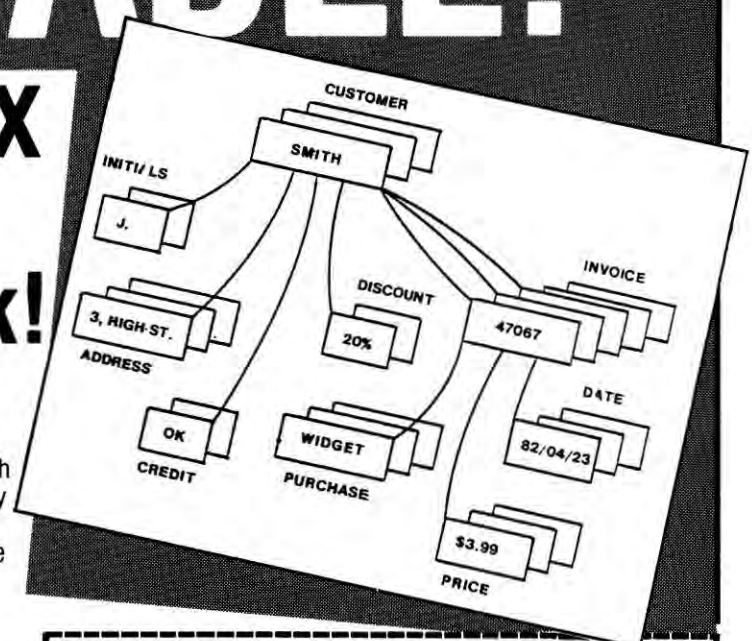

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Listing 1 continued

```
360 NEXT P:
365 PRINT@857,"***   ***";:PRINT@912,"* * * * * * * * * * * * *
* *";:PRINT@984,"*************";
370 FORD=1TO50:NEXTD:PRINT@857,"          ";
375 GOTO1
379 REM *** 5. MOVE CHARACTERS UPWARD. (DISPLAY) ***
380 PRINT@132,"P R O G R A M": PRINT@168,"R E M A R K S
385 PRINT"435 CLS:"CHR$(217)"' CLEAR SCREEN"
390 PRINT"440 FOR P=989 TO 157 STEP-64:     ' SET RANGE AND DECRE
MENT STEP"
395 PRINT"445 IF P>925 THEN 455:            ' SKIP FIRST ERASURE"

400 PRINT"450 PRINT@P+64,"CHR$(34)"   "CHR$(34)";:           ' E
RASE UNDER RISING MISSILE"
405 PRINT"455 PRINT@P,"CHR$(34)"AMA"CHR$(34)";:"CHR$(206)"' PRIN
T 'AMA' (TAIL) AT P"
410 PRINT"460 PRINT@P-63,"CHR$(34)"H"CHR$(34)";:"CHR$(205)"' PRI
NT 'H' (BODY) AT P-63"
415 PRINT"465 PRINT@P-127,"CHR$(34)"A"CHR$(34)";:"CHR$(204)"' PR
INT 'A' (NOSE) AT P-127"
420 PRINT"475 FOR D=1 TO 50: NEXT D:        ' WAIT A LITTLE BIT"
425 PRINT"480 NEXT P:"CHR$(214)"' DECREMENT P BY 64 (ONE LINE)";

430 GOSUB4:PRINT@909,CHR$(230);:PRINT@18,"P = 989";:PRINT@989,"A
MA";:PRINT@926,"H";:PRINT@862,"A";:FORD=1TO500:NEXTD:GOTO440
434 REM *** 5. MOVE CHARACTERS UPWARD. (PROGRAM) ***
435 CLS:
440 FOR P=989 TO 157 STEP-64:
445 IF P>925 THEN 455:
450 PRINT@P+64,"   ";:
455 PRINT@P,"AMA";:
460 PRINT@P-63,"H";:
465 PRINT@P-127,"A";:
470 PRINT@18,"P ="P  ;:
475 FOR D=1 TO 50: NEXT D:
480 NEXT P:
485 GOTO1
489 REM *** 6. MOVE CHARACTERS DIAGONALLY. (DISPLAY) ***
490 PRINT@92,"P = 968
495 PRINT@196,"P R O G R A M"CHR$(226)"R E M A R K S
500 PRINT@256,"545 CLS:"CHR$(232)"' CLEAR SCREEN"
505 PRINT"550 FOR P=968 TO 53 STEP-61:"CHR$(209)"' SET RANGE & S
TEP"
510 PRINT@384,"555 IF P>907 THEN 565:"CHR$(212)"' SKIP FIRST ERA
SURE"
515 PRINT"560 PRINT@P+61,"CHR$(34)"     "CHR$(34)";:"CHR$(207)"'
 ERASE BEHIND FLY SAUCER"
520 PRINT@512,"565 PRINT@P,"CHR$(34)"<XXX>"CHR$(34)";:"CHR$(207)
"' PRINT SAUCER AT POSITION P"
525 PRINT@576,"575 FOR D=1 TO 50: NEXT D:       ' WAIT A LITTLE
BIT (OPTIONAL)"
530 PRINT@640,"580 NEXT P:"CHR$(211)"' DECREMENT P, 61 PRINT@ PO
```

Listing 1 continues

```
 DEMONSTRATION  PROGRAM  MENU
 ==============================
 1. SHOW CHARACTER DISPLAY MAP.
 2. MOVE CHARACTERS RIGHTWARD.
 3. MOVE CHARACTERS LEFTWARD.
 4. MOVE CHARACTERS DOWNWARD.
 5. MOVE CHARACTERS UPWARD.
 6. MOVE CHARACTERS DIAGONALLY.
 7. MOVE GRAPHIC SHAPE RIGHTWARD.
 8. MOVE GRAPHIC SHAPE LEFTWARD.
 9. MOVE GRAPHIC SHAPE UPWARD.
10. EXIT PROGRAM.

 WHICH DEMO PROGRAM DO YOU WANT?
```

Fig. 2. Demo Program Menu Display

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"<XXX>" at its starting point. Statement 540 prints a press-to-run prompt. Pressing the space bar erases the prompt, cycles a short delay, and starts the demo program at statement 550.

Statement 550 specifies start, stop, and step values. Statements 560 and 565 erase and reprint the saucer, moving it diagonally upward between the displayed statements and their remarks. Statement 550's STEP – 61 decrements the saucer's PRINT@ location upward one line and rightward three character positions during each of 15 loops.

You can make the flying saucer streak upward by deleting statement 575; you can slow the saucer down by changing statement 575's delay value 50 to 150, or more. A slowdown makes reading the real-time PRINT@ values easier during the saucer's flight.

Moving Graphic Shapes

Demo programs 7 and 8 show how several graphic patterns can be linked together (concatenated) into strings and used to produce double-action graphics. Alternately displaying each of two or more graphic-pattern strings at one-pixel increments or decrements smooths the action. Both programs use A$ and

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Listing 1 continued

```
SITIONS"
535 PRINT@968,"<XXX> "CHR$(93)"---- FLYING SAUCER START POINT (P
 = 968)";
540 GOSUB4:PRINT@909,CHR$(230);:GOSUB115:GOTO550
544 REM *** 6. MOVE CHARACTERS DIAGONALLY. (PROGRAM) ***
545 CLS:
550 FOR P=968 TO 53 STEP-61:
555 IF P>907 THEN 565:
560 PRINT@P+61,"     ";:
565 PRINT@P,"<XXX>";:
570 PRINT@95,P ;:
575 FOR D=1 TO 50: NEXT D:
580 NEXT P:
585 GOTO1
589 REM *** 7. MOVE GRAPHIC SHAPE RIGHTWARD. (DISPLAY) ***
590 PRINT@132,"P R O G R A M"CHR$(224)"R E M A R K S
595 PRINT"650 CLS:"CHR$(232)"'CLEAR SCREEN"
600 PRINT"655 A$=CHR$(160)+CHR$(152)+CHR$(166)+CHR$(145): 'A STR
ING ("CHR$(160)+CHR$(152)+CHR$(166)+CHR$(145)")";
605 PRINT"660 B$=CHR$(128)+CHR$(176)+CHR$(142)+CHR$(177): 'B STR
ING ( "CHR$(176)+CHR$(142)+CHR$(177)")";
610 PRINT"665 FOR P=0 TO 60:"CHR$(222)"'SET P@ RANGE"
615 PRINT"675 PRINT@P,A$;:"CHR$(224)"'PRINT A$ AT P"
620 PRINT"680 GOSUB 705:"CHR$(226)"'WAIT A BIT"
625 PRINT"685 PRINT@P,B$;:"CHR$(224)"'PRINT B$ AT P"
630 PRINT"690 GOSUB 705:"CHR$(226)"'WAIT A BIT"
635 PRINT"695 NEXT P: END:"CHR$(224)"'INCREMENT P"
640 PRINT"705 FOR D=1 TO 10: NEXT D: RETURN:"CHR$(206)"'DELAY RO
UTINE"
645 PRINT@0,CHR$(160)+CHR$(152)+CHR$(166)+CHR$(145);:PRINT@93,"P
 = 0";:GOSUB4:GOTO655
649 REM *** 7. MOVE GRAPHIC SHAPE RIGHTWARD. (PROGRAM) ***
650 CLS:
655 A$=CHR$(160)+CHR$(152)+CHR$(166)+CHR$(145):
660 B$=CHR$(128)+CHR$(176)+CHR$(142)+CHR$(177):
665 FOR P=0 TO 60:
670 PRINT@93,"P ="P ;:
675 PRINT@P,A$;:
680 GOSUB 705:
685 PRINT@P,B$;:
690 GOSUB 705:
695 NEXT P:
700 GOTO 1:
705 FOR D=1 TO 10: NEXT D: RETURN:
709 REM *** 8. MOVE GRAPHIC SHAPE LEFTWARD. (DISPLAY) ***
710 PRINT@132,"P R O G R A M"CHR$(224)"R E M A R K S
715 PRINT"775 CLS:"CHR$(232)"'CLEAR SCREEN"
720 PRINT"780 A$=CHR$(138)+CHR$(169)+CHR$(140)+CHR$(172)+CHR$(12
9):'"CHR$(138)+CHR$(169)+CHR$(140)+CHR$(172)+CHR$(129)
725 PRINT"785 B$=CHR$(135)+CHR$(172)+CHR$(140)+CHR$(166)+CHR$(12
8):'"CHR$(135)+CHR$(172)+CHR$(140)+CHR$(166)
730 PRINT"790 FOR P=123 TO 64 STEP-1:"CHR$(213)"'SET RANGE/STEP"

735 PRINT"800 PRINT@P,A$;:"CHR$(224)"'PRINT A$ AT P"
740 PRINT"805 GOSUB 830:"CHR$(226)"'WAIT A BIT"
745 PRINT"810 PRINT@P,B$;:"CHR$(224)"'PRINT B$ AT P"
750 PRINT"815 GOSUB 830:"CHR$(226)"'WAIT A BIT"
755 PRINT"820 NEXT P: END:"CHR$(224)"'DECREMENT P"
760 PRINT"830 FOR D=1 TO 20: NEXT D: RETURN:"CHR$(206)"'DELAY RO
UTINE"
765 PRINT@123,CHR$(138)+CHR$(169)+CHR$(140)+CHR$(172)+CHR$(129);

770 PRINT@29,"P = 123";:GOSUB4:GOTO780
774 REM *** 8. MOVE GRAPHIC SHAPE LEFTWARD. (PROGRAM) ***
775 CLS:
780 A$=CHR$(138)+CHR$(169)+CHR$(140)+CHR$(172)+CHR$(129):
785 B$=CHR$(135)+CHR$(172)+CHR$(140)+CHR$(166)+CHR$(128):
790 FOR P=123 TO 64 STEP-1:
795 PRINT@32,P ;
800 PRINT@P,A$;:
805 GOSUB 830:
810 PRINT@P,B$;:
815 GOSUB 830:
820 NEXT P:
825 GOTO 1:
830 FOR D=1 TO 20: NEXT D: RETURN:
834 REM *** 9. MOVE GRAPHIC SHAPE UPWARD. (DISPLAY) ***
835 PRINT@4,"P R O G R A M":PRINT"850 CLS:":PRINT"855 FOR P=949
TO 117 STEP-64:":PRINT"865 PRINT@P+63,CHR$(142)+CHR$(131)+CHR$(1
41);:":PRINT"870 PRINT@P,CHR$(191);:":PRINT"875 PRINT@P-64,CHR$(
176);:'(42 ";CHR$(92);" = ASTERISK)"
840 PRINT"880 PRINT@P+63,CHR$(131)+CHR$(42)+CHR$(131);:":PRINT"8
85 PRINT@P-1,CHR$(160)+CHR$(191)+CHR$(144);:":PRINT"890 PRINT@P-
64,CHR$(188);:":PRINT"895 PRINT@P+63,STRING$(3,128);:  '(3 BLANK
S)"
845 PRINT"900 PRINT@P-1,CHR$(184)+CHR$(143)+CHR$(180);:":PRINT"9
05 PRINT@P-64,CHR$(191);:":PRINT"910 NEXT P:":PRINT@1012,CHR$(18
4)+CHR$(143)+CHR$(180);:PRINT@949,CHR$(191)" "CHR$(93)"--949";:P
RINT@106,"P = 949";:GOSUB4:GOTO855
```

Listing 1 continues

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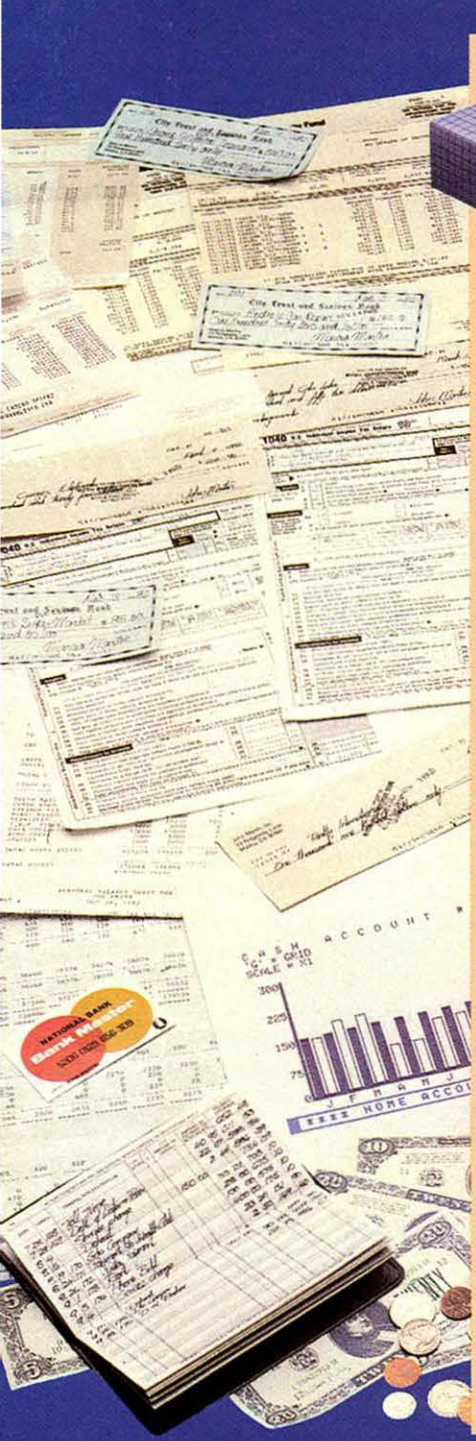

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B$ as their printing strings.

In program 7, A$ prints a six-pixel-long cyclist shape that spans from the center of one character position to the center of a fourth character position. B$ displays the same cyclist offset rightward one pixel width, except for the cyclist's head. B$'s first character, CHR$(128), is the indispensable trailing blank. It erases A$'s CHR$(160) as the cyclist moves rightward.

Statements 675 and 685 print A$ and B$ shapes, in turn, at the same PRINT@ location during each program loop. Moving the cyclist's body twice and the head once during each loop makes the head appear to move back and forth. Statements 680 and 690 provide slight delays to slow down cyclist movement.

Program 8 provides similar graphic actions, but in a leftward direction. A$ in statement 780 prints a horse shape. B$ in statement 785 prints the same shape, but offset leftward one pixel, except for the legs. The horse's legs occupy the same pixels in A$ and B$. Moving the horse's body twice while moving the legs once during each loop gives the horse a trotting appearance. B$'s CHR$(128) is the trailing blank.

Listing 1 continued

```
849 REM *** 9. MOVE GRAPHIC SHAPE UPWARD. (PROGRAM) ***
850 CLS:
855 FOR P=949 TO 117 STEP-64:
860 PRINT@109,P;
865 PRINT@P+63,CHR$(142)+CHR$(131)+CHR$(141);:
870 PRINT@P,CHR$(191);:
875 PRINT@P-64,CHR$(176);:
880 PRINT@P+63,CHR$(131)+CHR$(42)+CHR$(131);:
885 PRINT@P-1,CHR$(160)+CHR$(191)+CHR$(144);:
890 PRINT@P-64,CHR$(188);:
895 PRINT@P+63,STRING$(3,128);: '(3 BLANKS)
900 PRINT@P-1,CHR$(184)+CHR$(143)+CHR$(180);:
905 PRINT@P-64,CHR$(191);:
910 NEXT P:
915 PRINT@113,"--"CHR$(94);
920 GOTO 1
925 END
934 REM *** 1. SHOW CHARACTER DISPLAY MAP. ***
935 PRINT" 0--------------"CHR$(94)"64 PRINT@ POSITIONS PER LINE
--------------"CHR$(94)"63":PRINT" 64          (SEE TRS-80 VIDEO
 DISPLAY WORKSHEET)":W=127
940 FORP=122TO955STEP64:PRINT@P,W" "W+1;:W=W+64:NEXTP
945 PRINT@964,STRING$(53,45);CHR$(94)"1023";:PRINT@0,CHR$(149);
950 FORP=62TO958STEP64:PRINT@P,CHR$(170)" "CHR$(149);:NEXTP:PRIN
T@1022,CHR$(170);:FORP=73TO905STEP64:PRINT@P,CHR$(92);:NEXTP
955 PRINT@208,"C H A R A C T E R  D I S P L A Y  M A P";:PRINT@2
72,STRING$(39,61);:PRINT@336,"THE CHARACTER DISPLAY MAP HAS 16 L
INES.";:PRINT@400,"EACH LINE HAS 64 PRINT@ LOCATIONS WHERE";:PRI
NT@456,"16      ALPHANUMERIC OR GRAPHIC CHARACTERS  MAY";
960 PRINT@519,"LINES    BE DISPLAYED. THE LOCATIONS (POSITIONS)"
;:PRINT@592,"ARE NUMBERED  FROM 0 AT THE UPPER LEFT-";:PRINT@656
,"HAND CORNER OF TV SCREEN TO 1023 AT THE";:PRINT@720,"LOWER RIG
HT-HAND CORNER  OF THE SCREEN.";
965 PRINT@784,"PRINT@866,"CHR$(34)"END"CHR$(34)":, FOR EXAMPLE,
DISPLAYS";:PRINT@848,"THAT WORD HERE---"CHR$(94)"END.";:PRINT@91
3,"(PRESS <M> KEY FOR DEMO PROGRAM MENU)";:GOTO3
969 REM *** GRAPHIC TITLE ***
970 B$=CHR$(143)+CHR$(80)+CHR$(78)+CHR$(84)+CHR$(64)
975 PRINT@962,"BLOCK "CHR$(143)" SHOWS PRINT@ POSITION. CURRENT
PRINT@ POSITION ="P  ;:FORD=1TO1500:NEXTD
980 FORP=0TO65STEP5:PRINT@P,B$
985 PRINT@1018,P ;:NEXTP
990 FORP=110TO845STEP65:PRINT@P,B$+B$+B$+B$+B$;


995 PRINT@1018,P ;:FORD=1TO25:NEXTD:NEXTP
1000 FORP=890TO955STEP5:PRINT@P,B$;
1005 PRINT@1018,P ;:NEXTP
1010 FORP=853TO97STEP-63:PRINT@P,CHR$(143)"PRINT@"PCHR$(8)+CHR$(
44);
1015 PRINT@1018,P ;:GOSUB115:NEXTP
1020 PRINT@618,"PRESS";:PRINT@679,"<SPACE BAR>";:PRINT@743,"TO C
ONTINUE";
1025 GOSUB115:RETURN
```

```
                    P = 968

   P R O G R A M                          R E M A R K S
545 CLS:                                  ' CLEAR SCREEN
550 FOR P=968 TO 53 STEP-61:              ' SET RANGE & STEP
555 IF P>907 THEN 565:                    ' SKIP FIRST ERASURE
560 PRINT@P+61,"     ";:                  ' ERASE BEHIND FLY SAUCER
565 PRINT@P,"<XXX>";:                     ' PRINT SAUCER AT POSITION P
575 FOR D=1 TO 50: NEXT D:                ' WAIT A LITTLE BIT (OPTIONAL)
580 NEXT P:                               ' DECREMENT P, 61 PRINT@ POSITIONS


        PRESS <SPACE BAR> TO RUN THIS PROGRAM
     <XXX> <---- FLYING SAUCER START POINT (P = 968)
```

Fig. 3. Typical Program Display

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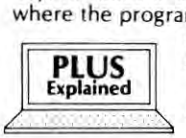

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Statements 805 and 815 provide slight delays.

Demo program 9 shows how stacked graphic patterns can be moved vertically. For lack of space, the display has only two remarks and doesn't show the graphic shapes used in the missile ascent loop. Missile-start-loop and ascent-loop shapes are shown in Fig. 4.

PRINT@1012 and PRINT@949 segments of statement 845 (Listing 1) print a two-line-tall missile (Fig. 4, A) on the display screen's bottom edge. Pressing the space bar starts demo-program execution at statement 855. This statement specifies start-to-stop values and a step decrement (−64).

Three three-statement groups (Fig. 4, B, C, and D) make up an ascent loop that raises the missile. Group A's three statements print the missile's bottom, center, and top sections. Each successive group offsets the missile shape upward one pixel (⅓ of a character line). CHR$(42) in statement 880 simulates a pulsating rocket engine by flashing an asterisk between the missile's tail fins (Fig. 4, C).

STRING$(3,128) in statement 895 prints three blanks that erase below the rising missile (Fig. 4, D). Fourteen loops through graphic-printing statements 865–905 raise the missile to the display screen's top edge.

You can decrease the missile's climb rate by adding statements 876, 891, and 906, each specifying GOSUB 705. For a snail's-pace climb, use GOSUB 115 in the three added statements. The slowed climb rate lets you see the missile inch upward three times while a displayed PRINT@ value decrements once.

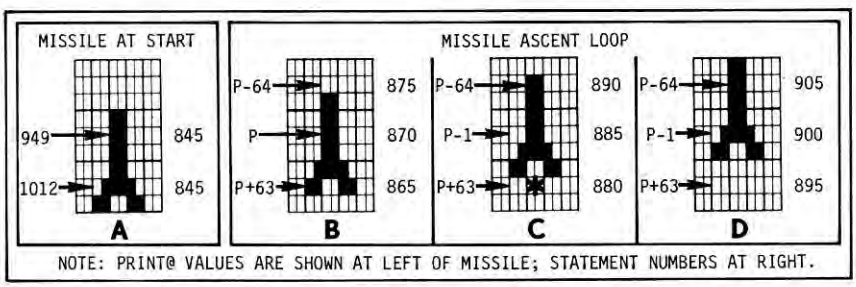

Fig. 4. Program 9 Graphic Shapes

Program 9 Variations

For clarity, demo program 9 has single-statement lines, blanks, and ending colons. The program occupies 285 RAM spaces; it raises the missile to the screen's top edge in 1.86 seconds.

Program 9 can be trimmed 47 bytes and speeded up 1/100 second as shown in Program Listing 2. This variation eliminates spaces and colons, and combines the original three-statement groups into multiple-statement lines 865, 880, and 895. Although it doesn't increase speed very much, it does save a significant number of RAM spaces. You'll eventually resign yourself to using multiple-statement lines and to eliminating spaces, ending quotes, and ending colons. The shortcuts save RAM space and reduce program key-in time.

Program Listing 3 uses a PRINT@ value for the missile's top-section print point, and then uses CHR$(26) downfeeds and CHR$(24) backspaces to

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reach its center- and bottom-section print points. This method for printing stacked graphic characters and strings appears in many recently published game programs.

In the Listing 3 version, statement 855 defines start, stop, and step values for printing the missile's top section. Statements 865, 880, and 895 print missile shapes, each offset upward one pixel. CHR$(176) in statement 865, for example, prints the top section, then (26) drops the cursor one line, and (24) moves it leftward one position.

Now, CHR$(191) prints the missile's center section, (26) drops the cursor one line, and STRING$(2,24) moves it leftward two positions. Finally, CHR$ (142), (131), and (141) print the missile's bottom section. Statements 880 and 895 repeat similar actions.

The downfeed and backspace method may be great for packed-string or super graphics, but it just slows things down in a strictly Basic program. The Listing 3 program takes 2.47 seconds to raise the missile to the screen's top edge while the Listing 2 program takes only 1.85. The latter program is 0.62 seconds faster and 31 bytes shorter.

These are ways you can easily and quickly move alphanumerics and graphic shapes about the TRS-80's display screen. Observing and studying the demo programs will clarify PRINT@ graphic concepts used in Basic and provide a springboard to super graphics. ■

Francis S. Kalinowski can be reached at 16 North Alder Drive, Orlando, FL 32807.

```
85Ø CLS
855 FORP=949TO117STEP-64
865 PRINT@P+63,CHR$(142)+CHR$(131)+CHR$(141);:PRINT@P,CHR$(191);
:PRINT@P-64,CHR$(176);
88Ø PRINT@P+63,CHR$(131)+CHR$(42)+CHR$(131);:PRINT@P-1,CHR$(16Ø)
+CHR$(191)+CHR$(144);:PRINT@P-64,CHR$(188);
895 PRINT@P+63,STRING$(3,128);:PRINT@P-1,CHR$(184)+CHR$(143)+CHR
$(18Ø);:PRINT@P-64,CHR$(191);
91Ø NEXTP
```

Program Listing 2

```
85Ø CLS
855 FORP=885TO53STEP-64
865 PRINT@P,CHR$(176)+CHR$(26)+CHR$(24)+CHR$(191)+CHR$(26)+STRIN
G$(2,24)+CHR$(142)+CHR$(131)+CHR$(141);
88Ø PRINT@P,CHR$(188)+CHR$(26)+STRING$(2,24)+CHR$(16Ø)+CHR$(191)
+CHR$(144)+CHR$(26)+STRING$(3,24)+CHR$(131)+CHR$(42)+CHR$(131);
895 PRINT@P,CHR$(191)+CHR$(26)+STRING$(2,24)+CHR$(184)+CHR$(143)
+CHR$(18Ø)+CHR$(26)+STRING$(3,24)+STRING$(3,128);
91Ø NEXTP
```

Program Listing 3

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Lisp: Basically Speaking—Part I

by Randy Beer

Interested in a language that uses objects instead of numbers? Lisp is a symbol-manipulation language that uses lists of objects.

Lisp is a programming language, usually considered to fall somewhere between machine language and higher-level languages such as Basic, Pascal, APL, or Fortran. Its syntax and data structures differ from more traditional languages. Much of today's research in symbolic math systems, natural language interfaces, and artificial intelligence is being done in Lisp, or in a higher-level language based on Lisp.

However, writing a program in Lisp no more guarantees that it will be intelligent than having a truckload of materials guarantees that you will be able to build a house. The basic building blocks appear to be there, but more work is necessary to even begin to assemble them into programs that exhibit intelligent behavior.

Perhaps because of its association with such abstract things as artificial intelligence, a stigma of complexity has been associated with Lisp. People who have seen a Lisp program without understanding it remember only the seemingly confusing syntax and endless parentheses. These things that tend to confuse the uninitiated are what makes Lisp powerful in the hands of an experienced programmer.

Understanding Lisp

Lisp is a symbol-manipulation language. Where many languages work with numbers, Lisp works with objects such as "chair" and "block." Relations between objects are represented as lists; hence, it is a list processor (from which Lisp gets its name). An example of a relationship between a chair and a block would be shown as: (ON BLOCK CHAIR).

These words or objects are called atoms. Numbers are also atoms. Symbolic atoms, however, cannot begin with a number, but can contain one. Thus FACT, ARG1, ONE, 12 and −3.14159 are all atoms; FACT, ARG1, and ONE are symbolic atoms; and 12 and −3.14159 are numbers. Two special atoms come predefined in every Lisp system; they are the atoms T and NIL, and can usually be thought of as logical true and false, respectively.

Lists are built out of atoms and other lists, with a left parenthesis to mark the beginning of a list and a right parenthesis to mark the end. (A B C), (MUL 2 3), (A (B (C D) E) F G), and () are all examples of lists.

The atom NIL serves a dual purpose in that it is also used to represent the empty list. NIL and () are equivalent in all respects.

Lisp works with symbolic or s-expressions composed of atoms and lists. Thus, anything that's an atom or a list is also an s-expression. In the eyes of a Lisp interpreter, programs and data are nearly identical. This fact contributes greatly to the power of Lisp, because it allows one program to write

User input is next to the $ Basic Lisp prompt, with interpreter response on the next line, as in all examples in this article. Note that all messages from the interpreter are preceded by a semi-colon. The OB LIST is where new atoms are stored.

```
$ (MUL2)
; MUL2 INVALID FUNCTION NAME

$ (%)
; MUL2 DELETED FROM OB LIST

$ (MUL 2 2)
4
```

Fig. 1. Typing Error Correction

```
$ (ADD 1 2.51 −3)
.51

$ (SUB 4 2)
2

$ (MUL 4 3 2 1)
24

$ (DIV 22 7)
3.14286

$ (POWER 2 3)
8

$ (MUL (ADD 2 3) (POWER 2 .5))
7.07107
```

Fig. 2. Arithmetic in Basic Lisp

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another program and then execute it.

Using Basic Lisp

It has been proven time and again that the best way to teach almost anything is to let the student get his hands dirty from the beginning. A Lisp interpreter written in Basic is included in Listing 1. Type in the program and try all of the examples given in this series and any other ideas you may have. Though it may seem contradictory to write an interpreter for such a symbolic, recursive language in Basic, it may help make Lisp available to as many people as possible.

Basic Lisp is only a subset of a full-blown Lisp system, but it should prove useful in teaching basic aspects of Lisp programming. All the examples in this series will be geared toward Basic Lisp, but important differences between it and more standardized versions will be pointed out along the way.

Typing an expression to the interpreter is easy. After entering a statement like (ADD 1 1), there is no need to hit return. As soon as you close all the open parentheses, the expression is evaluated and answered. In this case, a 2 is returned. One important thing to remember is that atoms must be separated by a space or a carriage return, so that (ADD11) is not at all the same as (ADD 1 1).

Since Lisp is a more highly interactive language than Basic (it actually processes some of your input as you're typing it in) and since Basic Lisp is an interpreter written in another language, speed typists beware! Trying to type too fast will only get you into trouble. A moderate, steady pace is best. Note that this speed problem stems from the fact that Basic Lisp is written in Basic, and is not a problem inherent in Lisp itself.

When you make a typo, it is best to delete it immediately to avoid filling up the interpreter's internal memory with mistakes. A special function is provided in Basic Lisp to make these deletions. You should immediately close the remaining open parentheses. (Backspacing will not work.) When the prompt returns (usually after an error message warning you that a mistake has been made), type (%) and the mistake is deleted. Figure 1 shows an example of the complete routine. Again, a more sophisticated Lisp system supports far easier methods of correcting mistakes.

The actual operation of a Lisp interpreter is simple. It reads and evaluates an s-expression and prints the result (also an s-expression).

An s-expression is evaluated using a few simple rules. The value of T is T, the value of NIL is NIL, and the value of any number is itself. The value of any other atom is the s-expression it is bound to (bound and unbound atoms will be explained shortly). Type in some atoms and let the interpreter evaluate them for you.

When a list (ADD 1 1) is evaluated, the first atom is treated a a function and the rest of the elements of the list are treated as arguments to that function. This is known as prefix nota-

Program Listing

```
5 REM      * BASIC LISP VER 1.1 *
10 REM * BY RANDY BEER; AUG., 1981 *
15 CLS:CLEAR325:DEFINTA-E,G-V,X-Z:DEFSTRO:DIMLM(1100),PL(1100),O
B(90),PT(90),ST(350),FP(50),T1(15),X1(15):N=3000
22 PRINTTAB(23)"BASIC LISP VER 1.1":PRINT:PRINT"INITIALIZING . .
 . WAIT":PRINT
24 FORJ=0TO48:READOB(J),PT(J):NEXT:PE=48:FE=1:OB(46)=CHR$(13):FP
(1)=MEM
26 FORJ=1TO1099:PL(J)=J+1:NEXT:PL(1100)=N:AS=1
28 T=3001:LP=3043:RP=3044:CC=33:N1=58:N2=44:LB=3031:QU=3030:NB=3
032
30 A=0:QT=0:J=0:PRINT:PRINT"$ ";:ONERRORGOTO26000:GOSUB50:GOSUB2
65:GOSUB210:GOTO30
50 J1=0:PRINTCHR$(14);:GOSUB90
55 GOSUB100:IFX<>LPRETURN
60 J1=J1+1:X1(J1)=AS:T1(J1)=AS:LM(T1(J1))=0:AS=PL(AS):IFQRETURN
65 GOSUB55:IFX=RPGOTO80
70 IFLM(T1(J1))<>0THENPL(T1(J1))=AS:T1(J1)=AS:AS=PL(AS)
75 LM(T1(J1))=X:IFQRETURNELSE65
80 PL(T1(J1))=N:X=X1(J1):IFLM(X)=0ANDPL(X)=NTHENPL(X)=AS:AS=X:X=
N
85 J1=J1-1:RETURN
90 A$=INKEY$:IFA$=""THEN90ELSEPRINTA$;:KK=ASC(A$):RETURN
100 IFKK=40THENX=LP:GOTO200
105 IFKK=41THENX=RP:IFJ1=1ORJ1=2ANDQTRETURNELSE200
110 IFKK=39THENQ=-1:QT=QT+1:GOSUB60:LM(T1(J1))=QU:Q=0:GOSUB90:GO
SUB55:Q=-1:GOSUB70:Q=0:GOSUB80:QT=QT-1:RETURN
```

Listing continues

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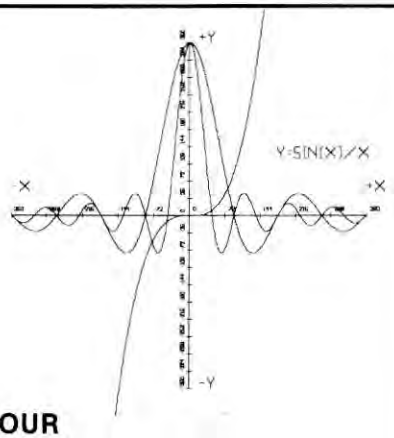

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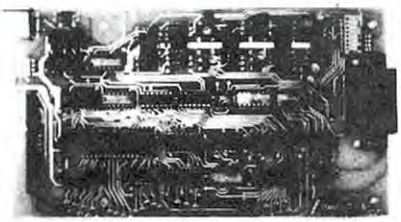

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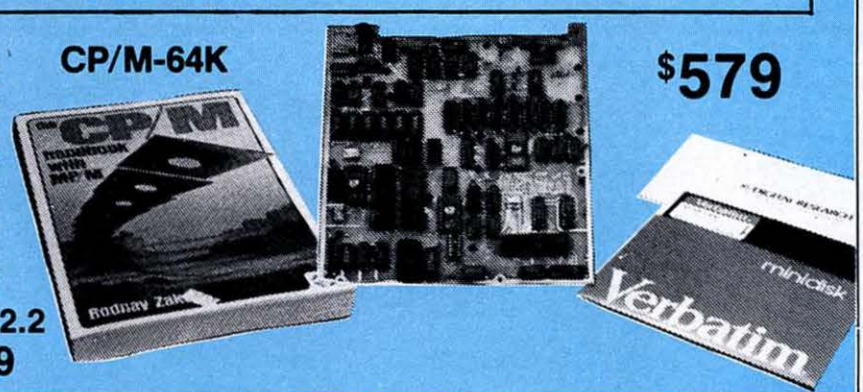

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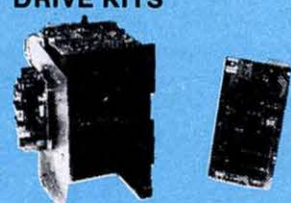

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Listing continued

```
115 IFKK<CCGOSUB90:GOTO100ELSE125
120 IFKK<CCORKK=40ORKK=41ORKK=39THEN130
125 I$=I$+A$:GOSUB90:GOTO120
130 IFASC(I$)<N1ANDASC(I$)>N2THEN150
135 FORJ=0TOPE:IFOB(J)=I$THENX=J+N:I$="":J=0:RETURNELSENEXT
145 J=0:PE=PE+1:OB(PE)=I$:X=PE+N:I$="":RETURN
150 WW=VAL(I$):GOSUB10000:I$="":RETURN
200 GOSUB90:RETURN
210 IFA$<>CHR$(13)PRINT
215 J1=1:X1(J1)=X:GOSUB225:PRINT:RETURN
225 IFX>5000PRINT"; UNPRINTABLE MACHINE CODE";:RETURNELSEIFX>400
0PRINTFP(X-4000);CHR$(24);:RETURN
230 IFX>=NPRINTOB(X-N);:RETURN
235 IFX=0RETURN
237 IFLM(X)=QUPRINT"'";:X=LM(PL(X)):GOSUB225:RETURN
240 J1=J1+1:X1(J1)=X:PRINT"(";
245 X=X1(J1):X=LM(X):GOSUB225
250 X=X1(J1):J1=J1-1:X=PL(X):IFX=NPRINT")";:RETURNELSEIFX>NPRINT
" . ";:GOSUB225:PRINT")";:RETURNELSEIFX=0THENX=1/0
255 J1=J1+1:X1(J1)=X:PRINT" ";:GOTO245
265 FP(1)=MEM:IFX>4000ANDX<5001ORX=NORX=TRETURN
270 IFX>NTHENV=X:X=PT(X-N):IFX=0ANDA=0THENER=6:GOTO25000ELSERETU
RN
275 ST(A+1)=TT:ST(A+2)=AL:ST(A+3)=C:ST(A+4)=E:A=A+4
280 AL=PL(X):E=X:X=LM(X):GOSUB265
285 IFX>=NANDX<4001THENER=1:GOTO25000
290 IFX>6000THEN320ELSEIFX>5000THEN315ELSEIFLM(X)=LBTHEN335ELSEI
FLM(X)=NBTHEN337ELSEER=1:GOTO25000
315 TT=X:GOSUB500:ONTT-5000GOSUB4000,4010,4025,4035,4060,4070,42
95,4290,4085,4095,4130,4170,4200,4220,4230,4245,4255,4300,4315,4
310,4450:GOTO330
320 R=X:X=AL:ONR-6000GOSUB4050,50,4120,4150,4190,4285,4265,4275,
4399,4500,4600,4650,4700,4750
330 E=ST(A):C=ST(A-1):AL=ST(A-2):TT=ST(A-3):A=A-4:RETURN
335 TT=AL:E=PL(X):AL=LM(E):GOSUB500:AL=TT:GOSUB500:C=LM(E):A=A-S
T(A):GOTO340
337 TT=AL:E=PL(X):AL=LM(E):GOSUB500
338 ST(A+1)=TT:ST(A+2)=1:C=LM(E):A=A+1
340 IFC<>NTHENPT(LM(C)-N)=ST(A):A=A+1:C=PL(C):GOTO340
345 A=A-ST(A)-1:TT=PL(E)
350 IFTT<>NTHENX=LM(TT):GOSUB265:TT=PL(TT):GOTO350
355 C=LM(E):A=A-ST(A)
360 IFC<>NTHENPT(LM(C)-N)=ST(A):A=A+1:C=PL(C):GOTO360
365 A=A-ST(A)-1:GOTO330
500 C=0:IFAL=NTHENIFC=0THENA=A+1:ST(A)=0:GOTO510ELSE510
505 X=LM(AL):GOSUB265:C=C+1:A=A+1:ST(A)=X:IFPL(AL)<>NTHENAL=PL(A
L):GOTO505
510 A=A+1:ST(A)=C:RETURN
4000 IFST(A)<>1THENER=2:GOTO25000
4005 A=A-1:IFST(A)=NTHENX=N:A=A-1:RETURN
4006 IFST(A)<2001ANDST(A)>0THENX=LM(ST(A)):A=A-1:RETURN
4007 ER=4:GOTO25000
4010 IFST(A)<>1THENER=2:GOTO25000
4015 A=A-1:IFST(A)=NTHENX=N:A=A-1:RETURN
4017 IFST(A)<2001ANDST(A)>0THENX=PL(ST(A)):A=A-1:RETURN
4020 ER=4:GOTO25000
4025 IFST(A)<>2THRNER=2:GOTO25000
4030 A=A-1:T2=AS:AS=PL(AS):LM(T2)=ST(A-1):PL(T2)=ST(A):A=A-2:X=T
2:RETURN
4035 IFST(A)<>2THENER=2:GOTO25000
4040 A=A-1:IFST(A-1)<NORST(A-1)>4000THENER=3:GOTO25000
4045 PT(ST(A-1)-N)=ST(A):A=A-2:RETURN
4050 X=LM(AL):RETURN
4060 WW=0:FORJ=1TOST(A):A=A-1:IFST(A)>4000ANDST(A)<5001THENWW=WW
+FP(ST(A)-4000):NEXTELSEER=5:GOTO25000
4065 A=A-1:GOSUB10000:RETURN
4070 IFST(A)<>2THENER=2:GOTO25000
4075 A=A-1:IFST(A)<4001ORST(A)>5000ORST(A-1)<4001ORST(A-1)>5000T
HENER=5:GOTO25000
4080 WW=FP(ST(A-1)-4000)-FP(ST(A)-4000):A=A-2:GOSUB10000:RETURN
4085 WW=1:FORJ=1TOST(A):A=A-1:IFST(A)>4000ANDST(A)<5001THENWW=WW
*FP(ST(A)-4000):NEXTELSEER=5:GOTO25000
4090 A=A-1:GOSUB10000:RETURN
4095 IFST(A)<>2THENER=2:GOTO25000
4100 A=A-1:IFST(A)<4001ORST(A)>5000THENER=5:GOTO25000
4105 A=A-1:IFST(A)<4001ORST(A)>5000THENER=5:GOTO25000
4110 IFFP(ST(A+1)-4000)=0THENER=7:GOTO25000
4115 WW=FP(ST(A)-4000)/FP(ST(A+1)-4000):A=A-1:GOSUB10000:RETURN
4120 IFLM(AL)>=NANDLM(AL)<4000THENX=LM(PL(AL)):GOSUB265:PT(LM(AL
)-N)=XELSEER=3:GOTO25000
4125 AL=PL(AL):IFAL=NTHENER=2:GOTO25000ELSEAL=PL(AL):IFAL=NRETUR
NELSE4120
4130 IFST(A)<>1THENER=2:GOTO25000
4135 A=A-1:IFST(A)>=NANDST(A)<5000THENX=T:A=A-1:RETURNELSEX=N:A=
A-1:RETURN
4150 C=LM(AL):X=LM(C):GOSUB265:IFX=NTHENAL=PL(AL):IFAL=NRETURNEL
SE4150
4155 AL=PL(C)
```

Listing continues

tion and, though awkward at first, it becomes easy to read with some practice.

Figure 2 contains some examples of arithmetic in Basic Lisp. Type them in, along with a few of your own, to better understand this notation.

Note that ADD and MUL work with any number of arguments. Note also that, in the last example, the arguments to a function can be another function call. In that case, the inner function call is evaluated first, and the results are returned as arguments to the first function. In the example, the results of (ADD 2 3) and (POWER 2 .5) are then multiplied together to obtain the final answer. This ability to nest expressions in Lisp is very important and can be carried to any reasonable depth (up to 15 in Basic Lisp).

Manipulating S-Expressions with Lisp

Before delving further into Lisp, you must know the process of quoting. An apostrophe is used to quote an s-expression in Basic Lisp. By quoting something, you are telling the interpreter not to evalute any further. In ef-

```
$ (SET 'BROTHERS '(RALPH JOHN))
(RALPH JOHN)

$ (SETQ SISTERS '(SHERRY BETTY))
(SHERRY BETTY)

$ BROTHERS
(RALPH JOHN)

$ SISTERS
(SHERRY BETTY)

$ (SETQ GIRLS SISTERS)
(SHERRY BETTY)

$ GIRLS
(SHERRY BETTY)

$ (SETQ GIRLS 'SISTERS)
SISTERS

$ GIRLS
SISTERS

$ SISTERS
(SHERRY BETTY)

$ SHERRY
; SHERRY UNBOUND ATOM

$ (SETQ ONE 1 TWO 2 THREE 3)
3

$ ONE
1
```

Fig. 3. SET and SETQ

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Listing continued

```
4160 X=LM(AL):GOSUB265:IFPL(AL)=NRETURNELSEAL=PL(AL):GOTO4160
4165 AL=PL(C)
4170 IFST(A)<>2THENER=2:GOTO25000
4175 A=A-1:IFST(A)=ST(A-1)THENX=TELSEX=N
4180 A=A-2:RETURN
4190 PL(E)=AS:AS=E:X=LM(AL):PT(X-N)=AL:IFLM(PL(AL))=NTHENLM(AL)=
LB:RETURNELSEIFLM(LM(PL(AL)))=LBORLM(LM(PL(AL)))=NBTHENPT(X-N)=L
M(PL(AL)):RETURNELSELM(AL)=LB:RETURN
4200 IFST(A)=0THENX=N:A=A-1:RETURNELSEX=AS:F=ST(A):A=A-F:FORJ=1T
OF:IFST(A)=0THENER=4:GOTO25000ELSEG=AS:AS=PL(AS):LM(G)=ST(A):A=A
+1:NEXT:PL(G)=N:A=A-ST(A)-1:RETURN
4220 A=A-1:IFST(A)=NTHENX=TELSEX=N
4225 A=A-1:RETURN
4230 IFST(A)<>1THENER=2:GOTO25000ELSEA=A-1
4235 IFST(A)>4000ANDST(A)<5000THENX=TELSEX=N
4240 A=A-1:RETURN
4245 IFST(A-1)>4000ANDST(A-1)<5000THENFORJ=1TOST(A)-1:A=A-1:IFST
(A-1)>4000ANDST(A-1)<5000THENIFFP(ST(A)-4000)<FP(ST(A-1)-4000)TH
ENX=T:NEXT:A=A-2:RETURNELSE4252ELSE4250
4250 ER=5:GOTO25000
4252 X=N:A=A-2:RETURN
4255 IFST(A-1)>4000ANDST(A-1)<5000THENFORJ=1TOST(A)-1:A=A-1:IFST
(A-1)>4000ANDST(A-1)<5000THENIFFP(ST(A)-4000)>FP(ST(A-1)-4000)TH
ENX=T:NEXT:A=A-2:RETURNELSE4261ELSE4260
4260 ER=5:GOTO25000
4261 X=N:A=A-2:RETURN
4265 IFAL<>NTHENX=LM(AL):GOSUB265:IFX<>NTHENAL=PL(AL):GOTO4265
4270 RETURN
4275 IFAL<>NTHENX=LM(AL):GOSUB265:IFX=NTHENAL=PL(AL):GOTO4275
4280 RETURN
4285 X=E:RETURN
4290 IFST(A)<>1THENER=2:GOTO25000ELSEA=A-1:X=ST(A):GOSUB210:X=0:
A=A-1:RETURN
4295 IFST(A)<>1THENER=2:GOTO25000ELSEA=A-1:X=ST(A):GOSUB265:A=A-
1:RETURN
4300 IFST(A)<>1THENER=2:GOTO25000
4305 A=A-1:X=ST(A):IFX>=NANDX<5000GOSUB225:X=0:A=A-1:RETURNELSEE
R=3:GOTO25000
4310 IFST(A)=0ORST(A-1)=NTHENX=N:A=A-ST(A)-1:RETURNELSEX=AS:FORJ
=A-ST(A)TOA-1:Y=ST(J):IFY=0ORY>2000ANDY<>NTHENER=4:ST(A)=Y:GOTO2
```

Listing continues

fect, you're declaring a constant. Thus, (MUL 2 3) is a function call resulting in a 6 and '(MUL 2 3) is just a list of three atoms: MUL, 2, and 3. The apostrophe is actually a shorthand for the QUOTE function and '(MUL 2 3) is represented internally as (QUOTE (MUL 2 3)). The two notations are identical in all respects, and either can be used. The single quote mark is more common because of the increased clarity.

Much like Basic variables, Lisp atoms can have values. Atoms that have been assigned a value are called bound atoms. Atoms that haven't yet received a value are called unbound atoms. Unlike regular variables, the value of an atom can be any Lisp object: a list, a number, or another atom.

There are no "string" atoms and "integer" atoms. A single atom can hold either value at different times. As mentioned earlier, the value of T, NIL, or any number is simply itself. The values of predefined function names like MUL and ADD are unprintable machine code and are actually pointers to the Basic subroutines that perform the functions. One atom that comes predefined in Basic Lisp is the atom FREE. Its value at any time is the amount of

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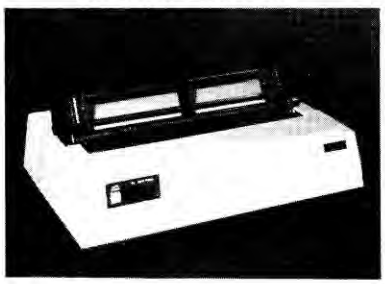

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- C.ITOH 8510AP CALL • 8510ACD ..... CALL
- C.ITOH 1541SP CALL • 1541SRE ..... CALL
- C.ITOH F10-40PU & F10-40RU ..... CALL
- C.ITOH F10-55PU & F10-55RU ..... CALL
- EPSON MX80 F/T GRAFTRAX PLUS ..... CALL
- EPSON MX100 GRAFTRAX PLUS ..... CALL
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- COMREX CR-1-S, CR-1-C, CR-1-Q ..... CALL
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- DAISY WRITERS ..... CALL

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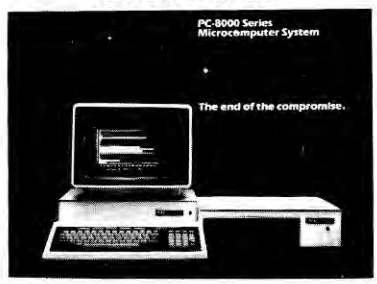

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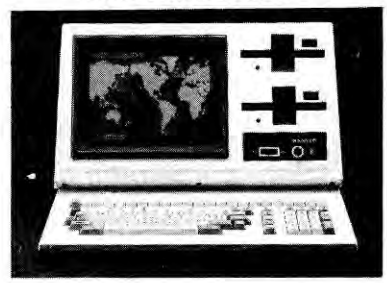

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TRS-80 memory remaining and it acts just like the MEM function in Level II.

Initially, all atoms that aren't predefined are unbound. They can be given values using the Lisp functions SET and SETQ. For example, suppose you wanted the atom BROTHERS to represent the list (RALPH JOHN). Typing in (SET 'BROTHERS '(RALPH JOHN)) would work, as would (SETQ BROTHERS '(RALPH JOHN)). Evaluating BROTHERS would return the list (RALPH JOHN).

Note the difference between SET and SETQ. SET first evaluates the atom to be bound, so that the atom must be quoted if that evaluation is to be stopped. SETQ performs no such evaluation.

Study the examples in Fig. 3, and try a few of your own, to practice using these two very important Lisp functions. Notice that SETQ can work with several assignments at once. Note also that SET and SETQ evaluate their second arguments (and fourth, sixth, and so on for SETQ) so that this argument must be quoted if that evaluation isn't desired. Remember that '2 and 2 result in the same thing, since the value of any number is itself.

Both SET and SETQ actually do two things. First, they assign the value of their second argument to their first. Second, they return the value of their last arguments. An assignment is known as a side-effect, because something has been permanently changed. Almost all Basic Lisp functions return a value, but only a few have side-effects. An example of a function without a side-effect is (ADD 1 1). This function call returns a 2, but changes nothing. Sometimes a function is used for its returned value, or for its side-effects (if any), and sometimes for both. The (SETQ B 'C) in (SETQ A (SETQ B 'C)) assigns C to B and returns C,

```
$ (CAR '((A B) (C D)))
(A B)

$ (CDR '((A B) (C D)))
((C D))

$ (CDR '(A))
NIL

$ (CAR NIL)
NIL

$ (CDR '())
NIL

$ (CAR (CDR '(RALPH SHERRY JOHN BETTY)))
SHERRY

$ (CAR '(CDR (A B C)))
CDR
```

Fig. 4. CAR and CDR

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```
5000
4312 IFY<>NTHENZ=AS:AS=PL(AS):LM(Z)=LM(Y):Y=PL(Y):GOTO4312
4313 NEXT
4314 A=A-ST(A)-1:PL(Z)=N:RETURN
4315 IFST(A)<>2THENER=2:GOTO25000
4320 A=A-1:IFST(A)<4001ORST(A)>5000THENER=5:GOTO25000
4325 A=A-1:IFST(A)<4001ORST(A)>5000THENER=5:GOTO25000
4330 WW=FP(ST(A)-4000)[FP(ST(A+1)-4000):GOSUB10000:A=A-1:RETURN
4399 IFLM(AL)<3000ORLM(AL)>4000THENER=1:GOTO4447ELSET2=PT(LM(AL)
-N):IFT2>2000ORT2=0THENER=1:GOTO4447ELSEIFLM(T2)<>LBANDLM(T2)<>N
BTHENER=1:GOTO4447
4400 PRINT:PRINT:PRINT"(DEFUN ";:X=LM(AL):A$=CHR$(13):GOSUB230:P
RINT" (";:X=LM(T2):GOSUB230:PRINT" ";:T2=PL(T2):X=LM(T2):J1=1:X1
(J1)=X:GOSUB225:J=0:J2=0
4405 T2=PL(T2):IFT2<>NPRINT:PRINTTAB(3);:X1(J2)=-2:X=LM(T2):GOSU
B4410:GOTO4405ELSEPRINT"))";:X=0:RETURN
4410 IFX>4000PRINTFP(X-4000);CHR$(24);:RETURN
4415 IFX>=NPRINTOB(X-N);:RETURN
4420 IFLM(X)=QUPRINT"'";:X=LM(PL(X)):GOSUB225:RETURN
4425 J=J+1:T1(J)=X:D=LM(X):B=D-N:IFB=40ORB=41ORB=31THEN4445ELSEI
FB<>6ANDB<>9ANDB<>10ANDB<>14ANDB<>20ANDB<>21PRINT"(";ELSE4435
4430 X=T1(J):X=LM(X):GOSUB4410:X=T1(J):J=J-1:X=PL(X):IFX=NPRINT"
)";:RETURNELSEJ=J+1:T1(J)=X:PRINT" ";:GOTO4430
4435 T1(J)=PL(T1(J)):PRINTTAB(X1(J2)+2)"(";:J2=J2+1:X1(J2)=POS(0
):X=D:GOSUB4415:PRINT
4440 X=LM(T1(J)):PRINTTAB(X1(J2)+2);:GOSUB4410:X=T1(J):J=J-1:X=P
L(X):IFX=NTHENJ2=J2-1:PRINT")";:RETURNELSEPRINT:J=J+1:T1(J)=X:GO
TO4440
4445 T1(J)=PL(T1(J)):PRINTTAB(X1(J2)+2)"(";:J2=J2+1:X1(J2)=POS(0
):X=D:GOSUB4415:PRINT" ";:X=LM(T1(J)):GOSUB4410:PRINT:T1(J)=PL(T
1(J)):GOTO4440
4447 E=0:LM(E)=LM(AL):GOTO25000
4450 IFST(A)<>2THENER=2:GOTO25000ELSEA=A-1:IFST(A)>2000THENER=4:
GOTO25000ELSEA=A-1:IFST(A)<NORST(A)>4000THENER=3:GOTO25000ELSEJ=
ST(A+1):D=ST(A):X=AS:Z=N
4455 IFJ<>NTHENIFLM(J)=DGOTO4460ELSEZ=AS:AS=PL(AS):LM(Z)=LM(J)EL
SEIFZ=NTHENX=N:RETURNELSEPL(Z)=N:RETURN
4460 J=PL(J):GOTO4455
4500 PRINT:PRINT"; HIT ENTER TO BEGIN";:GOSUB90:PRINT#-1,FE,PE,A
S:FORJ=2TOFE:PRINT#-1,FP(J):NEXT:FORJ=49TOPE:PRINT#-1,OB(J),PT(J
```

Listing continues

which is then assigned to A by the first SETQ. The result of the entire function call is to set both A and B to C.

The function EVAL provides an extra round of evaluation beyond the one already performed. In other words, the result of evaluting the argument is then evaluated again. Figure 5 shows an example of how the function EVAL is used.

You will find it useful to be able to take lists apart. Lisp provides two functions for doing this, CAR and CDR. These functions would probably be more understandable if they had been called FIRST and REST respectively, but you are left with historical convention. CAR returns the first element of a list: (CAR '(A B C)) would return A. CDR returns a list of all of the elements of a list except the first: (CDR '(A B C)) would return (B C). Some examples of the use of these two functions are in Fig. 5.

DELETE is a function that removes parts of a list. In Basic Lisp, DELETE takes an atom and a list as arguments and returns a copy of the list with all top-level occurrences of the atom deleted. Full-blown Lisp systems can delete any s-expression from a list, but Basic Lisp can delete only atoms.

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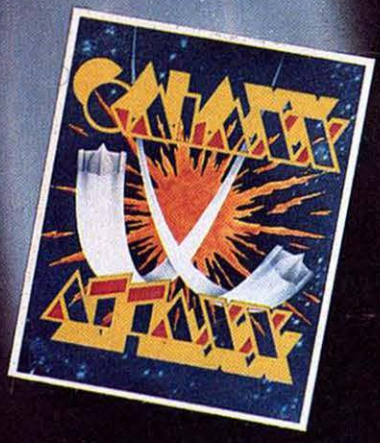

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Listing continued

```
):NEXT:FORJ=1TOAS:PRINT#-1,LM(J),PL(J):NEXT:X=0:RETURN
4600 PRINT:PRINT"; HIT ENTER TO BEGIN";:GOSUB90:INPUT#-1,FE,PE,A
S:FORJ=2TOFE:INPUT#-1,FP(J):NEXT:FORJ=49TOPE:INPUT#-1,OB(J),PT(J
):NEXT:FORJ=1TOAS:INPUT#-1,LM(J),PL(J):NEXT:X=0:RETURN
4650 X=0:A=A-1:IFPE>48THENPRINT:PRINT"; ";OB(PE);" DELETED FROM
OB LIST";:PT(PE)=0:OB(PE)="":PE=PE-1
4655 RETURN
4700 TT=LM(AL):E=PL(AL):AL=E
4705 X=TT:GOSUB265:IFX<>NTHENAL=E:GOSUB4800:GOTO4705ELSERETURN
4750 TT=LM(AL):E=PL(AL):AL=E
4755 X=TT:GOSUB265:IFX=NTHENAL=E:GOSUB4800:GOTO4755ELSERETURN
4800 IFAL<>NTHENX=LM(AL):GOSUB265:AL=PL(AL):GOTO4800
4805 RETURN
10000 FORJ=1TOFE:IFFP(J)=WWTHEN10010
10005 NEXT:FE=FE+1:FP(FE)=WW:X=FE+4000:RETURN
10010 X=J+4000:RETURN
25000 X=ST(A):J1=1:X1(J)=X:IFA$<>CHR$(13)THENPRINT
25001 A$=CHR$(13):ONERGOTO25002,25003,25004,25005,25006,25007,25
008
25002 PRINT"; ";:X=LM(E):GOSUB230:PRINT" INVALID FUNCTION NAME";
:GOTO25050
25003 PRINT"; IMPROPER NUMBER OF ARGUEMENTS TO SUBR OR NSUBR";:G
OTO25050
25004 PRINT"; ";:GOSUB225:PRINT" INVALID ATOM";:GOTO25050
25005 PRINT"; ";:GOSUB225:PRINT" INVALID LIST";:GOTO25050
25006 PRINT"; ";:GOSUB230:PRINT" INVALID NUMBER";:GOTO25050
25007 PRINT"; ";:X=V:GOSUB230:PRINT" UNBOUND ATOM";:GOTO25050
25008 PRINT"; DIVISION BY ZERO";:GOTO25050
25050 X=0:ONERRORGOTO25051:P=1/0
25051 PRINT:RESUME30
26000 IFA$<>CHR$(13)PRINT
26001 IFPE>90PRINT"; OB LIST FULL":PE=90:I$="":GOTO27100
26005 IFFE>50PRINT"; FP FULL":FE=50:I$="":GOTO27100
26010 IFAS=NPRINT"; LIST MEMORY FULL":GOTO27100
26013 IFERR/2+1=9THENIFA>350ORJ1>15ORJ2>15ORJ>15PRINT"; STACK OV
ERFLOW":GOTO27000
26015 PRINT"; ERROR"
27000 RESUME30
27100 PRINT"; HIT ENTER TO REINTIALIZE, ANY OTHER KEY TO CONTINU
E ":GOSUB90:IFA$=CHR$(13)PRINTCHR$(15):RUNELSE27000
50000 DATANIL,3000,T,3001,SETQ,6003,EQ,5012,CAR,5001,CDR,5002,CO
ND,6004,DEFUN,6005,ATOM,5011,LIST,5013,APPEND,5020,ADD,5005,SUB,
5006,MUL,5009,CONS,5003,NUMBERP,5015,GREATERP,5016,LESSP,5017,EV
AL,5007
50001 DATAPRINTF,6009,AND,6007,OR,6008,DELETE,5021,SET,5004,DIV,
5010,NOT,5014,POWER,5019,PRINT,5008,PATOM,5018,READ,6002,QUOTE,6
001,LAMBDA,6006,NLAMBDA,6006,SAVE,6010,LOAD,6011,RPAREN,3044,LPA
REN,3043,QT,3045,CR,3046
50002 DATASP,3047,DOWHILE,6013,DOUNTIL,6014,%,6012,(,0,),0,',0,C
R,0," ",0,FREE,4001
```

Model II/16 Conversion

BY JESSE W. BAKER

EDIT THE FOLLOWING LINES:

```
50 J1=0:PRINTCHR$(01);:GOSUB90
55 GOSUB100:IFX<>LPTHENRETURN
60 J1=J1+1:X1(J1)=AS:T1(J1)=AS:LM(T1(J1))=0:AS=PL(AS):IFQ<>0THENRETURN
65 GOSUB55:IFX=RPTHENGOTO80
75 LM(T1(J1))=X:IFQ<>0THENRETURNELSE65
105 IFKK=41THENX=RP:IFJ1=1ORJ1=2ANDQT<>0THENRETURNELSE200
115 IFKK<CCTHENGOSUB90:GOTO100ELSE125
210 IFA$<>CHR$(13)THENPRINT
225 IFX>5000THENPRINT"; UNPRINTABLE MACHINE CODE";:RETURNELSEIFX>4000THENPRINTFP
(X-4000);CHR$(28);:RETURN
230 IFX>=NTHENPRINTOB(X-N);:RETURN
235 IFX=0THENRETURN
237 IFLM(X)=QUTHENPRINT"'";:X=LM(PL(X)):GOSUB225:RETURN
250 X=X1(J1):J1=J1-1:X=PL(X):IFX=NTHENPRINT")";:RETURNELSEIFX>NTHENPRINT" . ";:G
OSUB225:PRINT")";:RETURNELSEIFX=0THENX=1/0
265 FP(1)=MEM:IFX>4000ANDX<5001ORX=NORX=TTHENRETURN
4025 IFST(A)<>2THENER=2:GOTO25000
4125 AL=PL(AL):IFAL=NTHENER=2:GOTO25000ELSEAL=PL(AL):IFAL=NTHENRETURNELSE4120
4150 C=LM(AL):X=LM(C):GOSUB265:IFX=NTHENAL=PL(AL):IFAL=NTHENRETURNELSE4150
4160 X=LM(AL):GOSUB265:IFPL(AL)=NTHENRETURNELSEAL=PL(AL):GOTO4160
4305 A=A-1:X=ST(A):IFX>=NANDX<5000THENGOSUB225:X=0:A=A-1:RETURNELSEER=3:GOTO2500
0
4330 WW=FP(ST(A)-4000)^FP(ST(A+1)-4000):GOSUB10000:A=A-1:RETURN
4405 T2=PL(T2):IFT2<>NTHENPRINT:PRINTTAB(3);:X1(J2)=-2:X=LM(T2):GOSUB4410:GOTO44
05ELSEPRINT")";:X=0:RETURN
4410 IFX>4000THENPRINTFP(X-4000);CHR$(28);:RETURN
4415 IFX>=NTHENPRINTOB(X-N);:RETURN
4420 IFLM(X)=QUTHENPRINT"'";:X=LM(PL(X)):GOSUB225:RETURN
26000 IFA$<>CHR$(13)THENPRINT
26001 IFPE>90THENPRINT"; OB LIST FULL":PE=90:I$="":GOTO27100
26005 IFFE>50THENPRINT"; FP FULL":FE=50:I$="":GOTO27100
26010 IFAS=NTHENPRINT"; LIST MEMORY FULL":GOTO27100
26013 IFERR/2+1=9THENIFA>350ORJ1>15ORJ2>15ORJ>15THENPRINT"; STACK OVERFLOW":GOTO
27000
27100 PRINT"; HIT ENTER TO REINTIALIZE, ANY OTHER KEY TO CONTINUE ":GOSUB90:IFA$
=CHR$(13)THENPRINTCHR$(02):RUNELSE27000
```

If lists can be taken apart, there should also be ways to put them together. CONS, LIST, and APPEND are three Lisp functions that do just that. CONS takes a list and a new first element for the list and returns a list with the new first element added. LIST makes a list out of all of its arguments. APPEND strings the top-level contents of each list given as an argument into a single list. Figure 5 shows examples of the functions DELETE, CONS, LIST, and APPEND.

You now have a good foundation of basic skills in Lisp programming and have been introduced to most of the functions of Basic Lisp. In Part II, you will put some of these pieces together as you learn how to define your own functions. ■

Randy Beer, a student of computer engineering, can be reached at 911 Lex-Ontario Road, Mansfield, OH 44903.

```
$ (SETQ GIRLS 'SISTERS)
SISTERS

$ (SETQ SISTERS '(SHERRY BETTY))
(SHERRY BETTY)

$ GIRLS
SISTERS

$ (EVAL GIRLS)
(SHERRY BETTY)

$ (DELETE 'A '(A B C))
(B C)

$ (SETQ A-LIST '(A (A B) C A))
(A (A B) C A)

$ (DELETE 'A A-LIST)
((A B) C)

$ A-LIST
(A (A B) C A)

$ (CONS 'A '(B C))
(A B C)

$ (LIST 'A '(B C) 'D)
(A (B C) D)

$ (APPEND '(A) '(B C) '((D)))
(A B C (D))

$ (LIST 'MUL 2 3)
(MUL 2 3)

$ (EVAL (LIST 'MUL 2 3))
6
```

Fig. 5. EVAL, DELETE, CONS, LIST and APPEND

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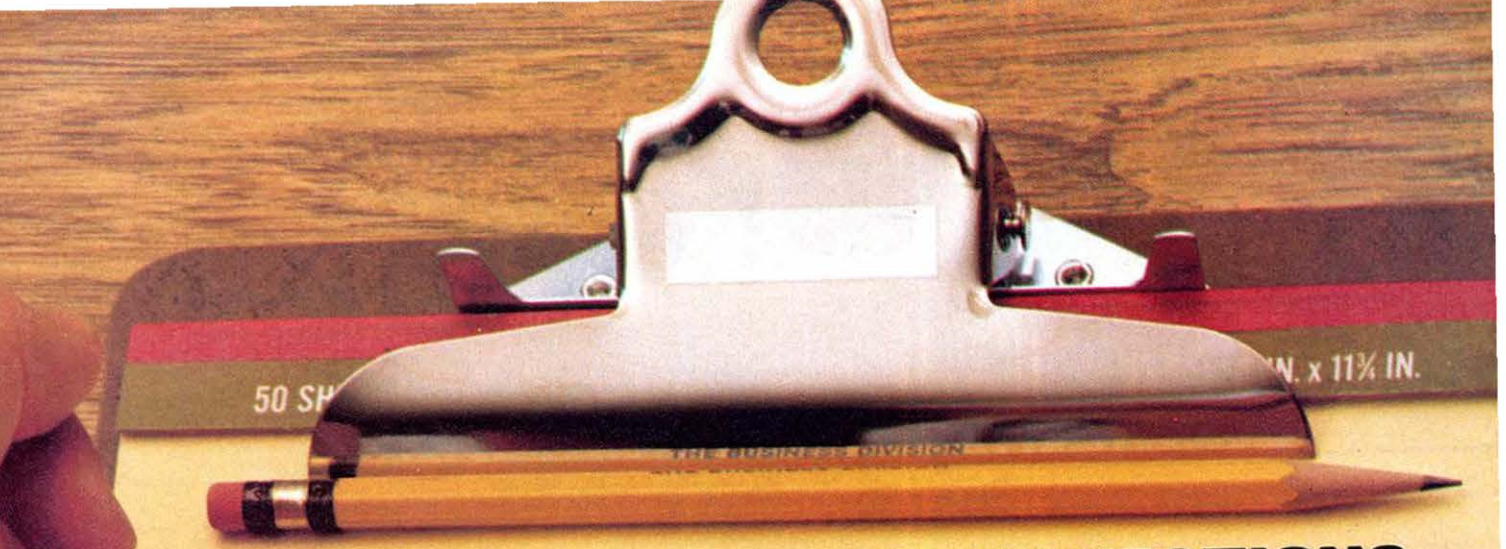

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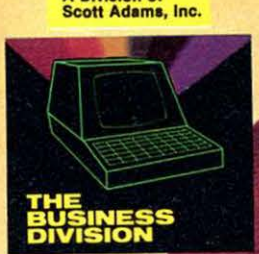

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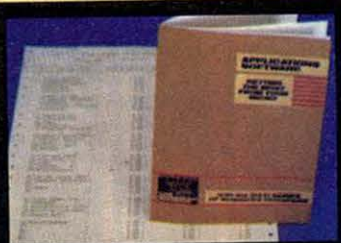

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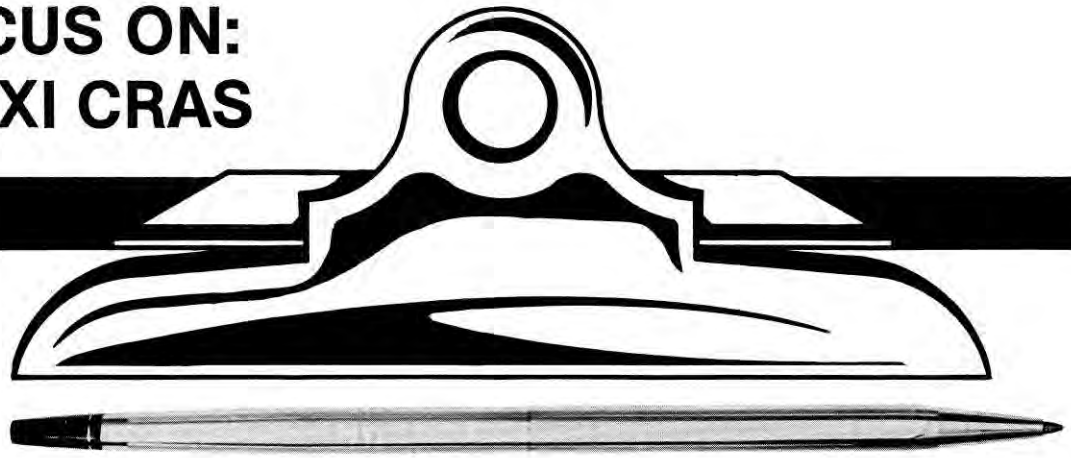

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CC DLOAD

by Frank Bogardus

First, read this article and learn about the Color Computer's ROM. Then you can use the DLOAD command to link it with the Model I.

Program Listing. Model I Host

```
                00100 ;************************************************
                00200 ;MODEL I HOST FOR COLOR COMPUTER DLOAD COMMAND
                00300 ;Written 02/12/82: For Color Computer Download.
                00400 ;
                00500 ;************************************************
5200            00600         ORG    5200H
                00700 ;RS232 port pointers:
00E8            00800 STATUS  EQU    0E8H          ;Modem status register
00E9            00900 CONFIG  EQU    0E9H          ;Read sense switches
00EA            01000 CONTRL  EQU    0EAH          ;UART cntrl (in)/status
00EB            01100 DATA    EQU    0EBH          ;DATA in/out
                01200 ;
4467            01300 MESAGE  EQU    4467H         ;NEWDOS80 message handler
402D            01400 DOS     EQU    402DH         ;DOS reentry
3840            01500 KBDCH   EQU    3840H         ;Break key location
                01600 ;=============================================
                01700 ;Initialize UART to 1200 bd, par=N,stop=2,word=8.
5200 D3E8       01800 INITU   OUT    (STATUS),A
5202 DBE8       01900         IN     A,(STATUS)
5204 3E7F       02000         LD     A,07FH        ;Bit: 0111 1111
5206 D3EA       02100         OUT    (CONTRL),A    ;Sets all but baud.
5208 3E77       02200         LD     A,77H
520A D3E9       02300         OUT    (CONFIG),A    ;Sets baud.
                02400 ;
520C DD211154   02500         LD     IX,CHKSUM
5210 31FFFF     02600         LD     SP,0FFFFH     ;Set to top of memory
                02700 ;=============================================================
                02800 ;General scheme:
                02900 ;  1. Get, echo, display Start Byte (STBYT=8AH).
                03000 ;  2. Get, display Name: save to NAMBUF
                03100 ;  3. Get checksum, echo 0C8H.
                03200 ;  4. Send Flag 1 and Flag 2 (FLG12)
                03300 ;  5. Calculate, send FLG12 checksum (CHKSUM).
                03400 ;  6. Get character: 9FH=Okay; 0BCH=Error.
                03500 ;  7. Get, save 2 byte block count (BLOCK)
                03600 ;  8. Get checksum, echo 0C8H.
                03700 ;  9. Send 1 byte, initialize checksum.
                03800 ; 10. Send 80 bytes, CHKSUM.
                03900 ; 11. Determine if more or end.
                04000 ;
                04100 ;=============================================
                04200 ;1.Get, echo, display start byte.
5213 CDEA53     04300 ONE     CALL   CLRBUF        ;Clear all buffers
5216 3E0E       04400         LD     A,0EH         ;Turn on cursor
5218 CDCD53     04500         CALL   H33
521B 214A54     04600         LD     HL,OKMSG      ;Main prompt
521E CD6744     04700         CALL   MESAGE        ;To screen
5221 CD9E53     04800 ONEA    CALL   IN232         ;Get byte or Break
5224 FE8A       04900         CP     8AH           ;DLOAD called?
5226 280A       05000         JR     Z,OKONE       ;Go if yes
5228 FEDB       05100         CP     0DBH          ;PROGRAM SAVE called?
522A CA1C53     05200         JP     Z,LLIST       ;Go if yes
522D CDBA53     05300         CALL   CHKERR        ;Error called from CC?
5230 18EF       05400         JR     ONEA          ;Keep trying for input
5232 CD8F53     05500 OKONE   CALL   OUT232        ;Echo character
5235 216554     05600         LD     HL,DLDMSG     ;Get DLOAD message
5238 CD6744     05700         CALL   MESAGE        ;To screen
                05800 ;2. Get, display name, save to NAMBUF
```

Listing continues

Loading and saving programs via the cassette recorder limits the Color Computer to lighter computing tasks. I needed a faster way to access programs without the expense of disks and without the major program handlers needed in the Color Computer. That amounted to an impossible set of specs, until I discovered DLOAD.

The Command

Page 146 of the Extended Color Basic manual explains the command: "The statement DLOADM can be used to download (transfer) USR functions from another computer." But when I tried DLOADM as a command, I got TM error (type mismatch).

Page 192 gives the syntax as DLOADM X,1. The explanation says, "...loads machine-language program at specified baud. 0 = 300 baud, 1 = 1200 baud."

Using this syntax also produces a TM error. The Color Computer ROM is obviously looking for a string somewhere. I tried DLOADM "TEST",1 with the same results.

I soon realized that I could use the Model I as my printer. I could send ev-

The Key Box

Model I
32K RAM
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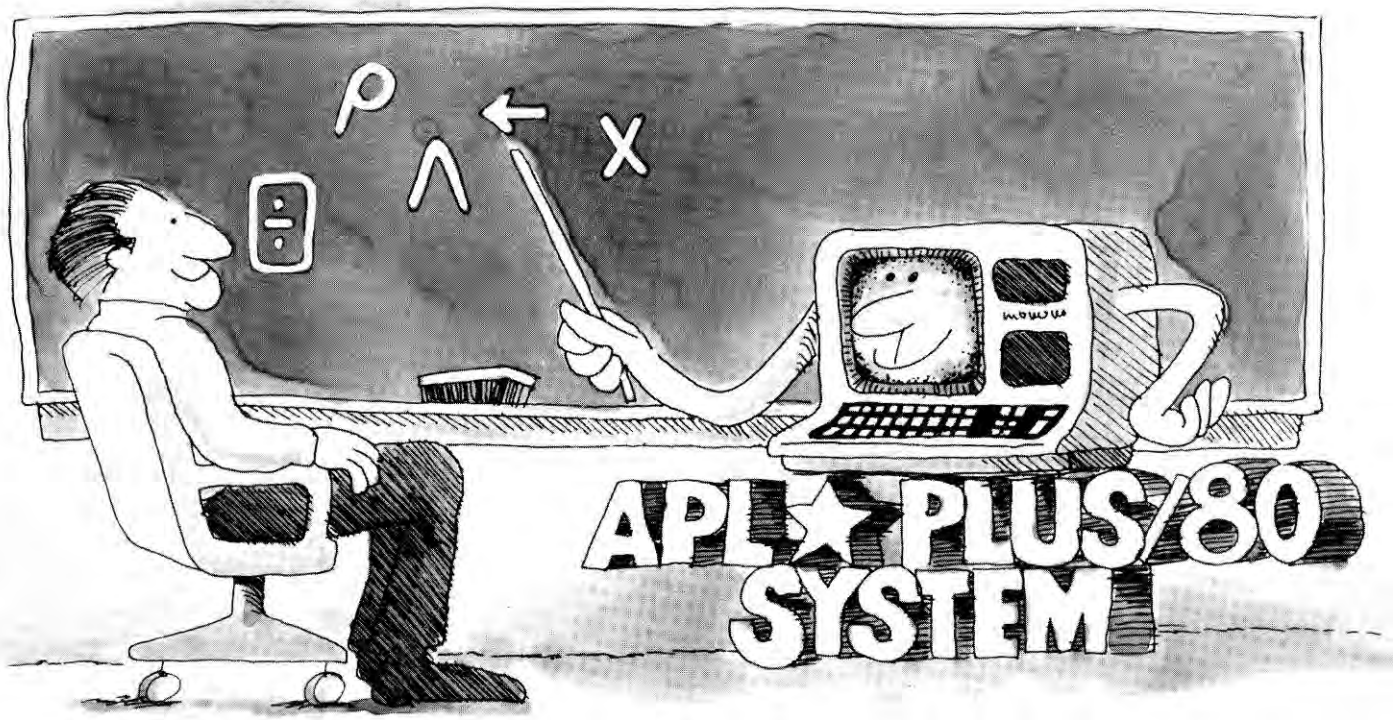

How much do you know about APL?

Q. APL uses "funny symbols." ☐ **TRUE** ☐ **FALSE**
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Listing continued

```
523B 0608     05900 TWO     LD      B,8             ;Max length
523D 217B55   06000         LD      HL,NAMBUF       ;Storage
5240 CD9E53   06100 GET1    CALL    IN232           ;Get byte
5243 CDBA53   06200         CALL    CHKERR          ;Error called from CC?
5246 77       06300         LD      (HL),A          ;Save byte
5247 CDCD53   06400         CALL    H33             ;Display byte
524A 23       06500         INC     HL              ;Bump buffer pointer
524B 05       06600         DEC     B               ;Decrement byte count
524C 20F2     06700         JR      NZ,GET1         ;Get more if B>0
524E 3E0D     06800         LD      A,0DH           ;For screen clarity
5250 CDCD53   06900         CALL    H33             ;Display carraige return
              07000 ;3. Get checksum, load program, echo 0C8H.
5253 CD9E53   07100 THREE   CALL    IN232           ;Get byte
5256 CDBA53   07200         CALL    CHKERR          ;Error called from CC?
5259 CD9D55   07300         CALL    RDPRG           ;Get program into buffer
525C 3EC8     07400         LD      A,0C8H          ;"OK" for CC
525E CD8F53   07500         CALL    OUT232          ;Send
5261 216E54   07600         LD      HL,BLKMSG       ;Block message
5264 CD6744   07700         CALL    MESAGE          ;Message handler
              07800 ;4. Send Flag 1 and Flag 2 (FLG12)
5267 3A0F54   07900 FOUR    LD      A,(FLG12)       ;Get Flag 1
526A CD8F53   08000         CALL    OUT232          ;Send
526D DD360000 08100         LD      (IX),0          ;Initialize Checksum
5271 CDC653   08200         CALL    ADDCS           ;Add to Checksum
5274 3A1054   08300         LD      A,(FLG12+1)     ;Get Flag 2
5277 CD8F53   08400         CALL    OUT232          ;Send
527A CDC653   08500         CALL    ADDCS           ;Add to Checksum
              08600 ;5. Send checksum.
527D 3A1154   08700         LD      A,(CHKSUM)      ;Get Checksum value
5280 CD8F53   08800         CALL    OUT232          ;Send
5283 DD360000 08900         LD      (IX),0          ;Reset Checksum.
              09000 ;6. Get character (9FH = Okay, 0BCH = Error)
5287 CD9E53   09100 SIX     CALL    IN232           ;Get byte
528A FE97     09200         CP      97H             ;"OK" sent from CC?
528C 2805     09300         JR      Z,OKSIX         ;Go if yes
528E CDBA53   09400         CALL    CHKERR          ;Error called from CC?
5291 18F4     09500         JR      SIX             ;Keep checking
5293 CD8F53   09600 OKSIX   CALL    OUT232          ;Echo 97H
              09700 ;7. Get, save 2 bytes (BLOCK)
5296 CD9E53   09800 SEVEN   CALL    IN232           ;Get byte
5299 CDBA53   09900         CALL    CHKERR          ;Error called from CC?
529C DD360000 10000         LD      (IX),0          ;Initialize Checksum
52A0 321254   10100         LD      (BLOCK),A       ;Save
52A3 CDC653   10200         CALL    ADDCS           ;Add to checksum
52A6 CD9E53   10300         CALL    IN232           ;Get second byte
52A9 CDBA53   10400         CALL    CHKERR          ;Error called from CC?
52AC 321354   10500         LD      (BLOCK+1),A     ;Save
52AF CDC653   10600         CALL    ADDCS           ;Add to Checksum
              10700 ;8. Get checksum, echo 0C8H.
52B2 CD9E53   10800 EIGHT   CALL    IN232           ;Get checksum from CC
52B5 3EC8     10900         LD      A,0C8H          ;Load "OK" byte
52B7 CD8F53   11000         CALL    OUT232          ;Send
              11100 ;9. Send 1 byte, initialize checksum.
52BA DD360000 11200 NINE    LD      (IX),0          ;Initialize Checksum
52BE 3A7954   11300         LD      A,(MARK)        ;Get "last block" mark
52C1 FE00     11400         CP      0               ;0 means not last block
52C3 2804     11500         JR      Z,NOTEND        ;Go if not last block
52C5 3E00     11600         LD      A,0             ;Flag 3 value, last block
52C7 1803     11700         JR      ISEND           ;Skip Flag 3 load
52C9 3A7654   11800 NOTEND  LD      A,(FLG3)        ;Load normal Flag 3 value
52CC CD8F53   11900 ISEND   CALL    OUT232          ;Send
52CF CDC653   12000         CALL    ADDCS           ;Maintain Checksum
              12100 ;10. Send 80 bytes, Checksum
52D2 0680     12200 TEN     LD      B,80H           ;Byte count
52D4 2A7754   12300         LD      HL,(PRGPTR)     ;Current program byte
52D7 7E       12400 SEND1   LD      A,(HL)          ;Load to A
52D8 CD8F53   12500 NODS    CALL    OUT232          ;Send
52DB F5       12600         PUSH    AF              ;Preserve on stack
52DC CDC653   12700         CALL    ADDCS           ;Maintain Checksum
52DF F1       12800         POP     AF              ;Return to A
52E0 FEFF     12900         CP      0FFH            ;End-of-program marker?
52E2 2005     13000         JR      NZ,GOSEND       ;Go if not
52E4 3E01     13100         LD      A,1             ;Last block mark
52E6 327954   13200         LD      (MARK),A        ;Set mark
52E9 23       13300 GOSEND  INC     HL              ;Bump program pointer
52EA 05       13400         DEC     B               ;Decrement counter
52EB 20EA     13500         JR      NZ,SEND1        ;More if not done
52ED 227754   13600         LD      (PRGPTR),HL     ;Done, save pointer
52F0 3A1154   13700         LD      A,(CHKSUM)      ;Get updated Checksum
52F3 CD8F53   13800         CALL    OUT232          ;Send
52F6 3E2E     13900         LD      A,'.'           ;One "." for each block
52F8 CDCD53   14000         CALL    H33             ;To display
              14100 ;11. Determine if more or done
52FB 3A7954   14200         LD      A,(MARK)        ;Last block mark
52FE FE01     14300         CP      1               ;Last block yet?
5300 C28752   14400         JP      NZ,SIX          ;Again if not
5303 3A7A54   14500         LD      A,(MARK2)       ;End block mark
5306 FE00     14600         CP      0               ;Send end yet?
5308 C21353   14700         JP      NZ,ALLDUN       ;If yes, all done
530B 3E01     14800         LD      A,1             ;End block value
530D 327A54   14900         LD      (MARK2),A       ;Set mark
5310 C38752   15000         JP      SIX             ;Send another block
5313 211E54   15100 ALLDUN  LD      HL,DUNMSG       ;Message to display
5316 CD6744   15200         CALL    MESAGE          ;Message handler
5319 C31352   15300         JP      ONE             ;Go to main prompt
              15400 ;=========================================
531C F5       15500 LLIST   PUSH    AF              ;Save for echo back
531D D3E8     15600         OUT     (STATUS),A      ;Reinitialize UART
531F DBE8     15700         IN      A,(STATUS)
5321 3E3F     15800         LD      A,3FH           ;7-bit, 2-stop, no parity
5323 D3EA     15900         OUT     (0EAH),A
5325 3E77     16000         LD      A,77H           ;1200 baud
5327 D3E9     16100         OUT     (0E9H),A
5329 F1       16200         POP     AF
532A 217B55   16300         LD      HL,NAMBUF       ;To save name
532D CD8F53   16400         CALL    OUT232          ;Echo
5330 CD9E53   16500 GETNXT  CALL    IN232           ;Get name byte
5333 CD8F53   16600         CALL    OUT232          ;Echo
```

Listing continues

erything out the RS-232 serial printer line, receive it with 7-bit, no-parity, 600-baud protocol, save it to disk, and print it later. This capability, and a 6809 disassembler, led to a full ROM printout. The command tables included CLOAD and CLOADM, as expected, but they contained DLOAD (not DLOADM) as the sole downloading command. By dropping the M I got the computer to hand up, suggesting that it was looking for a serial input.

I wanted to write a Color Computer monitor to load machine-language programs but I needed to find the ROM locations to send and receive single bytes through the RS-232 serial port. That solution would not allow loading Basic programs, but DLOAD was not supposed to do that, anyway.

However, after experimenting, I found that DLOAD is very good at loading Basic programs. It may load machine-language programs as well, but I haven't yet cracked the code for that.

The DLOAD Command

The program requires a thorough understanding of the DLOAD command. The only version I have been able to get a response from has the syntax: DLOAD "file name," X, where X is a 0 for 300-baud operation and a 1 for 1,200-baud operation. The Color Computer stores the countdown baud value for the DLOAD command at 0E6H. The value is 2CH for 1,200 baud (the initialized value) and B0H for 300 baud. You can set other baud rates by POKEing other values. This baud counter is separate from the two-byte counter for the printer function (maintained at 95H–96H), so you can maintain two different baud rates. Also, the values for a given baud rate are slightly higher for the DLOAD command than for the printer.

Following is a description of the ROM actions upon recognition of the DLOAD command:

- Control passes to 8C18H, where the name reads into a buffer at 01D2-01D9H, and the baud rate is deciphered and stored in 00E6H. The name is left justified in an 8-byte buffer and padded on the right by spaces.
- A handshaking byte of 8AH is sent to RS-232 out, and comes back as an echo from the RS-232.
- The ROM sends out an 8-byte name block, and it maintains a checksum of the characters sent.
- The checksum goes to RS-232 out, presumably for the host to verify the name; RS-232 in is checked for C8H.
- The ROM checks RS-232 in for

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```
5336 CDCD53   16700          CALL    H33             ;Send to screen
5339 FE0D     16800          CP      0DH             ;End of name?
533B 2804     16900          JR      Z,GETPRG        ;If yes, get program
533D 77       17000          LD      (HL),A          ;Save name
533E 23       17100          INC     HL              ;Bump pointer
533F 18EF     17200          JR      GETNXT          ;Get more
5341 21DB55   17300 GETPRG   LD      HL,PROGRM       ;Program buffer pointer
5344 CD9E53   17400 GETBYT   CALL    IN232           ;Get program byte
5347 CD8F53   17500          CALL    OUT232          ;Echo
534A CDCD53   17600          CALL    H33             ;Send to screen
534D FE5C     17700          CP      5CH             ;Shift/clear received?
534F 2008     17800          JR      NZ,GETMOR       ;If not, get more
5351 CD9E53   17900          CALL    IN232           ;Get carraige return
5354 CD8F53   18000          CALL    OUT232          ;Echo
5357 1804     18100          JR      SAVPRG          ;Go to Save routine
5359 77       18200 GETMOR   LD      (HL),A          ;Save program byte
535A 23       18300          INC     HL              ;Bump program pointer
535B 18E7     18400          JR      GETBYT          ;Get next byte
535D 36FF     18500 SAVPRG   LD      (HL),0FFH       ;Program end marker
535F 217B54   18600          LD      HL,BUFFER       ;Disk buffer
5362 117B55   18700          LD      DE,NAMBUF       ;File Control Block
5365 0600     18800          LD      B,0             ;LRL = 256
5367 CD2044   18900          CALL    OPENNW          ;Open file
536A C20554   19000          JP      NZ,FILERR       ;Check for error
536D DDE5     19100          PUSH    IX              ;Preserve IX on stack
536F DD21DB55 19200          LD      IX,PROGRM       ;IX = program pointer
5373 DD7E00   19300 SAVBYT   LD      A,(IX)          ;Get program byte
5376 FEFF     19400          CP      0FFH            ;End of program?
5378 2807     19500          JR      Z,SAVEND        ;End routine if yes
537A CD1B00   19600          CALL    WRITE           ;Byte to disk
537D DD23     19700          INC     IX              ;Bump program pointer
537F 18F2     19800          JR      SAVBYT          ;Get next byte
5381 CD2844   19900 SAVEND   CALL    CLOSE           ;Close file
5384 213F54   20000          LD      HL,SAVMSG       ;Message to display
5387 CD6744   20100          CALL    MESAGE          ;Message handler
538A DDE1     20200          POP     IX              ;Restore IX from stack
538C C30052   20300          JP      INITU           ;Reinitialize
              20400 ;=========================================
              20500 ;SUBROUTINES
              20600 ;SERIAL OUT: CHARACTER IN A.
538F F5       20700 OUT232   PUSH    AF
5390 CD9753   20800          CALL    READY
5393 F1       20900          POP     AF
5394 D3EB     21000          OUT     (0EBH),A        ;Send character out RS232
5396 C9       21100          RET
5397 DBEA     21200 READY    IN      A,(CONTRL)      ;Loop until next char
5399 CB77     21300          BIT     6,A             ;character can go out.
539B 28FA     21400          JR      Z,READY
539D C9       21500          RET
              21600 ;----------------------
              21700 ;SERIAL IN: CHARACTER IN A.
539E C5       21800 IN232    PUSH    BC              ;Preserve BC
539F CDA453   21900          CALL    IN1             ;Get byte
53A2 C1       22000          POP     BC
53A3 C9       22100          RET
53A4 0EEA     22200 IN1      LD      C,CONTRL        ;UART control register
53A6 ED40     22300 AGN1     IN      B,(C)           ;Get control status
53A8 CB78     22400          BIT     7,B             ;Test for Data Received
53AA 200A     22500          JR      NZ,GOTBYT       ;Go if set
53AC 3A4038   22600          LD      A,(KBDCH)       ;Check keyboard if not
53AF FE04     22700          CP      4               ;Test for break
53B1 20F3     22800          JR      NZ,AGN1         ;Loop til character rec'd
53B3 C32D40   22900          JP      DOS             ;To DOS if break
53B6 DBEB     23000 GOTBYT   IN      A,(DATA)        ;Get byte
53B8 B7       23100          OR      A               ;Set condition codes
53B9 C9       23200          RET
              23300 ;----------------------
53BA FEBC     23400 CHKERR   CP      0BCH            ;Error from CC?
53BC C0       23500          RET     NZ              ;Return if not
53BD 211454   23600          LD      HL,ERRMSG       ;Message to screen
53C0 CD6744   23700          CALL    MESAGE          ;Message handler
53C3 C30052   23800          JP      INITU           ;Reinitialize
              23900 ;----------------------
53C6 DDAE00   24000 ADDCS    XOR     (IX)            ;Maintain checksum
53C9 DD7700   24100          LD      (IX),A
53CC C9       24200          RET
              24300 ;----------------------
53CD D5       24400 H33      PUSH    DE              ;Preserve registers
53CE DDE5     24500          PUSH    IX
53D0 FDE5     24600          PUSH    IY
53D2 CD3300   24700          CALL    33H             ;One byte to screen
53D5 FDE1     24800          POP     IY              ;Restore registers
53D7 DDE1     24900          POP     IX
53D9 D1       25000          POP     DE
53DA C9       25100          RET
              25200 ;----------------------
53DB F5       25300 SETBUF   PUSH    AF              ;Preserve A
53DC 217B55   25400          LD      HL,NAMBUF       ;Buffer to clear
53DF 0621     25500          LD      B,33            ;Buffer length
53E1 3E20     25600          LD      A,20H           ;Load blank spaces
53E3 77       25700 SB1      LD      (HL),A          ;Begin clearing
53E4 23       25800          INC     HL
53E5 05       25900          DEC     B
53E6 20FB     26000          JR      NZ,SB1          ;Clear until countdown
53E8 F1       26100          POP     AF
53E9 C9       26200          RET
              26300 ;----------------------------
53EA 21DB55   26400 CLRBUF   LD      HL,PROGRM       ;Buffer to clear
53ED F3       26500          DI                      ;Avoid interference
53EE 3600     26600          LD      (HL),0          ;Load with nulls
53F0 11DC55   26700          LD      DE,PROGRM+1     ;Destination of nulls
53F3 010080   26800          LD      BC,8000H        ;Length of buffer
53F6 EDB0     26900          LDIR                    ;Clear buffer
53F8 FB       27000          EI                      ;Enable interrupts
53F9 CDDB53   27100          CALL    SETBUF          ;Clear name buffer
53FC 3E00     27200          LD      A,0             ;Reset:
53FE 327954   27300          LD      (MARK),A        ;- last block mark
5401 327A54   27400          LD      (MARK2),A       ;- end mark
5404 C9       27500          RET
```

Listing continues

three bytes in succession; the first two (flags 1 and 2) are stored and the third is a checksum of the first two. The two stored bytes of the program later determine the type of input (see "Flags").

- Upon successful receipt of the checksum, the ROM sends a 97H to RS-232 out, and echoes back through RS-232 in.
- Two bytes are sent to RS-232 out, then the checksum of the two is sent; a C8H must be returned to RS-232 in to indicate correct receipt of the checksum.
- The ROM requests a single byte (flag 3) from RS-232 in, and initializes the checksum (see flags).
- A block of 128 bytes is received from RS-232 in, then the checksum of the block plus flag 3; the block is stored at 01DAH, the cassette buffer.
- Depending on the flags, the Color Computer cycles for another 128-byte block declares an error, or ends successfully. Unless an error occurs, the loaded block is placed in the Basic program statement table, with all pointers correctly adjusted.

Checksum

The program maintains the checksum by performing an exclusive-or (XOR) between the previous value of the checksum and the ASCII of the value last received. The resulting value becomes the updated checksum. The checksum value always initializes to zero, and reinitializes each time its value goes to RS-232 out.

Flags

Flags 1 and 2 are the two bytes sent to the Color Computer when the ROM checks the RS-232. When the ROM requests a single byte from RS-232 in, flag 3 is sent. Flag 3 is figured into the data-block checksum, and sends it as the opening byte for each successive block.

I haven't yet figured out the flags' general purposes, but I have figured out the results for some of the combinations. I have also worked out a combination to successfully load a Basic program, which was my primary goal.

If flag 1 is an FFH the Color Computer returns an NE error, regardless of the other flags' values. The manual doesn't list that error. It might be the no-error error that I always feared would show up some day.

If flag 2 is an 00H, the Color Computer returns an FM error, which is a format error. This occurs in tape loading when CLOAD encounters a machine-language program, and when

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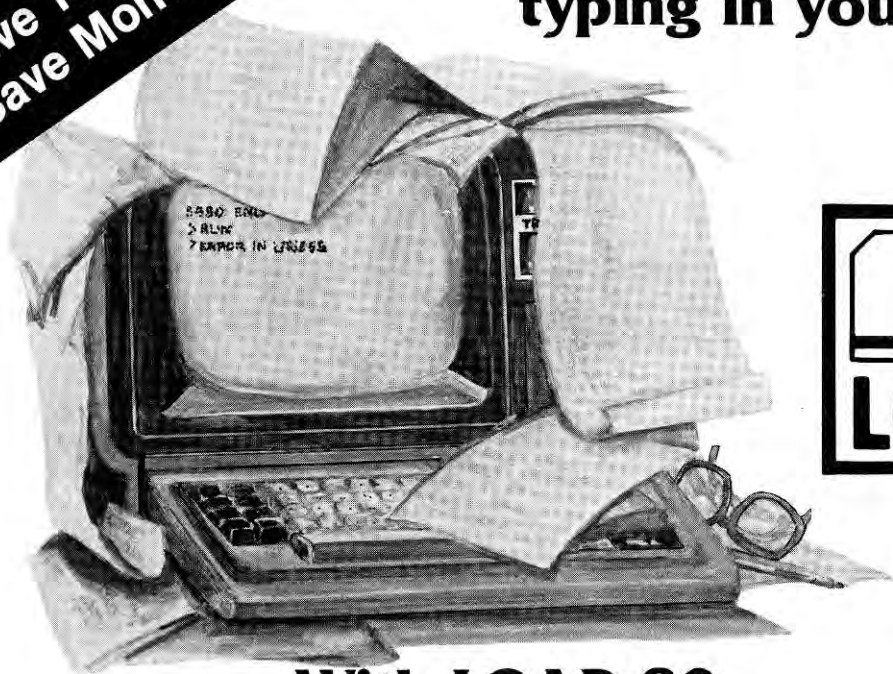

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Listing continued

```
                27600 ;-------------------------
5405 B7         27700 FILERR  OR      A               ;Set condition codes
5406 C8         27800         RET     Z               ;If no error
5407 CBFF       27900         SET     7,A             ;Prepare for display
5409 CD0944     28000         CALL    4409H           ;Display message
540C C30052     28100         JP      INITU           ;Reinitialize
                28200 ;=================================================
                28300 ;MARKERS, BUFFERS
540F 0101       28400 FLG12   DEFW    0101H
5411 00         28500 CHKSUM  DEFB    0               ; = IX
5412 0000       28600 BLOCK   DEFW    0               ;Count from CC
                28700 ;-------------------------------------------
                28800 ;MESSAGES
5414 49         28900 ERRMSG  DEFM    'I/O ERROR'
541D 0D         29000         DEFB    0DH
541E 0A         29100 DUNMSG  DEFB    0AH
541F 2A         29200         DEFM    '*** DONE ***'
542B 0D0A       29300         DEFW    0A0DH
542D 50         29400 LOADOK  DEFM    'PROGRAM LOAD OKAY'
543E 0D         29500         DEFB    0DH
543F 46         29600 SAVMSG  DEFM    'FILE SAVED'
5449 0D         29700         DEFB    0DH
544A 0A0A       29800 OKMSG   DEFW    0A0AH
544C 43         29900         DEFM    'Color Computer Host'
545F 0A         30000         DEFB    0AH
5460 2A         30100         DEFM    '* OK'
5464 0D         30200         DEFB    0DH
5465 0A         30300 DLDMSG  DEFB    0AH
5466 44         30400         DEFM    'DLOAD: '
546D 03         30500         DEFB    03H
546E 42         30600 BLKMSG  DEFM    'BLOCKS '
5475 03         30700         DEFB    03
                30800 ;-----------------------------------
                30900 ;MORE MARKERS
5476 80         31000 FLG3    DEFB    80H
5477 DB55       31100 PRGPTR  DEFW    PROGRM
5479 00         31200 MARK    DEFB    0
547A 00         31300 MARK2   DEFB    0
                31400 ;=================================================
                31500 ;DISK READ ROUTINE
4424            31600 OPEN    EQU     4424H           ;Existing file only
0013            31700 READ1   EQU     0013H           ;One byte read
4420            31800 OPENNW  EQU     4420H           ;New or existing file
001B            31900 WRITE   EQU     001BH           ;One byte read
4428            32000 CLOSE   EQU     4428H           ;File close
0100            32100 BUFFER  DEFS    256             ;User file buffer
557B 20         32200 NAMBUF  DEFM    '                '
559D D9         32300 RDPRG   EXX                     ;Use alternate registers
559E 08         32400         EX      AF,AF'
559F DDE5       32500         PUSH    IX              ;Preserve IX
55A1 117B55     32600         LD      DE,NAMBUF       ;File Control Block
55A4 217B54     32700         LD      HL,BUFFER
55A7 0600       32800         LD      B,0             ;LRL = 256
55A9 CD2444     32900         CALL    OPEN            ;If it exists
55AC C20554     33000         JP      NZ,FILERR       ;Check for error
55AF DD21DB55   33100         LD      IX,PROGRM       ;Pointer to load buffer
55B3 CD1300     33200 RDLOOP  CALL    READ1           ;One byte from disk
55B6 2817       33300         JR      Z,RDGO          ;Go if no error
55B8 FE1C       33400         CP      1CH             ;End of File error
55BA C20554     33500         JP      NZ,FILERR       ;Display other error
55BD DD3600FF   33600         LD      (IX),0FFH       ;EOF Marker in memory
55C1 21DB55     33700         LD      HL,PROGRM       ;Reset to program start
55C4 227754     33800         LD      (PRGPTR),HL     ;Set pointer
55C7 212D54     33900         LD      HL,LOADOK       ;Message to display
55CA CD6744     34000         CALL    MESAGE          ;Message handler
55CD 1807       34100         JR      PREXX           ;Prepare to exit
55CF DD7700     34200 RDGO    LD      (IX),A          ;Save byte loaded
55D2 DD23       34300         INC     IX              ;Bump pointer
55D4 18DD       34400         JR      RDLOOP          ;Get more
55D6 DDE1       34500 PREXX   POP     IX              ;Restore IX
55D8 D9         34600         EXX                     ;Restore main registers
55D9 08         34700         EX      AF,AF'
55DA C9         34800         RET
55DB            34900 PROGRM  EQU     $               ;Program buffer
5200            35000         END     INITU
00000 TOTAL ERRORS
```

CLOADM encounters a Basic program. This byte differentiates the two for the DLOAD command.

If flags 1 and 2 form 0001H, 00FFH, 0100H, or 01FFH, depending on the value of flag 3, no error returns.

If flag 3 is 00H, one data block is sent and the command considers itself finished. The block received is not processed as a Basic program. I use this as a way of ending the program load in the host program.

If flag 3 is 01H, the command looks for continuous blocks; they are not processed as Basic programs within the Color Computer. This value can be part of the key to loading a machine-language program.

If flag 3 is FFH, the command fails with a DS error, or a Direct Statement in File error. This error also occurs when a CLOAD command encounters a data tape, suggesting that the DLOAD command may also be available for loading data from the RS-232.

If Flag 3 is 80H, the DLOAD command processes the block as a Basic program and anticipates receipt of the next block. The host program uses this value until the entire program has downloaded, and then switches to 00H to signify the end of file.

ROM Locations

In deciphering the DLOAD command I discovered many general-purpose Color Computer ROM routines useful in two-way serial communication. I'll pass these along for those interested in working toward their own machine-language routines. The host program requires no machine-language monitor in the Color Computer. With a bit of work and imagination, a small monitor could facilitate full eight-bit interchanges with any computer.

The routines use the hardware stack area to keep track of what's going on; so use the entry and exit routines.

8DBCH—Gets single characters from RS-232 input, with characters received in A register. This call keeps trying for an input for a specified number of tries. The one-byte value at 00E7H times the two-byte value at 008AH determines the number of tries. These are initialized on power-up to five and 0000, giving five times 65536 tries before a return. The Y register must point to an area where at least three bytes can be used by the subroutine. I recommend the following routine:

```
CLRA          Clear A register
PSHS A,B,X    Set Hardware Stack
LEAY 0,S      Point Y to Stack
CALL $8DBCH   Get Character
Process character received in register A.
```

8E0CH—Sends single characters in register A to RS-232 output. The value at 00E6H determines the baud rate. The Y register must point to an area where at least three bytes can be used by the subroutine. Use the following routine:

```
LDA CHAR      Load character
PSHS A,B,X    Set Hardware Stack
LEAY 0,S      Point Y to Stack
CALL 8E0CH    Send Character
```

8DB8H—Sends characters out and waits for echo back. Set up this routine the same as 8E0CH, above.

8D72H—Sends characters out, waits for echo, and maintains checksum in the XOR format. Using the routine setups above, a PULS A,B,X should result in the last character received remaining in A, with the current checksum value in B.

8D62H—Sends out current checksum; resets checksum to zero; waits for a C8H returned; declares an error if not received (IO ERROR).

The Program

Program Listing 1 is a host program for the Model I. You can receive any program keyed into the Color Computer from the Model I and store them on disk.

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The last feature lets you use the Model I as a remote disk-recording device for all Color Computer programs, with the only connection needed between the two being a four-conductor wire.

The host program initializes the Model I RS-232 to eight bits, no parity, 1200 baud, then polls the RS-232 port waiting for one of two bytes: an 8AH, indicating the Color Computer is looking to download a program, or DBH, indicating a program is about to come in to be saved. If the computer receives the former, the program sets the name, loads the program from disk and runs through the remainder of the protocol.

To send a file from the Color Computer to the Model I, the file is essentially printed. A complication arises with the Color Computer 1.0 ROM: it prints a seven-bit rather than an eight-bit word, and the print protocol initializes at 600 baud. You can correct this by POKEing 29H in memory location 96H. The former problem is dealt with in the host program by treating one of the stop bits as part of the ASCII code. So, when the Color Computer sends 5BH (the left bracket, formed by shift/down arrow), the host recognizes the character by expecting the top bit to be on, to receive DBH. The Color Computer command to initiate a save is PRINT #−2, (shift/down arrow) FILENAME (enter).

The receipt of the misread 5BH causes the host to reinitialize to a seven-bit protocol, and to treat the incoming characters up to a carriage return as the file name. The Color Computer issues the command LLIST, which sends the program as an ASCII printout. When finished, a terminator signal is needed. The host program recognizes a 5CH, formed on the Color Computer with a shift/clear, and displayed as a backslash. When this byte is received, the program saves to disk under the received name and the RS-232 UART reinitializes to the eight-bit protocol.

This procedure allows an automatic save on the Model I by appending a Remark backslash to the end of any Color Computer program. It has the disadvantage of making the backslash a disallowed character in the body of a Basic program. If this proves a problem, the save command can be made more particular by checking that the most recent byte entered into the buffer was a carriage return (0DH), since the backslash can never appear as the leading character of the next Basic line.

I'm told the 1.1 ROM uses an eight-bit protocol. If that is true, the reinitialization portion of the save program (lines 15600–16100) will not be necessary. The host will be looking for 5BH, rather than DBH, to start the save process. Make the latter change at line 5100.

If you would rather run the whole thing at 300 baud, change the value loaded into the A register at lines 2200 and 16000 to 55H rather than 77H. ■

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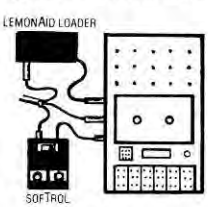

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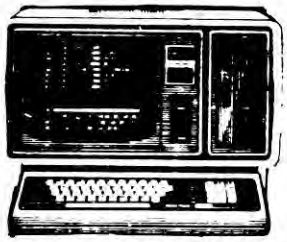

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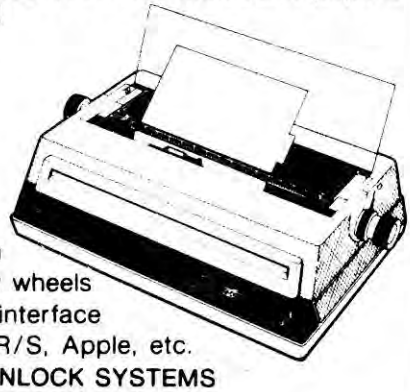

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APL Primer—Part IV

by Margaret M. Grothman

Have a matrix you'd like to transpose? This month we'll also tell you how to reduce, add multiply, ravel, rotate, and catenate it.

All variables used in the first three parts of this series were scalars or vectors. A scalar has a single value assigned to it; a vector has more than one value assigned. Scalars and vectors can be defined by their dimensions; a scalar has no dimensions, and a vector is an array of one dimension.

Recall that I used the shape function (shift P) to find the number of elements assigned to a vector. You can use a variation of the shape function (shift P shift P) to determine the number of dimensions of a variable:

```
Enter:  SCALAR←2
Enter:  ■P ■P SCALAR
Result: 0 (SCALAR has no dimensions).

Enter:  VECTOR←1 3 5
Enter:  ■P VECTOR
Result: 3 (There are three elements in
        VECTOR).

Enter:  ■P ■P VECTOR
Result: 1 (There is only one dimension in
        VECTOR).
```

Variables of up to five dimensions can be defined in APL80. The dyadic reshape function (also shift P) is used to build a multi-dimensional array. A two-dimensional array is called a matrix:

```
Enter:  ■Q←MATRIX←2 3 ■P 1 2 3 4 5 6
Result: 1 2 3
        4 5 6
```

The two integers preceding the shift P symbol describe the dimensions of the matrix, two rows and three columns. The numbers following the reshape symbol are the elements of the matrix.

When the shape function is applied to a multi-dimensional array, the number of elements in each dimension is given. Multiply those numbers together to find the total number of array elements:

```
Enter:  ■P MATRIX
Result: 2 3 (two rows, three columns, six
        elements)
```

In the following reshape statement, the list of elements does not entirely fill the array. When this happens, elements from the beginning of the list are repeated:

```
Enter:  ■Q←MATRIX←4 5 ■P 0 1 0
Result: 0 1 0 0 1
        0 0 1 0 0
        1 0 0 1 0
        0 1 0 0 1
```

If there are too many elements in the reshape statement, the matrix will be filled from the beginning of the list:

```
Enter:  ■Q←MATRIX←2 3 ■P ■I 10
Result: 1 2 3
        4 5 6
```

An array of literals or graphics characters can also be created. They are not printed in fields as numerical arrays are:

```
Enter:  GRAPHICS←#128 + ■I 63
Enter:  ■Q←GRMATRIX←7 9 ■P
        GRAPHICS
Result: graphics characters printed in seven
        rows
```

Arrays with more than two dimensions appear in blocks. For example, the following array consists of two rows, three columns, and two blocks. Note that the last two dimensions stated are the rows and columns:

```
Enter:  ■Q←ARRAY←2 3 2 ■P ■I 12
Result:  1  2
         3  4
         5  6

         7  8
         9  10
         11 12

Enter:  ■Q←GRMATRIX←3 3 7 ■P
        GRAPHICS
Result: graphics characters printed in three
        blocks of three rows and seven col-
        umns
```

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If more than three dimensions are specified, printing will be in sets of blocks:

```
Enter:  ■Q←ARRAY←2 2 2 3 ■P #130
Result: graphics character 130 printed in two
        sets of two blocks each. Each block
        contains two rows and three columns.
```

Row Vectors and Columns Vectors

You can assign a two-dimensional array in which one of the dimensions is one. This appears to be the same as a one-dimensional array, but it is not. The difference is occasionally significant. If it is necessary to make a distinction, call the single-dimensional array a list and the two-dimensional array a vector:

```
Enter:  ■Q←LIST←1 2 3
Result: 1 2 3

Enter:  ■Q←VECTOR←1 3 ■P ■I 3
Result: 1 2 3

Enter:  LIST = VECTOR
Result: LENGTH ERROR (LIST and
        VECTOR are not equivalent).
```

The variable VECTOR above is called a row vector, because it consists of a single row. A column vector can be created by reversing the dimensions:

```
Enter:  ■Q←ROWVEC←1 5 ■P ■I 5
Result: 1 2 3 4 5

Enter:  ■Q←COLVEC←5 1 ■P ■I 5
Result: 1
        2
        3
        4
        5

Enter:  ROWVEC = COLVEC
Result: LENGTH ERROR (ROWVEC and
        COLVEC are not equivalent).
```

Indexing Multi-Dimensional Arrays

Selecting one element from an array requires an argument consisting of as many integers as there are dimensions. The integers are enclosed in parentheses and must be separated by semicolons. For example, to select the element in the second row and the second column of the variable MATRIX below:

```
Enter:  ■Q←MATRIX←2 3 ■P ■I 6
Enter:  MATRIX (2;2)
Result: 5
```

To produce an entire row or column:

```
Enter:  MATRIX (2;)
Result: 4 5 6 (second row)

Enter:  MATRIX (;2)
Result: 2 5 (second column)
```

The next example returns the first and the third columns:

```
Enter:  MATRIX (;1 3)
Result: 1 3
        4 6
```

Take and Drop with Matrices

You can often use Take and Drop to accomplish the same task. The first of the two examples that follow takes two rows and three columns from MATRIX. The second example produces the same result by dropping one column from the right side. (The 0 indicates that no rows are to be dropped.)

```
Enter:  ■Q←MATRIX←2 4 ■P ■I 8
Enter:  2 3↑MATRIX
Result: 1 2 3
        5 6 7

Enter:  0 −1↓MATRIX
Result: 1 2 3
        5 6 7
```

The next set of examples also produces identical results. In the first, one row and two columns are dropped. In the second, one row is taken from the bottom and two columns are taken from the right:

```
Enter:  1 2↓MATRIX
Result: 7 8

Enter:  −1 −2↑MATRIX
Result: 7 8
```

Operations on Matrices

When two matrices are added, corresponding elements of each are added together to produce a new matrix. The dimensions of both matrices must be identical:

```
Enter:  ■Q←MAT1←2 3 ■P 1 3 5 2 4 6
Enter:  ■Q←MAT2←2 3 ■P 2 4 6 1 3 5
Enter:  ■Q←MAT1 + MAT2
Result: 3 7 11
        3 7 11
```

Matrix subtraction works in the same way:

```
Enter:  ■Q←MAT1−MAT2
Result: −1 −1 −1
         1  1  1
```

If the shift X multiplication symbol is applied to two matrices, element by element multiplication takes place. Yet, in mathematics, multiplication of matrices is defined differently. Each row is multiplied by each column to produce a new matrix consisting of the results of all row by column multiplications. For example:

$$\begin{vmatrix} 2 & 3 \\ 3 & 5 \\ 1 & 6 \end{vmatrix} \times \begin{vmatrix} 1 & 4 \\ 2 & 2 \end{vmatrix} = \begin{vmatrix} 8 & 14 \\ 13 & 22 \\ 13 & 16 \end{vmatrix}$$

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$2\times1+3\times2=8$
$2\times4+3\times2=14$
$3\times1+5\times2=13$
$3\times4+5\times2=22$
$1\times1+6\times2=13$
$1\times4+6\times2=16$

Notice that with this definition of multiplication, matrices do not have to be the same size. However, the number of columns in the first matrix must equal the number of rows in the second. The dimensions of the resulting matrix are equal to the number of rows in the first matrix and the number of columns in the second matrix. For example, the product of a 3-by-2 matrix and a 2-by-2 matrix is another 3-by-2 matrix.

The commutative law of multiplication does not apply to matrix multiplication. If the two matrices are exchanged and then multiplied, the result will not be the same. In fact, the two matrices above could not be multiplied at all if reversed in order, because the number of columns of the first would not equal the number of rows in the second.

The APL function needed to perform matrix multiplication is the inner product function; it is not available in APL80. Program Listing 1 is a user-defined function that you can use instead to multiply matrices. It is written with an explicit result, so that it can be called by another program.

```
)DEF XR←MAT1 MULT MAT2; D1; D2; I1; I2
1: D1←▪P MAT1
2: D2←▪P MAT2
3: →(D1(2) $ D2(1))/ERROR
4: MAT3←(D1(1),D2(2))▪P 0
5: I1←1
6: I2←1
7: LOOP: MAT3 (I1;I2)←+/MAT1(I1;)▪X MAT2 (;I2)
8: I2←I2+1
9: →(I2>D2(2))/NEXTROW
10: →LOOP
11: NEXTROW: I1←I1+1
12: →(I1>D1(1))/RESULT
13: I2←1
14: →LOOP
15: RESULT: XR←MAT3
16: →
17: ERROR: 'THESE MATRICES CANNOT BE MULTIPLIED.'
```

Program Listing 1

Line 3 compares the dimensions of each matrix. If the second dimension of the first matrix is not equal to the first dimension of the second matrix, multiplication is not possible, and execution skips to the error message in line 18.

Line 4 sets up the format of the product matrix. The matrix must be defined before assignments are made

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```
)DEF XR←TRANSPOSE OLDMAT
1: DIM←⍴P OLDMAT
2: →((⍴P DIM)<2)/ERROR
3: I←1
4: NEWMAT←(DIM(2),DIM(1))⍴P 0
5: LOOP: NEWMAT (I;)←OLDMAT (;I)
6: →(I=DIM(2))/RESULT
7: I←I+1
8: →LOOP
9: RESULT: XR←NEWMAT
10: →
11: ERROR: 'THIS IS NOT A MATRIX.'
12: 'IT CANNOT BE TRANSPOSED.'
```

Program Listing 2

to specific positions. Zeros are used here, but any number would do as well.

I1 and I2 are index variables. They are increased by one on each pass through the loop until they exceed the dimensions of the matrices. When that happens, execution passes to line 15 and the product matrix, MAT3, is printed:

```
Enter:  ⍴Q←A←3 3 ⍴P ⍴I 9
Enter:  ⍴Q←B←3 2 ⍴P ⍴I 6
Enter:  A MULT B
Result: 22 28
        49 64
        76 100
```

MULT can be used to multiply a row vector and a column vector, an operation that does not work with the shift X multiplication function in APL80. The dimensions of the result are 1 by 1, the number of rows in the first times the number of columns in the second:

```
Enter:  ⍴Q←ROW←1 3 ⍴P 1 2 3
Enter:  ⍴Q←COL←3 1 ⍴P 1 2 3
Enter:  ROW MULT COL
Result: 14
```

The product of the column vector and the row vector is a 3 by 3 matrix:

```
Enter:  COL MULT ROW
Result: 1 2 3
        2 4 6
        3 6 9
```

Matrix Transposition

The transpose function reverses the rows and columns of a matrix. It is not a built-in function in APL80, but it is useful in so many ways that it is worth the trouble to create a user-defined function (see Program Listing 2).

Line 4 defines a new matrix with dimensions the reverse of the old matrix. The loop transfers each column of the old matrix into a row of the new matrix:

```
Enter:  ⍴Q←MATRIX←3 4 ⍴P ⍴I 12
Enter:  TRANSPOSE MATRIX
Result: 1 5 9
        2 6 10
        3 7 11
        4 8 12
```

Use TRANSPOSE to convert a row vector into a column vector:

```
Enter:  ⍴Q←ROW←1 3 ⍴P ⍴I 3
Enter:  ⍴Q←COL←TRANSPOSE ROW
Result: 1
        2
        3
```

In APL80, some functions that operate on matrices, such as reverse, rotation and ravel, work only on rows and not on columns. TRANSPOSE can be used with these functions to allow vertical operation.

Matrix Reverse

When the reverse function is applied to a matrix in APL80, each row is reversed:

```
Enter:  ⍴Q←MATRIX←2 4 ⍴P ⍴I 8
Enter:  ⍴R MATRIX
Result: 4 3 2 1
        8 7 6 5
```

APL80 does not permit column reversal, but it can be done with a little help from TRANSPOSE:

```
Enter:  ⍴Q←TEMP←TRANSPOSE
        MATRIX
Enter:  ⍴Q←TEMP←⍴R TEMP
Enter:  ⍴Q←TRANSPOSE TEMP
Result: 5 6 7 8
        1 2 3 4
```

Matrix Rotation

The rotation function shares its symbol (shift R) with the reversal function. The function takes one or more elements from the end of a row and places it at the beginning of the row.

Using the 2-by-4 matrix defined above, the next example takes three elements off the beginning of each row and tacks them on to the end:

```
Enter:  3 ⍴R MATRIX
Result: 4 1 2 3
        8 5 6 7
```

If you want to rotate by columns, use TRANSPOSE first as you did in the reverse example above. After rotating, TRANSPOSE again to return to the original dimensions.

Ravel and Catenation

Ravel is a monadic function which uses the comma as its symbol. It sepa-

rates the elements of a multi-dimensional array into a vector.

```
Enter:  ■Q←MATRIX←3 2 ■P ■I 6
Enter:  ■Q←, MATRIX
Result: 1 2 3 4 5 6
```

The catenation function links scalars and lists together. In APL80, it does not work with matrices. It can be done indirectly in three steps:

```
Enter:  ■Q←MAT1←3 2 ■P ■I 6
Enter:  ■Q←MAT2←2 2 ■P ■I 4
Enter:  ■Q←MAT3←5 2 ■P (,MAT1),,
        MAT2
Result: 1 2
        3 4
        5 6
        1 2
        3 4
```

The third statement executed from right to left first ravels MAT2 and MAT1, then links them together, before reshaping them into a 5-by-2 matrix.

Matrix Reduction

Reduction may be applied to matrices row by row or column by column.

```
Enter:  ■Q←MATRIX←2 4 ■P ■I 8
Enter:  +/MATRIX
Result: 10 26

Enter:  ■X/MATRIX
Result: 24 1680

Enter:  ■X/MATRIX (;2)
Result: 12 (Multiplication reduction of
        column 2)
```

You can reduce the entire matrix by repeating the reduction symbol.

```
Enter:  +/+/MATRIX
Result: 36 (Product of all matrix elements)

Enter:  ■H/ ■H/MATRIX
Result: 8 (Maximum of entire matrix)
```

Experiment

We've looked at only a sample of the ways in which APL functions are used and combined. Often there are several ways to accomplish a task in APL. Experimentation in this language often yields valuable information.

The last lesson in this series will feature several applications of APL: a statistics program, the quadratic formula, a weight-loss program, and others. ■

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There was some amusement at the November meeting when the Radio Shack representatives stated that the software in the ROM cartridges could not be copied. This month's 68 Micro Journal reported they had disassembled the programs on ROM by covering some of the connector pins with tape. They promise details next month. Never tell a hobbyist something can't be done! This magazine seems to be the only source so far of technical informations on the TRS-80 color computer™. Devoted to SS-50 6800 and 6809 machines up to now, 68 Micro Journal plans to include the TRS-80 6809 unit in future issues.

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INSERT – New names can be quickly added to your list at any time. The new addresses are placed into the file in their proper sorted order eliminating the need for a separate sort operation after entering a stack of new names. POSTMAN will allow the operator to enter a "batch" of labels without returning to the control menu between each label insertion; thus speeding entry and reducing the aggravation of extra menu control keystrokes.

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EDIT – Information in any name entry can be quickly changed at will with "word processor" ease. A "transparent" cursor simply is moved to the label displayed on the computer screen and corrections are just typed over the existing label. If you happen to change a field which is also used as a sort key, POSTMAN will automatically move the changed label to its correct position in the list to maintain the sorted arrangement of the labels.

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15	Last Name	Last name of addressee	5	State	State, province, territory
15	First Name	First name of addressee	9	Zip	Zip code, zone, route
26	Company	Name of company	2	Data 1	User definable field
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"THERE IS ONLY ONE WAY TO DESCRIBE THE PERFORMANCE OF POSTMAN MASS MAILING SYSTEM, – 'FLAWLESS'."

Info World, by Tim Daneliuk, Vol. IV, No. 37, ©1982

InfoWorld
Software Report Card

Postman Version 2.29

	Poor	Fair	Good	Excellent
Performance	☐	☐	☐	☑
Documentation	☐	☐	☐	☑
Ease of Use	☐	☐	☐	☑
Error Handling	☐	☐	☐	☑

Business programs have come of age on the TRS-80* Mod I and III and the speed and flexibility of the POSTMAN MASS MAILING SYSTEM, makes it the best buy on the market today. In these rough economic times, every business program purchase must be selected very carefully and be evaluated and compared against all other competitors. POSTMAN MASS MAILING SYSTEM stands up to this scrutiny.

POSTMAN MASS MAILING SYSTEM has the capability of managing 22,000** names on floppy disk drives and up to 292,000** names on a hard disk system. No longer do you have to search from diskette to diskette to find the file you need. POSTMAN MASS MAILING SYSTEM utilizes all of the disk drives you have on line, and presents all at once, one large file totally accessible; as if you only had one large disk drive. In his review, Tim Daneliuk describes this unlimited storage capability aptly by saying: "POSTMAN 'spans' multiple disk drives" despite the unpretentious 5¼-inch mini-floppy disk. This exceptional feature gives you the ability to start with a two disk-drive system and add more disk drives as your business grows, without any difficulty.

Professional people in the industry have remarked how POSTMAN MASS MAILING SYSTEM, written entirely in Machine language and menu driven for simplicity, fulfills a variety of small business needs.

PURGE – Consider for instance, how it can purge duplicate lables, preventing you from mailing multiple information to the same person.

SORT – It has the ability to sort on any or all of the ten data files of the program quickly.

ERROR HANDLING – All erroneous data is trapped. It never fails because of incorrect operator entry.

Commonly Asked Questions About POSTMAN MASS MAILING SYSTEM

Q. How many names can I get on my standard 2 drive TRS-80 Mod III?

A. On the average 1900, depending on your operating system. LDOS is the least – Multi-DOS has over 2,000.

Q. How many disk drives can I run at the same time with your program?

A. At this time only 8 disk drives – 4 floppy disks and 4 hard disks.

Q. What is the capacity of a disk drive?

A. There are many different sizes of disk drives. See the chart below.

MOD I SINGLE DENSITY
- †35 Track Data Disk 642
- 40 Track Data Disk 742
- 80 Track Data Disk 1542

MOD I OR III DOUBLE DENSITY
- ††40 Track Data Disk 1346
- 80 Track Data Disk 2700
- 80 Track, Dual Head ..... 5500+

5 Meg Hard Drive - 38,000+ with LDOS or DOSPLUS Operating System
7.5 Meg Hard Drive - 68,000+ with LDOS or DOSPLUS Operating System

† Denotes the size on a standard system from Radio Shack. †† Requires hard disk version of Postman.

Q. Am I limited to only one disk drive or can I add more drives?

A. You can combine any of the above disk drives, up to a maximum of 4 dual headed 80 track drives, plus 4-7.5 meg hard drives, for a total capacity of 292,000* names. The system to date has been field tested, and is in everyday use at over 100,000 name capacity.

Q. Outstanding having all those names, but how does it effect the speed of the system?

A. As anyone could expect, as a system gets larger it reacts slower. Below is a sample of the different systems.

SYSTEM CAPACITY	SORT TIME - ONE FIELD	SORT TIME - ALL 10 FILEDS	INSERT TIME
1,342	12 Seconds	16 Seconds	1 Second
5,500	18 Seconds	28 Seconds	1 Second
11,000	24 Seconds	40 Seconds	2 Seconds
38,000	5 Minutes	7 Minutes	2 Seconds
78,000	8 Minutes	12 Minutes	2 Seconds
200,000	30 Minutes (estimated)	51 Minutes	4 Seconds

The above tests were done with a Mod III and DOSPLUS 4.0 Operating System. The speed you receive will depend on many factors. It should be noted that as you insert a name, it is put in sorted order on the disk. You never need to re-sort, unless you wish to change the order.

Q. Do you plan on adding anything new to your program soon?

A. Yes! and all registered owners of Postman Mass Mailing System can upgrade to the latest version for a nominal fee.

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See opposite page for more detailed information.

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Secret Ciphers

by George Reardon

If you've always wanted to send confidential material to other users, try this public-key cipher system. It's practically unbreakable.

Sample Output of Key Generating Program

YOUR 'M#' FACTOR IS 93,472,131,593,753
YOUR 'V#' FACTOR IS 24,386,371,646,218

YOUR SECRET KEY NUMBERS

1	3	16	84,207	31	2,759,275,293
2	4	17	168,413	32	5,518,550,585
3	10	18	336,824	33	11,037,101,168
4	19	19	673,650	34	22,074,202,338
5	42	20	1,347,302	35	44,148,404,671
6	82	21	2,694,606	36	88,296,809,345
7	162	22	5,389,211	37	176,593,618,688
8	330	23	10,778,422	38	353,187,237,374
9	658	24	21,556,837	39	706,374,474,747
10	1,314	25	43,113,676	40	1,412,748,949,494
11	2,633	26	86,227,351	41	2,825,497,898,990
12	5,266	27	172,454,706	42	5,650,995,797,979
13	10,524	28	344,909,411	43	11,301,991,595,963
14	21,051	29	689,818,824	44	22,603,983,191,925
15	42,103	30	1,379,637,643	45	45,207,966,383,847

CHECKSUM = 90,415,932,767,691

YOUR PUBLIC KEY NUMBERS

1	8,784,691,802,840	16	91,503,201,189,299	31	13,801,581,453,259
2	74,027,676,799,622	17	24,291,285,788,063	32	55,832,309,503,489
3	91,597,060,405,302	18	11,568,733,176,315	33	74,650,780,607,167
4	24,479,004,220,069	19	60,151,304,752,441	34	92,843,268,020,392
5	29,513,553,646,007	20	63,844,316,310,940	35	46,415,874,244,380
6	22,013,268,892,203	21	71,230,339,427,938	36	8,144,308,697,847
7	7,012,699,384,595	22	77,217,693,859,094	37	72,746,910,589,636
8	31,594,782,374,870	23	60,963,256,124,435	38	15,007,851,185,708
9	26,175,726,349,929	24	39,114,143,646,408	39	58,244,848,968,387
10	15,337,614,300,047	25	21,769,994,098,874	40	23,017,566,343,021
11	76,473,758,802,745	26	71,769,134,794,719	41	83,048,971,085,853
12	59,475,386,011,737	27	30,621,683,201,554	42	7,382,825,581,171
13	64,367,550,017,983	28	89,472,513,000,079	43	60,564,181,364,993
14	44,047,660,245,053	29	29,014,601,212,463	44	55,885,377,733,204
15	59,866,173,893,135	30	12,230,672,222,275	45	9,513,932,069,815

CHECKSUM =2,066,630,067,399,356

Table 1

Cryptography, the science of creating and using codes and ciphers, was one of the earliest applications for computers. Here are some programs implementing a public-key, cipher-type cryptosystem based on the "knapsack" system developed by Martin E. Hellman, Whitfield Diffie, and Ralph Merkle.

The knapsack system was described in Hellman's article, "The Mathematics of Public-Key Cryptography" (*Scientific American*, August 1979). You can use this system without understanding any of the math on which it is based; however, if you are interested in the math, Hellman's article is an excellent explanation.

Public-key cryptosystems are very practical. Suppose that you live in Florida and want to send your friend in California a secret message. Both of you have TRS-80 computers and the programs supplied with this article.

You call him and ask him for his public-key numbers. Then, enter his public-key numbers and your plaintext message into your machine, and read back the ciphertext numbers produced by your program. He enters the ciphertext numbers into his machine, which uses his secret-key numbers to decipher and print your message.

The Key Box

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64K RAM (Model II)
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Your message is secret no matter who is listening to your conversation because the public-key numbers revealed in the conversation are used only to encipher the message, not to decipher it. Furthermore, your friend can change his key as often as he wants to; all he has to do is tell you his new public-key numbers.

The ciphertext numbers can be transmitted in a variety of ways. In addition to reading them over the telephone, as in the foregoing example, you can send them by radio, print them for mailing or storage, transmit them as data by telephone, or store them on disk or tape for physical delivery to the receiver.

Breaking the Cipher

There are two ways that a cipher can be considered unbreakable. It can be absolutely unbreakable because there is no method that could break it, or it can be practically unbreakable because the methods for breaking it are unknown, logistically impossible, unacceptably expensive, or excessively time-consuming.

The system included with this article is not unbreakable, but it is relatively safe from a practical standpoint. A good way to illustrate this is to outline the steps used to break it.

Since this article is readily available to the cryptanalyst, assume that he can figure out exactly how the system works. Also assume that he knows the public-key numbers used to encipher the message he wants to break. In practice, a network of users would probably be discreet in handling their public keys.

The ciphertext produced by this sys-

```
Sample Output of Enciphering Program
Using Sample Key

The message to be enciphered is:
     80 MICROCOMPUTING IS THE FOREMOST
     MAGAZINE FOR TRS-80 USERS.

CIPHERTEXT NUMBERS

 1    1,220,461,426,274,640
 2    1,067,629,998,874,121
 3    1,015,828,902,257,543
 4    1,141,167,083,447,045
 5    1,059,855,933,193,997
 6      967,231,243,517,189
 7      946,730,068,520,674
 8      979,350,481,039,039
 9    1,005,481,392,923,270
 10   1,083,284,755,558,297
 11   1,283,563,678,344,191
 12   1,143,071,909,626,490

CHECKSUM =  12913656873576496
```

Table 2

Program Listing 1

```
10 REM  Copr. George Reardon, 1981
20 CLS:CLEAR5000:DEFINTA-Z:F$="##,###,###,###,###":G$="#########
#####":H$="#,###,###,###,###,###":CS$="CHECKSUM =":CN$="PRESS 'E
NTER' TO CONTINUE.":PT$="SECRET KEY     ":PB$="PUBLIC KEY     ":
RANDOM
30 DIMV#(87,3),SK#(45),PK#(45),P#(35)
40 CLS:X$="":INPUT"DO YOU HAVE A PRINTER CONNECTED (Y/N)";X$:IFX
$<>"Y"ANDX$<>"y"ANDX$<>"N"ANDX$<>"n"THENPRINT"ENTER 'Y' OR 'N'":
GOTO40ELSEIFX$="Y"ORX$="y"THENE=1
50 CLS:PRINT"DEVELOP YOUR FACTORS AND KEY NUMBERS":PRINT:PRINT"1
 - GENERATE YOUR SECRET FACTORS (M# AND V#)":PRINT"2 - GENERATE
YOUR SECRET AND PUBLIC KEY NUMBERS":PRINT
60 X#=0:INPUT"WHICH ROUTINE";X#:IFX#<1ORX#>2THENCLS:PRINT"ENTRY
MUST BE 1 OR 2":GOSUB470:GOTO50ELSEX=X#
70 CLS:ONXGOTO80,260
80 CLS:PRINT"TO GENERATE YOUR SECRET FACTORS (M# AND V#), FIRST
```

Listing 1 continues

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tem consists of one 15- or 16-digit number for each five characters of plaintext. Each of these numbers is the total of some, but not all, of the receiver's public-key numbers. The message is carried by the binary pattern reflecting which numbers are in the total and which are not. To find that pattern, the cryptanalyst could total various combinations of the public-key numbers, one at a time, to see which total equals the ciphertext number he is trying to break.

There are 35,184,372,088,832 possible combinations and totals of the 45 public-key numbers. A Level II Basic program can test about 90 combinations per minute. At this rate, the cryptanalyst could test half of the possible combinations (and thus could expect, on average, to break one ciphertext number representing five characters of plaintext) in about 370,000 years of continuous operation.

If the cryptanalyst has a computer that runs one million times faster than Level II Basic, it would still average about 135 days of continuous and expensive operation to break each ciphertext number by the brute-force method.

There are ways to use math and traditional cryptanalysis to avoid testing all the possible combinations, but doing this would not necessarily speed up the process of retrieving the message; the logic of a smart program is slower and more complicated than the brute-force approach. Also, relatively few people would know how to approach the problem.

This system contains features for resisting traditional cryptanalysis, which is based largely on the frequency of let-

Listing 1 continued

```
PICK AN":PRINT"ODD POSITIVE WHOLE NUMBER AT RANDOM BETWEEN 90,00
0,000,000,000":PRINT"AND 99,000,000,000,000.  THIS WILL BE A 14-
DIGIT NUMBER.":PRINT"ENTER THIS NUMBER (WITHOUT COMMAS).";
90 PRINT"  AVOID ROUND NUMBERS."
100 PRINT:M#=0:INPUT"NUMBER";M#:IFM#=ZTHEN50ELSEIFM#<90000000000
000ORM#>99000000000000THENPRINT"YOUR ENTRY MUST BE BETWEEN 90,00
0,000,000,000 AND 99,000,000,000,000":GOTO100
110 IFM#=2*INT(M#/2)THENPRINT"YOUR ENTRY IS NOT AN ODD NUMBER. T
RY AGAIN.":GOTO100
120 LM#=FIX(.6*(M#/(10[12))):LM#=100000000000*LM#:PRINT:PRINT"N
EXT, CHOOSE A NUMBER THAT IS BETWEEN ";USINGF$;LM#;:PRINT" AND":
PRINTUSINGF$;1.5*LM#;:PRINT".  ENTER THIS NUMBER (WITHOUT COMMAS
)."
130 PRINT:W#=0:INPUT"NUMBER";W#:IFW#=0THEN50ELSEIFW#<LM#ORW#>(1.
5*LM#)THENPRINT"ENTRY MUST BE BETWEEN";LM#;"AND";STR$(1.5*LM#):G
OTO130
140 PRINT:PRINT"THE COMPUTER IS NOW GENERATING YOUR FACTORS.
PLEASE STAND BY."
150 FORY=1TO87:FORYY=0TO3:V#(Y,YY)=0:NEXT:NEXT:V#(2,0)=M#:V#(2,1
)=W#:Y=2
160 V#(Y,2)=INT(V#(Y,0)/V#(Y,1))
170 V#(Y,3)=V#(Y,0)-V#(Y,1)*V#(Y,2):IFV#(Y,3)<0THENV#(Y,2)=V#(Y,
2)-1:GOTO170
180 IFV#(Y,3)<>0THENV#(Y+1,0)=V#(Y,1):V#(Y+1,1)=V#(Y,3):Y=Y+1:GO
TO160
190 IFV#(Y,1)<>1THENM#=M#+2:GOTO150
200 L=Y:V#(0,0)=1:V#(1,1)=1
210 FORY=2TOL:FORYY=0TO1:V#(Y,YY)=V#(Y,2)*V#(Y-1,YY)+V#(Y-2,YY):
NEXT:NEXT
220 IFV#(L-1,1)*V#(L,0)<V#(L-1,0)*V#(L,1)THENV#=V#(L-1,1)*(-1)EL
SEV#=V#(L-1,1)
230 IFV#<0THENV#=V#+M#:GOTO230
240 IFLEN(STR$(V#))<12THENPRINT:PRINT"PLEASE TRY AGAIN.":GOTO120

250 PRINT:PRINT"YOUR 'M#' FACTOR IS ";USINGF$;M#:PRINT"YOUR 'V#'
 FACTOR IS ";USINGF$;V#:PRINT"IF YOU ARE NOT USING A PRINTER, CO
PY THESE DOWN.":PRINT:INPUT"PRESS 'ENTER' TO CONTINUE AND RETURN
 TO MAIN MENU";Z$:GOTO50
260 IFM#=0ORW#=0ORV#=0THENPRINT"YOU CAN NOT GENERATE YOUR SECRET
 AND PUBLIC KEY NUMBERS UNTIL":PRINT"YOU HAVE GENERATED YOUR SEC
RET FACTORS M# AND V#.":PRINT:PRINTCN$;:INPUTZ$:GOTO50
270 CLS:PRINT"THE COMPUTER IS NOW GENERATING YOUR SECRET KEY NUM
BERS.":PRINT"PLEASE STAND BY FOR ABOUT 2 MINUTES."
280 L#=INT(M#/2)-1:FORY=1TO45:SK#(Y)=0:NEXT:T#=0:SK#(1)=RND(2)+1
:T#=SK#(1):H=2:FORY=2TO45:IFH=100THEN310
290 ST#=T#:KS#=SK#(Y-1):FORYY=YTO45:KS#=ST#+H:ST#=ST#+KS#:NEXT:I
FKS#=<L#ANDH<100THENH=H+1:GOTO290
300 IFKS#>L#THENH=H-1
310 X=RND(H):SK#(Y)=T#+X:T#=T#+SK#(Y):NEXT
320 CLS:CS#=0:FORY=1TO45:CS#=CS#+SK#(Y):NEXT
330 IFE=1THENLPRINT"YOUR 'M#' FACTOR IS ";USINGF$;M#:LPRINT"YOUR
 'V#' FACTOR IS ";USINGF$;V#:LPRINT" ":LPRINT" "
340 IFE=1THENLPRINT"YOUR SECRET KEY NUMBERS":LPRINT" ":FORY=1TO1
5:LPRINTY;TAB(5)USINGF$;SK#(Y);:LPRINTTAB(26)Y+15;TAB(31)USINGF$
;SK#(Y+15);:LPRINTTAB(52)Y+30;TAB(57)USINGF$;SK#(Y+30):NEXT
```

Listing 1 continues

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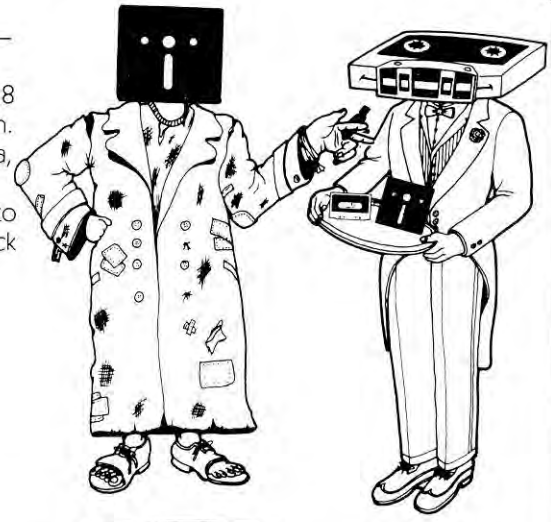

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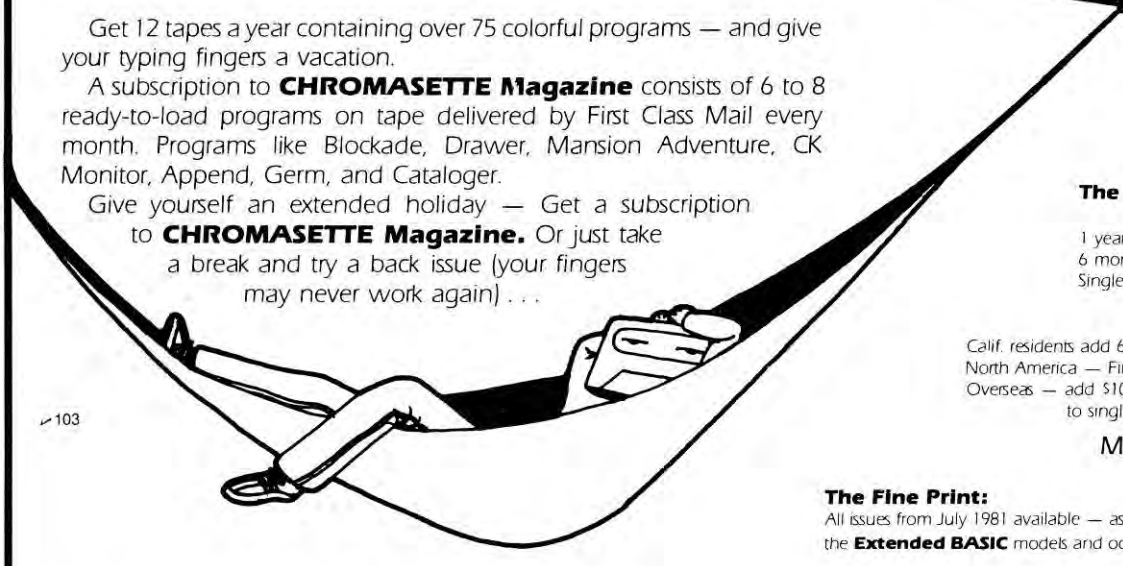

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Listing 1 continued

```
350 IFE=1THENLPRINT" ":LPRINTCS$;USINGH$;CS#:LPRINT" ":LPRINT" "
:GOTO380
360 PRINT"YOUR SECRET KEY NUMBERS":FORY=1TO15:PRINTMID$(PT$,Y,1)
;TAB(3)RIGHT$(STR$(Y),LEN(STR$(Y))-1);TAB(7)USING"##########";S
K#(Y);:PRINTTAB(21)RIGHT$(STR$(Y+15),LEN(STR$(Y+15))-1);TAB(25)U
SINGG$;SK#(Y+15);
370 PRINTTAB(42)RIGHT$(STR$(Y+30),LEN(STR$(Y+30))-1);TAB(46)USIN
GG$;SK#(Y+30):NEXT:PRINTCS$;USINGH$;CS#;:PRINT"    ";CN$;:INPUTZ
$
380 CLS:PRINT"THE COMPUTER IS GENERATING YOUR PUBLIC KEY NUMBERS
.":PRINT"PLEASE WAIT ABOUT 2 MINUTES.":X$=STR$(W#):FORY=1TO45:Y$
=STR$(SK#(Y)):Y$=STRING$(15-LEN(Y$),48)+RIGHT$(Y$,LEN(Y$)-1):GOS
UB480:PK#(Y)=T#:NEXT:CS#=0:FORY=1TO45:CS#=CS#+PK#(Y):NEXT:RF=0
390 IFE=1THENLPRINT"YOUR PUBLIC KEY NUMBERS":LPRINT" ":FORY=1TO1
5:LPRINTY;TAB(5)USINGF$;PK#(Y);:LPRINTTAB(26)Y+15;TAB(31)USINGF$
;PK#(Y+15);:LPRINTTAB(52)Y+30;TAB(57)USINGF$;PK#(Y+30):NEXT
400 IFE=1THENLPRINT" ":LPRINTCS$;USINGH$;CS#:LPRINT" ":LPRINT" "
:RF=RF+1:IFRF=1THENX$="":INPUT"DO YOU WANT A SECOND COPY OF YOUR
 PUBLIC KEY NUMBERS (Y/N)";X$:IFX$<>"Y"ANDX$<>"y"THEN50ELSE390
410 IFE=1THENGOTO50
420 CLS:PRINT"YOUR PUBLIC KEY NUMBERS":FORY=1TO15:PRINTMID$(PB$,
Y,1);"  ";RIGHT$(STR$(Y),LEN(STR$(Y))-1);TAB(7)USINGG$;PK#(Y);:P
RINTTAB(23)RIGHT$(STR$(Y+15),LEN(STR$(Y+15))-1);TAB(27)USINGG$;P
K#(Y+15);
430 PRINTTAB(43)RIGHT$(STR$(Y+30),LEN(STR$(Y+30))-1);TAB(47)USIN
GG$;PK#(Y+30):NEXT:PRINTCS$;USINGH$;CS#;:PRINT"    ";CN$;:INPUTZ
$:GOTO50
470 FORKK=1TO2000:NEXT:RETURN
480 PR$="":P1$=LEFT$(Y$,LEN(Y$)-7):P2$=RIGHT$(Y$,7):P3$=LEFT$(X$
,LEN(X$)-7):P4$=RIGHT$(X$,7):P#=VAL(P4$)*VAL(P2$):P$=STR$(P#):GO
SUB520:PR$=RIGHT$(P$,7):P#=VAL(LEFT$(P$,LEN(P$)-7)):P#=P#+VAL(P1
$)*VAL(P4$)+VAL(P3$)*VAL(P2$):P$=STR$(P#):GOSUB520
490 PR$=RIGHT$(P$,7)+PR$:P#=VAL(LEFT$(P$,LEN(P$)-7)):P#=P#+VAL(P
1$)*VAL(P3$):PR$=STR$(P#)+PR$
500 IFLEN(PR$)<17THEN510ELSETS$=LEFT$(PR$,16):PR$=RIGHT$(PR$,LEN
(PR$)-16):TS#=VAL(TS$):T#=INT(TS#/M#):T#=TS#-T#*M#:PR$=STR$(T#)+
PR$:GOTO500
510 TS#=VAL(PR$):T#=INT(TS#/M#):T#=TS#-T#*M#:RETURN
520 IFLEN(P$)<10THENP$=STRING$(10-LEN(P$),48)+RIGHT$(P$,LEN(P$)-
1)
530 RETURN
```

Program Listing 2

```
10 REM  Copr. George Reardon, 1981
20 CLS:PRINT"PLEASE STAND BY.":CLEAR1000:DEFINTA-Z:F$="##,###,##
#,###,###":G$="#,###,###,###,###,###":H$="################":CS$="C
HECKSUM = ":DF$="(DEFAULT TO MENU)":RANDOM:RP$="RECEIVER'S KEY "
30 DIMBC(58,20),RC#(45),CM#(12),P(17),N$(45)
40 FORY=1TO2:READT$(Y):NEXT:FORY=1TO45:N$(Y)=RIGHT$(STR$(Y),LEN(
STR$(Y))-1):N$(Y)=STRING$(2-LEN(N$(Y)),32)+N$(Y):NEXT:Y=0
50 READX:BC(Y,0)=X:FORYY=1TOX:READBC(Y,YY):NEXT:Y=Y+1:IFY<59THEN
GOTO50
60 X$="":CLS:INPUT"DO YOU HAVE A PRINTER CONNECTED (Y/N)";X$:IFX
$<>"Y"ANDX$<>"y"ANDX$<>"N"ANDX$<>"n"THENPRINT"ENTER 'Y' OR 'N'":
GOTO60ELSEIFX$="Y"ORX$="y"THENE=1
70 CLS:PRINT"ENCIPHERING MENU":PRINT:PRINT"1 - ENTER RECEIVER'S
PUBLIC KEY NUMBERS":PRINT"2 - ENTER PLAINTEXT MESSAGE STRINGS (C
IPHERTEXT NUMBERS":PRINT"    WILL BE PRINTED)":PRINT"3 - ERASE A
LL RECEIVER'S PUBLIC KEY NUMBERS":PRINT:T=1:MX=3:GOTO390
80 CLS:ONXGOTO90,140,380
90 CLS:PRINT"RECEIVER'S PUBLIC KEY NUMBERS";TAB(46)DF$:CS#=0:FOR
Y=1TO45:CS#=CS#+RC#(Y):NEXT:FORY=1TO15:PRINTMID$(RP$,Y,1);"  ";N
$(Y);:IFRC#(Y)<>0THENPRINTTAB(6)RC#(Y);
100 PRINTTAB(23)N$(Y+15);:IFRC#(Y+15)<>0THENPRINTTAB(26)RC#(Y+15
);
110 PRINTTAB(43)N$(Y+30);:IFRC#(Y+30)<>0THENPRINTTAB(46)RC#(Y+30
)ELSEPRINT" "
120 NEXT:PRINTCS$;USINGG$;CS#;:PRINT"    ";:T=2:MX=45:GOTO390
130 W#=0:INPUT"NUMBER";W#:IFW#=0THEN90ELSERC#(X)=W#:GOTO90
140 FL=0:FORY=1TO45:IFRC#(Y)=0THENFL=1:Y=45
150 NEXT:IFFL=1THENFL=0:PRINT"ALL 45 RECEIVER'S PUBLIC KEY NUMBE
RS MUST BE ENTERED BEFORE A":PRINT"MESSAGE CAN BE ENCIPHERED.":G
OSUB420:GOTO70
160 CLS:PRINT"ENTER PLAINTEXT MESSAGE STRING (60-CHARACTER MAXIM
UM).":PRINT"IF YOUR STRING INCLUDES A COMMA, A COLON, OR A LEADI
NG BLANK,":PRINT"YOU MUST ENCLOSE IT IN QUOTES.  THE ASTERISK MA
RKS THE 60TH":PRINT"CHARACTER WHEN QUOTES ARE NOT USED.";TAB(46)
DF$
170 M$="":PRINTTAB(61)"*":INPUTM$:IFM$=""THEN70ELSEM$=LEFT$(M$,6
0):FORY=1TOLEN(M$):AS=ASC(MID$(M$,Y,1)):IFAS<32OR(AS>90ANDAS<96)
THENPRINT"ILLEGAL CHARACTER IN STRING  -- REENTER STRING":GOSUB4
20:Y=LEN(M$):FL=1ELSEFL=0
180 NEXT:IFFL=1THEN160
```

Listing 2 continues

ters, words, and other character groups. Cryptanalysts also use the structure of the language, the habits of the people sending messages, and the expected subject of the message to test guesses at the probable message content.

This public-key system tends to smooth out character-frequency patterns. Each character can be enciphered in from 6 to 20 different ways; the most frequently used characters have the greatest number of variations. During enciphering, the variations are selected randomly.

This means that if the cryptanalyst guesses that the first five-letter group of a message is "these," he cannot readily confirm his guess because there are 1,216,800 different ways to encipher that group. The more common the characters are in a group, the more difficult the group is to confirm.

In contrast to the difficulty of breaking messages using the public-key numbers, deciphering the message using the secret-key numbers is very fast. The Level II Basic program deciphers each five-character group in about six seconds, and the supercomputer could do it instantaneously.

Using the System

To become a receiver, load and run Program Listing 1. Use a printer if you have one. First, generate your secret factors (menu routine 1); then generate your key numbers (menu routine 2).

If you are going to establish a network of users by distributing a directory of their public keys, you should make a second copy of your public-key numbers when the computer asks if you want one. You would submit the second copy for inclusion in the directory.

Your public-key numbers are the ones you publish. Others will use these numbers for enciphering their messages to you.

Do not disclose your secret factors or secret-key numbers. To save you the trouble of keying these in every time you decipher a message, build them into your deciphering program as shown in lines 40–100 of that program.

To send a message, load and run Program Listing 2. Use a printer if you have one.

Before you can send someone a message, you must enter that person's public-key numbers into the computer (menu routine 1). Do this, and use the checksum to assure accurate entry. The checksum is the total of the public-key numbers you have entered, and it must agree with the intended receiver's published checksum. If it does not, you

have made an entry error.

When the public-key numbers are entered correctly, you can enter message strings to be enciphered (menu routine 2).

If you want to send a message to a second receiver, it might be convenient to erase the first receiver's public-key numbers (menu routine 3) before entering the second receiver's public-key numbers.

To decipher messages that you receive, load and run Program Listing 3. Again, use your printer if you have one.

If you have not built your secret factors and secret-key numbers into your program, you must enter them with menu routines 1 and 2 before you can decipher a message. Be sure the checksum is correct after you have entered your secret-key numbers.

Select menu routine 3. A submenu will appear. Use routine 1 of this submenu for entering the ciphertext numbers sent to you. Be sure that the checksum is correct. When all of the ciphertext numbers are correctly entered, default by pressing enter, and you will return to the submenu.

Select routine 2 to decipher your message.

Listing 2 continued

```
190 PRINT:PRINT"THE STRING NOW BEING ENCIPHERED IS:":PRINTM$
200 NS=INT(LEN(M$)/5):IFNS*5<>LEN(M$)THENNS=NS+1:M$=M$+STRING$((
NS+1)*5-LEN(M$),32)
210 FORY=1TO12:CM#(Y)=0:NEXT:FORY=1TONS:C#=0:Y1=1:FORV=(5*(Y-1)+
1)TO(5*Y):AS=ASC(MID$(M$,V,1)):IFAS>90ANDAS<122THENAS=AS-32
220 AS=AS-32:X=BC(AS,RND(BC(AS,0))):IFX=>256THENC#=C#+RC#(Y1):X=
X-256
230 IFX=>128THENC#=C#+RC#(Y1+1):X=X-128
240 IFX=>64THENC#=C#+RC#(Y1+2):X=X-64
250 IFX=>32THENC#=C#+RC#(Y1+3):X=X-32
260 IFX=>16THENC#=C#+RC#(Y1+4):X=X-16
270 IFX=>8THENC#=C#+RC#(Y1+5):X=X-8
280 IFX=>4THENC#=C#+RC#(Y1+6):X=X-4
290 IFX=>2THENC#=C#+RC#(Y1+7):X=X-2
300 IFX=1THENC#=C#+RC#(Y1+8)
310 Y1=Y1+9:NEXT:CM#(Y)=C#:NEXT:C1#=0:C2#=0:FORY=1TO6:C1#=C1#+CM
#(Y):C2#=C2#+CM#(Y+6):NEXT:IFC1#<100ORC2#<100THENXX$=STR$(C1#+C2
#):GOTO340ELSEX$=STR$(C1#):Y$=STR$(C2#):Y=LEN(X$)-LEN(Y$):IFY<0T
HENX$=" "+STRING$(Y,48)+RIGHT$(X$,LEN(X$)-1)
320 IFY>0THENY$=" "+STRING$(Y,48)+RIGHT$(Y$,LEN(Y$)-1)
330 FORY=1TO17:P(Y)=0:NEXT:FORY=LEN(X$)TO2STEP-1:P(Y)=VAL(MID$(X
$,Y,1))+VAL(MID$(Y$,Y,1)):NEXT:XX$="":FORY=LEN(X$)TO2STEP-1:XX$=
RIGHT$(STR$(P(Y)),1)+XX$:P(Y-1)=P(Y-1)+VAL(LEFT$(STR$(P(Y)),LEN(
STR$(P(Y)))-1)):NEXT:XX$=STR$(P(1))+XX$
340 CLS:IFE=1THEN360ELSEPRINT"CIPHERTEXT NUMBERS":PRINT:FORY=1TO
12:PRINTY;:IFCM#(Y)<>0THENPRINTTAB(5)USINGG$;CM#(Y)ELSEPRINT" "
350 NEXT:PRINTCS$;XX$;:INPUT"    'ENTER' TO CONTINUE";Z$:GOTO160

360 LPRINT"CIPHERTEXT NUMBERS":LPRINT" ";FORY=1TO12:LPRINTY;:IFC
M#(Y)<>0THENLPRINTTAB(5)USINGG$;CM#(Y)ELSELPRINT" "
370 NEXT:LPRINT" ":LPRINTCS$;XX$:LPRINT" ";LPRINT" ";GOTO160
380 CLS:FORY=1TO45:RC#(Y)=0:NEXT:PRINT"RECEIVER'S PUBLIC KEY NUM
BERS ERASED":GOSUB420:GOTO70
390 X$="":PRINT"WHICH ";T$(T);:INPUTX$:IFX$=""THENPRINT" ":ONTGO
TO60,70
400 XX#=VAL(X$):IFXX#<1ORXX#>MXTHENPRINT" ":CLS:PRINT"ENTRY MUST
 BE BETWEEN 1 AND";MX:GOSUB420:ONTGOTO70,90
410 X=VAL(X$):ONTGOTO80,130
420 FORKK=1TO2000:NEXT:RETURN
430 DATAROUTINE,NUMBER
```

Listing 2 continues

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NEW!! POINTER VARIABLES!

Listing 2 continued

```
440 DATA20,15,47,71,103,114,124,135,143,154,167,184,206,232,241,
269,314,340,348,387,422,6,21,28,38,407,473,483,6,322,328,336,470
,490,492,6,261,268,274,303,317,349,6,81,84,97,123,215,219,6,22,2
6,35,377,459,462,6,41,42,95,104,125,243,6,266,276,292,311,318,45
5
450 DATA6,52,67,70,111,126,222,6,133,138,140,187,189,207,6,98,10
0,131,231,235,237,6,146,159,175,183,290,324,11,7,14,19,150,221,2
45,343,396,429,458,482,6,249,252,287,385,388,448,9,145,200,208,2
24,335,347,350,441,444,6,63,73,76,119,134,238
460 DATA6,137,246,250,315,400,416,6,190,192,223,352,386,392,6,65
,72,101,127,253,319,6,257,288,320,381,415,431,6,129,160,382,384,
439,445,6,66,68,96,379,443,446,6,258,260,272,362,367,375,6,48,80
,251,254,264,491,6,3,6,12,501,505,508
470 DATA6,5,10,18,477,487,493,6,9,17,20,494,502,506,6,24,33,40,4
75,478,499,6,34,36,130,239,247,471,6,132,136,144,191,351,463,6,1
,4,8,495,507,509,6,2,16,32,447,479,503,6,64,128,255,256,383,511,
13,29,61,77,87,139,174,197,229,275,331,356,376,394
480 DATA9,262,273,296,304,321,371,378,413,437,11,155,169,205,210
,302,305,309,353,409,420,496,11,30,93,102,117,153,179,180,217,22
6,242,278,20,0,23,79,89,107,120,122,172,182,204,227,277,299,323,
334,368,391,432,451,510,11,57,115,156,185,198,233,308,313,393
490 DATA398,401,11,45,51,54,58,78,85,425,428,433,436,440,13,59,8
6,109,149,173,195,211,281,301,332,339,389,419,13,83,110,142,157,
166,188,212,234,263,279,291,316,326,7,88,112,196,461,474,497,500
,9,148,152,162,176,194,423,427,430,438
500 DATA11,118,163,213,284,310,330,341,344,372,390,405,11,99,147
,209,214,218,271,306,403,408,412,417,13,43,121,141,181,228,327,3
37,346,452,464,468,480,484,13,31,39,94,105,158,216,230,240,244,3
12,345,449,453,11,46,53,60,90,92,108,248,355,357,358,361
510 DATA7,44,50,56,69,363,366,373
520 DATA13,171,178,203,270,286,325,333,354,395,450,456,460,466,1
3,55,113,186,201,220,282,295,338,397,402,410,424,454,18,27,62,75
,91,116,151,177,199,225,236,267,283,294,307,329,342,360,364,11,1
65,202,285,297,370,404,406,418,426,434,488
530 DATA9,161,164,168,193,442,467,486,498,504,9,259,265,280,289,
365,374,411,414,435,7,11,13,25,37,359,380,399,11,106,170,293,298
,300,369,421,457,465,472,481,7,49,74,82,469,476,485,489
```

Program Listing 3

```
10 REM   Copr. George Reardon, 1981
20 CLS:PRINT"PLEASE STAND BY.":CLEAR6000:DEFINTA-Z:F$="##,###,##
#,###,###":G$="#,###,###,###,###,###":H$="###############":CS$="C
HECKSUM = ":DF$="(DEFAULT RETURNS TO MENU)":NC$="ENTER NUMBERS O
NLY  --  NO COMMAS"
30 PT$="SECRET KEY     ":DIMBC$(511),CM#(12),SK#(45),P#(35),M$(6
0),P(17),N$(45):FORY=1TO45:N$(Y)=RIGHT$(STR$(Y),LEN(STR$(Y))-1):
N$(Y)=STRING$(2-LEN(N$(Y)),32)+N$(Y):NEXT
40 REM
50 REM  YOU CAN STORE YOUR SECRET FACTORS AND SECRET KEY NUMBERS

60 REM  HERE AND LOAD THEM AUTOMATICALLY WITH THE PROGRAM.
70 REM  EXAMPLE:  40 M#=93472131593753:V#=24386371646218:FORY=1T
O
80 REM               45:READSK#(Y):NEXT
90 REM            50 DATA3,4,10,19,42,82,162,330,658,1314(ETC.)
100 REM
110 FORY=1TO4:READT$(Y):NEXT:FORY=0TO511:READBC$(Y):NEXT:FORY=1T
O6:READX:BC$(X)=CHR$(34):NEXT
120 X$="":CLS:INPUT"DO YOU HAVE A PRINTER CONNECTED (Y/N)";X$:IF
X$<>"Y"ANDX$<>"y"ANDX$<>"N"ANDX$<>"n"THENPRINT"ENTER 'Y' OR 'N'"
:GOTO120ELSEIFX$="Y"ORX$="y"THENE=1
130 CLS:PRINT"DECIPHERING MAIN MENU":PRINT:PRINT"1 - ENTER YOUR
SECRET FACTORS (M# AND V#), IF NECESSARY":PRINT"2 - ENTER YOUR S
ECRET KEY NUMBERS, IF NECESSARY":PRINT"3 - DECIPHER MESSAGE":PRI
NT:T=1:MX=3:GOTO510
140 CLS:ONXGOTO150,170,220
150 CLS:XX#=0:INPUT"WHAT IS YOUR SECRET FACTOR 'M#' (DO NOT USE
COMMAS)";XX#:IFXX#=0THEN130ELSEM#=XX#:PRINT"FACTOR ENTERED IS";M
#:PRINT
160 PRINT:XX#=0:INPUT"WHAT IS YOUR SECRET FACTOR 'V#'";XX#:IFXX#
=0THEN130ELSEV#=XX#:PRINT"FACTOR ENTERED IS";V#:GOSUB540:GOTO130

170 CLS:PRINT"YOUR SECRET KEY NUMBERS";TAB(38)DF$:CS#=0:FORY=1TO
45:CS#=CS#+SK#(Y):NEXT:FORY=1TO15:PRINTMID$(PT$,Y,1);TAB(4)N$(Y)
;:IFSK#(Y)<>0THENPRINTTAB(7)SK#(Y);
180 PRINTTAB(21)N$(Y+15);:IFSK#(Y+15)<>0THENPRINTTAB(24)SK#(Y+15
);
190 PRINTTAB(42)N$(Y+30);:IFSK#(Y+30)<>0THENPRINTTAB(45)SK#(Y+30
)ELSEPRINT" "
200 NEXT:PRINTCS$;USINGG$;CS#;:PRINT"    ";:T=2:MX=45:GOTO510
210 R#=0:INPUT"NUMBER";R#:IFR#=0THEN170ELSESK#(X)=R#:GOTO170
220 IFM#=0ORV#=0THENPRINT"BEFORE YOU CAN DECIPHER A MESSAGE, YOU
```

Listing 3 continues

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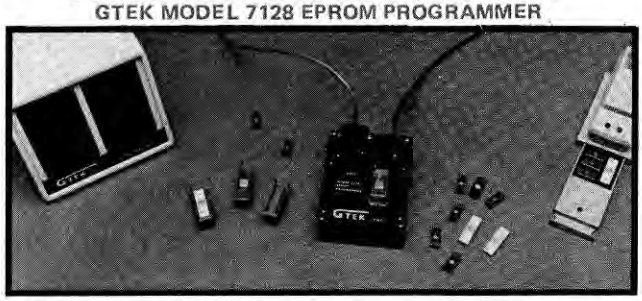
GTEK MODEL 7128 EPROM PROGRAMMER



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2716	2516	27C32	X2816	8749
2732	2532	C6716	48016	8741
2732A	2564	27C64		8742
2764	68766			8751
27128	8755			8755

- Read pin compatible ROMS also.
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↙299

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Listing 3 continued

```
 MUST ENTER YOUR SECRET":PRINT"FACTORS.":INPUT"PRESS 'ENTER' TO
RETURN TO THE MENU TO ENTER THEM.";Z$:GOTO130
230 CLS:FL=0:FORY=1TO45:IFSK#(Y)=0THENFL=1:Y=45
240 NEXT:IFFL=1THENFL=0:PRINT"BEFORE YOU CAN DECIPHER A MESSAGE,
 YOU MUST ENTER YOUR SECRET":PRINT"KEY NUMBERS.":INPUT"PRESS 'EN
TER' TO RETURN TO MAIN MENU TO ENTER THEM.";Z$:GOTO130
250 CLS:PRINT"DECIPHER A MESSAGE RECEIVED":PRINT:PRINT"1 - ENTER
 CIPHERTEXT NUMBERS RECEIVED":PRINT"2 - DECIPHER AND DISPLAY MES
SAGE":PRINT"3 - RETURN TO MAIN MENU":PRINT:T=3:MX=3:GOTO510
260 ONXGOTO270,360,130
270 FORY=1TO12:CM#(Y)=0:NEXT
280 CLS:PRINT"ENTER CIPHERTEXT NUMBERS RECEIVED";TAB(38)DF$:FORY
=1TO12:PRINTY;:IFCM#(Y)=0THENPRINT" "ELSEPRINTTAB(6)USINGG$;CM#(
Y)
290 NEXT:C1#=0:C2#=0:FORY=1TO6:C1#=C1#+CM#(Y):C2#=C2#+CM#(Y+6):N
EXT:IFC1#<100ORC2#<100THEN330ELSEX$=STR$(C1#):Y$=STR$(C2#):Y=LEN
(X$)-LEN(Y$):IFY<0THENX$=" "+STRING$(ABS(Y),48)+RIGHT$(X$,LEN(X$
)-1)
300 IFY>0THENY=" "+STRING$(Y,48)+RIGHT$(Y$,LEN(Y$)-1)
310 FORY=1TO17:P(Y)=0:NEXT:FORY=LEN(X$)TO2STEP-1:P(Y)=VAL(MID$(X
$,Y,1))+VAL(MID$(Y$,Y,1)):NEXT:XX$="":FORY=LEN(X$)TO2STEP-1:XX$=
RIGHT$(STR$(P(Y)),1)+XX$:P(Y-1)=P(Y-1)+VAL(LEFT$(STR$(P(Y)),LEN(
STR$(P(Y)))-1)):NEXT:XX$=STR$(P(Y))+XX$
320 PRINTCS$;" ";XX$:GOTO340
330 PRINTCS$;" ";C1#+C2#
340 T=4:MX=12:GOTO510
350 X#=0:INPUT"CIPHERTEXT NUMBER (NO COMMAS)";X#:CM#(X)=X#:GOTO2
80
360 CLS:PRINT"DECIPHERING.  PLEASE STAND BY.":PRINT"(DECIPHERING
 WILL TAKE ABOUT 6 SECONDS PER CIPHERTEXT NUMBER)":Y=1
370 IFCM#(Y)<>0THENY=Y+1:IFY<13THENGOTO370
380 W=Y-1:FORY=1TO60:M$(Y)="":NEXT:X$=STR$(V#):X$=STRING$(15-LEN
(X$),48)+RIGHT$(X$,LEN(X$)-1):FORY=WTO1STEP-1:B$=""
390 Y$=STR$(CM#(Y)):Y$=RIGHT$(Y$,LEN(Y$)-1):GOSUB550
400 FORYY=5TO1STEP-1:X=0:YZ=9*YY:IFSK#(YZ)=<T#THENX=X+1:T#=T#-SK
#(YZ)
410 IFSK#(YZ-1)=<T#THENX=X+2:T#=T#-SK#(YZ-1)
420 IFSK#(YZ-2)=<T#THENX=X+4:T#=T#-SK#(YZ-2)
430 IFSK#(YZ-3)=<T#THENX=X+8:T#=T#-SK#(YZ-3)
440 IFSK#(YZ-4)=<T#THENX=X+16:T#=T#-SK#(YZ-4)
450 IFSK#(YZ-5)=<T#THENX=X+32:T#=T#-SK#(YZ-5)
460 IFSK#(YZ-6)=<T#THENX=X+64:T#=T#-SK#(YZ-6)
470 IFSK#(YZ-7)=<T#THENX=X+128:T#=T#-SK#(YZ-7)
480 IFSK#(YZ-8)=<T#THENX=X+256:T#=T#-SK#(YZ-8)
490 M$(5*(Y-1)+YY)=BC$(X):NEXT:NEXT
500 CLS:IFE=1THENFORY=1TO60:LPRINTM$(Y);:NEXT:LPRINT" ":GOTO250E
LSEPRINT"THE MESSAGE STRING IS --":PRINT:FORY=1TO60:PRINTM$(Y);:
NEXT:PRINT" ":PRINT:PRINT:INPUT"PRESS 'ENTER' TO CONTINUE";Z$:GO
TO250
510 X$="":PRINT"WHICH ";T$(T);:INPUTX$:IFX$=""THENONTGOTO130,130
,130,250
520 XX#=VAL(X$):IFXX#<1ORXX#>MXTHENCLS:PRINT"ENTRY MUST BE BETWE
EN 1 AND";MX:GOSUB540:ONTGOTO130,170,250,280
530 X=VAL(X$):ONTGOTO140,210,260,350
540 FORKK=1TO2000:NEXT:RETURN
550 PR$="":P1$=LEFT$(Y$,LEN(Y$)-7):P2$=RIGHT$(Y$,7):P3$=LEFT$(X$
,LEN(X$)-7):P4$=RIGHT$(X$,7):P#=VAL(P4$)*VAL(P2$):P$=STR$(P#):GO
SUB650:PR$=RIGHT$(P$,7):P#=VAL(LEFT$(P$,LEN(P$)-7)):P#=P#+VAL(P1
$)*VAL(P4$)+VAL(P3$)*VAL(P2$):P$=STR$(P#):GOSUB650
560 PR$=RIGHT$(P$,7)+PR$:P#=VAL(LEFT$(P$,LEN(P$)-7)):P#=P#+VAL(P
1$)*VAL(P3$):PR$=STR$(P#)+PR$
570 IFLEN(PR$)<17THEN580ELSETS$=LEFT$(PR$,16):PR$=RIGHT$(PR$,LEN
(PR$)-16):TS#=VAL(TS$):T#=INT(TS#/M#):T#=TS#-T#*M#:PR$=STR$(T#)+
PR$:GOTO570
580 TS#=VAL(PR$):T#=INT(TS#/M#):T#=TS#-T#*M#:RETURN
590 DATAROUTINE,NUMBER,ROUTINE,NUMBER
600 DATAE,>,?,8,>,9,8,",",>,":",9,X,8,X,",",",",?,":",9,",",":",
!,%,E,;,X,%,T,!,A,D,O,?,;,<,%,<,X,!,O,;,&,&,N,Q,G,P," ",7,Z,Q,G,
(,P,G,S,Q,F,G,H,P,A,T,/,@,2,5,(,5,Q,(," ",2,/,Z,T,/,A,G,E,7,$,Z,
I,$,G,H,A,J,E,P,T,P,D,O,&,5,$,*,M,*,2,D," ",&,O,Y,E,P,H,I,(,J,S
610 DATA" ",F,T,D,L,/,E,N,E,$," ",&,(,2,@,4,<,*,=,),/," ",=,@,),
A,),N,I," ",=,.,+,M,K,H,",",T,K,D," ",C,F,I,O,+,4,V,K,L,V,U,I,"
",V,C,Y,R,E,H,A,+,K,T,R,D,D,N,E,+," ",F,S,),I,),1,=,1,V,K,H,J,A,
F,T,.,S,U,R,E,C," ",),.,M,C,H,I,L,M,$,O,D,M,$,S,",",(,1,.,T,D,E
620 DATAN,A,O,*," ",F,I,*,T,*,/,<,O," ",D,&,O,",",@,<,P,-,@,7,-,
2,7,@,@,3,6,W,6,#,B,I,7,W,',T,#," ",R,M,6,B,#,A,',E,D,I,W,H,S,T,
L,U,R,-,3,W,+,I,',Y,T,S,B,U,Y,E,Y,H,C,#,B,C,M,T,F,C,L,',O,F," ",
@,I,#,',2,3,B,,E,+,R,I,N,,T,L,A,H,R,E,.,,N,S,H," ",L,T,",",L,O
630 DATAN,.," ",#,.,=,1,C,R,P,A,P,P,X,T,P,6,Q,T,W,Q,6,E,Y,U,B,L,
Q,W,6,A,%,B,5,X,3,4,@,4,-,1," ",-,H,L,E,1,F,A,R,",",S,F,X,@,F,S,
M,U,L,U,!,M,C,S,W,M,B,W,3,@,M,U,H,C,Y," ",K,S,G,U,K,G,",",K,3,E,
G,U,W,G,B,K,4,G,.,V,5,.,4,5,?,-,O,R,E,N,O,S
640 DATA',R,Y,",",%,R,J,%,=,N,Y,R,V,N,Z,,<,Y,!,J,;,Z,9,;,?,N,Y,"
",!,N,Z,V,9,U,Z,,7,,9,":",>,C,J,V,;,J,8,":",?,V,8,":",>,8,>,E,@
,322,328,336,470,490,492
650 IFLEN(P$)<10THENP$=STRING$(10-LEN(P$),48)+RIGHT$(P$,LEN(P$)-
1)
660 RETURN
```

One of the advantages of public-key cryptosystems is that the receiver can verify the identity of the sender. For example, assume that Principal wants to instruct Agent to sell a car. He might send Agent the secret message: "Sell car for ten thousand. Signed, Principal."

Using Principal's public key to encipher the message, Agent replies: "Confirm identity by naming type of candy. Agent."

If Principal has protected his secret key, he should be the only person able to read Agent's authentication test. If he replies, "Licorice. Principal.," then Agent can confidently go ahead with the sale.

Program Enhancements

These programs are in their simplest form. They are written in Level II Basic, do not require a printer, and will run within 16K RAM on a Model I, II, or III. The following suggestions enhance this system by making it faster, more secure, or more convenient.

You can provide for the ciphertext to be stored on disk or cassette, or transmitted directly over the telephone.

You can link these programs to a word-processing program in order to encipher and decipher large files of text automatically.

Where a fixed network of users is contemplated, you can place a directory of all public keys on a standard disk to be distributed to the users.

You can compile the programs for greater speed.

For greater security, you can use the system in multiple layers (encipher the ciphertext numbers), or boost the power of the system by enlarging the key size above 45.

Finally, the system requires that some of the calculations be accurate to more than 30 digits, well beyond Level II's double precision. The published programs use string functions to accomplish this precision by mimicking manual-calculation methods.

If a high level of precision were available at high speed, the programs would run much faster. (This is also the principal constraint on enlarging the key size.) This can be accomplished with machine-language subroutines. ■

Author's Note: Since this article was written, new research has made simple knapsack ciphers vulnerable to mathematical analysis. The more complicated versions, using multiple iterations, may still be secure.

George Reardon can reached at 1450 Ranchero Drive, Sarasota, FL 33582.

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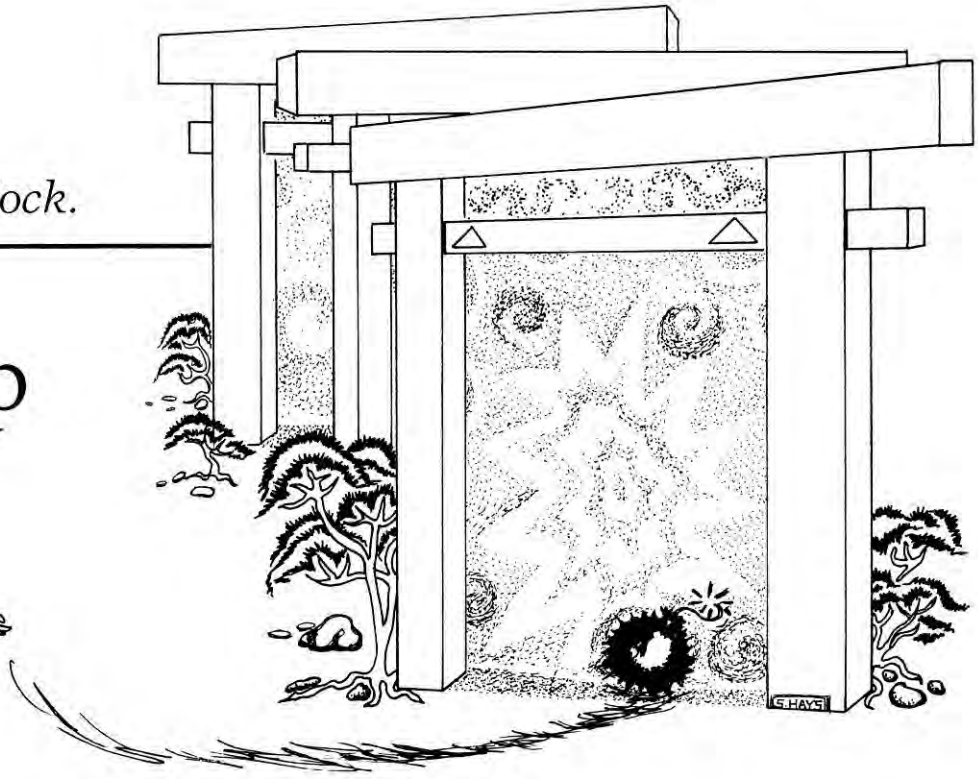
LOAD 80

You have to beat the clock.

Time Warp



Russ Hildreth
740 W. Sixth St.
Ontario, CA 91762

Time Warp is a real-time game in which you must destroy all the Time Gates.

When you run Time Warp the screen displays the high score and the Time Warp logo; press enter to start the game. You must now steer the warrior through all the Time Gates on each level.

When you go through all the Time Gates on one level, you get one bonus point for each second left; then you advance to the next level.

The game continues until you destroy all 100 Time Gates or you run out of time on any level. If you beat the old high score (initially set at 1,000) the program returns to the title page and allows you to enter your initials on the scoreboard.

This is an easy game to play at the beginning levels because you're allowed large periods of time. As you progress through the levels you're allowed less time to get through all the gates. Try to stay tight around the corners and learn strategy. These techniques have helped me score over 2,000 points.

The Key Box

Model I or III
16K RAM
Cassette or Disk Basic

Special Notes on Loading

All strings in this program need to be prepacked using VARPTR. Follow these steps exactly:

- Key in the entire program.
- Save the program.
- Run the program (wait for the title page, then press break).
- Delete line 175 and all lines after 60000.
- Save the program.

Note that M$(x) in lines 1-16 produces 43 spaces.

Summary

One defect in this program is the lack of sound; if you wish to add sound try line 390 (the Gate explosion) and line 310 (movement). ■

Program Listing

```
1 ' By Rusty Hildreth
2 ' For RadGraph
3 ' 740 West Sixth Street
4 ' Ontario, Ca 91762
5 ' (714) 983-0929
10 DIMM$(16):HI=1000:HI$="RUSS"
20 M$(1)="                                           "
30 M$(2)="                                           "
40 M$(3)="                                           "
50 M$(4)="                                           "
60 M$(5)="                                           "
70 M$(6)="                                           "
80 M$(7)="                                           "
90 M$(8)="                                           "
100 M$(9)="                                           "
```

Listing continues

Variable Table

HI = High score (initially 1000)
HI$ = High scorer
M$(x) = Maze strings (43 spaces!!)
G,K,A$,I,S,Z,T = Working variables
X,Y = Graphics location
L = Level you're on
TI = Remaining time
A = For PEEK of movement
D = Destroyed Time Gates for that level
SC = Score
Q$(x) = Letters for high scorer
AT = Ship location for title page

Table 1. Variables

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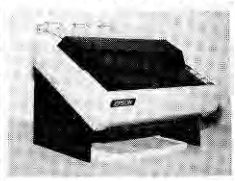

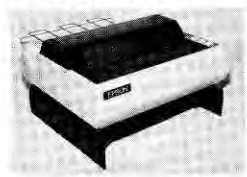

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COTTAGE SOFTWARE

PACKER: Machine language program that edits all or part of your Basic program to run faster, save memory, or ease editing. The 5 options include UNPACK—unpacks multiple statement lines into single statements maintaining logic, inserts spaces and renumbers lines. SHORT—deletes unnecessary words, spaces, and REM statements. PACK—packs lines into maximum multiple statement lines, including all branches. MOVE—moves line or blocks of lines to any new location on program. On 2 cassettes for 16K, 32K, & 48K
For TRS-80 Mod I or III Level II or Disk Basic ... $29.95

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COTTAGE SOFTWARE
614 N. HARDING
WICHITA, KANSAS 67208
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TRS-80™ is a trademark of Tandy Corporation

Listing continued

```
110 M$(10)="                                                  "
120 M$(11)="                                                  "
130 M$(12)="                                                  "
140 M$(13)="                                                  "
150 M$(14)="                                                  "
160 M$(15)="                                                  "
170 M$(16)="                                                  "
175 GOSUB60000
180 GOSUB1040
190 CLS:S=0:FORZ=1TO16:PRINT@S,M$(Z);:S=S+64:NEXTZ
200 FORX=94TO119:SET(X,2):SET(X,6):SET(X,8):SET(X,12):NEXTX
210 FORY=2TO12:SET(92,Y):SET(93,Y):SET(120,Y):SET(121,Y):NEXTY
220 PRINT@112,">TIME WARP<";:PRINT@240,"By RadGraph";
230 L=1
240 ONLGOSUB430,440,450,460,470,480,490,500,510,520
250 GOSUB530
260 PRINT@621,"LEVEL -";L;
270 X=42:Y=25
280 PRINT@813,"              ";
290 IFTI<=0THENGOTO950:ELSEPRINT@941,"";:PRINTUSING"TIME -###.#"
;TI;:SET(X,Y):SET(X+1,Y)
300 A=PEEK(14400)
310 IFA=0THENRESET(X,Y):RESET(X+1,Y):TI=TI-.1:GOTO290
320 IFA=8THENGOSUB370:IFPOINT(X,Y-1)=-1ORPOINT(X+1,Y-1)=-1THENTI
=TI-.1:GOTO290:ELSEIFY-1=1THENY=45:TI=TI-.1:GOTO290:ELSEY=Y-1:TI
=TI-.1:GOTO290
330 IFA=16THENGOSUB370:IFPOINT(X,Y+1)=-1ORPOINT(X+1,Y+1)=-1THENT
I=TI-.1:GOTO290:ELSEIFY+1=46THENY=2:TI=TI-.1:GOTO290:ELSEY=Y+1:T
I=TI-.1:GOTO290
340 IFA=32THENGOSUB370:GOSUB380:IFPOINT(X-2,Y)=-1THENTI=TI-.1:GO
TO290:ELSEX=X-2:TI=TI-.1:GOTO290
350 IFA=64THENGOSUB370:GOSUB380:IFPOINT(X+2,Y)=-1THENTI=TI-.1:GO
TO290:ELSEX=X+2:TI=TI-.1:GOTO290
360 GOTO290
370 RESET(X,Y):RESET(X+1,Y):RETURN
380 IFPOINT(X,Y-1)=-1ANDPOINT(X,Y+1)ANDPOINT(X+1,Y-1)=-1ANDPOINT
(X+1,Y+1)=-1THENGOTO390ELSERETURN
390 SET(X-2,Y):SET(X-1,Y):SET(X+2,Y):SET(X+3,Y):SET(X,Y-1):SET(X
,Y+1):SET(X+1,Y-1):SET(X+1,Y+1):FORT=1TO50:RESET(X-2,Y):RESET(X-
1,Y):RESET(X+2,Y):RESET(X+3,Y):RESET(X,Y-1):RESET(X,Y+1):RESET(X
+1,Y-1):RESET(X+1,Y+1):FORT=1TO50
400 D=D+1:SC=SC+5*L:PRINT@877,"SCORE -";SC;:IFD=10THEND=0:GOTO41
0:ELSETI=TI-.5:GOTO290
410 L=L+1:PRINT@813,"WARP BONUS -";INT(TI*1);:SC=SC+INT(TI*1):PR
INT@877,"SCORE -";SC;:FORI=1TO1000:NEXTI:PRINT@813,"
    ";
420 GOTO240
430 TI=100:RETURN
440 TI=90:RETURN
450 TI=80:RETURN
460 TI=70:RETURN
470 TI=60:RETURN
480 TI=50:RETURN
490 TI=40:RETURN
500 TI=30:RETURN
510 TI=20:RETURN
520 TI=10:RETURN
530 ONLGOTO900,860,820,780,740,700,660,620,580,540:GOTO940
540 PRINT@791,CHR$(179);:PRINT@680,CHR$(179);:PRINT@661,CHR$(179
);
550 PRINT@100,CHR$(179);:PRINT@515,CHR$(179);:PRINT@550,CHR$(179
);
560 PRINT@643,CHR$(179);:PRINT@933,CHR$(1799;:PRINT@902,CHR$(179
);
570 PRINT@78,CHR$(179);:RETURN
580 PRINT@398,CHR$(179);:PRINT@69,CHR$(179);:PRINT@93,CHR$(179);

590 PRINT@389,CHR$(179);:PRINT@552,CHR$(179);:PRINT@661,CHR$(179
);
600 PRINT@680,CHR$(179);:PRINT@787,CHR$(179);:PRINT@642,CHR$(179
);
610 PRINT@902,CHR$(179);:RETURN
620 PRINT@515,CHR$(179);:PRINT@93,CHR$(179);:PRINT@283,CHR$(179)
;
630 PRINT@550,CHR$(179);:PRINT@643,CHR$(179);:PRINT@539,CHR$(179
);
640 PRINT@791,CHR$(179);:PRINT@527,CHR$(179);:PRINT@923,CHR$(179
);
650 PRINT@650,CHR$(179);:RETURN
660 PRINT@923,CHR$(179);:PRINT@400,CHR$(179);:PRINT@102,CHR$(179
);
670 PRINT@680,CHR$(179);:PRINT@271,CHR$(179);:PRINT@934,CHR$(179
);
```

Listing continues

Listing continued

```
680 PRINT@780,CHR$(179);:PRINT@78,CHR$(179);:PRINT@517,CHR$(179)
;
690 PRINT@422,CHR$(179);:RETURN
700 PRINT@78,CHR$(179);:PRINT@100,CHR$(179);:PRINT@272,CHR$(179)
;
710 PRINT@293,CHR$(179);:PRINT@389,CHR$(179);:PRINT@412,CHR$(179
);
720 PRINT@528,CHR$(179);:PRINT@550,CHR$(179);:PRINT@643,CHR$(179
);
730 PRINT@799,CHR$(179);:RETURN
740 PRINT@902,CHR$(179);:PRINT@933,CHR$(179);:PRINT@791,CHR$(179
);
750 PRINT@648,CHR$(179);:PRINT@680,CHR$(179);:PRINT@515,CHR$(179
);
760 PRINT@528,CHR$(179);:PRINT@540,CHR$(179);:PRINT@421,CHR$(179
);
770 PRINT@93,CHR$(179);:RETURN
780 PRINT@69,CHR$(179);:PRINT@266,CHR$(179);:PRINT@400,CHR$(179)
;
790 PRINT@412,CHR$(179);:PRINT@661,CHR$(179);:PRINT@671,CHR$(179
);
800 PRINT@780,CHR$(179);:PRINT@791,CHR$(179);:PRINT@902,CHR$(179
);
810 PRINT@925,CHR$(179);:RETURN
820 PRINT@515,CHR$(179);:PRINT@412,CHR$(179);:PRINT@680,CHR$(179
);
830 PRINT@293,CHR$(179);:PRINT@780,CHR$(179);:PRINT@550,CHR$(179
);
840 PRINT@910,CHR$(179);:PRINT@400,CHR$(179);:PRINT@69,CHR$(179)
;
850 PRINT@287,CHR$(179);:RETURN
860 PRINT@421,CHR$(179);:PRINT@69,CHR$(179);:PRINT@643,CHR$(179)
;
870 PRINT@780,CHR$(179);:PRINT@266,CHR$(179);:PRINT@100,CHR$(179
);
880 PRINT@933,CHR$(179);:PRINT@680,CHR$(179);:PRINT@791,CHR$(179
);
890 PRINT@661,CHR$(179);:RETURN
900 PRINT@400,CHR$(179);:PRINT@412,CHR$(179);:PRINT@528,CHR$(179
);
910 PRINT@540,CHR$(179);:PRINT@261,CHR$(179);:PRINT@93,CHR$(179)
;
920 PRINT@648,CHR$(179);:PRINT@902,CHR$(179);:PRINT@925,CHR$(179
);
930 PRINT@515,CHR$(179);:RETURN
940 PRINT@365,"CONGRATULATIONS";:PRINT@429,"YOU PASSED THRU";:PR
INT@493,"ALL TIME GATES.";:PRINT@556,"YOU HAVE ESCAPED!";:FORK=1
TO500:NEXTK
950 PRINT@941,"TIME -0000 ";:IFSC>HITHENHI=SC:SC=0:ELSESC=0:FORT
=1TO2000:NEXTT:GOTO1040
960 A$=INKEY$:PRINT@365,"CONGRATULATIONS";:PRINT@429,"YOU HAVE S
CORED";:PRINT@493,"HIGHER THAN ANY";:PRINT@556,"ONE ELSE TODAY!!
!";:FORK=1TO3000:NEXTK
970 PRINT@685,"ENTER 4 INITIALS";
980 PRINT@755,"";
990 FORT=1TO4
1000 Q$(T)=INKEY$:IFQ$(T)=""THEN1000:ELSEPRINTQ$(T);:NEXT
1010 HI$=""
1020 FORT=1TO4:HI$=HI$+Q$(T):NEXT
1030 FORT=1TO1000:NEXTT
1040 CLS:PRINT@64,"RadGraph Software Presents:";
1050 PRINT@34,CHR$(138);:PRINT@35,CHR$(175);:PRINT@36,STRING$(28
,191);
1060 PRINT@103,STRING$(3,191);:PRINT@231,STRING$(3,191);
1070 PRINT@290,CHR$(168);:PRINT@291,CHR$(190);:PRINT@292,STRING$
(28,191);
1080 PRINT@354,CHR$(170);:PRINT@355,STRING$(2,191);:PRINT@357,CH
R$(183);:PRINT@358,CHR$(145);
1090 PRINT@419,CHR$(130);:PRINT@420,STRING$(4,131);:PRINT@424,ST
RING$(4,143);:PRINT@428,STRING$(20,191);
1100 SH$=CHR$(140)+CHR$(191)+CHR$(179)+CHR$(179)
1110 AT=188
1120 PRINT@AT,SH$;:FORG=1TO50:NEXTG:PRINT@AT,"    ";:AT=AT-1:IFA
T=165THEN1130ELSE1120
1130 PRINT@164,STRING$(3,191);:PRINT@170,STRING$(3,191);:FORT=1T
O100:NEXTT
1140 PRINT@103,"   ";:PRINT@164,"         ";:PRINT@231,"   ";:FO
RT=1TO100:NEXTT
1150 PRINT@100,STRING$(3,191);:PRINT@106,STRING$(3,191);:PRINT@1
67,STRING$(3,191);
1160 PRINT@228,STRING$(3,191);:PRINT@234,STRING$(3,191);:FORT=1T
O100:NEXTT
1170 PRINT@100,"         ";:PRINT@228,"         ";:FORT=1TO100:N
```

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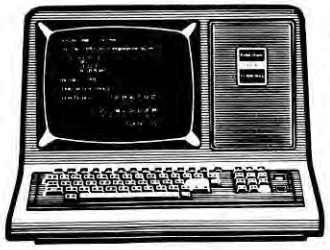

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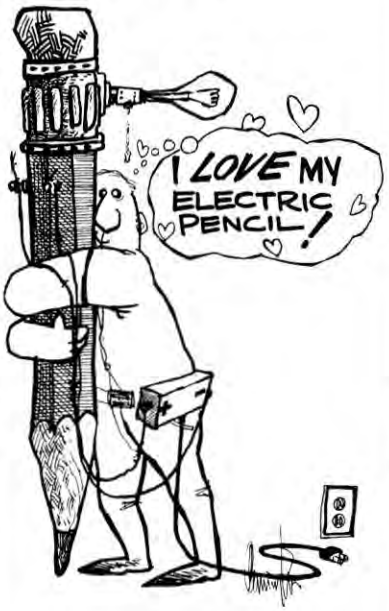
Listing continued

```
EXTT
1180 PRINT@167,"   ";:PRINT@AT-2,SH$;:FORT=1TO200:NEXTT
1190 FORX=10TO19:SET(X,7):NEXTX
1200 FORY=7TO11:SET(14,Y):SET(15,Y):NEXTY
1210 FORX=22TO27:SET(X,8):SET(X,12):NEXT
1220 FORY=8TO11:SET(24,Y):SET(25,Y):NEXT
1230 FORY=9TO13:SET(30,Y):SET(31,Y):SET(36,Y):SET(37,Y):NEXTY
1240 SET(32,10):SET(33,11):SET(34,11):SET(35,10)
1250 FORX=40TO46:SET(X,10):SET(X,12):SET(X,14):NEXT:SET(47,12):S
ET(48,12)
1260 SET(40,11):SET(41,11):SET(40,13):SET(41,13)
1270 SET(60,17):SET(61,17):FORY=18TO22:SET(54,Y):SET(55,Y):SET(6
0,Y):SET(61,Y):NEXT
1280 FORY=19TO22:SET(57,Y):SET(58,Y):NEXT:SET(56,22):SET(59,22)
1290 FORX=65TO68:SET(X,19):SET(X,21):NEXT
1300 FORY=20TO23:SET(64,Y):SET(65,Y):SET(68,Y):SET(69,Y):NEXT
1310 FORY=20TO24:SET(72,Y):SET(73,Y):NEXT
1320 FORX=74TO77:SET(X,20):NEXT
1330 SET(76,21):SET(77,21):SET(74,22):SET(75,22):SET(76,22)
1340 SET(75,23):SET(76,23):SET(76,24):SET(77,24)
1350 FORY=21TO25:SET(80,Y):SET(81,Y):NEXT
1360 FORX=82TO84:SET(X,21):SET(X,23):NEXT
1370 SET(85,21):SET(85,22):SET(84,22)
1380 PRINT@614,"By Rusty Hildreth";
1390 FORX=4TO31:SET(X,23):SET(X,30):NEXT
1400 FORY=24TO30:SET(4,Y):SET(5,Y):SET(30,Y):SET(31,Y):NEXT
1410 PRINT@515,"<HIGH SCORE>";:PRINT@580,HI$;" ";HI;
1420 PRINT@797,"Press <ENTER> To Start";
1430 A$=INKEY$
1440 IFINKEY$<>CHR$(13)THEN1440
1450 D=0:GOTO190
60000 FORE=1TO16
60010 X=PEEK(VARPTR(M$(E))+1)+PEEK(VARPTR(M$(E))+2)*256
60020 FORS=1TO43:READF:POKEX+S-1,F:NEXTS
60030 NEXTE
60040 RETURN
60050 DATA176,176,176,176,176,176,176,176,176,176,176,176,176,17
6,176,176,176,176,176,176,128,128,128,176,176,176,176,176,176,17
6,176,176,176,176,176,176,176,176,176,176,176,176,176,176,176
60060 DATA191,128,128,128,128,128,128,128,128,128,128,128,128,12
8,128,128,128,128,128,191,128,128,128,191,128,128,128,128,128,12
8,128,128,128,128,128,128,128,128,128,128,128,128,191
60070 DATA191,128,128,128,191,131,191,128,128,128,128,128,128,19
1,131,191,128,128,128,128,128,128,128,128,128,128,128,191,131,19
1,128,128,128,128,128,128,191,131,191,128,128,128,191
60080 DATA191,179,179,179,179,176,191,128,128,128,191,179,179,17
9,176,179,179,179,179,179,179,131,179,179,179,179,179,179,176,17
9,179,179,191,128,128,128,191,176,179,179,179,179,191
60090 DATA191,128,128,128,128,128,128,128,128,128,128,128,128,12
8,128,128,128,128,128,128,191,128,191,128,128,128,128,128,128,12
8,128,128,128,128,128,128,128,128,128,128,128,128,191
60100 DATA191,128,128,128,191,179,179,179,179,179,179,131,179,17
9,179,179,191,128,128,128,191,176,191,128,128,128,191,179,179,17
9,179,131,179,179,179,179,179,179,191,128,128,128,191
60110 DATA191,128,128,128,128,128,128,128,128,128,128,191,128,191,12
8,128,128,128,128,128,128,128,128,128,128,128,128,128,128,128,12
8,191,128,191,128,128,128,128,128,128,128,128,128,191
60120 DATA191,179,179,179,179,179,191,128,128,128,191,128,179,17
9,179,179,179,179,179,191,128,128,128,191,179,179,179,179,179,17
9,179,128,191,128,128,128,191,179,179,179,179,179,191
60130 DATA191,128,128,128,128,128,128,128,128,128,128,128,191,128,191,12
8,128,128,128,128,128,128,128,128,128,128,128,128,128,128,128,12
8,191,128,191,128,128,128,128,128,128,128,128,128,191
60140 DATA191,179,179,179,179,179,179,179,179,179,179,176,179,17
9,179,179,179,191,128,128,128,191,128,128,128,191,179,179,179,17
9,179,176,179,179,179,179,179,179,179,179,179,191
60150 DATA191,128,128,128,128,128,128,128,128,128,128,128,128,12
8,128,128,128,128,128,128,128,128,128,128,128,128,128,128,128,12
8,128,128,128,128,128,128,128,128,128,128,128,128,191
60160 DATA191,179,179,179,191,128,128,128,191,179,179,179,179,191,12
8,128,128,191,179,179,179,179,179,179,191,128,128,12
8,191,179,179,179,179,191,128,128,128,191,179,179,191
60170 DATA191,128,128,128,128,128,128,128,128,128,128,128,128,12
8,128,128,128,128,128,128,128,128,128,128,128,128,128,128,128,12
8,128,128,128,128,128,128,128,128,128,128,128,128,191
60180 DATA191,128,128,128,191,179,179,191,128,128,128,191,179,17
9,179,191,128,128,128,191,128,128,128,191,128,128,128,191,179,17
9,179,191,128,128,128,191,179,179,191,128,128,128,191
60190 DATA191,128,128,128,128,128,128,128,128,128,128,128,128,12
8,128,128,128,128,191,128,128,128,191,128,128,128,128,128,128,12
8,128,128,128,128,128,128,128,128,128,128,128,128,191
60200 DATA131,131,131,131,131,131,131,131,131,131,131,131,131,13
1,131,131,131,131,131,131,128,128,128,131,131,131,131,131,131,13
1,131,131,131,131,131,131,131,131,131,131,131,131,131
```

Word Processing Software for TRS-80* Model I



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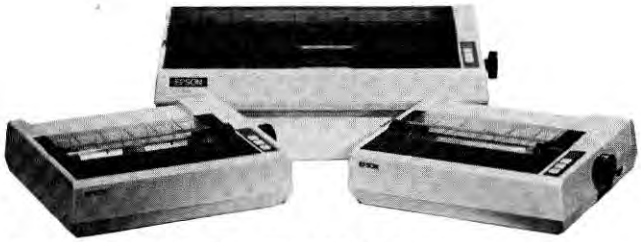

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Cassette Operating System

Richard W. Castor
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If microcomputers such as the TRS-80 could not sort, add, delete or edit, and otherwise manipulate numeric and alphanumeric data files, they would be little more than expensive calculators. Data base management is a simple and powerful but little understood ability of the microcomputer.

Most data files are two-dimensional. An address file, for example, consists of a card including:

0 Record number
1 Name
2 Street address
3 City and State
4 Zip code
5 Telephone number

I will refer to each of these six entries as *elements*, and to the group as a *record*. Hence we have a record of six elements. A group of one or more records constitutes a *data-base file*.

Data bases are configured into an *array* or *matrix* which consigns each record to a *row* and each element of a given record to a *column* in that row. Pages of a calendar, a chess board, or an athletic scoreboard are examples of this format. For the purposes of discussion I will refer to the array as A$(R,C) where R is the row and C is the column index. A string array takes full advantage of the powerful string statements available in Level II Basic.

Fig. 1 shows A$(R,C). Here the element A$(1,1) is the string DOE JOHN. A$(2,2) is the street address 217 PEACH ST. A$(O,C) are used for the headings and A$(R,O) are the record numbers.

There are no restrictions on the number or length of the *fields* (columns). However, Level II Basic allows only 248 characters per string element. If elements are of fixed length, such as Zip code (5) and Telephone number (12), include error trapping routines in the data entry module.

```
IF A$(R,4)<>5 THEN GOTO ZIP CODE
IF A$(R,5)<>12 THEN GOTO TELEPHONE #
```

The techniques I develop here utilize flags to permit variable fields—no blocking or field fills

A$(R,C)

ROW ↓ / COLUMN →	0	1	2	3	4	5
0	A$(0,0) RECORD #	A$(0,1) NAME	A$(0,2) STREET ADDRESS	A$(0,3) CITY & STATE	A$(0,4) ZIP CODE	A$(0,5) TELEPHONE #
1	A$(1,0) 1	A$(1,1) DOE JOHN	A$(1,2) 21 S. APPLE ST.	A$(1,3) NOWHERE IN	A$(1,4) 03527	A$(1,5) 312-855-3128
2	A$(2,0) 2	A$(2,1) DOE JANE	A$(2,2) 217 PEACH ST.	A$(2,3) ANYWHERE OH	A$(2,4) 75318	A$(2,5) 209-215-3456
3	A$(3,0) 3	A$(3,1)	A$(3,2)	A$(3,3)	A$(3,4)	A$(3,5)

ETC

Figure 1

Program Listing 1

```
3 X=32655
4 X=X-2:Y=INT(X/256):Z=X-(Y*256):POKE16561,Z:POKE16562,Y:CLEAR
5 CLS:CLEAR7000:DEFINTA-Z
6 DATA 33,0,60,205,132,2,126,35,205,100,2,254,132,202,169,127,25
4,131,194,154,127,205,248,1,201
7 FORI=32660TO32684:READX:POKEI,X:NEXTI
8 DATA 33,0,60,205,147,2,205,53,2,119,35,254,131,202,194,127,254
,132,194,179,127,205,248,1,201
9 FORI=32685TO32709:READX:POKEI,X:NEXTI
10 CLS:PRINTTAB(15)"**** CASSETTE OPERATING SYSTEM ****":PRINT:P
RINTTAB(17)"++++ BY RICHARD W. CASTOR ++++":PRINT:PRINTTAB(21)"*
*** VERSION 2.0 ****":PRINT
11 PRINT"THIS DATA BASE MANAGEMENT SYSTEM WILL ACCEPT FILES HAVI
NG TOTAL LENGTHS OF UP TO 7000 CHARACTERS.":PRINT
20 PRINTTAB(25)"**** MENU ****":PRINT
25 PRINT"TYPE (1) TO CREATE NEW DATA BASE"
30 PRINTTAB(5)"(2) TO SAVE CURRENT DATA BASE"
35 PRINTTAB(5)"(3) TO RETRIEVE DATA BASE FROM TAPE"
40 PRINTTAB(5)"(4) TO END SESSION"
45 'PRINT:PRINT"YOUR MENU SHOULD REPLACE THE ABOVE"
50 INPUT"MAKE SELECTION";Q:CLS
55 ONQGOTO100,800,900,1000
100 CLEAR7000:CLS:PRINTTAB(18)"**** DATA ENTRY MODULE ****":PRIN
T:INPUT"FILE NAME";N$:INPUT "DATE";D$
```

Listing 1 continues

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2. ERROR, ON ERROR GOTO, ERL, ERR RESUME.
3. No direct commands like AUTO, EDIT, LIST, LLIST ETC, although these commands may be used when writing programs.
4. Others NOT supported: CDBL, CINT, CSNG, DEFFN, FIX, FRE.
5. Normal CASSETTE I/O. (ZBASIC supports it's own SPECIAL CASSETTE I/O statements.)
6. SOME BASIC COMMANDS MAY DIFFER IN ZBASIC. For instance, END jumps to DOS READY, STOP jumps to BASIC READY etc.
7. MEMORY REQUIREMENTS: to approximate the largest BASIC program that can be compiled in your machine (at one time), enter BASIC and type: PRINT (MEM-6500)/2. Remember, you can merge compiled programs together to fill memory.

ZBASIC 2.2 SPEED COMPARISON DEMO

To help give you an idea how fast compiled programs are, we have included this demo program:

ZBASIC 2.2 DEMO PROGRAM

Time to compile and run complete program	**: 0 MIN. 2 SEC.**
BASIC Execution speed MOD 1, LEVEL II	**: 7 MIN. 34 SEC.**
ZBASIC Execution speed MOD 1, LEVEL II	**:0 MIN. 18 SEC.**
BASIC Program size (WITHOUT VARIABLES)	**: 895 BYTES**
ZBASIC Program size (WITHOUT VARIABLES)	**: 2733 BYTES**

(Remember that the ZBASIC program includes an 1879 byte subroutine package.) Program shown exactly as compiled and run in BASIC and ZBASIC.

```
10 '========= ZBASIC 2.2 EXAMPLE PROGRAM AND TIME TEST========
20 CLS:CLEAR100:DEFINT A-X:DEFSTR Z:DIM AA(64,24),Z(50):RANDOM
30 AA=100:BB=-1000:CC=3:DD=-3:EE=-9999:ST$="START TIME "+TIME$
40 FOR I=1TO127STEP2 :FOR J=47TO1STEP-3:XX=POINT(I,J):SET(I,J)
50 XX=(I-J)/CC*(7+I+J) :XX=ABS(INT(RND(I*J)-AA)+7) :RESET(I,J)
60 XX=PEEK(I+J) :POKE15360+I+J,J :OUT255,J AND (3*J):XX=INP(I)
70 AB$=STR$(I+J) :BA$=LEFT$(AB$,2) :AA(I/2,J/2)=VAL(BA$)+AA*3
80 BA$=BA$+RIGHT$(BA$,RND(3)) :XX=INSTR(1,BA$,"9"):XX=SQR(I*J)
90 BA$=MID$(BA$,2,2) :MID$(BA$,1,1)=Z :IF XX THEN 100 ELSE CLS
100 IF LEN(BA$))3 OR SGN(XX)=1 AND ASC(BA$)=32 THEN PRINT"+++";
110 IFPOS(0))62 THEN TRON:TROFF:PRINT ELSE XX=NOT(RND(99))+100
120 A$=INKEY$:IF A$="Y" OR A$="y" AND I)120 THEN PRINT"TRUE.."
130 RESTORE :READA,C,Z(J),D:GOSUB170:GOSUB170:GOSUB170:GOTO210
140 NEXT :PRINT"*";:NEXTI:CLS:PRINT@512,ST$,"STOP TIME ";TIME$
150 STOP'============== END OF MAIN TEST LOOP ================
160 DATA 12345,-1,"TEST",-9999
170 ON RND(6) GOTO 180,190,200,180,190,200
180 RETURN
190 RETURN
200 RETURN
210 ON RND(9) GOSUB 180,190,200,180,190,200,180,190,200
220 GOTO140
```

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Listing 1 continued

```
105 INPUT"HOW MANY RECORDS WILL THERE BE IN THIS FILE";R1:PRINT
110 INPUT"HOW MANY COLUMNS (ELEMENTS) PER RECORD";C1:DIMA$(R1,C1
):PRINT
115 CLS:PRINT"PLEASE ENTER COLUMN HEADINGS":PRINT:R=0
120 FORC=0TOC1
125 A$(R,C)=""
130 PRINT"COLUMN # ";C;" HEADING";:INPUTA$(R,C)
135 IFA$(R,C)=""THENA$(R,C)=" "
145 NEXTC:CLS
150 PRINT"PLEASE ENTER YOUR DATA BASE RECORDS":PRINT"TYPE AND <E
NTER> 5 ASTERISKS (*****) AS THE":PRINTTAB(5)"FIRST COLUMN OF YO
UR LAST RECORD"
155 FORR=R2+1TOR1
160 FORC=0TOC1
165 A$(R,C)="":PRINTA$(0,C);:INPUTA$(R,C)
170 IFA$(R,C)="*****"THENR2=R-1:GOTO20
175 IFA$(R,C)=""THENA$(R,C)=" "
176 '?"A$(R,C):?"IS THIS DATA CORRECT (Y/N)?"
177 'a$=INKEY$:IFA$=""THENGOTO177
178 'IFA$<>"Y"THENCLS:GOTO165
190 NEXTC:CLS:NEXTR
191 CLS:R2=R1:PRINT"FILE FULL":PRINT
195 INPUT"PRESS <ENTER> TO SEE MENU";X:CLS:GOTO20
800 CLS:PRINTTAB(20)"**** SAVE DATA BASE ****":PRINT:PRINT"PLACE
 CASSETTE RECORDER IN (RECORD) MODE. NOTE TAPE LOCATION":PRINT:I
NPUT"WHEN READY, PRESS <ENTER>";X:CLS
805 M=15360:R=0:C=0:PRINT#-1,R1,R2,C1,N$,D$
810 K=LEN(A$(R,C))
815 IF16383-(M+K)<2THENPOKEM-1,132:GOSUB850
820 FORI=1TOK:POKEM,ASC(MID$(A$(R,C),I,1)):M=M+1:NEXTI
825 IFC=C1ANDR=R2THENPOKEM,131:GOSUB850:GOTO840
830 IFC=C1ANDR<R2THENPOKEM,130:R=R+1:C=0:M=M+1:GOTO810
835 POKEM,129:C=C+1:M=M+1:GOTO810
840 CLS:PRINT"DATA BASE HAS BEEN COMMITTED TO TAPE":PRINT"NOTE T
APE LOCATION":PRINT
841 PRINT"DO YOU WANT A DUPLICATE OF THIS DATA BASE (Y/N)?"
842 A$=INKEY$:IFA$=""THENGOTO842
843 IFA$<>"Y"THENPRINT"DATA TRANSFERS TO TAPE COMPLETE":INPUT"PR
ESS <ENTER> FOR MENU";X:CLS:GOTO20
844 GOTO800
850 A=32660
855 POKE16526,A-INT(A/256)*256
860 POKE16527,INT(A/256)
865 X=USR(0)
870 M=15360:CLS:RETURN
900 PRINTTAB(20)"**** LOAD DATA BASE ****":PRINT:PRINT"PLACE CAS
SETTE RECORDER IN (PLAY) MODE AT PROPER LOCATION":PRINT:INPUT"WH
EN READY, PRESS <ENTER>";X:CLS
905 INPUT#-1,R1,R2,C1,N$,D$:DIMA$(R1,C1):M=15360:R=0:C=0:A$(R,C)
=""
910 GOSUB950
915 A$(R,C)=""
920 IFPEEK(M)=129THENC=C+1:M=M+1:GOTO915
925 IFPEEK(M)=130THENR=R+1:C=0:M=M+1:GOTO915
930 IFPEEK(M)=131THENCLS:PRINT"DATA ARRAY RESTORED":PRINT:INPUT"
PRESS <ENTER> TO CONTINUE";X:CLS:GOTO20
934 IFPEEK(M)=132THENC=C+1:IFC>C1THENC=0:R=R+1
935 IFPEEK(M)=132THENGOTO910
940 A$(R,C)=A$(R,C)+CHR$(PEEK(M)):M=M+1
945 GOTO920
950 A=32685:CLS
955 POKE16526,A-INT(A/256)*256
960 POKE16527,INT(A/256)
965 X=USR(0)
970 M=15360:RETURN
1000 INPUT "HAS THIS FILE BEEN SAVED? TYPE YES OR NO"; A1$
1010 IF A1$="YES" THEN 1020 ELSE 20
1020 END
```

Program Listing 2

```
3 X=32655
4 X=X-2:Y=INT(X/256):Z=X-(Y*256):POKE16561,Z:POKE16562,Y:CLEAR
5 CLS:CLEAR7000:DEFINTA-Z
6 DATA 33,0,60,205,132,2,126,35,205,100,2,254,132,202,169,127,25
4,131,194,154,127,205,248,1,201
7 FORI=32660TO32684:READX:POKEI,X:NEXTI
8 DATA 33,0,60,205,147,2,205,53,2,119,35,254,131,202,194,127,254
,132,194,179,127,205,248,1,201
9 FORI=32685TO32709:READX:POKEI,X:NEXTI
10 PRINTTAB(10)"**** CASSETTE OPERATING SYSTEM - EDITOR ****":PR
INT:PRINTTAB(17)"++++ BY RICHARD W. CASTOR ++++":PRINT:PRINTTAB(
21)"**** VERSION 2.0 ****":PRINT
```

Listing 2 continues

are required.

A matrix, wherein all elements are pure numerics, is a special case of array A$(R,C). Appropriate use of the STR$(N) and VAL(STRING) functions converts a numerical matrix to and from a string array A$(R,C) when required.

String arrays transfer the data base they contain to and from cassette tape. Now that I have established the data base format I will use, and CSAVE Listing 1.

Disk or Cassette?

It is discouraging to note the apparent abandonment of cassettes as serious storage in sequential data-based applications. Finkel and Brown in Chapter 6 of *Data File Programming in Basic* echo the consensus of opinion: "Before getting into the subject, however, we offer our editorial opinion on cassette data files. If you are planning to do a lot of serious programming using data files, then buy a disk drive at your earliest convenience."

For those with 16K Level II Model I, microcomputers equipped with the inexpensive CTR-80 cassette recorder, the future would appear bleak. Why then do mainframes use tape decks for their massive data banks?

The file capacity of the first TRS-80 disk drive is approximately 55,000 bytes of information and the capacity of each additional drive is 83,000 bytes. A cassette operating system, such as the one presented here, makes it possible to commit to C30 cassette tape approximately 45,000 bytes of data per side. Depending upon the program, since individual file lengths are limited only by the amount of free memory in RAM, 7-12K byte data bases can be manipulated in a 16K machine.

Cost and benefits favor slower tape decks for large semi-perma-

```
Add to data base
Review the entire file
Edit file
a. Review individual records—no changes
b. Delete an entire record
c. Change one or more elements
Save updated file
```

Table 1

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Listing 2 continued

```
11 PRINT"THIS DATA BASE MANAGEMENT SYSTEM WILL ACCEPT FILES HAVI
NG TOTAL LENGTHS OF UP TO 7000 CHARACTERS.":PRINT
13 GOSUB900
20 PRINTTAB(25)"**** MENU ****":PRINT
25 PRINT"TYPE (1) TO ADD TO DATA BASE"
30 PRINTTAB(5)"(2) TO SAVE CURRENT DATA BASE"
35 PRINTTAB(5)"(3) TO SEE THE ENTIRE FILE"
40 PRINTTAB(5)"(4) TO EDIT FILE"
45 PRINTTAB(5)"(5) TO END SESSION"
50 INPUT"MAKE SELECTION";Q:CLS
55 ONQGOTO150,800,200,300,1000
150 PRINT"PLEASE ENTER YOUR DATA BASE RECORDS":PRINT"TYPE AND <E
NTER> 5 ASTERISKS (*****) AS THE":PRINTTAB(5)"FIRST COLUMN OF YO
UR LAST RECORD"
155 FORR=R2+1TOR1
160 FORC=0TOC1
165 A$(R,C)="":PRINTA$(0,C);:INPUTA$(R,C)
170 IFA$(R,C)="*****"THENR2=R-1:GOSUB990:GOTO20
175 IFA$(R,C)=""THENA$(R,C)=" "
176 '?"A$(R,C):?"IS THIS DATA CORRECT (Y/N)?"
177 'a$=INKEY$:IFA$=""THENGOTO177
178 'IFA$<>"Y"THENCLS:GOTO165
190 NEXTC:CLS:NEXTR
191 CLS:R2=R1:PRINT"FILE FULL"
195 INPUT"PRESS <ENTER> TO MENU";X:CLS:GOTO20
200 N=0:FORR=0TOR2
205 N=N+1:IFN>(15/(C1+1))-1THENN=0:INPUT"PRESS <ENTER> TO CONTIN
UE";X:CLS
210 FORC=0TOC1
215 PRINTR,A$(R,C)
225 NEXTC:NEXTR:INPUT"PRESS <ENTER> FOR MENU";X:CLS:GOTO20
300 CLS:PRINT"SEARCH TO BE CONDUCTED ON THE BASIS OF -":PRINT
305 R=0:FORC=0TOC1:PRINTC,A$(R,C):NEXTC:PRINT
310 PRINT"MAKE SELECTION (0 THRU";C1;" )";:INPUTC2:PRINT:IFC2<0O
RC2>C1THENGOTO310
315 PRINT"ENTER ";A$(0,C2);" SOUGHT";:INPUTS$
320 C=C2
325 FORR=0TOR2
330 IFA$(R,C)=S$THENGOSUB355:C=C2
335 NEXTR:PRINT"END OF FILE":PRINT"DO YOU WANT ANOTHER SEARCH (Y
/N)?"
340 A$=INKEY$:IFA$=""THENGOTO340
345 IFA$<>"Y"THENPRINT"EDITING COMPLETE":INPUT"PRESS <ENTER> FOR
 MENU";X:CLS:GOTO20
350 GOTO300
355 CLS:PRINT"THE RECORD SOUGHT IS -"
360 PRINT"R","C"
365 FORC=0TOC1:PRINTR,C,A$(R,C):NEXTC:PRINT
370 PRINT"INDICATE A CHOICE OF ACTION":PRINT
375 PRINT"TYPE (1) TO VIEW RECORD ONLY - NO CHANGES"
380 PRINTTAB(5)"(2) TO DELETE ENTIRE RECORD"
385 PRINTTAB(5)"(3) TO CHANGE ONE OR MORE ELEMENTS"
390 PRINT:INPUT"MAKE SELECTION";Q:IFQ<0ORQ>3THENGOTO390
395 ONQGOTO400,405,410
400 PRINT:INPUT"PRESS <ENTER> TO CONTINUE";X:CLS:RETURN
405 FORC=0TOC1:A$(R,C)="":NEXTC:GOSUB440:RETURN
```

Listing 2 continues

nent files requiring occasional updates—genealogical records, magazine indexes, completed stock transactions, collectable inventories, annual budget summaries, mailing lists, personal finances, and so on—mundane tasks where time is not critical. Disks and other high-speed real-time and random access systems are essential for applications such as launch control or inertial guidance. Semi-permanent files predominate.

The average home computerist who abandons cassettes in favor of disks is usually a victim of oversell. The logical first step would be to expand active RAM and use all additional memory for enhanced cassette operations. Regardless of the system configuration—cassette or disk—the RAM available to the data base determines ultimate results. If you do not need high-speed data retrieval, cassette operation is a reasonable solution.

Disk Operating Systems (DOS) assign 256-byte buffers to each file opened. The Model I, Level II TRS-80 has an equivalent buffer—the video monitor memory block 15360–16383, of 1024-byte capacity, begging for service.

If you load available RAM to capacity with the elements of a data base array A$(R,C), you can transfer the individual elements into and out of the video monitory memory space in 1024-byte streams creating a cassette sec-

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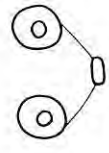

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Listing 2 continued

```
410 INPUT"ENTER COLUMN (C) INDEX OF ELEMENT TO BE CHANGED";C3:A$
(R,C3)="":PRINT
415 INPUT"NEW DATA";A$(R,C3):IFA$(R,C3)=""THENA$(R,C3)=" ":PRINT

420 INPUT"ANOTHER CHANGE (Y/N)";A$:IFA$="Y"THENGOTO410
435 CLS:RETURN
440 R3=R:R2=R2-1:CLS:PRINT"BE PATIENT. i'M MOVING RECORDS"
445 FORR3=RTOR2
450 FORC=0TOC1
455 A$(R3,C)=A$(R3+1,C)
460 NEXTC:NEXTR3:RETURN
800 CLS:PRINTTAB(20)"**** SAVE DATA BASE ****":PRINT:PRINT"PLACE
 CASSETTE RECORDER IN (RECORD) MODE. NOTE TAPE LOCATION":PRINT:I
NPUT"WHEN READY, PRESS <ENTER>";X:CLS
805 M=15360:R=0:C=0:PRINT#-1,R1,R2,C1,N$,D$
810 K=LEN(A$(R,C))
815 IF16383-(M+K)<2THENPOKEM-1,132:GOSUB850
820 FORI=1TOK:POKEM,ASC(MID$(A$(R,C),I,1)):M=M+1:NEXTI
825 IFC=C1ANDR=R2THENPOKEM,131:GOSUB850:GOTO840
830 IFC=C1ANDR<R2THENPOKEM,130:R=R+1:C=0:M=M+1:GOTO810
835 POKEM,129:C=C+1:M=M+1:GOTO810
840 CLS:PRINT"DATA BASE HAS BEEN COMMITTED TO TAPE":PRINT"NOTE T
APE LOCATION":PRINT
841 PRINT"DO YOU WANT A DUPLICATE OF THIS DATA BASE (Y/N)?"
842 A$=INKEY$:IFA$=""THENGOTO842
843 IFA$<>"Y"THENPRINT"DATA TRANSFERS TO TAPE COMPLETE":INPUT"PR
ESS <ENTER> FOR MENU";X:CLS:GOTO20
844 GOTO800
850 A=32660
855 POKE16526,A-INT(A/256)*256
860 POKE16527,INT(A/256)
865 X=USR(0)
870 M=15360:CLS:RETURN
900 PRINTTAB(20)"**** LOAD DATA BASE ****":PRINT:PRINT"SELECT TH
E DATA BASE FILE TAPE TO BE EDITED":PRINT"PLACE CASSETTE RECORDE
R IN (PLAY) MODE AT PROPER LOCATION":PRINT:INPUT"WHEN READY, PRE
SS <ENTER>";X:CLS
905 INPUT#-1,R1,R2,C1,N$,D$:DIMA$(R1,C1):M=15360:R=0:C=0:A$(R,C)
=""
910 GOSUB950
915 A$(R,C)=""
920 IFPEEK(M)=129THENC=C+1:M=M+1:GOTO915
925 IFPEEK(M)=130THENR=R+1:C=0:M=M+1:GOTO915
930 IFPEEK(M)=131THENCLS:PRINT"DATA ARRAY RESTORED":PRINT:INPUT"
PRESS <ENTER> TO CONTINUE";X:CLS:GOSUB975:GOTO20
934 IFPEEK(M)=132THENC=C+1:IFC>C1THENC=0:R=R+1
935 IFPEEK(M)=132THENGOTO910
940 A$(R,C)=A$(R,C)+CHR$(PEEK(M)):M=M+1
945 GOTO920
950 A=32685:CLS
955 POKE16526,A-INT(A/256)*256
960 POKE16527,INT(A/256)
965 X=USR(0)
970 M=15360:RETURN
975 PRINT"FILE TITLE ";N$," DATE ";D$:PRINT:PRINT"RECORDS REMAIN
ING ";R1-R2,"NEXT RECORD";R2+1:PRINT
980 PRINT"COLUMN HEADINGS":R=0:FORC=0TOC1:PRINTC,A$(R,C):NEXTC
985 PRINT:INPUT"TO SEE MENU, PRESS <ENTER>";X:CLS:RETURN
990 CLS:PRINT:INPUT"ENTER NEW DATE";D$:RETURN
1000 INPUT "HAS THIS FILE BEEN SAVED? TYPE YES OR NO"; A1$
1010 IF A1$="YES" THEN 1020 ELSE 20
1020 END
```

Program Listing 3

```
3 X=32655
4 X=X-2:Y=INT(X/256):Z=X-(Y*256):POKE16561,Z:POKE16562,Y:CLEAR
5 CLS:CLEAR7000:DEFINTA-Z
6 DATA 33,0,60,205,132,2,126,35,205,100,2,254,132,202,169,127,25
4,131,194,154,127,205,248,1,201
7 FORI=32660TO32684:READX:POKEI,X:NEXTI
8 DATA 33,0,60,205,147,2,205,53,2,119,35,254,131,202,194,127,254
,132,194,179,127,205,248,1,201
9 FORI=32685TO32709:READX:POKEI,X:NEXTI
10 CLS:PRINTTAB(6)"**** CASSETTE OPERATING SYSTEM - SORT & REPOR
T ****":PRINT:PRINTTAB(17)"++++ BY RICHARD W. CASTOR ++++":PRINT
:PRINTTAB(21)"**** VERSION 2.0 ****":PRINT
11 PRINT"THIS DATA BASE MANAGEMENT SYSTEM WILL ACCEPT FILES HAVI
NG TOTAL LENGTHS OF UP TO 7000 CHARACTERS.":PRINT
13 GOSUB900
20 PRINTTAB(25)"**** MENU ****":PRINT
25 PRINT"TYPE (1) TO SEE THE ENTIRE FILE"
30 PRINTTAB(5)"(2) TO SORT FILE"
35 PRINTTAB(5)"(3) TO SAVE SORTED DATA BASE"
40 PRINTTAB(5)"(4) TO END SESSION"
```

Listing 3 continues

Listing 3 continued

```
45 '
50 INPUT"MAKE SELECTION";Q:CLS
55 ONQGOTO200,500,800,1000
200 N=0:FORR=0TOR2
205 N=N+1:IFN>(15/(C1+1))-1THENN=0:INPUT"PRESS <ENTER> TO CONTIN
UE";X:CLS
210 FORC=0TOC1
215 PRINTR,A$(R,C)
225 NEXTC:NEXTR:INPUT"PRESS <ENTER> FOR MENU";X:CLS:GOTO20
500 CLS:PRINT"SORT TO BE CONDUCTED ON THE BASIS OF -":PRINT
505 R=0:FORC=0TOC1:PRINTC,A$(R,C):NEXTC:PRINT
510 PRINT"MAKE SELECTION (0 THRU ";C1;" )";:INPUTC2:PRINT:IFC2<0
ORC2>C1THENGOTO510
511 PRINT"BE PATIENT, i'M SORTING"
514 P=0
515 K1=R2+1:P$=A$(0,C2):A$(0,C2)=""
520 K1=INT(K1/2)
525 IFK1=0THENPRINT"SORT COMPLETED":A$(0,C2)=P$:PRINT:INPUT"PRES
S <ENTER> FOR MENU";X:CLS:GOTO20
526 P=P+1
530 FORST=1TOK1-1
535 I=ST
540 J=ST+K1
545 SW=0
550 IFA$(I,C2)=<A$(J,C2)GOTO575
555 SW=1
556 PRINT@896,"PASS = ";P,"I=";I,"J=";J,"K1=";K1
560 FORC=0TOC1
561 IFA$(I,C)=""THENA$(I,C)=" "
562 T$(C)=A$(I,C):NEXTC
565 FORC=0TOC1
566 IFA$(J,C)=""THENA$(J,C)=" "
567 A$(I,C)=A$(J,C):NEXTC
570 FORC=0TOC1:A$(J,C)=T$(C):NEXTC
575 I=J:J=J+K1:PRINT@832,"I=";I,"J=";J
580 IFJ<R2+1THENGOTO550
585 IFSW=0GOTO595
590 GOTO535
595 NEXTST:GOTO520
800 CLS:PRINTTAB(20)"**** SAVE DATA BASE ****":PRINT:PRINT"PLACE
 CASSETTE RECORDER IN (RECORD) MODE. NOTE TAPE LOCATION":PRINT:I
NPUT"WHEN READY, PRESS <ENTER>";X:CLS
805 M=15360:R=0:C=0:PRINT#-1,R1,R2,C1,N$,D$
810 K=LEN(A$(R,C))
815 IF16383-(M+K)<2THENPOKEM-1,132:GOSUB850
820 FORI=1TOK:POKEM,ASC(MID$(A$(R,C),I,1)):M=M+1:NEXTI
825 IFC=C1ANDR=R2THENPOKEM,131:GOSUB850:GOTO840
830 IFC=C1ANDR<R2THENPOKEM,130:R=R+1:C=0:M=M+1:GOTO810
835 POKEM,129:C=C+1:M=M+1:GOTO810
840 CLS:PRINT"DATA BASE HAS BEEN COMMITTED TO TAPE":PRINT"NOTE T
APE LOCATION":PRINT
841 PRINT"DO YOU WANT A DUPLICATE OF THIS DATA BASE (Y/N)?"
842 A$=INKEY$:IFA$=""THENGOTO842
843 IFA$<>"Y"THENPRINT"DATA TRANSFERS TO TAPE COMPLETE":INPUT"PR
ESS <ENTER> FOR MENU";X:CLS:GOTO20
844 GOTO800
850 A=32660
855 POKE16526,A-INT(A/256)*256
860 POKE16527,INT(A/256)
865 X=USR(0)
870 M=15360:CLS:RETURN
900 PRINTTAB(20)"**** LOAD DATA BASE ****":PRINT:PRINT"SELECT TH
E DATA BASE FILE TAPE TO BE VIEWED":PRINT"PLACE CASSETTE RECORDE
R IN (PLAY) MODE AT PROPER LOCATION":PRINT:INPUT"WHEN READY, PRE
SS <ENTER>";X:CLS
905 INPUT#-1,R1,R2,C1,N$,D$:DIMA$(R1,C1),T$(C1):M=15360:R=0:C=0:
A$(R,C)=""
910 GOSUB950
915 A$(R,C)=""
920 IFPEEK(M)=129THENC=C+1:M=M+1:GOTO915
925 IFPEEK(M)=130THENR=R+1:C=0:M=M+1:GOTO915
930 IFPEEK(M)=131THENCLS:PRINT"DATA ARRAY RESTORED":PRINT:INPUT"
PRESS <ENTER> TO CONTINUE";X:CLS:GOSUB975:GOTO20
934 IFPEEK(M)=132THENC=C+1:IFC>C1THENC=0:R=R+1
935 IFPEEK(M)=132THENGOTO910
940 A$(R,C)=A$(R,C)+CHR$(PEEK(M)):M=M+1
945 GOTO920
950 A=32685:CLS
955 POKE16526,A-INT(A/256)*256
960 POKE16527,INT(A/256)
965 X=USR(0)
970 M=15360:RETURN
975 PRINT"FILE TITLE ";N$," DATE ";D$:PRINT:PRINT"RECORDS REMAIN
ING ";R1-R2,"NEXT RECORD";R2+1:PRINT
980 PRINT"COLUMN HEADINGS":R=0:FORC=0TOC1:PRINTC,A$(R,C):NEXTC
985 PRINT:INPUT"TO SEE MENU, PRESS <ENTER>";X:CLS:RETURN
990 CLS:PRINT:INPUT"ENTER NEW DATE";D$:RETURN
1000 INPUT "HAS THIS FILE BEEN SAVED? TYPE YES OR NO"; A1$
1010 IF A1$="YES" THEN 1020 ELSE 20
1020 END
```


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tor. This sector contains four times the data of a disk sector and, including the 256-byte leader, is approximately 20.74 seconds long. For the average home computerist on a budget, the cost per file is attractive and retrieval times are acceptable.

Any data base which can be configured into a two-dimensional array A$(R,C) can be recorded on cassette tape using the Cassette Operating System technique in Listing 1. In the case of a single-dimension list, the column index is one; i.e., A$(R,1) is a list of R elements. With a little programming ingenuity, you can move three-dimensional arrays (A$(R,C,P), where R is the row, C the column, and P the page index) into and out of RAM using the video monitor memory block as a transfer buffer. The scheme summarized in Figs. 2 and 3 is simple and straightforward.

Although I used graphic codes as flags (129 End of Element; 130 End of Record; 131 End of File; and 132 End of Sector) to be visible on the Monitor for data-base analysis, you can employ unused control codes instead. This involves, in addition to obvious changes in Basic program lines, minor changes in the machine language routines embedded in Data lines 6 and 8; change 131 and 132 wherever they appear to the control codes selected.

Program lines 3-4 reserve high memory above 32655 in a 16K machine for the save data base routine (lines 6-7), the load data base routine (lines 8-9), and Radio Shack's KBFIX if used.

I included a menu module (lines 20-55), a data entry module (lines 100-195), and an end program module (lines 1000-1020) for demonstration purposes.

You can use the save data base module (lines 800-870) and the load data base module (lines 900-970) in conjunction with lines 3-9 in your other programs.

Do not press the break key while the save data or load data base routines are executing. Break destroys the array by putting invalid data into the video monitor memory block. Place Clear statements carefully to avoid DD errors (Double Dimen-

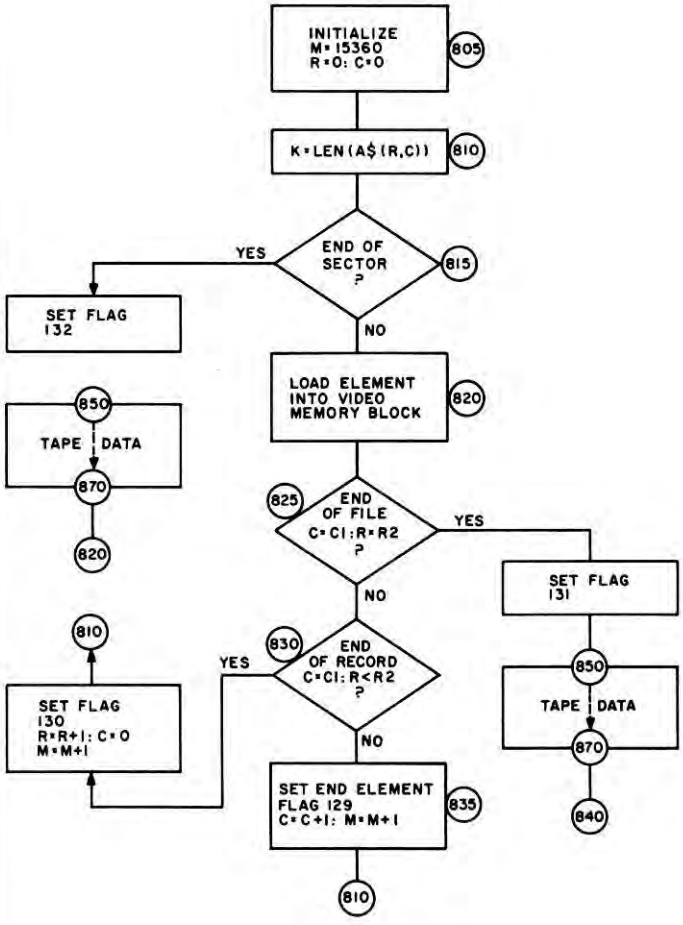

Figure 2

sioning) or loss of the array parameters R1, R2, C1 and N$, D$.

Listing 1 is the file initialization level of your cassette data files. Listing 2 addresses itself to the next logical step in any data base operating system—editing and updating. The editor is menu driven and provides the options shown in Table 1. Editors are customized to a particular data base and depend largely on the sophistication necessary to ensure valid data. The simple editor presented here illustrates fundamental concepts.

Because of 16-line video monitor screen limitations the editor as written displays properly records having up to six fields (C1 = 0 to 5). Remove Print spacing statements to display files having additional column headings. The format of this editor makes it easily modified. It can be used as a guide in a wide variety of applications.

Listing 3 is an introduction to data base manipulation. A Shell-Metzner sort routine permits ascending order sorts on the basis of any field. You can use it to alphabetize a random address file or to create mailing labels on the basis of zip code.

From here on data base use depends on the individual applications such as statistical reports, graphical presentations, management information, inventory control, and investment analysis. This brief introduction to Data Base Management (DBM) should inspire you to adapt your cassette to tasks previously deemed ill-advised. ■

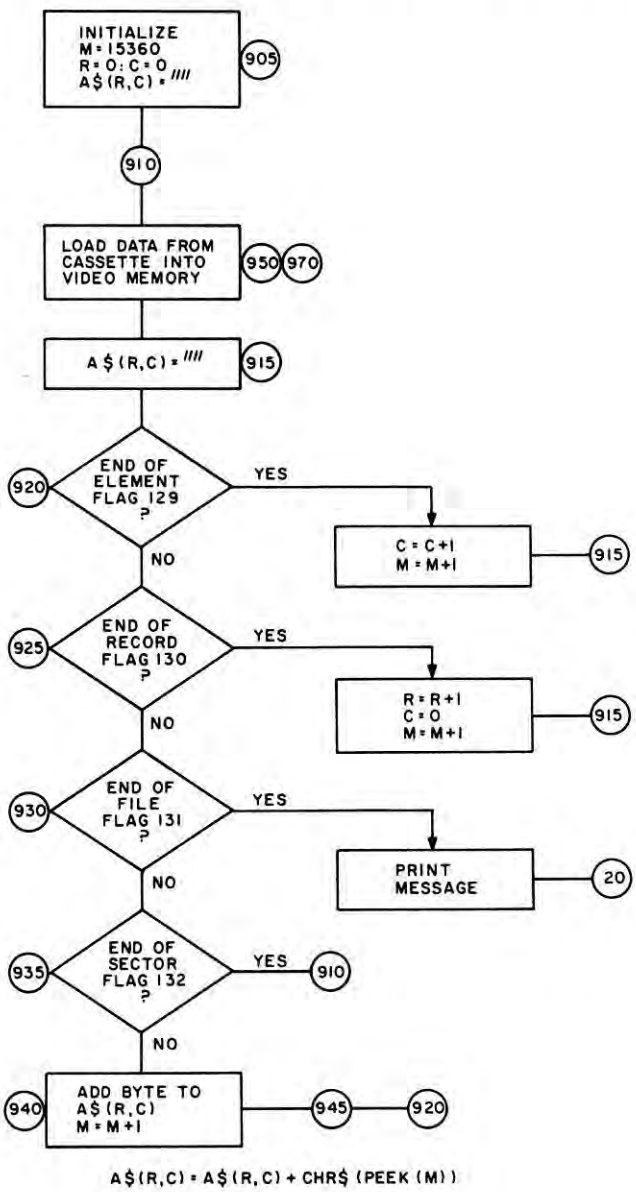

Figure 3

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I have developed two programs for the Model II to teach my son, who decided to play the clarinet, to read music. The first program (see Program Listing 1) is a conversion of J. David McClung's "Music-Note Recognition" program (*80 Microcomputing*, September 1980, p. 182).

Program Listing 2 is an extension of the first and covers both bass and treble clefs. All major keys are included (from no sharps or flats to seven sharps or flats).

The programs offer a timing feature so your child can select a time in which to answer the questions. Before starting the quizzes, your child can review the notes or all the keys in both clefs. Although the second program permits your child to repeat the review, it will not be long before he discovers the hold key stops the display for a longer look.

After the review, your child takes a 20-item quiz. When he has completed the test, the computer grades and scores

Q(X)—Randomly chosen notes for questions	A—Number of correct answer
Q(Y)—Checks random choices for duplicates	A1—Number of answer chosen
Q(N1)—Sequence of notes chosen for questions	G—Grade
Q(N2)—Sequence of questions missed for review	F1—Print flag for question number
E(W)—Array of questions missed	F2—Print flag for key signature
LS(X)—Print locations for sharps	F3—Print flag for sharp or flat
LF(X)—Print locations for flats	F4—Response to yes or no question
R—Number correct	F5—Location in front of answer 1 for cursor
W—Number wrong	N$—Name of child
T—Time chosen to answer questions	S$—Print string for staff line
T1—Timing loop variable	V$—Void or null string to erase print line
N—Sequential number of key signature routine	I$—INKEY$ input
C—Clef	K$—Name of key signature
S—Number of sharps	A$—INKEY$ input for multiple choice answer
F—Number of flats	Z$—Dummy input for Line Input

Table 1

Program Listing 1

```
10 REM NOTE RECOGNITION PROGRAM
20 REM BY J DAVID MC CLUNG
30 REM ADAPTED WITH PERMISSION FOR MODEL II
35 REM BY CHARLES R. PERELMAN
40 CLEAR 500:GOTO 200:'SKIP INPUT ROUTINE
```

Listing continues

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it. Then he can review the questions missed, run the program again or end it.

Converting the Model I "Music Note Recognition" program for the Model II was challenging. How could I produce the clefs and other musical notation on the Model II with its limited graphics characters and without Set or Reset?

I created images with the CHR$ command and with some of the special keyboard characters. CHR$(2) turns the cursor off while the program draws the graphics. CHR$(1) turns it on again. The backslash character is obtained with control and 9. CHR$(31) produces double-sized letters and CHR$(30) returns to regular 80-character lines. Listing 2 uses the same commands. I eliminated the question mark that appears after Input by using Line Input in Listing 1.

Listing 1 uses a subroutine for printing notes (line 1570). I substituted an INKEY$ routine for pressing enter for program branching. In David McClung's program, if you pressed a key after the time limit expired, but before the next question was presented, this input would appear as a wrong answer to the following question. This program clears INKEY$ before the timing routine to avoid this problem.

Listing 1 continues

```
100 'INPUT ROUTINE AND TIMING LOOP
110 FOR L=1 TO H:I$=INKEY$
120 IF I$>="A" AND I$<="G" THEN PRINT I$;:RETURN
130 IF I$<>"" THEN PRINT@ 0,"*** ANSWER A,B,C,D,E,F OR G ***"
140 NEXT:RETURN
200 DIM A(20):DIM E(20)'BEGIN PROGRAM
210 CLS:M$=STRING$(77,"_"):R=0:K$=STRING$(3,CHR$(155)):J$=STRING$(63," ")
220 CLS:PRINT@25,"MUSIC NOTE RECOGNITION"
230 PRINT:PRINT"THIS PROGRAM IS DESIGNED TO TEACH STUDENTS THE NAMES OF EACH"
231 PRINT"LINE AND SPACE ON THE MUSICAL STAFF.":PRINT:PRINT:
232 PRINT"THE QUIZ WILL CONSIST OF 20 QUESTIONS":PRINT:PRINT
240 I$=INKEY$:PRINT"DO YOU WANT TO REVIEW?  ";:GOSUB 1580:IF D=0 THEN 240
260 IF D=1 THEN 1400
300 'GET INFORMATION
310 CLS:INPUT "WHAT IS YOUR FIRST NAME";N$
320 PRINT:INPUT"HOW MANY SECONDS FOR EACH QUESTION";H:H=H*80:IF H<1 THEN 320
330 '59 SECONDS MAXIMUM
340 IF H> 4720 THEN PRINT"YOU CAN'T HAVE THAT LONG":PRINT:GOTO 320
400 'SELECT TEST QUESTIONS, NO REPEATS
410 PRINT:PRINT"STANDBY--THE COMPUTER IS SELECTING THE QUESTIONS"
420 FOR X=1 TO 20
430  A(X)=RND(23):FOR Y=0 TO (X-1):IF A(Y)=A(X) THEN GOTO 430 ELSE NEXT Y
440 NEXT X
500 'TEST'
510 FOR G=1 TO 20:N=A(G):GOSUB1000:GOSUB1110:GOSUB1570
550 PRINT@ 0,"#";G;" ";"WHAT IS THE NAME OF THIS NOTE":I$=INKEY$:GOSUB 110
560 PRINT@ 0,J$:IF I$=Q$ THEN R=R+1:PRINT@ 0,"CORRECT!":GOTO 590
570 IF I$<>Q$ AND I$<>""THEN PRINT@ 0,"WRONG!  THE NOTE IS ";Q$;:P=P+1:E(P)=A(G)
580 IF I$="" THEN PRINT@ 0,"YOUR TIME IS UP!  THE NOTE IS ";Q$;:P=P+1:E(P)=A(G)
590 GOSUB 1600:NEXT
600 CLS:PRINT CHR$(31)'EVALUATE TEST RESULTS  CHR$(31) FOR DOUBLE SIZE
610 PRINT"TEST RESULT":PRINT:PRINT N$;" ,YOUR TEST RESULT IS:"
620 PRINT:PRINT"NUMBER CORRECT= ";R:PRINT"NUMBER MISSED= ";(20-R)
650 PRINT"SCORE          =";:U=((R/20)*100):PRINTUSING"###%";U
660 PRINT"GRADE          =";
670 IF U<60 THEN PRINT"F"
680 IF U>59 AND U<70 THEN PRINT"D"
690 IF U>69 AND U<80 THEN PRINT"C"
700 IF U>79 AND U<90 THEN PRINT"B"
710 IF U>89 THEN PRINT"A"
715 FOR Y=1 TO 2800:NEXT Y
720 PRINT:IF U=100 THEN PRINT"YOU DID GREAT!";GOSUB 1600:GOTO 900
721 PRINT CHR$(30)'REM BACK TO REGULAR SIZE
800 I$=INKEY$'REVIEW THE QUESTIONS MISSED
810 PRINT::PRINT"DO YOU WANT TO RECHECK THE ONES YOU MISSED?":GOSUB 1580
811 IF D=0 THEN 800
812 IF D=2 THEN CLS:GOTO 900
820 CLS:FOR O=1 TO (20-R):N=E(O):GOSUB 1000:GOSUB1110:GOSUB1570
860 PRINT@ 0,"TRY THIS ONE AGAIN":I$=INKEY$:GOSUB 110:PRINT@ 0,J$:IF I$=Q$ THEN
PRINT@ 0,"CORRECT!":GOTO 880
865 IF I$=""THEN  PRINT@ 0,"YOUR TIME IS UP!":GOSUB 1600:GOTO 860
870 PRINT@ 0,"WRONG!":GOSUB 1600:GOTO 860
880 GOSUB 1600:NEXT O
890 CLS:PRINT CHR$(31):PRINT"CONGRATULATIONS,";N$:PRINT:PRINT:PRINT"YOU GOT THEM
 ALL":GOSUB 1600::PRINT:PRINT"FINALLY":PRINT:GOSUB 1600:PRINT"AFTER MUCH EFFORT"
:GOSUB 1600:PRINT CHR$(30)
900 PRINT CHR$(30):PRINT:PRINT"DO YOU WANT ANOTHER QUIZ?  ";:GOSUB 1580
910 IF D=0 THEN 900
920 IF D=1 THEN PRINT CHR$(01):RUN ELSE GOTO 1700
1000 'SELECT NOTE
1010 ON N GOTO 1031,1030,1029,1028,1027,1026,1025,1024,1023,1022,1021,1020,1043,
1042,1041,1040,1039,1038,1037,1036,1035,1034,1033,1032
1020 Q$="G":S=555:C=1:FLAG=2:RETURN
1021 Q$="F":S=630:C=1:FLAG=2:RETURN
1022 Q$="E":S=704:C=1:FLAG=2:RETURN
1023 Q$="D":S=777:C=1:FLAG=2:RETURN
1024 Q$="C":S=850:C=1:FLAG=2:RETURN
1025 Q$="B":S=923:C=1:FLAG=2:RETURN
1026 Q$="A":S=997 :C=1:FLAG=1:RETURN
1027 Q$="G":S=1071:C=1:FLAG=1:RETURN
1028 Q$="F":S=1145:C=1:FLAG=1:RETURN
1029 Q$="E":S=1219:C=1:FLAG=1:RETURN
1030 Q$="D":S=1293: C=1:FLAG=1:RETURN
1031 Q$="C":S=1367:C=1:FLAG=1:RETURN
1032 Q$="C":S=474:C=2:FLAG=2:RETURN
1033 Q$="B":S=548:C=2:FLAG=2:RETURN
1034 Q$="A":S=622:C=2:FLAG=2:RETURN
1035 Q$="G":S=696:C=2:FLAG=2:RETURN
1036 Q$="F":S=770:C=2:FLAG=2:RETURN
1037 Q$="E":S=844:C=2:FLAG=2:RETURN
1038 Q$="D":S=918:C=2:FLAG=2:RETURN
1039 Q$="C":S=992 :C=2:FLAG=2:RETURN
1040 Q$="B":S=1066:C=2:FLAG=1:RETURN
1041 Q$="A":S=1140:C=2:FLAG=1:RETURN
1042 Q$="G":S=1214:C=2:FLAG=1:RETURN
1043 Q$="F":S=1288:C=2:FLAG=1:RETURN
1100 'PRINT STAFF
1110 CLS:PRINT CHR$(02):PRINT@ 562,M$:PRINT:PRINT TAB(2)M$:PRINT:PRINT TAB(2)M$:
PRINT:PRINT TAB(2)M$:PRINT:PRINT TAB(2)M$:RETURN
1200 'DRAW TREBLE CLEF
1210 FOR D=8 TO 15:PRINT@(D,6 ),CHR$(156):NEXT D
1220 PRINT@ 647,"\":PRINT@ 727,CHR$(149):PRINT@ 807,"/":PRINT@ 885,"/":PRINT@ 96
4,"/":PRINT@ 1043,"/":PRINT @ 1123,CHR$(149):PRINT@ 1203,CHR$(92):PRINT@ 1208,"/
":PRINT@ 1128,CHR$(149):PRINT@ 1048,CHR$(92):PRINT@ 967,"_":RETURN
1300 'BASS CLEF
1310 PRINT@ 804,CHR$(92):PRINT@ 724,"/":PRINT@ 645,"_":PRINT@ 646,"_":PRINT@ 727
,CHR$(92):PRINT@ 808,CHR$(149):PRINT@ 888,CHR$(149):PRINT@ 968,"/":PRINT@ 1047,"
/":PRINT@ 730,CHR$(154):PRINT@ 890,CHR$(154):RETURN
1400 'REVIEW TREBLE
1420 GOSUB 1110:GOSUB1210:PRINT@ 0,"TREBLE CLEF"
1440 Q=1:FOR N=1 TO 12:GOSUB 1000:GOSUB 1570
1470 NEXT N:PRINT@ (16,32),"TO REVIEW BASS CLEF - PRESS ENTER";:LINEINPUT Z$
1480 CLS:GOSUB1110:GOSUB1310:PRINT@ 0,"BASS CLEF"
1520 FOR N=13 TO 24:GOSUB 1000:GOSUB 1570
1550 NEXTN:Q=0:PRINT@ (16,32),"TO PROCEED WITH QUIZ - PRESS ENTER";:LINEINPUT Z$
1560 GOTO 310
1570 'NOTE PRINT SUBROUTINE
1571 IF C=1 THEN GOSUB 1210 ELSE GOSUB 1310
1572 IF FLAG=1 THEN PRINT@ S-77,CHR$(156):PRINT@ S-157,CHR$(156):PRINT@ S-237,CH
R$(156):PRINT@ S,K$
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Listing 1 continued

```
1573 IF FLAG=2 THEN PRINT@ S+80,CHR$(156):PRINT@ S+160,CHR$(156):PRINT@ S+240,CH
R$(156):PRINT@ S,K$
1574 IF S=474 OR S=1367 THEN PRINT@ S-1,"-":PRINT@ S+3,"-"
1575 IF Q=1 THEN PRINT@ S+82,Q$
1576 RETURN
1580 'CHOICE SUBROUTINE
1581 PRINT"PLEASE PRESS 'Y' FOR YES OR 'N' FOR NO."
1582 I$=INKEY$:IF I$="" THEN 1582
1584 IF I$="Y" OR I$="y" THEN D=1:RETURN
1585 IF I$="N" OR I$="n" THEN D=2:RETURN ELSE PRINT;PRINT"PLEASE PRESS ONLY 'Y'
OR 'N'":D=0:RETURN
1600 'PAUSE
1610 FOR Y=1 TO 2000:NEXT:RETURN
1700 PRINT:PRINT"END OF PROGRAM.  REVIEW YOUR NOTES AGAIN SOMETIME.":END
```

Program Listing 2

```
10 REM MAJOR KEY SIGNATURES
20 REM PARTIALLY BASED ON  FORMAT BY J DAVID MC CLUNG
30 REM PROGRAM TO LEARN SHARPS AND FLATS
40 REM BY CHARLES R. PERELMAN
50 CLEAR 500
60 DIM Q(30):DIM E(30)
70 LS(1)=570:LS(2)=812:LS(3)=494:LS(4)=736:LS(5)=978:LS(6)=660:LS(7)=902
80 LF(1)=812:LF(2)=575:LF(3)=898:LF(4)=661:LF(5)=984:LF(6)=747:LF(7)=1070
90 CLS:S$=STRING$(77,"_"):R=0:V$=STRING$(63," ")
100 CLS:PRINT@25,"MAJOR KEY SIGNATURES"
110 PRINT:PRINT"THIS PROGRAM WILL HELP YOU LEARN MAJOR KEY SIGNATURES."
120 PRINT"FROM 0 TO 7 SHARPS OR FLATS WILL APPEAR ON THE STAFF FOR BOTH"
130 PRINT"   TREBLE CLEF AND BASS CLEF. "
140 PRINT"YOU MUST CHOOSE ONE OF FOUR ANSWERS."
150 PRINT"YOU MAY SET TIME FOR ANSWERING FROM 4 TO 30 SECONDS."
160 PRINT"THE UP AND DOWN ARROW KEYS WILL MOVE THE CURSOR FOR YOU."
170 PRINT"PRESS 'ENTER' KEY WHEN THE CURSOR IS IN FRONT OF YOUR CHOICE.":PRINT
180 I$=INKEY$:PRINT"DO YOU WANT TO REVIEW?  ";:GOSUB 1310:IF F4=0 THEN 180
190 IF F4=1 THEN 1060
200 'GET INFORMATION
210 CLS:INPUT "WHAT IS YOUR FIRST NAME";N$
220 PRINT:INPUT"HOW MANY SECONDS FOR EACH QUESTION";T:T=T*80
230 IF T<320 THEN PRINT:PRINT"MUST BE AT LEAST 4 SECONDS.  TRY AGAIN":GOTO 220
240 IF T> 2400 THEN PRINT"MUST BE LESS THAN 30 SECONDS.  TRY AGAIN":GOTO 220
250 'SELECT TEST QUESTIONS, NO REPEATS
260 PRINT:PRINT"*** PLEASE WAIT--THE COMPUTER IS SELECTING THE QUESTIONS ***"
270 FOR X=1 TO 20
280  Q(X)=RND(29):FOR Y=0 TO (X-1):IF Q(Y)=Q(X) THEN GOTO 280ELSE NEXT Y
290 NEXT X
300 'TEST'
310 FOR N1=1 TO 20:N=Q(N1):GOSUB650:GOSUB970:GOSUB1200:GOSUB 1380:GOSUB 1490
320 PRINT@ 0,V$:IF A1=A THEN R=R+1:PRINT@ 0,K$;" IS CORRECT!":GOTO 350
330 IF A$="" THEN PRINT@ 0,"YOUR TIME IS UP!  THE KEY IS ";K$;:W=W+1:E(W)=Q(N1)
340 IF A1<>A AND A$<>"" THEN PRINT@0,"WRONG! THE KEY IS ";K$;:W=W+1:E(W)=Q(N1)
350 GOSUB 1360:NEXT
360 CLS:PRINT CHR$(31)'EVALUATE TEST RESULTS    DOUBLE SIZE
370 PRINT"TEST RESULT":PRINT:PRINT N$;",YOUR SCORE IS:"
380 PRINT:PRINT"NUMBER CORRECT= ";R:PRINT"NUMBER MISSED= ";(20-R)
390 PRINT"SCORE          =";:G=((R/20)*100):PRINTUSING"###%";G
400 PRINT"GRADE          =";
410 IF G<60 THEN PRINT"F"
420 IF G>59 AND G<70 THEN PRINT"D"
430 IF G>69 AND G<80 THEN PRINT"C"
440 IF G>79 AND G<90 THEN PRINT"B"
450 IF G>89 THEN PRINT"A"
460 FOR T1=1 TO 2800:NEXT T1
470 PRINT:IF G=100 THEN PRINT"YOU DID GREAT!":GOSUB 1360:GOTO 620
480 IF G<70 THEN PRINT"YOU NEED MORE STUDY.":GOSUB 1360
490 PRINT CHR$(30):PRINT    BACK TO REGULAR SIZE
500 REM REVIEW THE QUESTIONS MISSED
510 I$=INKEY$:PRINT"DO YOU WANT TO RECHECK THE ONES YOU MISSED?":GOSUB 1310
520 IF F4=0 THEN 500
530 IF F4=2 THEN CLS:GOTO 620
540 F1=1:FOR N2=1 TO (20-R):N=E(N2)
550 CLS:GOSUB650:GOSUB970:GOSUB1200:PRINT@0,"TRY THIS ONE AGAIN"
560 FOR T1=1 TO 500:NEXT T1:GOSUB1380:GOSUB1490:PRINT@0,V$
570 IF A1=A THEN PRINT@0,K$;" IS CORRECT!":GOTO 600
580 IF A$=""THEN  PRINT@ 0,"YOUR TIME IS UP!":GOSUB 1360:GOTO 550
590 PRINT@ 0,"WRONG!":GOSUB 1360:GOTO 550
600 GOSUB 1360:NEXT N2
610 CLS:PRINT CHR$(31):PRINT"CONGRATULATIONS,";N$:PRINT:PRINT:PRINT"YOU GOT THEM
 ALL":GOSUB 1360::PRINT:PRINT"FINALLY":PRINT:GOSUB 1360:PRINT"AFTER MUCH EFFORT"
:GOSUB 1360:PRINT CHR$(30)
620 PRINT CHR$(30):PRINT:PRINT"DO YOU WANT ANOTHER QUIZ?  ";:GOSUB 1310
630 IF F4=0 THEN 620
640 IF F4=1 THEN PRINT CHR$(01):F1=0:RUN ELSE GOTO 1620
650 S=0:F=0 'SELECT KEY SIGNATURE
660  ON N GOTO 670,680,690,700,710,720,730,740,750,760,770,780,790,800,810,820,8
30,840,850,860,870,880,890,900,910,920,930,940,950,960
670 K$="C":C=1:S=0:F=0:A=2:RETURN
680 K$="G":C=1:S=1:A=3:RETURN
690 K$="D":C=1:S=2:A=1:RETURN
700 K$="A":C=1:S=3:A=1:RETURN
710 K$="E":C=1:S=4:A=4:RETURN
720 K$="B":C=1:S=5:A=2:RETURN
730 K$="F#":C=1:S=6:A=3:RETURN
740 K$="C#":C=1:S=7:A=1:RETURN
750 K$="F":C=1:F=1:A=3:RETURN
760 K$="Bb":C=1:F=2:A=3:RETURN
770 K$="Eb":C=1:F=3:A=2:RETURN
780 K$="Ab":C=1:F=4:A=1:RETURN
790 K$="Db":C=1:F=5:A=4:RETURN
800 K$="Gb":C=1:F=6:A=4:RETURN
810 K$="Cb":C=1:F=7:A=2:RETURN
820 K$="C":C=2:S=0:F=0:A=2:RETURN
830 K$="G":C=2:S=1:A=3:RETURN
```

Listing 2 continues

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Listing 2 continued

```
840 K$="D":C=2:S=2:A=1:RETURN
850 K$="A":C=2:S=3:A=1:RETURN
860 K$="E":C=2:S=4:A=4:RETURN
870 K$="B":C=2:S=5:A=2:RETURN
880 K$="F#":C=2:S=6:A=3:RETURN
890 K$="C#":C=2:S=7:A=1:RETURN
900 K$="F":C=2:F=1:A=3:RETURN
910 K$="Bb":C=2:F=2:A=3:RETURN
920 K$="Eb":C=2:F=3:A=2:RETURN
930 K$="Ab":C=2:F=4:A=1:RETURN
940 K$="Db":C=2:F=5:A=4:RETURN
950 K$="Gb":C=2:F=6:A=4:RETURN
960 K$="Cb":C=2:F=7:A=2:RETURN
970 'PRINT STAFF
990 CLS:PRINT CHR$(02):PRINT@ 562,S$:FOR X=1 TO 4:PRINT:PRINT TAB(2)S$:NEXT:RETU
RN
1000 'DRAW TREBLE CLEF
1010 FOR X=8 TO 15:PRINT@(X,6),CHR$(156):NEXT X
1020 PRINT@ 647,"\":PRINT@ 727,CHR$(149):PRINT@ 807,"/":PRINT@ 885,"/":PRINT@ 96
4,"/":PRINT@ 1043,"/":PRINT @ 1123,CHR$(149):PRINT@ 1203,CHR$(92):PRINT@ 1208,"/
":PRINT@ 1128,CHR$(149):PRINT@ 1048,CHR$(92):PRINT@ 967,"_":RETURN
1030 'BASS CLEF
1040 PRINT@ 804,CHR$(92):PRINT@ 724,"/":PRINT@ 645,"_":PRINT@ 646,"_":PRINT@ 727
,CHR$(92):PRINT@ 808,CHR$(149):PRINT@ 888,CHR$(149):PRINT@ 968,"/":PRINT@ 1047,"
/":PRINT@ 730,CHR$(154):PRINT@ 890,CHR$(154):RETURN
1050 REM REVIEW KEYS IN TREBLE CLEF
1060 CLS:PRINT"*** PLEASE DO NOT PRESS KEYS UNTIL REQUESTED ***"
1070 PRINT:PRINT"*** COMPUTER WILL SHOW YOU ALL THE KEYS ***"
1080 GOSUB 1370:F3=0:F2=1
1090 GOSUB 970:GOSUB1010:PRINT@242,"TREBLE CLEF"
1100 IF F3=0 THEN FOR N=1 TO 8:GOSUB 1120:NEXT N:F3=1:PRINT@(16,31),"TO CONTINUE
 WITH FLATS - PRESS ENTER";:LINE INPUT Z$:GOTO 1090
1110  FOR N=9 TO 15:GOSUB 1120:NEXT N:F3=0:GOTO 1130
1120 GOSUB 650:GOSUB 1200:GOSUB1360:RETURN
1130 PRINT@ (16,32),"TO REVIEW BASS CLEF - PRESS ENTER";:LINEINPUT Z$
1140 CLS:GOSUB970:GOSUB1040:PRINT@ 242,"BASS CLEF"
1150 IF F3=0 THEN FOR N=16 TO 23:GOSUB1120:NEXTN:F3=1:PRINT@(16,27),"TO CONTINUE
 WITH FLATS - PRESS ENTER";:LINE INPUT Z$:GOTO 1140GOTO 1140
1160 FOR N=24 TO 30:GOSUB1120:NEXTN
1170 CLS:PRINT"DO YOU WANT TO REVIEW AGAIN BEFORE TAKING THE QUIZ?":GOSUB 1310
1180 IF F4=0 THEN 1170ELSE IF F4=1 THEN 1060
1190 F2=0:GOTO 210
1200 IF C=1 THEN GOSUB1010ELSE GOSUB 1040' TO CLEF ROUTINES
1210 IF S=0 THEN GOTO 1250'GOTO FLATS ROUTINE
1220 REM SHARP AND FLAT PRINTING
1230 IF C=1 THEN FORX=1 TO S:PRINT@ LS(X),CHR$(143);CHR$(143):PRINT@LS(X)+80, CH
R$(143);CHR$(143):NEXT:GOTO 1280
1240 IF C=2 THEN FOR X=1 TO S:PRINT@ LS(X)+162,CHR$(143);CHR$(143):PRINT@LS(X)+2
```

Listing 2 continues

Table 1 lists the variables I used in Listing 2. I chose letters for variables that are generally the initial letters of words describing the variable's function. This facilitates tracing the flow of the program. I used F variables as flags to print or avoid printing various program elements.

Since approximately 80 iterations of the timing loop are equivalent to one second on my Model II, I used this factor at line 220. Error-trapping keeps the time for the question display within the limits stated in the program.

Beginning at line 670, each key signature is represented by one of the 30 subroutines. Key signature name, clef, number of sharps or flats, and number of the multiple choice answer are coded for each key.

Lines 180 and 1500 clear INKEY$ before sampling the keyboard to avoid a key struck inadvertently or just before time ran out on a question from being input as the next answer. You can readily adapt the multiple-choice routine, which activates the up and down arrow cursor keys, for other Model II programs. This subroutine is complicated by being placed within a timing loop.

Line 1500 makes sure the cursor is on, initializes the location where you

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want the cursor to print in front of answer number one, and clears any stray keystroke from INKEY$. The cursor is placed in front of answer one and the timing loop entered at 1520.

The up arrow outputs an ASCII 30 and the down arrow 31. Lines 1540 and 1570 move the cursor in the direction of the arrow. When your child selects his answer by pressing enter (ASCII 13), line 1590 marks the choice with CHR$(62) (greater-than sign). The number of the choice is returned to the main program to be tested for a match with the correct answer. Lines 1550 and 1570 move the cursor from number four to the top when using the down arrow and to number four from the top when using the up arrow.

If your child presses an odd or incorrect key, line 1600 traps the error and returns to wait for other input. All these actions take place within the original time limit. If time expires before your child makes his choice, line 1610 returns to the main program. ■

Charles Perelman can be reached at 9777 Wilshire Boulevard, Suite 700, Beverly Hills, CA 90212.

Listing 2 continued

```
42, CHR$(143);CHR$(143):NEXT:GOTO 1280
1250 IF F=0 THEN 1280
1260 IF C=1 THEN FOR X=1 TO F:PRINT@ LF(X),CHR$(156):PRINT@LF(X)+80,CHR$(156);CH
R$(45);CHR$(44):PRINT@LF(X)+160,CHR$(96);CHR$(45);CHR$(39):NEXT:GOTO 1280
1270 IF C=2 THEN FOR X=1 TO F:PRINT@LF(X)+160,CHR$(156):PRINT@LF(X)+240,CHR$(156
);CHR$(45);CHR$(44):PRINT@LF(X)+320,CHR$(96);CHR$(45);CHR$(39):NEXT
1280 IF F2=1 THEN PRINT@ 1315,"KEY OF ";K$;ELSE GOTO 1300
1290 IF S=1 THEN PRINT" - ";S;" SHARP" ELSE IF S>1 THEN PRINT" - ";S;" SHARPS"EL
SE IF F=1 THEN PRINT" - ";F;" FLAT"ELSE IF F>1 THEN PRINT" - ";F;" FLATS"
1300 RETURN
1310  CHOICE SUBROUTINE
1320 PRINT "PLEASE PRESS 'Y' FOR YES OR 'N' FOR NO."
1330 I$=INKEY$:IF I$="" THEN 1330
1340 IF I$="Y" OR I$="y" THEN F4=1:RETURN
1350 IF I$="N" OR I$="n" THEN F4=2:RETURN ELSE PRINT:PRINT"PLEASE PRESS ONLY 'Y'
 OR 'N':FOR X=1 TO 100:NEXT:PRINT CHR$(254);:F4=0
1360 'PAUSE
1370 FOR T1=1 TO 2000:NEXT:RETURN
1380 REM QUESTION ROUTINE
1390 PRINT@ 1380,"MOVE CURSOR  WITH UP OR DOWN ARROW, PRESS ENTER"
1400 IF F1=0 THEN PRINT@ 1460,"#";N1;" WHAT IS THE KEY?"
1410 IF F<>0 GOTO 1440
1420 IF S=0 OR S=3 OR S=4 THEN PRINTTAB(25)"1. A":PRINTTAB(25)"2. C":PRINTTAB(25
)"3. F":PRINTTAB(25)"4. E"
1430 IF S=1 OR S=5 OR S=7 THEN PRINTTAB(25)"1. C#":PRINTTAB(25)"2. B":PRINTTAB(2
5)"3. G":PRINTTAB(25)"4. F#"
1440 IF S=2 OR S=6 THEN PRINTTAB(25)"1. D":PRINTTAB(25)"2. C":PRINTTAB(25)"3. F#
":PRINTTAB(25)"4. C#"
1450 IF F=1 OR F=4 OR F=6 THEN PRINTTAB(25)"1. Ab":PRINTTAB(25)"2. Bb":PRINTTAB(
25)"3. F":PRINTTAB(25)"4. Gb"
1460 IF F=2 OR F=3 THEN PRINTTAB(25)"1. F":PRINTTAB(25)"2. Eb":PRINTTAB(25)"3. B
b":PRINTTAB(25)"4. Gb"
1470 IF F=5 OR F=7 THEN PRINTTAB(25)"1. Gb":PRINTTAB(25)"2. Cb":PRINTTAB(25)"3.
Fb":PRINTTAB(25)"4. Db"
1480 RETURN
1490 'MULTIPLE CHOICE ROUTINE
1500 PRINT CHR$(01):F5=1463:A1=0:A$=INKEY$
1510 PRINT@ F5," ";
1520 FOR X=1 TO T
1530 A$=INKEY$
1540 IF A$="" THEN 1610ELSE IF ASC(A$)=30 THEN F5=F5-80
1550 IF F5<1463 THEN F5=1703
1560 IF ASC(A$)=31 THEN F5=F5+80
1570 IF F5=1783 THEN F5=1463
1580 IF ASC(A$)=30 OR ASC(A$)=31 THEN PRINT@F5," ";:GOTO 1530
1590 IF ASC(A$)=13 THEN A1=(F5-1463)/80+1:PRINT@F5,CHR$(62);:RETURN
1600 PRINT@1790,"ONLY UP OR DOWN ARROW OR ENTER PLEASE":PRINT@F5," ";:GOTO1530
1610 NEXT X:RETURN
1620 PRINT:PRINT"END OF PROGRAM.  REVIEW YOUR KEYS AGAIN SOMETIME.":END
```


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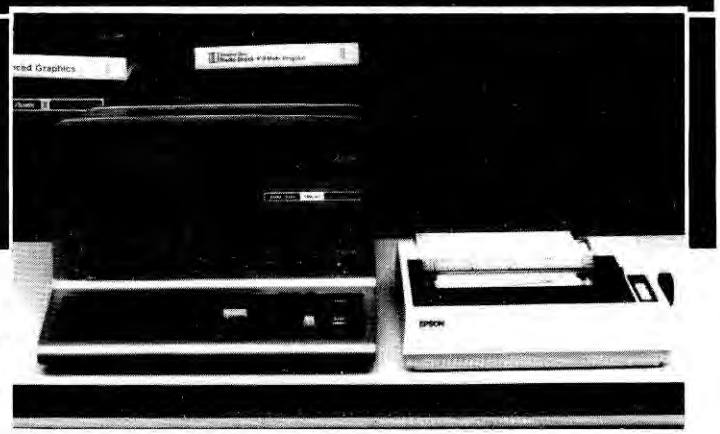

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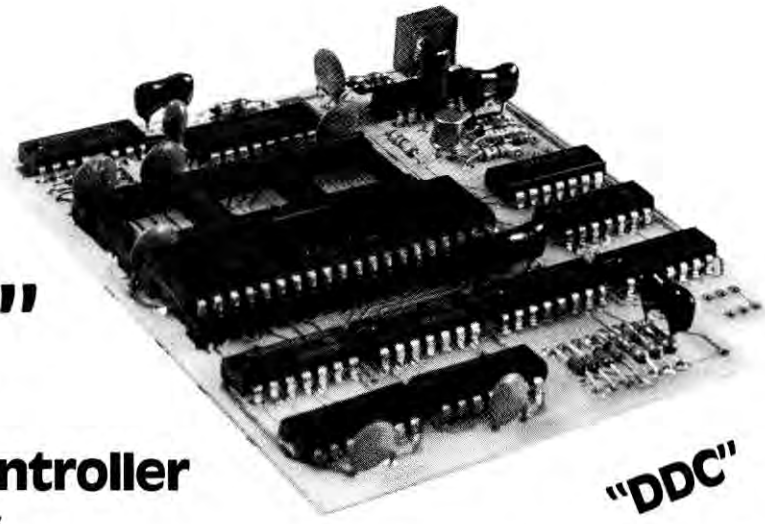

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Tests were conducted on AEROCOMP'S "DDC", Percom's "Doubler A"* and "Doubler II"* and LNW's "LNDoubler"** using a Radio Shack TRS80*** Model I, Level 2, 48 K with TRS80 Expansion Interface and a Percom TFD100 * disk drive (Siemens Model 82). Diskette was Memorex 3401. The test diskette chosen was a well used piece of media to determine performance under adverse conditions. The various double density adapters were installed sequentially in the expansion interface.
The test consisted of formatting 40 tracks on the diskette and writing a 6DB6 data pattern on all tracks. The 6DB6 pattern was chosen because it is recommended as a "worst case" test by manufacturers of drives and diskettes. An attempt was then made to read each sector on the disk once - no retrys. Operating system was Newdos/80, Version 1.0, with Double Zap, Version 2.0. Unreadable sectors were totalled and recorded. The test was run ten times with each double density controller and the data averaged. Test results are shown in the table.

★ Features

TRS80 Model I owners who are ready for reliable double density operation will get (1) 80% more storage per diskette, (2) single and double density data separation with far fewer disk I/O errors, (3) single density compatibility and (4) simple plug-in installation. Compatible with all existing double density software.

★ Value

$139.95 **for the BEST double density controller on the market.**
$179.95 for "DDC" complete with DOSPLUS 3.3D
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★ TEST RESULTS ★

MFR & PRODUCT	SECTORS LOCKED OUT (AVG)
AEROCOMP "DDC"	0
PERCOM "DOUBLER II"	18
PERCOM "DOUBLER A"	250
LNW "LNDOUBLER"	202

Note: test results available upon written request. All tests conducted prior to 8-25-81

Aerocomp's 14 day money back guarantee applies to hardware only.
Specials will be prorated. Shipping $2.00 in Cont. US. See opposite page for details.

Data Separators

The advances that make the "DDC" great are incorporated in the new AEROCOMP Single Density Data Separator ("SDS") and Double Density Data Separator ("DDS").

★ Has your original manufacturer left you holding the bag?

If you already own a Percom "Doubler A", "Doubler II" or LNW "LNDoubler", the AEROCOMP "DDS" will make it right. Look at the test results:

MFR. & PRODUCT	SECTORS LOCKED OUT	
	WITHOUT "DDS"	WITH "DDS"
PERCOM "DOUBLER II"	18	1
PERCOM "DOUBLER A"	250	0
LNW "LNDOUBLER"	202	0

Note: Same test procedures as "DDC".
* Trademark of Percom Data Co.
** Trademark of LNW
*** Trademark of Tandy Corporation

★ **"DDS"** **$49.95**
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See opposite page ▸▸▸▸▸▸

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Let your computer be the drudge.

Build a Better Budget

D. S. Kemball-Cook
934 Jennings Road
Fairfield, CT 06430

Ten years of financial work made me an expert at filling out 13-column spread sheets. During the annual budget preparation season, the stacks of 11 by 17 paper grew to where we began to measure them by the inch to estimate time left to the finish line. The numbers seemed harder to add as the clock approached 10:00 pm. We spent half of our time developing the numbers to put in the various columns—what we were being paid for; the other half was drudge work—adding down and across. The calculators would grind away performing this purely mechanical function. Everyone knew it was necessary, so the griping was kept to a minimum.

When a TRS-80 found its way into my hands and I became familiar with its capabilities, I determined to let this machine be our salvation. A financial analyst should use his expertise to generate the base data, and leave the mechanical cost extension to less expensive talent. Part of the requirement would be to develop a routine which could be operated by someone unfamiliar with the specific data.

The program shown in the listing gave us the needed tool before the next budget season arrived. The final product had to look professional to keep the accountants from raising their eyebrows—perfectly aligned columns, two places for cents, centered headers and so forth.

I developed the program on a Model I, 32K, twin disk drive machine. However, it will operate on a Level II, 16K. It requires a 132 column printer, but you can modify the code to run in 80 columns. The 132 column format allows for reasonable line titles and proper spacing, as well as manipulation of large numbers. In order to meet our group's needs, the program spaces all columns and headers evenly, regardless of whether the number of columns is 3, 8, or 12. Our computer printouts from the IBM mainframe in the Midwest used a six over six format convention (January-June on line one and July-December on line two). People were used to seeing that data arrangement, so the program prints in that format when more than six columns are needed.

Program Listing

```
100 REM*** DRUDGE
110 CLEAR2000:W$="##########.##-"
120 DEFDBL C,T,L,M
130 CLS
140 PRINT"SET PRINTER - 14 7/8 INCH PAPER - (ENTER)":INPUTM9$
150 CLS:FORX=1TO2:LPRINTCHR$(138):NEXTX
160 PRINT"ENTER SPREAD SHEET TITLE":INPUTR$
170 Q=LEN(R$):Q1=(132-Q)/2
180 LPRINTTAB(Q1)R$
190 CLS
200 PRINT"ENTER TODAY'S DATE - FORMAT (XX/XX/XX)":INPUTD$
210 LPRINTTAB(62)D$:LPRINTSTRING$(Q1,32);:FORI=1TOQ:LPRINT"-";:N
EXTI
220 LPRINTCHR$(138)
230 CLS
240 PRINT"THE COMPUTER HAS TO BE TOLD HOW MANY COLUMNS YOU WANT
THIS"
250 PRINT"SPREAD SHEET TO HAVE, NOT INCLUDING THE TOTAL COLUMN."

260 PRINT"YOU ARE ALLOWED TO HAVE ANY NUMBER UP TO 12, GIVING YO
U"
270 PRINT"AS MUCH AS ONE FULL YEAR'S DATA."
280 PRINT
290 PRINT"A MENU FOLLOWS, GIVING YOU A CHOICE TO PICK FROM."
300 PRINT
310 PRINT"PRESS THE 'ENTER' KEY WHEN YOU ARE READY TO CONTINUE."
320 PRINT
330 PRINT"MENU FOLLOWS......"
```

Listing continues

Program Operation

Lines 110 and 120 clear string space, set the formatted output parameter, and set the appropriate variables to double precision.

Lines 140-220 prompt the operator to enter the spread sheet title and date, which are then centered and printed.

Lines 240-1700 allow the operator to select the number of columns to be used from a simple menu. The operator assigns variables used for column spacing on the output report. The computer accepts column headers and drops to the subroutine in line 5000 to print them.

The program then goes to subroutines in lines 6000 and 7000 which prompt the operator to enter line titles and data. Variables V1 and V2 are counters for paging on reports which run more than one page.

To exit to the totals output, line 6070 prompts the operator to enter the word End as a line title. At that time, the computer goes to lines 3000-4999, which print the totals and end execution.

The Key Box

Basic Level II
Model I
32K RAM
TRSDOS
Two disk drives
Radio Shack Line Printer VI

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LNW Research Corp.

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✓32

*8" drive operation requires special cable, 8" double-density requires 3.55MHz CPU speed-up modification or LNW-80 4MHz computer.

Listing continued

```
340 INPUTM9$
350 CLS:PRINT"THESE ARE YOUR CHOICES:":PRINT
360 PRINT"              1.     1  COLUMN."
370 PRINT"              2.     2  COLUMNS."
380 PRINT"              3.     3  COLUMNS."
390 PRINT"              4.     4  COLUMNS."
400 PRINT"              5.     5  COLUMNS."
410 PRINT"              6.     6  COLUMNS."
420 PRINT"              7.     7  COLUMNS."
430 PRINT"              8.     8  COLUMNS."
440 PRINT"              9.     9  COLUMNS."
450 PRINT"             10.    10  COLUMNS."
460 PRINT"             11.    11  COLUMNS."
470 PRINT"             12.    12  COLUMNS."
480 PRINT:INPUT"TYPE IN A NUMBER FROM 1 TO 12 - PRESS (ENTER)";Z
490 IFZ<1THENZ=13:CLS
500 IFZ<>1THEN600
510 S=37
600 IFZ<>2THEN700
610 S=20
700 IFZ<>3THEN800
710 S=12
800 IFZ<>4THEN900
810 S=7
900 IFZ<>5THEN1000
910 S=4
1000 IFZ<>6THEN1100
1010 S=1
1100 IFZ<>7THEN1200
1110 S=1
1120 S2=73
1200 IFZ<>8THEN1300
1210 S=1
1220 S2=60
1300 IFZ<>9THEN1400
1310 S=1
1320 S2=46
1400 IFZ<>10THEN1500
1410 S=1
1420 S2=32
```

Listing continues

This program does not offer the real-time capabilities included in some of the packages now available on the market. However, it beats doing the old "down and across" method.■

Mr. Kemball-Cook is the data services manager for Eldorado Tool division of Litton Industries, Milford, CT.

Model II/16 Conversion

CONVERSION BY J.J. BARBARELLO

ADD THE FOLLOWING LINES:

```
1871 IF S1(X)<0 THEN PRINT"-----HEADER TOO LONG. TRY AGAIN-----":X=X-1
1872 NEXTX
```

EDIT THE FOLLOWING LINES:

```
100 REM*** DRUDGE (Converted for Model II by J.J. Barbarello, 12 October 1982)
140 PRINTTAB(19)"N O T I C E: 132 COLUMN PRINTER REQUIRED.":PRINTSTRING$(79,45)
150 SYSTEM"FORMS":CLS
160 PRINT"ENTER SPREAD SHEET TITLE:    ";STRING$(131,".");:PRINT@(0,29),;:LINE IN
PUT R$:IF LEN(R$)>131 THEN PRINT"-----TITLE TOO LONG. TRY AGAIN-----":GOTO 160
220 LPRINT
1870 FORX=1TO2:PRINT"ENTER COLUMN HEADER # "X:INPUTA$(X):S1(X)=13-LEN(A$(X))
3010 LPRINT
5030 LPRINT:RETURN
5100 LPRINTSTRING$(30,32);:FORX=1TO6:LPRINTSTRING$(S,32);:LPRINTSTRING$(S1(X),32
);:LPRINTA$(X);:NEXTX:LPRINT
5120 LPRINT:RETURN
7005 LPRINT:V2=V2+1
7008 SYSTEM"T":GOSUB5000
```


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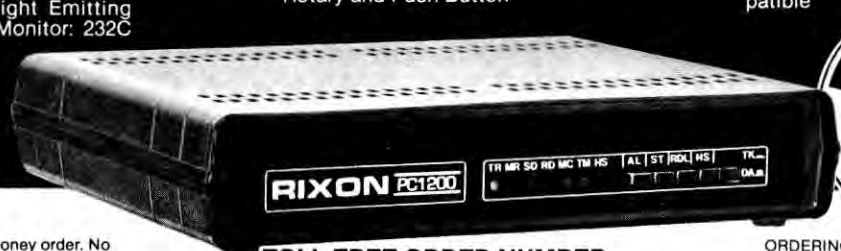

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Listing continued

```
1500 IFZ<>11THEN1600
1510 S=1
1520 S2=17
1600 IFZ<>12THEN1700
1610 S=1
1620 S2=3
1700 IFZ>12THENCLS:PRINT"THE NUMBER SELECTED IS NOT BETWEEN 1 &
12.  TRY AGAIN...":PRINT:GOTO240
1710 DIMA$(12),S1(12),C(12),T(12)
1800 REM*** INPUT OF COLUMN HEADERS
1810 CLS
1820 PRINT"YOU WILL BE GENERATING A SPREAD SHEET WITH "Z" COLUMN
S"
1830 PRINT"PLUS A COLUMN FOR YOUR LINE TOTALS.  COLUMN TITLES AR
E"
1840 PRINT"TYPED IN UPON PROMPT FROM THE COMPUTER.  COLUMN TITLE
S"
1850 PRINT"MUST NOT EXCEED 13 CHARACTERS (XXXXXXXXXXXXX)."
:PRINT
1860 PRINT"INPUT YOUR COLUMN HEADERS...":PRINT
1870 FORX=1TOZ:PRINT"ENTER COLUMN HEADER # "X:INPUTA$(X):S1(X)=1
3-LEN(A$(X)):NEXTX
1880 CLS
1890 PRINT"YOUR COLUMN HEADERS ARE..."
1900 FOR X=1TOZ:PRINTA$(X):NEXTX
1910 REM*** DIRECTS TO SUB-ROUTINE TO PRINT HEADERS
1920 GOSUB5000
2000 REM*** DIRECTS TO SUB-ROUTINE TO PRINT DETAIL LINES
2005 IFZ2>20THENGOSUB5000
2010 GOSUB6000
3000 REM*** PRINTS MAJOR TOTALS
3010 LPRINTCHR$(138)
3020 IFZ>6THEN3100
3030 LPRINTTAB(5)"***** MAJOR TOTALS *****  ";
3040 FORI=1TOZ:LPRINTSTRING$(S,32);:LPRINTUSINGW$;T(I);:NEXTI:LP
RINTSTRING$(S,32);:LPRINTUSINGW$;MT:END
3100 LPRINTTAB(5)"***** MAJOR TOTALS *****  ";
3110 FORI=1TO6:LPRINTSTRING$(S,32);:LPRINTUSINGW$;T(I);:NEXTI:LP
RINT""
3120 LPRINTSTRING$(31,32);:FORI=7TOZ:LPRINTSTRING$(S,32);:LPRINT
USINGW$;T(I);:NEXTI:LPRINTSTRING$(S2,32);:LPRINTUSINGW$;MT
4999 END
5000 REM*** SUB-ROUTINE TO PRINT HEADERS
5005 V1=V1+1
5010 V2=6:IFZ>6THEN5100
5020 LPRINT" #        LINE LABEL          ";:FORX=1TOZ:LPRINTSTR
ING$(S,32);:LPRINTSTRING$(S1(X),32);:LPRINTA$(X);:NEXTX:LPRINTST
RING$(S,32);:LPRINT"    TOTALS"
5030 LPRINTCHR$(138):RETURN
5100 LPRINTSTRING$(30,32);:FORX=1TO6:LPRINTSTRING$(S,32);:LPRINT
STRING$(S1(X),32);:LPRINTA$(X);:NEXTX:LPRINT""
5110 LPRINT" #        LINE LABEL          ";:FORX=7TOZ:LPRINTSTR
ING$(S,32);:LPRINTSTRING$(S1(X),32);:LPRINTA$(X);::NEXTX:LPRINTS
TRING$(S2,32);:LPRINT"    TOTALS"
5120 LPRINTCHR$(138):RETURN
6000 REM*** SUB-ROUTINE TO PRINT DETAIL LINES
6010 CLS
6020 PRINT"FIRST THE APPROPRIATE LINE LABEL IS ENTERED.":PRINT"D
ETAIL LINES ARE ENTERED NEXT.  THERE MAY BE AS MANY"
6030 PRINT"AS NEEDED.  THE COMPUTER WILL ASK FOR "Z" ENTRIES FOR
"
6040 PRINT"EACH LINE.  ENTER EACH NUMBER AFTER PROMPT.":PRINT
6050 PRINT"IF YOU WANT TO END INPUT AND HAVE TOTALS PRINTED -"
6060 PRINT"TYPE IN THE WORD END FOR THE LINE LABEL - PROGRAM WIL
L":PRINT"EXIT TO TOTAL PRINTOUT ROUTINE."
6070 PRINT:PRINT"ENTER THE LINE LABEL (OR END TO EXIT)":INPUTA1$
:IFA1$="END"THEN6100
6075 L=0:FORX=1TOZ:PRINT"ENTER NUMBER FOR COLUMN # "X:INPUTC(X)
6080 L=L+C(X):T(X)=T(X)+C(X):MT=MT+C(X):NEXTX:N=N+1
6090 GOSUB7000:CLS:GOTO6050
6100 CLS:RETURN
7000 REM*** PRINTING OF DETAIL LINES
7001 IFV2>6THEN7005
7002 IFV1=1THENV2=8
7005 LPRINT" ":V2=V2+1
7007 IFV2<55THEN7010
7008 FORQ=1TO11:LPRINT" ":NEXTQ:GOSUB5000
7010 IFZ>6THEN7100
7020 V2=V2+1:LPRINTN;TAB(5);A1$;TAB(31);:FORI=1TOZ:LPRINTSTRING$
(S,32);:LPRINTUSINGW$;C(I);:NEXTI:LPRINTSTRING$(S,32);:LPRINTUSI
NGW$;L:RETURN
7100 V2=V2+1:LPRINTN;TAB(5);A1$;TAB(31);:FORI=1TO6:LPRINTSTRING$
(S,32);:LPRINTUSINGW$;C(I);:NEXTI:LPRINT""
7110 V2=V2+1:LPRINTSTRING$(31,32);:FORI=7TOZ:LPRINTSTRING$(S,32)
;:LPRINTUSINGW$;C(I);:NEXTI:LPRINTSTRING$(S2,32);:LPRINTUSINGW$;
L:RETURN
```

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Self-Modifying Programs

by Robert Rifkin

Are you tired of writing virtually identical Print and LPRINT statements? Eliminate those clumsy code duplications with this idea.

A Basic program can modify portions of its own text during execution, either under control of the Basic program or with interactive keyboard input. This is accomplished without altering the values of any variables, and without employing any programming techniques beyond Level II Basic. These techniques permit more program control to be exercised over instructions located anywhere within the program. Either technique may be implemented without difficulty in programs already written.

Consider the following common problem when programming in Level II Basic. Screen output is generated by the Print instruction while line-printer output requires an LPRINT instruction. To select the output mode at the execution stage, two virtually identical groups of output statements are necessary. The programmer has to set a flag to determine which statement to execute. When output statements are numerous and complex, this may involve an enormous and clumsy duplication of code.

You can use a single set of output statements if you alter the Basic instruction word preceding each line of output code during program execution.

Basic Instructions Memory Format

Basic instruction words are stored in memory as numbers from 129–250 decimal. In this format, each instruction word consumes one byte of memory rather than one byte for each character of the instruction word.

Moreover, you can change any instruction word to any other word by POKEing the desired three-digit command into the proper memory location. This way a statement line containing a Print instruction will have the instruction code number 178 in memory preceding the associated output code. You can convert this Print to an LPRINT by POKEing 175 into the correct memory location.

A major problem with this method is knowing where the Basic instruction resides in memory. In TRS-80 Basic, the problem is complicated by multiple statement lines. Also, when programs are edited, the memory location of the instruction tokens will change, apparently foiling any attempt to implement the technique except in limited situations. The potential benefits of this technique do not justify the difficulty of constantly having to determine and revise POKE addresses each time a program is edited. The benefits could not be fully realized if you had to locate all the statements to be altered at the beginning of the program.

Marking the Location

Two methods can overcome these problems. The first method exploits the fact that string literals in the text of a Basic program are stored within the program text area of memory rather than in string storage space. The string's pointer points to the area of memory where the Basic statement containing the string is stored. In writing the Basic program, if the instruction code words targeted for alteration are preceded by a string literal statement, such as A$="A", its pointer will point a few bytes lower in memory than the target instruction word, no matter where the statement line winds up after other parts of the program are edited. This pointer is automatically established by the inter-

```
10       'THIS CODE ILLUSTRATES USE OF THE DUMMY STRING
20 D=13
30 INPUT "SELECT SCREEN (S) OF PRINTER OUTPUT (L)"; O$
40 IF O$="S" TK=178 ELSE TK=175
50 A$="A" : GOSUB 100 : LPRINT "OUTPUT TEXT HERE...." : STOP
100 P=VARPTR(A$) : P2=PEEK(P+1)+256*PEEK(P+2) : POKE P2+D,TK : R
ETURN
```

Program Listing 1

The Key Box

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preter when it executes the instructions A$ = "A".

The second method uses the GOSUB function. When a GOSUB is executed the stack is loaded with a pointer to the place in memory where the next non-black character following the GOSUB is stored. If a GOSUB immediately precedes the target instruction code to be altered, the top of the stack contains a pointer pointing a few bytes lower in memory than the target byte.

The only relationship that has to remain constant is the distance, in bytes, from the string literal or GOSUB to the target instruction word. Since the target instruction word would be immediately preceded by either the string literal or GOSUB, only these brief portions of code need be invariant to subsequent editing. In fact, with the modifications described later, the exact distance can, to an extent, be ignored by the programmer allowing the computer to measure it at execution time.

Once the pointer is established, a subroutine is accessed to implement the POKEing of the selected token in accordance with the value of the pointer. The string literal method also requires the use of a GOSUB instruction to access this subroutine, as opposed to the second method which relies on the stack for a pointer.

Method One

First, define a dummy string literal, such as A$ = "A". Then execute a GOSUB to a short subroutine to POKE the instruction token. Follow the GOSUB with the statement containing the target byte to be POKEd by the subroutine. The subroutine is terminated by a Return. This subroutine can be located anywhere.

"You can use a single set of output statements if you alter the Basic instruction word preceding each line. . . "

Program Listing 1 will output the words "output text here. . . ." either to the screen or line printer. If the program had been listed following execution using the screen for output, line 50 would contain Print instead of LPRINT.

In line 20, the variable D represents the distance in bytes from the location of the string A in line 50, to the location of the target byte containing the token for Print or LPRINT. Distance can be determined by counting characters from the dummy string to the target byte. Include blanks, but count Basic instruction words as only one character. Or use PEEK to measure the distance in the command mode or as part of the POKE subroutine described below.

Lines 30–40 enable the operator to select whether output will be to screen or the printer by assigning the appropriate token to the variable TK.

In line 50, when the interpreter encounters the string literal definition, it establishes a three-byte block of information about the string A including its address in memory. This information can be accessed by the instruction VARPTR. In line 100, P = VARPTR(A$) will set P equal to the decimal address in memory of the first of the three bytes in this information block. PEEK(P) returns the length of the string and will not be important here. PEEK(P + 1) returns the least significant byte of the ad-

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dress in memory of the string and PEEK(P+2) returns the most significant byte of this address. PEEK(P) + 256*PEEK(P+1) returns the decimal address of A in memory.

This address is determined in the subroutine on line 100 as P2. Next, the previously chosen token is POKEd into memory a distance D bytes away from this address. The subroutine then returns to find the new op-code token in the appropriate byte and executes it.

Several points should be kept in mind. First, the same dummy string can be used before each target instruction word. Each time it is encountered by the interpreter during program execution, the pointer is revised accordingly. Second, by using a DEFSTR statement, the dollar sign is not needed. After DEFSTR A, the dummy string statements can be of the form A="A".

Third, the null string will also work, that is A$=" " or A=" " if DEFSTR has been used. Fourth, for a particular variable instruction word, only one POKE subroutine is needed as long as each time it appears it is preceded by the string literal and GOSUB. Finally, the pointer is established only at the time the program is executed, not when it is entered into memory.

As long as the distance, D, between the dummy string and variable instruction is constant, changes in the program or editing will not disturb the distance relationship. The addition of a few lines to the POKE subroutine eliminates the need to calculate D and allow it to be variable as well (Program Listing 2). The added code in lines 110 and 120 looks at the memory area containing line 50 byte by byte to determine the location of the target byte.

This way, a single GOSUB can initiate the POKE operation for all remaining code in that line, altering several tokens at a time. This is shown on Program Listing 3. The subroutine in lines 110 and 120 scans the memory containing the target line of code, POKEing at the appropriate places until it detects a byte containing a zero denoting the end of the target line. In line 110 the counter X can go up to 256, the maximum length of a line. This method cancels the need to place a string literal and GOSUB before each target token in a compound statement line.

Method Two

Since a GOSUB must be executed in method one, why not eliminate the string definition altogether; the GOSUB itself sets a suitable pointer in the stack. This method is somewhat more elegant, slightly more economical in code, but a bit more complicated.

Program Listing 4 illustrates this method. A pointer to the top of the stack can be found at locations 16616 and 16617 decimal. The address 16616 contains the least significant byte of the address of the top of the stack and 16617 the most significant byte.

When a GOSUB is executed, the interpreter loads the stack with a pointer to the first non-blank character following the GOSUB. The least significant byte of this address is found three bytes from the top of the stack and the most significant byte is four bytes from the top.

In line 100 of Listing 4, SP is the address contained by the stack pointer and R is the address of the first non-blank character following the GOSUB. Here again, once the distance D between the first non-blank character following the GOSUB and the target instruction word is known, the desired token can be POKEd this distance beyond the address in the stack.

In Listing 4, D equals six bytes, and R plus D is used as an argument of the POKE in line 110. As in Listing 3, additional subroutine code can be used to automatically determine the location of the target byte. When the subroutine returns it finds the desired instruction in place and executes it.

These methods may be employed in a variety of circumstances. Transformations of PRINT# and INPUT#, Print Using, and LPRINT Using and others are easy to accomplish.

For controlling line or screen output, I have stored the POKE subroutine on disk in several forms as ASCII files. Using the code in Listing 3 as an example, I assign lines 30 and 40 a very low line number, such as 5 and 10, and lines 100–120 high numbers such as 15000–15020. All my programs' line numbers fall between these extremes. Then I insert A$=" ": GOSUB 15000 in the appropriate places. Next, I merge the program with the ASCII disk file for my finished program.

Another Example

Program Listing 5 illustrates the potential for simplifying code and improving control in a different application. The problem is to examine the effect of changes in any one of four variables on the value of X in the equation:

$$X = A + 2*B + 3*C + 4*D$$

where the three remaining variables are held constant.

```
30 INPUT "SELECT SCREEN (S) OR PRINTER OUTPUT (L)"; O$
40 IF O$="S" TK=178 ELSE TK=175
50 A$="A" : GOSUB 100 : LPRINT "OUTPUT TEXT HERE...." : STOP
100 P=VARPTR(A$) : P2=PEEK(P+1)+256*PEEK(P+2)
110 FOR X=P2 TO P2+30 : IF PEEK(X)=178 OR PEEK(X)=175 THEN POKE
X,TK : RETURN
120 NEXT X
```

Program Listing 2

```
30 INPUT "SELECT SCREEN (S) OF PRINTER OUTPUT (L)"; O$
40 IF O$="S" TK=178 ELSE TK=175
50 A$="A" : GOSUB 100 : LPRINT "OUTPUT TEXT HERE...." : LPRINT "
ADDITIONAL OUTPUT TEXT...." : STOP
100 P=VARPTR(A$) : P2=PEEK(P+1)+256*PEEK(P+2)
110 FOR X=P2 TO P2+256 : IF PEEK(X)=0 THEN RETURN
115 IF PEEK(X)=178 OR PEEK(X)=175 THEN POKE X,TK
120 NEXT X
```

Program Listing 3

```
10      'THIS CODE ILLUSTRATES USE OF THE STACK POINTER
30 D=6 : INPUT "SELECT SCREEN (S) OF PRINTER OUTPUT (L)"; O$
40 IF O$="S" TK=178 ELSE TK=175
50 GOSUB 100 : PRINT "OUTPUT TEXT HERE...." : STOP
100 SP=PEEK(16616)+256*PEEK(16617) : R=PEEK(SP+3)+256*PEEK(SP+4)

110 POKE R+D,TK : RETURN
```

Program Listing 4

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Four separate For...Next statements would be required with associated flags using standard programmable methods. Listing 5 achieves this with a single For...Next loop by POKEing the ASCII code of the loop variable into the appropriate byte of memory.

In Listing 5, the loop variable is not yet listed in line 20. This code employs method two, the stack pointer, to direct the POKEing operation. In the subroutine beginning on line 100, the operator selects the loop variable and parameters. In line 110, SP is the address of the top of the stack and R the address of the first non-blank character following the GOSUB in line 20.

In line 120, the ASCII value of the selected loop variable V$ is POKEd eight bytes above R. The subroutine then returns to execute the loop. The program may then be run with another one of the variables selected for the loop.

In line 10, the values of the fixed variables are assigned. The value assigned the variable selected for the loop is a dummy and will be overwritten by the loop.

Method one, using a string literal, could have been employed with equal effectiveness. In that case, the code on line 20 would be slightly longer and the code on line 110 would be somewhat simpler. Again, editing will not have any adverse effect on the program as long as the distance between the 100 and the equal sign in line 20 remained unchanged.

Program Listing 5 could be designed to automatically sequence through various sets of loop variables and loop parameters, effectively automatically editing its own text during execution.

Program Listing 6 illustrates the code required in the POKE subroutine for users with additional memory. As explained in the level II instruction manual POKE addresses greater than 32767 must be represented as (address – 65536). The modified code in Listing 6 automatically takes this anomaly into consideration. ■

```
10 INPUT "INPUT A,B,C,D";A,B,C,D
20 GOSUB 100 : FOR =L1 TO L2 STEP S
30 X=A+2*B+3*C+4*D : PRINT X
40 NEXT : END
100 INPUT "SELECT LOOP VARIABLE, LOOP LIMITS AND STEP";
V$,L1,L2,S
110 SP=PEEK(16616)+256*PEEK(16617) : R=PEEK(SP+3)
+256*PEEK(SP+4)
120 POKE R+8,ASC(V$) : RETURN
```

Program Listing 5

```
100 SP=PEEK(16616)+256*PEEK(16617) : IF SP>32767 THEN K=-65536
ELSE K=0
110 R=PEEK(K+SP+3)+256*PEEK(K+SP+4) : POKE R+D,TK : RETURN
```

Program Listing 6

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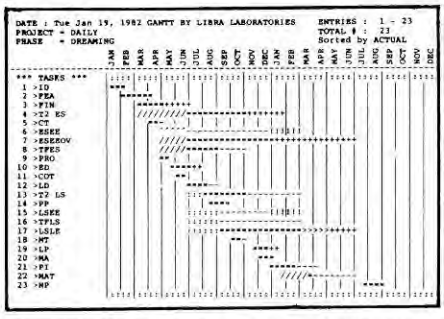

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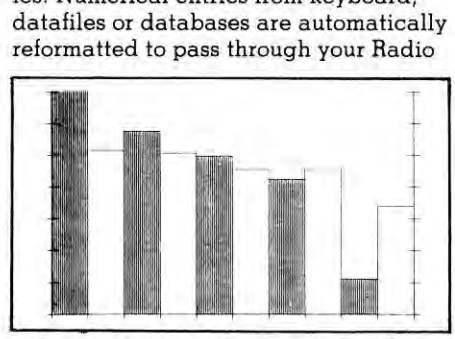

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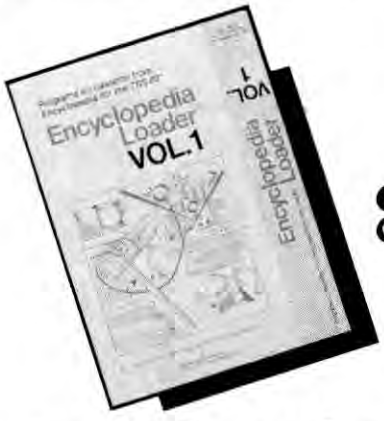

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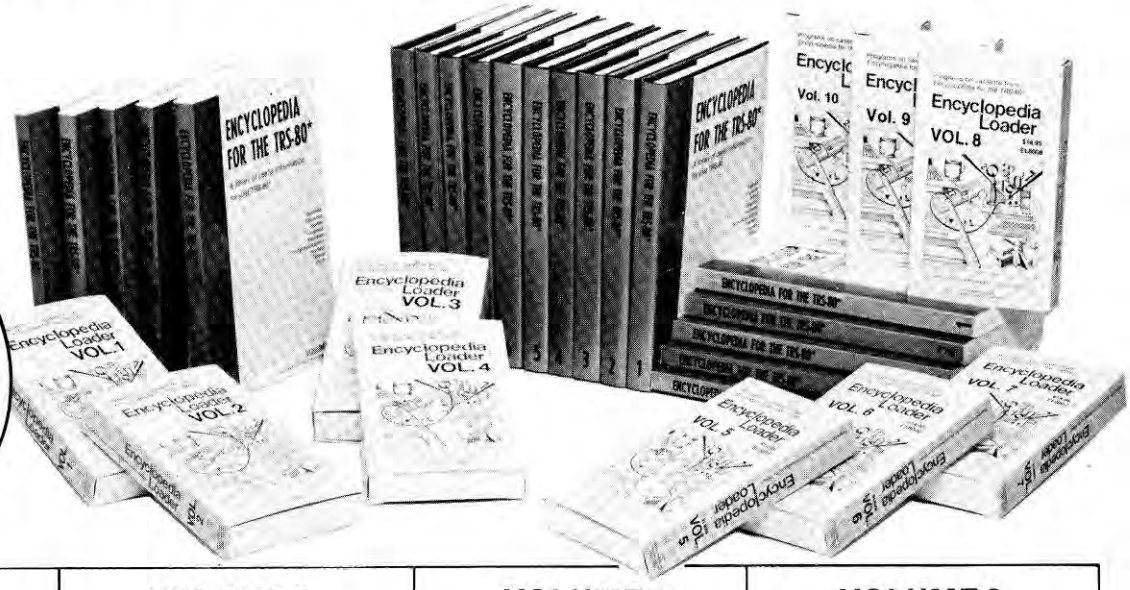

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"		" " UP TO 256 ZEROS)
"		" "
"		" "
00		" "
A5		FINAL SYNC BYTE
55		SYSTEMS TAPE SPECIFIER
4D	M	PROGRAM NAME (6 BYTES)
45	E	
52	R	
47	G	
45	E	
20	(SPACE)	END OF PROGRAM NAME
3C		BEGINNING OF DATA BLOCK
02		NO. OF BYTES IN DATA BLOCK
B1		LSB OF STARTING ADDRESS FOR
40		MSB LOADING DATA BLOCK
FE		START OF DATA CODE
7A		FOR DATA BYTES SPECIFIED
69		CHECKSUM BYTE
3C		BEGINNING OF DATA BLOCK
		NO. OF BYTES IN DATA BLOCK
"		LSB OF STARTING ADDRESS FOR
"		MSB LOADING DATA BLOCK
"		
"		
"		
"		
"		CHECKSUM
3C		BEGINNING OF DATA BLOCK
"		
"		
"		
"		CHECKSUM
78		END OF DATA SPECIFIER
00		LSB OF STARTING ADDRESS
7B		MSB OF MERGE PROGRAM

Fig. 1. Format for Machine-Language Tape. When a tape is loaded into a computer, it must follow a set format. First, the computer reads a series of sync bytes. After reading that, the computer looks for a byte to identify the tape. For a machine-language tape, the byte would be 55 hexadecimal. Next, the tape has six bytes indicating the program's name; then byte 3CH starts a block of data. That is followed by a byte offering values from 1-256 for the number of bytes to be read. Then comes the least significant and most significant bytes of the address where the data will be loaded. After loading, a checksum byte verifies the correct bytes have been read. When all data has been read, an end of data control byte (78H) tells the computer the next two bytes will be the starting address of the Merge program. Then your cassette player stops and your program has been loaded.

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Did you ever want to load more than one program at a time from tape to computer? Time consuming, right? It would be easier to pack the programs on a special utility tape and load them as a machine-language program.

I have three programs to help you do this:

- Merge—A machine-language program to copy and merge any number of other machine-language programs into one continuous loading unit.
- POKE—A Basic program which can be used to either analyze or modify machine-language programs. It is designed to be used in conjunction with Merge.
- Bassys—A machine-language program to convert a Basic program to a machine-language format so it can be combined with machine-language programs using Merge.

The driving force in developing these programs was Merge. It is, by far, the more useful of the three; though each has its utility when used with the other programs.

These programs evolved from a need I had for a machine-language tape copying program to make back-up copies of my programs. It is important to have back-ups as I have sadly found out. More than once I have mistakenly bulk erased the wrong tape or have placed a cassette too close to the computer's power supply and had programs ruined. After writing a program copier to make these back-ups, I could now goof up and do all the temporary destruction of cassettes I wished without serious consequence.

From my copying program evolved Merge. Now I can make my back-up copies and join two or more machine-language programs into a continuous loading unit. The only restriction is the

The Key Box

Basic Level II
Model I

merged programs occupy different areas in the computer's memory. Merge is designed for 16K computers. Though its starting address can be raised to accommodate larger systems, those systems would likely have disk drives and not need Merge.

To understand Merge, it is necessary to know how a machine-language tape is formatted (see Fig. 1). Merge (Program Listing 1) reads the machine-language tape instead of your ROM routine (System command) and loads the program into a table for recall later. When Merge is ordered to merge machine-language tapes, it starts loading at 78H (end of data specifier) after changing it to 3CH (data block specifier).

This process is repeated until the memory is filled. When you finish a load, the name of the last program to enter the computer will appear on the screen. An error message will also appear if you exceed the machine's memory during a load. In this case the end of data specifier and start address of the last full program will be restored.

Understanding machine-language format also can be useful when using POKE (Program Listing 2)—a program to make changes in the machine-language code after it's loaded into the Merge table.

After you enter and run POKE, you enter the decimal address of the byte you wish to examine or change (See Fig. 2). If you want to examine the entire Merge table, hit Enter and its beginning will be entered by default. Wherever possible, INKEY$ is used to change memory values or give other commands (See Fig. 7).

Entering P determines where the byte (78H) signaling the end of the data appears in the Merge table and displays the byte's address, ready for modification. In POKE, you can then add machine code to any machine-language program in memory.

Before you modify your programs, you must change the 78H byte to 3CH. After you have made your modifications, replace the 78H byte and the least significant and most significant bytes of the starting address of your modified program.

A code can be added to set memory size automatically (See Fig. 3). The memory size address set should be two bytes less than the program address. When going back to Basic as Merge does, your computer may run out of memory unless adequate string space has been reserved as shown in the Merge listing. By setting memory size in this manner or even POKEing it using Basic initializes the string space pointer improperly.

If the memory size pointer is at an address less than the string space pointer, you must

```
ENTER NEW ADDRESS?
DEC   HEX   BINARY     ADDRESS
85    55    01010101   18976    U
77    4D    01001101   18977    M
69    45    01000101   18978    E
82    52    01010010   18979    R
71    47    01000111   18980    G
69    45    01000101   18981    E
32    20    00100000   18982
60    3C    00111100   18983    <
2     02    00000010   18984
177   B1    10110001   18985
64    40    01000000   18986    @
254   FE    11111110   18987
122   7A    01111010   18988    z
105   69    01101001   18989    i
60    3C    00111100   18990    < LETTER T 84 01010100
2     02    00000010   18991    AF 175 10101111
160   A0    10100000   18992    INTEGER 133
10000101
64    40    01000000   18993    @
133   85    10000101   18992
175   AF    10101111   18991
84    54    01010100   18990    T

CONTROL KEYS

G = GO FORWARD      M = GO TO MERGE     Z = BINARY
H = HELP            N = NEW ADDRESS     ↑ = FAST REVERSE
I = INTEGER         P = POKE ADDENDA    ↓ = FAST FORWARD
L = LETTER          R = REVERSE

DEFAULT = ENTER HEXADECIMAL CODE TO CHANGE BYTE DISPLAYED
ENTER NEW ADDRESS?
```

Fig. 2. POKE Sample Run. In this exercise using nonsense commands, Merge has been entered in the Merge table using Merge. The memory address has defaulted to 18976, the start of the Merge table. The G command is entered to advance to another address in the table; L to modify a displayed byte by the ASCII value of T; and A and F to change AF to a hexadecimal value. The byte at 18992 is changed to 133 decimal by hitting I, 133 and Enter. A displayed address is decremented by entering R; the command table displayed by hitting H; and pressing Enter alone defaults to the last address displayed.

Program Listing 1. Merge

```
                00010 ;*****************************************
*******
                00020 ;***                    MERGE
    ***
                00030 ;***    SYSTEMS TAPE COPIER AND MERGE PROGRA
M   ***
                00040 ;***            BY THOMAS L. QUINDRY
    ***
                00050 ;***               TLQ ENTERPRISES
    ***
                00060 ;***               6237 WINDWARD DRIVE
    ***
                00070 ;***               BURKE, VA 22015
    ***
                00080 ;***    COPYRIGHT (C) 1981, THOMAS L. QUINDR
Y   ***
                00090 ;*****************************************
*******
7B00            00100 START   EQU     7B00H
4A20            00110 LOAD    EQU     4A20H
40B1            00120         ORG     40B1H
40B1 FE7A       00130         DEFW    START-2         ;SET MEMORY
SIZE
40A0            00140         ORG     40A0H
40A0 CC7A       00150         DEFW    START-52        ;SET CLEAR 5
0
7B00            00160         ORG     START
7B00 31C77F     00170         LD      SP,START+04C7H
7B03 CDC901     00180         CALL    01C9H           ;CLEAR SCREE
N
7B06 21274A     00190         LD      HL,LOAD+7
7B09 22257C     00200         LD      (MRG),HL
7B0C 3E00       00210         LD      A,0
7B0E 32277C     00220         LD      (MRG+2),A
7B11 3A277C     00230 START1  LD      A,(MRG+2)
7B14 FE20       00240         CP      32
7B16 2006       00250         JR      NZ,START2
7B18 21917E     00260         LD      HL,MESS7
7B1B CDA728     00270         CALL    28A7H
7B1E 21577D     00280 START2  LD      HL,MESS1        ;PROGRAM NAM
E
7B21 CDA728     00290         CALL    28A7H
7B24 217F7D     00300         LD      HL,MESS2        ;LOAD TAPE M
ESSAGE
7B27 CDF801     00310         CALL    01F8H           ;STOP RECORD
ER
7B2A CDA728     00320         CALL    28A7H           ;WRITE ON SC
REEN
7B2D 21BD7E     00330         LD      HL,MESS9
7B30 CDA728     00340         CALL    28A7H
7B33 3A0438     00350 LOOP1   LD      A,(3804H)
7B36 FE04       00360         CP      4               ;CHECK FOR R
 KEY
7B38 CA387C     00370         JP      Z,RECORD
7B3B 3A4038     00380         LD      A,(3840H)
7B3E FE01       00390         CP      1               ;CHECK FOR E
NTER KEY
7B40 20F1       00400         JR      NZ,LOOP1
7B42 CDC901     00410         CALL    01C9H
7B45 21E27E     00420         LD      HL,MESS10
7B48 CDA728     00430         CALL    28A7H
7B4B AF         00440         XOR     A
7B4C 31C77F     00450         LD      SP,START+04C7H
7B4F CD1202     00460         CALL    0212H           ;START RECOR
DER
7B52 CD9602     00470         CALL    0296H           ;READ SYNC B
YTE
7B55 CD3502     00480         CALL    0235H           ;READ DATA
7B58 FE55       00490         CP      85              ;SEE IF SYST
EM TAPE
7B5A 2815       00500         JR      Z,CONT1
7B5C CD3502     00510         CALL    0235H           ;CHECK AGAIN
 FOR SYSTEM TAPE
7B5F FE55       00520         CP      85
7B61 280E       00530         JR      Z,CONT1
7B63 CDC901     00540         CALL    01C9H
7B66 21997D     00550         LD      HL,MESS3        ;ERROR MESSA
GE
7B69 CDA728     00560         CALL    28A7H
```

Listing 1 continues

initialize it automatically (See Fig. 4) or by a Clear nn command in Basic. (The amount of free string space you want is nn.) Without one of these commands, the Basic interpreter may calculate a negative value for free string space and an error message will be displayed. In Fig. 4, free string space is set to 50 decimal by starting string space at 32H (50 decimal) below the memory size set in the previous example.

When using these listings, always save space for the checksum by entering a dummy value. Merge calculates the correct value before the machine-language program is written to tape.

You can also go directly from the Basic command mode to a machine-language program (Fig. 5). This listing changes the LPRINT addressing block to go to the machine-language program rather than to the printer. If you are going to use a printer, many other Disk Basic address blocks are available (See *80 Microcomputing*, February 1980). Without Disk Basic, if you enter disk commands like Name, Load, Kill, Merge and Save, you will get an error message. But by putting your machine-language address where the error codes are, when you enter disk commands you can jump to other programs in memory. However, some of those commands require extra information, so it may be impractical to use them. All these addresses require a jump command (C3H) before the least significant and most significant bytes of the destination address. Direct your branching commands to follow C3H (195 decimal). It starts each command in the branching table for Disk Basic commands.

A very useful function is automatic start up of a machine-language program (See Fig. 6). Though not included in Merge, this code could be added to it. By changing the original code at 41E2H, you can jump to the start of any ma-

Listing 1 continued

```
7B6C CD2B7C    00570          CALL    SAVE1
7B6F 18A0      00580          JR      START1
7B71 21204A    00590 CONT1    LD      HL,LOAD          ;STARTING DA
TA LOCATION
7B74 77        00600          LD      (HL),A
7B75 23        00610          INC     HL
7B76 0606      00620          LD      B,6              ;READ TAPE N
AME
7B78 DD21373C  00630          LD      IX,3C37H         ;VIDEO LOCAT
ION
7B7C CD3502    00640 LOOP2    CALL    0235H
7B7F DD7700    00650          LD      (IX),A           ;WRITE TAPE
NAME
7B82 77        00660          LD      (HL),A
7B83 DD23      00670          INC     IX
7B85 23        00680          INC     HL
7B86 10F4      00690          DJNZ    LOOP2
7B88 2A257C    00700          LD      HL,(MRG)
7B8B CD3502    00710 LOOP3    CALL    0235H            ;LOOK FOR EN
D
7B8E 77        00720          LD      (HL),A
7B8F 23        00730          INC     HL
7B90 FE3C      00740          CP      3CH
7B92 2002      00750          JR      NZ,CONT2
7B94 1813      00760          JR      RESUME
7B96 FE78      00770 CONT2    CP      78H              ;END
7B98 2870      00780          JR      Z,FINISH
7B9A CDC901    00790 ABORT    CALL    01C9H
7B9D 21C57D    00800          LD      HL,MESS4         ;ERROR MESSA
GE
7BA0 CDA728    00810          CALL    28A7H
7BA3 CD2B7C    00820          CALL    SAVE1
7BA6 C3117B    00830          JP      START1
7BA9 CD3502    00840 RESUME   CALL    0235H            ;DATA INPUT
7BAC 4F        00850          LD      C,A
7BAD 1E00      00860          LD      E,0              ;START ADDIN
G CHECKSUMS
7BAF 77        00870          LD      (HL),A
7BB0 23        00880          INC     HL
7BB1 3A3F3C    00890          LD      A,(3C3FH)        ;LOAD SYMBOL
 ROUTINE
7BB4 EE0A      00900          XOR     0AH
7BB6 323F3C    00910          LD      (3C3FH),A        ;LOAD STAR O
R SPACE
7BB9 0602      00920          LD      B,2
7BBB CD3502    00930 OVER     CALL    0235H
7BBE 77        00940          LD      (HL),A
7BBF 23        00950          INC     HL
7BC0 83        00960          ADD     A,E              ;ADD CHECKSU
MS
7BC1 5F        00970          LD      E,A
7BC2 10F7      00980          DJNZ    OVER
7BC4 CD3502    00990 LOOP4    CALL    0235H
7BC7 77        01000          LD      (HL),A
7BC8 23        01010          INC     HL
7BC9 0D        01020          DEC     C
7BCA 83        01030          ADD     A,E
7BCB 5F        01040          LD      E,A
7BCC E5        01050          PUSH    HL               ;PROTECTED M
EMORY CHECK
7BCD D5        01060          PUSH    DE
7BCE ED5BB140  01070          LD      DE,(40B1H)
7BD2 1B        01080          DEC     DE
7BD3 1B        01090          DEC     DE
7BD4 1B        01100          DEC     DE
7BD5 B7        01110          OR      A
7BD6 ED52      01120          SBC     HL,DE            ;SUBTRACT PR
OTECTED MEMORY POINTER
7BD8 380F      01130          JR      C,OKAY           ;OKAY IF MIN
US
7BDA CDC901    01140          CALL    01C9H
7BDD 21307F    01150          LD      HL,MESS12        ;MEMORY OVER
LOAD MESSAGE
7BE0 CDA728    01160          CALL    28A7H
7BE3 CD2B7C    01170          CALL    SAVE1
7BE6 C33E7C    01180          JP      CORDER
7BE9 D1        01190 OKAY     POP     DE
7BEA E1        01200          POP     HL
7BEB 3A4038    01210          LD      A,(3840H)
7BEE FE04      01220          CP      4                ;CHECK FOR B
REAK
7BF0 2009      01230          JR      NZ,DOXOR
7BF2 CD2B7C    01240          CALL    SAVE1
7BF5 CDC901    01250          CALL    01C9H
7BF8 C3117B    01260          JP      START1
7BFB AF        01270 DOXOR    XOR     A
7BFC B1        01280          OR      C
7BFD 20C5      01290          JR      NZ,LOOP4
7BFF CD3502    01300          CALL    235H
7C02 77        01310          LD      (HL),A
7C03 23        01320          INC     HL
7C04 BB        01330          CP      E                ;CHECKSUM
7C05 2093      01340          JR      NZ,ABORT         ;IF CHECKSUM
 ERROR
7C07 C38B7B    01350          JP      LOOP3
7C0A CD3502    01360 FINISH   CALL    0235H
7C0D 77        01370          LD      (HL),A
7C0E 23        01380          INC     HL
7C0F CD3502    01390          CALL    0235H
7C12 77        01400          LD      (HL),A
7C13 2B        01410          DEC     HL
7C14 2B        01420          DEC     HL
7C15 22257C    01430          LD      (MRG),HL         ;LOAD END AD
DRESS HERE
7C18 11287C    01440          LD      DE,SAVE
7C1B 010300    01450          LD      BC,3
7C1E EDB0      01460          LDIR
7C20 CDF801    01470          CALL    01F8H            ;TURN OFF CA
SSETTE
7C23 1813      01480          JR      RECORD
7C25 274A      01490 MRG      DEFW    LOAD+7
7C27 00        01500          DEFB    0
7C28 78        01510 SAVE     DEFB    78H
```

Listing 1 continues

HI-OCTANE IBM PC POWER FOR YOUR TRS-80

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- Centronics Printer Port

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- IPM PC Diskette Format
- TRSDOS ↔ CP/M86 File Transfer Utilities

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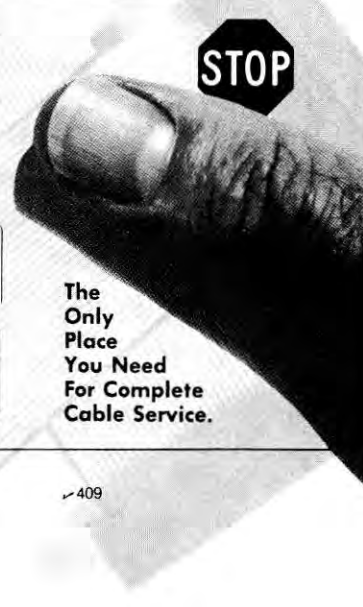

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Listing 1 continued

```
7C29 0000      01520          DEFW    0
7C2B 21287C    01530 SAVE1    LD      HL,SAVE
7C2E ED5B257C  01540          LD      DE,(MRG)
7C32 010300    01550          LD      BC,3
7C35 EDB0      01560          LDIR
7C37 C9        01570          RET
7C38 31C77F    01580 RECORD   LD      SP,START+04C7H
7C3B CDC901    01590          CALL    01C9H
7C3E 21214A    01600 CORDER   LD      HL,LOAD+1       ;BLOCK MOVE
TAPE NAME
7C41 11373C    01610          LD      DE,3C37H        ;DESTINATION
7C44 010600    01620          LD      BC,6
7C47 EDB0      01630          LDIR                    ;EXECUTE TRA
NSFER TO VIDEO
7C49 CDF801    01640          CALL    01F8H           ;STOP RECORD
ER
7C4C 21577D    01650          LD      HL,MESS1
7C4F CDA728    01660          CALL    28A7H
7C52 21DF7D    01670          LD      HL,MESS5        ;RECORDING I
NSTRUCTIONS
7C55 CDA728    01680          CALL    28A7H
7C58 217F7D    01690          LD      HL,MESS2
7C5B CDA728    01700          CALL    28A7H
7C5E 21EB7D    01710          LD      HL,MESS6        ;HOW TO GET
BACK TO START
7C61 CDA728    01720          CALL    28A7H
7C64 3A0238    01730 AGN      LD      A,(3802H)
7C67 FE20      01740          CP      32              ;CHECKS FOR
M KEY
7C69 CA137D    01750          JP      Z,MERGE
7C6C FE40      01760          CP      64              ;CHECKS FOR
N KEY
7C6E CA007B    01770          JP      Z,START
7C71 3A4038    01780          LD      A,(3840H)
7C74 FE04      01790          CP      4               ;LOOK FOR BR
EAK KEY
7C76 CACC06    01800          JP      Z,06CCH         ;JUMP TO BAS
IC
7C79 FE02      01810          CP      2               ;LOOK FOR CL
EAR KEY
7C7B CA1C7D    01820          JP      Z,RENAME
7C7E FE01      01830          CP      1               ;LOOK FOR EN
TER KEY
7C80 20E2      01840          JR      NZ,AGN
7C82 CDC901    01850          CALL    01C9H
7C85 21087F    01860          LD      HL,MESS11
7C88 CDA728    01870          CALL    28A7H
7C8B 31C77F    01880          LD      SP,START+04C7H
7C8E AF        01890          XOR     A
7C8F CD1202    01900          CALL    0212H
7C92 CD8702    01910          CALL    0287H           ;WRITE SYNC
BYTE
7C95 21204A    01920          LD      HL,LOAD         ;LOOK FOR DA
TA HERE
7C98 7E        01930          LD      A,(HL)
7C99 CD6402    01940          CALL    0264H           ;START WRITI
NG SYSTEM TAPE
7C9C 23        01950          INC     HL
7C9D 0606      01960          LD      B,6
7C9F 7E        01970 LOOPA    LD      A,(HL)
7CA0 CD6402    01980          CALL    0264H
7CA3 23        01990          INC     HL
7CA4 10F9      02000          DJNZ    LOOPA
7CA6 7E        02010 LOOPB    LD      A,(HL)
7CA7 CD6402    02020          CALL    0264H
7CAA 23        02030          INC     HL
7CAB FE3C      02040          CP      3CH
7CAD 2002      02050          JR      NZ,CONTA
7CAF 1807      02060          JR      RES
7CB1 FE78      02070 CONTA    CP      78H
7CB3 2842      02080          JR      Z,FINIS
7CB5 C39A7B    02090          JP      ABORT
7CB8 7E        02100 RES      LD      A,(HL)
7CB9 4F        02110          LD      C,A
7CBA 1E00      02120          LD      E,0             ;START ADDIN
G NEW CHECKSUM
7CBC CD6402    02130          CALL    0264H
7CBF 23        02140          INC     HL
7CC0 3A3F3C    02150          LD      A,(3C3FH)       ;LOAD SYMBOL
 ROUTINE
7CC3 EE0A      02160          XOR     0AH
7CC5 323F3C    02170          LD      (3C3FH),A       ;LOAD STAR O
R SPACE
7CC8 0602      02180          LD      B,2
7CCA 7E        02190 OVERA    LD      A,(HL)
7CCB CD6402    02200          CALL    0264H
7CCE 23        02210          INC     HL
7CCF 83        02220          ADD     A,E             ;ADD CHECKSU
MS
7CD0 5F        02230          LD      E,A
7CD1 3A4038    02240          LD      A,(3840H)
7CD4 FE04      02250          CP      4               ;CHECK FOR B
REAK KEY
7CD6 C2DF7C    02260          JP      NZ,OVERB
7CD9 CDC901    02270          CALL    01C9H
7CDC C3117B    02280          JP      START1
7CDF 10E9      02290 OVERB    DJNZ    OVERA
7CE1 B0        02300          OR      B
7CE2 20E6      02310          JR      NZ,OVERA
7CE4 7E        02320 LOOPC    LD      A,(HL)
7CE5 CD6402    02330          CALL    0264H
```

Listing 1 continues

CONVERT YOUR SERIAL PRINTER TO PARALLEL

The UPI serial printer interfaces allow an ASCII serial printer to be connected to the parallel printer port on TRS-80 Models I, II and III.

Software compatibility problems are totally eliminated because the TRS-80 "Thinks" that a parallel printer has been attached. No machine language driver needs to be loaded into high memory. VISACALC, SCRIPSIT, BASIC, FORTRAN, etc. all work as if a parallel printer was in use.

The UPI interfaces are completely self contained and ready to use. A 34 conductor cable and connector plugs onto the parallel printer port of the Model I expansion interface or onto the parallel printer port on the back of Models II and III. A DB25 socket mates with the cable from your serial printer. The UPI interfaces convert the parallel output of the TRS-80 printer port into serial data in both the RS232-C and 20 MA. loop formats.

BINARY DEVICES
Formerly SPEEDWAY ELECTRONICS
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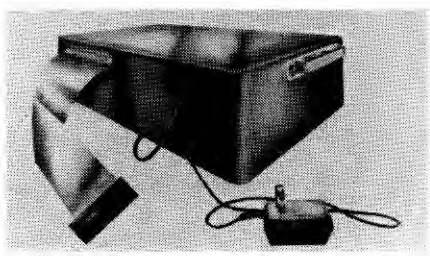

Switch selectable options include:

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- Handshake polarity (RS232-C)
- Nulls after Carriage Return
- 7 or 8 Data Bits per word
- 1 or 2 Stop Bits per word
- Parity or no parity
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Listing 1 continued

```
7CE8 23        02340          INC     HL
7CE9 0D        02350          DEC     C
7CEA 83        02360          ADD     A,E
7CEB 5F        02370          LD      E,A
7CEC AF        02380          XOR     A
7CED B1        02390          OR      C
7CEE 20F4      02400          JR      NZ,LOOPC
7CF0 7B        02410          LD      A,E             ;WRITE CHECK
SUM
7CF1 CD6402    02420          CALL    0264H
7CF4 23        02430          INC     HL
7CF5 18AF      02440          JR      LOOPB
7CF7 7E        02450 FINIS    LD      A,(HL)
7CF8 CD6402    02460          CALL    0264H
7CFB 23        02470          INC     HL
7CFC 7E        02480          LD      A,(HL)
7CFD CD6402    02490          CALL    0264H
7D00 2B        02500          DEC     HL
7D01 2B        02510          DEC     HL
7D02 22257C    02520          LD      (MRG),HL
7D05 11287C    02530          LD      DE,SAVE
7D08 010300    02540          LD      BC,3
7D0B EDB0      02550          LDIR
7D0D CDF801    02560          CALL    01F8H
7D10 C3387C    02570          JP      RECORD
7D13 32277C    02580 MERGE    LD      (MRG+2),A
7D16 CDC901    02590          CALL    01C9H
7D19 C3117B    02600          JP      START1
7D1C CDC901    02610 RENAME   CALL    01C9H
7D1F DD21214A  02620          LD      IX,LOAD+1
7D23 21AA7E    02630          LD      HL,MESS8
7D26 CDA728    02640          CALL    28A7H
7D29 0606      02650          LD      B,6
7D2B DD360020  02660 BLANK    LD      (IX),20H
7D2F DD23      02670          INC     IX
7D31 10F8      02680          DJNZ    BLANK
7D33 0606      02690          LD      B,6
7D35 DD21373C  02700          LD      IX,3C37H
7D39 21214A    02710          LD      HL,LOAD+1
7D3C CD2B00    02720 NAME     CALL    2BH
7D3F B7        02730          OR      A
7D40 28FA      02740          JR      Z,NAME
7D42 FE0D      02750          CP      0DH
7D44 CA387C    02760          JP      Z,RECORD
7D47 FE1F      02770          CP      1FH
7D49 28D1      02780          JR      Z,RENAME
7D4B 77        02790          LD      (HL),A
7D4C DD7700    02800          LD      (IX),A
7D4F 23        02810          INC     HL
7D50 DD23      02820          INC     IX
7D52 10E8      02830          DJNZ    NAME
7D54 C3387C    02840          JP      RECORD
7D57 53        02850 MESS1    DEFM    'SYSTEMS TAPE COPIER AND MER
GE PROGRAM'
7D7C 0D        02860          DEFB    0DH
7D7D 0D00      02870          DEFW    0DH
7D7F 4C        02880 MESS2    DEFM    'LOAD TAPE AND PRESS ENTER'
7D98 00        02890          DEFB    0
7D99 4E        02900 MESS3    DEFM    'NOT A SYSTEMS TAPE - TRY AN
OTHER LOCATION'
7DC2 0D        02910          DEFB    0DH
7DC3 0D00      02920          DEFW    0DH
7DC5 43        02930 MESS4    DEFM    'CHECKSUM REGISTER ERROR'
7DDC 0D0D      02940          DEFW    0D0DH
7DDE 00        02950          DEFB    0
7DDF 54        02960 MESS5    DEFM    'TO RECORD, '
7DEA 00        02970          DEFB    0
7DEB 0D        02980 MESS6    DEFB    0DH
7DEC 54        02990          DEFM    'TO MERGE ANOTHER SYSTEMS PR
OGRAM, PRESS M'
7E15 0D        03000          DEFB    0DH
7E16 54        03010          DEFM    'TO ENTER A NEW FILENAME, PR
ESS CLEAR'
7E3A 0D        03020          DEFB    0DH
7E3B 54        03030          DEFM    'TO LOAD A NEW SYSTEMS PROGR
AM WITHOUT MERGING, PRESS N'
7E71 0D        03040          DEFB    0DH
7E72 54        03050          DEFM    'TO RETURN TO BASIC PRESS BR
EAK'
7E90 00        03060          DEFB    0
7E91 50        03070 MESS7    DEFM    'PROGRAM TO BE MERGED BY'
7EA8 0D00      03080          DEFW    0DH
7EAA 45        03090 MESS8    DEFM    'ENTER NEW FILENAME'
7EBC 00        03100          DEFB    0
7EBD 0D        03110 MESS9    DEFB    0DH
7EBE 54        03120          DEFM    'TO RECORD EXISTING PROGRAM,
 PRESS R'
7EE1 00        03130          DEFB    0
7EE2 54        03140 MESS10   DEFM    'TO ABORT LOADING ROUTINE, P
RESS BREAK'
7F07 00        03150          DEFB    0
7F08 54        03160 MESS11   DEFM    'TO ABORT RECORDING ROUTINE,
 PRESS BREAK'
7F2F 00        03170          DEFB    0
7F30 41        03180 MESS12   DEFM    'AVAILABLE MEMORY OVERLOADED
'
7F4B 0D        03190          DEFB    0DH
7F4C 4C        03200          DEFM    'LAST PROGRAM DISREGARDED'
7F64 0D0D      03210          DEFW    0D0DH
7F66 0D00      03220          DEFW    0DH
7B00           03230          END     START
00000 TOTAL ERRORS
```


Q: What is the hardest thing in the world?
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chine-language program. But first, you must jump to another address not in your machine-language program. Then, before jumping to the program's starting address and with code loaded by your POKEd modification, you must reinstate the code at 41E2H to C9H.

When keying in POKE, REM statements and all unnecessary spaces must be eliminated, so it will fit in the memory preceeding the Merge table. After keying in POKE, it should run with memory left for variables and other overhead below 4A00H (18944 decimal). The Merge table starts at 4A20H (18976 decimal). This economizing is

Program Listing 2. POKE

```
5 'POKE - BY THOMAS L. QUINDRY
          TLQ ENTERPRISES
          6237 WINDWARD DRIVE
          BURKE, VA 22015

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** DO NOT KEY IN REMARK STATEMENTS OR SPACES **
10 CLEAR 50
20 DEFINT A-Z
30 POKE 16526, 56
40 POKE 16527, 124
50 N=18976
60 GOTO 160
65 '
** HELP **
70 CLS
80 PRINT
90 PRINT"CONTROL KEYS"
100 PRINT"G = GO FORWARD" TAB(20)"M = GO TO MERGE" TAB(41)"Z = B
INARY"
110 PRINT"H = HELP" TAB(20)"N = NEW ADDRESS" TAB(41)CHR$(91)" =
FAST REVERSE"
120 PRINT"I = INTEGER" TAB(20)"P = POKE ADDENDA" TAB(41)CHR$(92)
" = FAST FORWARD"
130 PRINT"L = LETTER" TAB(20)"R = REVERSE"
140 PRINT
150 PRINT"DEFAULT = ENTER HEXIDECIMAL CODE TO CHANGE BYTE DISPLA
YED"
155 '
** MEMORY PEEK **
160 PRINT
170 INPUT"ENTER NEW ADDRESS";N
180 PRINT"DEC HEX  BINARY  ADDRESS"
190 S=PEEK(N)
200 S1=INT(S/16)
210 IF S1<10 THEN S2=S1+48 ELSE S2=S1+55
220 S3=S-S1*16
230 IF S3<10 THEN S4=S3+48 ELSE S4=S3+55
235 '

** DECIMAL AND HEXIDECIMAL DISPLAY **
240 A$=CHR$(S2)+CHR$(S4)
250 PRINT STAB(5)A$;
260 GOSUB 860
265 '

** MEMORY ADDRESS **
270 PRINT N;
275 '
** ASCII DISPLAY **
280 IF PEEK(N)>32 AND PEEK(N)<91 THEN PRINT" ";CHR$(PEEK(N));" "
;
290 IF PEEK(N)>95 AND PEEK(N)<128 THEN PRINT" ";CHR$(PEEK(N));"
";
295 '
** KEYBOARD INPUTS **
300 Z2=0
310 GOSUB 450
320 IF Z2<>-9Z1=Z*16: GOSUB 450: Z=Z+Z1
330 IF Z>255 OR Z<0 THEN PRINT: PRINT"** ERROR IN INPUT OR INKEY
$ FUNCTION - REDO **": GOTO 180
340 IF Z2<>-9 PRINT Z,: S=Z: GOSUB 860
350 POKE N, Z
360 N=N+1
370 PRINT
380 GOTO 190
390 N=N+1
400 PRINT
410 GOTO 190
420 N=N-2
430 Z2=-9
440 GOTO 390
445 '
** KEYBOARD INPUT SELECTOR/CODER **
450 YY=PEEK(14400)
460 IF YY=8 THEN 420
470 IF YY=16 THEN 430
480 Y$=INKEY$
490 IF Y$="" THEN 450
500 IF Y$="G" THEN 430
510 IF Y$="H" THEN 80
520 IF Y$="I" THEN 640
530 IF Y$="L" THEN 940
540 IF Y$="M" THEN X=USR(0)
550 IF Y$="N" THEN RUN
560 IF Y$="P" THEN N=PEEK(31781)+256*PEEK(31782): PRINT: PRINT"P
OKE ADDENDA": GOTO 190
570 IF Y$="R" THEN 420
580 IF Y$="Z" THEN 700
585 '
** HEXIDECIMAL CONVERSION **
590 Z=ASC(Y$)-55
600 IF Z<3 THEN Z=Z+7
```

Listing 2 continues

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Listing 2 continued

```
610 IF Z>15 THEN 450
620 PRINT Y$;
630 RETURN
635 '
** DECIMAL CONVERSION **
640 Z1=0
650 INPUT" INTEGER";Z
660 S=Z
670 GOSUB 850
680 Z2=-9
690 RETURN
695 '
** BINARY CONVERSION **
700 Z1=0
710 PRINT" BINARY ";
720 W=256
730 Z=0
740 FOR Z2=0 TO 7
750 Y$=INKEY$
760 IF Y$="" THEN 750
770 W=W/2
780 IF Y$="0" THEN PRINT"0";: NEXT: GOTO 820
790 PRINT"1";
800 Z=Z+W
810 NEXT
820 PRINT Z;
830 Z2=-9
840 RETURN
845 '
** BINARY DISPLAY **
850 IF Z>255 OR Z<0 THEN RETURN
860 S9=S
870 N9=128
880 C$=""
890 IF INT(S9/N9)=1 THEN D$="1": S9=S9-N9 ELSE D$="0"
900 C$=C$+D$
910 IF N9>1 THEN N9=N9/2: GOTO 890
920 PRINT" ";C$;
930 RETURN
935 '
** LETTER CONVERSION **
940 Z1=0
950 PRINT" LETTER ";
960 Y$=INKEY$
970 IF Y$="" THEN 960
980 S=ASC(Y$)
990 Z=S
1000 PRINT TAB(26)CHR$(S)TAB(30)S;
1010 GOSUB 850
1020 Z2=-9
1030 RETURN
```

done so you will have adequate memory to copy or merge long programs. If you elect to pack lines tighter than shown, the Merge table can be lowered. Take care to allow enough memory overhead for program operation.

POKE is not a machine-language program. It can be put in machine-language format for merging by using Bassys (see Fig. 7). It will format any Basic program fitting in memory below the beginning of the Merge table. However, it

HEX CODE	
3C	
02	
B1	LSB MEMORY SIZE SPECIFIER
40	MSB MEMORY SIZE SPECIFIER
LSB	MEMORY SIZE TO SAVE MINUS 2
MSB	MEMORY SIZE TO SAVE
FF	DUMMY CHECKSUM

Fig. 3. Saving Memory Size

HEX CODE	
3C	
02	
A0	LSB START OF STRING AREA SPECIFIER
40	MSB START OF STRING AREA SPECIFIER
LSB	STRING SPACE - MEMORY SIZE SAVED MINUS
MSB	52 IS EQUIVALENT TO CLEAR 50
FF	DUMMY CHECKSUM

Fig. 4. Saving String Space

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cannot change two Basic programs to machine-language format and merge them because those programs normally occupy the same memory space. Bassys is designed to be used once, so there is no need to save memory size for it. It formats one Basic program, then jumps to Merge.

To merge POKE, CLOAD it, then load Merge and Bassys using the System command. After Bassys has been loaded, press Enter. POKE will be formatted immediately and control passed to Merge. In the screen's upper right corner, instructions for Merge and "Basic"—the name for the formatted program—will be displayed. Press M to enter the merge mode. Put the Merge tape in your recorder, hit Play and Enter. The program will be entered in the Merge table following the machine-language-formatted POKE. Then, in the upper right corner of the screen, the name of the last program entered will be displayed. To copy the merged programs, put a fresh cassette into your recorder, hit Record and Enter. You can make as many copies as you like using this method. And you can use it to merge as many programs as you like—as long as you don't run out of memory.

After all programs to be merged have been entered in memory, you may want to change their starting address. Return to Basic, run POKE and use the P command to find the end of data pointer (78H). Use the G command to advance the memory location by one, then enter the least and most significant byte of the new starting address.

You can merge to a machine-language program a Basic program longer than POKE by making a second Merge with a high-

HEX CODE	
3C	
02	
26	LSB LPRINT ADDRESS BLOCK
40	MSB LPRINT ADDRESS BLOCK
LSB	MACHINE LANGUAGE PROGRAM ADDRESS
MSB	MACHINE LANGUAGE PROGRAM ADDRESS
FF	DUMMY CHECKSUM

Fig. 5. Going to Machine Language and Skipping Printer Routine

HEX CODE	
3C	
03	
E2	LSB SYSTEM LOADING ROUTINE VECTOR
41	MSB SYSTEM LOADING ROUTINE VECTOR
C3	MACHINE CODE FOR JUMP TO
LSB	ANY ADDRESS BLOCK NOT USED BY YOUR PROGRAMS
MSB	ANY ADDRESS BLOCK NOT USED BY YOUR PROGRAMS
FF	DUMMY CHECKSUM
3C	
0B	
LSB	SAME AS ABOVE
MSB	SAME AS ABOVE
3A	MACHINE CODE FOR LOAD "A" REGISTER WITH
C9	MACHINE CODE FOR RETURN
3E	LOAD ADDRESS BELOW WITH "A" REGISTER
E2	LSB SYSTEM LOADING ROUTINE VECTOR
41	MSB SYSTEM LOADING ROUTINE VECTOR
C3	JUMP TO
LSB'	MACHINE LANGUAGE PROGRAM
MSB'	MACHINE LANGUAGE PROGRAM
FF	DUMMY CHECKSUM

Fig. 6. Automatic Start Up of Machine-Language Program

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er Merge table address. If your Merge table address is 5D80H instead of 4A20H, you will have room in it for a good sized Basic program and Bassys. Bassys has no difficulty locating the Merge table because it receives the location from Merge. However, you may first have to make a machine-language tape of the machine-language-formatted Basic program, use your original Merge to load it, then merge it to the machine-language program.

Merge, POKE and Bassys will add to your TRS-80's versatility and end the frustration of waiting for more than one program to load before loading your next.■

G	GO FORWARD	INCREMENTS ADDRESS TO BE EXAMINED OR MODIFIED BY ONE
H	HELP	DISPLAYS COMMAND TABLE
I	INTEGER	ALLOWS ADDRESS DISPLAYED TO BE MODIFIED BY AN INTEGER FROM 0 TO 255
L	LETTER	ALLOWS ADDRESS DISPLAYED TO BE MODIFIED BY AN ASCII LETTER
M	GO TO MERGE	JUMPS TO THE MACHINE LANGUAGE PROGRAM CALLED MERGE
N	NEW ADDRESS	ENTER DECIMAL ADDRESS TO BE EXAMINED OR MODIFIED
P	POKE ADDENDA	JUMPS TO END OF DATA SPECIFIER IN MERGE TABLE IF PROGRAM HAS BEEN ENTERED
R	REVERSE	DECREMENTS ADDRESS TO BE EXAMINED OR MODIFIED BY ONE
Z	BINARY	ALLOWS ADDRESS DISPLAYED TO BE MODIFIED BY 8 DIGIT BINARY NUMBER (ENTER 0'S AND 1'S, ANY KEY BUT 0 ENTERS 1)
↑	FAST REVERSE	DECREMENTS ADDRESS TO BE EXAMINED CONTINUOUSLY
↓	FAST FORWARD	INCREMENTS ADDRESS TO BE EXAMINED CONTINUOUSLY

Fig. 7. Control Keys for POKE

Program Listing 3. Bassys

```
                00100 ;*****************************************
**
                00110 ;***                BASSYS               *
**
                00120 ;***    CONVERT BASIC PROGRAM TO SYSTEM  *
**
                00130 ;***       FORMAT FOR MERGE PROGRAM      *
**
                00140 ;***        BY THOMAS L. QUINDRY         *
**
                00150 ;***           TLQ ENTERPRISES           *
**
                00160 ;***           6237 WINDWARD DRIVE       *
**
                00170 ;***           BURKE, VA 22015           *
**
                00180 ;*** COPYRIGHT (C) 1981, THOMAS L. QUINDRY *
**
                00190 ;*****************************************
**
                00200
7B00            00210 START   EQU     7B00H           ;START OF ME
RGE PROGRAM
7B72            00220 MRGTBL  EQU     START+0072H
7C25            00230 MRG     EQU     START+0125H
7C28            00240 SAVE    EQU     START+0128H
7C38            00250 RECORD  EQU     START+0138H
7A00            00260 BEGIN   EQU     7A00H           ;START OF BA
SSYS
7A00            00270         ORG     BEGIN
7A00 31C77F     00280         LD      SP,START+04C7H
7A03 21A17A     00290         LD      HL,TABLE        ;SET UP SYST
EM FORMAT
7A06 ED5B727B   00300         LD      DE,(MRGTBL)
7A0A 010B00     00310         LD      BC,0BH
7A0D EDB0       00320         LDIR                    ;TRANSFER
7A0F D5         00330         PUSH    DE              ;SAVE NEXT T
RANSFER ADDR
7A10 E1         00340         POP     HL              ;GET NEXT TR
ANSFER ADDR
7A11 3AA440     00350         LD      A,(40A4H)       ;GET START O
F BASIC PROGRAM
7A14 77         00360         LD      (HL),A
7A15 23         00370         INC     HL
7A16 3AA540     00380         LD      A,(40A5H)
7A19 77         00390         LD      (HL),A          ;START OF BA
SIC PROGRAM NOW ENTERED
7A1A 23         00400         INC     HL
7A1B E5         00410         PUSH    HL              ;SAVE NEXT T
RANSFER ADDR
7A1C 21F940     00420         LD      HL,40F9H        ;GET END OF
```

Listing 3 continued

```
BASIC PROGRAM
7A1F 22AA7A     00430         LD      (ADDR),HL       ;PUT IN TABL
E
7A22 21A77A     00440         LD      HL,TABLE1       ;SET UP SYST
EM FORMAT
7A25 D1         00450         POP     DE              ;GET NEXT TR
ANSFER ADDR
7A26 010500     00460         LD      BC,05H
7A29 EDB0       00470         LDIR
7A2B D5         00480         PUSH    DE              ;SAVE NEXT T
RANSFER ADDR
7A2C E1         00490         POP     HL              ;GET NEXT TR
ANSFER ADDR
7A2D 3AF940     00500         LD      A,(40F9H)       ;GET END OF
BASIC PROGRAM
7A30 77         00510         LD      (HL),A
7A31 23         00520         INC     HL
7A32 3AFA40     00530         LD      A,(40FAH)
7A35 77         00540         LD      (HL),A          ;END OF BASI
C PROGRAM NOW ENTERED
7A36 23         00550         INC     HL
7A37 E5         00560         PUSH    HL              ;SAVE NEXT T
RANSFER ADDR
7A38 AF         00570         XOR     A
7A39 32A97A     00580         LD      (BYTES),A       ;SET BYTES C
OUNT TO 0
7A3C 2AA440     00590         LD      HL,(40A4H)      ;GET BASIC P
ROGRAM START
7A3F 2B         00600         DEC     HL
7A40 22AA7A     00610         LD      (ADDR),HL
7A43 E5         00620         PUSH    HL              ;SAVE START
ADDR
7A44 D1         00630         POP     DE              ;GET START A
DDR
7A45 2AF940     00640         LD      HL,(40F9H)      ;GET BASIC P
ROGRAM END
7A48 B7         00650         OR      A               ;CLEAR CARRY
 FLAG FOR SUB
7A49 ED52       00660         SBC     HL,DE           ;GET NO. BYT
ES OF PROGRAM
7A4B E5         00670         PUSH    HL              ;SAVE NO. PR
OGRAM BYTES
7A4C C1         00680         POP     BC              ;GET NO. PRO
GRAM BYTES
7A4D D1         00690         POP     DE              ;GET NEXT TR
ANSFER ADDR
7A4E 78         00700         LD      A,B
7A4F B7         00710         OR      A
7A50 2817       00720         JR      Z,LSB           ;IF <256 BYT
ES GOTO LSB
7A52 C5         00730 MSB     PUSH    BC              ;SAVE REMAIN
ING PROGRAM BYTES
7A53 21A77A     00740         LD      HL,TABLE1       ;PUT IN SYST
EM FORMAT
7A56 010500     00750         LD      BC,05H
7A59 EDB0       00760         LDIR
7A5B 2AAA7A     00770         LD      HL,(ADDR)       ;GET START A
DDR FOR BLOCK
7A5E 010001     00780         LD      BC,0100H
7A61 EDB0       00790         LDIR
7A63 22AA7A     00800         LD      (ADDR),HL       ;PUT NEW BLO
CK ADDR IN TABLE
7A66 C1         00810         POP     BC              ;GET REMAINI
NG PROGRAM BYTES
7A67 10E9       00820         DJNZ    MSB
7A69 79         00830 LSB     LD      A,C             ;SET UP REMA
INDER OF BYTES
7A6A 32A97A     00840         LD      (BYTES),A       ;REMAINDER I
N TABLE
7A6D C5         00850         PUSH    BC              ;SAVE REMAIN
ING PROGRAM BYTES
7A6E 21A77A     00860         LD      HL,TABLE1       ;SYSTEM FORM
AT
7A71 010500     00870         LD      BC,05H
7A74 EDB0       00880         LDIR
7A76 2AAA7A     00890         LD      HL,(ADDR)       ;GET START A
DDR FOR BLOCK
7A79 C1         00900         POP     BC              ;GET REMAINI
NG PROGRAM BYTES
7A7A EDB0       00910         LDIR
7A7C D5         00920         PUSH    DE              ;SAVE NEXT T
RANSFER LOCATION
7A7D E1         00930         POP     HL              ;GET NEXT TR
ANSFER LOCATION
7A7E 23         00940         INC     HL
7A7F 22257C     00950         LD      (MRG),HL        ;SET MERGE P
ROGRAM COUNTER
7A82 3E78       00960         LD      A,78H
7A84 77         00970         LD      (HL),A
7A85 23         00980         INC     HL
7A86 3ECC       00990         LD      A,0CCH          ;LSB BASIC S
TART
7A88 77         01000         LD      (HL),A
7A89 32297C     01010         LD      (SAVE+1),A
7A8C 23         01020         INC     HL
7A8D 3E06       01030         LD      A,06H           ;MSB BASIC S
TART
7A8F 77         01040         LD      (HL),A
7A90 322A7C     01050         LD      (SAVE+2),A
7A93 3E02       01060         LD      A,02H           ;RE-INITIALI
ZE TABLE
7A95 32A97A     01070         LD      (BYTES),A
7A98 21A440     01080         LD      HL,40A4H
7A9B 22AA7A     01090         LD      (ADDR),HL
7A9E C3387C     01100         JP      RECORD          ;JUMP TO MER
GE, RECORD
7AA1 55         01110 TABLE   DEFB    055H            ;SYSTEM FORM
ATTING TABLE
7AA2 42         01120         DEFM    'BASIC'
7AA7 203C       01130 TABLE1  DEFW    3C20H
7AA9 02         01140 BYTES   DEFB    02H             ;ORIGINAL BL
OCK FOR 2 BYTES DATA
7AAA A440       01150 ADDR    DEFW    40A4H           ;ORIGINAL BL
OCK FOR START OF BASIC PROGRAM
7A00            01160         END     BEGIN
00000 TOTAL ERRORS
```

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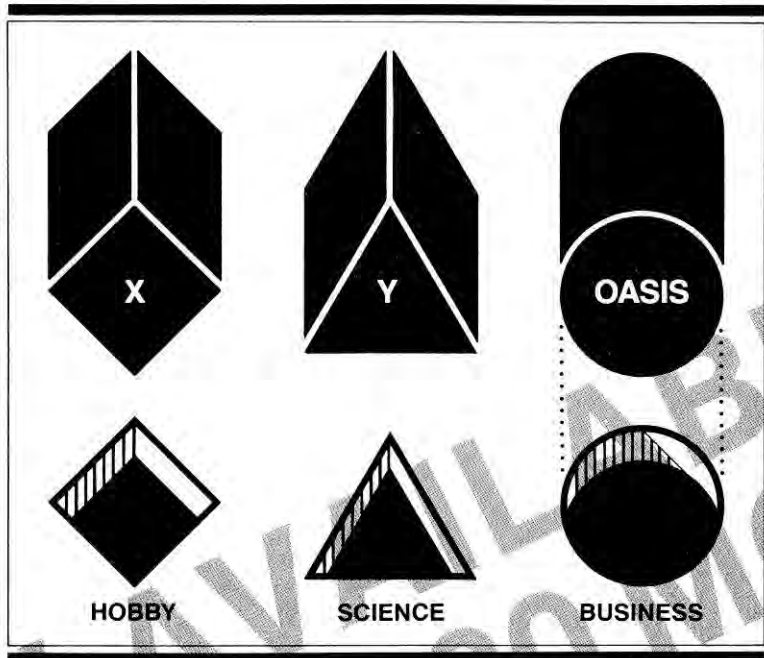

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NOT AVAILABLE FOR SOMEONE

PRINT to LPRINT for free.

Seeker

Jon Mark O'Connor
56 Eustis Parkway
Waterville, ME 04901

When I am at a loss for something to do, I scan software advertisements to find programs that appear interesting. I often attempt to duplicate the programs I see there. Here's one that caught my eye: a Print to LPRINT program. This version (Seeker) won't cost you a dime.

Seeker

An unusual feature of Seeker is the ability to spot-check your lines. After indicating specific lines that are to have token changes, the program will stop at each occurrence of the token. If you wish to change the token, hit Y.

When selecting spot-checking, each token will flash off and on. When you change a token, you will not see it happen on the screen. A screen display would require constant reshifting of the screen lines; it tends to slow the action down.

If you opt to change Prints to LPRINTs and you are spot-checking, remember that the program will stop at every PRINT@. A PRINT@ should not be changed to an LPRINT, since no printer will accept this. I have allowed for the following setups of PRINT@:

```
PRINT@960
PRINT @960
```

Some unpacking programs insert the extra space between Print and @. If you don't own a packing program or never insert the extra space, you may change line 60190 to IF PEEK (L% + 1) = 64NEXT.

Though this program is presented as a Print/LPRINT changer, you can seek out

Program Listing

```
59999 STOP
60000 CLEAR4000:DEFINTC-Y:DEFSTRB,Z
60010 DIML%,YY%,MM%,GJ%,RQ$,G%,XP%,XX!,QS$,T%,FL$,LL!,Z2$,RR$,XR
%,Z3$,Z4$,QM%,UH%,Z1$,FL!,ML%,XT!,B9$,OK%,HV%,QW$,Z5$,YR%,H%,UY%
,B$(125)
60020 CLS:GOTO60220
60030 PRINT@704,Z1;:XP=PEEK(XP)+PEEK(XP+1)*256
60040 XX!=PEEK(XP+2)+PEEK(XP+3)*256:IFXX!>LL!THEN60210ELSEPRINT@
704,USINGZ2;XX!;:FORL%=XP+4TOXP+255:IFPEEK(L%)=0ORPEEK(L%)=147TH
EN60060ELSEIFPEEK(L%)>128PRINTB(PEEK(L%)-128);:NEXT
60050 PRINTCHR$(PEEK(L%));:NEXTELSENEXT
60060 YY=710:PRINT@YY,;:FORL%=XP+4TOXP+255
60070 IFPEEK(L%)=147ORPEEK(L%)=0THEN60030ELSEIFPEEK(L%)=MMTHEN60
090ELSEIFPEEK(L%)>128YY=YY+LEN(B(PEEK(L%)-128)):NEXT
60080 YY=YY+1:NEXTELSENEXT
60090 FORT=1TO20:NEXT:PRINT@YY,STRING$(LEN(B(PEEK(L%)-128)),191)
;
60100 FORT=1TO20:NEXT:PRINT@YY,B(PEEK(L%)-128);
60110 QM=LEN(B(PEEK(L%)-128)):PRINT@960,Z3;:PRINT@980,Z4;
60120 QS$=INKEY$
60130 IFQS$="Y"THENPOKEL%,ML:PRINT@960,Z5;:QN=LEN(B(PEEK(L%)-128
)):IFQN>QM,YY=YY-(QN-QM):GOTO60070ELSEIFQM>QNTHENYY=YY+(QM-QN):G
OTO60070
60140 IFQS$="N"THENYY=YY+LEN(B(PEEK(L%)-128)):L%=L%+1:GOTO60070E
LSE60070
60150 XP=PEEK(XP)+PEEK(XP+1)*256
60160 XX!=PEEK(XP+2)+PEEK(XP+3)*256:IFXX!>LL!THEN60210ELSEPRINTT
AB(16)USINGZ2;XX!;:FORL%=XP+4TOXP+255:IFPEEK(L%)=147ORPEEK(L%)=0
THEN60150ELSEIFPEEK(L%)=MMPOKEL%,ML:NEXTELSENEXT
60170 XP=PEEK(XP)+PEEK(XP+1)*256
60180 XX!=PEEK(XP+2)+PEEK(XP+3)*256:IFXX!>LL!THEN60210ELSEPRINTT
AB(16)USINGZ2;XX!;:FORL%=XP+4TOXP+255:IFPEEK(L%)=0THEN60170ELSEI
FPEEK(L%)<>178NEXT
60190 IFPEEK(L%+2)=64ORPEEK(L%+1)=64NEXT
60200 IFPEEK(L%)=MMPOKEL%,ML:NEXTELSENEXT
60210 PRINT@960,:INPUT"ENTER";UY:CLS:LIST-59999
```

Listing continues

First Line	
10-	Line 10 to end of your program
-90	First line of your program to line 90
20-50	These lines only
Last Line	
.	Same as first line input
-	First line input to end
80	First line input to line 80

Table 1

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any token and change it to another token.

The Program

First, merge this program with your existing program. Your program may not have line numbers that exceed 59998. To activate Seeker, enter Run 60000. If Seeker is to be used for a long stretch, include a GOTO 60000 in the first line of your program.

Seeker's first task is to read your data. You'll then be asked for the first line in your program to be checked. If you indicate a specific line number, hit enter. You will be prompted for the last line input. I have included some variations for the first and last line inputs (see Table 1).

If you attempt to insert a non-existent line number, you will receive a listing of your program.

After the line inputs, you are asked for the token you wish changed. Look through Seeker's data list to see how each token is spelled. Tokens such as TAB(and STRING$ must have the opening parenthesis and dollar sign, respectively. You will be informed of input errors.

After inputting correctly, you are asked what you wish the token changed to; again, be careful. The next input is for spot-checking. A negative response gives you a display of line numbers only.

The program ignores remarks. You may use ? for Print and L? for LPRINT.

It may take a second or so for Seeker to find your beginning line, but then the change process runs quickly.■

Listing continued

```
60220 Z1=STRING$(5,255)+CHR$(196):Z2="##### ":Z3=CHR$(200)
60230 Z4="CHANGE <Y OR N>":Z5="OKAY":RESTORE:CLS
60240 XP=PEEK(16548)+PEEK(16549)*256:PRINT@448,"SEEKER":PRINT
60250 PRINT"READING YOUR DATA....."
60260 READB9:IFB9="***"THEN60270ELSE60260
60270 FORGJ=0TO122:READB(GJ):NEXT:CLS
60280 PRINT@448,:PRINTTAB(16):INPUT"FIRST LINE ";FL$
60290 IFLEFT$(FL$,1)=CHR$(45)ANDMID$(FL$,2,1)=>CHR$(48)FL!=PEEK(
XP+2)+PEEK(XP+3)*256:OK=999:LL!=VAL(MID$(FL$,2,LEN(FL$))):GOTO60
350
60300 FORUH=1TOLEN(FL$)
60310 IFMID$(FL$,UH,1)=CHR$(45)ANDMID$(FL$,UH+1,1)=>CHR$(48)LL!=
VAL(MID$(FL$,UH+1,LEN(FL$))):OK=999:FL!=VAL(MID$(FL$,1,UH)):GOTO
60350
60320 NEXT
60330 IFRIGHT$(FL$,1)=CHR$(45)FL!=VAL(FL$):LL!=59998:GOTO60360
60340 FL!=VAL(FL$):GOTO60360
60350 IFLL!<FL!THEN60280ELSEIFFL!=>60000THEN60420
60360 XR=XP:IFFL!=PEEK(XR+2)+PEEK(XR+3)*256THEN60400
60370 IFXT!>FL!THEN60420ELSEIFXT!=60000THEN60420
60380 XR=PEEK(XR)+PEEK(XR+1)*256:XT!=PEEK(XR+2)+PEEK(XR+3)*256
60390 IFXT!=FL!THEN60400ELSE60370
60400 IFOK=999THEN60450ELSEPRINTTAB(16)"LINE # "FL!" IS IN LIST
60410 GOTO60450
60420 PRINTCHR$(13)TAB(16)"NOT AVAILABLE LINE NUMBER  "
60430 FORT=1TO20:FORTT=1TO50:NEXT:PRINT@980,"WILL LIST PROGRAM";

60440 FORTT=1TO50:NEXT:PRINT@980,CHR$(210);:NEXT:PRINT:LIST-5999
9
60450 YR=XR:IFOK=999THEN60510ELSEIFLL!=59998THEN60550ELSEPRINTTA
B(16)
60460 INPUT"LAST LINE ";LL$:LL!=VAL(LL$):IFLL!=FL!THEN60540
60470 IFLL$="."LL!=FL!:GOTO60540
60480 IFLL$="-",LL!=59998:GOTO60540ELSEIFLL!=>60000THEN60450
60490 IFLL!=FL!THEN60540
60500 IFLL!<FL!PRINTTAB(16)"CAN'T DO THAT!":GOTO60450
60510 IFYT!>LL!THEN60420ELSEIFYT!=60000THEN60420
60520 YR=PEEK(YR)+PEEK(YR+1)*256:YT!=PEEK(YR+2)+PEEK(YR+3)*256
60530 IFYT!=LL!THEN60540ELSE60510
60540 PRINTTAB(16)"LINE # "LL!" IS IN LIST       "
60550 PRINT@846,CHR$(240)
60560 PRINT@846,"WHAT DO YOU WANT TO CHANGE";:INPUTRQ$
60570 IFRQ$="'"MM=147:RQ$="REM":GOTO60630
60580 IFRQ$="?"MM=178:RQ$="PRINT":GOTO60630
60590 IFRQ$="L?"MM=175:RQ$="LPRINT":GOTO60630
60600 PRINT@980,CHR$(210);:FORG=0TO122:IFRQ$=B(G)THEN60620ELSENE
XT
60610 GOTO60700
60620 MM=G+128
60630 PRINT@874,RQ$;:PRINT@912,CHR$(236);
60640 PRINT@913,"CHANGE "RQ$TAB(31)"TO WHAT";:INPUTRR$
60650 IFRR$="'"ML=147:RR$="REM":GOTO60720
60660 IFRR$="?"ML=178:RR$="PRINT":GOTO60720
60670 IFRR$="L?"ML=175:RR$="LPRINT":GOTO60720
60680 FORH=1TO122:IFB(H)=RR$THEN60690ELSENEXT:GOTO60630
60690 ML=H+128:GOTO60720
60700 PRINT@850,CHR$(230);:PRINT@914,CHR$(230);
60710 PRINT@980,"NOT ACCEPTED";:GOTO60550
60720 PRINT@936,RR$;:FORG=1TO3:PRINT:NEXT
60730 'IFMM=MLTHEN60770ELSEPRINT@832,TAB(18);
60740 INPUT"SPOT CHECK EACH LINE";QW$
60750 IFQW$="Y"HV=999:GOSUB60790:GOTO60040
60760 IFQW$="N"HV=0:GOSUB60770ELSE60730
60770 GOSUB60790:PRINT@576,"CHANGING ALL "RQ$" 'S TO "RR$" 'S  "

60780 IFML=175ANDHV=0THEN60180ELSEIFHV=0THEN60160ELSE60040
60790 XP=XR:CLS:PRINT@472,"S E E K E R";:RETURN
60800 DATA"***",END, FOR, RESET, SET, CLS, CMD, RANDOM, NEXT, DA
TA
60810 DATA INPUT, DIM, READ, LET, GOTO, RUN, IF, RESTORE, GOSUB,
 RETURN
60820 DATA REM, STOP, ELSE, TRON, TROFF, DEFSTR, DEFINT, DEFSNG
60830 DATA DEFDBL, LINE, EDIT, ERROR, RESUME, OUT, ON, OPEN, FIE
LD
60840 DATA GET, PUT, CLOSE, LOAD, MERGE, NAME, KILL, LSET, RSET,
 SAVE
60850 DATA SYSTEM, LPRINT, DEF, POKE, PRINT, CONT, LIST, LLIST
60860 DATA DELETE, AUTO, CLEAR, CLOAD, CSAVE, NEW, TAB(, TO
60870 DATA FN, USING, VARPTR, USR, ERL, ERR, STRING$, INSTR
60880 DATA POINT, TIME$, MEM, INKEY$, THEN, NOT, STEP, +, -
60890 DATA *, /, [, AND, OR, >, =, <, SGN, INT, ABS, FRE, INP
60900 DATA POS, SQR, RND, LOG, EXP, COS, SIN, TAN, ATN, PEEK
60910 DATA CVI, CVS, CVD, EOF, LOC, LOF, MKI$, MKS$, MKD$, CINT
60920 DATA CSNG, CDBL, FIX, LEN, STR$, VAL, ASC, CHR$, LEFT$, RI
GHT$, MID$
60930 END
```


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Travel agents are going to love this one.

Reservation Cancellation

Arthur J. Welcher
360 South Wetherly Drive
Beverly Hills, CA 90211

If you run a travel agency specializing in customized vacations you have probably had clients make and change complex itineraries several times. When overwhelmed by writing 2^n cancellation letters and requests for new reservations, let this program write the letters for you.

Once a viable itinerary is entered into a file, it requires only the name and address of the desired hotel to write the reservation request. Changes in the itinerary automatically write the cancellation letter and the reservation request covering the cancelled time period. It is also possible to produce a printed itinerary.

Line Functions

Lines 10 to 260 set the program format, including the menu. Line 40 dimensions the two arrays used in the program. The first number in the array limits the number of entries per itinerary. These parameters are for 16K memory. If your computer contains more than 16K, alter line 40 to accommodate as many as 50 entries. Also change line 20 to Clear 1000 to handle the added capacity. The Y array holds the itinerary and reservation requests, the U array holds the cancellations.

Lines 1052–1160 are for entering an itinerary. After each complete set, you have the opportunity to view the itinerary, and you may leave it, or add another stop. When you have entered the complete itinerary, you may then check it, print it and write the reservation request for each stop. The program contains a brief form letter for that purpose, but if your agency uses a preprinted form for reservations and cancellations, you can re-format both letter-writing sections to match your printed forms. The reservation request is in lines 6560–6960 and the cancellation order is in lines 6000–6280. After all forms are printed, return to Menu and select option 4 to store data under a client file. A disk without DOS easily holds about 45 different files.

You can call up the file at a future date by selecting menu option 5. Select menu option 3 to make an itinerary change. When you enter a replacement trip plan, the computer writes the *new* reservation request and the cancellation order. It then displays the updated itinerary, permits you to print it out, and save it . . . until the next time! ■

Mr. Welcher recently retired from CBS-TV Hollywood where he worked in technical operations for 30 years. He and his wife have opened their own travel agency, Town and Country Travel, in Encinitas, CA.

Program Listing

```
1 '****************************************
2 '*                                      *
3 '*       ITINERARY RESERVATION          *
4 '*         AND CANCELLATION             *
5 '*              BY                      *
6 '*          ARTHUR WELCHER              *
7 '*                                      *
8 '****************************************
10 REM ITINERARY
20 CLEAR  150
30 DEFSTR I,U
40 DIM I(10,7),U(10,7)
50 CLS
60 INPUT"ITINERARY FOR (NAME)";CN$
100 CLS
115 K1=0
120 PRINT"TO ENTER ITINERARY - - SELECT 1"
140 PRINT"TO VIEW FINAL ITINERARY SELECT 2"
160 PRINT"TO MAKE A CHANGE- - - - SELECT 3"
180 PRINT"TO STORE ON DISK- - - - SELECT 4"
200 PRINT"TO PUT DATA INTO COMPUT.SELECT 5"
220 REM 6000 IS LETTER SUB
240 INPUT Q
260 CLS: ON Q GOTO 1000,12000,3000,4000,5000
1000 REM ENTER ITIN
1020 Y=Y+1
1052 INPUT"FLIGHT NO.";I(Y,7)
1060 INPUT"CITY";I(Y,0)
1080 INPUT"FROM (DATE)";I(Y,1)
1100 INPUT"NUMBER OF DAYS";I(Y,2)
1120 INPUT"HOTEL";I(Y,3)
1140 INPUT"NUMBER OF ROOMS";I(Y,4)
1160 INPUT"PRICE RANGE";I(Y,5)
1180 PRINT"ENTRY COMPLETE":PRINT
1200 PRINT"TO CONTINUE ITINERARY SELECT 1"
1220      PRINT"TO VIEW FINAL ITINERARY SELECT 2"
1230 INPUT"TO PRINT FINAL ITINERARY SELECT 3";Q
1240 CLS:ON Q GOTO 1000,12000,12000
3000 REM CHANGE ITIN
3002 Q=0
3005 FORL=1TOY
3010 U(L,3)="NONE"
3015 NEXT
3020 K1=1:GOSUB12040
3040 INPUT"DELETE ITEM NO.";Z
3060    CLS:GOSUB15000
3080 PRINT ZTAB(5)  I(Z,0)TAB(19) I(Z,7)TAB(28) I(Z,1) TAB(38) I
(Z,2)TAB(42)  I(Z,3) TAB(POS(0)+2)I(Z,4)TAB(60)    I(Z,5)
3100 FORL=1TOY
3120 IFZ=LTHEN U(L,0)=I(L,0):U(L,7)=I(L,7):U(L,1)=I(L,1):U(L,2)=
I(L,2):U(L,3)=I(L,3):U(L,4)=I(L,4):U(L,5)=I(L,5)
3140 NEXTL
3160 REM U LIST IS CANSELTN
3180 PRINT"ENTER CHANGE (USE COMMA BETWEEN ENTRIES)"
3200 PRINTZ
3210 INPUT"CITY";I(Z,0)
3220 INPUT"FLIGHT";I(Z,7)
3230 INPUT"ARRIVING";I(Z,1)
3240 INPUT"DAYS";I(Z,2)
3250 INPUT"HOTEL";I(Z,3)
3260 INPUT"ROOMS";I(Z,4)
3270 INPUT"PRICE";I(Z,5)
3280 PRINT"CHANGE  NOTED  ":PRINT
3300 PRINT"TO MAKE ANOTHER CHANGE  SELECT 1"
```

Listing continues

Model II/16 Conversion

CONVERSION BY MIKE KILROY

DELETE THE FOLLOWING LINES:

6515

EDIT THE FOLLOWING LINES:

```
20 CLEAR  3000
6000 'NONESENSE LINE
16000 LPRINTXTAB(5)I(X,0)TAB(20)I(X,7)TAB(30)I(X,1)TAB(41)I(X,2)TAB(49)I(X,3)TAB
(POS(0)+2)I(X,4)TAB(63);"    ";I(X,5)
```

The Key Box

Model I and III
Disk Basic
16K RAM
Printer

Listing continued

```
3320 PRINT"TO WRITE LETTERS          SELECT 2"
3342 INPUT "TO CONTINUE              SELECT 3";Q
3360 CLS:ON Q GOTO3020,6000,100
4000 REM STORE DATA DISK
4020 PRINT"TO STORE ITINERARY ON DATA DISK "
4060 INPUT"WHEN READY PRESS ENTER";Q
4070 OPEN"O",1,LEFT$(CN$,6)
4080 CLS:PRINT@100, "WRITING DISK"
4100 PRINT# 1,Y
4120 FOR S=1 TO Y
4140 PRINT# 1,S;",";I(S,0);",";I(S,7);",";I(S,1);",";I(S,2);",";
I(S,3);",";I(S,4);",";I(S,5)
4160 NEXT
4170 CLOSE
4180 CLS:PRINT@100,"DATA RECORDED"
4200 PRINT"TO CONTINUE PRESS ENTER";Q
4220 GOTO 100
5000 REMTO READ DATA DISK
5010 GOTO5070
5020 CLS:PRINT"TO READ ITINERARY RECORD"
5060 INPUT"PRESS ENTER";Q
5070 OPEN"I",1,LEFT$(CN$,6)
5080 CLS:PRINT@100,"READING DISK"
5100 INPUT# 1,Y5
5120 FORY=1TOY5
5140 INPUT# 1,Y,I(Y,0),I(Y,7),I(Y,1),I(Y,2),I(Y,3),I(Y,4),I(Y,5)
5150 NEXT
5155 CLOSE
5160 PRINT@100,"ITINERARY IN COMPUTER"
5170 GOTO100
5180 PRINT:PRINT"TO CONTINUE PRESS ENTER"
5200 INPUT Q
5220 GOTO100
6000 POKE14312,30
6040 FORR=1TOY
6060 IFU(R,3)="NONE"THEN6500
6080 LPRINTTAB(12)"COMPUTER CANCELLATION FORM"
6090 LPRINT""
6100 LPRINT"RESERVATION MANAGER"
6120 LPRINTU(R,3);" HOTEL"
6140 LPRINTU(R,0)
6150 LPRINT""
6160 LPRINT"DEAR SIR :"
6170 LPRINT""
6180 LPRINT"PLEASE CANCEL THE SPACE YOU HOLD ON ";U(R,1)
6200 LPRINT"FOR"CN$
6220 LPRINT"IF THERE IS A DEPOSIT, PLEASE RETURN"
6230 LPRINT"IT TO DIANE WELCHER OF TERRACE TRAVEL"
6240 LPRINT"AT THE ADDRESS SHOWN ABOVE."
6260 LPRINT""
6270 LPRINT""
6280 LPRINTTAB(20)"THANK YOU VERY MUCH"
6300 FOR GH=1 TO 5:LPRINT"":NEXT
6500 NEXTR
6510 REM RESERV LETR
6515 POKE14312,30
6520 FORR=1TOY
6530 IF U(R,3)="  " THEN6890
6540 IFK1=1ANDU(R,3)="NONE"THEN6890
6560 LPRINTTAB(12)"COMPUTER RESERVATION FORM"
6570 LPRINT""
6580 LPRINT"RESERVATION MANAGER"
6600 LPRINTI(R,3);" HOTEL"
6620 LPRINTI(R,0)
6630 LPRINT""
6640 LPRINT"DIR SIR:"
6650 LPRINT""
6660 LPRINT"PLEASE RESERVE FOR ";CN$
6680  GOSUB 6900
6700 LPRINTCN$" WILL ARRIVE ON ";I(R,1)
6720 LPRINT"AND REQUEST A ";I(R,2);" DAY STAY."
6740 LPRINT"SEND CONFIRMATION TO DIANE WELCHER"
6760 LPRINT"IN CARE OF TERRACE TRAVEL "
6765 LPRINT"AT THE  ADDRESS SHOWN ABOVE."
6770 LPRINT""
6780 LPRINTTAB(20)"THANK YOU VERY MUCH"
6800 FORGH=1 TO5:LPRINT"":NEXT
6890 NEXTR
6895  GOTO100
6900 IF VAL(I(R,4))>1THEN 6960
6920 LPRINT"ONE ROOM IN THE $";I(R,5);" PRICE RANGE"
6940 GOTO6970
6960 LPRINTI(R,4)" ROOMS, EACH IN THE $";I(R,5);" PRICE RANGE."
6970 RETURN
12000 REM VIEW FINAL ITIN
12010 Q=0
12020 K1=0
12040 K=0
12060 GOSUB15000
12080 IFQ1=2 THEN15450
12090 FORX=1 TOY
12095 IF Q1=2 THEN 16000
12100 PRINTXTAB(5)I(X,0)TAB(19)I(X,7)TAB(28)I(X,1)TAB(38)I(X,2)T
AB(42)I(X,3)TAB(POS(0)+2)I(X,4)TAB(60)I(X,5)
12120 K=K+1:IFK=12THEN12400
12140 NEXT
12160 IFK1=1THENRETURN
12180 PRINT"ITINERARY COMPLETE":PRINT
12200 PRINT"TO WRITE RESERVATION LETTERS  SELECT 1"
12210 PRINT"TO PRINT OUT ITINERARY          SELECT 2"
12220 INPUT"TO CONTINUE                   SELECT 3";Q1
12240 CLS:ONQ1GOTO6510,12000,100
12400 INPUT"PRESS ENTER TO CONTINUE";Q
12420 GOTO12140
15000 REM PRINTOUT
15010 PRINT"ITINERARY OF "CN$:PRINT
15020 PRINT"ITEM    CITY       FLIGHT       ARR.     DAYS    HOTEL (R
MS)    PRICE"
15040 RETURN
15450               LPRINT" ITINERARY FOR  ";CN$
15500               LPRINT"ITEM      CITY       FLIGHT       ARR.
  DAYS     HOTEL (RMS)      PRICE"
15510 GOTO12090
16000 POKE14312,29:LPRINTXTAB(5)I(X,0)TAB(20)I(X,7)TAB(30)I(X,1)
TAB(41)I(X,2)TAB(49)I(X,3)TAB(POS(0)+2)I(X,4)TAB(63);"    ";I(X,5
)
16020 GOTO12120
```


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The Poop on PEEK

by Steve Saisi

The Color Computer is a great game machine. Killing aliens is my favorite activity, but I get tired of pressing the same key 50 times just to get my space ship to the other side of the screen. If only there were an alternative to the INKEY$ function. . .

Well, there is—PEEK. Richard Zidonis' explanation of PEEK on the Model I (*80 Micro*, June 1980, p. 82) can be applied to the Color Computer.

Use PEEK instead of INKEY$ on your CC to give your tired arms a rest during fast games.

Finding the Right Values to PEEK

The Color Computer's keyboard memory is at decimal locations 338-345. When no keys are pressed, each location equals 255. When a key is pressed, one location will change in value.

To use the PEEK function, first select a control key. Use S for now. Referring to the chart in Table 1, you can see that 341 is to the left of S. Now looking straight up from S you can see 251 at the top. This means when the S is pressed, PEEK(341) = 251. So the English translation of "IF PEEK(341) = 251" is "If the S key is being pressed."

Using PEEK in a Program

Compare Program Listings 1 and 2. Listing 1 uses the INKEY$ command for a drawing program, while Listing 2 uses PEEK. Now run each, using U for up, D for down, L for left, and R for right. Which is easier to draw with?

The Key Box

Color Computer
16K RAM
Extended Color Basic

Listing 1 takes longer to draw things because you must press the same key over and over. With Listing 2 you had to press each key only once for each direction traveled by the dot.

Line 5 of Listing 2 sets X and Y to 10. Line 10 clears the screen to black. Line 20 says, "If U is pressed, take one away from the Y value so the dot goes up." Lines 30, 40, and 50 ask about the D, L, and R keys. Line 60 puts the dot on the screen, and then line 70 completes the loop by sending control back to line 20. This loop gives the user plenty of time to enter a keystroke. ■

Steve Saisi (112 Tophet Road, Carlisle, MA 01741) is a high-school senior.

```
 5 X=10:Y=10
10 CLS 0
20 A$=INKEY$
30 IF A$="U" THEN Y=Y-1
40 IF A$="D" THEN Y=Y+1
50 IF A$="L" THEN X=X-1
60 IF A$="R" THEN X=X+1
70 SET(X,Y,8)
80 GOTO 20
```

Program Listing 1

```
 5 X=10:Y=10
10 CLS 0
20 IF PEEK(343)=251 THEN Y=Y-1
30 IF PEEK(342)=254 THEN Y=Y+1
40 IF PEEK(342)=253 THEN X=X-1
50 IF PEEK(340)=251 THEN X=X+1
60 SET(X,Y,8)
70 GOTO 20
```

Program Listing 2

		(X)						
		254	253	251	247	239	223	191
	338	@	H	P	X	0	8	ENTER
	339	A	I	Q	Y	1	9	CLEAR
	340	B	J	R	Z	2	:	
	341	C	K	S	up	3	;	
(Y)	342	D	L	T	dwn	4	,	
	343	E	M	U	lft	5	-	
	344	F	N	V	rt	6	.	
	345	G	O	W	spc	7	/	

PEEK(Y) = X

Table 1. PEEK Chart

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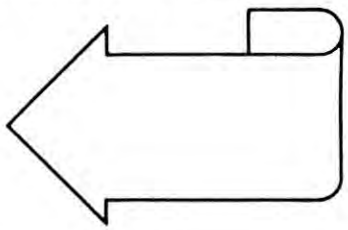

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Compac

by Brian Cameron and Dan Gould

This communications package lets you "talk" to other computers, transferring programs between micros, minis, or even time-sharing mainframes.

Program Listing

```
                01000 ;HEADING COMPAC COMMUNICATION PROG
                01010 ;-------------------------------------------------
                01020 ;  INITIALIZATION ROUTINE
                01030 ;-------------------------------------------------
                01040 ;
E300            01050           ORG   0E300H          ;START OF PROG
0000            01060 DISP      EQU   0000H
401E            01070 VIDRAM    EQU   401EH
0060            01080 DELAY     EQU   0060H
000D            01090 CR        EQU   0DH
0060            01100 SHFTAT    EQU   96              ;SHIFT AT SIGN
00FF            01110 TRUE      EQU   0FFH           ;LOGICAL TRUE
0000            01120 FALSE     EQU   00H            ;LOGICAL FALSE
0000            01130 EOM       EQU   00H
01C9            01140 CLEAR     EQU   01C9H
002B            01150 KBD       EQU   2BH            ;KEYBOARD ROUTINE
0033            01160 DSP       EQU   33H
00EA            01170 CTRL      EQU   0EAH           ;RS232 CONTROL
00EB            01180 DATA      EQU   0EBH           ;RS232 DATA
0080            01190 RXRDY     EQU    080H
0040            01200 TXRDY     EQU    040H
4020            01210 CURPOS    EQU   4020H
402D            01220 DOS       EQU   402DH
E300            01230 COMPAC    EQU   $
E300 31E3EA     01240           LD    SP,STACK       ;INIT STACK POINTER
E303 3E00       01290           LD    A,00H          ;SET TO DEST CUR
E305 3272E6     01300           LD    (CURFLG),A     ;INIT IT
E308 214BEA     01310           LD    HL,LOGO
E30B CDE3EA     01320           CALL  MSGDSP
E30E AF         01330           XOR   A
E30F 324BEA     01340           LD    (LOGO),A       ;GET RID OF MSG
                01350 ;
E312 3E0E       01360           LD    A,0EH          ;TURN CURSOR ON
E314 CD3300     01370           CALL  DSP            ;SHOW IT
E317 CD73E6     01380           CALL  CASEC          ;CHECK FOR CASE UP/LOW
E31A CD8AE5     01390           CALL  DANMSG          ;DISPLAY MSG
E31D 0D         01400           DEFB  CR
E31E 50         01410           DEFM  'PROMPTS (Y/N) ?'
     52 4F 4D 50 54 53 20 28
     59 2F 4E 29 20 3F
E32D 0D         01420           DEFB  CR
E32E 00         01430           DEFB  EOM
                01440 ;
E32F CD90E5     01450           CALL  OURKBD           ;SCAN FOR REPLY
E332 CD3300     01460           CALL  DSP            ;DISPLAY ENTRY
E335 CBAF       01470           RES   5,A            ;INSURE UPPER CASE
E337 FE59       01480           CP    59H            ;IS IT A Y
E339 C2CEE3     01490           JP    NZ,NORMAL       ;NO - DO NORMAL CODE
                01500 ;
E33C            01510 BAGAIN    EQU   $
E33C CD8AE5     01520           CALL  DANMSG          ;DISPLAY MSG
E33F 0D         01530           DEFB  CR
E340 42         01540           DEFM  'BAUD (A) 300 (B) 1200'
     41 55 44 20 28 41 29 20
     33 30 30 20 28 42 29 20
     31 32 30 30
E355 0D         01550           DEFB  CR
E356 00         01560           DEFB  EOM
                01570 ;
E357 CD90E5     01580           CALL  OURKBD           ;SCAN FOR REPLY
```

Listing continues

Compac is a program that lets you pass machine-language programs between your computer and a timesharing system, or between you and other TRS-80 users.

Compac was written for a disk-based system with a full 48K of memory. The operating system we used was NEWDOS80. Compac loads at address E300 hex, but you can move it anywhere you like by reassembling the program.

When you start Compac from the DOS-ready level, the program name will be displayed along with a prompt asking if you have a lowercase mod installed. If the response to the lowercase question is Y, then lowercase conversion will be used. A reminder to flip the switch to upper/lowercase position is displayed for users with a case switch on their system.

You will then be asked if you want prompts. If you hit enter, you will avoid the prompt questions and the terminal mode will be set to 300 baud and half-duplex mode. The prompt questions will ask you for baud-rate setting and duplex setting. The format of the prompts are:

BAUD (A) 300 (B) 1200

DUPLEX (A) HALF (B) FULL

In each case, if enter is pressed, you will receive the default setting for the

The Key Box

Model I
48K RAM
Assembly Language
Editor/Assembler
One Disk Drive

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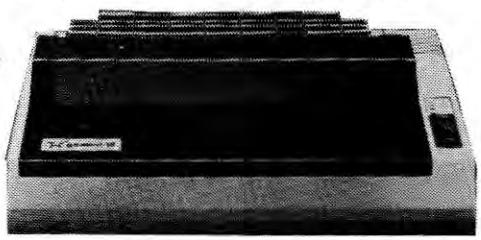

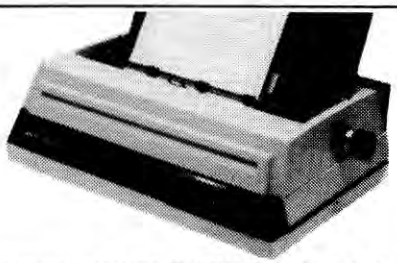

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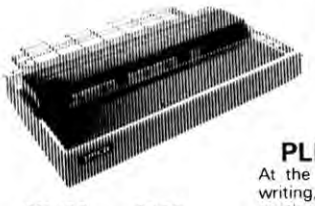

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MX-80 F/T $475
MX-100 $599

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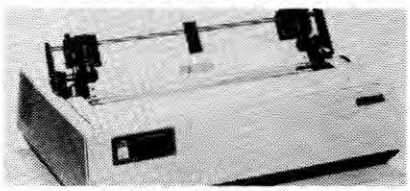

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Listing continued

```
E35A CD3300    01590          CALL  DSP             ;SHOW IT
E35D 21D1E3    01600          LD    HL,BAUD+1       ;SETUP HL TO POINT TO BAUD
E360 FE0D      01610          CP    CR             ;IS IT DEFAULT?
E362 2816      01620          JR    Z,DO300         ;YES - MAKE IT 300
E364 FE2A      01630          CP    2AH             ;IS IT A *
E366 2866      01640          JR    Z,NORMAL
E368 CBAF      01650          RES   5,A             ;INSURE UPPER CASE
E36A FE41      01660          CP    41H             ;A = 300 BAUD?
E36C 280C      01670          JR    Z,DO300         ;YES- MAKE IT 300 BAUD
E36E FE42      01680          CP    42H             ;IS IT B
E370 280D      01690          JR    Z,DO12          ;YES - SET 1200 BAUD
E372 2195E4    01700          LD    HL,RMSG         ;POINT TO MSG
E375 CDE3EA    01710          CALL  MSGDSP           ;DISPLAY MSG
E378 18C2      01720          JR    BAGAIN          ;DISPLAY MSG AGAIN
               01730 ;
E37A           01740 DO300    EQU   $
E37A 3E55      01750          LD    A,055H          ;GET 300 BAUD RATE
E37C 77        01760          LD    (HL),A          ;MODIFY CODE
E37D 1803      01770          JR    DUTOP       ;CONTINUE
E37F           01780 DO12     EQU   $
E37F 3E77      01790          LD    A,077H          ;GET 1200 BAUD RATE
E381 77        01800          LD    (HL),A          ;MODIFY CODE
E382           01810 DUTOP    EQU   $
E382 CD8AE5    01820          CALL  DANMSG           ;DISPLAY MSG
E385 0D        01830          DEFB  CR
E386 44        01840          DEFM  'DUPLEX  (A) HALF  (B) FULL'
     55 50 4C 45 58 20 20 28
     41 29 20 48 41 4C 46 20
     20 28 42 29 20 46 55 4C
     4C
E3A0 0D        01850          DEFB  CR
E3A1 00        01860          DEFB  EOM
               01870 ;
E3A2 CD90E5    01880          CALL  OURKBD            ;CHECK FOR A CHAR
E3A5 CD3300    01890          CALL  DSP             ;SHOW IT
               01900 ;
E3A8 FE0D      01910          CP    CR             ;IS IT DEFAULT?
E3AA 2816      01920          JR    Z,HDUP        ;YES - SET TO HALF
E3AC FE2A      01930          CP    2AH             ;IS IT A *
E3AE 281E      01940          JR    Z,NORMAL      ;YES GO TO NORMAL
E3B0 CBAF      01950          RES   5,A             ;INSURE UPPER CASE
E3B2 FE41      01960          CP    41H             ; A = HALF
E3B4 280C      01970          JR    Z,HDUP          ;YES - SET TO HALF
E3B6 FE42      01980          CP    42H             ; B = FULL
E3B8 280F      01990          JR    Z,FDUP        ;YES - SET TO FULL
               02000 ;
E3BA 2195E4    02010          LD    HL,RMSG         ;GET START OF MSG
E3BD CDE3EA    02020          CALL  MSGDSP           ;DISPLAY MSG
E3C0 18C0      02030          JR    DUTOP         ;ASK AGAIN
               02040 ;
E3C2           02050 HDUP     EQU   $
E3C2 3EFF      02060          LD    A,0FFH          ;GET HALF DUP
E3C4 32A8E4    02070          LD    (DUPLEX),A          ;STORE IT
E3C7 1805      02080          JR    NORMAL          ;JUMP OVER FULL CODE
E3C9           02090 FDUP     EQU   $
E3C9 3E00      02100          LD    A,00H           ;GET FULL DUP
E3CB 32A8E4    02110          LD    (DUPLEX),A          ;STORE IT
E3CE           02120 NORMAL   EQU   $
E3CE D3E8      02130          OUT    (0E8H),A
E3D0 3E55      02140 BAUD     LD     A,055H
E3D2 D3E9      02150          OUT    (0E9H),A
E3D4 3EA5      02160          LD     A,0A5H
E3D6 D3EA      02170          OUT    (0EAH),A
E3D8 CDC901    02180          CALL CLEAR
               02190 ;
E3DB CD8AE5    02200          CALL  DANMSG
E3DE 0D        02210          DEFB  CR
E3DF 50        02220          DEFM  'PRESS CLEAR ? FOR HELP'
     52 45 53 53 20 43 4C 45
     41 52 20 3F 20 46 4F 52
     20 48 45 4C 50
E3F5 0D        02230          DEFB  CR
E3F6 00        02240          DEFB  EOM
               02250 ;
E3F7 3A72E6    02260          LD    A,(CURFLG)
E3FA FEFF      02270          CP    0FFH            ;IS IT NORMAL TYPE?
E3FC 2005      02280          JR    NZ,TOP        ;NO
E3FE 3E0F      02290          LD    A,0FH           ;TURN OFF CURSOR
E400 CD3300    02300          CALL  DSP           ;TURN OFF CURSOR
               02310 ;-----------------------------------------------
               02320 ;       MAINLINE PROGRAM
               02330 ;-----------------------------------------------
               02340 ;
E403           02350 TOP      EQU   $
E403 CD9DE5    02360          CALL  SWAPIT
E406 3A4038    02361          LD     A,(3840H)      ;CHECK BREAK KEY STATUS
E409 E604      02362          AND    04H
E40B 203D      02363          JR     NZ,BREAK
E40D CD2B00    02370          CALL  KBD             ;SCAN KEYBOARD
E410 B7        02380          OR    A               ;ANYTHING?
E411 2858      02390          JR    Z,CKIN        ;NO - CHECK INPUT
E413 FE60      02400          CP    SHFTAT          ;IS IT SHIFT AT SIGN?
E415 200A      02410          JR    NZ,NOLOC      ;NO - NEXT TEST
E417 3AAAE4    02420          LD    A,(CAPLOC)
E41A EEFF      02430          XOR   0FFH            ;REVERSE CAPSLOCK BYTE
E41C 32AAE4    02440          LD    (CAPLOC),A
E41F 184A      02450          JR    CKIN
               02460 ;
E421           02470 NOLOC    EQU   $
E421 FE0A      02480          CP    0AH             ;DOWN ARROW?
E423 2846      02490          JR    Z,CKIN        ;YES IGNORE FOR NOW
E425 214038    02500          LD    HL,3840H        ;GET ROW
E428 CB66      02510          BIT   4,(HL)          ;TEST CONTROL KEY
E42A 2804      02520          JR    Z,NOTCTL      ;NOT DOWN
E42C CBB7      02530          RES   6,A             ;MAKE CONTROL
E42E 182A      02540          JR    NBRK          ; SHOW AND TELL
E430           02550 NOTCTL   EQU   $
E430 CDC2E5    02560          CALL  REVBIT          ;REVERSE BITS
```

Listing continues

option and you will be given the next prompt. If an asterisk is entered, you will be given the default and no other prompts will be made. If A is entered, you will receive the A option, and if you enter B, that option will be set.

Several other commands in the command mode will prompt for information. They work in the same way. The A option is always the default and only enter is required. After the control settings are made, you will be reminded that there is an internal help facility accessed through the use of the clear key followed by a question mark.

Compac operates in two modes: the communications mode and the command mode.

Communications Mode

Communications, or terminal, mode is the normal state of the program when it is talking to the host computer. In this mode the TRS-80 acts like a normal terminal.

The program strips off all hexadecimal 7F characters that it receives from the host computer. Some large computers use these characters to pad or allow delay time. Since they are not part of your text, you remove them rather than display them.

Another character to remove from the line is a hexadecimal 0A—the line-feed character. The host computer usually transmits a carriage return and a line-feed character at the end of each line.

A carriage return returns the cursor to the beginning of the current line, and the following line feed positions the cursor on the next line. Since the TRS-80 does both functions on the receipt of a carriage return, the line feed causes it to double-space. Thus, it is necessary to remove all line feeds received from the host.

Several keys serve a special function. The clear key, for example, gets you into command mode. Shift @ is the caps-lock key, an on/off function. The down arrow is the control key. The right arrow is the tab key. An arrow is displayed if in half duplex when the tab key is pressed. The left arrow is the backspace key. The break key gives a 200ms break on the communications line.

Most host computers can send an alarm to the terminal. On the system we use at work, each time a message is sent from one user to another, a control G is also sent. It is this control G signal that tells the terminal to sound the alarm.

The TRS-80 does not support this control-key function, but by using the sound routine in the May 1980 issue of *80 Microcomputing*, we were able to

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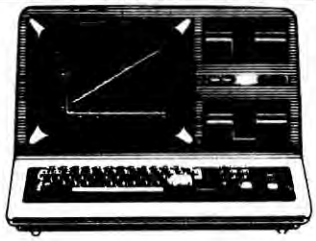

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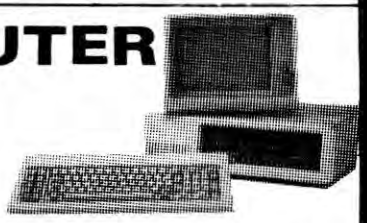

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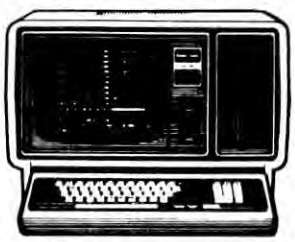

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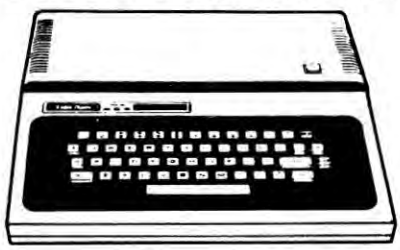

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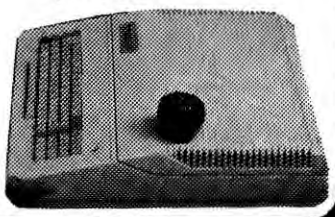

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Listing continued

```
E433 FE1F     02570          CP    1FH          ;IS IT A CLEAR?
E435 CAABE4   02580          JP    Z,CMDHND     ;JUMP TO CMD HANDLER
E438 FE08     02590          CP    08H          ;IS IT A BKSP?
E43A CAEDE5   02600          JP    Z,BKSP       ;YES DO IT
E43D FE09     02610          CP    09H          ;IS IT A TAB
E43F 2007     02620          JR    NZ,NOTAB     ;NO - SKIP TAB CODE
E441 3E5E     02630          LD    A,5EH        ;GET READY TO DISPLAY
E443 CD3300   02640          CALL  DSP          ;SHOW IT
E446 3E09     02650          LD    A,09H        ;RESTORE TAB CHAR
E448          02660 NOTAB    EQU   $
E448 1810     02665          JR    NBRK
E44A          02690 BREAK    EQU   $
E44A 3EA1     02700          LD    A,0A1H       ;GET READY TO BREAK
E44C D3EA     02710          OUT   (0EAH),A     ;SEND BREAK
E44E 014A35   02720          LD    BC,354AH     ;SET WAIT TIME
E451 CD6000   02730          CALL  DELAY        ;GO WAIT
E454 3EA5     02740          LD    A,0A5H       ;TURN OFF BREAK
E456 D3EA     02750          OUT   (0EAH),A     ;SEND RESET
E458 1811     02760          JR    CKIN         ;CHECK FOR INPUT
E45A          02770 NBRK     EQU   $
E45A 08       02780          EX    AF,AF'       ;SAVE AF REGS
E45B 3AA8E4   02790          LD    A,(DUPLEX)   ;GET STATUS OF DUPLEX
E45E FEFF     02800          CP    0FFH         ;IS IT SET TO HALF?
E460 2006     02810          JR    NZ,NODSP     ;NO - DO NOT DISPLAY
E462 08       02820          EX    AF,AF'       ;RESTORE AF REGS
E463 CD3300   02830          CALL  DSP          ;ECHO
E466 1801     02840          JR    DSPIT        ;AVOID NODSP CODE
E468          02850 NODSP    EQU   $
E468 08       02860          EX    AF,AF'       ;RESTORE AF REGS
E469          02870 DSPIT    EQU   $
E469 D3EB     02880          OUT   (DATA),A
              02890 ;
E46B          02900 CKIN     EQU   $
E46B DBEA     02910          IN    A,(CTRL)     ;GET STATUS
E46D E680     02920          AND   RXRDY            ;ANYTHING WAITING?
E46F CA03E4   02930          JP    Z,TOP        ;NO - RETURN
E472 DBEB     02940          IN    A,(DATA)     ;GET BYTE FROM LINE
E474 FE0A     02950          CP    0AH          ;IS IT A LF?
E476 28F3     02960          JR    Z,CKIN        ;YES - IGNORE
E478 FE7F     02970          CP    7FH          ;IS IT A DEL
E47A 28EF     02980          JR    Z,CKIN        ;YES - IGNORE
E47C FE08     02990          CP    08H          ;IS IT BKSP?
E47E 2004     03000          JR    NZ,TBELL     ;NO - CONTINUE
E480 3E18     03010          LD    A,18H        ;CHANGE TO OUR BKSP
E482 180C     03020          JR    NOBELL       ;USE COMMON CODE
E484          03030 TBELL    EQU   $
E484 FE07     03040          CP    07H          ;IS IT A BELL
E486 2008     03050          JR    NZ,NOBELL    ;NO- BYPASS
E488 212003   03060          LD    HL,0320H     ;SET SOUND
E48B CD70E5   03070          CALL  SOUND
E48E 18DB     03080          JR    CKIN       ;TRY AGAIN
              03090 ;
E490          03100 NOBELL   EQU   $
              03110 ;
E490 CD3300   03120          CALL  DSP          ;ECHO
E493 18D6     03130          JR    CKIN       ;TRY AGAIN
              03140 ;
E495 0D       03150 RMSG     DEFB  CR
E496 49       03160          DEFM  'INVALID RESPONSE'
     4E 56 41 4C 49 44 20 52
     45 53 50 4F 4E 53 45
E4A6 0D       03170          DEFB  CR
E4A7 00       03180          DEFB  EOM
              03190 ;
E4A8 FF       03200 DUPLEX   DEFB  0FFH
              03210 ;
E4A9 00       03220 CSAVE    DEFB  00H
              03230 ;
E4AA 00       03240 CAPLOC   DEFB  00H          ;CAPS LOCK INDICATOR
              03250 ;-----------------------------------------
              03260 ;          COMMAND HANDLER                ;
              03270 ;-----------------------------------------
E4AB          03280 CMDHND   EQU   $
E4AB 3E3E     03290          LD    A,3EH        ;SHOW IT IS SPECIAL
E4AD CD3300   03300          CALL  DSP          ;DISPLAY COMMAND
E4B0 CD90E5   03310          CALL  OURKBD       ;SCAN FOR COMMAND
E4B3 FE1F     03320          CP    1FH          ;IS IT A CLEAR
E4B5 2006     03330          JR    NZ,NOTCL     ;NO
E4B7 CDC901   03340          CALL  CLEAR      ;JUST CLEAR SCREEN
E4BA C36BE4   03350          JP    CKIN         ; CONTINUE
E4BD          03360 NOTCL    EQU   $
E4BD CD3300   03370          CALL DSP           ;DISPLAY COMMAND
E4C0 CBAF     03380          RES   5,A          ;INSURE UPPER CASE
E4C2 FE1F     03390          CP    1FH          ;IS IT ?
E4C4 CAECE8   03400          JP    Z,HELP       ;YES
E4C7 FE43     03410          CP    43H
E4C9 CACCE6   03420          JP    Z,CCASE
E4CC FE50     03430          CP    50H
E4CE CA27E8   03440          JP    Z,PCMD
E4D1 FE44     03450          CP    44H
E4D3 CA11E6   03460          JP    Z,DEST
E4D6 FE45     03470          CP    45H
E4D8 284C     03480          JR    Z,CSECK
E4DA FE4E     03490          CP    4EH
E4DC CA1EE6   03500          JP    Z,NDEST
E4DF FE58     03510          CP    58H
E4E1 CAD5E6   03520          JP    Z,LDHEX
E4E4 FE4A     03530          CP    4AH
E4E6 CAA2E7   03540          JP    Z,JUMP
E4E9 FE42     03550          CP    42H
E4EB 2823     03560          JR    Z,GODOS
E4ED FE48     03570          CP    48H
E4EF 2825     03580          JR    Z,LFULL
E4F1 FE46     03590          CP    46H
E4F3 2829     03600          JR    Z,LFULL2
              03610 ;
E4F5          03620 ICMD     EQU $
              03630 ;
E4F5 00       03640          NOP
```

Listing continues

modify it to provide a signal each time a control G was received. You'll need a small amplifier connected to the cassette port to hear the signal.

Command Mode

Command mode is a way of stepping into the communication program and requesting it to do some special task.

In order to exit the terminal mode, the program must be able to recognize a special code that tells it that it is now in command mode. Use the clear key for this purpose.

Each time the clear key is pressed, a > character appears on the screen as a prompt. The next character following the > character is the single-character command to the communication program.

By providing an in-line help facility, you won't have to keep consulting the listing in this magazine. All you have to remember is to type in >?.

"Several keys serve a special function."

If a command is entered that is not in the valid list of commands, an error message will be displayed. So if you type in a >Y, you will be told that it is invalid, and will promptly be returned to the communications program.

>B returns the user to the DOS warm-start address.

>C asks you if a lowercase mod is installed on your system. If you have lowercase capability, the driver will support it. Otherwise, all text will be displayed in uppercase only.

>D is one of three types of cursors supported by Compac. By default you will enter the program with the regular solid underscore familiar to Basic. This is referred to as a destructive cursor. If you decide to restore this cursor type, you can use the >D command (see >N command for other cursor types).

The >E command asks if you want a checksum performed while you are doing a hexadecimal load. This is desirable in some cases: While testing the relocatability of the communications program, we would often zap a byte or two in the text or object deck, rather than reassemble the source. This would throw the checksum off at the end of the line. Without the ability to turn off the error-

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Listing continued

```
E4F6 00         03650           NOP
E4F7 00         03660           NOP
                03670 ;
E4F8 CD8AE5     03680           CALL  DANMSG          ;DISPLAY MSG
E4FB 0D         03690           DEFB  CR
E4FC 49         03700           DEFM  'INVALID COMMAND'
     4E 56 41 4C 49 44 20 43
     4F 4D 4D 41 4E 44
E50B 0D         03710           DEFB CR
E50C 00         03720           DEFB  EOM
                03730 ;
E50D C36BE4     03740           JP    CKIN            ;START AGAIN
                03750 ;
                03760 ;
E510            03770 GODOS     EQU   $
E510 CDC901     03780           CALL  CLEAR
E513 C32D40     03790           JP    DOS             ;RETURN TO DOS
                03800 ;-------------------------------------------------
                03810 ;       LFULL/LFULL2 - ROUTINES TO
                03820 ;                      SET FULL AND HALF
                03830 ;                      DUPLEX FLAG
                03840 ;-------------------------------------------------
                03850 ;
E516            03860 LFULL     EQU   $
E516 3EFF       03870           LD    A,0FFH          ;LOAD HALF
E518 32A8E4     03880           LD    (DUPLEX),A        ;STORE IT
E51B C36BE4     03890           JP    CKIN            ;RETURN
                03900 ;
E51E            03910 LFULL2    EQU   $
E51E 3E00       03920           LD    A,00H           ;LOAD FULL
E520 32A8E4     03930           LD    (DUPLEX),A        ;STORE IT
E523 C36BE4     03940           JP    CKIN            ;RETURN
                03950 ;-------------------------------------------------
                03960 ;    CHECKSUM ON/OFF SWITCH
                03970 ;-------------------------------------------------
                03980 ;
E526            03990 CSECK     EQU   $
E526 CD8AE5     04000           CALL  DANMSG          ;SHOW IT
E529 0D         04010           DEFB  CR
E52A 43         04020           DEFM  'CHECKSUM TEST  (A) ON  (B) OFF'
     48 45 43 4B 53 55 4D 20
     54 45 53 54 20 20 28 41
     29 20 4F 4E 20 20 28 42
     29 20 4F 46 46
E548 0D         04030           DEFB  CR
E549 00         04040           DEFB  EOM
                04050 ;
E54A CD90E5     04060           CALL  OURKBD          ;CHECK KEYS
E54D CBAF       04070           RES   5,A             ;INSURE UPPER CASE
E54F FE41       04080           CP    41H             ;IS IT A (ON)?
E551 280D       04090           JR    Z,CSON        ;YES - SET IT
E553 FE42       04100           CP    42H             ;IS IT B (OFF)?
E555 2811       04110           JR    Z,CSOFF       ;YES - SET OFF
E557 2195E4     04120           LD    HL,RMSG         ;INVALID
E55A CDE3EA     04130           CALL  MSGDSP          ;SHOW IT
E55D C36BE4     04140           JP    CKIN            ;RETURN
                04150 ;
E560            04160 CSON      EQU   $
E560 3EFF       04170           LD    A,0FFH          ;SET ON
E562 32A1E7     04180           LD    (CSEC),A        ;STICK IN
E565 C36BE4     04190           JP    CKIN            ;RETURN
                04200 ;
E568            04210 CSOFF     EQU   $
E568 3E00       04220           LD    A,00H           ;SET OFF
E56A 32A1E7     04230           LD    (CSEC),A        ;STICK IT
E56D C36BE4     04240           JP    CKIN            ;RETURN
                04250 ;-------------------------------------------------
                04260 ;     SOUND GENERATING ROUTINE
                04270 ;-------------------------------------------------
                04280 ;
E570            04290 SOUND     EQU   $
E570 3E01       04300           LD    A,1
E572 0E00       04310           LD    C,0
E574 ED5B3D40   04320           LD    DE,(403DH)
E578            04330 LOADB     EQU   $
E578 45         04340           LD    B,L
E579 2F         04350           CPL
E57A            04360 LOOP      EQU   $
E57A E603       04370           AND   3
E57C B3         04380           OR    E
E57D D3FF       04390           OUT   (0FFH),A
E57F 0D         04400           DEC   C
E580 2804       04410           JR    Z,DNTST
E582 10F6       04420           DJNZ  LOOP
E584 18F2       04430           JR    LOADB
E586            04440 DNTST     EQU   $
E586 25         04450           DEC   H
E587 20F1       04460           JR    NZ,LOOP
E589 C9         04470           RET
                04480 ;-------------------------------------------------
                04490 ; DANMSG - A TRICK DAN SHOWED ME FOR MSG DISPLAY
                04630 ;-------------------------------------------------------
                04640 ;
E58A            04650 DANMSG    EQU   $
E58A E1         04660           POP   HL              ;GET MSG ADDR
E58B CDE3EA     04670           CALL  MSGDSP          ;SHOW IT
E58E E5         04680           PUSH  HL              ;SAVE IT AS OUR RETURN
E58F C9         04690           RET
                04700 ;-------------------------------------------------
                04710 ;      OURKBD -- WAITS FOR A KEY TO BE PRESSED
                04720 ;                AND SWAPS CURSOR WHILE WAITING
                04730 ;-------------------------------------------------
                04740 ;
E590            04750 OURKBD    EQU   $
E590 CD9DE5     04760           CALL  SWAPIT
E593 CD2B00     04770           CALL  KBD             ;GET A CHAR
E596 B7         04780           OR    A               ;ANYTHING?
E597 28F7       04790           JR    Z,OURKBD      ;NO - KEEP LOOKING
```

Listing continues

check feature, we would have received errors.

We have also found that some output files, from cross software, are generated without a valid checksum count at the end of each record. Some programs try to save space and just fill the checksum byte with x'00'. For this reason you want to be able to turn checksum on or off. The checksum check is on when the program is first initialized.

The communications program starts up in half-duplex mode by default. >F refers to the full-duplex setting. If you are running on a full-duplex system, set the program correctly or you will get duplicate characters displayed for each keystroke you make.

>H is the half-duplex setting. Although the default is half duplex, we felt it was necessary to provide the ability to reset this mode in case you were communicating with several host computers, each with possibly half- or full-duplex settings. This will eliminate the need to reload the program. Simply change the transmission mode.

>J will allow you to jump to any address in memory. This requires the hexadecimal address, and a full four characters are necessary before the jump is performed.

If you have several programs in memory, such as a monitor, you do not need to reset your system to get to another program. This command also works well with the >X command. After you have downloaded a program, you can simply jump off to the starting address.

The nondestructive cursor (>N) is of two types. The first type is an underscore character similar to the destructive cursor that Radio Shack provides in Basic. The second type is a lozenge, or the graphics character produced by displaying a hexadecimal 8F. Both these cursor types are flashing cursors.

If you were to backspace over characters just typed, you would be able to see both the cursor character and the character that was on the screen before the backspace was performed. After you have entered the >N command, you will be prompted for the type of cursor you wish to have displayed.

Two commands allow the transfer of files between the host computer and your TRS-80 system. The first is the hex load command, >X. This command will start transferring a file into your system according to the format laid down and referred to as the Intel standard.

The format of the command is >X 'cmd', where 'cmd' is the command you would enter from your terminal if

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SMALL BUSINESS COMPUTERS

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Listing continued

```
E599 CDC2E5   04800          CALL  REVBIT          ;REVERSE BIT
E59C C9       04810          RET
E59D          04820 SWAPIT    EQU  $
E59D 3A72E6   04830          LD    A,(CURFLG)
E5A0 FEFF     04840          CP    0FFH            ;SHOW WE DO SWAP CODE?
E5A2 201D     04850          JR    NZ,SKSWAP     ;NO
              04860 ;
E5A4 D9       04870          EXX                   ;SAVE REGS
E5A5 2A2040   04880          LD    HL,(CURPOS)     ;GET CURSOR POSITION
E5A8 7E       04890          LD    A,(HL)          ;GET CHAR AT CURPOS
E5A9 32A9E4   04900          LD    (CSAVE),A       ;SAVE IT
E5AC 3A71E6   04910          LD    A,(CURCHR)
E5AF 77       04920          LD    (HL),A      ;SHOW IT
E5B0 01FF01   04930          LD    BC,01FFH        ;DELAY LIMIT
E5B3 CD6000   04940          CALL  DELAY           ;DELAY A BIT
E5B6 3AA9E4   04950          LD    A,(CSAVE)         ;LOAD THE CHAR
E5B9 77       04960          LD    (HL),A      ;SHOW IT
E5BA 01FF01   04970          LD    BC,01FFH        ;SET DELAY TIME
E5BD CD6000   04980          CALL  DELAY           ;DELAY A BIT
E5C0 D9       04990          EXX                   ;RESTORE REG
E5C1          05000 SKSWAP    EQU  $
E5C1 C9       05010       RET
              05020 ;-----------------------------------------------
              05030 ;       REVBIT - ROUTINE TO CONVERT
              05040 ;                UPPER CASE TO LOWER
              05050 ;                AND LOWER TO UPPER
              05060 ;-----------------------------------------------
              05070 ;
E5C2          05080 REVBIT   EQU   $
E5C2 FE41     05090          CP    41H             ;CAPS A?
E5C4 FAECE5   05100          JP    M,NOREV
E5C7 FE7B     05110          CP    7BH             ;LOW CASE Z?
E5C9 F2ECE5   05120          JP    P,NOREV
E5CC FE5B     05130          CP    5BH             ;SQUARE BRACKET?
E5CE 281C     05140          JR    Z,NOREV
E5D0 F2D5E5   05150          JP    P,TESTUL
E5D3 1807     05160          JR    REV           ;REVERSE CODE
E5D5          05170 TESTUL   EQU   $
E5D5 FE60     05180          CP    60H             ;ACCENT GRAVE
E5D7 2813     05190          JR    Z,NOREV
E5D9 FAECE5   05200          JP    M,NOREV
E5DC          05210 REV      EQU   $
E5DC EE20     05220          XOR   20H             ;REVERSE CASE
E5DE 08       05230          EX    AF,AF'          ;SAVE CHAR IN A
E5DF 3AAAE4   05240          LD    A,(CAPLOC)      ;GET CAPSLOCK FLAG
E5E2 FEFF     05250          CP    TRUE            ;IS IT SET?
E5E4 2005     05260          JR    NZ,NOLOCK     ;NO DO NOT LOCK
E5E6 08       05270          EX    AF,AF'          ;YES GET OUR CHAR
E5E7 CBAF     05280          RES   5,A             ;CHANGE TO UPPER CASE
E5E9 1801     05290          JR    NOREV
E5EB          05300 NOLOCK   EQU   $
E5EB 08       05310          EX    AF,AF'          ;RESTORE CHAR
E5EC          05320 NOREV    EQU   $
E5EC C9       05330          RET
              05340 ;-------------------------------------------------------

              05350 ;                BACKSPACE CODE
              05360 ;-------------------------------------------------------

              05370 ;
E5ED          05380 BKSP     EQU   $
E5ED 3A72E6   05390          LD    A,(CURFLG)      ;GET CURSOR TYPE
E5F0 FEFF     05400          CP    0FFH            ;IS IT DESTRUCTO?
E5F2 2006     05410          JR    NZ,JOUT       ;YES JUST OUTPUT BKSP
E5F4 3A1F40   05420          LD    A,(CURPOS-1)      ;GET CURSOR POS
E5F7 32A9E4   05430          LD    (CSAVE),A         ;SAVE THE CHAR
E5FA          05440 JOUT     EQU   $
E5FA 3AA8E4   05450          LD    A,(DUPLEX)      ;GET STATUS OF SYSTEM
E5FD FEFF     05460          CP    0FFH            ;SET TO HALF DUP?
E5FF 2804     05470          JR    Z,JOUT2       ;YES
E601 3E7F     05480          LD    A,07FH          ;LET PDP DEL IT
E603 1807     05490          JR    JOUT3         ;SEND IT
E605          05500 JOUT2    EQU   $
E605 3E18     05510        LD    A,18H         ;RESTORE THE BKSP CHAR
E607 CD3300   05520          CALL DSP              ;DO THE BKSP
E60A 3E08     05530          LD    A,08H           ;TELL CMS TO DEL
E60C          05540 JOUT3    EQU   $
E60C D3EB     05550          OUT   (DATA),A        ;SEND IT
E60E C36BE4   05560          JP    CKIN            ;CHECK INPUT
              05940 ;-----------------------------------------------
              05950 ;       DEST/NDEST - ROUTINES TO GIVE USER
              05960 ;                    A NONDESTRUCTIVE OR
              05970 ;                    DESTRUCTIVE CURSOR
              05980 ;-----------------------------------------------
              05990 ;
E611          06000 DEST     EQU   $
E611 3E00     06010          LD    A,00H           ;SET TO DEST CURSOR
E613 3272E6   06020          LD    (CURFLG),A          ;STORE IT
E616 3E0E     06030          LD    A,0EH           ;TURN CURSOR ON
E618 CD3300   06040          CALL  DSP             ;TURN CURSOR ON
E61B C36BE4   06050          JP    CKIN             ;RETURN
              06060 ;
E61E          06070 NDEST    EQU   $
E61E 3EFF     06080          LD    A,0FFH          ;SET NON-DESTRUCTIVE
E620 3272E6   06090          LD    (CURFLG),A          ;STUFF IT
E623 3E0F     06100          LD    A,0FH           ;TURN CURSOR OFF
E625 CD3300   06110          CALL  DSP             ;TURN CURSOR OFF PART2
E628          06120 CMAGN    EQU   $
E628 CD8AE5   06130          CALL  DANMSG           ;SHOW IT
E62B 0D       06140          DEFB  CR
E62C 43       06150          DEFM  'CHOOSE CURSOR (A) '
     48 4F 4F 53 45 20 43 55
     52 53 4F 52 20 28 41 29
     20
E63E 5F       06160          DEFB  5FH
E63F 20       06170          DEFM  '  (B) '
     20 28 42 29 20
E645 8F       06180          DEFB  8FH
```

Listing continues

you wanted to display the file on the screen. You must start the command with a single quote. The ending quote is not necessary, since pressing the enter key will terminate the line.

At this point the file will be sent down the line to your TRS-80. Instead of seeing the file displayed on the screen, you will see the flashing stars in the upper right corner. A series of colons should be displayed after the command line. Each record of the file starts with a colon as you will see when we explain the format.

If you receive a checksum error, you will be returned immediately to terminal mode and the rest of the file will be displayed on the screen. This can be terminated in the same way as you would stop a regular file that was being typed on the screen.

"You must start the command with a single quote."

>P, the Intel punch command, works in the same way as the >X command, except it will take the memory range you specify in the start and end address prompts and send the file to your host computer, also in Intel format. The start and end addresses must be the hexadecimal address, not decimal.

Before you enter the >P command, you must first prepare your host computer to receive the file. Normally this is done by entering the input mode of an on-line editor. When the file is transmitted to the host, it will appear as though you are quickly typing in the lines of text. Each line is terminated with a carriage return to let the host go to a new line.

A delay has been added after every CR to allow the host to put up its input prompt. The stars will flash in the upper right corner of the screen while the file is being transmitted. The colon character will also be displayed as described in the >X command.

Since we are using the clear key to get into Compac command mode, you must press it again to clear the screen.

User Commands

Although we have provided you with several commands, you can add your own; simply replace the NOP instructions at location E4F5, E4F6 and E4F7

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```
E646 0D        06190           DEFB  CR
E647 00        06200           DEFB  EOM
               06210 ;
E648 CD90E5    06220           CALL  OURKBD          ;GET CHAR
E64B FE0D      06230           CP    CR             ;IS IT CR?
E64D 2812      06240           JR    Z,ULINE        ;YES - DEFAULT
E64F CBAF      06250           RES   5,A             ;INSURE UPPER CASE
E651 FE41      06260           CP    41H            ;IS IT AN A
E653 280C      06270           JR    Z,ULINE        ;YES
E655 FE42      06280           CP    42H              ;IS IT A B
E657 2810      06290           JR    Z,BOX          ;YES
E659 2195E4    06300           LD    HL,RMSG          ;INVALID
E65C CDE3EA    06310           CALL  MSGDSP           ;SHOW IT
E65F 18C7      06320           JR    CMAGN          ;TRY AGAIN
               06330 ;
E661           06340 ULINE     EQU   $
E661 3E5F      06350           LD    A,5FH
E663 3271E6    06360           LD    (CURCHR),A
E666 C36BE4    06370           JP    CKIN
               06380 ;
E669           06390 BOX       EQU   $
E669 3E8F      06400           LD    A,8FH
E66B 3271E6    06410           LD    (CURCHR),A
E66E C36BE4    06420           JP    CKIN
               06430 ;
E671 5F        06440 CURCHR    DEFB  5FH
E672 00        06450 CURFLG    DEFB  00H
               06460 ;-----------------------------------------
               06470 ;              CASE CODE                  *
               06480 ;-----------------------------------------
               06490 ;
E673           06500 CASEC     EQU   $
E673 CD8AE5    06510           CALL  DANMSG           ;DISPLAY IT
E676 0D        06520           DEFB  CR
E677 4C        06530           DEFM  'LOWER CASE INSTALLED (Y/N) ?'
     4F 57 45 52 20 43 41 53
     45 20 49 4E 53 54 41 4C
     4C 45 44 20 28 59 2F 4E
     29 20 3F
E693 00        06540           DEFB  EOM
               06550 ;
E694 CD90E5    06560           CALL  OURKBD             ;LOOK FOR INPUT
E697 08        06570           EX    AF,AF'           ;SWAP REGS
E698 CDC901    06580           CALL  CLEAR
E69B 08        06590           EX    AF,AF'           ;RESTORE REGS
E69C CBAF      06600           RES   5,A              ;INSURE UPPER CASE
E69E FE59      06610           CP    59H              ;IS IT A Y
E6A0 2023      06620           JR    NZ,SKIPVD      ;NO DO NORMAL CODE
               06630 ;
E6A2 212DEA    06640          LD     HL,VID+DISP
E6A5 221E40    06650          LD     (VIDRAM),HL
E6A8 CD8AE5    06660           CALL  DANMSG           ;DISPLAY IT
E6AB 0D        06670           DEFB  CR
E6AC 46        06680           DEFM  'FLIP SWITCH TO UP/'
     4C 49 50 20 53 57 49 54
     43 48 20 54 4F 20 55 50
     2F
E6BE 6C        06690           DEFB  6CH
E6BF 6F        06700           DEFB  6FH
E6C0 77        06710           DEFB  77H
E6C1 0D        06720           DEFB  CR
E6C2 00        06730           DEFB  EOM
               06740 ;
E6C3 1806      06750           JR    CTCUP
E6C5           06760 SKIPVD    EQU   $
E6C5 215804    06770           LD    HL,0458H
E6C8 221E40    06780           LD    (VIDRAM),HL
E6CB           06790 CTCUP     EQU   $
E6CB C9        06800           RET
               06810 ;
               06820 ;
E6CC           06830 CCASE     EQU   $
E6CC CD73E6    06840           CALL  CASEC            ;SET THE CASE
E6CF C36BE4    06850           JP    CKIN             ;RETURN
               06860 ;-----------------------------------------------
               06870 ;              LOAD HEX CODE COMMAND             ;
               06880 ;-----------------------------------------------
               06890 ;
E6D2           06900 PRELDX    EQU   $
E6D2 CD3300    06910           CALL  DSP              ;SHOW IT
E6D5           06920 LDHEX     EQU   $
E6D5 CD90E5    06930           CALL  OURKBD             ;CHECK KEYS
E6D8 FE20      06940           CP    20H              ;IS IT A BLANK?
E6DA 28F6      06950           JR    Z,PRELDX       ;YES - IGNORE
E6DC FE01      06960           CP    1                ;IS IT A BREAK?
E6DE CA4AE4    06970           JP    Z,BREAK          ;YES - TERMINATE
E6E1 FE27      06980           CP    27H              ;SINGLE QUOTES?
E6E3 2855      06990           JR    Z,PREFN          ;YES - DO PART2
E6E5 CD8AE5    07000           CALL  DANMSG
E6E8 0D        07010           DEFB  CR
E6E9 46        07020           DEFM  'FORMAT IS  >X '
     4F 52 4D 41 54 20 49 53
     20 20 3E 58 20
E6F7 27        07030           DEFB  27H
E6F8 43        07040           DEFM  'CMD'
     4D 44
E6FB 27        07050           DEFB  27H
E6FC 0D        07060           DEFB  CR
E6FD 57        07070           DEFM  'WHERE CMD IS HOST COMMAND TO LIST FILE'
     48 45 52 45 20 43 4D 44
     20 49 53 20 48 4F 53 54
     20 43 4F 4D 4D 41 4E 44
     20 54 4F 20 4C 49 53 54
     20 46 49 4C 45
E723 0D        07080           DEFB  CR
E724 00        07090           DEFB  EOM
               07100 ;
E725 C36BE4    07110           JP    CKIN
```

Listing continues

with a call to your command handler routine. It should be done in such a way that if your command is not found, it will do a return. The program will handle the error message and properly return to terminal mode.

Description of Intel Format

Cross software are programs that run on one computer, but produce output that is recognized on a completely different computer. Cross software exists for many types of microcomputers. There are some general-purpose cross assemblers available that allow the user to define the type of micro for which he wishes to use the code.

Cross software can be in the form of a cross assembler, cross compiler, simulator, or even a cross disassembler. Each one of these programs allows the user to create jobs to run on a micro using a powerful host editor, then test the program for errors. It simulates the running of the program even before it is ever loaded into the micro system.

This does not require expensive hardware on your micro system. The important thing is that files produced by this cross software are in a format that can be read by the next step in the process.

For example, the output from the cross assembler is in a format that can be read by the simulator. In order to load the program into your micro system, you must know what format it is in. This is why standards are set. Most Intel 8080 and Zilog Z80 cross software produce object files in a standard fashion.

The standard format used has position 1 containing a colon. This shows the start of each record. Positions 2 and 3 contain the number of hexadecimal bytes of data there are in the record. When punching a file with the >P command, the program will send hexadecimal 1E data bytes.

Positions 4 and 5 contain the most-significant byte of the start address of the data.

Positions 6 and 7 contain the least-significant byte of the start address of the data.

Positions 8 and 9 contain an ASCII zero. This is the record-type byte. We will only be concerned with the record type of zero.

Position 10 and up contain the data for the length specified in positions 2 and 3.

The last two positions contains a checksum of all bytes except the delimiter, carriage return, and line feed. Each record is followed by a carriage-return line feed. ■

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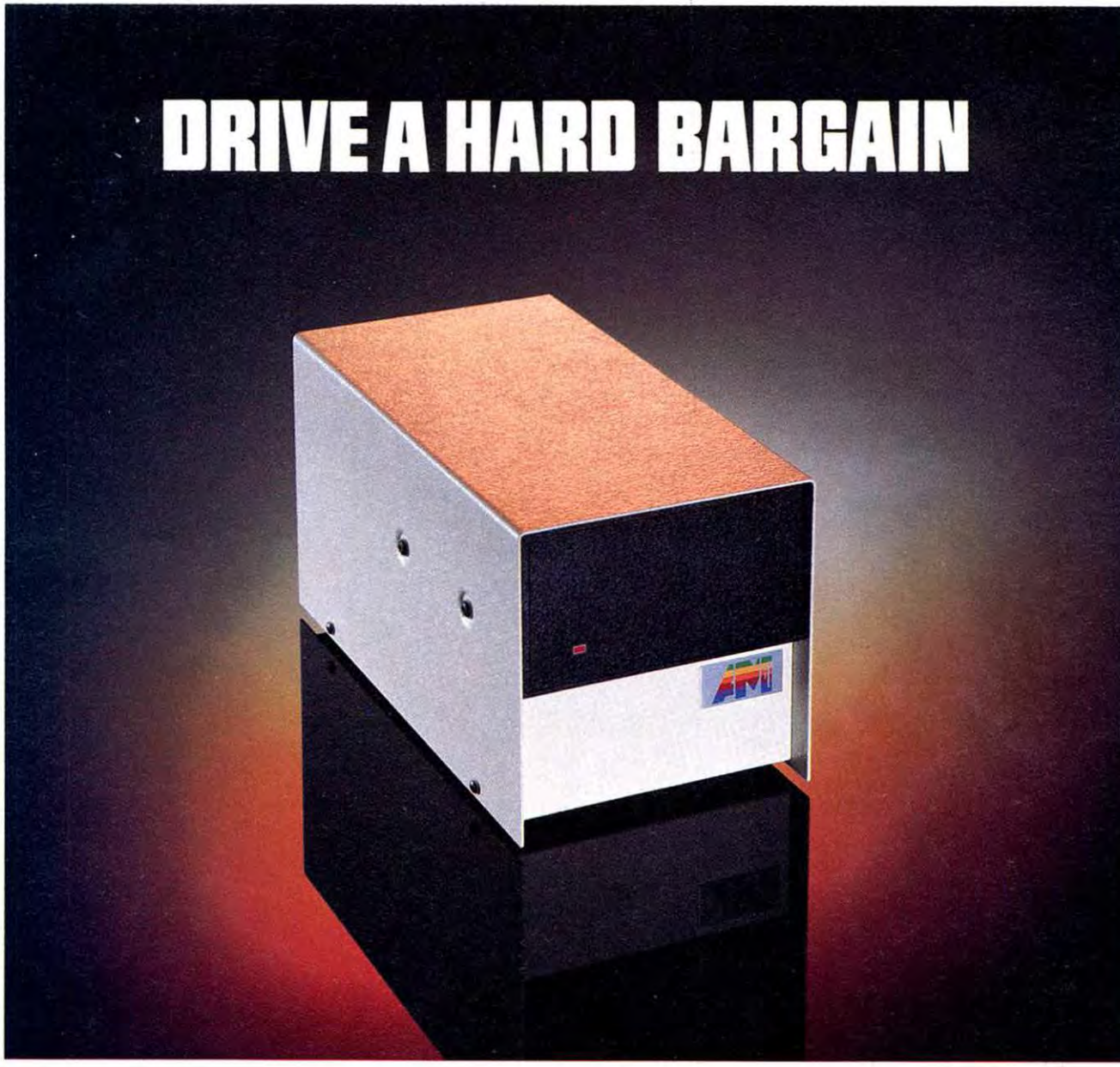

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```
                07120 ;
E728            07130 FNFT      EQU   $
E728 CD90E5     07140           CALL  OURKBD          ;GET KEYBOARD INPUT
E72B FE01       07150           CP    1               ;IS IT A BREAK?
E72D CA4AE4     07160           JP    Z,BREAK         ;YES - CANCEL LINE
E730 FE27       07170           CP    27H             ;IS IT ENDING  QUOTE?
E732 2806       07180           JR    Z,PREFN
E734 FE0D       07190           CP    CR             ;IS IT A CR
E736 2807       07200           JR    Z,FNEND        ;YES - END UP
E738 D3EB       07210           OUT   (DATA),A        ;SEND IT
E73A            07220 PREFN     EQU   $
E73A CD3300     07230           CALL  DSP             ;SHOW IT
E73D 18E9       07240           JR    FNFT           ;GO GET MORE
E73F D3EB       07250 FNEND:    OUT   (DATA),A        ;SEND
                07260 ;
E741 CD3300     07270           CALL  DSP             ;SHOW
E744 DBEA       07280 WAIT5:    IN    A,(CTRL)        ;GET STATUS
E746 E680       07290           AND   RXRDY               ;ANYTHING WAITING
E748 28FA       07300           JR    Z,WAIT5         ;LOOK AGAIN
E74A DBEB       07310           IN    A,(DATA)        ;GET A BYTE
E74C FE3B       07320           CP    3BH             ;IS IT A SEMI
E74E CA6BE4     07330           JP    Z,CKIN           ;YES - ERROR
E751 FE3A       07340           CP    3AH             ;IS IT A COLIN
E753 20EF       07350           JR    NZ,WAIT5       ;NO - LOOK FOR MORE
E755 CD3300     07360           CALL  DSP             ;SHOW IT
E758 3E2A       07370           LD    A,'*'
E75A 323E3C     07380           LD    (3C3EH),A
E75D CD2C02     07390           CALL  22CH
                07400 ;LOOK FOR NUMBER OF CHAR TO RECEIVE
E760 CD09EA     07410           CALL  GETNUM
E763 47         07420           LD    B,A             ;SAVE AS COUNTER
E764 CD00EA     07430           CALL  GETHL           ;GET STARTING ADDR
E767 B0         07440           OR    B               ;SET FLAG ...
E768 2003       07450           JR    NZ,NOEND
E76A C36BE4     07460           JP    CKIN             ;DONE LOADING
E76D CD09EA     07470 NOEND     CALL  GETNUM      ;SHOULD BE ZERO
E770 80         07480           ADD   A,B             ;FORM ...
E771 85         07490           ADD   A,L             ;CHECKSUM ...
E772 84         07500           ADD   A,H             ;AND SAVE IT ...
E773 4F         07510           LD    C,A             ;IN THE C REGISTER
E774            07520 LDLP      EQU   $
E774 CD09EA     07530           CALL  GETNUM
E777 77         07540           LD    (HL),A
E778 23         07550           INC   HL
E779 81         07560           ADD   A,C
E77A 4F         07570           LD    C,A             ;CHECKSUM
E77B 10F7       07580           DJNZ  LDLP           ;KEEP LOOKING
E77D CD09EA     07590           CALL  GETNUM          ;SHOULD BE CHECKSUM
E780 81         07600           ADD   A,C
E781 28C1       07610           JR    Z,WAIT5         ;CHECKSUM OK
E783 3AA1E7     07620           LD    A,(CSEC)        ;GET THE CSE CHECK
E786 FEFF       07630           CP    0FFH            ;IS IT ON?
E788 20BA       07640           JR    NZ,WAIT5        ;NO CONTINUE LOADING
E78A CD8AE5     07650           CALL  DANMSG           ;DISPLAY MSG
E78D 0D         07660           DEFB  CR
E78E 43         07670           DEFM  'CHECKSUM ERROR'
     48 45 43 4B 53 55 4D 20
     45 52 52 4F 52
E79C 0D         07680           DEFB  CR
E79D 00         07690           DEFB  EOM
                07700 ;
E79E C36BE4     07710           JP    CKIN
                07720 ;
E7A1 FF         07730 CSEC      DEFB  0FFH
                07740 ;-------------------------------------------------
                07750 ;                 JUMP COMMAND                    ;
                07760 ;-------------------------------------------------
E7A2            07770 JUMP      EQU   $
E7A2 CD1EE8     07780           CALL  GETADR
E7A5 CD90E5     07790           CALL  OURKBD              ;GET CHAR
E7A8 FE0D       07800           CP    CR             ;WAS IT CR?
E7AA 203D       07810           JR    NZ,CJMP        ;NO - TERMINATED WRONG!
E7AC E9         07820           JP    (HL)            ;JUMP OFF TO ADDR
                07830 ;
E7AD            07840 GETJNM    EQU   $
E7AD C5         07850           PUSH  BC              ;SAVE REGS
E7AE CDBCE7     07860           CALL  GETJDG          ;GET FIRST DIGIT
E7B1 87         07870           ADD   A,A             ;SHIFT OVER FOUR
E7B2 87         07880           ADD   A,A
E7B3 87         07890           ADD   A,A
E7B4 87         07900           ADD   A,A
E7B5 47         07910           LD    B,A             ;SAVE IT FOR ADD
E7B6 CDBCE7     07920           CALL  GETJDG          ;GET SECOND DIGIT
E7B9 80         07930           ADD   A,B             ;PUT TOGETHER
E7BA C1         07940           POP   BC              ;RESTORE REGS
E7BB C9         07950           RET
                07960 ;
E7BC            07970 GETJDG    EQU $
E7BC CD90E5     07980           CALL  OURKBD          ;GET BYTE FROM KEYBOARD
E7BF FE01       07990           CP    1               ;IS IT BREAK?
E7C1 2826       08000           JR    Z,CJMP         ;YES GIVE MSG AND RETURN
E7C3 CD3300     08010           CALL  DSP
E7C6 FD2104E8   08020           LD    IY,CCK          ;POINT TO START OF TABLE
E7CA FDBE00     08030 TNEXTC    CP    (IY+0)         ;SAME?
E7CD 280F       08040           JR    Z,FOUNDC       ;YES
E7CF 08         08050           EX    AF,AF'          ;SWAP REGS
E7D0 FD7E00     08060           LD    A,(IY+0)        ;LOAD BYTE TO TEST
E7D3 FEFF       08070           CP    0FFH            ;END?
E7D5 280F       08080           JR    Z,ENDTAB       ;YES RETURN
E7D7 08         08090           EX    AF,AF'          ;RESTORE REGS
E7D8 FD23       08100           INC   IY              ;ADD ...
E7DA FD23       08110           INC   IY              ;... TWO
E7DC 18EC       08120           JR    TNEXTC          ;TRY AGAIN
E7DE            08130 FOUNDC    EQU   $
E7DE FD23       08140           INC   IY              ;POINT TO CHAR
E7E0 FD7E00     08150           LD    A,(IY+0)          ;LOAD NEW CHAR
E7E3            08160 DIGIT     EQU   $
E7E3 E60F       08170           AND   0FH             ;STRIP
```

Listing continues

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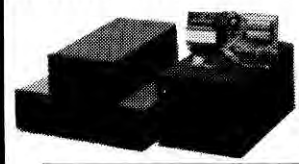

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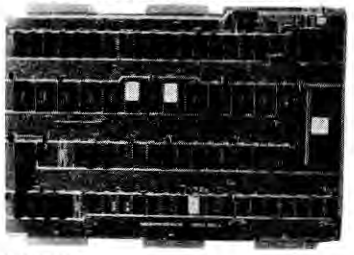

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Listing continued

```
E7E5 C9          08180          RET
                 08190 ;
E7E6             08200 ENDTAB   EQU   $
E7E6 08          08210          EX    AF,AF'          ;RESTORE REGS
E7E7 18FA        08220          JR    DIGIT
                 08230 ;
E7E9             08240 CJMP     EQU   $
E7E9 CD8AE5      08250          CALL  DANMSG
E7EC 0D          08260          DEFB  CR
E7ED 43          08270          DEFM  'COMMAND TERMINATED'
     4F 4D 4D 41 4E 44 20 54
     45 52 4D 49 4E 41 54 45
     44
E7FF 0D          08280          DEFB  CR
E800 00          08290          DEFB  EOM
                 08300 ;
E801 C36BE4      08310          JP    CKIN            ;RETURN TO NORM CODE
                 08320 ;
E804 410A        08330 CCK      DEFW  0A41H
E806 420B        08340          DEFW  0B42H
E808 430C        08350          DEFW  0C43H
E80A 440D        08360          DEFW  0D44H
E80C 450E        08370          DEFW  0E45H
E80E 460F        08380          DEFW  0F46H
E810 610A        08390          DEFW  0A61H
E812 620B        08400          DEFW  0B62H
E814 630C        08410          DEFW  0C63H
E816 640D        08420          DEFW  0D64H
E818 650E        08430          DEFW  0E65H
E81A 660F        08440          DEFW  0F66H
E81C FFFF        08450          DEFW  0FFFFH
E81E             08460 GETADR   EQU   $
E81E CDADE7      08470          CALL  GETJNM          ;GET 1ST PART OF ADDR
E821 67          08480          LD    H,A             ;SAVE IT IN HIGH
E822 CDADE7      08490          CALL  GETJNM          ;GET LAST PART OF ADDR
E825 6F          08500          LD    L,A             ;SAVE IT IN LOW
E826 C9          08510          RET
                 08520 ;-----------------------------------------------
                 08530 ;              PUNCH HEX COMMAND
                 08540 ;-----------------------------------------------
E827             08550 PCMD     EQU   $
E827 CD8AE5      08560          CALL  DANMSG
E82A 0D          08570          DEFB  CR
E82B 53          08580          DEFM  'START ADDRESS'
     54 41 52 54 20 41 44 44
     52 45 53 53
E838 0D          08590          DEFB  CR
E839 00          08600          DEFB  EOM
                 08610 ;
E83A CD1EE8      08620          CALL  GETADR          ;GET FIRST ADDR
E83D E5          08630          PUSH  HL              ;STORE IT
E83E CD8AE5      08640          CALL  DANMSG
E841 0D          08650          DEFB  CR
E842 45          08660          DEFM  'END ADDRESS'
     4E 44 20 41 44 44 52 45
     53 53
E84D 0D          08670          DEFB  CR
E84E 00          08680          DEFB  EOM
                 08690 ;
E84F CD1EE8      08700          CALL  GETADR          ;GET SECOND
E852 D1          08710          POP   DE              ;RESTORE START ADDR
                 08720 ;
E853             08730 PUNLIN   EQU   $
E853 E5          08740          PUSH  HL              ;SAVE END ADDR
E854 061E        08750          LD    B,30            ;TOTAL MAX LENGTH
E856 A7          08760          AND   A               ;CLEAR CARRY
E857 ED52        08770          SBC   HL,DE           ;COMPARE START AND END
E859 DAA7E8      08780          JP    C,ENDPUN        ;DONE
E85C 7C          08790          LD    A,H             ;HOW DIFFERENT?
E85D A7          08800          AND A
E85E 2006        08810          JR    NZ,PUNCHL     ;LOTS
E860 7D          08820          LD    A,L
E861 B8          08830          CP    B               ;MORE THAN 30?
E862 3002        08840          JR    NC,PUNCHL     ;YES
E864 47          08850          LD    B,A             ;NO
E865 04          08860          INC   B
                 08870 ;
E866             08880 PUNCHL   EQU   $
E866 EB          08890          EX    DE,HL           ;PUT START ADDR IN DE
E867 3E2A        08900          LD    A,'*'
E869 323E3C      08910          LD    (3C3EH),A
E86C CD2C02      08920          CALL  22CH
E86F 3E3A        08930          LD    A,':'
E871 CD3300      08940          CALL  DSP
E874 CDE1E8      08950          CALL  POUT
E877 78          08960          LD    A,B             ;NUMBER OF BYTES
E878 CDC8E8      08970          CALL  PUTA
E87B 84          08980          ADD   A,H
E87C 85          08990          ADD   A,L             ;FORM CHECKSUM
E87D 4F          09000          LD    C,A
E87E 7C          09010          LD    A,H             ;PUT...
E87F CDC8E8      09020          CALL  PUTA            ;OUT...
E882 7D          09030          LD    A,L             ;THE...
E883 CDC8E8      09040          CALL  PUTA            ;ADDRESS
E886 97          09050          SUB   A               ;CLEAR DATA TYPE RECORD
E887 CDC8E8      09060          CALL  PUTA
                 09070 ;
E88A             09080 PUNLP    EQU   $
E88A 7E          09090          LD    A,(HL)
E88B CDC8E8      09100          CALL  PUTA
E88E 81          09110          ADD   A,C
E88F 4F          09120          LD    C,A
E890 23          09130          INC   HL
E891 10F7        09140          DJNZ  PUNLP
E893 ED44        09150          NEG
E895 CDC8E8      09160          CALL  PUTA
E898 3E0D        09170          LD    A,CR            ;CR
E89A CDE1E8      09180          CALL  POUT
```

Listing continues

Listing continued

```
E89D 01FFFF    09190           LD    BC,0FFFFH       ;DELAY A BIT ...
E8A0 CD6000    09200           CALL  DELAY           ;SO LINE CAN RECOVER
E8A3 D1        09210           POP   DE              ;GET BACK END ADDR
E8A4 EB        09220           EX    DE,HL
E8A5 18AC      09230           JR    PUNLIN
               09240 ;
E8A7           09250 ENDPUN    EQU   $
E8A7 E1        09260           POP   HL
E8A8 3E3A      09270           LD    A,':'
E8AA CDE1E8    09280           CALL  POUT
E8AD 0606      09290           LD    B,6             ;SET THE COUNT
E8AF           09300 SNDSIX    EQU   $
E8AF 3E30      09310           LD    A,'0'
E8B1 CDE1E8    09320           CALL  POUT
E8B4 10F9      09330           DJNZ  SNDSIX
E8B6 3E0D      09340           LD    A,CR            ;CR
E8B8 CDE1E8    09350           CALL POUT
E8BB CD8AE5    09360           CALL  DANMSG
E8BE 0D        09370           DEFB  CR
E8BF 44        09380           DEFM  'DONE'
     4F 4E 45
E8C3 0D        09390           DEFB  CR
E8C4 00        09400           DEFB  EOM
               09410 ;
E8C5 C36BE4    09420           JP    CKIN
               09430 ;
E8C8           09440 PUTA      EQU   $
E8C8 F5        09450           PUSH  AF
E8C9 0F        09460           RRCA
E8CA 0F        09470           RRCA
E8CB 0F        09480           RRCA
E8CC 0F        09490           RRCA
E8CD CDD1E8    09500           CALL  INVCON
E8D0 F1        09510           POP   AF
E8D1           09520 INVCON    EQU   $
E8D1 F5        09530           PUSH  AF
E8D2 E60F      09540           AND   0FH
E8D4 FE0A      09550           CP    0AH             ;CHAR OR NUMBER?
E8D6 3802      09560           JR    C,NOADD
E8D8 C607      09570           ADD   A,7
E8DA           09580 NOADD     EQU   $
E8DA C630      09590           ADD   A,30H
E8DC CDE1E8    09600           CALL  POUT
E8DF F1        09610           POP   AF
E8E0 C9        09620           RET
               09630 ;
E8E1           09640 POUT      EQU   $
E8E1 08        09650           EX    AF,AF'
E8E2           09660 POUT2     EQU   $
E8E2 DBEA      09670           IN    A,(CTRL)        ;GET STATUS
E8E4 E640      09680           AND    TXRDY
E8E6 28FA      09690           JR    Z,POUT2         ;NO
E8E8 08        09700           EX    AF,AF'          ;RESTORE A REG
E8E9 D3EB      09710           OUT   (DATA),A
E8EB C9        09720           RET
               09730 ;-----------------------------------------------
               09740 ;       HELP - INLINE DOCUMENTATION FOR USER
               09750 ;-----------------------------------------------
               09760 ;
E8EC           09770 HELP      EQU   $
E8EC CDC901    09780           CALL  CLEAR
E8EF CD8AE5    09790           CALL  DANMSG          ;GO DO IT
E8F2 20        09800           DEFM  '  >B - RETURN TO DOS'
     20 3E 42 20 2D 20 52 45
     54 55 52 4E 20 54 4F 20
     44 4F 53
E906 0D        09810           DEFB  CR
E907 20        09820           DEFM  '  >C - CASE UP/LOW'
     20 3E 43 20 2D 20 43 41
     53 45 20 55 50 2F 4C 4F
     57
E919 0D        09830           DEFB  CR
E91A 20        09840           DEFM  '  >D - DESTRUCTIVE CURSOR'
     20 3E 44 20 2D 20 44 45
     53 54 52 55 43 54 49 56
     45 20 43 55 52 53 4F 52

E933 0D        09850           DEFB  CR
E934 20        09860           DEFM  '  >E - ERROR CHECK ON CHECKSUM'
     20 3E 45 20 2D 20 45 52
     52 4F 52 20 43 48 45 43
     4B 20 4F 4E 20 43 48 45
     43 4B 53 55 4D
E952 0D        09870           DEFB  CR
E953 20        09880           DEFM  '  >F - FULL DUPLEX'
     20 3E 46 20 2D 20 46 55
     4C 4C 20 44 55 50 4C 45
     58
E965 0D        09890           DEFB  CR
E966 20        09900           DEFM  '  >H - HALF DUPLEX'
     20 3E 48 20 2D 20 48 41
     4C 46 20 44 55 50 4C 45
     58
E978 0D        09910           DEFB  CR
E979 00        09920           DEFB  EOM
E97A CD8AE5    09930           CALL  DANMSG          ;SHOW PART 2
E97D 20        09940           DEFM  '  >J - JUMP TO AN ADDRESS '
     20 3E 4A 20 2D 20 4A 55
     4D 50 20 54 4F 20 41 4E
     20 41 44 44 52 45 53 53
     20
E997 0D        09950           DEFB  CR
E998 20        09960           DEFM  '  >N - NON DESTRUCTIVE CURSOR'
     20 3E 4E 20 2D 20 4E 4F
     4E 20 44 45 53 54 52 55
     43 54 49 56 45 20 43 55
     52 53 4F 52
E9B5 0D        09970           DEFB  CR
```

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E9B6 20          09980            DEFM  '  >P - INTEL HEX PUNCH'
     20 3E 50 20 2D 20 49 4E
     54 45 4C 20 48 45 58 20
     50 55 4E 43 48
E9CC 0D          09990            DEFB  CR
E9CD 20          10000            DEFM  '  >X - INTEL HEX LOAD'
     20 3E 58 20 2D 20 49 4E
     54 45 4C 20 48 45 58 20
     4C 4F 41 44
E9E2 0D          10010            DEFB  CR
E9E3 20          10020            DEFM  '  >CLEAR - CLEARS SCREEN'
     20 3E 43 4C 45 41 52 20
     2D 20 43 4C 45 41 52 53
     20 53 43 52 45 45 4E
E9FB 0D          10030            DEFB  CR
E9FC 00          10040            DEFB  EOM
E9FD C36BE4      10050            JP    CKIN            ;RETURN
EA00 CD09EA      10060 GETHL:     CALL  GETNUM
EA03 67          10070            LD    H,A
EA04 CD09EA      10080            CALL  GETNUM
EA07 6F          10090            LD    L,A
EA08 C9          10100            RET
                 10110 ;
EA09 C5          10120 GETNUM:    PUSH  BC
EA0A CD18EA      10130            CALL  GETDG
EA0D 87          10140            ADD   A,A
EA0E 87          10150            ADD   A,A
EA0F 87          10160            ADD   A,A
EA10 87          10170            ADD   A,A
EA11 47          10180            LD    B,A
EA12 CD18EA      10190            CALL  GETDG
EA15 80          10200            ADD   A,B
EA16 C1          10210            POP   BC
EA17 C9          10220            RET
                 10230 ;
EA18 DBEA        10240 GETDG:     IN    A,(CTRL)        ;CHECK STATUS
EA1A E680        10250            AND    RXRDY
EA1C 28FA        10260            JR    Z,GETDG       ;YES WAIT
EA1E DBEB        10270            IN    A,(DATA)        ;GET BYTE
EA20 FE30        10280            CP    30H             ;CHECK IF A DIGIT
EA22 38F4        10290            JR    C,GETDG       ;NO
EA24 FE3A        10300            CP    3AH             ;LESS THAN 9
EA26 3802        10310            JR    C,NOSUB
EA28 D607        10320            SUB   7               ;MAKE 30 - 3F
EA2A E60F        10330 NOSUB:     AND   0FH
EA2C C9          10340            RET
                 10350 ;
                 10360 ;-----------------------------------------------
                 10370 ;       VID - VIDEO DRIVER TO SUPPORT
                 10380 ;             LOWER CASE DISPLAY
                 10390 ;-----------------------------------------------
                 10400 ;
EA2D DD6E03      10410 VID      LD      L,(IX+3)
EA30 DD6604      10420          LD      H,(IX+4)
EA33 DA9A04      10430          JP      C,049AH
EA36 DD7E05      10440          LD      A,(IX+5)
EA39 B7          10450          OR      A
EA3A 2801        10460          JR      Z,NUL
EA3C 77          10470          LD      (HL),A
EA3D 79          10480 NUL      LD      A,C
EA3E FE20        10490          CP      20H
EA40 DA0605      10500          JP      C,0506H
EA43 FE80        10510          CP      80H
EA45 D2A604      10520          JP      NC,04A6H
EA48 C37D04      10530          JP      047DH
EA4B             10540 LOGO      EQU   $
EA4B 1C          10550           DEFB  1CH
EA4C 1F          10560           DEFB  1FH
EA4D 17          10570           DEFB  17H
EA4E 0D          10580           DEFB  CR
EA4F 0D          10590           DEFB  CR
EA50 0D          10592           DEFB   CR
EA51 0D          10593           DEFB   CR
EA52 43          10600           DEFM  'COMPAC COMMUNICATIONS PACKAGE'
     4F 4D 50 41 43 20 43 4F
     4D 4D 55 4E 49 43 41 54
     49 4F 4E 53 20 50 41 43
     4B 41 47 45
EA6F 0D          10610           DEFB  CR
EA70 0D          10620           DEFB  CR
EA71 20          10630           DEFM  '      BY BRIAN CAMERON'
     20 20 20 20 42 59 20 42
     52 49 41 4E 20 43 41 4D
     45 52 4F 4E
EA86 0D          10640           DEFB  CR
EA87 0D          10650           DEFB  CR
EA88 20          10660           DEFM  '       AND DAN GOULD'
     20 20 20 20 20 41 4E 44
     20 44 41 4E 20 47 4F 55
     4C 44
EA9B 0D          10670           DEFB  CR
EA9C 00          10671           DEFB  EOM
0046             10900           DEFS  70
EAE3             10910 STACK     EQU   $
EAE3             10940 MSGDSP    EQU   $
EAE3 7E          10950           LD    A,(HL)
EAE4 B7          10960           OR    A
EAE5 CAEFEA      10980           JP    Z,LP1
EAE8 23          10985           INC    HL
EAE9 CD3300      10990           CALL  DSP
                 10995
EAEC C3E3EA      11000           JP    MSGDSP
EAEF             11010 LP1       EQU   $
EAEF 23          11015           INC    HL
EAF0 C9          11020           RET
                 11030 ;
                 11040 ;
E300             11050          END     COMPAC
00000 TOTAL ERRORS
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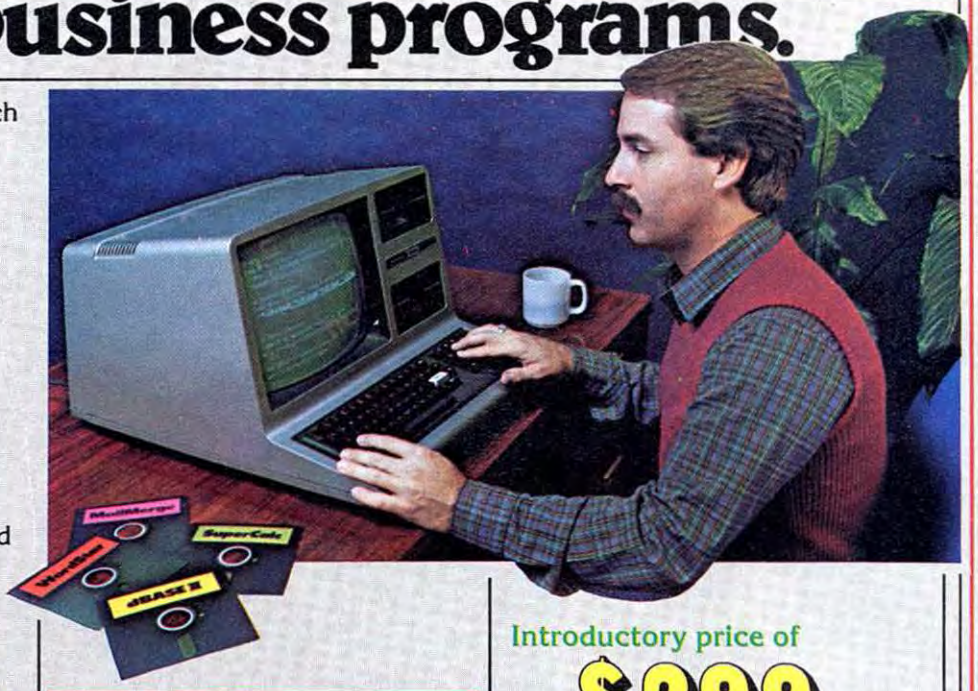

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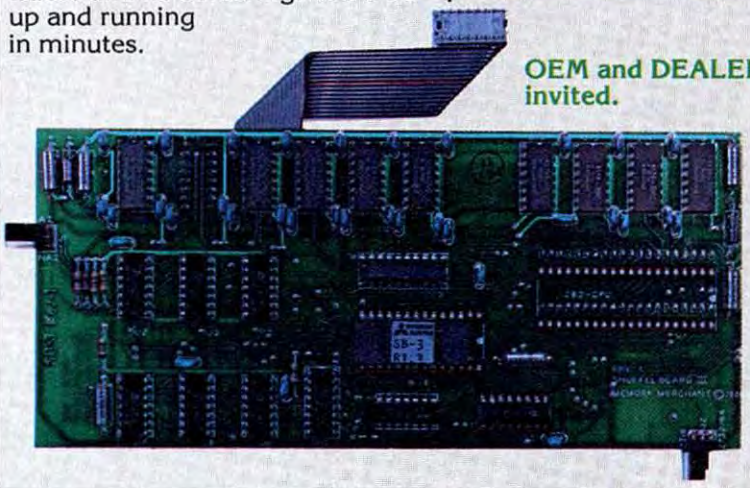

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Do-It-Yourself Computer

by John D. Chipman

The LNW-80 is a versatile and inexpensive upgrade from a Model I, if you are handy with a soldering iron and have some patience.

When I decided to replace my Model I with a newer machine, I compared the features and prices of a number of micros. The LNW-80 offered most of what I wanted at a good price—and it was compatible with my TRS-80 software. The LNW's features include compatibility, high-resolution monochrome graphics, color graphics, and optional double-density support.

To get more microcomputer for my money, I assembled the LNW-80 system myself. LNW does sell the unit, completely wired and tested, with a 90-day warranty period for a reasonable price.

This article describes the modifications I made to the original LNW-80 kit. I've outlined some of the problems I encountered while building the kit, as well as described some of the unique features of the LNW-80. I've made no attempt, however, to give you a blow-by-blow account of the construction of the component PC boards.

As a supplement to the LNW-80 instruction booklet, see Dennis Kitsz's 80 Applications column in the October 1982, (p. 425), and January 1983, (p. 356), issues of *80 Micro*.

This article will discuss only the construction of basic LNW-80 and support circuitry. The LNW expansion board, also used in the LNW-80 system, has been reviewed in the May 1981 (p. 230) issue of *80 Micro* and shall not be discussed in any detail.

Construction Tips

Let me start off with some do's and don'ts:

- *Do not* attempt to build the LNW-80 yourself unless you have had extensive hardware construction experience, or at least have a friend who has.
- *Do not* use cheap components, questionable substitutions, or "pull-out" ICs. It will cost you more in the long run, tracking down that second-hand intermittent IC during the debugging process.
- *Do* use high-quality IC sockets throughout. This will allow IC substitutions during the hardware debugging process.
- *Do* use a high-quality, low-wattage, pencil soldering iron. The LNW-80 board is multilayered, with extremely small trace spacings. The use of high-wattage, larger irons will result in solder bridges and lifted contact pads.
- *Do* use thin solder wire to prevent solder bridges. Size .032 inch appears to be just right.
- *Do* clean and inspect all solder joints as you assemble, using a magnifier and good lighting. It will be harder to find poor solder joints or bridges later with a full board.
- *Do* check and recheck the board assembly before applying power and smoke testing. Are all the ICs in the right place and in the right way? How about resistors and capacitors?
- *Do* check the power-supply section before jumpering voltages to the main board. Check power again immediately after installing the jumpers.

Once again, the LNW-80 is not a Heathkit and should not be considered as one. Neophyte kit-builders beware; you are better off buying the assembled unit.

A Piece at a Time

If, at this point, you decide to go ahead with the you-do-it approach, LNW will sell bare boards and subkits. This facilitates building the complete LNW-80 system one piece at a time. It is also easier on the wallet that way. If you already own a TRS-80 Model I without Radio Shack's Expansion Interface and want to switch to the LNW-80 system, a good approach would be to start with the LNW expansion board. If you have excessive trouble constructing the expansion board, then you ought to reconsider your plans for the LNW-80.

The basic LNW-80 board is a stand-alone unit, but you will need a case, power transformer, keyboard, and muffin fan to make it operational. LNW Research sells all these items as well as several miscellaneous starter parts kits. The starter parts kits are se-

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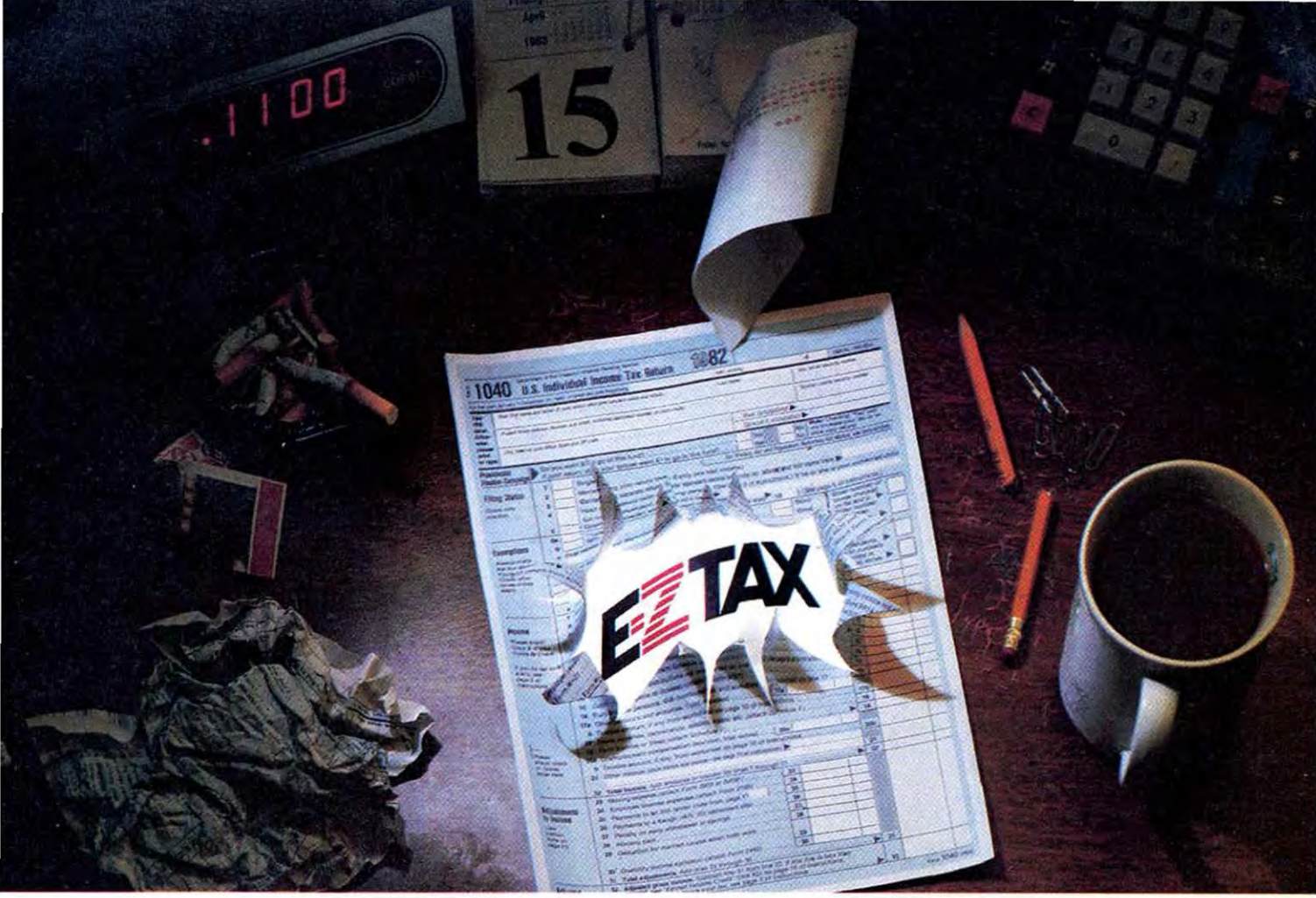

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LNW-80 Board

The basic LNW-80 board is a high-quality, multilayer printed circuit board. Component layout is neat and noncluttered. All etches are tinned and lacquer coated. The component side is silk-screened with component locations. All ICs are oriented in the same direction. Traces and pads on the board are extremely small, so be careful with any soldering or desoldering operations.

One of the more important features is that the 40-pin expansion bus connector is gold plated. This plating will certainly go a long way in eliminating the infamous Model I connector degradation problem.

One of the nicer features of the LNW-80 is that several homebrewing options are allowed. For example, with a half-dozen or so minor component changes, you can tailor the unit to provide either a baseband NTSC video output or an RF modulated video output. The RF modulated output is compatible with any standard TV set. Unfortunately, I saw no easy way to provide switching capability between the two modes. There is even an option for converting the NTSC output to RGB standards in order to increase color resolution. However, to do this requires more than a few simple component changes. A special RGB driver PROM chip is also required and is not yet available from LNW.

Some other important board options are high-resolution/color graphics, ROM selections, and keyboard selections. Since most people will buy the LNW-80 for its high-resolution/color graphics capability I don't consider it as a board option, but it can be deleted. You would then be left with standard TRS-80 graphics capability. This allows the construction of the board without the high-resolution graphics at the outset to save time and money. The hi-res graphics could then be added at a later date.

"Neophyte kit-builders beware; you are better off buying the assembled unit."

ROM and keyboard options also add to the unit's construction flexibility. With simple jumper changes, either the Radio Shack three-chip ROM set, the newer Radio Shack two-chip set, or the LNW six-chip set (2716s) can be used. Likewise, two interfaces are provided: one for the Radio Shack keyboard and the other for an LNW keyboard (or any other nonencoded keyboard having the proper XY format).

I would like to give LNW Research an "attaboy" for their foresight on the ROM and keyboard options. These options give you the choice of cannibalizing an old TRS-80 Model I for some of the more expensive components (i.e., keyboard, LII ROMS, and RAM chips). After all, LNW could have left out these two options, saving production costs while forcing the builder to purchase their six-chip set and keyboard. So, if you now own a Model I and want to convert to the LNW-80, consider the resale value of your TRS-80 versus the cost of buying a new keyboard, ROM, and RAM set. Sooner or later it will be cheaper to cannibalize.

Keyboard

Many of those cheap surplus keyboards are just not compatible with the TRS-80 crosspoint matrix. If you decide

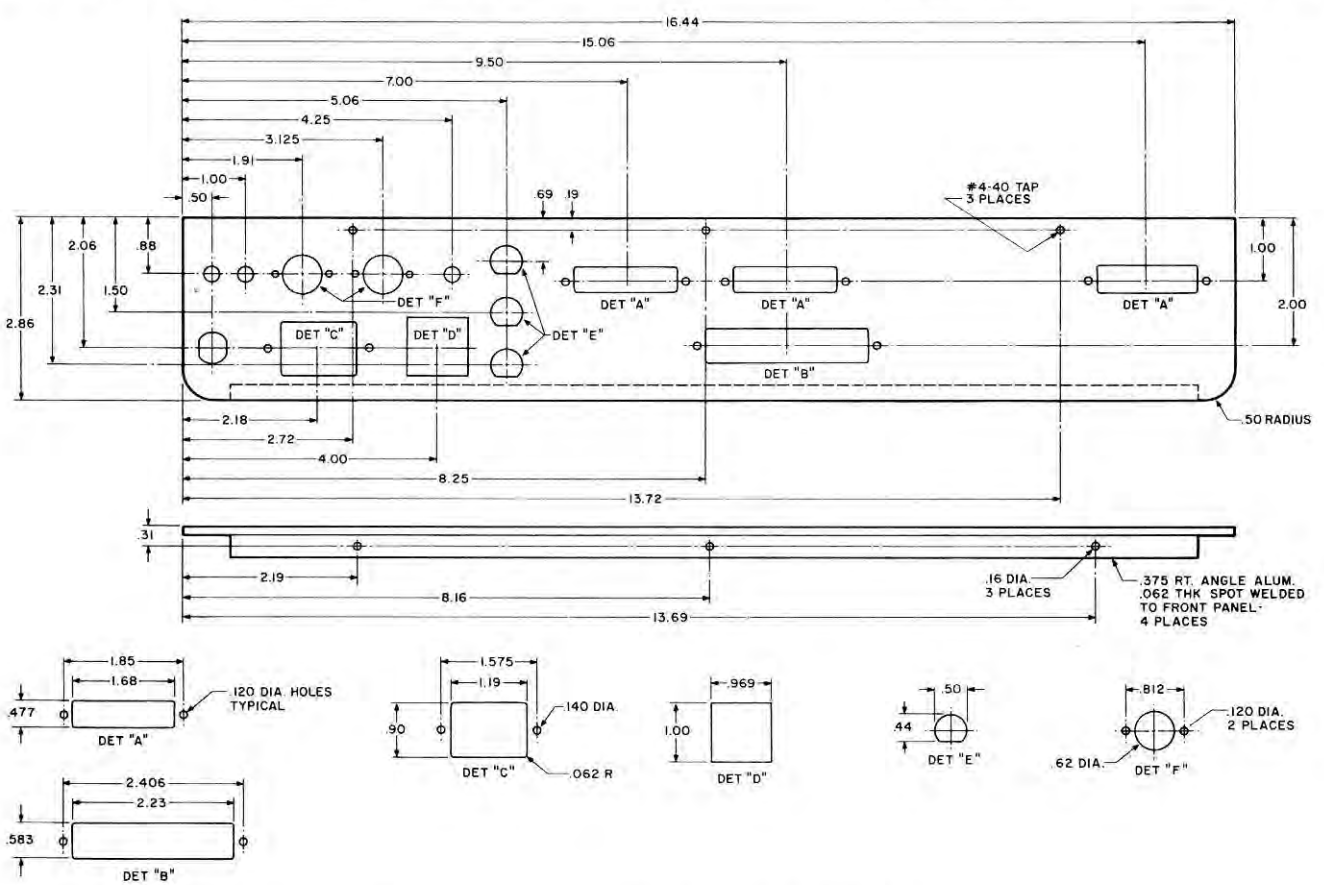

Fig. 1. Layout of the new I/O backpanel for the LNW chassis.

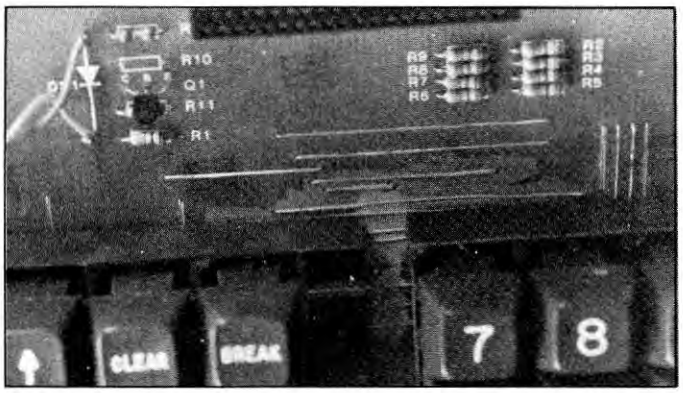

Photo 1. A Close-up of the LNW Keyboard Unit Illustrating the Coated Wire Jumpers.

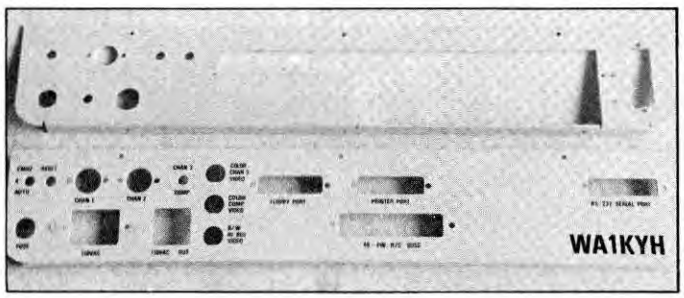

Photo 2. Side-by-Side Comparison Between the Original LNW Backpanel (Top) and the newly designed Version (Bottom)

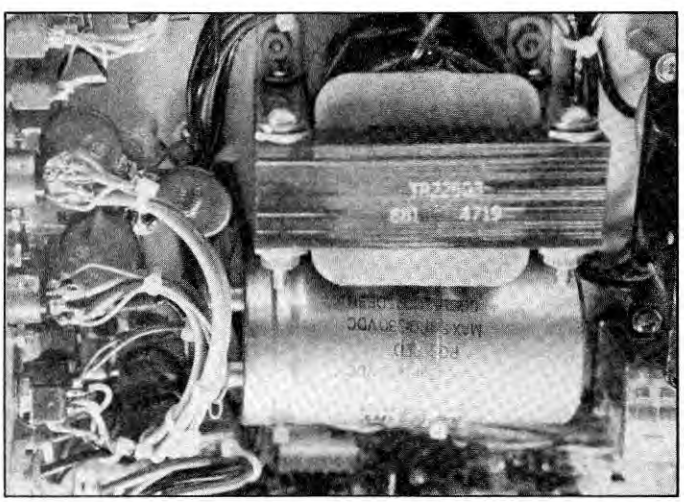

Photo 3. Close-up of the Raw Power-Supply Section

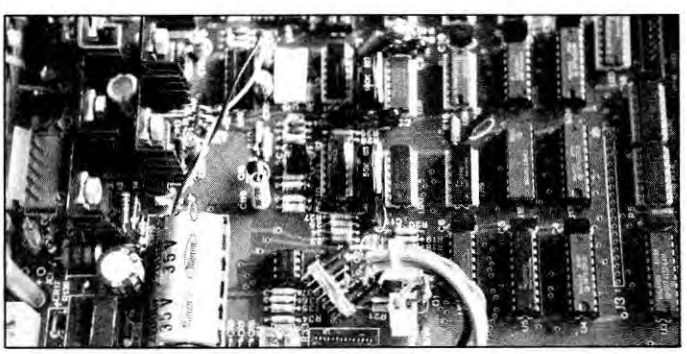

Photo 4. Close-up Showing the Homebrew, 7-Pin Connector Used to Connect the LNW-80 Board to the Off-Board Cassette Relay

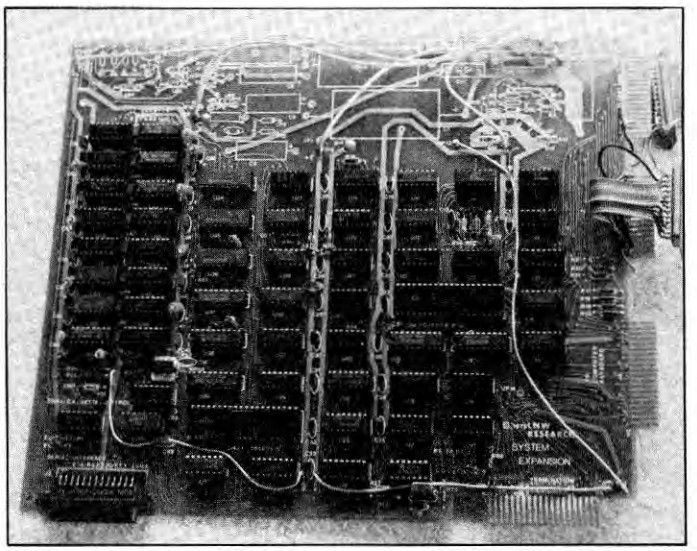

Photo 5. The LNW Expansion Board with DP-25 Connector Loops Installed on the Printer and Floppy Ports

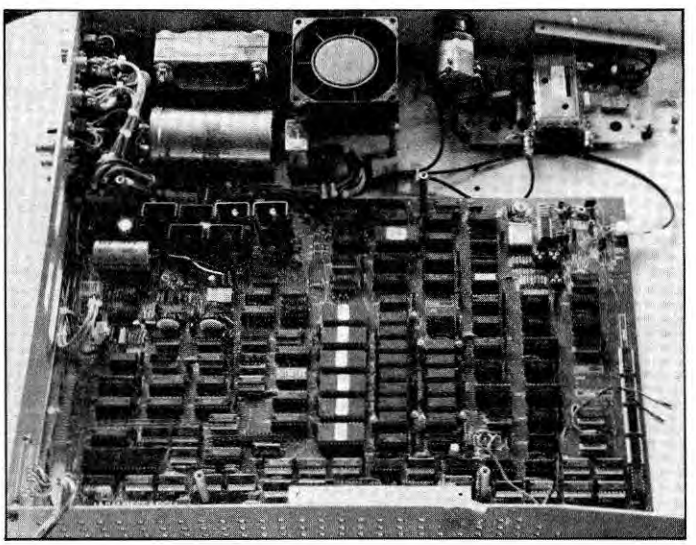

Photo 6a. LNW System Assembly with the LNW-80 Board, RF Mod, and Raw Power-Supply Section

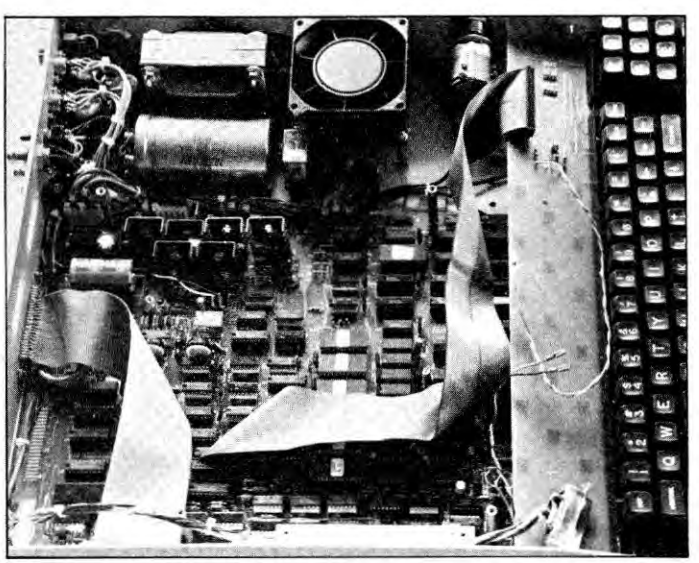

Photo 6b. LNW System Assembly with the Keyboard Unit Added

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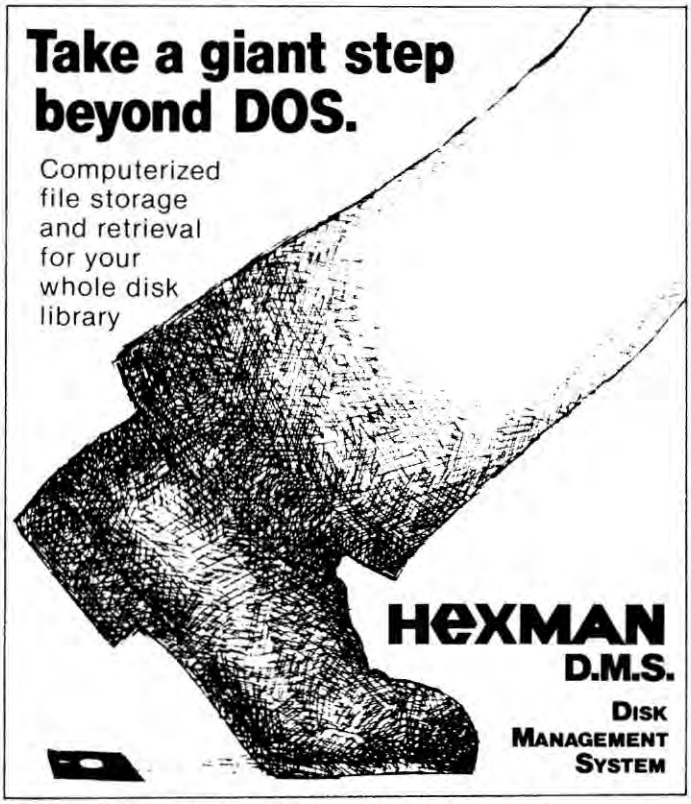

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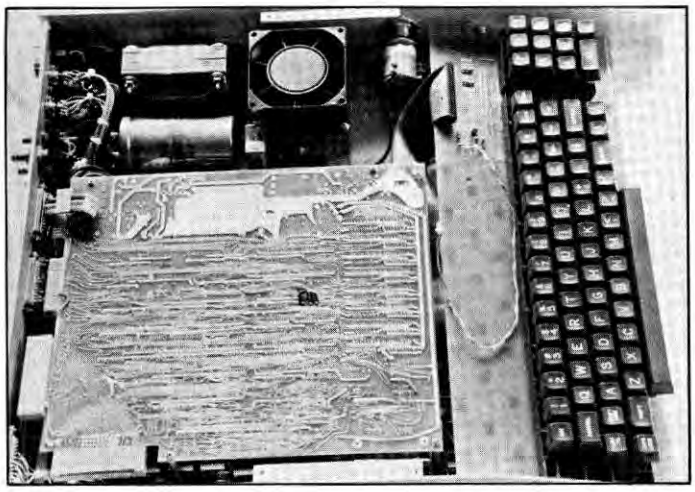

Photo 6c. LNW System with All Boards (Including Expansion) Installed

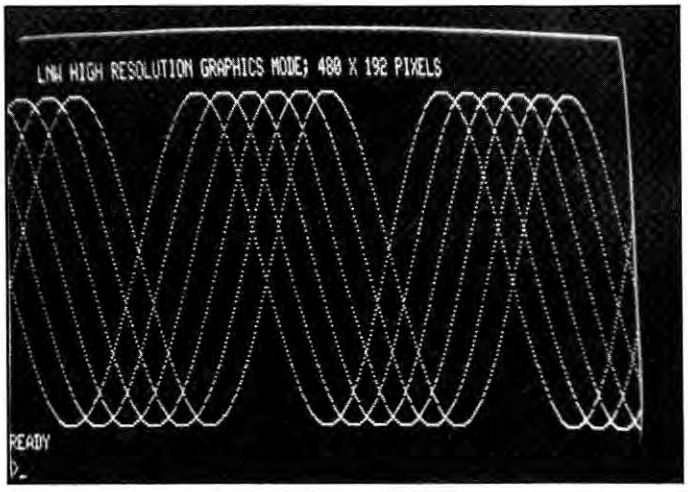

Photo 8. An Illustration of the Unit's High-Resolution Graphics as Seen on a Monitor

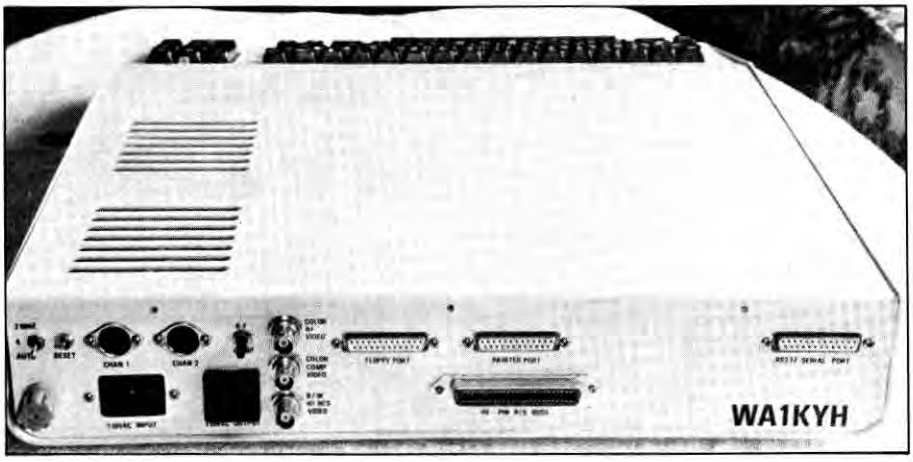

Photo 7. A Rear View of the Completed LNW System with the New I/O Backpanel Installed

to go the surplus route, take a good look at the level of effort the conversion will require. Having sold my TRS-80, cannibalization was out, so I plunked down some more green stuff for LNW's keyboard kit.

While I was impressed by the quality of LNW's LNW-80 and Expansion PC boards, I was unimpressed by the quality of the keyboard kit's PC board. The PC board is a single-layer type and a bit flimsy for its intent. The fact that the PC board has traces only on the underside requires you to install wire jumpers on the component (keys) side. The installed jumpers complete the crosspoint (XY) matrix.

The kit includes several feet of fine wire (approximately No. 30) for the jumpers, but I ran short and had to scrounge around for more. Another problem was that the wire supplied was bare, making is too easy to short wires running parallel to each other.

A few of these parallel wire runs were several inches in length, while spaced only about 1/8 inch apart. When the keys are installed on top of these jumpers, movement can occur resulting in shorts. To solve this problem, coat or tape the wires down against the PC board. I used fingernail polish for coating the wires, which can be seen in a close-up in photo 1.

Chassis

When assembly of the LNW-80 keyboard and expansion board was complete, I had to place them into a box of some kind. After looking for a reasonably inexpensive chassis with no success, I ordered the LNW-80 chassis kit. It is rightfully advertised as a rugged, all-steel unit. It comes in three major pieces: a U-shaped bottom, a top having a keyboard cut-out, and a back I/O panel. Miscellaneous hardware is included as well.

I wanted to minimize RFI. This means using a tight metal box with small holes only and grounded I/O connectors. One look at the LNW-80 chassis' back panel told me that some additional metal work would be necessary. The back panel has one large rectangular hole measuring 2 by 8 inches.

A second problem is the way LNW suggests mounting the muffin fan. Mounted in this position, all the fan does is stir up the air around it. There is no useful air flow between the circuit boards.

Two major modifications were made to LNW's chassis. One was the design of a new I/O backpanel using RFI-tight I/O connectors (in lieu of ribbon edge connectors). A modular ac plug/filter was selected for the 110VAC line input. All video signals go through standard BNC connectors and the cassette signals go through shielded DIN connectors (R/S compatible).

The floppy and printer ports, as well as the RS-232 ports, go through DP-25 series bulkhead mounting jacks. A standard 50-pin telephone connector was chosen for the 40-pin R/S expansion bus output. The 50-pin connector is inexpensive and plentiful on the surplus market.

Ten of the contacts are unused, letting you add special outputs if desired. The layout of this new panel is provided in Fig. 1. Photo 2 shows a side-by-side comparison between the LNW and the newly designed I/O panels.

The second modification greatly enhanced the circuit-board cooling. This consisted of drilling a three-row pattern of small 1/8-inch holes, on ½-inch centers, on the chassis side opposite the fan. These holes can be seen in several of the photos in this article. Air enters through these side holes and flows between the LNW-80 and expansion board towards the fan.

The fan, in turn, exhausts the air

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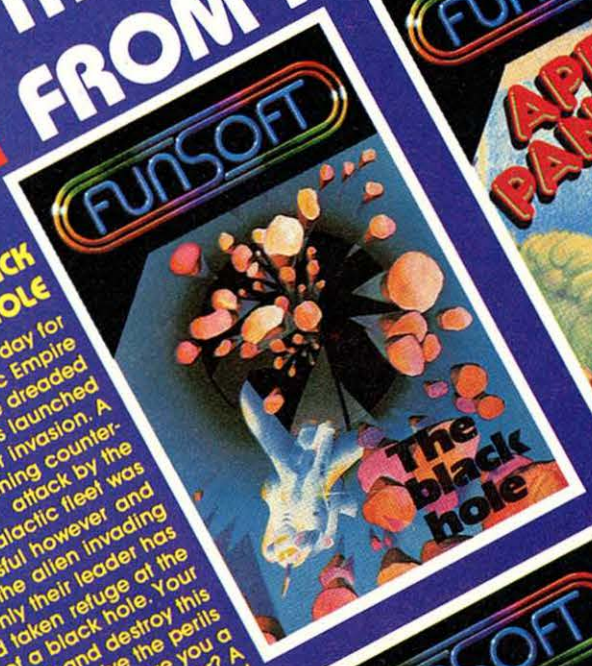

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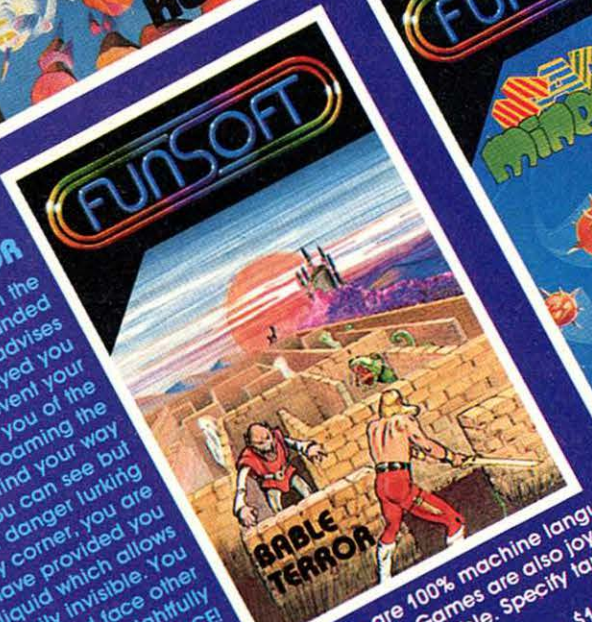

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through one set of LNW's precut vent slots on the chassis top. To maximize this airflow, glue a piece of metal or plastic over the second set of precut slots. This prevents air from entering one set of slots only to be blown out of the other.

Character Generator

The LNW-80 board provides options for using either a TRS-80-compatible, Motorola character-generator chip or a programmed 2716 chip from LNW. LNW told me that the choice was up to me, but that the LNW chip has some special features. More significantly, the price was about 30 percent less than Motorola's chip, so I bought LNW's. I am still not sure what the special features are, but it does have descenders on lowercase.

Additional Construction Notes

As mentioned earlier, a Corcom model 6EF2, 110VAC line connector/filter is used for the ac input to the computer. This eliminates ac noise sources that can disturb the microcomputer's operation. Along with this line filter, three transorb varistors (GE MOV130) are used to suppress line transients. Line transients can cause severe damage to high-speed ICs. A schematic of my ac power section (off the LNW board) is shown in Fig. 2.

I also decided to mount and wire the diode bridge CR1 and capacitor C1 off-board, thus supplying raw +10 V dc (5V line) to the LNW-80 board. This was easier than connecting the board directly to the transformer output and then having to run extra leads from the board back to these components.

"Line transients can cause severe damage to high-speed ICs."

Photo 3 is a close-up of the raw, off-board power supply. Notice the three large GE varistors mounted on the ac line filter's output on the right side. A diode bridge, CR1, is mounted on a small heat sink affixed to the chassis bottom directly below the fan.

The LNW board's color video output can be wired for either NTSC video or RF modulated video. Since RF modulated video signals have lower quality and resolution, I wired my unit up for direct NTSC output. But wanting the best of both worlds, I also installed an off-board RF video modulator controlled by a toggle switch on the back I/O panel. This allows using either an NTSC monitor or a standard color TV set with the simple flick of a switch. A schematic of the RF hookup used is presented in Fig. 3.

I used a Radio Shack RF modulator kit, PN 277-122, but there are several RF modulators available from both commercial and surplus vendors that will work well. Notice that the DPDT switch also disconnects dc power to the RF modulator when not in use.

With the newly designed I/O backpanel installed, a few minor board modifications are necessary in order to be compatible with this backpanel. Since the two cassette DIN plugs and their switching relay were installed off-board, they required a new PC board connector instead of the single DIN PC mount jack.

My solution was to use a 7-pin IC socket and component carrier both of which were cut in half lengthwise. The

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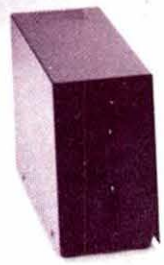

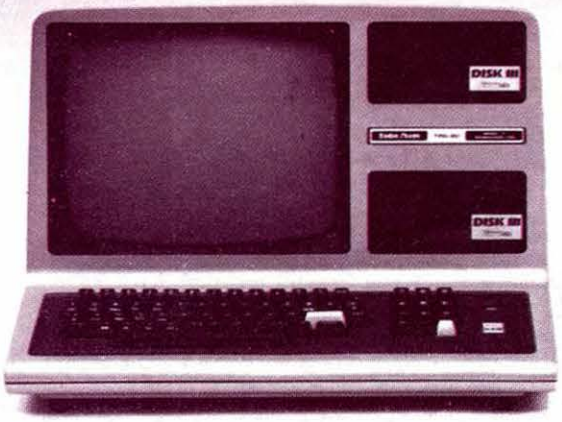

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socket half was soldered where the PC-mounted DIN plug should go. The component half was then attached to the audio cables connecting the off-board cassette relay. Photo 4 provides a close-up of this special cassette connection.

Another LNW-80 board modification involved converting the floppy and printer-port PC edge connectors to DP25 connectors. Two-inch sections of ribbon cable, formed into a loop from the back of the PC edge fingers to the DP25 connectors, were used. This mounting method gives you the capability to temporarily push the DP25 connector out of the way in order to test a new accessory having the standard R/S cable and connector. Usually this is a good idea before you modify the accessory or make a new DP25 cable. Photo 5 shows the installation of the DP25 connectors on the LNW Expansion Board.

The adapter cable is modified so that it is terminated at one end with a 50-pin, telephone-type connector, and at the other with a R/S 40-pin card edge connector. It is easily assembled with the use of an 8-inch piece of 40-conductor ribbon cable.

Final assembly of the unit is illustrated by Photos 6a–6c. Notice the Radio Shack RF Modulator in the upper right corner of Photo 6a. The modulator resides beneath the LNW keyboard unit (Photo 6b). The ac power switch (SW1 in Fig. 2), obtained from a surplus electronics outlet, is mounted to the chassis side, next to the RF modulator. Photo 7 shows the completely assembled unit with the new I/O backpanel.

Unit Operation

The LNW-80 system performs just like the Model I, Level II, so it will not be necessary to learn new system software. However, the LNW-80 does provide some extended capabilities over the TRS-80.

Probably the greatest single feature is its high-resolution graphics capability. A simple cosine function-plotting program was run as an example (Photo 8). Notice how small the individual pixels are, a great improvement over the TRS-80. The LNW-80 also provides medium-resolution color graphics of 128 by 192 pixels. Since I do not own a color NTSC monitor, I cannot comment on this feature.

A nice built-in hardware feature is a high-speed (4 MHz) switch. With the simple flick of the switch, your program will run twice as fast. Star Trek is considerably more enjoyable when screen refreshes are almost instantaneous.

When using Model I DOS, a third position of this switch will automatically slow the speed down whenever the disk is being accessed, returning back to high-speed operation afterwards. Unfortunately, this autospeed position does not take into account cassette I/O operations. You have to remember to manually slow down the speed in order to read or write to cassettes at the TRS-80-compatible rate (500 baud).

LNW also includes a hardware lowercase modification. But like the Model Is modified for lowercase, you still need to load a lowercase software driver. One good feature of the LNW-80 is that the lowercase option is switch-selectable from the keyboard. Locking out the lowercase function is useful when you run across programs and utilities that do strange things when run with the lowercase mod.

In the Complaint Department

There are two major areas of criticism that I have on the LNW-80 system. The first and greatest gripe is their documentation. Assembly instructions were very sketchy and troubleshooting information was almost nonexistent. The schematics received were hand-drawn and contained errors. I found several errors during the hardware debugging process.

The second area of discontent is software support. Special drivers are required to use various LNW features, such as hi-res graphics. LNW claims multiple line formats up to 24 lines by 80 characters. This is easier said than done, since you first have to develop a machine-language software driver to do it. LNW does give some cursory information on generating special-feature drivers. However, the information is of little use to someone who is ignorant about machine coding—like me!

In all fairness to LNW, I decided to call in order to get additional information to help alleviate the previous problems. After several unsuccessful attempts to talk with someone knowledgeable, I wrote a letter to the company president. After waiting over two months in anticipation of a response, I gave up.

One final note: LNW will repair homebrewed LNW-80s at a reasonable cost should you build and then be unable to get the unit running properly.

Whether you build or buy an LNW-80 microcomputer system, I'm sure you'll enjoy it. ■

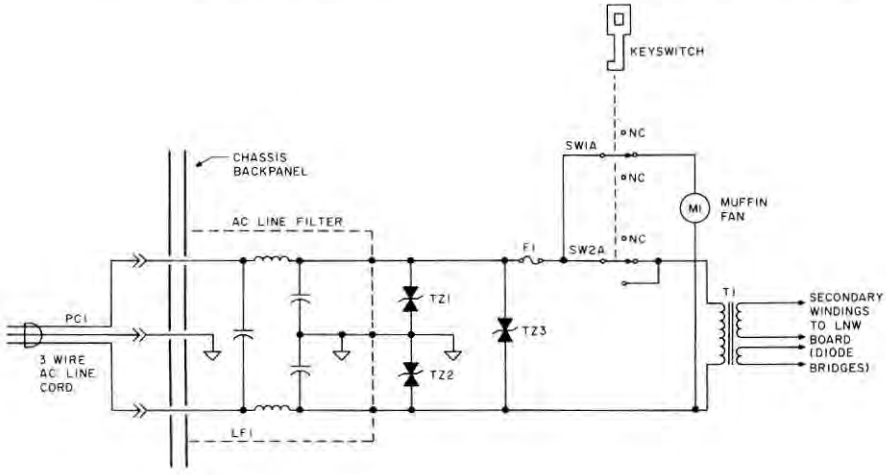

Fig. 2. Power Schematic

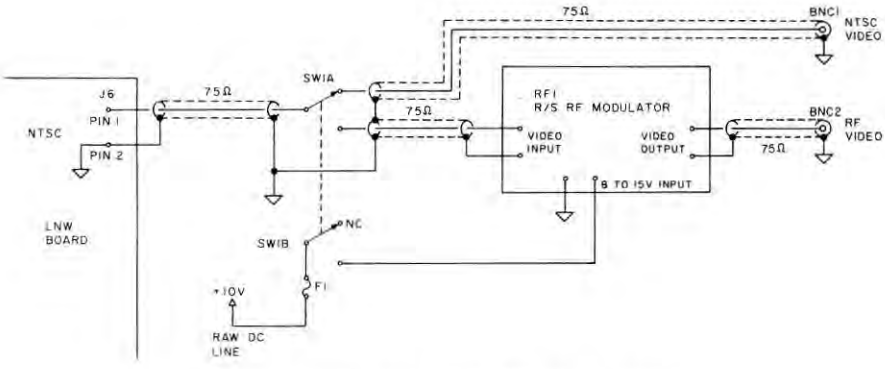

Fig. 3. Schematic of the NTSC/RF video switching.

In The Beginning Was The Word...

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Music-80

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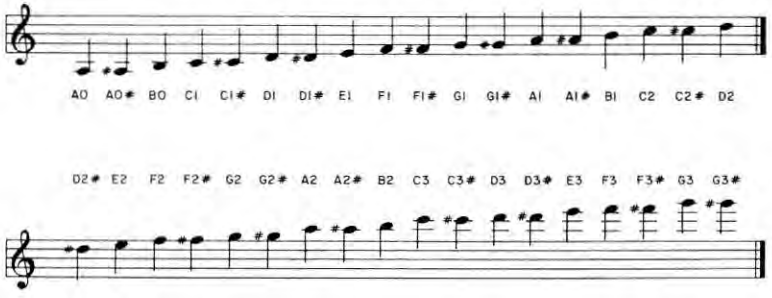

Fig. 1. Possible Notes and Their Respective Symbols

Address				
Dec.	**Hex**	**Contents**	**Symbolic**	**Comments**
16384	4000	C3 96 1C	JP 1C96	RST 1 & 2
16387	4003	C3 78 1D	JP 1D78	RST 3
16390	4006	C3 90 1C	JP 1C90	RST 4
16393	4009	C3 D9 25	JP 25D9	RST 5
16396	400C	C9	RET	RST 6
16397	400D	00	NOP	
16398	400E	00	NOP	
16399	400F	C9	RET	RST 7
16400	4010	00	NOP	
16401	4011	00	NOP	

Table 1. RAM Vectors (RSTs 1-7)

Program Listing 1. Music-80

```
100 '*************************************************************
110 '**                                                         **
120 '**                    M U S I C - 8 0                      **
130 '**                                                         **
140 '**                    Peter M. Freese                      **
150 '**               Clermont, New Jersey  08210               **
160 '**                                                         **
170 '*************************************************************
200 POKE16396,23
210 CLEAR5000:DEFINTA-Z:ONERRORGOTO9000
220 DIMTAU(36),NT$(36),MUSIC$(500),FR(36),B,N:GOSUB230:GOTO350
230 INPUT"BASE NOTE (DEF=220)  ";BN:IFBN=0THENBN=220
240 INPUT"WHAT NOTE GETS ONE BEAT (DEF=4)     1/";NB
250 IFNB=0THENNB=4
260 S=30976:RESTORE
```

Listing 1 continues

Teach your TRS-80 to belt out all your favorite tunes with this easy-to-use interpreter.

Music-80 is a music-generator program that can be used as a composing aid, a musical instrument, or a teaching aid for music.

High-resolution graphics depicting musical scores are impractical on the TRS-80 because of its limited graphics capabilities. Therefore, a text form of music is imperative. This coded format is easy to use and very symbolic of the notes represented.

You can tune the program's entire scale as a single entity and play music at any user-selected speed. The program uses the cassette to load and save music. A combination of Basic and machine language makes the program easy to understand and produces good-quality, square-wave music.

Music-80 is designed to run on a Level II 16K computer. It can contain 500 notes, in the range of an A below middle C to a G# two octaves above middle C. The default frequency range

The Key Box

Model I
16K RAM (32K and 48K with modification)
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Cassette Port Amplifier

Listing 1 continued

```
270 FORI=STOS+63:READJ:POKEI,J:NEXTI
280 SP=31232
290 FORI=0TO35:FR(I)=BN*2%[(I/12%):TAU(I)=1.774E6/(34%*FR(I))-2+
1:READNT$(I):NEXTI
300 TAU(36)=0
310 FR(36)=202
320 NT$(36)="REST"
330 POKE16526,0:POKE16527,121:POKE16396,213
340 RETURN
350 GOSUB8500:L=1
360 DATA14,255,33,255,121,35,94,35,86,35,122,179,200,70,120,183,
40,23,62,5,237,121,70,0,16,253,62,4,237,121,70,0,16,253,27,122,1
79,32,235,24,220,62,4,237,121,70,0,16,253,62,4,237,121,70,0,16,2
53,27,122,179,32,235,24,197
370 DATAA0,A0#,B0,C1,C1#,D1,D1#,E1,F1,F1#,G1,G1#,A1,A1#,B1,C2,C2
#,D2,D2#,E2,F2,F2#,G2,G2#,A2,A2#,B2,C3,C3#,D3,D3#,E3,F3,F3#,G3,G
3#
500 '##########      EXECUTIVE      ##########
510 '
520 B$="":L0=L
530 PRINT":";CHR$(14);CHR$(31);:T9=0
540 T9=T9+1:A$=INKEY$:IFA$=""THENIFT9<20THEN540ELSEIFT9>30THENPR
INTCHR$(14);:T9=0:GOTO540ELSEPRINTCHR$(15);:GOTO540
550 IFASC(A$)>31THEN630
560 IFASC(A$)=1THENSTOP
570 IFA$=CHR$(31)THENCLS:GOTO520
580 IFA$=CHR$(13)THEN640
590 IFA$=CHR$(8)ANDLEN(B$)>0THENB$=LEFT$(B$,LEN(B$)-1):GOTO640
600 IFA$=CHR$(8)THEN650
610 IFA$=CHR$(24)ANDLEN(B$)>0THENFORI=1TOLEN(B$):PRINTCHR$(8);:N
EXTI:B$=""
620 GOTO540
630 B$=B$+A$
640 PRINTA$;CHR$(14);
650 IFASC(A$)<>13THEN540
660 PRINTCHR$(15);
665 IFRIGHT$(B$,1)=" "THENB$=LEFT$(B$,LEN(B$)-1):GOTO665
670 IFB$="COMPOSE"THENGOSUB1000:GOTO520
680 IFB$="DELETE"THEN1500
690 IFB$="INSERT"THEN2000
700 IFB$="REPLACE"THEN2500
710 IFB$="ADD"THEN3000
720 IFB$="PLAY"THEN3500
730 IFB$="PLAY/CONT"ORB$="PLAY CONT"ORB$="PLAY /CONT"THEN3500
740 IFB$="VIEW"THEN4000
750 IFB$="RANDOM"THENGOTO4500
760 IFB$="SCALE"THENGOTO5000
770 IFB$="KILL"THEN5500
780 IFB$="LOAD"THEN6000
790 IFB$="SAVE"THEN6500
800 IFB$="TUNE"THENGOSUB230:GOTO520
810 IFB$="HELP"THEN9500
900 IFB$=""THEN520
910 PRINT"?Syntax Error":GOTO520
1000 '**********  COMPOSE  **********
1010 '
1020 IFB$="COMPOSE"THENL=1
1030 M$="":PRINTUSING"####)";L;:INPUTM$
1040 IFM$=""THENRETURN
1050 S0$=M$:S1$="-":GOSUB7520:IFP=0THENER=1:GOSUB8000:GOTO1030
1060 IFVAL(LEFT$(M$,P-1))=0THENER=2:GOSUB8000:GOTO1030
1070 R$=MID$(M$,P+1)
1080 F0=-1
1090 FORI0=0TO36:IFNT$(I0)=R$THENF0=I0
1100 NEXTI0
1110 IFF0=-1THENER=3:GOSUB8000:GOTO1030
1120 MUSIC$(L)=CHR$(127+VAL(M$))+CHR$(128+F0):L=L+1:GOTO1030
1500 '**********  DELETE  **********
1510 '
1520 IFL=1THENER=6:GOSUB8000:GOTO520
1530 INPUT"ENTER LINES TO DELETE (FIRST, LAST (OR 0,0 FOR EXEC))
";F,LS
1540 IFF=0ANDLS=0THEN520
1550 IFLS>LORLS<1ORF>LORF<0THENER=4:GOSUB8000:GOTO1510
1560 IFLS<FTHENER=5:GOSUB8000:GOTO1510
1570 FORI=FTOLS:MUSIC$(I)=MUSIC$(I+(LS-F+1)):NEXTI:L=L-(LS-F+1)
1580 GOTO520
2000 '**********  INSERT  **********
2010 '
2020 IFL=1THENER=6:GOSUB8000:GOTO520
2030 L0=L
2040 INPUT"LINE TO BEGIN INSERTING";L
2050 M$="":PRINTUSING"####)";L;:INPUTM$
2060 IFM$=""THENL=L0:GOTO520
2070 S0$=M$:S1$="-":GOSUB7520:IFP=0THENER=1:GOSUB8000:GOTO2050
2080 IFVAL(LEFT$(M$,P-1))=0THENER=2:GOSUB8000:GOTO2050
2090 R$=MID$(M$,P+1):F0=-1
2100 FORI0=0TO36:IFNT$(I0)=R$THENF0=I0
```

Listing 1 continues

works out to be about 220–1660 Hz.

Running the Program

In order to use the program, the memory size must first be set to 30900. This protects the short machine-language program and music data. After you run the program it should query with:

BASE NOTE (DEF = 220) ?_

Normally, you respond with just a carriage return. The computer then queries with:

WHAT NOTE GETS ONE BEAT (DEF = 4) 1/?_

In most scores, a quarter note gets one beat, which is common time or 1/4. Simply press return to use the default value of a quarter note. After a slight delay the screen clears and some titles are printed at the top. The cursor appears to the right of a colon, indicating you are in the command mode. You can now enter any one of the 15 commands.

Commands

Compose allows the user to enter music. If the data set is not empty, then it is cleared. Music is entered in the following format: (note duration)-(note letter)(note octave)[#].

The note duration is the denominator of the duration fraction. An eighth note has a duration of 8. The note letter is any of C, D, E, F, G, A, or B. The note octave is a single digit in reference to middle C. A 1 indicates the octave of middle C. Thus, a middle C quarter note is entered as 4-C1.

A G-sharp eighth note an octave above middle C is entered as 8-G2#. The # is used to indicate sharps. Since the TRS-80 has no convenient symbol to represent a flat, a B-flat quarter note just below middle C must be entered as 4-B0#. Figure 1 shows all possible notes and their corresponding note values.

Each note is assigned a line number. This enables the user to insert, delete, or replace notes. Listings 2 and 3 give an example of music entered in Music-80. To indicate a rest, use the keyword Rest in place of the note letter and octave.

When entering music, the program prompts you with each line number. Enter a blank line to get back to the command mode. Compose should only be used to begin entering a score.

Delete is used to purge a single note or a series of notes within a specified range. The program responds with:

ENTER LINES TO DELETE
(FIRST, LAST (OR 0,0 FOR EXEC))?

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Listing 1 continued

```
2110 NEXTI0
2120 IFF0=-1THENER=3:GOSUB8000:GOTO2050
2130 FORI=L0TOLSTEP-1:MUSIC$(I+1)=MUSIC$(I):NEXTI
2140 MUSIC$(L)=CHR$(127+VAL(M$))+CHR$(128+F0)
2150 L=L+1:L0=L0+1:GOTO2050
2500 '**********  REPLACE  **********
2510 '
2520 IFL=1THENER=6:GOSUB8000:GOTO520
2530 L0=L
2540 INPUT"LINE TO BEGIN REPLACING";L
2550 GOSUB1010
2560 IFL>L0THENGOTO520
2570 L=L0:GOTO520
3000 '**********  ADD  **********
3010 '
3020 GOSUB1000
3030 GOTO520
3500 '**********  PLAY  **********
3510 '
3520 IFL=1THENER=6:GOSUB8000:GOTO520
3530 INPUT"BEATS PER MINUTE";BM:IFBM=0THEN3530
3540 BS!=BM/60
3550 SP=31232:CLS
3560 FORI=1TOL-1
3570 PRINT@58,I
3580 S0$=MUSIC$(I)
3600 PS=ASC(MID$(S0$,2))-128
3620 TAU=TAU(PS)
3630 FR=FR(PS)
3640 D!=NB/(ASC(S0$)-127)/BS!/(1/FR)
3650 H1=INT(D!/256)
3660 H2=D!-(H1*256)
3670 IFH1>255THENPOKESP,255:POKESP+1,255:POKESP+2,TAU:SP=SP+3:H1
=H1-256:GOTO3670
3680 POKESP,H2:POKESP+1,H1:POKESP+2,TAU
3690 SP=SP+3
3700 NEXTI
3710 POKESP,0:POKESP+1,0:POKESP+2,0
3715 OUT255,4:FORI=1TO500:NEXTI
3720 X=USR(0):IFINKEY$=CHR$(13)THEN3740
3730 IFB$<>"PLAY"THEN3720
3740 OUT255,0:GOTO520
4000 '**********  VIEW  **********
4010 '
4020 IFL=1THENER=6:GOSUB8000:GOTO520
4030 C=14:FORI=1TOL-1
4040 PRINTI;")    ";STR$(ASC(MUSIC$(I))-127);"-";NT$(ASC(MID$(MUS
IC$(I),2))-128)
4050 IFC=0THENGOSUB7000
4060 C=C-1
4070 NEXTI
4080 GOTO520
4500 '**********  RANDOM  **********
4510 '
4520 FORI=1TO60:N=RND(37)-1
4530 IFRND(3)<>1THENMUSIC$(I)=CHR$(135)+CHR$(N+128):NEXTI:GOTO45
50
4540 MUSIC$(I)=CHR$(143)+CHR$(N+128):NEXTI
4550 L=61
4560 B$="PLAY CONT"
4570 GOTO3530
5000 '**********  SCALE  **********
5010 '
5020 FORI=0TO36:MUSIC$(I+1)=CHR$(143)+CHR$(I+128):NEXTI
5030 L=37:GOTO3530
5500 '**********  KILL  **********
5510 '
5520 PRINT"Are you sure you want to kill the buffer?"
5530 K$=INKEY$:IFK$<>"Y"ANDK$<>"N"THEN5530
5540 IFK$="N"THEN520
5550 L=1:GOTO520
6000 '**********  LOAD  **********
6010 '
6020 PRINT"Ready tape, and press :ENTER:"
6030 IFINKEY$<>CHR$(13)THEN6030
6040 L=1
6050 K=1
6060 INPUT#-1,A$:PRINT@63," ";
6070 A1$=MID$(A$,K,2)
6080 IFA1$=""THEN6050ELSEIFA1$="."THEN520
6090 MU$(L)=A1$:K=K+2:L=L+1:GOTO6070
6500 '**********  SAVE  **********
6510 '
6520 PRINT"Ready tape, and press :ENTER:"
6530 IFINKEY$<>CHR$(13)THEN6530
6540 I=1
6550 A$="":PRINT@63," ";
6560 A$=A$+MU$(I):I=I+1
```

Listing 1 continues

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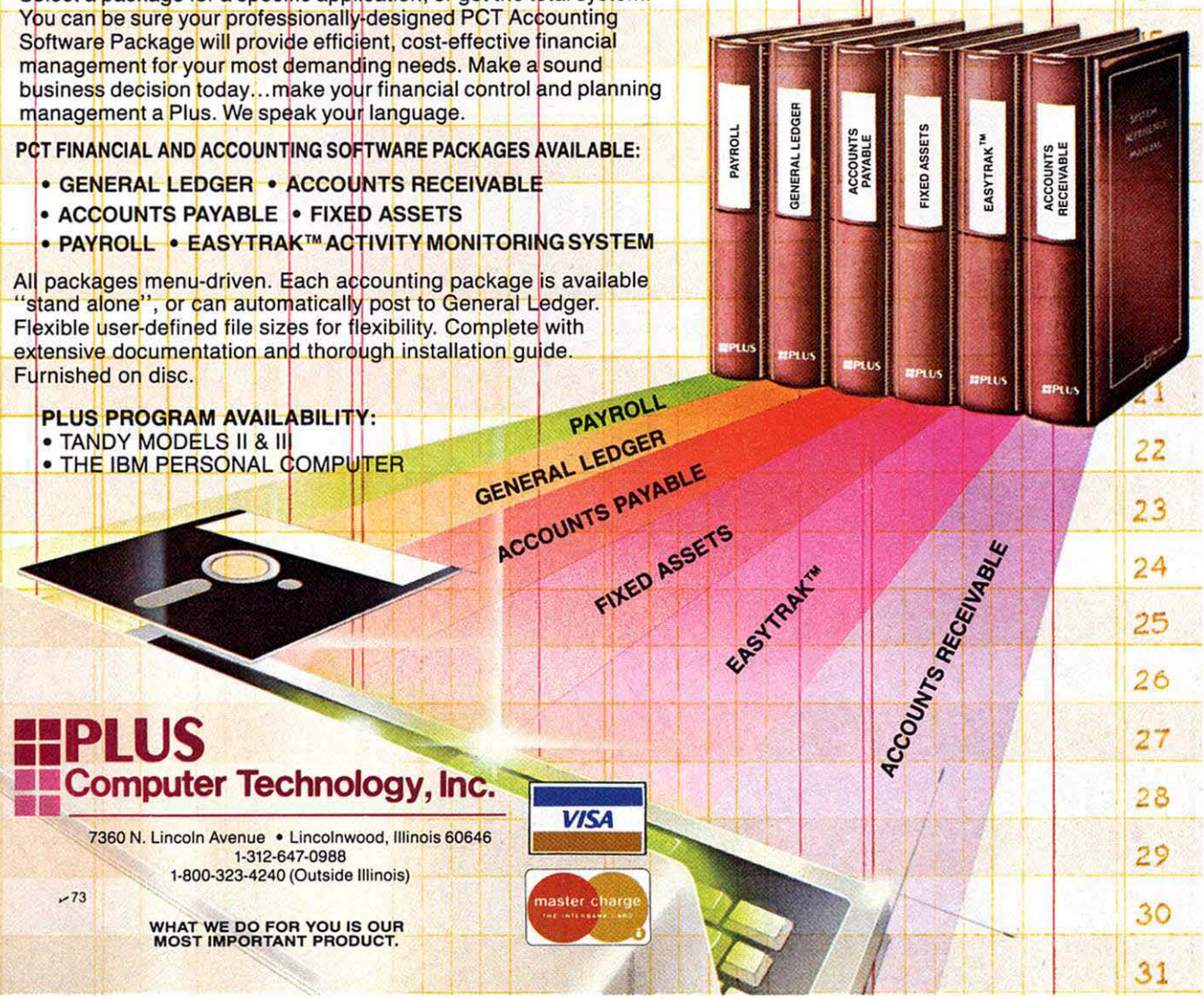

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If you decide you do not want to delete any lines, or you forget what their line numbers are, you can type in 0,0 and return to the command mode. If a single note is to be deleted, enter its line number as both first and last numbers.

Insert allows you to insert notes between other notes in the score. It prompts you to enter the line to begin inserting. Enter the line number where you want the new notes to go. All notes after and including the line to begin inserting are pushed down. Enter the notes in the same fashion described under Compose. Enter a blank line to get back to the command mode.

Replace is very similar to Compose and Insert, except the lines are overlaid, or replaced. You are prompted to enter the line to begin replacing. As in the other two commands, simply enter a blank line to get back to the command mode. Add is identical to Compose except the lines are added to the end of the score. Enter a blank line to get back to the command mode.

Play translates each note into a special code used by the machine-language routine and POKEs it into memory starting at 31232 decimal. A line count-

Listing 1 continued

```
6570 IFI=LTHENA$=A$+".":PRINT#-1,A$:GOTO520
6580 IFLEN(A$)=240THENPRINT@62,"**";:PRINT#-1,A$:GOTO6550
6590 GOTO6560
7000 '**********  VIEW (KEY SCAN)  **********
7010 '
7020 A$=INKEY$:IFA$=""THEN7020
7030 IFASC(A$)=32THENC=1:RETURN
7040 IFASC(A$)=13THENC=15:RETURN
7050 GOTO7020
7500 '**********  INSTR SUBROUTINE  **********
7510 '
7520 P=0
7530 FORI1=1TOLEN(S0$)
7540 IFMID$(S0$,I1,LEN(S1$))=S1$THENP=I1:I1=LEN(S0$)
7550 NEXTI1:RETURN
8000 '**********  ERROR MESSAGES  **********
8010 '
8020 ONERGOTO8030,8040,8050,8060,8070,8080
8030 PRINT"?Wrong format: "CHR$(34)"-"CHR$(34)" expected.":RETUR
N
8040 PRINT"Numeral expected before "CHR$(34)"-"CHR$(34):RETURN
8050 PRINT"?Incorrect note code":RETURN
8060 PRINT"?Invalid line number":RETURN
8070 PRINT"?Improper sequence":RETURN
8080 PRINT"?Music buffer empty":RETURN
8500 '**********  OPENING MESSAGE  **********
8510 '
8520 CLS:PRINT@149,"MUSIC-80: Version 3.1"
8530 PRINT"Written by: P. M. Freese"
8540 PRINT"80 Microcomputing"
8550 RETURN
9000 IFERR<>44THENONERRORGOTO0
9010 PRINT:IFL<L0THENL=L0
9020 RESUME520
9500 '**********  HELP  **********
9510 '
9520 PRINT"ADD","INSERT","PLAY CONT","SCALE","COMPOSE","KILL","R
ANDOM","TUNE","DELETE","LOAD","REPLACE","VIEW","HELP","PLAY","SA
VE"
9530 GOTO520
```


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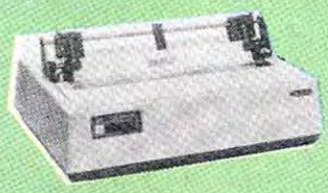

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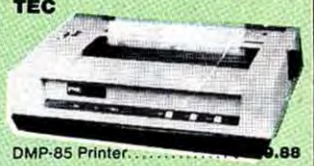

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A terminal program from Micro-Systems Software, makers of DOSPLUS. Microterm supports the features on auto-dial & answer modems like the Lynx & Smartmodem. Features pre-programmed dial & transmit, direct file transfer, 34K capture buffer, and high operational baud rate (near 9600). Specify Model I or Model III when ordering
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SOFTWARE

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The preferred disk operating system for Model I or III. Features BASIC array sort, (multi-key, multi-array), active "DO", device routing, DOS command repeat, etc. Exceptional. Specify Model I or III, single or double track, 40 or 80 track drive
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NewScript
Prosoft's **NewScript** is the best word processing software available for the TRS-80 Model I or III. **NewScript** supports the features of most popular printers, including NEC, C. Itoh, Okidata, Epson, Centronics, etc.
NewScript features true proportional spacing, single and double width type, subscripts, superscripts, underlining, boldface, multiple pitches, full-screen editing, global search & replace, and customized "form" letters that also will create a MAIL LABEL (see below).
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Mailing Label Option **$15.00**

ScripSit/NewScript Conversion
Takes either Electric Pencil or Scripsit files and converts them to **NewScript** files. Upgrade your older library of files with this handy program.
Scriptsit Conversion **$15.00**

Electric Webster
A 50,000 word dictionary for **NewScript**. It can be selected from the main menu, used, then returns you to main menu. The Electric Webster features spell checking, options on change, & a "browse" feature allowing you to choose spellings or to enter your own. Fully compatible with **NewScript**.
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er is given in the upper right corner of the screen. When the entire score has been translated, the music will be played once through the cassette output port.

If you do not have an amplifier to hook up to the auxiliary plug, you can record the music on tape and then play it back. Just get a tape ready before you type in Play and make sure you have the record and play buttons pushed down. The recorder turns on automatically and then turns off when the score is complete.

Play Cont or Play/Cont accomplishes the same thing as Play, except the score is played over and over again until the enter key is pressed. View is used for displaying the score. You can scroll up a single line by pressing the space bar or scroll up a page by pressing enter.

Kill does what its name implies: It clears the entire music buffer. It queries on whether you are sure you want to kill the present score. If you are sure, just press the Y key. Otherwise just press N and the score remains intact.

Load allows you to load a previously recorded musical score from tape. Any notes in memory are wiped out. A set of asterisks in the upper right corner let you know it's loading. The right one flashes on and off as each record is loaded. A slight delay may occur as

where N =	Effect on break key
23	Disable break key, return as ASCII value 2
49	Causes computer to lock up
51	Computer goes to "Memory Size?" question
201	Normal
207	Generates an ?SN ERROR
213	Generates an ?L3 ERROR
245	Generates an ?FC ERROR

Table 2. Break Key Control

Program Listing 2. J.S. Bach, Sonata #6 in G Major

```
1 )  16-G2
2 )  16-REST
3 )  8-REST
4 )  16-G2
5 )  16-REST
6 )  8-REST
7 )  8-G2
8 )  16-F2#
9 )  16-E2
10 )  8-D2
11 )  8-C2
12 )  8-B1
13 )  8-G2
14 )  8-A1
15 )  8-F2#
16 )  8-G1
17 )  16-G2
18 )  16-F2#
19 )  16-G2
20 )  16-A2
21 )  16-B2
22 )  16-C3#
23 )  16-D3
24 )  16-REST
25 )  8-REST
26 )  16-D3
27 )  16-REST
28 )  8-REST
29 )  8-D3
30 )  16-C3#
31 )  16-B2
32 )  16-A2
33 )  16-D3
34 )  16-G2
35 )  16-D3
36 )  16-F2#
37 )  16-D3
38 )  16-C3#
39 )  16-D3
40 )  16-E2
41 )  16-D3
42 )  16-C3#
43 )  16-D3
44 )  4-D2
45 )  8-REST
46 )  16-A1
47 )  16-F1#
48 )  16-D1
49 )  16-REST
50 )  16-D1
51 )  16-REST
52 )  8-D1
53 )  16-B1
54 )  16-G1
55 )  16-D1
56 )  16-REST
57 )  16-D1
58 )  16-REST
59 )  8-D1
60 )  16-C2
61 )  16-A1
62 )  16-D1
63 )  16-REST
64 )  16-D1
65 )  16-REST
66 )  8-D1
67 )  16-F1#
68 )  16-A1
69 )  8-C2
70 )  16-A1
71 )  16-C2
72 )  8-F2#
73 )  16-C2
74 )  16-F2#
75 )  16-G2
76 )  16-REST
77 )  8-A2
78 )  8-F2#
79 )  8-G2
80 )  8-REST
81 )  16-B1
82 )  16-A1
83 )  16-C2
84 )  16-B1
85 )  16-A1
86 )  16-G1
87 )  16-G2
88 )  16-REST
89 )  8-A1
90 )  8-F1#
91 )  8-G1
92 )  16-F2
93 )  16-REST
94 )  16-F2
95 )  16-REST
96 )  8-F2
97 )  8-B1
98 )  16-E2
99 )  16-REST
100 )  8-A2
101 )  8-F2#
102 )  8-G2
103 )  8-A1
104 )  16-B1
105 )  16-C2
106 )  8-D2
107 )  8-C2
108 )  4-B1
109 )  32-A1
110 )  32-B1
111 )  32-A1
112 )  32-B1
113 )  32-A1
114 )  32-B1
115 )  32-A1
116 )  32-B1
117 )  8-G1
118 )  16-A1
119 )  16-B1
120 )  16-C2
121 )  16-D2
122 )  16-E2
123 )  16-F2#
124 )  16-G2
125 )  16-D2
126 )  8-B2
127 )  16-B2
128 )  16-A2
129 )  16-G2
130 )  16-F2#
131 )  16-G2
132 )  16-B2
133 )  8-D2
134 )  16-D2
135 )  16-F2
136 )  16-E2
137 )  16-D2
138 )  16-E2
139 )  16-C2
140 )  8-G2
141 )  16-G2
142 )  16-F2
143 )  16-E2
144 )  16-D2
145 )  16-E2
146 )  16-G2
147 )  8-C2
148 )  16-C2
149 )  16-B1
150 )  16-A1
151 )  16-G1
152 )  16-A1
153 )  16-F1#
154 )  8-C2
155 )  16-C2
156 )  16-B1
157 )  16-A1
158 )  16-G1
159 )  16-A1
160 )  16-C2
161 )  8-F1#
162 )  16-F1#
163 )  16-A1
164 )  16-G1
165 )  16-F1#
166 )  16-G1
167 )  16-D1
168 )  16-G1
169 )  16-B1
170 )  16-D2
171 )  16-B1
172 )  8-G2
173 )  32-B1
174 )  32-C2
175 )  32-B1
176 )  32-C2
177 )  8-A1
178 )  4-G1
179 )  8-REST
180 )  8-A1
181 )  8-D2
182 )  8-E2
183 )  16-F2#
184 )  16-D2
185 )  16-F2#
186 )  16-A2
187 )  8-C3
188 )  4-REST
189 )  8-G1
190 )  8-B1
191 )  8-D2
192 )  16-G2
193 )  16-D2
194 )  16-G2
195 )  16-A2
196 )  8-B2
197 )  4-REST
198 )  16-C2#
199 )  16-D2
200 )  16-E2
201 )  16-F2#
202 )  4-G2
203 )  16-E2
204 )  16-C2#
205 )  8-A1
206 )  4-G2
207 )  8-A2
208 )  8-F2#
209 )  8-D2
210 )  16-D2
211 )  16-B1
212 )  16-C2#
213 )  16-F2#
214 )  16-E2
215 )  16-D2
216 )  16-C2#
217 )  16-B1
218 )  16-A1
219 )  16-C2#
220 )  16-E2
221 )  16-C2#
222 )  16-A2
223 )  16-E2
224 )  16-C2#
225 )  16-E2
226 )  16-A1
227 )  16-C2#
```

Listing 2 continues

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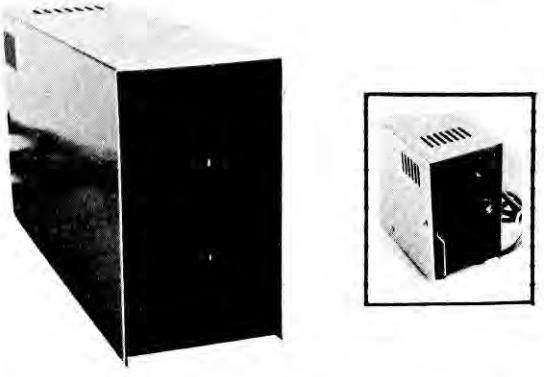

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Listing 2 continued

```
228 )   16-E2
229 )   16-C2#
230 )   16-A2
231 )   16-E2
232 )   16-C2#
233 )   16-E2
234 )   16-A1
235 )   16-D2
236 )   16-F2#
237 )   16-D2
238 )   16-A2
239 )   16-F2#
240 )   16-D2
241 )   16-F2#
242 )   16-A1
243 )   16-C2
244 )   16-F2#
245 )   16-C2
246 )   16-A2
247 )   16-F2#
248 )   16-C2
249 )   16-F2#
250 )   16-B1
251 )   16-D2
252 )   16-G2
253 )   16-D2
254 )   16-B2
255 )   16-G2
256 )   16-D2
257 )   16-G2
258 )   16-B1
259 )   16-D2
260 )   16-G2
261 )   16-D2
262 )   16-B2
263 )   16-G2
264 )   16-D2
265 )   16-G2
266 )   16-C2
267 )   16-E2
268 )   16-G2
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270 )   16-B2
271 )   16-G2
272 )   16-E2
273 )   16-G2
274 )   16-C2
275 )   16-E2
276 )   16-G2
277 )   16-E2
278 )   16-B2
279 )   16-G2
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284 )   16-E2
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287 )   16-E2
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291 )   16-C2
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300 )   16-F2#
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304 )   16-D2#
305 )   16-F2#
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307 )   16-D2#
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311 )   16-F2#
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313 )   16-F2#
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315 )   16-D2#
316 )   16-E2
317 )   16-D2#
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321 )   16-E2
322 )   16-B1
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324 )   16-E2
325 )   16-D2#
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327 )   16-E2
328 )   16-D2#
329 )   16-E2
330 )   16-B1
331 )   16-D2#
332 )   16-E2
333 )   16-D2#
334 )   16-F2#
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336 )   16-D2#
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338 )   16-A1
339 )   16-D2#
340 )   16-E2
341 )   16-D2#
342 )   16-F2#
343 )   16-E2
344 )   16-D2#
345 )   16-E2
346 )   8-E1
347 )   16-E2
348 )   16-REST
349 )   8-REST
350 )   4-E2
351 )   16-D2
352 )   16-C2
353 )   16-B1
354 )   16-E2
355 )   16-A1
356 )   16-E2
357 )   16-G1
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359 )   8-E2
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361 )   8-D2#
362 )   16-E1
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364 )   16-E1
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366 )   16-G1
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380 )   16-D2
381 )   16-C2
382 )   4-G2
383 )   8-G2
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385 )   16-E2
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387 )   16-C2
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389 )   16-A1
390 )   8-B1
391 )   8-G1
392 )   8-REST
393 )   16-E2
394 )   16-C2#
395 )   16-A1
396 )   16-REST
397 )   16-A1
398 )   16-REST
399 )   8-A1
400 )   16-F2#
401 )   16-D2
402 )   16-A1
403 )   16-REST
404 )   16-A1
405 )   16-REST
406 )   8-A1
407 )   16-G2
408 )   16-E2
409 )   16-A1
410 )   16-REST
411 )   16-A1
412 )   16-REST
413 )   8-A1
414 )   16-C2#
415 )   16-E2
416 )   8-G2
417 )   16-E2
418 )   16-C2#
419 )   8-A1
420 )   16-C2#
421 )   16-E2
422 )   16-F2#
423 )   16-REST
424 )   8-G2
425 )   8-E2
426 )   8-F2#
427 )   16-A1
428 )   16-REST
429 )   16-A1
430 )   16-REST
431 )   8-A1
432 )   8-F2#
433 )   16-G1
434 )   16-REST
435 )   8-G2
436 )   8-E2
437 )   8-F2#
438 )   8-REST
439 )   16-F1#
440 )   16-E1
441 )   16-G1
442 )   16-F1#
443 )   16-E1
444 )   16-D1
445 )   16-D2
446 )   16-REST
447 )   8-G2
448 )   8-E2
449 )   8-F2#
450 )   8-C2#
451 )   8-A1
452 )   4-D2
453 )   16-D2
454 )   16-F2#
455 )   8-A2
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457 )   16-E2
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460 )   8-F2#
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471 )   16-REST
472 )   8-REST
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475 )   16-B1
476 )   16-A1
477 )   16-D2
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479 )   16-D2
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481 )   16-D2
482 )   16-C2#
483 )   16-D2
484 )   16-E1
485 )   16-D2
486 )   16-C2#
487 )   16-D2
488 )   4-D1
489 )   8-REST
490 )   16-A1
491 )   16-F1#
492 )   16-D1
493 )   16-REST
```

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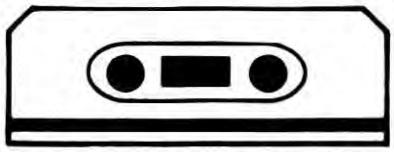

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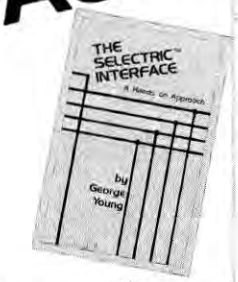

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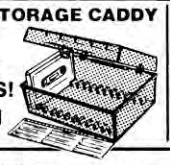

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Listing 2 continued

```
494 )  16-D1
495 )  16-REST
496 )  8-D1
497 )  16-B1
498 )  16-G1
499 )  16-D1
500 )  16-REST
501 )  16-D1
502 )  16-REST
503 )  8-D1
504 )  16-C2
505 )  16-A1
506 )  16-D1
507 )  16-REST
508 )  16-D1
509 )  16-REST
510 )  8-D1
511 )  16-F1#
512 )  16-A1
513 )  8-C2
514 )  16-A1
515 )  16-C2
516 )  8-F2#
517 )  16-C2
518 )  16-F2#
519 )  16-G2
520 )  16-REST
521 )  8-A2
522 )  8-F2#
523 )  8-G2
524 )  8-REST
525 )  16-B1
526 )  16-A1
527 )  16-C2
528 )  16-B1
529 )  16-A1
530 )  16-G1
531 )  16-G2
532 )  16-REST
533 )  8-A1
534 )  8-F1#
535 )  8-G1
536 )  16-F2
537 )  16-REST
538 )  16-F2
539 )  16-REST
540 )  8-F2
541 )  8-B1
542 )  16-E2
543 )  16-REST
544 )  8-A2
545 )  8-F2#
546 )  8-G2
547 )  8-A1
548 )  16-B1
549 )  16-C2
550 )  8-D2
551 )  8-C2
552 )  4-B1
553 )  32-A1
554 )  32-B1
555 )  32-A1
556 )  32-B1
557 )  32-A1
558 )  32-B1
559 )  32-A1
560 )  32-B1
561 )  1-G1
562 )  1-G1
563 )  1-REST
564 )  1-REST
565 )  1-REST
566 )  1-REST
```

```
1 )  16-G1
2 )  16-A1#
3 )  16-D2#
4 )  16-D2
5 )  16-D2#
6 )  32-A1#
7 )  32-REST
8 )  16-A1#
9 )  32-G1#
10 )  32-REST
11 )  16-G1#
12 )  32-G1
13 )  32-REST
14 )  16-G1
15 )  32-F1
16 )  32-REST
17 )  16-F1
18 )  16-A1#
19 )  16-D2
20 )  16-C2
21 )  16-D2
22 )  32-G1#
23 )  32-REST
24 )  16-G1#
25 )  32-G1
26 )  32-REST
27 )  16-G1
28 )  32-F1
29 )  32-REST
30 )  16-F1
31 )  32-D1#
32 )  32-REST
33 )  16-D1#
34 )  16-G1
35 )  16-C2
36 )  16-A1#
37 )  16-C2
38 )  32-G1
39 )  32-REST
40 )  16-G1
41 )  32-F1
42 )  32-REST
43 )  16-F1
44 )  32-D1#
45 )  32-REST
46 )  16-D1#
47 )  32-D1
48 )  32-REST
49 )  16-D1
50 )  16-F1
51 )  16-A1#
52 )  16-G1#
53 )  16-A1#
54 )  32-F1
55 )  32-REST
56 )  16-F1
57 )  32-D1#
58 )  32-REST
59 )  16-D1#
60 )  32-C1#
61 )  32-REST
62 )  16-C1#
63 )  32-C1
64 )  32-REST
65 )  8-C1
66 )  4-C2
67 )  8-F2
68 )  16-F2
69 )  16-G2#
70 )  16-G2
71 )  16-F2
72 )  32-E2
73 )  36-F2
74 )  32-E2
75 )  36-F2
76 )  40-E2
77 )  44-F2
78 )  48-E2
79 )  52-F2
80 )  56-E2
81 )  60-F2
82 )  64-E2
83 )  64-F2
84 )  64-E2
85 )  64-F2
86 )  8-E2
87 )  4-F2
```

Program Listing 3. J.S. Bach, Opening Measures of Sonata #2 in E Minor

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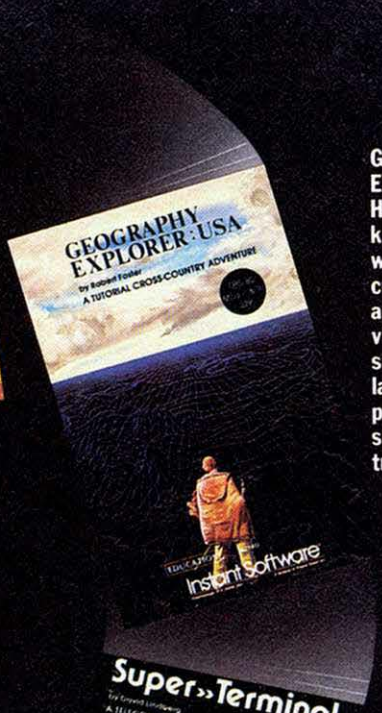

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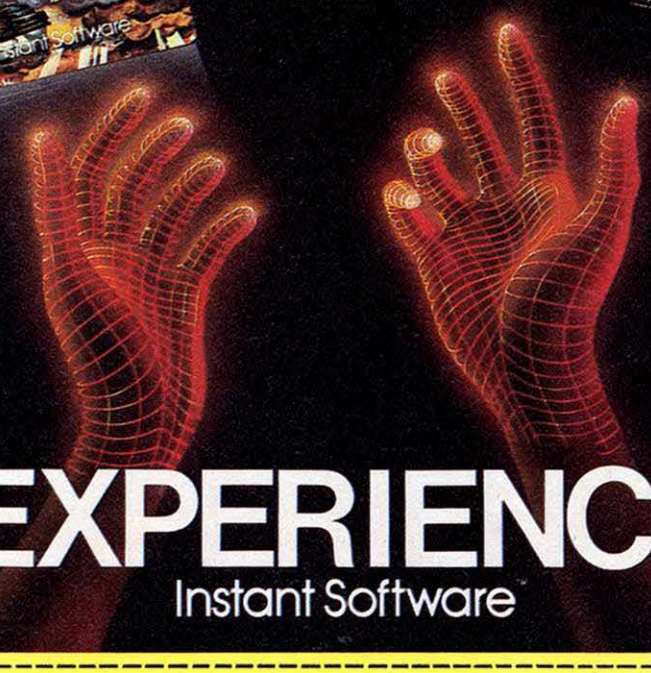

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Basic rearranges string storage space.

Save lets you save the score in memory on tape. A set of asterisks in the upper right corner let you know it's saving. The right one flashes on and off as each record is written. As in the save routine, a slight delay may occur as Basic rearranges string storage space.

Random loads the data set with 60 random notes, and then executes a Play Cont.

Scale loads the data set with a chromatic scale of 36 notes starting with A0 and ending with G3#. It then executes a Play Cont.

Tune allows you to run through the initial startup procedure where you entered the base note and answered the "Which notes get one beat?" question.

Help lists Music-80's command set. Use this if you forget what commands are available.

Special Features

At any time during the program execution, the break key can be used as an abort key to return to Music-80's command mode. This feature is accomplished by causing the break key to generate an ?L3 error. The error-trapping routine at line 9000 checks for an ?L3 error (error code 44). If so, it resumes at line 520, which is Music-80's command processor. Otherwise it generates the appropriate error message.

Here is how the program controls the break key. When Basic is interpreting a program, it periodically scans the keyboard. It checks for any key being pressed and stuffs its ASCII value in a location to be read by the INKEY$ statement. If that value is a shift @, then the interpreter pauses the program. If the ASCII value is a 01 (code for break key), the interpreter subsequently does a RST 6, which in turn jumps to RAM RST vector 6 at 400C hex (16396 decimal).

Table 1 shows what the RST vectors look like normally. At this point in Basic's execution, the accumulator contains the ASCII code for the break key (01). If I change the accumulator's contents, I can fool the interpreter into thinking the break key wasn't pressed, thus disabling the break key.

In addition to the accumulator containing a 01, the DE register pair contains a memory location that we can jump to in order to generate an ?L3 error. If I push DE onto the stack (213 is the decimal code for the PUSH DE instruction), then that address is used for the return instruction. Table 2 shows the effects certain values have on the break key when they are POKEd into 400C hex.

"High-resolution graphics depicting musical scores are impractical on the TRS-80. . ."

Another special feature of Music-80 is the compressed tape format for the Load and Save routines. The music score is stored in a large array. If you write each element of the array to the cassette individually with a PRINT #-1 statement, then each note gets a separate leader, sync byte, data block, and so on (about 5 seconds to write each record).

If a score has 300 notes, then storing it on tape takes 300 leaders, sync bytes, and data blocks. That would take a long time to save. Therefore, I organized the data into blocks of 120 notes each (except for the last block, which will generally have less). Since each note uses two bytes, each block is 240 characters long. I found that data would be lost if I used records with lengths over 248, so I decided on 240, just to be safe. These blocks are written out to the cassette as a single entity, drastically reducing the time it would take to Load/Save the music buffer.

Entering and Playing Music

Enter trills as a series of 32nd notes. Enter dotted notes as two notes (i.e., enter a dotted eighth note as an eighth note and a sixteenth note).

```
210 CLEAR13000:DEFINTA-Z:ONERRORGOTO9000
220 DIMTAU(36),NT$(36),MUSIC$(1500),FR(36),B,N:GOSUB230:GOTO350
260 S=-4608:RESTORE
280 SP=-4352
330 POKE16526,0:POKE16527,238:POKE16396,213
Change the fifth data item from 121 to 238
3550 SP=-4352:CLS

Set memory size to 60900
```

Program Listing 4a. Modifications for 32K machines

```
210 CLEAR8000:DEFINTA-Z:ONERRORGOTO9000
220 DIMTAU(36),NT$(36),MUSIC$(1000),FR(36),B,N:GOSUB230:GOTO350
260 S=-19456:RESTORE
280 SP= 19170
330 POKE16526,0:POKE16527,180:POKE16396,213
360 Change the fifth data item from 121 to 180
3550 SP=-19170:CLS

Set memory size to 46000
```

Program Listing 4b. Modifications for 48K machines

Program Listing 5

```
10 CMD"T"
20 CLEAR 1000
30 DEFINT A-Z
40 DIM N$(36)
50 FOR I=0 TO 36:READ N$(I):NEXT I
60 DATA A0,A0#,B0,C1,C1#,D1,D1#,E1,F1,F1#,G1,G1#,A1,A1#,B1,C2,C2
#,D2,D2#,E2,F2,F2#,G2,G2#,A2,A2#,B2,C3,C3#,D3,D3#,E3,F3,F3#,G3,G
3#,REST
70 DEF FNS$(Z)=MID$(STR$(Z),2)
80 INPUT"FILENAME";F$
90 OPEN "O",1,F$
100 LINE INPUT"PRESS ENTER WHEN TAPE IS READY";D$
110 K=1
120 L=1
130 INPUT#-1,A$
140 A1$=MID$(A$,L,2)
150 IF A1$="" THEN 120 ELSE IF A1$="." THEN 170
```

Listing 5 continues

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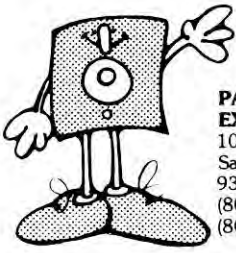

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Listing 5 continued

```
160 PRINT #1,K;")   ";FNS$(ASC(A1$)-127);"-";N$(ASC(MID$(A1$,2))-
128):L=L+2:K=K+1:GOTO 140
170 CMD"R":CLOSE:END
```

```
10 CMD"T"
20 CLEAR 1000
30 DEFINT A-Z
40 DIM N$(36)
50 FOR I=0 TO 36:READ N$(I):NEXT I
60 DATA A0,A0#,B0,C1,C1#,D1,D1#,E1,F1,F1#,G1,G1#,A1,A1#,B1,C2,C2
#,D2,D2#,E2,F2,F2#,G2,G2#,A2,A2#,B2,C3,C3#,D3,D3#,E3,F3,F3#,G3,G
3#,REST
70 CLS
80 INPUT"FILENAME";F$
90 OPEN "I",1,F$:R=0
100 LINE INPUT"PRESS ENTER WHEN TAPE IS READY";D$
110 A$=""
120 PRINT @ 63," ";
130 INPUT #1,L$:R=R+1:PRINT @ 128,R;"RECORDS READ.";
140 P=INSTR(L$,")"):IF P=0 THEN 280
150 L$=MID$(L$,P+1)
160 P=INSTR(L$,"-"):IF P=0 THEN 280
170 L1$=LEFT$(L$,P-1):L2$=MID$(L$,P+1)
180 A1=VAL(L1$):IF A1=0 THEN 280
190 A2=-1
200 FOR I=0 TO 36
210 IF L2$=N$(I) THEN A2=I
220 NEXT I
230 IF A2<0 THEN 280
240 A$=A$+CHR$(127+A1)+CHR$(128+A2)
250 IF EOF(1) THEN A$=A$+".":PRINT @ 62,"**";:PRINT # -1,A$:PRIN
T @ 63," ";:CLOSE:PRINT @ 192,"DONE.":CMD"R":END
260 IF LEN(A$)=240 THEN PRINT @ 62,"**";:PRINT # -1,A$:GOTO 110
270 GOTO 130
280 PRINT"ERROR.":CLOSE:CMD"R":END
```

Program Listing 6

Play the scores at about 120–180 beats per minute. At slower speeds the songs drag along and at faster speeds it becomes difficult to distinguish between notes.

Modifying the Program

A few changes to the program allow it to run on your 32K or 48K TRS-80. These changes *do not* modify the program for Disk Basic, they simply allow it to use more memory. Program Listings 4a and 4b show these changes.

If you want to put score data on disk, Program Listing 5 does just that. I used it to get listings of score data by transferring the data to disk, and then listing the newly created file with Print.

You can edit these files with a disk text editor and then put them back on tape using Program Listing 6.

You might use Music-80 to create a game that plays a song at the beginning and the ending. Maybe you could write a program that composes music of reasonable quality. ■

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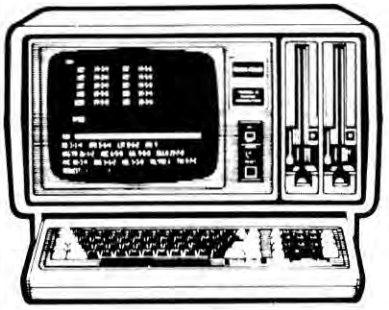

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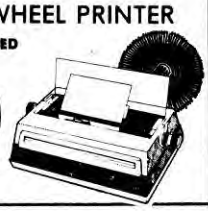

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Ward off the invading hordes.

Turret

Adam Finkelstein
21 Oak Tree Lane
Irvine, CA 92715

If you enjoy arcade games but do not enjoy feeding quarter after quarter into that ever-hungry slot then you will want to try Turret.

Turret is like Space Invaders, but there is only one invader on the screen at any given time. The object is to ward off the invading fleet before it lands. Each invader starts at the top of the screen and moves at random—right, left, and down—taking from six to twenty-five seconds to land, depending on your skill level (1-10). You control a turret that moves right and left along the bottom of the screen. You fire missiles from the turret toward the invader; if the missile hits the invader a spectacular graphic explosion occurs. If the missile passes the invader you have another chance to shoot (only one missile can be on the screen at any time).

The computer keeps track of your score and energy units. It takes seven energy units to fire a missile and two more to turn it as you guide it at the invader. If the invader lands before you shoot it, it destroys a random number of energy units. If your score reaches five hundred before your energy reaches zero you have warded off the invading fleet!

Controlling the turret and its missiles is easy.

Key 4 moves the turret left;
6 moves it right;
5 fires the missile;
A guides the missile left; and
D guides the missile right.

This program uses PEEKs. If you press a key and hold it down the computer repeats the action until you let go. For example, press 4 to continue moving the turret left. You can press more than one key at a time and the computer will respond to them. You can press 4 and 5 and A at the same time; the turret will move left, fire, and the missile will move left at once. To make things easier, use your left hand on the A and the D and put your right hand on the number pad 4, 5, and 6.

The Screen

Nine stars in the background add a nice atmosphere to an otherwise blank screen. The invader is in constant motion. Your score and energy units appear on the bottom of the screen. One line above that is the turret. When you hit the invader there is a graphic explosion about an inch in diameter. This is the scene for a fast and exciting real-time Space Invader game. ■

The Key Box

Model I or III
Cassette or Disk Basic

```
0 REM ----- CREATING GRAPHIC STRINGS FOR EXPLOSION -----
10 CLS:CLEAR 2000:RANDOM
20 PRINT CHR$(23):PRINT @470, "TURRET"
30 FOR K=1 TO 10:PRINT @0, 10-K
40 A$(K)=CHR$(RND(4)*16+112)+CHR$(RND(16)*4+124)
50 FOR I=1 TO 4:A$(K)=A$(K)+CHR$(RND(64)+127):NEXT I
60 A$(K)=A$(K)+CHR$(RND(16)*4+124)+CHR$(RND(4)*16+112)+CHR$(26)
   +STRING$(9,2 4)
70 FOR I=1 TO 10:A$(K)=A$(K)+CHR$(RND(64)+127):NEXT I
80 A$(K)=A$(K)+CHR$(26)+STRING$(9,24)+CHR$(RND(4)+127)+CHR$(RND(16)
   +127)
90 FOR I=1 TO 4:A$(K)=A$(K)+CHR$(RND(64)+127):NEXT I
100 A$(K)=A$(K)+CHR$(RND(16)+127)+CHR$(RND(4)+127)
110 NEXT K
120 REM ----- CREATE TURRET -----
130 FOR I=0 TO 1:FOR J=1 TO 4:READ M:S$(I)=S$(I)+CHR$(M):NEXT J,I
140 DATA 24,184,91,180,24,184,32,180
200 REM ----- MAIN PROGRAM -----
210 CLS:DEFINT A-Z:DIM S(9):EU=500
220 FOR I=1 TO 9:S(I)=RND(896)-1:NEXT I
230 INPUT "WHAT SKILL LEVEL (1-EASY TO 10-HARD)";L:IF L>0 AND L<11
    IF L<8 I
F L<4 THEN Q=1 ELSE Q=2 ELSE Q=3 ELSE 230
240 E=0:D=RND(2)-1:A=926:X=90
250 CLS:PRINT @960, "POINTS: ";P;:PRINT @989, "ENERGY UNITS: ";EU;
260 FOR I=1 TO 9:PRINT @S(I), ".";:NEXTI
270 PRINT @B, CHR$(24);STRING$(3,32);:PRINT @A, S$(E);
280 IF E=1 THEN PRINT @G, " ";:PRINT @F, "[";:IF F<X+5 AND F>X-1
    THEN 560
290 Z=PEEK(14352):IF EU<1 THEN Z=0:EU=0:G=F:F=64:E=2:L=10
300 IF Z=48 AND E=1 THEN B=A:A=A-2
310 IF Z=96 AND E=1 THEN B=A:A=A+2
320 IF Z=48 AND E=0 THEN B=A:A=A-2:E=1:F=A:EU=EU-7
330 IF Z=96 AND E=0 THEN B=A:A=A+2:E=1:F=A:EU=EU-7
340 IF Z=16 THEN B=A:A=A-2
350 IF Z=64 THEN B=A:A=A+2
360 IF Z=32 AND E=0 THEN E=1:F=A:EU=EU-7
370 IF A<897 THEN A=958
380 IF A>958 THEN A=897
390 IF RND(9)=4 THEN D=1-D
400 IF RND(12-L)=1 THEN PRINT @X, STRING$(5,32);:X=X+64
410 IF D=1 THEN X=X+Q ELSE X=X-Q
420 PRINT @X-Q, STRING$(5+2*Q,32);:PRINT @X, "<=+=>";
430 S=S+1:IF S>9 THEN S=1
440 PRINT @S(S), ".";
450 IF X>890 THEN 500
460 IF E=1 AND F<X+5 AND F>X-1 THEN 560
470 IF E=1 THEN G=F:F=F-64:GOTO 800
480 IF E>0 AND F<X THEN E=0:PRINT @G, " ";:G=0
490 PRINT @1003, EU;:GOTO 270
500 CLS:PRINT CHR$(23):N=RND(50)+49:IFN>EU THEN N=EU
510 PRINT "OH, NO - THE ALIEN LANDED !!!"
520 PRINT "YOU LOST";N;"OF YOUR ENERGY UNITS"
540 PRINT "... TOO BAD !!!"
550 FOR I=1 TO 1900:NEXT I:P=P-15:EU=EU-N:IF EU=0 THEN 600
    ELSE GOTO 240
560 PRINT @G, ".";:PO=POS(0):PRINT @X, STRING$(5,32);
570 IF PO=0 THEN F=F+1
580 IF PO>54 THEN F=F+54-PO
590 GOTO 700
600 CLS:PRINT CHR$(23):PRINT "WELL, THAT'S THE END OF YOUR"
610 PRINT "ENERGY SUPPLY.  YOU HAD";P:PRINT"POINTS."
620 P$="Y":PRINT:INPUT "DO YOU WANT TO PLAY AGAIN";P$
630 IF LEFT$(P$,1)="Y" THEN RUN ELSE CLS:END
700 LX=RND(5)+3:FOR I=1 TO LX:FOR K=1 TO 10:PRINT @F-64, A$(K);
710 P=P+1:PRINT @968, P;:NEXT K,I:IF P<500 THEN 240
720 CLS:PRINT CHR$(23):PRINT "CONGRATULATIONS..."
730 PRINT "YOU WARDED OFF THE ENEMY FLEET"
740 PRINT "WITH";EU;"OF YOUR ENERGY LEFT"
750 PRINT "LEFT.  YOU HAD";P;"POINTS.":GOTO620
800 Z=PEEK(14343)
810 IF Z=2 THEN F=F-1:EU=EU-2
820 IF Z=16 THEN F=F+1:EU=EU-2
830 GOTO 480
```

Program Listing

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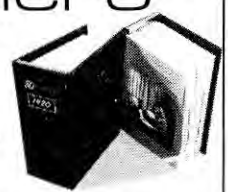

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A Color Computer makes judging easy.

Scholastic Bowl

James W. Wood
424 N. Missouri, Box 507
Atwood, IL 61913

High school scholastic bowl is gaining popularity. Scholastic meets are based on the college bowl game. A moderator reads a toss-up question to two teams of five players. The first player to push his switch gets a chance to answer the question. For a correct answer the team receives ten points and the chance to answer a twenty point bonus. An incorrect answer gives the other team a chance to respond to the toss-up. The teams have only fifteen seconds after the moderator reads the toss-up to answer. Table 1 lists the complete rules of the game.

Originally, contestants raised their hands. Various electronic designs showed who pushed his switch first by turning on that player's light. Sounds signaled the moderator that someone had pushed his switch and he should stop reading the question. Circuits can be added to lock out the players' switches after fifteen seconds, eliminating the judgement call of whether a light was on before time expired.

The equipment to do all this is expensive and hard to obtain. A TRS-80 Color Computer, a few parts, and my program can make a system which works better and costs less.

Program Listing 1 is for a 4K Color Computer; it does not include the timer. Program Listing 2 requires 16K Extended Color Basic because it uses the Timer command.

In Listing 1 the program scans the joystick readings until someone pushes a switch. The closed switch returns a joystick input value other than zero. With nonzero values, the program determines which switch was pushed and lights the area under the corresponding number. Numbers 1-5 are for the players of the team on the moderator's left, 6-10 on his right. To reset the computer to start scanning switches again, press any key.

Listing 2 contains several refinements including a timer. There will be no more arguments about who pressed his switch first. The computer locks all switches out after 15 seconds on a toss up question.

Program Description

Lines 20-60 of Listing 2 set up the display for the toss-up question. Lines 70-90 look for a closed switch on the toss up. Lines 100-130 look for a closed switch on the toss-up with the timer. Lines 140-160 set up the display for the bonus question. Lines 170-190 look for a closed switch on the bonus question. Lines 200-230 look for a closed switch on the bonus question with the timer. Lines 240-330 determine which switch is closed. Lines 340-350 produce a sound for the team whose switch is closed. Lines 360-450 route the program to the proper lines for the next toss-up or bonus question.

Modifications

The program will expand to

The Key Box

Extended Color Basic
Color Computer
16K RAM

Each team will consist of five students; one is designated the captain.

An adult who will coach must accompany each team.

Each team must be present at the site of the match at least ten minutes before it is scheduled to begin.

Each match consists of two 12-minute halves with a three minute break between them. If time runs out as the moderator is reading a question, the question will be completed. If the question is a toss up and is answered correctly the moderator will give the bonus question to that team.

A maximum of 40 questions will constitute one round of the contest, (25 toss up and 15 bonus questions). The round will end after 24 minutes or a depletion of toss up or bonus questions, whichever comes first.

Toss up questions are worth 10 points and may be answered by individuals only; no conferring is allowed. The first individual to press his switch is eligible to answer the question for his team. The student must be recognized by the moderator and then give his answer immediately. If the answer is correct, that team gets ten points and the opportunity to answer a bonus question.

Bonus questions are worth 20 points and consist of two or more parts. The team will be given 30 seconds to confer after the moderator has read the question. The captain of the team will give the answer or will designate someone else to answer.

If an individual answers a toss up incorrectly, an individual from the other team may press his switch, be recognized by the moderator, and give an answer. The time remaining to answer a toss up after the first team answers incorrectly is the remainder of the original 15 seconds or 3 seconds, whichever is longer. There are no penalties for wrong answers.

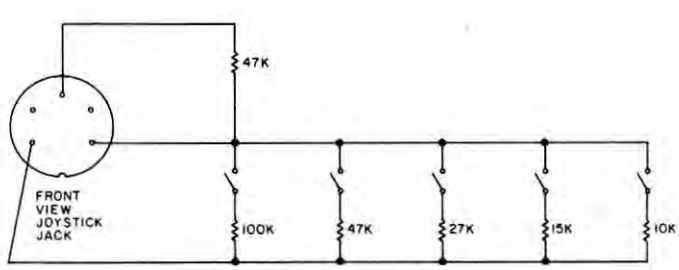
Questions used in the matches are supplied by members of the participating high schools.

The moderator will ask the team members to introduce themselves by pressing their switch. The captain (seated in the middle) will introduce the team coach as well as himself.

During a match, a student will be allowed to talk only at specified times. Any other talking results in a penalty. Students may talk while answering a toss up or a bonus question; while consulting on a bonus question; while asking for a question or a part of a question to be reread; and while introducing themselves or their coach.

If there is a question on procedure or on a particular answer the coach, not the students, should ask it. If the students feel a mistake has been made, the coach should report it for future use. The judge's decision is final.

Table 1. Scholastic Bowl Rules and Regulations



Make both sides' (teams') equipment identical

Figure 1

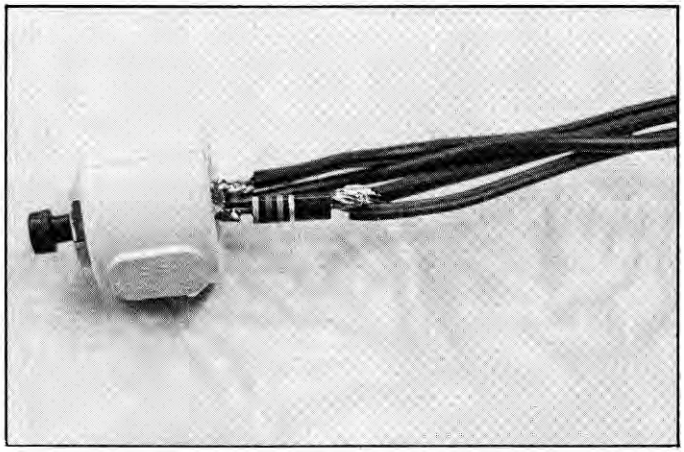


Photo 1. Player's Switch with PVC Pipe.

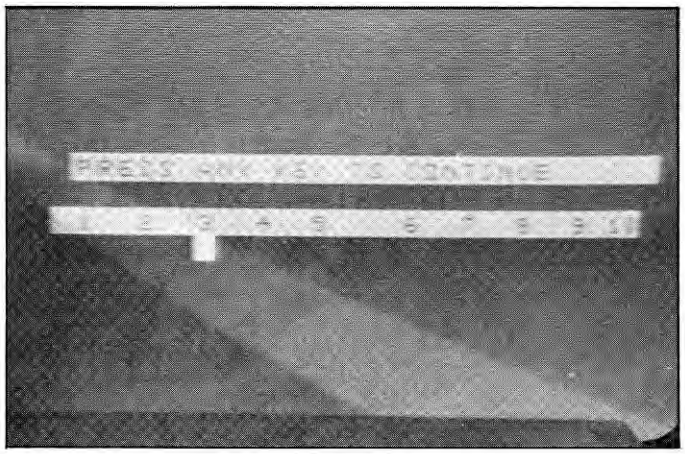


Photo 4. Completed System.

keep a running score from toss-up and bonus questions. The program could also keep track of each contestant's total correct toss-ups for a most valuable player award.

Construction

Constructing the circuit is simple. The only electronic components are resistors and switches (see Fig. 1). Figure 2 shows the parts list. To enclose each player's switch I used PVC pipe (see Photo 1); however, I will build the next set with each switch mounted in a small chassis box. A chassis box will reduce wear and tear on the wires because they will not be moving around constantly in the contestant's hand.

The male joystick jack is not available at any Radio Shack store (figure that out); they can't even order them. But a Switchcraft part #12BL5M costs $3 each and is an exact match.

The hardware is easiest to build starting at the jack. Be sure to leave enough wire between switches so that contes-

Resistors ½ watt, 10 percent
Two 100K ohm
Two 27K ohm
Two 15K ohm
Two 10K ohm
Four 47K ohm
10 spst normally open push-button switches
Wire, 2 and 3 conductor
Two male joystick jacks
Miscellaneous hardware to enclose push-buttons

Fig. 2. Parts List

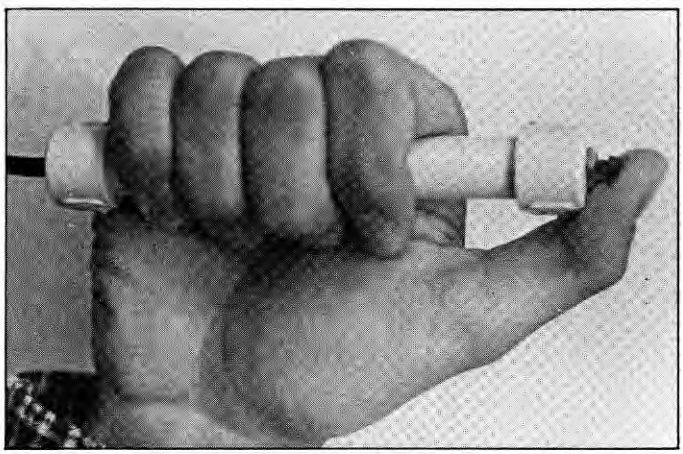


Photo 2. Middle Player on Moderator's Left is Ready.

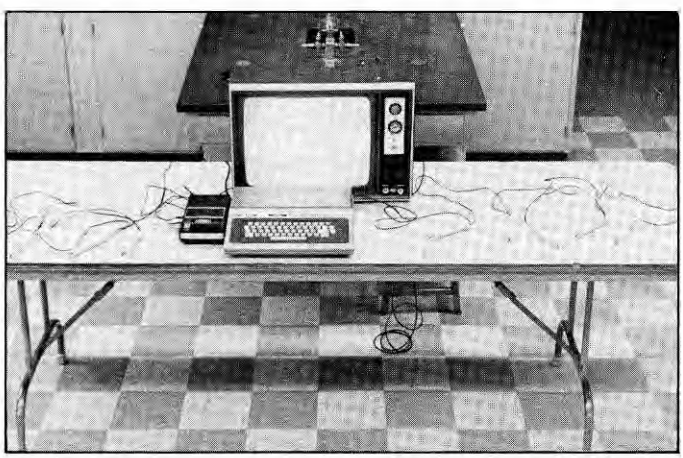


Photo 3. Team Member Ready to Pounce on Switch.

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tants won't be pulling them out of each other's hands.

After the program is running and equipment is connected (the program will not run without the hardware) all you need is ten competitors and forty questions. The scholastic meet can be an educational experience for the students involved and for you if you are making the set of questions. My favorite scholastic meet is a triangular meet. Team A brings the questions for team B versus team C, and so on. With this format each team prepares a set of questions and watches two other teams try to answer them.■

James Wood teaches at Atwood Hammond High School where he has coached the scholastic team for six years. His hobbies include photography and ham radio.

```
1 CLS
5 GOTO500
10 CLS0
15 PRINT"READY FOR QUESTION";
16 PRINT@288," 1  2  3  4  5    6  7  8  9 10";
20 R=JOYSTK(0):L=JOYSTK(2)
30 IF L=0 AND R=0 THEN 20 ELSE IF L>R THEN 200 ELSE 100
100 IF R>15 AND R<21 THEN POKE1362,255:GOTO300
110 IF R>31 AND R<35 THEN POKE1365,255:GOTO300
120 IF R>39 AND R<43 THEN POKE1368,255:GOTO300
130 IF R>47 AND R<52 THEN POKE1371,255:GOTO300
140 IF R>52 AND R<57 THENPOKE1374,255:GOTO300
200 IF L>15 AND L<21 THEN POKE1357,255:GOTO400
210 IF L>31 AND L<35 THEN POKE1354,255:GOTO400
220 IF L>39 AND L<43 THEN POKE1351,255:GOTO400
230 IF L>47 AND L<52 THEN POKE1348,255:GOTO400
240 IF L>52 AND L<57 THEN POKE1345,255:GOTO400
300 SOUND200,2:GOTO500
400 SOUND100,2
500 PRINT@225,"PRESS ANY KEY TO CONTINUE"
505 PRINT@0,"                ";
510 A$=INKEY$:IFA$=""THEN510
520 L=0:R=0:GOTO10
600 SOUND10,3:GOTO500
```

Program Listing 1

```
10 REM JAMES W. WOOD, 424 N. MISSOURI, ATWOOD, ILL, 61913
20 CLS0:PRINT@257,"PRESS SPACE BAR TO CONTINUE";
30 X=0:Y=0:CLS0
40 PRINT@257,STRING$(28,128);
50 PRINT@5,"READY FOR TOSS UP";:PRINT@35,"PUSH 'T' TO START TIME
R";
60 PRINT@288," 1  2  3  4  5    6  7  8  9 10"
70 R=JOYSTK(0):L=JOYSTK(2)
80 A$=INKEY$:IF A$="T" THENPRINT@352,"TIMER RUNNING";:GOTO100
90 IF L=0 AND R=0 THEN 70 ELSE IF L>R THEN 290 ELSE 240
100 TIMER=0:X=1
110 R=JOYSTK(0):L=JOYSTK(2)
120 IF TIMER>900 THEN SOUND5,3:GOTO20
130 IF L=0 AND R=0 THEN110 ELSE IF L>R THEN 290 ELSE240
140 X=2:Y=0:PRINT@320,STRING$(32,128);:PRINT@65,"BONUS";:PRINT@9
8,"PRESS 'B' FOR BONUS TIMER";
150 PRINT@0,STRING$(64,128);
160 PRINT@352,STRING$(32,128);
170 R=JOYSTK(0):L=JOYSTK(2)
180 A$=INKEY$:IF A$="B" THENPRINT@389,"BONUS TIMER RUNNING";:GOT
O200
190 IF L=0 AND R=0 THEN 170 ELSE IF L>R THEN 290 ELSE 240
200 TIMER=0
210 R=JOYSTK(0):L=JOYSTK(2)
220 IF TIMER>1800 THEN SOUND5,3:GOTO170
230 IF L=0 AND R=0 THEN210 ELSE IF L>R THEN 290 ELSE 240
240 IF R>15 AND R<21 THEN POKE1362,255:GOTO340
250 IF R>31 AND R<35 THEN POKE1365,255:GOTO340
260 IF R>39 AND R<43 THEN POKE1368,255:GOTO340
270 IF R>47 AND R<52 THEN POKE1371,255:GOTO340
280 IF R>52 AND R<57 THEN POKE1374,255:GOTO340
290 IF L>15 AND L<21 THEN POKE1357,255:GOTO350
300 IF L>31 AND L<35 THEN POKE1354,255:GOTO350
310 IF L>39 AND L<43 THEN POKE1351,255:GOTO350
320 IF L>47 AND L<52 THEN POKE1348,255:GOTO350
330 IF L>52 AND L<57 THEN POKE1345,255:GOTO350
340 SOUND200,2:GOTO360
350 SOUND120,2
360 IF X=0 AND Y=0 THEN PRINT@352,"'C'ORRECT OR 'I'NCORRECT" ELS
E 380
370 A$=INKEY$:IF A$="C" THEN 140 ELSE IF A$="I" THEN Y=1:PRINT@3
20,STRING$(64,128);:GOTO70 ELSE 370
380 IF X=1 AND Y=0 THENPRINT@352,"'C'ORRECT OR 'I'NCORRECT"; ELS
E 420
390 A$=INKEY$:IF A$="C" THEN 140 ELSE IF A$="I" THEN Y=1:PRINT@3
20,STRING$(64,128);:GOTO400 ELSE 390
400 IF TI>720 THEN TIMER=720
410 GOTO110
420 IF Y=1 THEN PRINT@352,"'C'ORRECT OR 'I'NCORRECT"; ELSE440
430 A$=INKEY$:IF A$="C" THEN140 ELSE IF A$="I" THEN20 ELSE430
440 IF X=2 THEN PRINT@352,"PRESS SPACE BAR TO CONTINUE";
450 A$=INKEY$:IF A$<>" " THEN 450 ELSE PRINT@320,STRING$(32,128)
;:GOTO30
```

Program Listing 2

COLOR COMPUTER SOFTWARE

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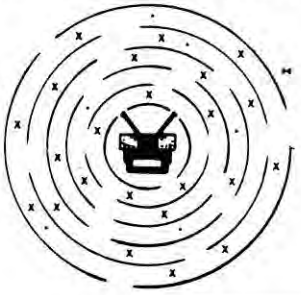

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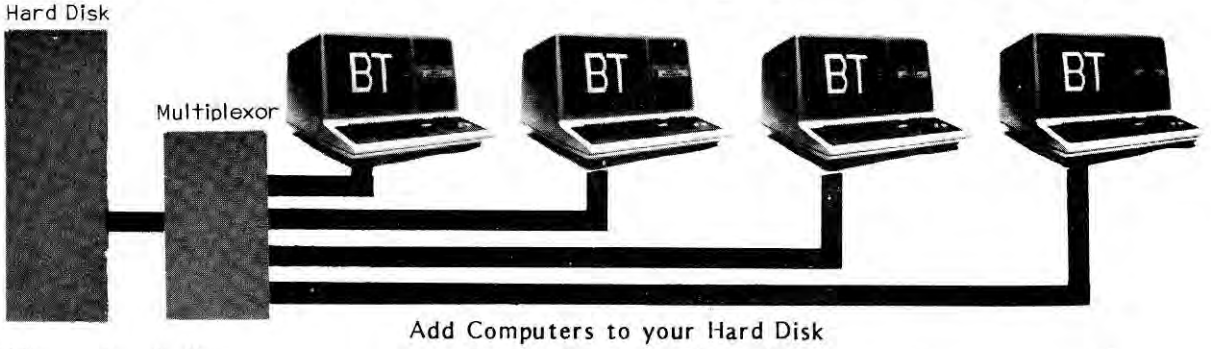

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Put Euclid to work in your TRS-80.

The 2,000-Year-Old Algorithm

Program Listing

```
1   '-------------------------
2   ' GREATEST COMMON DIVISOR
3   'USING EUCLIDEAN ALGORITHM
4   '-------------------------
5 Z=0:CLEAR100:GOSUB4000
9 INPUT"ENTER YOUR FIRST NAME.,";E$
10 GOSUB4000:PRINTTAB(2) "GREATEST COMMON DIVISOR":PRINT:PRINT
 "IF YOU ARE FIMILIAR WITH THE"
11 PRINT"EUCLIDEAN ALGORITHM OR SIMPLY"
12 PRINT"DO NOT CARE ABOUT THE ALGORITHM"
13 PRINT"...HEAVEN FORBID..."
14 PRINT"YOU MAY TYPE 'F' TO <FIND> THE"
15 PRINT"GREATEST COMMON DIVISOR OF"
16 PRINT"A SET OF NUMBERS."
17 PRINT:PRINT"OTHERWISE, IT WILL BE ASSUMED"
18 PRINT"THAT YOU HAVE A GENUINE"
19 PRINT"INTEREST IN LEARNING HOW THE"
20 PRINT"ALGORITHM WORKS..."
21 PRINT"TYPE 'G' FOR <GENUINE INTEREST>"
22 B$=INKEY$
23 IFB$="F"THEN1320
24 IFB$="G"THEN45
25 GOTO22
40   '-------------------------
41   'EXPLANATION OF EUCLIDEAN
42   '       PROCESS
43   '    WITH EXAMPLES
44   '-------------------------
45 GOSUB4000:PRINTTAB(3)"GREATEST COMMON DIVISOR":PRINT:PRINT
50 PRINT"THIS PROGRAM UTILIZES THE"
60 PRINT"EUCLIDEAN ALGORITHM TO FIND THE"
70 PRINT"GREATEST COMMON DIVISOR (GCD)"
80 PRINT"OF 2 OR MORE NUMBERS."
90 PRINT:PRINT"THE GREATEST COMMON DIVISOR..."
100 PRINT"SOMETIMES REFERRED TO AS THE"
110 PRINT"GREATEST COMMON FACTOR..."
115 PRINT"IS VERY USEFUL IN REDUCING"
117 PRINT"FRACTIONS TO SIMPLEST FORM.":PRINT
118 GOSUB3000
300 GOSUB4000:PRINT"PERHAPS IT WOULD BE FAVORABLE"
310 PRINT"AT THIS TIME TO EXPLAIN A BIT"
320 PRINT"ABOUT THE EUCLIDEAN"
340 PRINT"TECHNIQUE FOR FINDING THE GCD."
350 PRINT:PRINT"PRESS 'C' IF YOU ARE IN THE"
360 PRINT"LEAST BIT CURIOUS..."
365 N=0
370 B$=INKEY$:N=N+1
380 IFN=500THENPRINT"YOU REALIZE YOU CAN'T PUT THIS   OFF FOREVER...";E$
390 'FB$<>"C"THEN370ELSE400
400 GOSUB4000:PRINT" EUCLID DEVELOPED A TECHNIQUE"
410 PRINT"FOR FINDING THE GCD THAT WAS"
420 PRINT"BASED ON THE DIVISION RELATION."
430 PRINT"HIS PROCESS, CALLED THE"
440 PRINT"EUCLIDEAN ALGORITHM, IS"
450 PRINT"APPLIED AS FOLLOWS....":PRINT:PRINT
460 GOSUB3000
500 Z=Z+1:GOSUB4000:PRINT"SUPPOSE WE ARE TO FIND THE GCD"
510 PRINT"OF 84 AND 270.  DIVIDE THE"
520 PRINT"SMALLER NUMBER (84) INTO THE"
530 PRINT"LARGER NUMBER (270)."
535 PRINT:PRINT"THE REMAINDER IS 18."
537 FORX=1TO3000:NEXT
539 PRINT:PRINTSTRING$(32,"-")
540 IFZ=1THENPRINT"YOU MAY WISH TO BEGIN TAKING"
550 IFZ=1THENPRINT"NOTES AT THIS TIME...":PRINT:PRINTSTRING$(32,"-")
552 IFZ>=2THENPRINT"I HOPE YOU HAVE ALL OF THIS"
553 IFZ>=2THENPRINT"IN YOUR NOTES, ALREADY...":PRINT:PRINTSTRING$(32,"-")
555 GOSUB3000
560 GOSUB4000:PRINT"AS WILL SOON BE SHOWN, THE"
570 PRINT"ORIGINAL GCD IS EQUAL TO THE"
```

Listing continues

Steven M. Groll
204 Cimarron Drive
Victoria, TX 77901

Euclid, the Greek mathematician, developed a technique for finding the greatest common divisor (GCD) of a set of numbers. This Euclidean Algorithm is based on the following division relation:

For positive integers a and b, b can be written as b = aq + r where q and r are non-negative integers with 0 <= r < a.

This relation is more commonly seen as dividend = (divisor × quotient) + remainder.

The Euclidean algorithm facilitates finding the GCD of two whole numbers as follows:

If x and y are two whole numbers with x < y, and r is the remainder when y is divided by x, then GCD(x,y) = GCD(r,x).

Finishing the problem is a repetition of the above. Since each remainder is less than the one before, a zero remainder is eventually reached, but you stop when it is apparent the next division will produce the remainder 0. For example:

```
GCD(168,540) = GCD(36,168)
             = GCD(24,36)
             = GCD(12,24)
             = 12
```

This technique is irrelevant unless you teach seventh and eighth grade math, use a microcomputer to enhance math studies in the classroom, or want to write a fraction tutor program.

In my early investigations into fractions and microcomputer applications, the following program was very helpful.

```
20 INPUT A                    'Numerator
30 INPUT B                    'Denominator
40 FOR I = A TO I STEP -1
50 IF A/I = INT (A/I) THEN 70
60 NEXT I
70 IF B/I <> INT (B/I) THEN 60
80 PRINT"THE GCD OF";A;"AND";B;
   "IS";I
```

Then I input A = 1415 and B = 1800 and waited 32 seconds for a response. Until that time I had considered this program time efficient.

What I needed was a time-efficient program for *all* input values of A and B. I rewrote the program using the Euclidean

The Key Box

Model I or III
Color Computer
16K RAM
Cassette Basic

Listing continued

```
580 PRINT"GCD OF THE REMAINDER (18) AND"
590 PRINT"THE SMALLER GIVEN NUMBER (84)."
600 PRINT:PRINT"GCD(84,270) = GCD(18,84)."
610 PRINT:PRINT"REMEMBER....."
620 PRINT:PRINT"    18 = REMAINDER ( 270/84 )":PRINT:PRINT
630 GOSUB3000
640 GOSUB4000:PRINT"THIS PROCEDURE IS REPEATED."
650 PRINT:PRINT"SINCE EACH REMAINDER IS LESS"
660 PRINT"THAN THE ONE BEFORE, A ZERO"
670 PRINT"REMAINDER MUST EVENTUALLY BE"
680 PRINT"OBTAINED.  BUT WE STOP ONE STEP"
690 PRINT"EARLIER, WHEN IT IS APPARENT"
700 PRINT"THAT THE NEXT DIVISION WILL"
710 PRINT"PRODUCE THE REMAINDER 0."
715 PRINT:PRINT"GCD(84,270)=GCD(18,84)"
716 PRINTTAB(11)"=GCD(12,18)"
717 PRINTTAB(11)"=GCD(6,12)"
718 PRINTTAB(11)"=6"
720 PRINT:GOSUB3000
730 GOSUB4000
900 GOSUB4000
910 PRINT"WHEN THE DIVISION PRODUCES THE"
920 PRINT"REMAINDER 0, AS WITH 6 AND 12"
930 PRINT"THEN THE SMALLER NUMBER (6),"
940 PRINT"IS OBVIOUSLY A DIVISOR BOTH OF"
950 PRINT"ITSELF AND OF THE LARGER"
960 PRINT"NUMBER (12), AND SO MUST BE THE"
970 PRINT"GCD.  HENCE, THE FINAL STEP..."
980 PRINT"   GCD(6,12) = 6."
990 PRINT:PRINT"THEREFORE: GCD(84,270) = 6.":PRINT:PRINT
1000 GOSUB3000
1001    '------------------
1002    ' ALLOW FOR REVIEW
1003    '------------------
1005 GOSUB4000
1010 IFZ>=2THEN1100
1020 PRINT"THIS MAY BE A GOOD CHANCE TO"
1030 PRINT"TAKE A BREATHER...":PRINT:PRINT
1050 GOSUB5000
1060 B$=INKEY$:IFB$="R"THEN500
1070 IFB$="C"THEN1100
1080 GOTO1060
1100 GOSUB4000:PRINT"WE'RE READY TO MOVE ON, NOW...":PRINT:PRINT:GOSUB3000
1150    '---------------------------
1151    '       CHOICE OF:
1152    '   WHY DOES IT WORK?
1153    '          OR
1154    ' LET'S WORK SOME PROBLEMS!
1155    '---------------------------
1200 GOSUB4000:PRINT"IF YOU HAVE A DESIRE TO HAVE"
1210 PRINT"AN EXPLANATION AS TO THE 'WHY'"
1220 PRINT"OF THE PROCESS..."
1230 PRINT"PRESS 'W' FOR <WHY DOES IT WORK>"
1240 PRINT"OTHERWISE..."
1250 PRINT"TYPE 'L' FOR <LET'S HURRY UP"
1260 PRINT"AND WORK SOME PROBLEMS BEFORE"
1270 PRINT"I FORGET HOW THIS WORKS>."
1280 B$=INKEY$:IFB$="W"THENGOSUB7000
1290 IFB$="L"THEN1400
1300 GOTO1280
1310    '----------------------
1311    '  INTRODUCTION TO
1312    'CALCULATION PROCESS
1313    '----------------------
1320 GOSUB4000
1330 PRINT:PRINT"TYPE 'T' IF YOU WANT TO FIND"
1340 PRINT"THE GCD OF 'TWO' NUMBERS..."
1350 PRINT:PRINT"TYPE 'M' IF YOU WANT TO FIND"
1360 PRINT"THE GCD OF '3 OR MORE' NUMBERS."
1365 PRINT:PRINT"TYPE 'R' IF YOU WANT TO 'REDUCE'
1366 PRINT"A FRACTION' TO SIMPLEST TERMS."
1370 B$=INKEY$
1380 IFB$="T"THEN1400
1390 IFB$="M"THEN9000
1393 IFB$="R"THEN9600
1395 GOTO1370
1400 GOSUB4000
1410 PRINT"ENTER 2 NUMBERS AND YOU WILL"
1420 PRINT"SEE THE STEP BY STEP PROCESS"
1430 PRINT"FOR FINDING THE GCD BY THE"
1440 PRINT"EUCLIDEAN ALGORITHM."
1445 PRINT:PRINT"* THE FIRST NUMBER MUST BE"
1446 PRINT"SMALLER THAN THE SECOND NUMBER *"
1450 PRINT:INPUT"ENTER THE FIRST NUMBER...";N1
1460 PRINT:INPUT"ENTER THE SECOND NUMBER...";N2
1470 IFN2<N1THEN1500
1475 IFN1=0ORN2=0THEN1400
1480 GOTO1530
1495    '----------------------
1496    'CORRECT INPUT ERRORS
1497    '----------------------
1500 GOSUB4000:PRINT"* THE FIRST NUMBER MUST BE"
1510 PRINT"SMALLER THAN THE SECOND NUMBER *"
1520 FORX=1TO2000:NEXT:GOTO1400
1525    '-----------------------------------
1526    'CALCULATIONS AND A DISPLAY OF THE
1527    'STEP BY STEP PROCESS FOR GCD
1528    '-----------------------------------
1530 A1=N1:A2=N2
1540 GOSUB4000:PRINT"GCD(";A1;",";A2;")"
1545 Y=0
1550 Y=Y+1:Q=INT(A2/A1)
1560 R=A2-(A1*Q)
1562 C$=STR$(A1):D$=STR$(A2):C=LEN(C$):D=LEN(D$)
1570 IFR=0ANDY=1THENPRINTTAB(9+C+D)"= ";A1
1571 IFR=0ANDY>1THENPRINT:PRINTTAB(8)"= ";A1
1572 IFR=0THEN1600
1575 A2=A1:A1=R
1579 PRINT
1580 PRINTTAB(8)"= GCD(";A1;",";A2;")
1583 IFY=6GOSUB3000:GOSUB4000
1585 GOTO1550
1600 PRINT:GOSUB3000
1605    '----------
1606    '   MENU
1607    '----------
1610 GOSUB4000
1700 PRINT"WHAT WOULD YOU LIKE TO DO NOW,"
1710 PRINT5;"?"
1720 PRINT:PRINT"<F>IND THE GCD OF TWO NUMBERS"
1730 PRINT"<T>HIS TIME LET'S FIND THE GCD"
1740 PRINT"    OF 3 OR MORE NUMBERS"
1750 PRINT"<I> WOULD REALLY LIKE TO SEE"
1760 PRINT"    THE METHOD FOR FINDING THE"
1770 PRINT"    GCD OF 3 OR MORE NUMBERS!"
1780 PRINT"<W>HY DOES THIS EUCLIDEAN"
1790 PRINT"    PROCESS WORK?"
```

Listing continues

"Euclidean Tutor was written for gifted and talented math students."

algorithm, and these are the results: one second of calculation time when A = 1415 and B = 1800. I now had a time-efficient computer algorithm for finding the greatest common divisor (GCD) of two numbers.

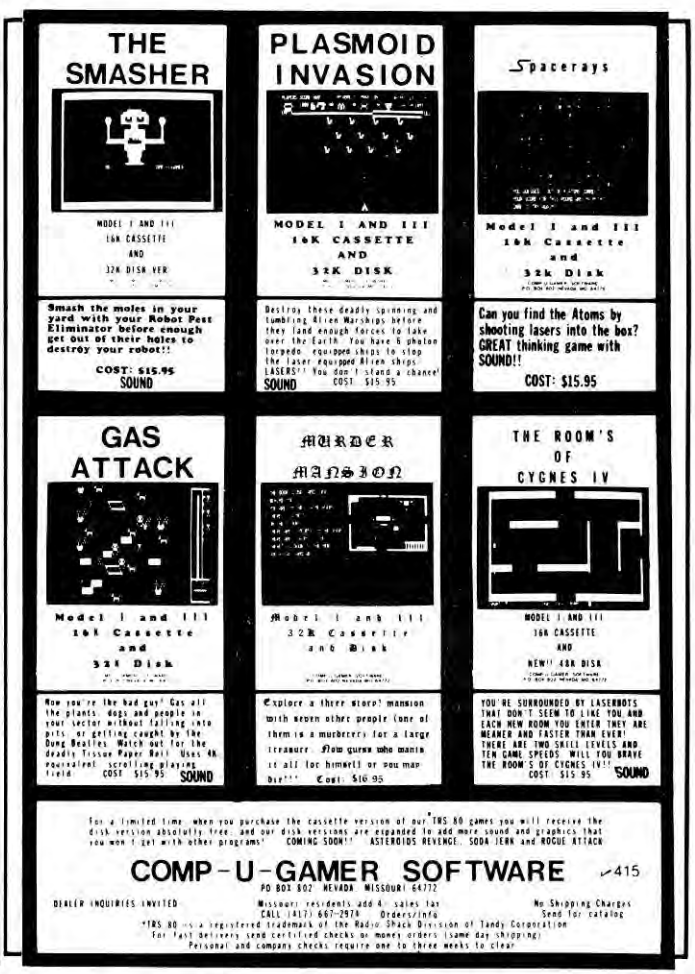
Single-precision variables are stored with seven digits of precision and printed out with six digits of precision. All numeric variables are assumed to be single precision unless otherwise defined (the reason for lines 9042-9043 and line 9065). You may remove these lines if in line 9000 you include the following statement: DEFDBL M,Q,R.

DEFDBL causes the variables beginning with M, Q and R to be treated as double-precision variables (allowing for 17 digits of precision and up to 16 digits of display).

The program listing, Euclidean Tutor, was written for use as an extension with seventh and eighth grade gifted and talented mathematics students. The program is detailed in its explanation of the Euclidean Algorithm, and incorporates both of the pre-mentioned subroutines.

The program takes advantage of the 32-character format CHR$(23). The section Reducing Fractions works well on a Model I (the 32-character format), but it requires some editing to work on the Model III. One way to get around the editing is to revert to standard format (64 characters per line) when the original fraction and its reduced form are printed on the screen. This can be accomplished by changing line 9600 to read: 9600 CLS. ■

Steven Groll is a microcomputer instructor at the University of Houston, Victoria Campus.



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- Save buffer on disk
- Send or receive ASCII or binary files
- Xon/Xoff protocol
- Checksum verification of file transfers
- Works with all operating systems

TELCOM II

TELCOM II is the new generation of our earlier program. It includes all of the features of TELCOM I shown above, with many improvements and enhancements. The terminal mode has a help menu and will communicate as fast as 4800 baud. You can even receive data while you are at the main menu or in other modes. You can load a disk file into the buffer, type into the buffer, open, close, transmit, print, or reset the buffer. You can view the buffer (or data that has already scrolled off the screen). There are ten different automatic messages which can include control characters and delays. They allow you to log-on or auto dial with a single command. There are five different character translation tables. Finally, there is an intelligent file transfer mode that detects and CORRECTS ERRORS in transmission. It will also SEND and FETCH files with an unattended computer, and is compatible with the LYNC program for CP/M and the IBM PC.

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Listing continued

```
1795 PRINT"<R>EDUCE FRACTIONS
1800 PRINT"<S>TART OVER
1805 PRINT"<Q>UIT
1810 B$=INKEY$
1820 IFB$="S"THEN10
1830 IFB$="L"THEN1400
1840 IFB$="W"THEN7000
1850 IFB$="I"THEN8000
1860 IFB$="T"THEN9000
1865 IFB$="Q"THEN6000
1866 IFB$="R"THEN9600
1870 GOTO1810
2999   '
3000 INPUT"PRESS <ENTER> TO CONTINUE...";A$
3010 RETURN
3999   '
4000 CLS:PRINTCHR$(23):RETURN
4995   '-----------------------
4996   'SUBROUTINE FOR REVIEW
4997   '-----------------------
5000 FORX=1TO500:NEXT
5010 PRINT:PRINT"IF YOU WISH TO REVIEW..."
5020 PRINT"    TYPE 'R' FOR <REVIEW>."
5030 FORX=1TO500:NEXT
5040 PRINT:PRINT"IF YOU WISH TO CONTINUE..."
5050 PRINT"    TYPE 'C' FOR <CONTINUE>."
5060 RETURN
5995   '-------------------
5996   'FAREWELL STATEMENT
5997   '-------------------
6000 GOSUB4000
6005 PRINT"WELL, ";E$:PRINT
6010 PRINT"I HOPE YOU HAVE A BETTER,"
6020 PRINT:PRINT"IF NOT COMPLETE, UNDERSTANDING"
6030 PRINT:PRINT"OF THE EUCLIDEAN ALGORITHM"
6040 PRINT:PRINT"AND SOME OF ITS USES..."
6050 PRINT:GOSUB3000
6060 GOSUB4000
6070 PRINT"GOODBYE..."
6075 FORX=1TO700:NEXT
6080 PRINT:PRINT:PRINT:PRINT"AND HAVE A PLEASANT DAY!
6090 FORX=1TO2000:NEXT:GOTO1
6995   '-------------------------
6996   'EXPLANATION AS TO 'WHY'
6997   '  GCD PROCESS WORKS
6998   '-------------------------
7000 GOSUB4000
7010 PRINT"TO SEE THE 'WHY' OF THE PROCESS:"
7020 PRINT"CONSIDER THE BASIC DIVISION"
7030 PRINT"RELATION RESULTING FROM THE"
7040 PRINT"DIVISION OF 84 INTO 270."
7050 PRINT:PRINT"270 = (84 X 3) + 18"
7055 PRINT:PRINT"DIVIDEND ="
7056 PRINT"(DIVISOR X QUOTIENT) + REMAINDER"
7060 PRINT:GOSUB3000
7070 GOSUB4000
7080 PRINT"ANY DIVISOR OF BOTH 84 AND 270"
7090 PRINT"MUST ALSO DIVIDE 18."
7100 PRINT"THIS CAN BE SEEN FROM THE"
7110 PRINT"FOLLOWING:"
7120 PRINT:PRINT"270 - (84 X 3) = 18."
7130 PRINT:PRINT"NOW, ANY DIVISOR OF BOTH 84 AND"
7140 PRINT"270 IS A DIVISOR OF:"
7150 PRINT"  270 - (84X3), "
7160 PRINT"WHICH IS EQUAL TO 18."
7170 PRINT:GOSUB3000
7180 GOSUB4000
7190 PRINT"THEREFORE, THE GCD OF 84 AND"
7200 PRINT"270 IS A DIVISOR OF 18 AND 84."
7210 PRINT:PRINT"THE CONCLUSION IS:"
7220 PRINT:PRINT"GCD(84,270)=GCD(18,84)."
7230 PRINT:PRINT"FINISHING THE PROBLEM IS A"
7240 PRINT"REPETITIVE PROCESS OF THE ABOVE."
7250 PRINT:GOSUB3000
7260 GOSUB4000
7270 PRINT"IF YOU HAD PROBLEMS WITH THE"
7280 PRINT"EXPLANATIONS SO FAR, MAYBE IT"
7290 PRINT"WOULD BE HELPFUL TO RECALL A"
7300 PRINT"THEOREM IN NUMBER THEORY..."
7310 PRINT:PRINT:GOSUB3000
7320 GOSUB4000
7330 PRINT"LET A, B, C BE COUNTING NUMBERS."
7340 PRINT" 1) IF A/B AND B/C THEN A/B+C."
7350 PRINT:PRINT" 2) IF A/B AND A/C AND B-C"
7360 PRINT"    EXISTS, THEN A/B-C."
7370 PRINT:PRINT" 3) IF A/B AND B/C THEN A/C."
7380 PRINT:PRINT"THE ABOVE NOTATION (EX. B/A)"
7390 PRINT"IS STATED (B IS A DIVISOR OF A)."
7400 GOSUB3000
7410 GOSUB4000
7420 PRINT"IF YOU WISH TO REVIEW THE 'WHY'"
7430 PRINT"OF THE PROCESS TYPE 'W'."
7440 PRINT:PRINT"IF YOU WISH TO RETURN TO THE"
7450 PRINT"'MENU' TYPE 'M'."
7460 B$=INKEY$
7470 IFB$="W"THEN7000
7480 IFB$="M"THEN1610
7490 GOTO7460
7995   '-----------------------------
7996   'EXPLANATION FOR FINDING THE
7997   '    GCD OF 3 NUMBERS
7998   '-----------------------------
8000 GOSUB4000
8010 PRINT"THE FOLLOWING SHOULD BE NOTED:"
8020 PRINT:PRINT"THE GCD OF THREE (3) OR MORE"
8030 PRINT"NUMBERS IS FOUND BY FINDING"
8040 PRINT"THE GCD OF THE FIRST TWO,"
8050 PRINT"NEXT OF THAT GCD AND THE THIRD"
8060 PRINT"NUMBER, AND SO FORTH."
8065 PRINT:PRINT:GOSUB3000:GOSUB4000
8070 PRINT"TO FIND THE GCD(48,72,108,150),"
8080 PRINT"FOR EXAMPLE,"
8090 PRINT"WE HAVE SUCCESSIVELY:"
8100 PRINT:PRINT:PRINT"    GCD(48,72)=24"
8110 PRINT:PRINT"   GCD(24,108)=12"
8120 PRINT:PRINT"   GCD(12,150)=6  (ANSWER)"
8130 PRINT:PRINT:GOSUB3000
8140 GOSUB4000
8150 PRINT"IF YOU FEEL LIKE YOU NEED"
8160 PRINT"ANOTHER EXAMPLE,"
8170 PRINT"TYPE 'A' FOR 'ANOTHER'"
8180 PRINT:PRINT"IF YOU FEEL LIKE YOU HAVE A"
8190 PRINT"WORKING KNOWLEDGE OF THIS"
8200 PRINT"PROCESS TYPE 'B' FOR"
8205 PRINT"'BACK TO MENU'"
8210 B$=INKEY$
8220 IFB$="B"THEN1610
```

Listing continues

Listing continued.

```
8230 IFBS="A"THEN 8500
8240 GOTO8210
8500 GOSUB4000
8510 PRINT"LET'S FIND THE GCD(180,288,432)."
8520 PRINT:PRINT:PRINT"  GCD(180,288)=GCD(108,180)"
8530 PRINTTAB(14)"=GCD(72,108)"
8540 PRINTTAB(14)"=GCD(36,72)"
8550 PRINTTAB(14)"=36
8560 PRINT:PRINT"    GCD(36,432)=36   (ANSWER)"
8570 PRINT:PRINT:INPUT"PRESS <ENTER> TO RETURN TO THE  MAIN MENU...";A$
8580 GOTO1610
8995   '-------------------
8996   ' CALCULATIONS FOR
8997   '    THE GCD OF
8998   '3 OR MORE NUMBERS
8999   '-------------------
9000 GOSUB4000
9010 INPUT"HOW MANY NUMBERS TO BE INPUT?";F
9030 PRINT:PRINT"* NUMBERS MUST BE INPUT IN"
9040 PRINT"ORDER FROM SMALLEST TO LARGEST *"
9045 FORG=1TOF
9050 PRINT:PRINT"INPUT #";G;":";
9060 INPUTM(G)
9070 IFG>=2THEN9100
9080 NEXT
9090 GOTO9190
9100 IFM(G)>M(G-1)THEN9080
9110 GOSUB4000:PRINT"THE NUMBERS MUST BE INPUT IN"
9120 PRINT"ORDER FROM SMALLEST TO LARGEST"
9130 FORX=1TO2000:NEXT:GOSUB4000
9140 GOTO9045
9190 CLS
9200 FORG=1TOF-1
9210 Q=INT(M(G+1)/M(G))
9220 R=M(G+1)-(M(G)*Q)
9230 IFR=0THEN9300
9240 M(G+1)=M(G)
9250 M(G)=R
9260 GOTO9210
9300 IFG=F-1THEN9400
9305 M(G+1)=M(G)
9310 NEXT
9400 GOSUB4000:PRINT"GCD = ";M(G)
9500 PRINT:PRINT:PRINT:GOSUB3000
9510 GOTO1610
9600 GOSUB4000
10010 '
10020 '
10030 '
10040 '
10050 ' ------------------------
10060 '   EUCLIDEAN ALGORITHM
10070 '
10080 '   COMPLETED   3/18/81
10090 '
10100 ' S T E V E N   G R O L L
10110 ' ------------------------
10120 '
10130 '
10140 '
```


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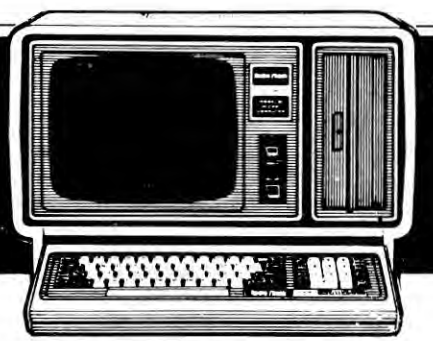

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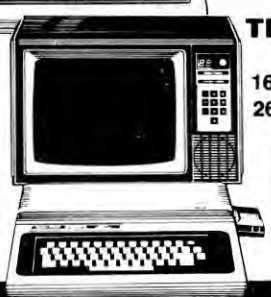

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by Franklyn D. Miller

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```
870 IF P2 =  9 THEN D = 1
880 IF P2 = 10 THEN D = 2
890 IF P2 = 11 THEN D = 3
900 IF P2 = 12 THEN D = 4
910 IF P2 = 13 THEN D = 5
920 IF P2 = 14 THEN D = 6
930 IF P2 = 15 THEN D = 7
940 IF P2 = 16 THEN D = 8
950 IF P2 = 17 THEN D = 9
960 IF P2 = 18 THEN D = 10
970 IF P2 = 19 THEN D = 11
980 IF P2 = 20 THEN D = 12
990 IF P2 = 21 THEN D = 13
1000 IF P2 = 22 THEN D = 14
1010 IF P2 = 23 THEN D = 15
1020 IF P2 = 24 THEN D = 16
```

Program Listing 1

N2	Difference	E	Difference
18	—	1	—
24	6	2	1
30	6	3	1
36	6	4	1
42	6	5	1
48	6	6	1
54	6	7	1
60	6	8	1

Table 1. Constant difference in Listing 2

Compressions

I shall present a number of programming examples and my compression suggestions. With some imagination you will be able to expand the concepts to encompass a host of other compressions. On some programs extensive rewriting is necessary. On others, it is fairly simple.

The examples I present are not made up—they are all from current literature. Remember, a working program may be completely different from the documented version. A published program should be well documented and the logic should be clear, while a working program should be streamlined.

Let's consider Program Listing 1. There are 16 unnecessary Thens; eliminating these immediately saves 16 bytes. Can we do better? Of course. The whole routine occupies 246 bytes of memory. It may be reduced to 11 bytes by the statement:

```
870 D = P2 - 8
```

This is a savings of 235 bytes!

This simple example replaces a series of If...Then statements with a simple arithmetical expression. You need merely notice that D is always eight less than P2. (This routine appeared recently in *80 Micro*.)

Another example is shown in Program Listing 2. This code requires 168 bytes of memory and requires 216 characters. It may be replaced by the single line:

```
1380 E = N2/6 - 2 : GOTO 1500
```

This line saves 148 bytes.

How can you tell if such a compaction is easily possible? If there is a linear relationship between the variables, it is always possible. To find if such a relationship exists, you may plot N2 versus E on graph paper to see if a straight line results.

Another simple method is shown in Table 1. Note in Table 1 the constant differences for both N2 and E. We can easily develop a linear equation by solving two simultaneous equations.

E = A + BN2 is the required equation where A and B are constants. Therefore, substituting for E and for N2 the end values

$$1 = A + 18B$$
$$8 = A + 60B$$

Subtract the equations above to give:

$$-7 = 0 - 42B$$

so that B equals 1/6.

Substituting B into the equation above we have:

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B1	Difference	X	Difference
20	—	27	—
19	1	29	2
18	1	31	2
17	1	33	2
16	1	35	2
15	1	37	2
14	1	39	2
13	1	41	2

Table 2. Constant difference in Listing 3

```
1380 IF N2 = 18 THEN E = 1 : GOTO 1500
1390 IF N2 = 24 THEN E = 2 : GOTO 1500
1400 IF N2 = 30 THEN E = 3 : GOTO 1500
1410 IF N2 = 36 THEN E = 4 : GOTO 1500
1420 IF N2 = 42 THEN E = 5 : GOTO 1500
1430 IF N2 = 48 THEN E = 6 : GOTO1500
1440 IF N2 = 54 THEN E = 7 : GOTO 1500
1450 IF N2 = 60 THEN E = 8 : GOTO 1500
```

Program Listing 2

```
1030 IF B1 = 20 THEN X = 27 : RETURN
1040 IF B1 = 19 THEN X = 29 : RETURN
1050 IF B1 = 18 THEN X = 31 : RETURN
1060 IF B1 = 17 THEN X = 33 : RETURN
1070 IF B1 = 16 THEN X = 35 : RETURN
1080 IF B1 = 15 THEN X = 37 : RETURN
1090 IF B1 = 14 THEN X = 39 : RETURN
1100 IF B1 = 13 THEN X = 41 : RETURN
```

Program Listing 3

```
430 IF C3 = 2 GOTO 470
440 IF C3 = 3 GOTO 680
450 IF C3 = 4 GOTO 940
460 IF C3 = 5 GOTO 1360
```

Program Listing 4

```
40230 IF F = 160 GOTO 40410
40240 IF F = 168 GOTO 40420
40250 IF F = 176 GOTO 40430
40260 IF F = 184 GOTO 40440
```

Program Listing 5

```
2314 IF X < .1 THEN 2340
2315 IF X < .2 THEN 2345
2316 IF X < .3 THEN 2350
2317 IF X < .4 THEN 2355
2318 IF X < .5 THEN 2360
2319 IF X < .6 THEN 2365
2320 IF X < .7 THEN 2370
2321 IF X < .8 THEN 2375
2322 IF X < .9 THEN 2380
```

Program Listing 6

```
110 PRINT"<4>"TAB(25)"(RESERVED)
120 PRINT"<5)"TAB(25)"(RESERVED)
130 PRINT"<6>"TAB(25)"(RESERVED)
140 PRINT"<7>"TAB(25)"(RESERVED)
150 PRINT"<8>"TAB(25)"(RESERVED)"
160 PRINT"<9>"TAB(25)"(RESERVED)"
```

Program Listing 7

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$$1 = A + 18 \times 1/6$$
$$1 = A + 3$$

Therefore A equals minus two. Consequently, the equation above becomes:

$$E = -2 + N2*(1/6)$$

You can rearrange this to:

$$E = N2/6 - 2$$

It is possible to use a similar method with non-linear relationships, but the more complicated solution requires a quadratic equation. The solution of such simultaneous equations becomes rather tedious.

To illustrate these ideas more fully, I shall give a few more examples with solutions. Listing 3 is taken from a purchased program.

Again, there are constant differences in both variables (see Table 2). Thus, we have a linear relationship. Solving the equations

$$\begin{aligned} 27 &= A + 20B \\ 41 &= A + 13B \\ \hline -14 &= 0 + 7B \\ B &= -2 \\ 27 &= A - 40 \\ A &= 67 \end{aligned}$$

```
830 PRINT@847,A(1);:PRINT@852,A(2);:PRINT@857,A(3);:PRINT@862,A(
4);:PRINT@867,A(5);:PRINT@872,A(6);
840 PRINT@616,A(8);:PRINT@611,A(9);:PRINT@606,A(10);:PRINT@601,A
(11);:PRINT@596,A(12);:PRINT@591,A(13);
```

Program Listing 8

Therefore, 1030 X = 67 - 2 * B : RETURN is the condensed version and saves 156 bytes.

Listings 4 and 5 are given without comment. The compressed version for Listing 4 is 430 ON C3-1 GOTO 470,680,940, 1360; for Listing 5 we get 40230 ON F/8-19 GOTO 40410, 40420, 40430,40440.

Listing 6 is a special example of this method of compression. It can be rewritten as follows:

```
2314 IF X < .9 ON 10*(X + .1)
GOTO 2340,2345,2350,2355,2360,2365,2370,
2375,2380
```

It is not necessary to convert to integers, because Basic uses only the integer portion of a number with On... GOTO and On...GOSUB statements.

Listing 7 is a different example of the sort of code which can be compressed. In this case 120 bytes may be saved by rewriting as follows:

```
110 FOR I = 4 TO 9 : PRINT "("I")" TAB(25)
"(RESERVED)" : NEXT
```

Listing 8 presents a similar example and can be rewritten for a savings of 90 bytes as:

```
830 K = 845 : FOR I = 1 TO 6 : PRINT
@K,A(I); : K=K+5 : NEXT : K= 616 : FOR I
= 8 TO 13 PRINT @K,A(I);: K = K-5 : NEXT
```

A compression of Listing 9 is almost trivial. To save 40 bytes use:

```
950 FOR I = 1 TO 6 : T1 = T1 + A(I) : T2 = T2
+ A(I+7) : NEXT : T2 = T2 + A(0)
```

How often have you seen something like Listing 10? Because it is used frequently in game programs, you can save both execution time and memory by compression. In this case, the relationship is not quite linear. Try using the ASCII equivalents of the letters involved (see Table 3).

In this instance plot column three against the numbers 1,2,3,4. Draw a straight line that looks like a best fit. Then fit an equation, using the line you drew, to go through the end points. We find:

```
2000 X = ASC(D$) - 64 : ON
.167*(1 + .167*X)GOSUB 2940,2920,2900,2930
```

This example does not save much memory, but it does illustrate the principle that letters can often be manipulated to achieve code compression. (Once again, Basic uses only the integer portion of an expression in On...GOSUB.) In general, when writing your own programs use letters whose ASCII codes differ by a constant increment.

Listing 11 gives us the opportunity for a slightly different twist. We may substitute a new line 290. But watch out—don't get your data statements out of order!

```
290 RESTORE : X = ASC(MID$(E$(N),11,1))-
64 : FOR I=1 TO X : READ P$ : NEXT : ON X
GOTO 350,360,370,380,390
295 DATA GOTO, GOSUB THEN, ELSE,
RESUME
```

We used a little trickery here. If, for example, MID$(E$(N),11,1) equals "B" then X equals two and we read the first and second data statements. Thus, at the end of the loop P$ equals GOSUB. Since X equals two the On...

```
950 T1=A(1)+A(2)+A(3)+A(4)+A(5)+A(6)+A(7)
960 T2=A(8)+A(9)+A(10)+A(11)+A(12)+A(13)+A(0)
```

Program Listing 9

```
2000 IFD$="S"GOSUB2900
2001 IFD$="N"GOSUB2920
2002 IFD$="W"GOSUB2930
2003 IFD$="E"GOSUB2940
```

Program Listing 10

Letter	ASCII	ASCII-64
E	69	5
N	79	15
S	83	19
W	87	23

Table 3. ASCII equivalents of Listing 10

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```
290 IFMID$(E$(N),11,1)="A"THENP$="GOTO":GOTO350
295 IFMID$(E$(N),11,1)="B"THENP$="GOSUB":GOTO360
300 IFMID$(E$(N),11,1)="C"THENP$="THEN":GOTO370
310 IFMID$(E$(N),11,1)="D"THENP$="ELSE":GOTO380
320 IFMID$(E$(N),11,1)="E"THENP$="RESUME":GOTO390
```

Program Listing 11

```
20 IFI$="B"THEN200
30 IFI$="O"THEN300
40 IFI$="H"THEN400
```

Program Listing 12

GOTO jumps to line 360. However, the data statements must precede all others in the program. If there are no other data statements in the program, there is no problem. If there are, you may need a dummy Read before they are used.

Listing 12 can be compressed, but you cannot save a great deal of memory. Test your grasp of these principles by doing the compression yourself.

One answer is:

```
20 ON(ASC(I$)-64)*.15+.8GOTO
200,300,400
```

With a little imagination you can apply these concepts in your own programming and in adapting other programs. In many cases they save significant amounts of memory, execution time, typing effort, and debugging time.

One thing more can be done. The instruction GOSUB 5000 requires five bytes of memory for storage plus additional bytes for execution (the return address must be pushed into the stack). Whenever possible it is better to use a GOTO and a smaller line number. GOTO 999 requires four bytes and GOTO 99 requires only three. Keep the line numbers in GOTO, GOSUB, Then and Else as small as possible. For faster execution place all subroutines near the beginning of the program, since Basic starts at the beginning to search for subroutines.

Further Hints

- Don't put quotation marks at the end of a line. They are unnecessary.
- Instead of statements like this:

```
10 PRINT TAB(20); "Price"; K
```

use:

```
10 PRINT TAB(20) "Price" K
```

and save two bytes. Never use a semicolon except after Print Using and to maintain the cursor position. It is also necessary in input statements.

- Don't use:

```
10 A$ = INKEY$ : IFA$ = "" THEN 10
```

unless you wish to save a keyboard entry. Instead use:

```
10 IF INKEY$ = "" THEN 10
```

which saves six bytes.

- Use multiple statement lines whenever possible.
- Don't dimension arrays any larger than necessary, but *always* dimension them.
- Don't use a colon before Else.
- Don't use ' for REM; it uses more memory.
- Remember that each array uses 12 bytes minimum.
- Avoid parentheses if possible. They require a lot of memory at run time for storage.
- Always define integers and strings. An integer requires only two bytes for storage, single precision five.
- Don't repeat numerical values in your program, assign them to a variable. It's faster and saves memory.
- When using multiple print statements in a set of instructions, put as much as possible on one line. You can format by using a line feed (↓), which costs only one byte.
- Use the space compression codes where possible. For example, try using CHR$(X) where X is greater than 191 instead of putting spaces inside quotation marks.
- Don't use a whole string of CHR$s to construct graphics strings. Use a loop, Read and concatenation to build a string. Take advantage of the control characters listed in the Level II manual to build a string.

Follow these precepts when writing or modifying programs and you will be surprised at how much memory you can save. ■

Franklyn Miller has written several articles on the Color Computer. He lives at 8871 Falmouth Drive, Cincinnati, OH 45231.

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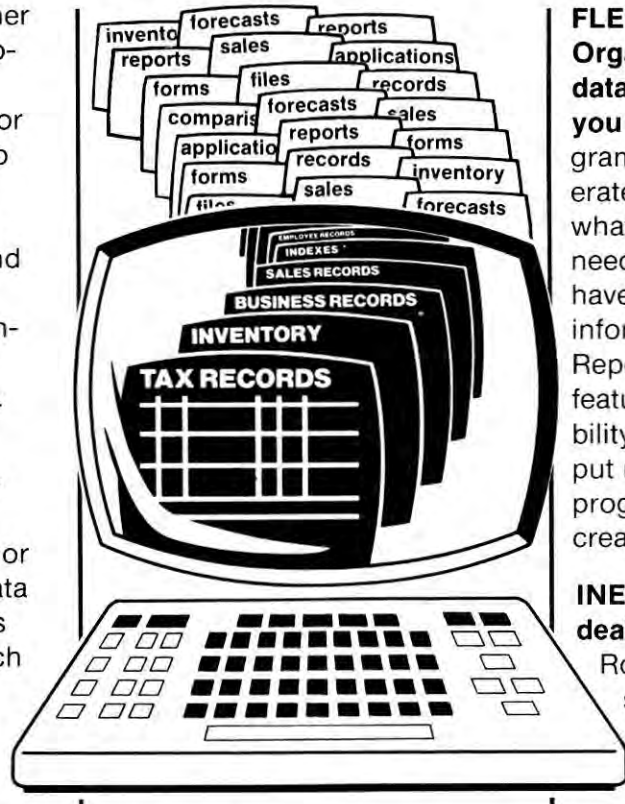

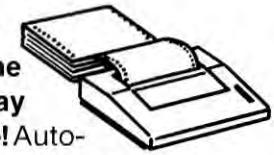

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Real World, It's About Time!

by David Engelhardt

Yes, you can use your micro for something other than games! In this article you will find out how to devise a clock that keeps real time.

A real-world interface for your TRS-80 opens up virtually unlimited new applications. I will show you how to build such an interface for your Model III using S-100 plug-in cards and motherboard, and a 5-volt power supply. The real-world interface includes a real-time clock with software. The plug-in S-100 cards (manufactured by Vector Electronics Co., part number 8802-1) are large enough to add multiple circuits, simplifying construction. Photo 1 illustrates the size of the card. It can hold the real-world interface, real-time clock, and still have plenty of room left for a future circuit.

The motherboard (QMB-12 model) is manufactured by Wameco Inc. (You can find their ads in the back of electronics magazines.) The motherboard allows expansion to 12 extra cards, except for the real-world interface and clock card. (See Photo 2.) Unfortunately, you cannot use all S100 manufactured cards, such as memory and modem cards, on the Model III unless they are port-addressable. (They can be used on a Model I.)

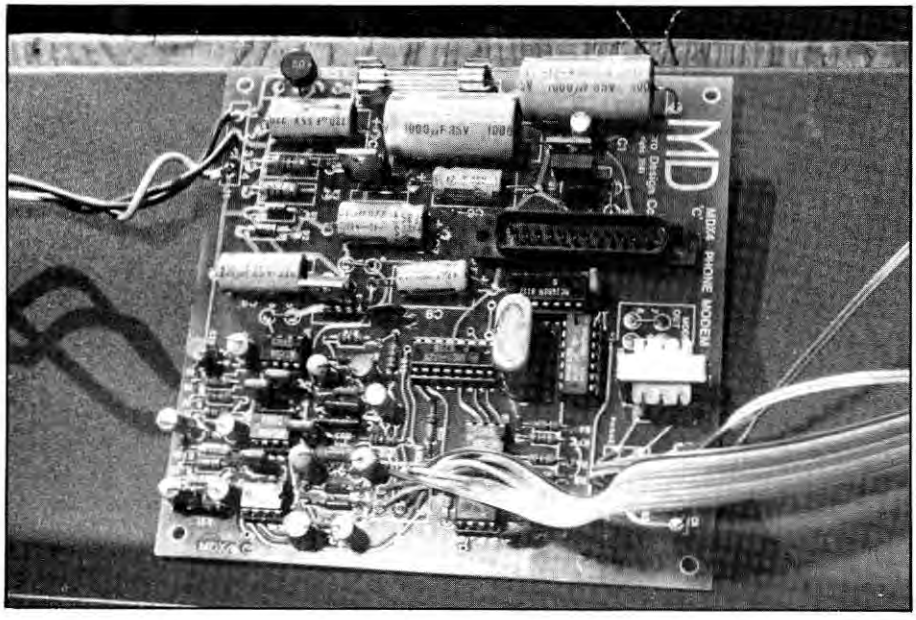

Photo 1

The Model III uses an internal hardware buffer that is software-controllable. You can turn it on or off by setting a specific bit on a designated port. This feature ensures that no noise will be generated on the internal bus from any outside source, and that no signals will be accessed from the real world unless the bus has been enabled by the user.

External interrupts operate in the same way. They also have to be enabled under software control by setting an appropriate bit on a designated port in order for the Model III to recognize them. I chose to add an external buffer, rather than use the Model III's. This gives extra protection to the Model III's system; in the event of an accident, I can easily repair my interface, and I protect the Model III's internal buffer.

Expansion Cable

The expansion edge connector for the Model III is located at the bottom center, toward the back of the computer. This expansion connector is labeled J2 and is a 50-pin edge connector. Pins 1 and 50 are also labeled on each side of this edge connector. This assures correct alignment when you put the expansion cable onto the computer. Be sure to mark and designate the wire circuit for pin 1 on the cable, as this should go to the appropriate pin 1 on the edge connector.

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I purchased the expansion cable connector and the ribbon cable from Apparat Inc. (4401 South Tamarac Parkway, Denver, CO 80237, 303-741-1778).

What you use to connect the other end of the cable is your choice. You can hard-wire it to the interface/clock board or use a spectra strip connector like the one I used. (The part number is 802-150-002.) This connector requires square pins that you solder to the interface/clock board. These square pins are also available from Vector Electronics Co., and are referred to as wrap-post pins (part number T46-1).

Cable Construction

Both connectors are attached to the ends of the ribbon cable using the same method. Insert the ribbon cable between the snap-on cover and the main connector body. Apply even pressure to ensure correct alignment when the two pieces are squeezed together.

As you squeeze the two pieces together, small pieces of metal cut through the wire insulation to make electrical contact with the wire inside. Be careful to make certain that each run on the ribbon cable lines up with its appropriate contact.

If the connectors have designated pin labels on them, they may not be correct. Pin 1 labeled on the connector may not line up with the labeled pin 1 on the computer edge connector when the expansion cable is attached.

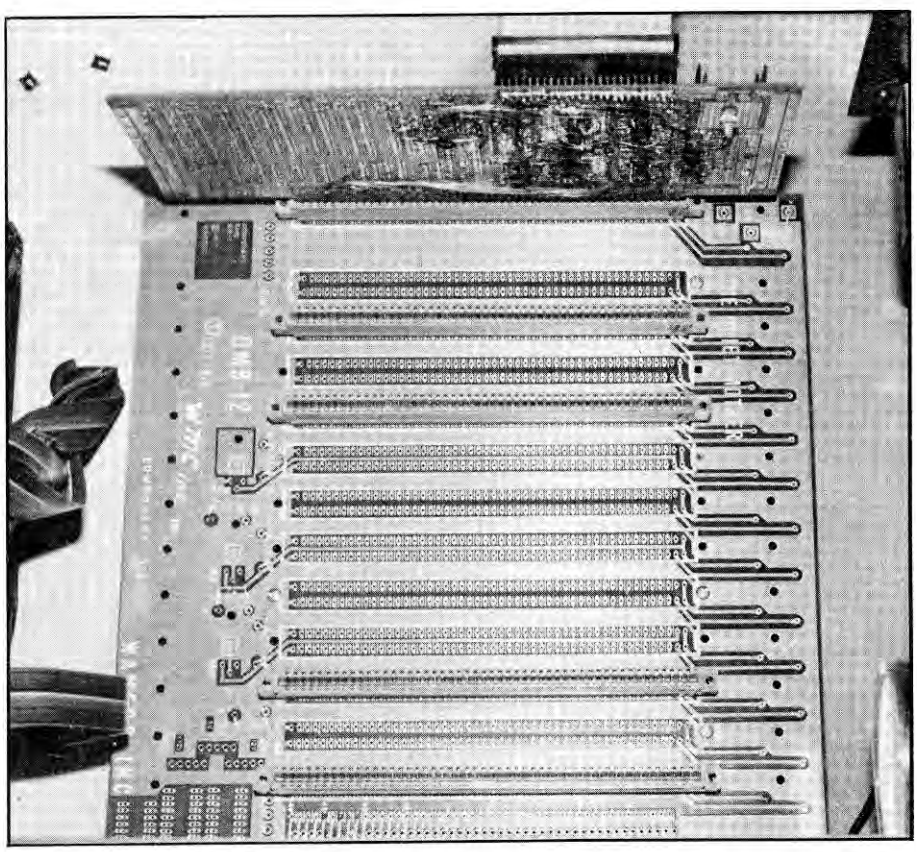
You are finished when you can snap the cover to the main body. When you are finished with both ends, check each connection for shorts and continuity with an ohmmeter.

I again stress the importance of correctly aligning pin 1 on the computer edge connector to pin 1 on the connector at the other end attached to the interface board. An error results if alignment is not correct. The expansion cable can now be attached to the computer at any time. The ribbon cable should exit straight out the back of the computer without bending.

Power Supply

The power supply shown in Fig. 1 is typical, and it has given me trouble-free performance for more than two years. I bought the transformer from Radio Shack, and I am using only one-half of the secondary winding to supply the raw voltage before it is rectified.

After rectification, the voltage is in the 11- to 12-volt range, so be sure to use 5-volt power supply regulators like a 7805 in all your circuits. The secondary winding is rated at 4 amps, and I use a 3-amp fuse for safety. The 220-ohm



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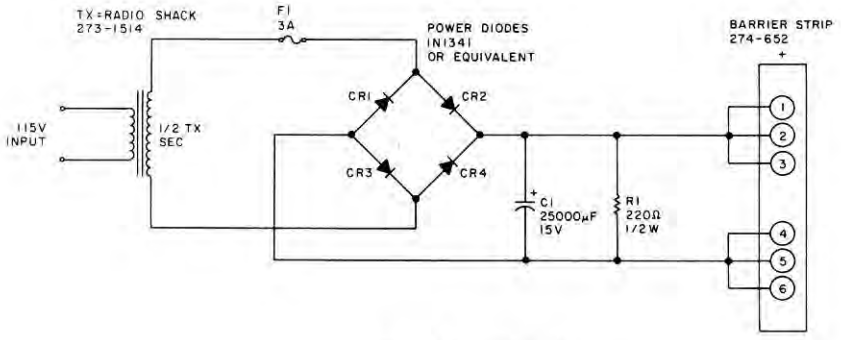

Fig. 1. Power Supply

resistor bleeds the capacitor to prevent a stored charge and possible electric shock when power is turned off.

I constructed the power supply on a perfboard (also available from Radio Shack). The power diodes are rated for 6 amps and should be heat-sinked in case of heavy loading in the future. If you use this type of power diodes, be sure to use mica washers to guarantee electrical insulation from each other if they are to be mounted on a heat sink.

The voltage output is brought out to a barrier strip, which allows multiple voltage take-off points. I attached one end of my power leads to the barrier strip using crimp-on connectors and the other end of the wire went to a designated power pin (I used pin 1) on the Wameco expansion motherboard.

The Real-World Interface

The real-world interface schematic is shown in Fig. 2. The left side of the schematic indicates the signals and pin numbers coming from the Model III to the real-world-interface circuitry and is labeled J2. Only half of the address lines available (A0–A7) and a few other signals are missing, such as RD and WR. This is the difference between the Model III and Model I's expansion capability.

The Model I has most of the Z80 signals available at the expansion connector, but the Model III hasn't. Since half of the address lines are missing on the Model III, including the loss of WR and RD signals, the Model III's expansion capability is designed strictly for ports. Radio Shack has reserved ports 80 to FF for their printer, RS-232, disk system, cassette, and some system control. This still leaves ports 0 to 7F available, or 128 separate ports.

The interface address lines are buffered through one tri-state 74LS367 (U2) and part of another (U3). These signals will always be present on the interface expansion bus as the enable pins on the 74LS367s are tied low. The IN, OUT, MI, and IORQ signals are buffered through the rest of U3's gates, which are also always present on the expansion bus.

Some signals at J2 are not buffered. Signals such as IOBUSINT, IOBUSWAIT, and EXTIOSEL are inputs to the Model III where the RESET line is an output. The RESET line can be used to clear or reset circuits when the computer's reset button is pushed. Since it does not require driver capability, as compared to an address or data line, I didn't buffer it.

Data lines (D0–D7) are run through a transceiver chip (U1) that saves extra wiring and hardware, and gives a neater appearance. The 74LS245 allows data transfer from either direction depending upon its control logic. Another nice feature of the 74LS245 is that it provides complete isolation to the real-world bus system if its enable input is logically high.

The in and out signals control the operation of the 74LS245. Both signals are combined through a 74LS08 AND gate (U4A), which has its output tied to the 74LS245's enable (pin 19). This allows the chip to be enabled only when there is either an IN command or an OUT command. At all other times, the chip is isolating the real-world data bus from the computer.

The direction of data on the 74LS245 is controlled via the DR line (pin 1). Under normal conditions the DR line is tied to VCC due to the pull-up resistor R1. This puts the 74LS245 into an OUT mode so the direction of data is from left (A) to right (B) in reference to Fig. 2. The IN signal controls switching the direction of data transfer from right (B) to left (A). Refer to the 74LS245 truth table in Fig. 2 for a better idea of its basic functions.

An important function of the real-world interface is to supply the signal to enable the Model III's internal buffer

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for an IN command. Radio Shack labeled this input EXTIOSEL. Unless this line is tied low, the Model III will never see any data from the real-world interface.

Since EXTIOSEL must be tied low for an input function, I used the IN signal to control it. I used gate U4C to perform this function. I could have tied the IN signal directly to EXTIOSEL, but gate U4C provides isolation and helps protect the EXTIOSEL line going into the Model III.

A signal that was available only on the Model I expansion bus is the interrupt acknowledge (INTACK) signal. This signal is important in the use of interrupts. Fortunately, Radio Shack provided the two signals needed to create the INTACK signal: MI and IORQ. Both are combined through gate U5A. When both of these signals are active low, the INTACK signal is generated to give an active low signal out.

Interface Construction

Be sure to use sockets for all your integrated circuits. I used wire-wrap from Radio Shack for my connections. A wire stripper facilitates working with this small-sized wire. I recommend using wire-wrap because it is small, easy to work with, and comes in various colors. I used blue wire for address lines, yellow for data lines, green for control signals, and red for power. Different colors make troubleshooting much easier.

Carefully solder the square vector pins to where you want the spectra-strip connector to go on the S-100 card. When you are finished, there should be two rows of 25 pins each. Take the appropriate color of wire-wrap and solder one end to the back side of the vector pin. Attach the other end to the input of the designated interface chip. Repeat this step until all the signals coming from the

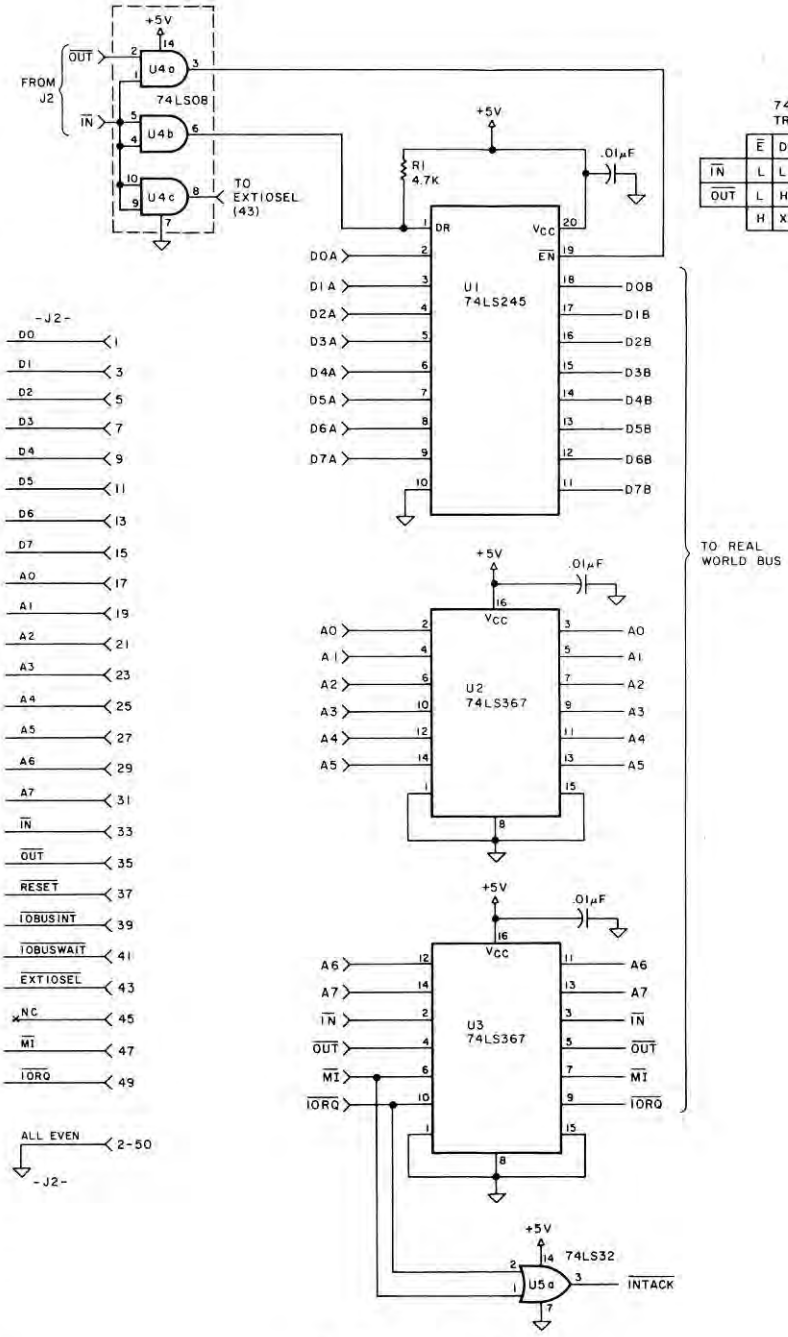

Fig. 2. Real-World Interface

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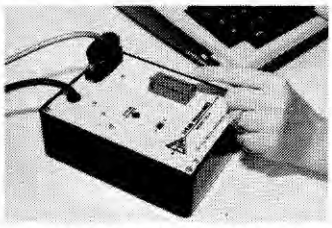

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computer are connected to their designated inputs.

Remember, some of these signals will not be connected to any interface input, so connect them directly to the S-100 card edge contact. Where you connect the outputs from the interface to the S-100 contacts is up to you. I used the standard S-100 bus designations for my guideline. All the even pins (2–50) coming from J2 are wired to ground.

When you install the 5-volt regulator, be sure to measure the voltage before you plug in the integrated circuits. If the voltage is less than 4.9 volts, add a 75μF electrolytic capacitor on the regulator's input lead. This boosts regulation up to approximately 5 volts. Add .01 μF capacitors across each integrated circuit for filtering purposes. Sometimes when these ICs are doing high-speed switching, noise is generated and the .01 μF capacitor filters most of it out.

The Real-Time Clock

The entire schematic for the real-time clock is shown in Fig. 3. The port decoding section consists of U1, U2, and two gates of U3. U1 and U2 are two-input exclusive-OR gates that make up the main port decoding section. Switches S1 to S6 consist of a seven-DIP-switch package that plugs into a 14-pin IC socket with one switch left over. These switches are used to set or change the desired clock port to whatever desired, but they must be within the 0 to 7F port limits.

I use four ports to operate the real-time clock via the 8255, because the clock has to be set up for reading and writing on an address basis through the 8255. The 8255 is used as the interface between the clock and computer due to the clock's slow internal setup time. The clock can take up to 6 microseconds to read the time; the 8255 operates a little faster.

Address lines A2 to A7 are tied to U1 and U2 to decode the port (with the exception of address lines A0 and A1). Address lines A0 and A1 are tied directly to the 8255 to decode its four internal ports.

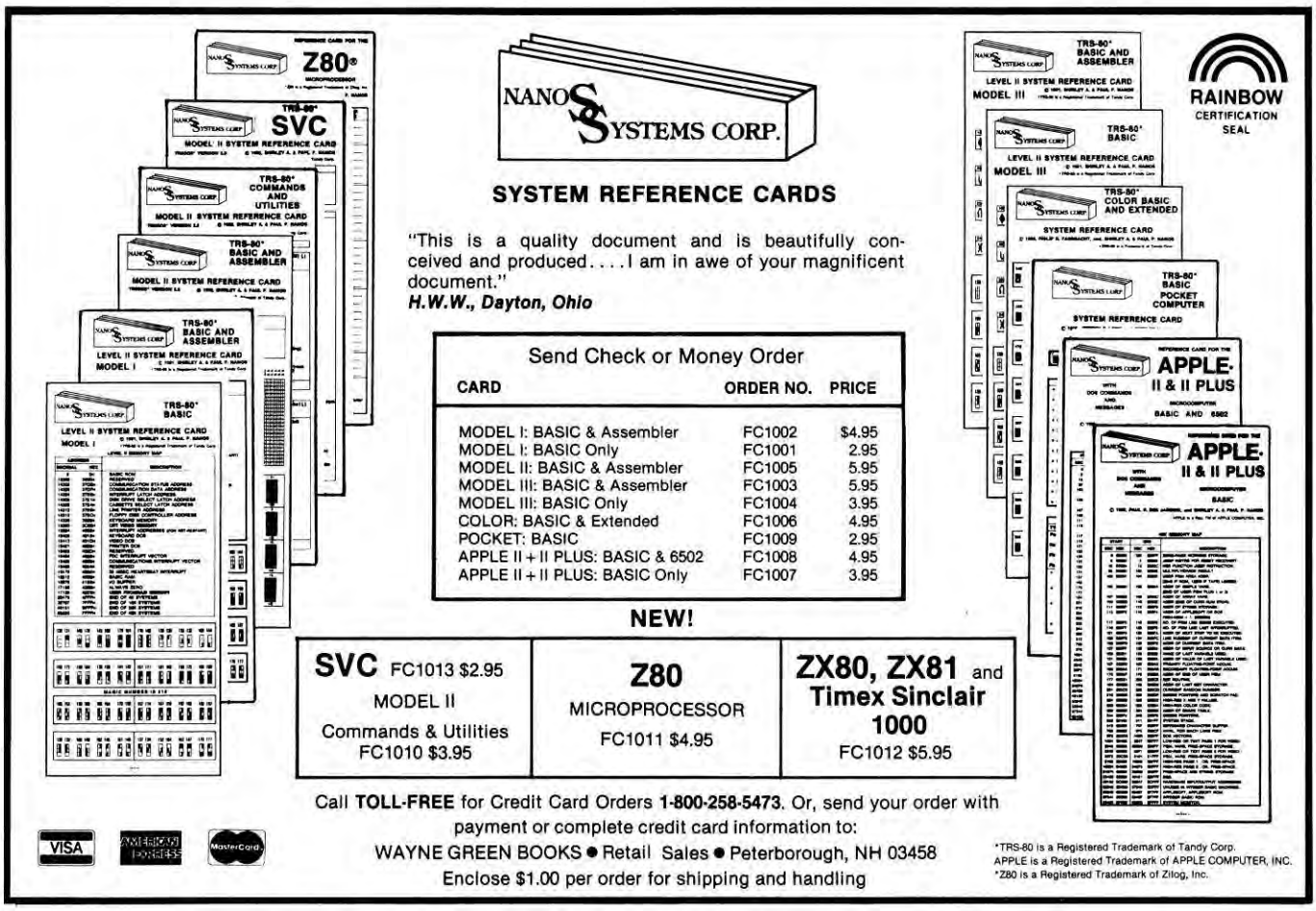
U1 and U2 turn on for a decoding range of four, while address lines A0 and A1 actually perform the individual internal selection between ports 0 to 3 of the 8255 chip. This means that U1 and U2 set up the bottom port number and stay selected while the combination of A0 and A1 make up the next three ports.

U1 makes up the most-significant half of the clock's port number. Only one-half of U2 is used to make up the least-significant half of the clock's port with two gates left for future spares. The port number is selected by setting switches S1 to S6 to either high (open) or ground. The switches that are set to ground are the ones that actually make up the port's number.

When the port is deselected, the logic state on pin 1 of U3A is normally low. The exclusive-OR gate will always output a logic low whenever there are either two lows or two highs on the gate's inputs. Thus, if the decoding switch is open, a high state is given to one of the inputs. If an address line on the other input is also high at the same time, it yields a resultant logical low on the output gate, and the decoder is turned off.

Only one gate of U1 and U2 with a low output is required to turn off the decoder section. Since a logical high is required on pin 1 of U3A to turn on the decoder, all the decoding exclusive-OR gates must have a logical-high output. The exclusive-OR gate supplies a logical-high output only when both of the inputs on each gate are of opposite states.

For example, I decoded my clock for ports 30 to 33 hex, which is the same as 48 to 51 decimal. Since the most-significant port digit is 3, I set switches S3 and



S4 to ground and left S1 and S2 open. The least-significant digit is a zero, so switches S5 and S6 are also left open. The switches that are tied to ground apply a logic low to one of the gate's inputs, while the open switches apply logical highs to their respective pins.

When port 30 is selected, address lines A7 and A6 are low, thus giving opposite states on the inputs to the gates resulting in a logical high on the outputs. Address lines A4 and A5 are high, and since the switches have been set low, the inputs are again in opposite states giving a logical high for an output.

The least-significant digit works in the same way. Since you are only looking at address lines A2 to A7 for decoding, the decoder is enabled no matter what state address lines A0 and A1 are in. This gives you the range for the four required ports.

Any time one of the four ports is selected, there is either an IN or an OUT signal in conjunction with it. These two signals are applied to the gates of U3B and its output goes high when either of the IN or OUT signals are present. The logical-high output of U3B combined with the decoded port signal are applied to the inputs of U3A to give a logical low output. This combination enables

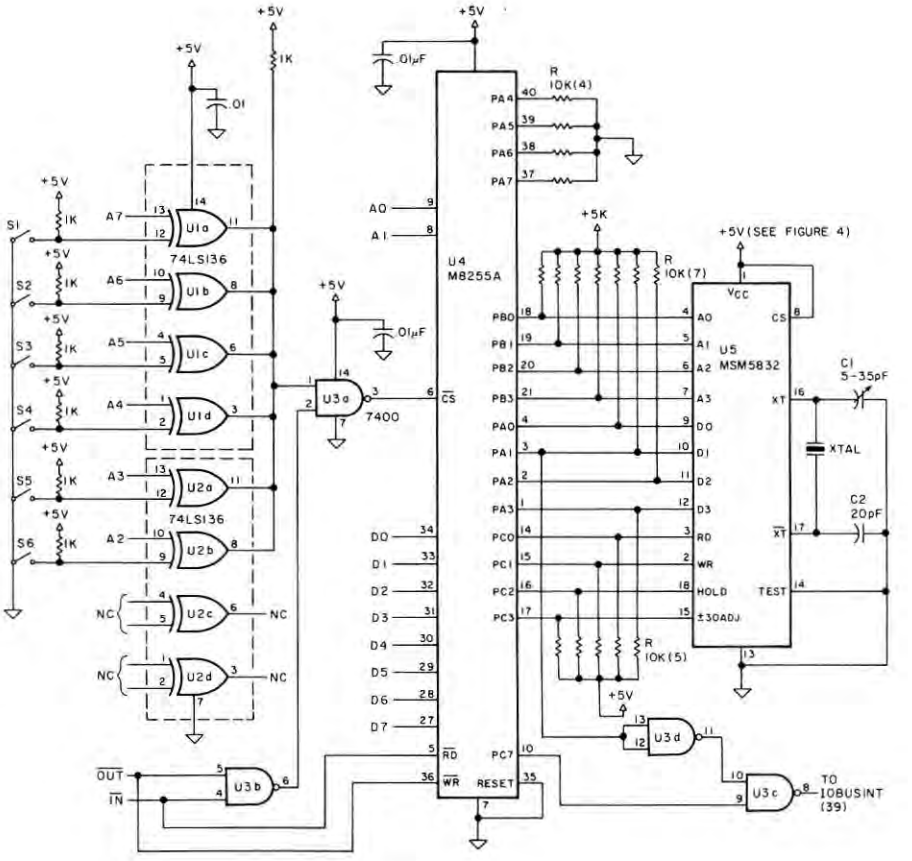


Fig. 3. Real-Time Clock

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the 8255 chip.

There turned out to be only one problem with the decoding circuit. It acted like it was never decoding or selecting the CS input on the 8255. A logic probe kept indicating that there was a signal, but didn't say why it was not working. I used an oscilloscope to see what the signal looked like. It appeared fully functional, so I decided to change U3 from a 74LS00 to a 7400.

The 8255 functioned normally after the change was made. I then tried again using a different 74LS00 and the circuit once more quit working. I concluded that the 74LS00 did not have enough drive to enable the 8255 when the port was decoded. This is why U3 is a regular TTL gate and the others are not.

As mentioned, address lines A0 and A1 are connected directly to the 8255 to control its internal ports. All eight data lines are also connected directly to the 8255. The IN signal is tied to the RD input, and the OUT signal is tied to the WR input of the 8255.

The 8255 was designed to allow the use of 24 I/O pins, which can be individually programmed in two groups of 12 and used in three major modes of operation. Depending upon the control word written to the 8255, these lines can be configured to read or write, and to have latching or nonlatching outputs.

The 8255 was designed to be configured to any system or device with little difficulty. Get *Intel's Component Data Catalog* for more information. This book describes in detail the 8255's many different combinations and configurations.

For this application, the 8255 operates in mode zero. Port 33 hex is used to write the control word (which is 128 decimal for mode 0) to the 8255 chip. Port 32 is used to communicate with port C. Port 31 sets up communications with port B, and port 30 sets up communications with port A on the 8255.

Port C from the 8255 is used to set up the control functions for the clock. Port B addresses the appropriate counters for reading or writing time data, and port A reads or writes the data to and from the clock.

As you can see from Fig. 3, data is either read or written using the first four data lines PA0 to PA3. This means that when port A is read, data lines PA4 to PA7 might give useless or floating information. I decided to tie these lines to ground through 10K resistors to cure this problem. This also eliminates the need for masking out the useless data, and saves extra programming steps.

The clock being used in this circuit is a MSM5832 integrated circuit manufactured by OKI Semiconductor. (It is available from JDR Microdevices Inc., 1224 S. Bascom Ave., San Jose, CA, 800-538-5000 for $7.45. Send an additional $3.95 for the crystal.) When you purchase this clock, get the spec sheets, which contain much valuable information on its functions.

The MSM5832 is a real-time clock/calendar chip and provides many capabilities to the user. It provides time in hours (12- or 24-hour format), minutes, seconds, month, day, year (including leap year), and day of week. Table 1 lists MSM5832's functions. It shows what addresses are required to read the appropriate internal time counters.

This chip also includes reference signals to the computer at 1,024 times per second, once per second, once per minute, or once per hour. I use the once-per-second reference signal in conjunction with the 8255 for interrupt control.

ADDRESS INPUTS				INTERNAL COUNTER	DATA I/O				DATA LIMITS	NOTES
A_0	A_1	A_2	A_3		D_0	D_1	D_2	D_3		
0	0	0	0	SI	*	*	*	*	0-9	SI OR SIO ARE RESET TO ZERO IRRESPECTIVE OF INPUT DATA D0-D3 WHEN WRITE INSTRUCTION IS EXECUTED WITH ADDRESS SELECTION.
1	0	0	0	SIO	*	*	*		0-5	
0	1	0	0	MI	*	*	*	*	0-9	
1	1	0	0	MIIO	*	*	*		0-5	
0	0	1	0	HI	*	*	*	*	0-9	
1	0	1	0	HIO	*	*	-	'	0-1 / 0-2	D_2 = "1" FOR PM; D_3 = "1" FOR 24 HOUR FORMAT; D_2 = "0" FOR AM; D_3 = "0" FOR 12 HOUR FORMAT
0	1	1	0	W	*	*	*		0-6	
1	1	1	0	DI	*	*	*	*	0-9	
0	0	0	1	DIO	*	*	'		0-3	D_2 = "1" FOR 29 DAYS IN MONTH 2; D_2 = "0" FOR 28 DAYS IN MONTH 2 (2)
1	0	0	1	MOI	*	*	*	*	0-9	
0	1	0	1	MO IO	*				0-1	
1	1	0	1	YI	*	*	*	*	0-9	
0	0	1	1	YIO	*	*	*	*	0-9	

(1) * DATA VALID AS "0" OR "1"
BLANK DOES NOT EXIST (UNRECOGNIZED DURING A WRITE AND HELD AT "0" DURING A READ)
' DATA BITS USED FOR AM/PM, 12/24 HOUR AND LEAP YEAR
(2) IF D_2 PREVIOUSLY SET TO "1", UPON COMPLETION OF MONTH 2 DAY 29, D_2 WILL BE INTERNALLY RESET TO "0"

Table 1. MSM5832 Functions

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This reference signal is combined with the output of PC7 through gate U3C.

This output will be the interrupt signal going into the computer at one-second intervals, if enabled. The clock program reads the time and displays it on the screen once every second. The one-second interrupt is also handy for future applications that may need timing control to operate control circuits, such as a sprinkler system.

One important feature of this interrupt is that by combining the reference signal with PC7, you can turn it on or off at will. If you decide to turn it off, the clock program ceases to read and display the time, but the real-time clock chip still keeps time. When the interrupt is again enabled, the current time is then read and displayed on the screen.

Another important feature is that I can allow another device to interrupt the computer by turning off the clock's interrupt signal and wait for the other device to cause the interrupt. I feel that this added control feature allows greater flexibility for an interrupt system.

The MSM5832 chip also provides the capability for a rechargeable Nicad battery back-up in case of system power failure. Figure 4 shows the schematic for this circuit. This is also shown in the MSM5832's data sheet. Q1 and Q2 work together to make up a solid-state switch.

As long as 5 volts is supplied to Q1, it keeps Q2 turned on. Power flows through the emitter-collector junction of Q2 to charge the Nicad batteries and power the clock chip. In the event of a power loss, Q2 is turned off and isolates all the external circuits from being fed off the batteries.

There are many types of AA-size rechargeable Nicad batteries. Radio Shack and General Electric sell them; check prices for the best deal. The more use Nicad batteries receive, the longer they last; try to use them frequently by cutting off the main 5-volt source.

Real-Time Clock Construction

The clock's construction is basically the same as the interface construction. The MSM5832 clock chip and the 8255 are sensitive to static charges, so be extra careful that you are grounded to the same circuit you're working with to avoid static damage. Check your circuit carefully for wiring errors, opens, and shorts before you apply power to the real-time clock section. If everything looks good, plug in all your IC's. You are now ready to load in the Basic program to check out the real-world interface and real-time clock.

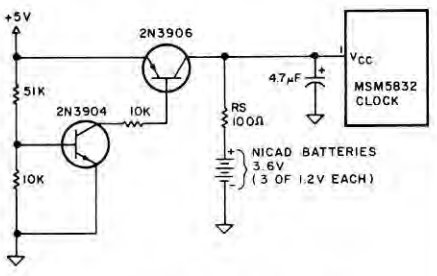

Fig. 4. Battery Back-Up

Program Listing 1 is the Basic program that tests construction and operation of both the interface and real-time clock circuits. This program tests all the MSM5832's time capabilities by selecting the options that are asked upon execution of the program.

Once the data is loaded to the clock chip, the program continuously scans the clock to update and display the time. Notice that an OUT instruction is used to set up the appropriate clock

A) **5-Volt Power-supply Parts List (Fig. 1)**

TX	18.0 CT, 4A transformer	RS #273-1514 or equiv.
CR1-CR4	Power Diodes	1N1341 or equiv.
C1	Filter Cap	25000 uf @ 15V electrolytic
R1	Bleeder Resistor	220 ohm ½ watt
F1	Fuse	3 amp
Misc.	Barrier Strip	RS #274-652

B) **Real-World Interface Parts List (Fig. 2)**

U1	74LS245
U2, U3	74LS367
U4	74LS08
U5	74LS32
R1	4.7K ohm ¼ watt
Caps (Filter)	.01 uf @ 25V disk
J2	RS #276-1566 or equiv.

C) **Real-Time Clock Parts List (Fig. 3)**

U1, U2	74LS136
U3	7400
U4	8255A
U5	MSM5832
S1-S6	RS #275-1301
Caps (Filter)	.01 uf @ 25V disk
C1	5-35 pf (adjustable)
C2	20 pf disk or equiv.
XTAL	32768 Hz

Resistors are ¼ watt:

1K ohm	Quantity of 7
10K ohm	Quantity of 16

D) **Clock Battery Back-up Parts List (Fig. 4)**

Q1	2N3906
Q2	2N3904
R1	51K ohm ¼ watt
R2, R3	10K ohm ¼ watt
Rs	100 ohm ½ watt
C1	4.7 uf @ 25V electrolytic
Batteries (3)	1.2V Nicad General Electric or equiv.

E) **Misc.**

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Table 2. Parts Lists

```
5 REM *      B A S I C  P R O G R A M  # 1
10 CLS:CLEAR100: REM * BASIC PROGRAM TO TEST CLK AND INTERFACE
20 INPUT"DO YOU WANT -12- OR -24- HOUR FORMAT";H$
30 IF H$="24" THEN P$="0": GOTO60: REM * USED TO BYPASS AM/PM
40 CLS:INPUT"DO YOU WANT -AM- OR -PM- (A/P)";P$
50 DATA SUNDAY   ,MONDAY   ,TUESDAY  ,WEDNESDAY,THURSDAY ,FRIDAY   ,SATURDAY
60 FORI=0TO6:READ D$(I):NEXTI :REM * READ DAYS OF WEEK TO ARRAY
70 CLS:INPUT"ENTER H10 H1 M10 M1";H1,H,M1,M
80 CLS:INPUT"ENTER Y10 Y1 M10 M1 D10 D1";Y1,Y,MB,ML,D1,D
90 CLS:INPUT"ENTER DAY CODE (SUN TO SAT =0 - 6)";W
95 CLS:INPUT"IS THIS A LEAP YEAR?  (Y/N)";LY$
100 IFP$="P"  THEN H1=H1+4: REM * SET BIT 3 FOR PM INDICATION
110 IFH$="24" THEN H1=H1+8: REM * SET BIT 4 FOR 24 HOUR MODE
115 IF LY$="Y" THEN D10=D10+4: REM * USED TO TEST LEAP YEAR
120 OUT236,16: REM * TURN ON COMPUTER'S INTERNAL BUFFER
130 OUT51,128: REM * SET UP CLOCK CHIP FOR MODE 0
140 OUT50,6: REM * SET UP CLOCK'S WRITE AND HOLD CONTROLS
150 OUT49,0:OUT48,0:OUT49,1:OUT48,0: REM * WRITE TIME DATA
160 OUT49,2:OUT48,M:OUT49,3:OUT48,M1
170 OUT49,4:OUT48,H:OUT49,5:OUT48,H1
180 OUT49,6:OUT48,W:OUT49,7:OUT48,D:OUT49,8:OUT48,D1
190 OUT49,9:OUT48,ML:OUT49,10:OUT48,MB
200 OUT49,11:OUT48,Y:OUT49,12:OUT48,Y1
210 CLS
220 OUT236,16: REM * ENABLE TRS-80'S INTERNAL BUS
225 OUT51,144: REM * SET TO MODE 0 AND PORT A TO READ ONLY
230 OUT50,1: REM * SET CLOCK'S CONTROL FOR READ FUNCTION
235 REM * READ THE CLOCK'S TIME DATA AND DISPLAY TIME
240 OUT49,1:PRINT@50,INP(48);:OUT49,0:PRINT@52,INP(48);" ";
250 OUT49,3:PRINT@44,INP(48);:OUT49,2:PRINT@46,INP(48);":";
260 OUT49,5:PRINT@38,(INP(48) AND 3);:OUT49,4:PRINT@40,INP(48);":";
270 OUT49,8:PRINT@32,(INP(48) AND 3);:OUT49,7:PRINT@34,INP(48);"  ";
280 OUT49,10:PRINT@26,INP(48);:OUT49,9:PRINT@28,INP(48);"/";
290 OUT49,12:PRINT@20,INP(48);:OUT49,11:PRINT@22,INP(48);"/";
295 IF P$="0" GOTO 320: REM * SKIP AM/PM DISPLAY FOR 24 HOUR
300 OUT49,5:IF (INP(48) AND 4)=0 THEN PRINT@60,"A.M.";
310 IF (INP(48) AND 4)=4 THEN PRINT@60,"P.M.";
320 OUT49,6:D=INP(48):PRINT@100,D$(D);:REM *PRINT DAY OF WEEK
330 GOTO 240: REM * GO BACK AND SCAN TIME
```

Program Listing 1

counter. An input instruction is then executed to read that counter.

Lines 120 and 220 turn on the computer's internal bus so data can be transmitted and received. This internal bus stays enabled as long as the Basic program is running. If you hit the break key and want to continue execution without destroying the current time, type "Out236,16:Cont" to continue where you left off.

Program Listing 2 initializes the clock's time and is used with the machine-language Program Listing 3 under interrupt control. The Assembly-language program should be executed before this Basic program. The first part of the Assembly clock routine sets up the interrupts and enables them so that this Basic program executes properly.

It seems more efficient to initialize the clock with a Basic program than to add more machine code, which takes up more memory. Once this Basic program is run, the clock should keep the correct time for as long as it has power. If there is ever a need to change any of the clock's internal counters, use output instructions under Basic control.

Listing 2 must set up the clock chip so that the interrupts are enabled to allow the machine-language program to work. Line 120 again enables the computer's internal bus for data I/O. Line 225 puts the 8255 chip in mode 0 along with configuring the ports so that port A is input only, and ports B and C have input and latching outputs.

In order for the clock to generate interrupts, three requirements must be

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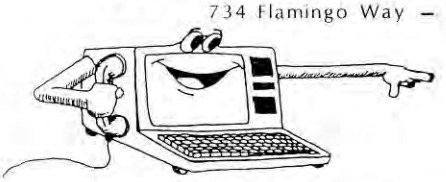

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met. First, the clock must be set up for a read mode continuously, so that line 230 performs this function via port C's latching capability. Second, port B is used on line 240 to latch the clock's address lines to a high state.

Third, the output of PC7 of the 8255 must be high to allow interrupts to the computer. Line 230 also performs this function. PC0 is used to set the clock's read input high and PC7 is used to enable the interrupts with a combined value of 129 for Line 230. Upon execution of this program, the clock should be displaying the time at one-second intervals.

```
5 REM *       B A S I C   P R O G R A M   # 2
10 CLS:CLEAR100: REM * BASIC PROGRAM TO INITIALIZE CLK
20 INPUT"DO YOU WANT -12- OR -24- HOUR FORMAT";H$
30 IF H$="24" THEN P$="0": GOTO60: REM * USED TO BYPASS AM/PM
40 CLS:INPUT"DO YOU WANT -AM- OR -PM- (A/P)";P$
50 DATA SUNDAY    ,MONDAY    ,TUESDAY   ,WEDNESDAY,THURSDAY ,FRIDAY    ,SATURDAY
60 FORI=0TO6:READ D$(I):NEXTI :REM * READ DAYS OF WEEK TO ARRAY
70 CLS:INPUT"ENTER H10 H1 M10 M1";H1,H,M1,M: REM *HOURS MINUTES
80 CLS:INPUT"ENTER Y10 Y1 M10 M1 D10 D1";Y1,Y,MB,ML,D1,D
90 CLS:INPUT"ENTER DAY CODE (SUN TO SAT =0 - 6)";W
95 CLS:INPUT"IS THIS A LEAP YEAR?  (Y/N)";LY$
100 IFP$="P"  THEN H1=H1+4: REM * SET BIT 3 FOR PM INDICATION
110 IFH$="24" THEN H1=H1+8: REM * SET BIT 4 FOR 24 HOUR MODE
115 IF LY$="Y" THEN D10=D10+4: REM * USED TO TEST LEAP YEAR
120 OUT236,16: REM * TURN ON COMPUTER'S INTERNAL BUFFER
130 OUT51,128: REM * SET UP CLOCK CHIP FOR MODE 0
140 OUT50,6: REM * SET UP CLOCK'S WRITE AND HOLD CONTROLS
150 OUT49,0:OUT48,0:OUT49,1:OUT48,0: REM * WRITE TIME DATA
160 OUT49,2:OUT48,M:OUT49,3:OUT48,M1
170 OUT49,4:OUT48,H:OUT49,5:OUT48,H1
180 OUT49,6:OUT48,W:OUT49,7:OUT48,D:OUT49,8:OUT48,D1
190 OUT49,9:OUT48,ML:OUT49,10:OUT48,MB
200 OUT49,11:OUT48,Y:OUT49,12:OUT48,Y1
210 CLS
220 OUT236,16: REM * ENABLE TRS-80'S INTERNAL BUS
225 OUT51,144: REM * SET TO MODE 0 AND PORT A TO READ ONLY
230 OUT50,129: REM * SET CLOCK TO READ AND ENABLE INTERRUPTS
240 OUT49,15:  REM * SET ADDRESS LINES HIGH FOR INTERRUPTS
250 END
```

Program Listing 2

The Machine-Language Program

This program is the heart of the clock. It executes once a second if the interrupt requirements have properly been completed via the Basic initialization program. The first part of the program sets up the needed vector jumps and enables the appropriate TRS-80 ports. Lines 170–230 make sure that the 8255 is set not to interrupt until the initialization program has been executed.

The computer must know where to go when it is interrupted, so lines 150 and 160 load the appropriate address to the interrupt vector area. This address points to where the label START resides within the program. Remember, all the code before the START label was used only once to initialize all of the vectors and ports. Lines 130 and 140 set address 4213 in the computer to 12 to allow the computer to be interrupted from external signals.

After you test the interface and clock circuits using Program Listing 1, load the machine-language program first and execute it by performing a /32448 enter. If the ready prompt is displayed, the first section was executed without any error.

Sometimes the jump back into Basic causes a syntax error on the first command you try to execute. Usually, trying the command again clears up the problem. Now, load Program Listing 2 to initialize the clock. Answer all the

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questions in regard to real-time information. Upon completion of this program, the current time should now be displayed on the upper right corner of the display.

To disable the interrupts and display, perform an Out236,16: Out50,0 under Basic. Remember, the current time will still be updated in the MSM5832 clock chip. To display the time and reenable the interrupts, perform an Out236,16: Out50,129. The displayed time will be the current time with no loss of information.

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David Engelhardt can be reached at 10221 W. 101st Place, Broomfield, CO 80020.

Program Listing 3

```
                00010 ;CLOCK INITIALIZATION AND INTERRUPT READ PROGRAM
                00020 ;WRITTEN BY DAVE ENGELHARDT   3/15/82
                00030 ;SAVE MEMORY SIZE OF -32447-      (THIS WILL ALLOW ROOM
                00040 ;                                 FOR PATCHING IN FUTURE
                00050 ;                                 PROGRAMS.)
                00060 ;EXECUTE WITH A ' /32448 '
                00070 ;
                00080 ;         INITIALIZATION SECTION
                00090 ;
7EC0            00100           ORG     7EC0H   ;START OF INITIALIZATION SECTION
7EC0 C07E       00110 BEGIN     DEFW    BEGIN
7EC2 F3         00120           DI                      ;DISABLE INTERRUPTS
7EC3 3E0C       00130           LD      A,12            ;USED TO SET INTERRUPTS
7EC5 321342     00140           LD      (4213H),A       ;ENABLE EXT INTERRUPTS
7EC8 21E17E     00150           LD      HL,START        ;LOAD START OF CLOCK
7ECB 223E40     00160           LD      (403EH),HL      ;  TO INTERRUPT VECTOR
7ECE 3E10       00170           LD      A,16
7ED0 D3EC       00180           OUT     (0ECH),A        ;ENABLE TRS MAIN BUS
7ED2 3E80       00190           LD      A,128           ;SET UP 8255 FOR
7ED4 D333       00200           OUT     (SETUP),A       ;  MODE 0
7ED6 AF         00210           XOR     A
7ED7 D332       00220           OUT     (OUTC),A        ;MAKE SURE PC7 IS OFF
7ED9 D3EC       00230           OUT     (0ECH),A        ;SHUT OF MAIN BUS
7EDB ED56       00240           IM      1               ;SET MODE 1 INTERRUPT
7EDD FB         00250           EI                      ;ENABLE INTERRUPTS
7EDE C3191A     00260 EXI       JP      1A19H           ;BACK TO BASIC
                00270 ;
                00280 ;
0030            00290 INPUTA    EQU     30H     ;USED TO CONTROL CLOCK DATA LINES
0031            00300 OUTB      EQU     31H     ;USED TO CONTROL CLK ADDRSS LINES
0032            00310 OUTC      EQU     32H     ;USED TO CONTROL CLK FUNCTIONS
0033            00320 SETUP     EQU     33H     ;USED TO CONFIGURE 8255
                00330 ;
                00340 ;         CLOCK INTERRUPT/READ PROGRAM
                00350 ;
7EE1 E5         00360 START     PUSH    HL              ;SAVE REGISTORS
7EE2 D5         00370           PUSH    DE
7EE3 C5         00380           PUSH    BC
7EE4 DDE5       00390           PUSH    IX
7EE6 FDE5       00400           PUSH    IY
7EE8 F5         00410           PUSH    AF
7EE9 3E10       00420           LD      A,16            ;VALUE FOR TRS BUS
7EEB D3EC       00430           OUT     (0ECH),A        ;ENABLE MAIN BUS
7EED 3E90       00440           LD      A,144           ;SET 8255 FOR CONTROL
7EEF D333       00450           OUT     (SETUP),A       ;CONFIGURE 8255
7EF1 3E01       00460           LD      A,1             ;SET UP FOR READ
7EF3 D332       00470           OUT     (OUTC),A        ;PORT C FOR READ
7EF5 0E31       00480           LD      C,OUTB          ;C IS USED FOR OUT INSTR.
7EF7 060C       00490           LD      B,12            ;USED TO ADDRESS COUNTERS
7EF9 21AD7F     00500           LD      HL,BUFFER       ;START OF TIME STORAGE
7EFC CDDE7F     00510           CALL    GET             ;GET Y10
7EFF CDDE7F     00520           CALL    GET             ;GET Y1
7F02 362F       00530           LD      (HL),'/'        ;PUT / IN WORD
7F04 23         00540           INC     HL              ;INC TO NEXT LOC IN BUFF
7F05 CDDE7F     00550           CALL    GET             ;GET M10
7F08 CDDE7F     00560           CALL    GET             ;GET M1
7F0B 362F       00570           LD      (HL),'/'        ;PUT IN SEPERATOR
7F0D 23         00580           INC     HL              ;INC TO NEXT POSITION
7F0E CDDE7F     00590           CALL    GET             ;GET D10
7F11 CB57       00600           BIT     2,A             ;IS OF LEAP BIT SET?
7F13 2805       00610           JR      Z,GETD1         ;SKIP IF NOT SET
7F15 E633       00620           AND     33H             ;STRIP OFF LEAP BIT
7F17 2B         00630           DEC     HL              ;BACK UP 1 POSITION
7F18 77         00640           LD      (HL),A          ;PUT CORRECT VALUE IN
7F19 23         00650           INC     HL              ;INC TO NEXT POSTION
7F1A CDDE7F     00660 GETD1     CALL    GET             ;GET D1
7F1D CDEA7F     00670           CALL    FILL            ;INSERT 2 SPACES
7F20 CDDE7F     00680           CALL    GET             ;GET DAY DIGIT (0-6)
7F23 E607       00690           AND     07H             ;MASK FOR DAY CODE
7F25 2B         00700           DEC     HL              ;RE-ALIGN BUFF PTR
7F26 119D7F     00710           LD      DE,SU           ;GET ADDRESS OF TABLE
7F29 17         00720           RLA                     ;SHIFT FOR 2 WORD OFFSET
7F2A 83         00730           ADD     A,E             ;ADD DAY INDEX TO A
7F2B 5F         00740           LD      E,A             ;PUT INDEX TO A REG
7F2C C5         00750           PUSH    BC              ;SAVE PORT & ADRSS CONTRL
7F2D 1A         00760           LD      A,(DE)          ;GET PTR TO DAY CODE
7F2E 32AB7F     00770           LD      (TEMP1),A       ;SAVE LSB OF DAY CODE
7F31 13         00780           INC     DE              ;INDEX TO GET NEXT PTR
7F32 1A         00790           LD      A,(DE)          ;GET NEXT PTR TO DAY CODE
```


Listing 3 continues

Listing 3 continued

```
7F33 32AC7F   00800          LD      (TEMP2),A       ;SAVE MSB OF DAY CODE
7F36 ED5BAB7F 00810          LD      DE,(TEMP1)      ;GET ADDRESS OF DAY
7F3A EB       00820          EX      DE,HL           ;SWAP PTRS FOR LDIR MOVE
7F3B 010300   00830          LD      BC,3            ;SET CTR TO MOVE 3 BYTES
7F3E EDB0     00840          LDIR                    ;MOVE IT
7F40 EB       00850          EX      DE,HL           ;RESTORE PTRS.
7F41 C1       00860          POP     BC              ;RESTORE PORT & ADDRESS'S
7F42 CDEA7F   00870          CALL    FILL            ;FILL WITH SPACES
7F45 CDDE7F   00880          CALL    GET             ;GET H10
7F48 2B       00890          DEC     HL              ;SET BACK BUFF PTR
7F49 F5       00900          PUSH    AF              ;SAVE A REG FOR AM CHECK
7F4A E633     00910          AND     33H             ;MASK FOR H10 VALUE
7F4C 77       00920          LD      (HL),A          ;PUT H10 VALUE TO BUFFER
7F4D 23       00930          INC     HL              ;NEXT BUFFER LOCATION
7F4E CDDE7F   00940          CALL    GET             ;GET H1
7F51 363A     00950          LD      (HL),':'        ;PUT IN COLON
7F53 23       00960          INC     HL              ;NEXT BUFFER LOCATION
7F54 CDDE7F   00970          CALL    GET             ;GET M10
7F57 CDDE7F   00980          CALL    GET             ;GET M1
7F5A 363A     00990          LD      (HL),':'        ;PUT IN COLON
7F5C 23       01000          INC     HL              ;NEXT BUFFER LOCATION
7F5D CDDE7F   01010          CALL    GET             ;GET S10
7F60 CDDE7F   01020          CALL    GET             ;GET S1
7F63 CDEA7F   01030          CALL    FILL            ;FILL WITH SPACES
7F66 F1       01040          POP     AF              ;RESTOR AM/PM INFO
7F67 CB5F     01050          BIT     3,A             ;IS THIS 24 HOUR FORMAT?
7F69 2805     01060          JR      Z,AMPM          ;SKIP AM/PM DISPLAY SECT
7F6B CDEA7F   01070          CALL    FILL            ;BLANK WHERE AM WAS TO BE
7F6E 180D     01080          JR      DISPLY          ;GO AND DISPLAY TIME
7F70 CB57     01090 AMPM     BIT     2,A             ;IS PM BIT SET?
7F72 2004     01100          JR      NZ,PM           ;PM BIT SET
7F74 3641     01110 AM       LD      (HL),'A'        ;AM CODE
7F76 1802     01120          JR      CONT
7F78 3650     01130 PM       LD      (HL),'P'        ;PM CODE
7F7A 23       01140 CONT     INC     HL              ;INC TO NEXT BUFFER PTR
7F7B 364D     01150          LD      (HL),'M'        ;PUT IN THE M FOR AM/PM
7F7D 21AD7F   01160 DISPLY   LD      HL,BUFFER       ;BEGIN OF TIME INFO
7F80 11243C   01170          LD      DE,3C24H        ;DESTINATION TO SCREEN
7F83 011B00   01180          LD      BC,27           ;NUMBER OF TIME WORDS
7F86 EDB0     01190          LDIR                    ;MOVE THE TIME TO SCREEN
7F88 3E0F     01200 NODISP   LD      A,15            ;FOR CLOCK ADDRESSES
7F8A D331     01210          OUT     (OUTB),A        ;SET ADDRESS LINES HIGH
7F8C 3E81     01220          LD      A,129           ;SET READ HIGH-ENABLE INT
7F8E D332     01230          OUT     (OUTC),A        ;TURN ON INTRUPTS VIA PC7
7F90 AF       01240          XOR     A               ;CLEAR A REG
7F91 D3EC     01250          OUT     (0ECH),A        ;TURN OFF TRS MAIN BUS
7F93 F1       01260          POP     AF              ;RESTORE REGISTORS
7F94 FDE1     01270          POP     IY
7F96 DDE1     01280          POP     IX
7F98 C1       01290          POP     BC
7F99 D1       01300          POP     DE
7F9A E1       01310          POP     HL
7F9B FB       01320          EI                      ;ENABLE INTERRUPTS
7F9C C9       01330          RET                     ;RETURN TO INTERRUPTED PT
              01340 ;
              01350 ;        INDEX TO DAY MESSAGE TABLE
              01360 ;
7F9D C97F     01370 SU       DEFW    SUN
7F9F CC7F     01380 MO       DEFW    MON
7FA1 CF7F     01390 TU       DEFW    TUE
7FA3 D27F     01400 WE       DEFW    WED
7FA5 D57F     01410 TR       DEFW    THR
7FA7 D87F     01420 FR       DEFW    FRI
7FA9 DB7F     01430 SA       DEFW    SAT
              01440 ;
              01450 ;
7FAB 00       01460 TEMP1    DEFB    0               ;LSB STORAGE FOR DAY
7FAC 00       01470 TEMP2    DEFB    0               ;MSB STORAGE FOR DAY
001C          01480 BUFFER   DEFS    28              ;TIME INFORMATION BUFFER
              01490 ;
              01500 ;        TABLE OF DAY MESSAGES
              01510 ;
7FC9 53       01520 SUN      DEFM    'SUN'
     55 4E
7FCC 4D       01530 MON      DEFM    'MON'
     4F 4E
7FCF 54       01540 TUE      DEFM    'TUE'
     55 45
7FD2 57       01550 WED      DEFM    'WED'
     45 44
7FD5 54       01560 THR      DEFM    'THR'
     48 52
7FD8 46       01570 FRI      DEFM    'FRI'
     52 49
7FDB 53       01580 SAT      DEFM    'SAT'
     41 54
              01590 ;
              01600 ;        SUBROUTINE TO READ THE CLOCK'S COUNTERS
              01610 ;



7FDE ED41     01620 GET      OUT     (C),B           ;SET UP ADDRESS FOR READ
7FE0 ED41     01630          OUT     (C),B           ;TIME DELAY
7FE2 DB30     01640          IN      A,(INPUTA)      ;READ TIME
7FE4 C630     01650          ADD     A,30H           ;OBTAIN ASCII VALUE
7FE6 77       01660          LD      (HL),A          ;PUT VALUE TO BUFFER
7FE7 23       01670          INC     HL              ;INC TO NEXT BUFFER PTR
7FE8 05       01680          DEC     B               ;DEC B FOR NEXT COUNTER
7FE9 C9       01690          RET                     ;FINISHED!
              01700 ;
              01710 ;        ROUTINE TO PUT SPACES BETWEEN TIME INFO
              01720 ;
7FEA 3620     01730 FILL     LD      (HL),20H        ;ASCII SPACE CODE
7FEC 23       01740          INC     HL              ;INC NEXT SPACE
7FED 3620     01750          LD      (HL),20H        ;PUT IN NEXT SPACE
7FEF 23       01760          INC     HL              ;INC BUFFER PTR.
7FF0 C9       01770          RET                     ;DONE
              01780 ;
7EC0          01790          END     BEGIN
00000 TOTAL ERRORS
```


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Stuart F. Ring
106 Marble Drive
Rochester, NY 14615

I've written a program for a 16K Level II Model I or III that summarizes my expenditures in the form of an easy-to-understand bar chart. Bar charts show the relative importance of the information displayed.

First, I sketched on paper what I wanted the chart to look like. I needed to show at least 12 items (monthly financial records). I wanted the bars to run vertically on the sheet. Horizontal bar charts are not as easy to interpret. I wanted a title at the top of the page. When I thought about labeling the axes, I decided to use the title to indicate order of magnitude for the vertical axis and just simply number the vertical axis. For the horizontal axis, I decided upon letters of the alphabet for each bar (labels won't fit—especially for items like car expenses, heating, and so on). I listed the items on the page beneath the chart, hence the layout of the final product (see Fig. 1).

Auto-scaling of the axes is complicated and obligates you to some form of auto-titling to indicate the scale factor. I wanted a fixed-size chart and also wished to avoid unusual scales with 0.454 (or the like) increments. As a compromise I selected 0.1, 0.2, or 0.4 as increment sizes and a fixed chart height of 25 increments. The program selects the proper increment but limits you to input values between 0–10. When using the program I pick the proper multiple of 10 to scale the data by and include it as part of the title, for example, "Thousands of Dollars," or "Miles per Gallon/10." This format is popular in news presentations and magazines.

Since my Centronics 730 printer lacks graphics characters, my final requirement was ASCII characters only. I chose asterisks for the bars and periods and plus signs for the axes. You may want to create side-by-side bars from different characters, for example, asterisks and pound signs, to allow comparisons to stand out.

"You may want to create side-by-side bars from different characters to allow comparisons to stand out."

The Key Box

Model I or III
16K RAM
Level II Basic
Printer

Concept

If I treated the chart as a large array, it would be easy to create vertical bars, horizontal bars, labels, axes, or whatever in Basic. All that would remain would be to print the array. First, I considered storing CHR$s directly in the array. After some experimenting it became apparent that this approach would consume too much memory, be too slow, and produce unusual results when printed unless properly filled with spaces. When I consulted the table of character codes in Appendix C, page 2 of the Level II Basic manual, the answer became obvious. I set up the array for the chart using integers in memory and created the bars, axes, and so on using the codes. Conversion to ASCII characters is then accomplished by the print routine.

Figure 2 illustrates conceptually how the chart array appears in memory. For example, the first two entries in row 0 (49,48) represent the codes for the vertical scale value of 10. The 42 in column 10, row 2 is the code for an asterisk (part of a vertical bar). The 66 in column 10, row 26 is the code for the letter B. By using this approach, the chart can be created easily using Basic, takes a minimum of memory, and is convenient to print. It's easy to adapt this approach to whatever format suits your application.

Using the Program

When you first run the program, you will notice a few seconds delay and the message "Zeroing Graph Parameters" will appear on the screen. This occurs while the program fills the chart array with the character codes for a space. If the program didn't do this, the printer would ignore the blanks between axes, bars, and so on and print a strange looking chart. After the array is created and blanked for the printer, the program asks for the title. Again I suggest that you include your chosen scale factor. Next you are asked for the number of items to be charted (the program permits up to 12). Finally, the program asks for a description of the item and its value (a number between 1–10) until all of the items have been entered. During this process you can correct input errors.

The program is short, and I've added comments to differentiate the various functions. Lines 10–50 dimension the array and

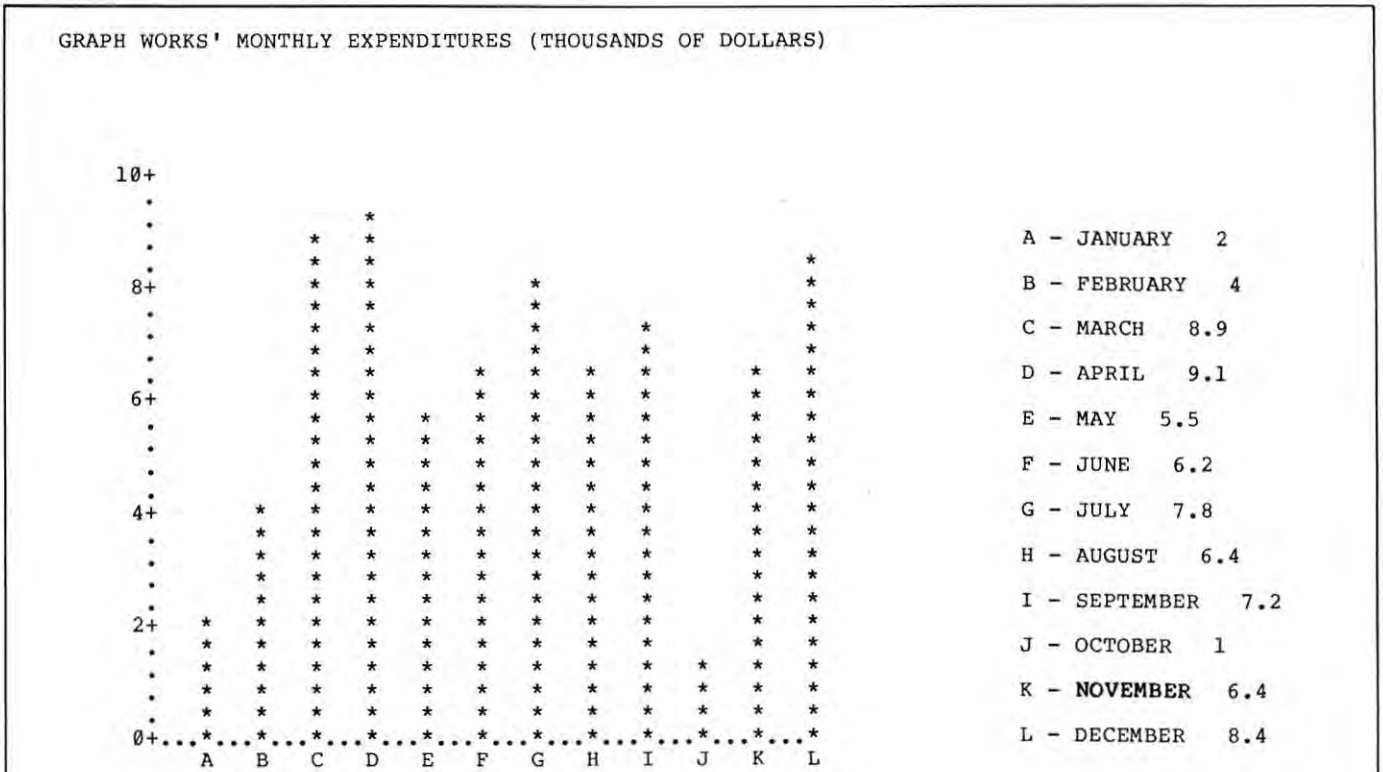

Fig. 1. Sample Bar Chart

```
COLUMN     0    1    2    3    4    ....10.............52
ROW  0    49   48   43   32   32    ....42...
ROW  1    32   32   46   32   32    ....42...
ROW  2    32   32   46   32   32    ....42...
      .
      .
ROW 25    32   48   43   46   46    ....42...
ROW 26    32   32   32   32   32    ....66...
```

Fig. 2. Array Format with Character Codes

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clear string space. Lines 60-140 put spaces in the array and create the axes. Lines 150-350 are for data input. Lines 360-400 select and label the vertical scale. Lines 410-460 label the horizontal axis. Lines 470-550 insert bars in the array. Lines 590-710 are the print routine.■

Stuart Ring is employed by Eastman Kodak Company. He likes to travel and read science fiction.

```
10 ' BAR CHART ROUTINE ::::::::::::::::::
20 '12/81 S. F. RING
30 CLEAR 5000
40 DEFINT I-N
50 DIM IM(26,52),P$(26),A$(12),V(12),D$(12)
60 CLS: PRINT" BARCHART ROUTINE"
70 PRINT: PRINT "ONE MOMENT...ZEROING GRAPH PARAMETERS....."
80 FOR I=0 TO 26: FOR J=0 TO 51: IM(I,J)=32: NEXT J,I
90 FOR J=4 TO 51 'DRAW HORIZONTAL AXIS ::::
100 IM(25,J)=46 : NEXT J
110 FOR I=0 TO 25 'DRAW VERTICAL AXIS :::::::
120 IM(I,3)=46 : NEXT I
130 FOR I=25 TO 0 STEP -5 'VERTICAL TICKS ::::::
140 IM(I,3)=43: NEXT I
150 'DATA INPUT ::::::::::::::::
160 CLS: INPUT"ENTER THE CHART TITLE";TTL$
170 INPUT"ENTER THE NUMBER OF ITEMS (UP TO 12)";NB
180 IF NB<1 OR NB>12 THEN GOTO 170
190 FOR N=0 TO NB-1
200 IA=65+N
210 PRINT "ENTER DESCRIPTION OF ITEM ";CHR$(IA)
220 INPUT D$(N)
230 PRINT "ENTER VALUE (POSITIVE BETWEEN 0 AND 10) FOR ";D$(N)
240 INPUT V(N)
250 IF V(N)<0 OR V(N)>10. THEN PRINT " NEGATIVE OR VALUES GREATE
R THAN 10.0 NOT PERMITTED.": GOTO 240
260 DU$=" "
270 INPUT "ENTRIES CORRECT (Y OR N)";DU$
280 PRINT
290 IF DU$="N" GOTO 210
300 NEXT N
310 'FIND LARGEST VALUE AND SET SCALE ::::::::::::::
320 X=0
330 FOR I=0 TO NB-1
340 IF X<V(I) THEN X=V(I)
350 NEXT I
360 'LABEL SCALE ::::::::::
370 IF X<=2.5 THEN SC=2.5:IM(0,0)=50:IM(0,1)=46:IM(0,2)=53:IM(5,
0)=50:IM(5,1)=46:IM(5,2)=48:IM(10,0)=49:IM(10,1)=46:IM(10,2)=53:
IM(15,0)=49:IM(15,1)=46:IM(15,2)=48:IM(20,0)=48:IM(20,1)=46:IM(2
0,2)=53
380 IF X=<2.5 THEN IM(25,0)=48:IM(25,1)=46:IM(25,2)=48:GOTO 410
390 IF X<=5 THEN SC=5:IM(0,2)=53:IM(5,2)=52:IM(10,2)=51:IM(15,2)
=50:IM(20,2)=49:IM(25,2)=48:GOTO 410
400 SC=10: IM(0,1)=49:IM(0,2)=48:IM(5,2)=56:IM(10,2)=54:IM(15,2)
=52:IM(20,2)=50:IM(25,2)=48
410 'LABEL AXIS ::::::::::::::
420 K=0
430 FOR J=7 TO (NB*4+4) STEP 4
440 IM(26,J)=65+K
450 K=K+1
460 NEXT J
470 'CREATE BARS ::::::::::::::::::
480 FOR N=0 TO NB-1
490 HT=V(N)*25/SC
500 IF HT-INT(HT)>=.5 THEN IH=INT(HT)+1 ELSE IH=INT(HT)
510 IF IH=0 THEN GOTO 550
520 FOR I=0 TO IH
530 IM(25-I,7+4*N)=42
540 NEXT I
550 NEXT N
560 GOSUB 590
570 GOTO 60
580 END
590 'PRINT ROUTINE ::::::::::::::::
600 FOR I=0 TO 26: P$(I)=CHR$(0): NEXT I
610 IX=(80-LEN(TTL$))/2:LPRINT CHR$(138): LPRINT TAB(IX);TTL$: L
PRINT STRING$(2,CHR$(138))
620 LPRINT CHR$(138):FOR I=0 TO 26
630 FOR J=0 TO 51
640 S$=CHR$(IM(I,J))
650 P$(I)=P$(I)+S$: NEXT J
660 LPRINT TAB(15);P$(I): NEXT I
670 LPRINT STRING$(2,138)
680 FOR N=0 TO NB-1
690 LPRINT CHR$(138);TAB(10);CHR$(65+N);" - ";D$(N);"  ";V(N)
700 NEXT N
710 RETURN:END
```

Program Listing

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Move it into high memory.

Relocate Debug

Jerry W. O'Dell
Eastern Michigan University
Ypsilanti, MI 48197

Radio Shack's machine-language monitor for the Models I and III, Debug, is not as sophisticated as other monitors available, but I like its display format and it works well. Debug resides in low memory, from 4332H-493FH. If you are the curious type, as I am, and you like to poke around in commercial programs to see how they work, this is a disadvantage, for the programs usually lie in the same area as that taken up by Debug. Why not move Debug up to a higher location in memory?

Model III Flight Plan

My Model III has 48K memory. If you have only 16K, see below.

The Key Box

Basic Level II
Model III
16K RAM

Debug is not a small program (1550 bytes). You have to change the addresses of all relevant jumps and calls. The difficulty is that you should not change all of them. Some of the calls in Debug are to routines in the TRS-80 ROM, others are to addresses used by the system. Which ones should you change? You will need a good disassembler to find out.

Fortunately, my trusty Instant Software disassembler TLDIS disassembled Debug without a hitch. Inspection of the code showed clearly that you should leave intact all addresses below 4300H, and change all those above that value.

Looking at the 14 pages of disassembled code, there are 137 addresses to change! I wrote a Basic program to do the job (see the Program Listing).

The program is simple. Moving Debug a convenient distance makes it even easier. If we relocate the program from 4332H to F332H, we have to change only one byte of machine code per location. That leaves the program somewhat below the top of memory, but it was easier to move things to F332H. You only have to add B0H (176 decimal) to each relevant code.

Lines 10-200 of the program contain the addresses to be changed, in hex. Lines 5025-5070 convert these hex values into decimal for the TRS-80. Lines 5080-5120 convert the present value in the location to hex for viewing by the operator, and lines 5130 and 5140 make the actual conversion.

How to Do It

Load Debug into its normal location, as shown in its manual. Enter Debug, and put the following program in locations 8000H (for example) and beyond:

```
21 32 43 11 32 F3 01 0E 06 ED B0 C3 09 49
```

This simple LDIR program moves Debug from 4332H to F332H. Now using Debug itself jump to 8000H, thus executing the little program. When this is done, you will have a copy of Debug in high memory.

Reset the computer (do not turn it off) and set memory size at 32767 or some other convenient value. Load the Basic program from tape, and run it. Watch the numbers very carefully as they appear on the screen. They should all be between 43 and 49. If you get some other number, your addresses are wrong in lines 10-200. You will get an OD error when it is done, but that's ok.

Type System, and respond to the prompt with /63753. That's F909 in decimal, the entry point of the newly located program. If you did everything correctly, you will be in the Debug located in high memory. Now use Debug to save itself on tape (preferably at high speed), so you can reload it when you wipe out all memory (as you certainly will while debugging). Debug now starts at F332, ends at F93F, and the entry point is F909H.

For 16K Users

If you have a 16K machine, just change a few numbers. Set memory size at 25999 or so. Change line 5075 of the program from 45056 (B000H) to 12288 (3000H). Change line 5130 from 176 (B0H) to 48 (30H). In lines 5080 and 5140 change the " – 1* (65536-NN)" to NN.

You will also have to change the little machine-language program used to move Debug. Change F3 to 73. Then, with Debug jump to the place you choose to start the little machine-language program—I suggest 7000H. Now, Debug will start at 7332H and end at 793FH, with the entry point at 7909H.

This conversion leaves most of the important pointers in their original positions. This is especially the case with the stack pointer. You can move SP by changing the values in 4344H and above, but very strange things happen when you run Debug.

This conversion makes Debug even more useful than before. For example, EDTASM for the Models I and III loads from tape at 500 baud, and seemingly takes forever. If you want to change the tape speed of the program, you need to know certain things: Debug will tell you that the entry point of the program is 4BEA, and that the program starts around 4610 and ends around 6320. When

you know these things, you can use Debug to write a tape of EDTASM at high speed. Now it loads in about 40 seconds, rather than two minutes! Unfortunately, EDTASM still writes its own tapes at 500 baud, but at least you have eliminated one annoying delay. ■

Jerry O'Dell is professor of psychology at Eastern Michigan University.

```
10 DATA 4349,4351,4355,435E,4361,437E,4387,4390,4395,439A
20 DATA 439D,43B7,43BC,43C1,43CE,43D3,43D8,43DD,43E6,43EB,43EE
30 DATA 43F1,43FF,4402,4414,4418,441C
40 DATA 442A,442D,4433,443D,4440,4443,4446,444A,4459
50 DATA 445D,4474,4477,447A,447D,4483,448A,448F,4492
60 DATA 4495,449A,44A3
70 DATA 4500,4503,4508,450B
80 DATA 4510,4515,4519,4522,4527,452A,4548,454C,4557
90 DATA 4561,4564,4567,456A,456D,4572,457B,457E
100 DATA 4589,4592,45C0,45C5,45CC,45D3,45D8
110 DATA 45FD,4608,4613,4617,4622,4629,4646,4649
120 DATA 4668,466B,4680,4687,468C,468F,46C1
130 DATA 46E9,46EC,46EF,46F5,46FB
140 DATA 4753,475D,4760,4769,4788,4791,47A0
160 DATA 47B4,47B7,47D6,47F8,47FB,47FE,4802
170 DATA 4805,4808,480B,480F,4813,481A,481D,4820,4823,4827
180 DATA 482A,482D,4830
190 DATA 4859,4863,487D,4881,4885,488B,4895,48A0,48AF
200 DATA 4905,4908,4910,4916,491C
5010 REM  BEGINNING OF LOOP
5020 READ A$
5025 NN=0                          'SET SUM TO ZERO
5030 FOR J=1 TO 4                  'LOOP TO DECODE HEX TO DEC
5040 B$=MID$(A$,J,1):C=ASC(B$)     'GET CHARACTER AS NUMBER
5050 IF C<64 THEN C=C-48 ELSE C=C-55  'ADJUST FOR ASCII SHIFT
5060 NN=NN+(65536/(16[J))*C        'MAKE SUM
5070 NEXT J
5075 NN=NN+45056                   'INCREASE BY B000 HEX
5080 D=PEEK(-1*(65536-NN))         'GET VALUE FROM NEW LOCATION
5090 E=INT(D/16):F=D-16*E          'CONVERT TO HEX IN THESE LINES
5100 IF E<10 THEN G$=CHR$(E+48) ELSE G$=CHR$(E+55)
5110 IF F<10 THEN H$=CHR$(F+48) ELSE H$=CHR$(F+55)
5120 PRINT A$;TAB(5);G$;H$         'PRINT OLD VALUES AS WORKING
5130 F=D+176                       'ADD B0 TO THE VALUE
5140 POKE(-1*(65536-NN)),F         'PUT NEW VALUE IN LOCATION
8000 GOTO 5010
```

Program Listing

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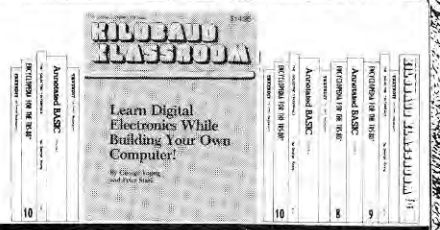

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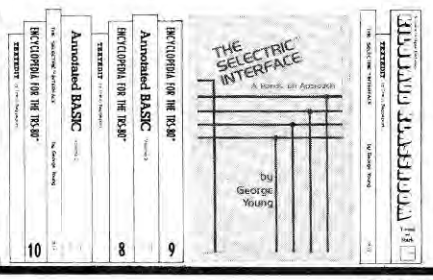

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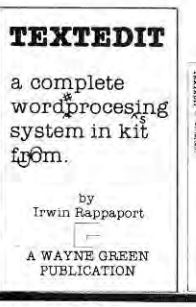

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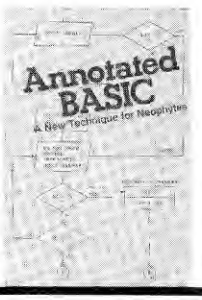

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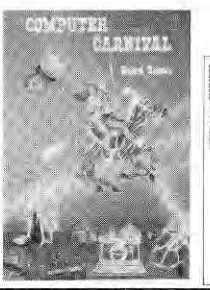

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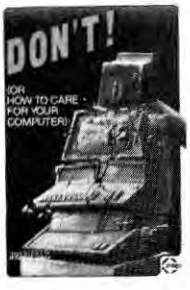

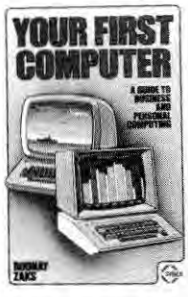

SOME OF THE BEST FROM KILOBAUD/MICROCOMPUTING—A collection of the best articles that have recently appeared in Kilobaud/MICROCOMPUTING. Included is material on the TRS-80 and PET systems, CP/M, the 8080/8085/Z80 chips, the ASR-33 terminal. Data base management, word processing, text editors and file structures are covered too. Programming techniques and hardcore hardware construction projects for modems, high speed cassette interfaces and TVTs are also included in this large format, 200 plus page edition. BK7311 $10.95.*

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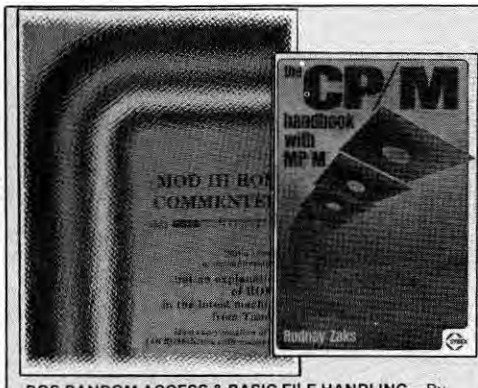

Special Interests

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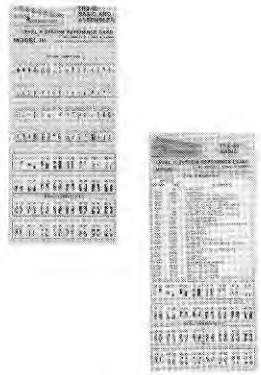

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Z80

INSIDE LEVEL II—For machine language programmers. This is a comprehensive reference guide to the Level II ROMs, allowing easy utilization of the sophisticated routines they contain. It concisely explains set-ups, calling sequences, variable passage and I/O routines. Part II presents an entirely new composite program structure which unloads under the SYSTEM command and executes in both BASIC and machine code with the speed and efficiency of a compiler. Special consideration is given to disk systems. BK1183 $15.95.*

Z-80 ASSEMBLY LANGUAGE PROGRAMMING—by Lance A. Leventhal. This book thoroughly covers the Z-80 instruction set, abounding in simple programming examples illustrating software development concepts and actual assembly language usage. Features include Z-80 I/O devices and interfacing methods, assembler conventions, and comparisons with 8080A/8085 instruction sets and interrupt structure. BK1177 $16.99.*

TRS-80 ASSEMBLY LANGUAGE—by Hubert S. Howe, Jr. This book incorporates into a single volume all the pertinent facts and information you need to know to program and enjoy the TRS-80. Included are clear presentations of all introductory concepts, completely tested practical programs and subroutines, details of ROM and RAM and disk operating systems, plus comprehensive tables, charts and appendices. Suitable for the first time user or more experienced users. BK1217 $9.95.*

PROGRAMMING THE Z-80—by Rodnay Zaks. Here is assembly language programming for the Z-80 presented as a progressive, step-by-step course. This book is both an educational text *and* a self-contained reference book, useful to both the beginning and the experienced programmer who wish to learn about the Z-80. Exercises to test the reader are included. BK1122 $15.95.*

6809

6809 MICROCOMPUTER PROGRAMMING AND INTERFACING—by Andrew C. Staugaard, Jr. Getting involved with Tandy's new Color Computer? If so, this new book from the Blacksburg Group will allow you to exploit the awesome power of the machine's 6809 microprocessor. Detailed information on processor architecture, addressing modes, register operation, data movement, arithmetic logic operations, I/O and interfacing is provided, as well as a review section at the end of each chapter. Four appendices are included covering the 6809 instruction set, specification sheets of the 6809 family of processors, other 6800 series equipment and the 6809/6821 Peripheral Interface Adapter. This book is a must for the serious Color Computer owner. BK1215 $13.95.*

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TEXTEDIT—A Complete Word Processing System in Kit Form—by Irwin Rappaport. TEXTEDIT is an inexpensive word processor that you can adapt to suit your differing needs—from form letters to lengthy texts. Written in TRS-80 Disk BASIC, the system consists of several modules, permitting the loading and use of only those portions needed. A disk is also available which provides the direct loading of the modules, however, the book is required for documentation. For Model I and III with TRSDOS CONVERT., one disk drive (2 disk drives or copy utility needed to transfer to system disk). Runs under TRSDOS 2.2/2.3. May not function under other systems. BK7387 $9.97 Disk DS7387 $19.97

Disk is manufactured by Instant Software, a division of Wayne Green inc.

THE NEW WEATHER SATELLITE HANDBOOK—by Dr. Ralph E. Taggart WB8DQT. Here is the completely updated and revised edition of the best-selling *Weather Satellite Handbook*—containing all the information on the most sophisticated and effective spacecraft now in orbit. Dr. Taggart has written this book to serve both the experienced amateur satellite enthusiast and the newcomer. This book is an introduction to satellite watching, that tells you how to construct a complete and highly effective ground station. Not just ideas, but solid hardware designs and all the instructions necessary to operate the equipment are included. An entire chapter is devoted to microcomputers and the Weather Satellite Station, and for the thousands of experimenters who are operating stations. *The New Weather Satellite Handbook* details all the procedures necessary to follow the current spacecraft. Weather Satellite contains Operation Satellite Systems, Antenna Systems, Weather Satellite Receivers, A Cathode Ray Tube (CRT) Monitor for Satellite Picture Display, A Direct-Printing Fascimile System for Weather Satellite Display, How to Find the Satellite, Test Equipment, Microcomputers and the Weather Satellite Station, Station Operations. **BK7383 $8.95.***

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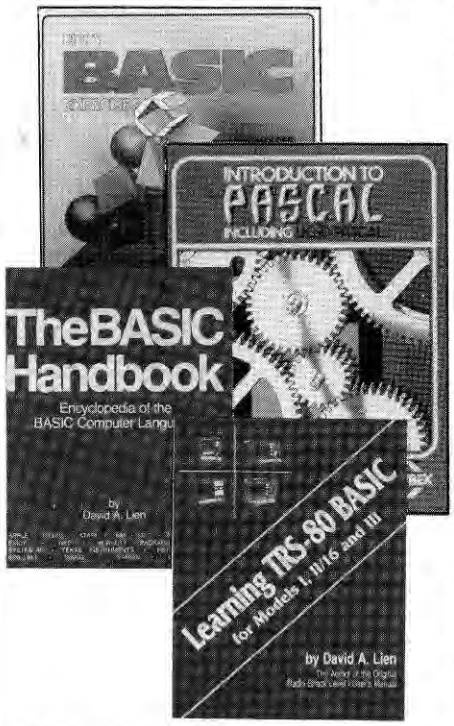

INTRODUCTION TO TRS-80 LEVEL II BASIC AND COMPUTER PROGRAMMING—by Michael P. Zabinski. Written by an experienced educator, this is the book for those beginners who want to learn about computers without having to become an expert. It has practical programs, useful line-by-line comments, excellent flowcharts accompanied by line numbers and over 200 exercises which help the reader assess progress, reinforce comprehension, and provide valuable practical experience. BK1219 $10.95.*

50 BASIC EXERCISES—by J. P. Lamoitier. This book is structured around the idea that the best way to learn a language is through actual practice. It contains 50 completely explained exercises: statement and analysis of the problem, flowcharts, programs and actual runs. Program subjects include mathematics, business, games, and operations research, and are presented in varying levels of difficulty. This format enables anyone to learn BASIC rapidly, checking their progress at each step. BK1192 $12.95*

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PROGRAMMING IN PASCAL—by Peter Grogono. The computer programming language PASCAL was the first language to embody in a coherent way the concepts of structured programming, which has been defined by Edsger Dijkstra and C.A.R. Hoare. As such, it is a landmark in the development of programming languages. PASCAL was developed by Niklaus Wirth in Zurich; it is derived from the language ALGOL 60 but is more powerful and easier to use. PASCAL is now widely accepted as a useful language that can be efficiently implemented, and as an excellent teaching tool. It does not assume knowledge of any other programming language and therefore suitable for an introductory course. BK1140 $12.95.*

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INTRODUCTION TO PASCAL—By Rodnay Zaks. A step-by-step introduction for anyone wanting to learn the language quickly and completely. Each concept is explained simply and in a logical order. All features of the language are presented in a clear, easy-to-understand format with exercises to test the reader at the end of each chapter. It describes both standard PASCAL and UCSD PASCAL, the most widely used dialect for small computers. No computer or programming experience is necessary. BK1189 $15.95

THE BASIC HANDBOOK—SECOND EDITION—by David Lien. This book is unique. It is a virtual ENCYCLOPEDIA of BASIC. While not favoring one computer over another, it explains over 250 BASIC words, how to use them and alternate strategies. If a computer does not possess the capabilities of a needed or specified word, there are often ways to accomplish the same function by using another word or combination of words. That's where the HANDBOOK comes in. It helps you get the most from your computer, be it a "bottom-of-the-line" micro or an oversized monster. BK1174 $19.95.*

LEARNING TRS-80 BASIC-by David A. Lien. Dr. Lien, who is the author of THE BASIC HANDBOOK and the original Radio Shack LEVEL I USER'S MANUAL, has compiled a tutorial which includes portions of the original USER'S MANUAL, and most of LEARNING LEVEL II along with extensive additions. It will completely cover the TRS-80 Models I, II, III, and 16 (sorry, not the color or pocket computers). It is, of course, written in the easy learning style which readers of Dr. Lien's books have come to enjoy. BK1175 $19.95.

BASIC BASIC (2ND EDITION)—by James S. Coan. This is a textbook which incorporates the learning of computer programming using the BASIC language with the teaching of mathematics. Over 100 sample programs illustrate the techniques of the BASIC language and every section is followed by practical problems. This second edition covers character string handling and the use of data files. BK 1026 $11.50.*

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HOW TO MAKE MONEY WITH COMPUTERS—In 10 information-packed chapters, Jerry Felsen describes more than 30 computer-related, money-making, high profit, low capital investment opportunities. BK1003 $15.00.*

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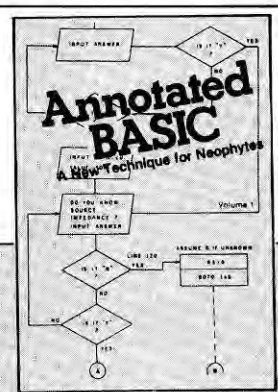

ANNOTATED BASIC—A NEW TECHNIQUE FOR NEOPHYTES.—BASIC programming was supposed to be simple—a beginner's programming language which was so near to English that is could be easily understood. But, in recent years, BASIC has become much more powerful and therefore much more difficult to read and understand. BASIC simply isn't basic anymore.

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Business

BUSINESS SYSTEM BUYER'S GUIDE—By Adam Osborne with Steven Cook. When you enter the market place of small business computers, you face a bewildering array of products, prices, features and fables. This guide cuts through the jargon and unravels the task of buying the right computer system. This book provides solid information on how to determine your needs, how to choose software and hardware for all business applications, what to expect from vendors, what to avoid, and what questions you must ask. It also provides a wealth of detailed information on products, manufacturers, retailers and the whole microcomputer market. BK1229 $9.95

SO YOU ARE THINKING ABOUT A SMALL BUSINESS COMPUTER—by Richard G. Canning and Nancy C. Leeper. For a well-organized manual on the process of selecting the right computer system for your small business, this text can't be excelled. Designed to introduce the novice in data and word processing to the real benefits of computerization, the book is filled with money- and time-saving tips, photos of equipment, lists of suppliers, prices, explanations of computer terminology, and helpful references to additional sources of information. Everyone contemplating a first computer installation should have this book. BK1222 $14.00*

SOME COMMON BASIC PROGRAMS— Published by Adam Osborne & Associates, Inc. Perfect for non-technical computerists requiring ready-to-use programs. Business programs, plus miscellaneous programs. Invaluable for the user who is not an experienced programmer. All will operate in the stand-alone mode. BK1053 $14.99 paperback.

THEORY Z—How American Business Can Meet the Japanese Challenge—by William Ouchi. Why are the Japanese catching up and surpassing American industrial productivity? What allows Japanese industrialists to offer guaranteed lifetime employment to their workforce? This book will help you understand the Theory Z managerial philosophy and its implications for the American corporate future. Examples are given of the American industrial giants already operating under Z-style management, and the impact of this style on the quality of their executives and workers is explored. A must for the alert businessman, large or small. BK1226 $12.95*

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NEWS THIS MONTH

MAGAZINE STAFF BOLTS

When Ziff-Davis bought *PC*, a disgruntled publisher and his crew started a new magazine with a little help from one of Ziff's competitors.

PAGE 366

SOVIETS TAP U.S. HIGH TECH

Whenever the Russians find a gap in their technology, they fill it by stealing from America.

PAGE 368

COLOR COMPUTER IN KOREA

With more space needed to make its new micros, Tandy announced Color Computers for the European market will be produced in Korea.

PAGE 372

GAMES

The arcade alternative

Very soon you will be able to receive video games over cable TV.

Tired of pumping two-bit pieces into those armless bandits in your local arcade? International Cablecasting Companies Inc. of Los Angeles has a solution for you.

Starting this September, that firm will be feeding to an estimated 6 million cable viewers 20 video games a month over The Games Network.

A household wanting games programming buys it off their local cable company. The household receives from the company International Cablecasting's hardware, a 6502-based microcomputer with 64K of RAM, 24-key keypad, and 280 x 192 high-resolution color graphics.

International Cablecasting's micro, called the Wizard I, also has ports for a printer, disk drives, a video disk player, an ASCII keyboard, joysticks and game paddles. "We'll be providing all sorts of software via cable television in addition to the video games," observed Director of International Affairs and Executive Vice President Thom Keith.

And the Wizard is tailor-made for Apple owners. "Almost everything we have is Apple compatible," Keith said.

But having a Wizard in your living room isn't quite like having your own micro.

You can't hack around inside the machine. If the case is opened, the unit won't work, and you'll have to call a service person to revive the micro.

Dunlop: Rocker turned video game wizard.

And you can't take the computer over to your neighbors' for a casual evening of fun. Each Wizard has a unit address and system address. When a unit is turned on, the head-end mini checks those addresses. If they don't match, the Wizard's channel access is blocked.

The system also contains safeguards against pirating its software.

Currently, Interac Corporation, which did all the interactive technology for Walt Disney's Experimental Prototype Community of Tomorrow in Florida, is manufacturing the Wizard. But Keith said Pioneer, the stereo people, will take over production in 1984.

How much does it cost to produce the Wizard? "We're not exactly sure yet," Keith confessed. "We feel we're going to lose money on the first units going out. They're expensive to produce, let's put it that way."

The Los Angeles gamesters recommend cable companies charge subscribers $49.95 to install the Wizard I. The cable company keeps $15 of the installation fee and the customer gets $20 when he terminates his subscription

Subscriptions to the network are expected to cost $14 to $15, depending on where a subscriber lives.

The local cable company receives, without charge from International Cablecasting, two Digital Equipment Corporation minicomputers to install at the head-end of the TV system.

"Only one computer system is in use at any given time," the promotional material for the network explained. "The second serves as a backup. So if one computer should go down, service to subscribers will be maintained automatically by the secondary equipment."

International Cablecasting added, "This is one of the most failsafe systems in existence."

Cable companies are hot over broadcasting video games, according to one published report, because they see them as a means of drawing in more cable subscribers.

"The marketing surveys that were done," Keith noted, "indicate about a third of the current cable subscribers show very very high interest for the games network and would probably sign up for it if it were available to them."

"They also indicated about 10 percent of the people that are not subscribing to cable now for any reason would subscribe to cable if they could get The Games Network.

"We're looking at a pretty high penetration."

That notion hasn't been overlooked by others in the industry. Mattel and the General Instrument Corporation have fired up a cable venture to deliver games to an Intellivision console. And, according to one observer, several other companies are looking into cable games.

Keith, a pioneer in cable programming, and his partner, Larry Dunlop, formerly a rock 'n' roll performer and personal manager for celebrities, began to shape their ideas about the games channel in January 1982.

In March, they formed International Cablecasting and set up shop in Hollywood at the Sunset-Gower Studios, former home of Columbia Pictures.

Later, the firm moved to a spacious Queen Anne home constructed in 1895. Keith sees the move as symbolic. "One of the main reasons we chose this location," he said, "is that we perceive ourselves to be the 'third wave' in home entertainment and education—and *home* is the key word—so we've created a home environment that's a working environment."

Another important word (and one that might be used to defuse criticism of the network) is education. Keith, who directed *The Boob Tube* in 1973, said 25 percent of the programming on the network will be educational.

The network's promotional material added: "Parents would rather kids played arcade games at home. Kids would rather have unlimited plays. Providing a wholesome form of recreation and instruction pleases civic leaders."

Since last September, Keith and company have been testing their ideas on Group W's 40,000 subscriber cable company in Fullerton, CA.

"It seems to be working very well," said Keith, the first provider of regularly scheduled cable programming in the United States.

Keith: Third Wave of home entertainment.

He added, "We've been looking at some of the nuances we should put in the production model of the in-home unit. The whole idea is to make it as user-friendly as possible and to increase the playability of it. To make it easy to operate and as sturdy as possible so it can withstand a lot of hard use in the home environment."

Some of the games tested in Fullerton include Snack Attack, a Pac-Man style game; Aztec, a multi-level maze game; Night Mission, an electronic pinball game; and Ruskie Duck, where a player must find a Russian duck containing the secrets to the MX missile.

International Cablecasting contends it will be getting the best games for its viewers: "We pay the excellent royalties, based on the total number of the The Games Network subscribers. And exposure on The Games Network is indicative that the game is a hit, meaning that it will increase sales to people who play the games on computers, home games machines, and at arcades."

Each month, five of the 20 games offered are replaced with new games. The head-end computer automatically tallies the games played and uses the information in determining which games to replace and which to keep.

Games will differ from region to region of the country, Keith said. "The 20 games playing on a cable system in Santa Monica," he noted, "may be entirely different from the 20 games playing in Savannah, Georgia."

Keith's firm won't be stopping with The Games Network. For late 1984, it's planning the IQ channel, offering college, high school, and other kinds of courses.

And for 1985, it's planning the Fantasy Channel. Using the video disk port of the Wizard, a viewer will be able to download software allowing him to interact with the disk player. "He could direct his own movies," Keith said, "and get into role playing, fantasy, and all kinds of things." ■

DOCUMENTATION

Mass defections at *PC*

The staff at the magazine for the IBM PC took a look at their new bosses and jumped to the competition.

It may have been microcomputer publishing's version of the Saturday Night Massacre.

It began last November 22 on a rainy San Francisco morning outside the offices of the magazine for the IBM personal computer.

When *PC* Publisher David Bunnell arrived at the locked offices, he found a man and a woman waiting on the doorstep. They told him their employer—Ziff-Davis Publishing Company of New York City—was the new owner of *PC*.

The announcement surprised Bunnell. The week before he'd been told by *PC*'s chief investor, Tony Gold, they'd be meeting with Patrick McGovern, chairman of CW Communications, to solidify plans to sell the magazine to that computer publisher.

"All indications were they were going to sign a deal; that Tony had agreed to do that with CW," Bunnell told *80 Micro*. "That made us very happy because we liked the terms we were going to receive from CW."

Bunnell had another reason to be surprised by the visit from Ziff-Davis. "We had an agreement in writing with Tony that he would not conclude a deal with Ziff-Davis without our approval," he said.

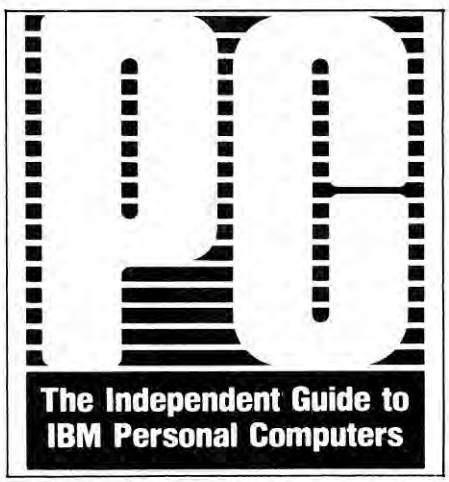
The arrival of the Ziff-Davis representatives—on the day dubbed "Black Monday" by former *PC* staffers—seemed to worsen an already bad situation.

"There was a lot of bad feeling between the staff and Tony Gold," Bunnell said.

When *PC* began, he explained, Gold promised Bunnell and other key staffers stock in the magazine. Bunnell said the stock would be awarded over a three-year period and ultimately amount to 45 percent of the magazine.

The first year Gold had to make good on his promise was 1982. Bunnell said Gold never awarded the stock.

Then, all of a sudden, there was Ziff-Davis on the doorstep. "They didn't have the courtesy to give us a phone call," Bunnell observed. "That was not received very well with the staff."



The New York publisher's next announcement wasn't well received either.

"They met with our employees," Bunnell said, "and told them they wouldn't fire anyone before Christmas."

Then they began to pick the stock agreement apart. Bunnell explained: "They picked at it for technicalities, like it was written on Tony's stationery and not corporate letterhead."

"They took the position," he continued, "that they had bought 100 percent of the company from Tony Gold and they had no obligation to myself or other stockholders or to any of the employees."

"Ziff was very heavy-handed," Bunnell added.

"That's absolutely untrue," countered Eileen Markowitz, general manager of Ziff-Davis's computer group. "We treated them fairly and honestly from the very beginning."

She confirmed Ziff-Davis had prepared compensation packages for the *PC* staff, but refused to elaborate on what was in them.

According to Bunnell, Ziff paid Gold $1.2 million for *PC* and for the next five years, will continue paying him 3 percent of the magazine's annual revenues.

Asked about those figures, Markowitz said, "I can't comment on that. It's not public information. I don't know where he'd get his numbers from."

After Ziff's representatives—Markowitz and Larry Spawn—had met with *PC*'s staff, Bunnell met McGovern of CW. They decided to start another magazine, *PC World*.

Then the resignations started. That Wednesday Bunnell and associate publishers Cheryl Woodward and Jacqueline Poitier resigned. The next week 48 *PC* staffers resigned and joined Bunnell at *PC World*.

"We had hoped that the staff would continue on with *PC*, but we were prepared if they were not going to stay on," observed Markowitz.

"They anticipated we might do this because they knew they were screwing us," declared Bunnell.

He added: "It would have been better for us to start off (*PC World*) with 12 or 15 key people. You can't open a business like ours and have something for 48 people to do.

"Everyone told me they had to quit and we felt obligated to hire them. So we've got a lot of people licking envelopes and typing letters on typewriters and things they wouldn't normally be doing until we get up to full speed."

The first issue of *PC World* was expected to be on the newsstands last month. Bunnell said he expected the first print run to be 130,000. According to a statement, initial circulation is expected to be 100,000, with expected growth to 250,000 by this fall.

In addition to reporting on PC development, the statement said, *PC World* will build elaborate hardware projects and tell readers how to do them. The first two projects will be building a local office network linked by Ethernet and an "ultimate, super PC"—a PC "with thousands of peripherals and hundreds of capabilities."

But will the rush of energy and enthusiasm accompanying the start-up of a new magazine erase the lingering bitterness resulting from the mass defections from *PC*?

Probably not. According to *The Wall Street Journal*, Ziff has filed a lawsuit against Bunnell for damages. And when Bunnell was asked if he would be filing a lawsuit related to the takeover, he replied, "It's highly likely." ■

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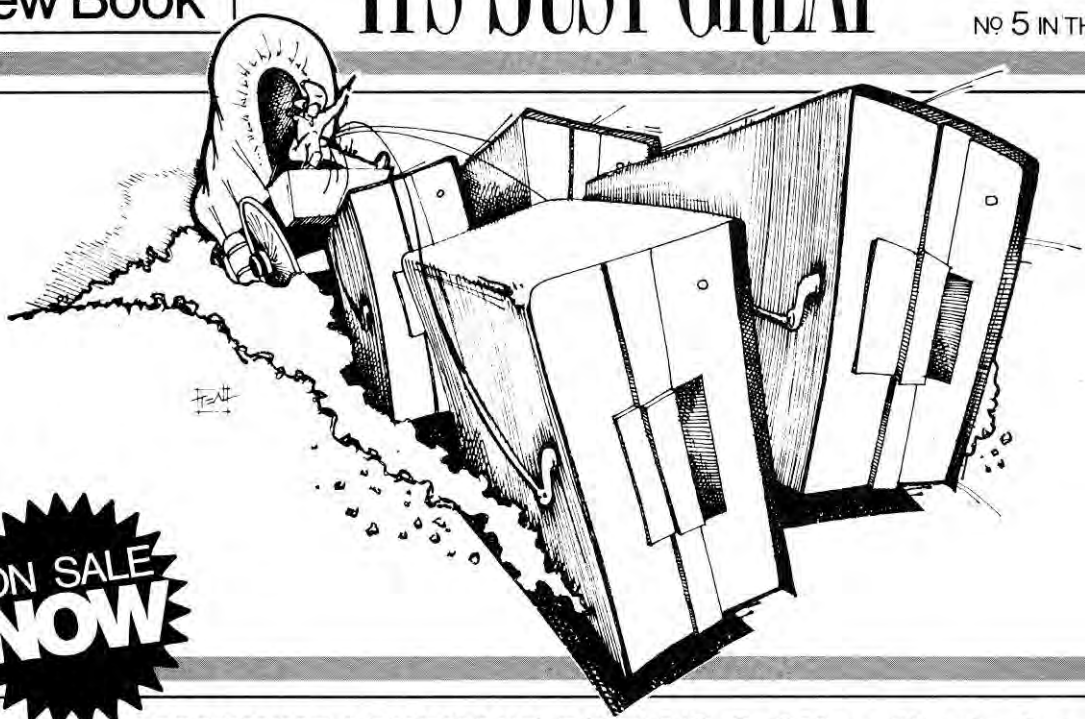

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LAW

High tech red theft

According to a Congressional subcommittee, the Soviets fill in their technological gaps with American know how.

The Soviet Union feels free to tap American computer technology whenever it needs it.

That's the opinion of Sam Nun, ranking minority member of the U.S. Senate's Permanent Subcommittee on Investigations.

Nun and the subcommittee's minority staff conducted an 18-month inquiry into illegal diversion of American technology.

"The Soviets view American technology as their technology, to be utilized whenever needed," the Georgia Democrat observed.

One former Soviet engineer told Nun's panel: "Soviet authorities have come to the realistic conclusion that their country's level of technology is too far behind the West for them to make great strides through copying. They do not have the human resources or the fine-tuned equipment required to copy.

"Once they know what makes a given piece of machinery work, they find that they do not have the technical know-how and equipment to produce the product themselves. That is why they want Western high-technology machines that will enable them to produce the products."

"Small firms are specially enticing to Russian agents," Nun's minority investigators reported. "[M]any of these enterprises are on the cutting edge of important technological breakthroughs," they said. "Yet because they are starting out, their products have not yet been incorporated into military programs and are unclassified and vulnerable."

In the investigators' report on their inquiry, the U.S. Commerce Department and its Compliance Division—the agencies responsible for enforcing restrictions on high-tech exports under the 1979 Export Administration Act—were targets of criticism.

"The evidence strongly suggests," the report said, "that the Commerce Department to date has been unable to enforce the EEA controls in the face of mounting Soviet efforts to secure sensitive American technology."

"The Commerce Department," the report said, "has as its major focus the promotion of trade and is not comfortable with the task of limiting the sale of anything..."

One Compliance Division agent told the panel the agency described the agency as "totally ineffective" in preventing Soviet filching of high-tech items. The Kremlin's spy organization, the KGB, he maintained, could not have organized the Compliance Division in a way more beneficial to Soviet interests.

Sherman M. Funk, the Commerce Department's inspector general, shared the panel's views on the agency. In a report on the division, Nun's report said, Funk found:

- Investigators conducted their inquiries by phone and mail due to a restricted travel policy in the department. The result: A consortium of companies continued exporting stolen high-tech products to the USSR and Soviet Bloc;
- The division hired an untrained and inexperienced agent and let him conduct investigations for six months without investigator's credentials;
- In fiscal 1981, the division spent $24.98 to train agents and nothing in FY 1982;
- The division bought office furniture and machinery with money earmarked to buy equipment needed for gathering evidence in criminal investigations. The agency later borrowed the hardware from other federal agencies; and
- An upper echelon Commerce official "improperly" interceded in division in-

Who's to **blame?**

Private industry must share the blame for high-tech products being diverted to the Soviet Union and used to bolster the Kremlin's military machine, a Santa Clara County law enforcement official told the Nun panel.

Deputy District Attorney Douglas K. Southard said the high-tech industry has neglected to police itself. He noted a senior executive at a large intergrated-circuit producer told him, "Hey, we're in the chip-making business. That's the Fed's problems to worry about where it goes afterwards."

What does a chip thief look like? Many are middle class professionals leading ostensibly respectable lives while they line their briefcases and jackets with stolen chips, Southard said.

Why do they steal? The Silicon Valley is, Southard claimed, "a prime example of capitalism on the rampage. Everyone wants to become an overnight millionaire and money flows like water, tempting the otherwise honest citizen to scramble fast to get his share of the pie."

Although critical of government efforts to deal with high-tech diversion, Charles P. Lecht concurred that the problem had to be dealt with at the factory.

The former president and chairman of the board of Advanced Computer Techniques Corporation of New York said government enforcement efforts emphasized the wrong end of the problem. Too much attention has been paid to stopping stolen technology at the border.

Today's technology, he said, is too small to be detected at the point of exit. It would be wiser to concentrate at the source, at the plants and factories that develop and produce the high technology. ■

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The editors of 80 Micro have also awarded their Hall of Fame Awards. From among every software package on the market, the editors picked only six that they felt made a lasting and significant contribution to the TRS-80 computer. NEWDOS/80 was one of the six.

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vestigations, parcelling crucial ones to a consultant and "favorite son" investigators.

Despite the division's ineffectiveness dealing with high-tech theft, the report said federal law enforcement and national security officials refused to appear before the subcommittee and acknowledge the agency's deficiencies.

Even one of the department's most severe critics changed his tune when appearing before the panel, the report said.

In 1980, Lawrence J. Brady told the subcommittee the department's preoccupation with promoting trade undermined national security considerations. But in 1982, now part of the brass overseeing the compliance division, Brady claimed Commerce "had a new way of doing things" and "was now very sensitive to Soviet technology acquisition efforts and was capable of blunting them."

After a law enforcement agency arrests high-tech thieves, loopholes sometimes let them sidestep justice.

John N. Maguire, president of Software NG of North America, spent seven months helping the FBI nail Marc Andre DeGeyter, a 31-year-old Belgian with financial ties to the Soviets.

DeGeyter attempted to steal from Maguire's firm Adabas a $10 million program representing the highest level of sophistication in a data base to date. The Belgian was convicted and received a four-month jail term.

Contrast that, McGuire told the subcommittee, with the 40-year sentence a Celanese Corporation employee received for selling trade secrets to a Japanese competitor of Celanese.

"[A] businessman received 40 years for selling trade secrets to a competitor," he noted, "while a Soviet agent receives four months for attempting to transfer one of our most guarded technology secrets to the USSR. It is, indeed, a sad state of affairs if those cases accurately reflect this country's priorities on technology transfer."

Not only did DeGeyter escape with a light sentence, but the government had no grounds to deport him. Aliens could be deported, a Justice Department official told the panel, for only misdemeanors involving moral turpitude, not stealing secrets for a foreign government.

Santa Clara County Deputy District Attorney Douglas K. Southard cited three cases where the law benefited chip thieves.

Local police arrested Larry E. Lowery when they found his company, Brut Electronics, housed 11,000 stolen integrated circuits worth $100,000 to $150,000.

While the prosecution prepared its case against Lowery, one of its witnesses was savagely beaten and unable to testify. Another witness was murdered execution-style. But Lowery was convicted and sentenced to two years in prison.

He appealed that sentence. While free on bail pending the appeal, Lowery and an associate robbed $3.4 million in high-tech equipment from Monolithic Memories in Sunnyvale, CA.

"Because of the complexity of the case and the circumstantial nature of the evidence available," Southard told the subcommittee, "it would be a very difficult task to fully prosecute all the people involved. Undoubtedly, it will be years before the investigation is completed and prosecutions promulgated."

Another case may never be prosecuted because of the expense involved in prosecuting high-tech crime.

John Henry Jackson, previously convicted five times for theft and forgery but never sent to jail, was tied by Southard's office to the theft of $1 million in integrated circuits from Intel Corporation, and to stolen, counterfeit, and substandard ICs traced to firms in Virginia, California, and West Germany.

Southard explained:

"[T]he cost of such a prosecution would be almost prohibitive for a local jurisdiction.

"The estimated cost of producing the minimum one dozen witnesses from Europe and the East Coast necessary to prove the evidentiary chain in the Jackson case is in excess of the entire witness budget for the County of Santa Clara for an entire year.

"Public safety considerations simply will not allow property crime prosecutions to take precedence over violent crime prosecutions." ■

What to **do?**

The Nun panel's 69-page report made 17 recommendations for combating the Soviets' campaign to filch American high technology. They included:

- Identify and control specific high-tech items the Soviets want, instead of trying to control all high-tech exports;
- Set up a $5-million center staffed with technical and national security experts. The center would study complex export license applications and research technical questions related to export matters;
- Allow high-tech firms to export items the Soviets can obtain from other countries;
- Inventory the high technology already lost to the Soviets;
- Make a criminal offense possession or attempted possession of restricted goods with intention to export the goods unlawfully;
- Make an espionage conviction grounds for revoking an export license;
- Allow customs officials to make warrantless arrests, searches, and seizures of outboard cargoes and persons;
- Allow court-authorized electronic surveillance in cases involving violations of the federal Export Administration Act and Arms Export Control Act;
- Increase penalties under the Arms Export Act to $1 million or five times the worth of the exports for corporations, and $250,000, 10 years in prison, or both, for persons;
- Make violations of the export act punishable under the federal racketeering (RICO) statute;
- Educate NATO members on why high-tech diversions hurt them as much as us;
- Educate private industry on the diversion problem;
- Encourage the private sector to increase its security precautions against high-tech diversion; and
- Eliminate application of the federal Freedom of Information Act to foreign nationals. ■

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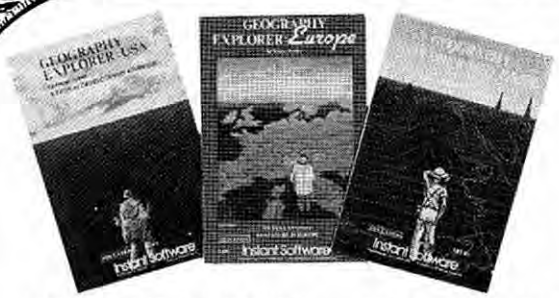

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PULSE TRAIN

Color Computer in Korea, three new micros in '83 pipeline

Tandy's made it official. It has opened a final-assembly facility in South Korea to produce Color Computers for the European market.

According to a report in the *Electronic News*, it is believed Tandy's move is aimed at freeing more manufacturing space in Texas for three new computers it intends to introduce in 1983.

Prior to Tandy's official announcement, *80 Micro* (January 1982, p.372) reported one Tandy UK executive said Korean production could lower the retail price of the Color Computer in Britain and make it more competitive with other home computers there.

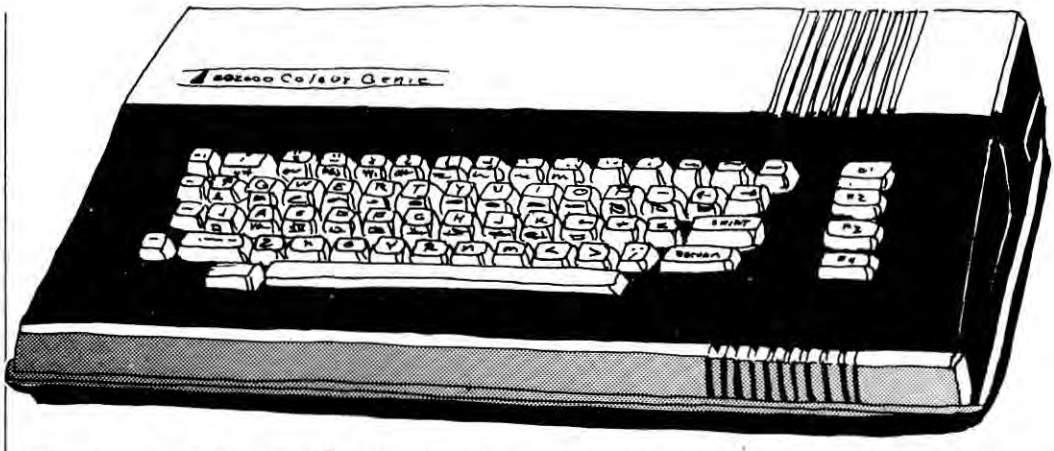
The European Color Computer is designed for 240-volts operation and compatibility with the PAL video standard.

The Korean plant has been used by Tandy for 10 years to produce non-computer products.

Production of the European Color Computer began in November, the *Electronic News* reported.

It said Tandy would not discuss volumes to be produced at the Korean facility. It is expected, however, that the shift of the European version to Korea will free space in Tandy's domestic plants for both increased production of U.S. market items and production of new computers expected to be introduced in 1983.

Quoting unnamed sources, the *Electronic News* said two of the new models would be an upgraded Model III (called the Model IV) and an enhanced version of the Model II (called the Model 12).



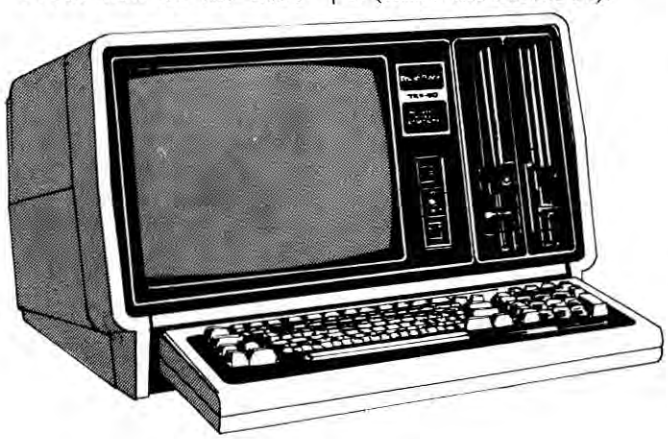
Competition from micros like the Colour Genie have encouraged Tandy to produce its Color Computer in the Far East.

The industry weekly said the Model IV would be Z80 based with 128K RAM, 80 column display, and priced under $3,000.

The Model 12 would have a larger power supply and more expansion slots than the Model II, the newspaper reported. The micro is also expected to have a green CRT and one "slimline" drive.

Electronic News also reported Beta testing of a revamped multi-user version of the Model 16 is set for December and January, with the first ones being shipped at the end of January or early February.

The Model 16 with a multi-user operating system written by Ryan-McFarland was slated to be available last June. The electronics tabloid noted, however, Radio Shack has confirmed a Unix-like operating system, Unos, has been picked for the multi-user version and the Ryan-McFarland system maintained for the single-user versions.



Model 16: New multi-user operating system.

Radio Shack also confirmed to the newspaper it is rewriting Profile III-plus, its data base management software for the Model III, to allow the program to operate with a hard disk. A former Tandy executive told *80 Micro* Profile III-plus worked improperly with a hard disk.

The *Electronic News* said John Shirley, Radio Shack's vice president for computer merchandising, insisted the rewrite was to "take advantage" of hard disk capabilities.

Radio Shack opens training center in Big Apple

Radio Shack has opened its first stand-alone computer training center in New York City and depending on its success, could set up more across the country.

According to *Computer Retail News*, the move is aimed at strengthening the firm's user training programs, ducing the burden on store personnel, and promoting the enterprise as more than

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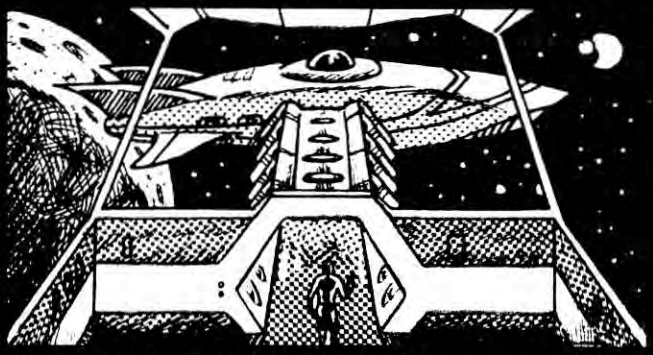

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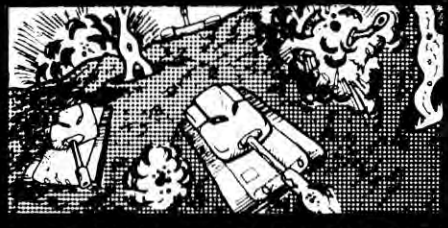
ADVENTURE TRILOGY A Trilogy of quests *featuring 3-D high-res graphics in machine code.* First comes ritual combat on the **WORLD UNDER THE CIMEEON MOON,** to test your worthiness as a warrior. Once proven, you will be teleported to **DAZMAR'S UNDERWORLD OF DOOM** to search for the Eye of Dazmar. The **FORSAKEN GULCH** is the final arena, where a wicked idol awaits restoration.

THE NIBBLER & MS. NIBBLER A fast maze chase game featuring the nibbler man and three bumbling preditors. *Written in machine code and joystick compatible,* this fun packed game is enjoyed by all. **MS. NIBBLER** is similar to THE NIBBLER described above but features a different maze and MS. NIBBLER for the ladies.



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PULSE TRAIN

In old New York, space is at a premium; so Radio Shack's 13 Manhattan stores will be served by one training center.

just a hardware seller.

It said Radio Shack started the center at a time when vendors and resellers have become concerned about user training and support.

"With the recent surge into hardware and software retailing by major department stores, bookstores, and even supermarkets," the publication said, "dealers have become especially concerned with upgrading their training programs to give themselves a competitive edge over mass-merchandisers."

It said the new center is for patrons of Radio Shack's 13 Manhattan stores.

Ron Stegall, marketing vice president for Radio Shack, told *Computer Retail News*, "We've had training centers within our computer stores since the beginning."

The Radio Shack Computer Training Center, he said, is simply an expanded version of the training facilities existing in Radio Shack's Computer Centers.

The facility, located in midtown Manhattan, has three classrooms. The courses offered, Stegall said, run the gamut from introduction to TRS-80 Basic to advanced languages. Prices for the courses range from $29.95 to $150, or about $10 an hour, he noted.

Radio Shack's New York-based stores, he observed, have been unable to set up adequate training areas because office space in Manhattan is difficult to find.

"The problem we've experienced, especially in metropolitan areas, is that they require a lot of space. It is very hard to find locations that are always the right square-footage for computer centers," he told the publication.

The center is being run on an experimental basis, he said, and if it develops as expected, Radio Shack will consider adding more training centers in other major cities.

Blues for the Big Blue

Imitators and wildcat dealers, who have raked in cash from the popularity of Tandy and Apple computers, are turning their sights on the Big Blue.

The Wall Street Journal cited at least eight companies attempting to exploit the demand for IBM's Personal Computer. Meanwhile, the *Electronic News* reported unauthorized IBM dealers were upgrading 16K PCs to 64K RAM and underselling the Armonk, NY, giant.

Workalikes of the PC could be more significant than Tandy or Apple clones, the business daily said, because most independent software companies are concentrating on writing programs for the Big Blue machine. That means, *The Journal* maintained, the PC will have first crack at major new soft-

The Franklin Ace: Aggravates Apple, inspires Big Blue's competitors.

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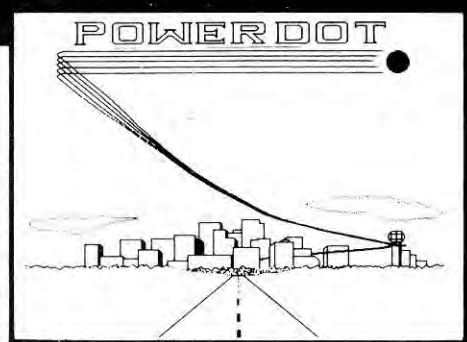

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PULSE TRAIN

Personal Micro Computers Inc. makes a living manufacturing workalike Model I's.

ware. If imitators want to offer that software with their micros, the machines will have to be IBM compatible.

At a trade show in Tokyo late last year, six major Japanese companies displayed so-called IBM-compatible personal computers. However, three of the machines—those made by Hitachi, Mitsubishi, and NEC—didn't have the PC's microprocessor, the Intel 8088. And of the other three:

- Sanyo's MBC-55 can't run many important IBM programs, including VisiCalc;
- Panasonic's JB-3000 needs a utility program (provided by the company) to enable it to run IBM programs; and
- Toshiba will rely on its own software for its Pansopia 16.

Meanwhile, in Houston, TX, Compaq Computer Corporation has announced a portable PC. At $2995, the micro sells for $800 less than its IBM host. It weighs 28 pounds, has a nine-inch CRT and two disk drives, and runs all major PC programs.

And in Columbia, MD, Columbia Data Products Inc. is producing an IBM clone called the Multi-Personal Computer. "IBM can't meet the demand for its Personal Computer and people aren't going to wait," company manager Jack Horner told *The Journal*.

Compaq President Rod Canion noted he expected his firm's micro to supplement, not supplant, PC usage. He told *The Journal*: "We think the Compaq will appeal primarily to companies who already have a large investment in IBM Personal Computers...and who want a few portable units for employees to take home nights or weekends or on field assignments."

Other exploiters have forced IBM to restrict shipments of its 16K PC, according to the *Electronic News*. Those wildcat dealers are buying 16K micros for around $1,250, adding three 16K chips for $1 each and a 320K disk drive for $300, and selling the package for well under IBM's $2,400 for the same set up.

The computer industry weekly said the maverick upgrades are also raising havoc with IBM's service centers, which are being asked to repair machines housing non-IBM parts.

Although the mavericks pose a threat to IBM's anointed dealers, some of the chosen have decided to fight fire with fire. The *Electronic News* reported Computerland outlets in the Los Angeles area were promoting 64K PCs with 160K Tandon drives for $1,855. The same system with an IBM drive would cost $2,200.

To counter moves by imitators and mavericks, IBM has clipped a page from Tandy's book. "If a problem comes up, and IBM can determine the problem was caused by a non-IBM part, they have no obligation to work on it," Computerland's Richard Mandel told the *Electronic News*.

Tandy and Apple have filed lawsuits to stop imitators from marketing clones. No decisions have been handed down in those cases.

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The Trilogy controller uses the newest floppy disk controller chip on the market- the WD2793 from Western Digital. The disk controller chip features ON CHIP PHASE LOCK LOOP DATA SEPARATOR (which means highest reliability), ON CHIP WRITE PRECOMPENSATION (reliability again), and a host of other features too numerous to mention.

NOTE: For supporting 8 inch single and double density drives the user will have to install a clock speed up board in his system. The 8 inch drives running double density require a CPU clock of 4.0 MHz. The virgin Model III has a 2.02 MHz clock. The Winchester support on the Trilogy is identical to our old series of M3DC1 board and as such would still need the Winchester accessories kit, Winchester host adapter, Winchester controller, and a Winchester drive.

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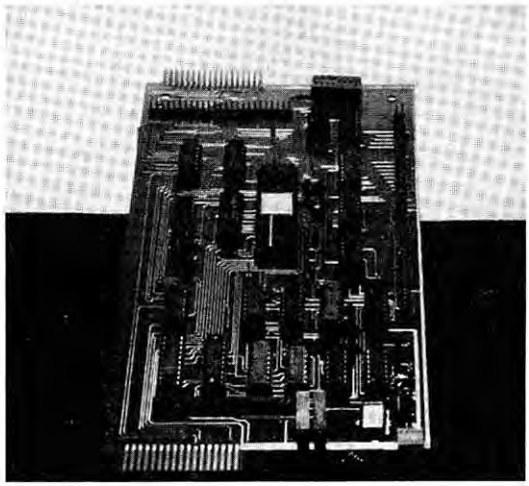

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which includes the switching power supply,drive mounting brackets and all necessary cables to complete the installation of disk drives into your Model III.

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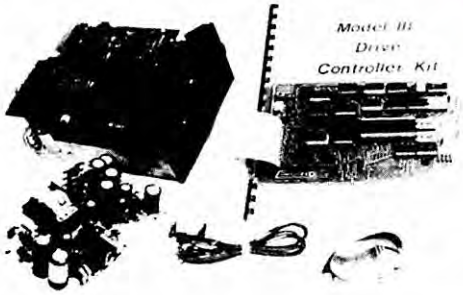

Complete Model III Disk Drive Kits include the Computex drive controller with capabilities of Winchester drive expansion. Virtually everything you will need to install disk drives in your Model III is included- We even include one of the most popular DOS systems available, DOS PLUS 3.4

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PULSE TRAIN

Meanwhile, the imitators continue to rake in profits. An Apple imitator, Franklin Computer Corporation of Pennsauken, NJ, is selling 1500 clones a month, according to *The Wall Street Journal*. That's only 1 percent of Apple sales, *The Journal* said, but it amounts to $27 million in annual retail sales.

But IBM imitators will need more than compatibility to cut into the Big Blue's share of the pie, noted Computerland's president, Ed Faber. He told *The Journal*: "The new machines will have to run IBM software and then offer some considerable advantage just to offset the halo effect of the IBM name. You cannot just come out with an IBM copy and expect to get a major market share."

Osborne: You don't even need a good product for success in the microcomputer industry.

Osborne says price and reliability key to micro success

The biggest mistake made by businesses entering the microcomputer industry is concentrating on flashy technology.

That's the opinion of microdom's *enfant terrible* Adam Osborne.

Speaking at the First Southeast Asian Computer Hardware and Software Show and Conference held last October in Singapore, Osborne observed:

"The first and biggest mistake that people make is to dwell too long on the technological advancement of the microcomputer.

"Let me tell you. IBM is the leading computer company in the world and quickly becoming the leading microcomputer company in the world. Yet, IBM learned long ago that to be number one, you do not have to have the best product.

"You don't even have to have a good product. "You have to have an adequate product that is properly supported and readily available."

Osborne, maker of a $1795 portable micro, said: "People who are technically knowledgeable spend too much time worrying about the technical features of the microcomputer and don't worry enough about the only thing that is important. That is, the ability of the microcomputer to provide the buyer with a low cost and reliable solution."

"If you have a low-cost, highly reliable product," he went on to say, "you will do well... Japan has the lowest cost and the highest reliability of any country in the world. That is why they have done well."

Osborne warned businessmen about believing they would make a financial "killing" by selling software. He called America's software industry "a quagmire" and maintained it was "quickly

Osborne's portable micro embodies his market theories.

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Hard to believe? Listen to Mr. John Tibbits, Vice President of The Datalex Company in San Francisco discuss their software developed on the UCSD p-System. "I was at a conference recently where one of the speakers was talking about converting a reasonably sized product from CP/M-80 to CP/M-86, and he said it would take six months. We bought our [IBM] PC on a Thursday afternoon and by Friday noon we had our entire system running. [With the UCSD p-System] software conversion only means a media conversion." Not only is program conversion a dead issue, but preservation of your software investment is economically feasible as you upgrade from machine to machine.

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†PCD Supports Systems Software on DEC LSI-II, Radio Shack Models II, III, & 16, Altos, Terak, IBM PC, Apple II+, & Sage.

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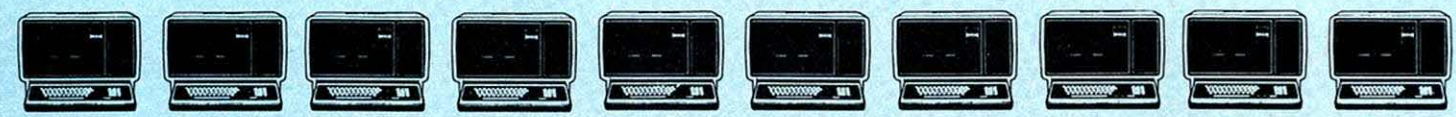

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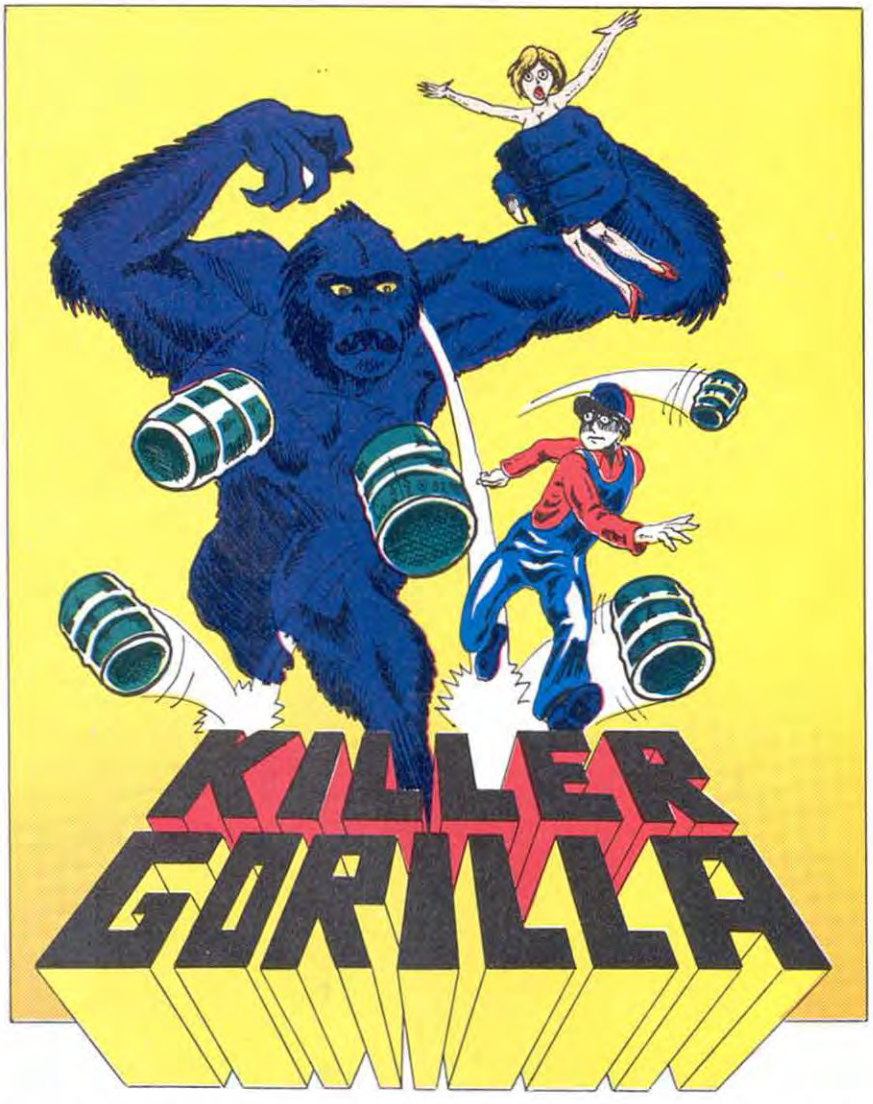

"DV'S" PROGRAM OF THE MONTH

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Volume 4 All The News That's Fit To *ZAP!*

Users vote no to the same OLD ARCADE GAMES

(DV 1982) Blurry eyed users have turned to **DISPLAYED VIDEO** to answer their need for new and exciting arcade games. In response, **DISPLAYED VIDEO** has announced eight new programs for the TRS-80* Models I-III. These arcade type games feature sound, graphics, joystick compatibility and are written in machine language for maximum speed! Both disk and tape versions allow the user to save high scores, a feature not usually found on cassette based games. Maze enthusiasts seem to like Ghost Hunter and Killer Beetles, while gun slingers look toward Insect Frenzy, Jungle Raiders, Space Shootout, Alien Cresta and Battle Stations for excitement. A Game that does not fall into these categories is Hoppy. It features wild drivers, sinking turtles, and hungry alligators. These programs are distributed exclusively by **DISPLAYED VIDEO** and written by Dubois and McNamara. Pricing for these programs is **$15.95** for tape and **$19.95** for disk. Reliable sources inside the company indicate Killer Gorilla will be available by the time you read this.

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becoming a graveyard" for investment companies.

"If you approach the software market looking on it as a service where you are selling the time of programmers for profit—much as a lawyer sells his time or a doctor sells his time—you will make money," he said. "If you think that you are going to write programs and sell them the way Digital Research (makers of CP/M) did to make a lot of money, you are wrong. You will not. Very, very few companies will make money that way."

Osborne contended software and book publishing are similar.

"No publishing company would survive today if they paid their authors a salary to write books," he declared. "If any author calculates the time he spends writing a book and the royalty he gets from a book, he will find he is one of the worst paid people in the world. Authors make little money. They carry on writing for the glory, not for the money.

"You see, publishers have made their profits for decades screwing authors.

"Having been a publisher, I know that."

Japanese winning factory war

The Japanese are winning the war on the factory floor.

That's what *The Wall Street Journal* reported recently.

"Factory discipline is imperative in the making of a computer chip, a microscopic maze of circuits on which a single mote of dust looms like Mount Everest," the business daily said. "But American companies haven't paid enough attention to the nitty-gritty details of their manufacturing practices.

As a result, consultants told *The Journal*, Japanese companies have outperformed American companies on the factory floor.

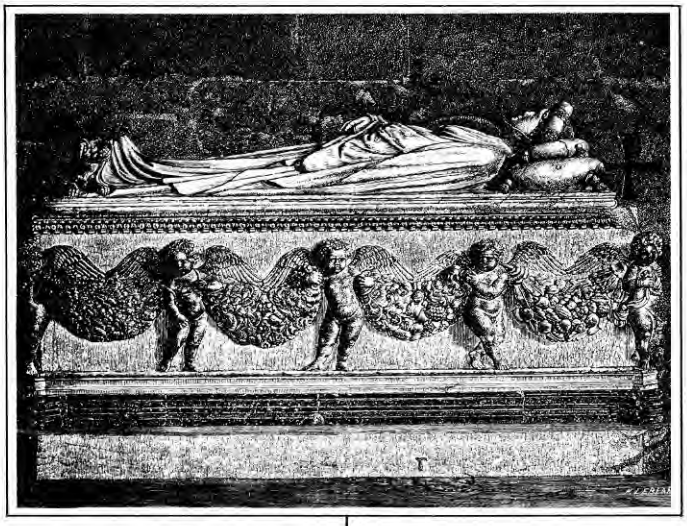
The newspaper said the Japanese have brought superior discipline and attention to detail to their factories, winning higher product yields with American technology, design, and equipment. Delivering more goods with less waste helped Japan seize 60 percent of the 64K RAM market.

Making fingernail-sized chips, etched with thousands of circuits, is devilishly complicated, *The Journal* explained, and involves scientific and technical disciplines from chemistry and lithography to optics and electronics. Chip designs that are measured in microns (thousands of a millimeter) require a pristine, dust-free environment.

"Still," Richard Ruddell, president of Ruddell Associates in San Jose, told the newspaper, "I've visited factory clean rooms where assembly workers wore mascara so thick it looked like they had caterpillars on their eyes, and bearded men walked around without face coverings."

Without clean rooms like this one at the New World Computer Company in Irvine, CA, America may lose high-tech war with Japan on factory floor.

PULSE TRAIN



Montgomery: No winners, just the last frog to die.

To improve factory production, some manufacturers are turning to consultants like Thomas Group Inc. in Ethel, LA. "Success in the 1970s was having the right product at the right time," founder Philip R. Thomas told *The Journal*. "In the 1980s, what will separate the winners from the losers will be manufacturing."

The Thomas Group works on an incentive fee basis, usually a percentage of the profit improvement, which it said usually falls in the $3 million to $4 million range.

Corporations perpetuate the problem, maintained the group's Ben Jacoby. "We promote our brightest people into design and engineering, while the Japanese put their superstars into manufacturing."

But other executives warn about the dangers of automatically turning to consultants. Management sometimes pays for outside advice it can get from insiders.

"I had complained for a year that our cycle times were too long, says a chip-manufacturing manager. "Thomas Group helped drive the point home, but there was a lot of resentment among my people who had been saying the same thing all along."

The entertainment of despair

"Video games are the entertainment of despair," opined M. R. Montgomery in the *Boston Globe Magazine*, "unless you are of a cheerful disposition, in which case they are the entertainment of frustration."

In an article titled "Fantasy and Fatalism in the Video Arcade," Montgomery observed, "Psychologists are uncertain about whether people put coins in slot machines out of hope that they'll win or some masochistic pleasure in losing. There is no question what will happen in the video arcade. You will lose."

There's a deep difference between pinball and Pac Man, Montgomery contends. Win a game of pinball and you get a free game at the same level of difficulty. The more you win at a video game, the greater the level of difficulty and the greater the probability of losing.

"This is necessary," the magazine's staff writer maintained, "because the purpose of the video arcade is to extract quarters from the population... What appears to be an increase in the sophistication of the game is simply an increase in the ability of the machine to require feeding."

Montgomery went on to declare:

"It is precisely that automatic and inflexible increase in difficulty that makes the arcade game entirely different from all other forms of human recreation ever invented.

"Gamblers know that they aren't playing on a level field, but they demand that the slant never change.

"In the video arcade, when you win, they start loading the dice, they quit dealing you face cards, they start adding house numbers on the roulette wheel."

Video games create the illusion of variation, the *Globe* columnist philosophized. In that way, they are divorced from life.

"In any given contest, on any given day, you could win," Montgomery said. "Not in the arcade.

"You can only be the last frog to die, and the machine will spell out the message that you are the high scorer for the day, which means the one who took the longest to lose."

He concluded, "Video games are perfect for people who really believe that the world is coming to an end."

Dragon ditches Mettoy

The stunning success of Dragon Data's 6809-E-based microcomputer (*80 Micro*, February 1983, p.362) has enabled the British firm to buy itself out from under its parent company, Mettoy

"I think if you look at Mettoy's interim results, published last week, you will see why we had to do the deal," Managing Director Tony Clarke told the British microcomputer magazine *MicroScope*.

The parent, Mettoy, lost £2.5 million during the first nine months of its fiscal year.

The Dragon 32 has proved to be a retailer's goldmine, according to the computer fortnightly.

According to Managing Director-designate Clarke, Dragon has 25 percent of the UK home computer market, but he expects the market to reach £300 million in 1983.

The electronic id

What would Freud say if told the id could be captured in an analytical engine? Software of the future might do that, according to a bi-monthly newsletter published by International Development Inc. of Norwalk, CT. In fact, the ar-

PULSE TRAIN

ticle appearing in *VideoPrint* maintained software that thinks like a person is a necessary catalyst for videotext to grow into the booming personal computer market.

Steven Weissman, author of the article, predicted such software would be an electronic id, able to predict a user's immediate information needs and wants and satisfy them even before they're requested.

"The idea," he said, "is to provide the computer with a complete ethnic, social and psychological picture of yourself. This way the computer can think like you do even before you do.

"It can select the TV program it knows will be of most interest to you, then recommend a couple of martinis before dinner. (A dinner which, of course, it is preparing for you, on the basis of your calories, protein, nutrient and vitamin requirements.) After dinner it will play a video game against you, letting you win if it thinks your ego needs that tonight."

Cautioning against ignoring the exploding personal computer market in favor of more traditional videotext schemes, the publication urges the development of such custom-tailored software to "put the 'personal' into personal computing" and hence "get the pc into the mainstream as quickly as possible by making it a part of its user."

The "idware" package, Weissman explained, would prompt a user through a series of personal questions, like his or her birthday, physical characteristics, likes and dislikes. The questions allow the program to create a profile of the user.

"Given that it knows your birthday," Weissman said, "it would automatically compute your astrological chart and your biorythms and know what kind of day you had. That way you can be greeted by an appropriate message."

The newsletter contended Weissman's predictions are not as far-fetched as you might believe. Just as some videotext tests permit users to establish permanent files to automatically gather their most desired pages of information, it noted, a chipster—armed with the proper software and more memory than is allowed individuals tied to a centralized computer—could do the same thing on a larger, more individual scale. ■

They're all Klingons to me

CHARLIE BOWEN wryly observes TRS-80 owners need not worry about smut peddlers a la **CUSTER'S REVENGE** exploiting the Models I or III. The system operator of CompuServe's author's special interest group noted when it comes to dirty games "we TRS-80 folks have to really use our imaginations (where the real dirty stuff is!) 'cause men and women look alike on our machines—like Klingon warships." ■ You might recall Atari Consumer Products Division President **MICHAEL MOONE** blasting individuals (like the makers of **CUSTER'S REVENGE**) that "take refuge behind certain legal precepts to the dismay of the majority of the people." Apparently, Moone has forgotten those "legal precepts" (namely the First Amendment) also protect video arcades (in which Atari has a certain interest). ■ Another Atari executive, **DONALD B. OSBORNE**, told local officials to stop "nipping" at the video game industry. Speaking at a gathering held by the National Recreation and Park Association in Louisville, KY, Osborne declared, "We're not against regulation. We just want to be able to responsibly regulate ourselves." ■ Also at the Louisville gathering, former California educator **B. DAVID BROOKS** said he's been studying the effect of video games for two years and has found nothing harmful about them. Brooks said he's been conducting his research independently. However, the AP reported **ATARI** paid Brook's transportation costs to and from the gathering. ■ Atari founder **NOLAN BUSHNELL** offered this advice to parents of the sugar and spice set: "This may sound silly, but I think parents should drag their little girls into the arcades, kicking and screaming, for their own sake." ■ **POUNDFOOLISH PUBLICATIONS** of Dubuque, IA, has started publishing *Little k*, a bi-monthly newsletter for **POCKET COMPUTER** users. Subscriptions are $12 a year. A new weekly newspaper for personal computer retailers is being published by **LEBHAR-FRIEDMAN INC.** of New York. The tabloid is called *Computer + Software News*. Meanwhile, in Camden, ME, **NEW ENGLAND PUBLICATIONS** has started a magazine for Color Computer users called *THE COLOR COMPUTER MAGAZINE*. ■ With department stores getting into the micro business, computer retailers hope to get an edge on the K-Marts of the world by offering their customers service and support. But that edge may be dulled quickly. **ANN & HOPE**, a Rhode Island chain of department stores, offers its micro buyers free computer classes and membership in its own computer club. ■ An amusing double gaffe at the **NORTHEAST COMPUTER SHOW** last October. A youngster approached **SCOTT ADAMS** standing at the Adventure International booth. "Do you work here?" the kid asked. And after receiving an affirmative nod from Adams, he inquired, "Do you make games for the TRS-80?" ■

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MEDICAL OPINION

by Philip R. Mills, M.D.

Data bases and taxes

I appreciate the large response I have had from readers with information on how to access Medline from the home or office. According to Dr. Prescott, Assistant Professor of Clinical Pediatrics at the University of Texas, Lockheed Corporation operates a multi-interest data-base system known as Dialog that can be tapped using any computer system set up for telecommunication. It can be accessed locally through Telenet or Tymnet (available in most major cities), and requires a 300- or 1,200-baud modem capable of running with 1 start bit, 7 data bits, 1 parity bit, 1 stop bit, and no parity. Full or half duplex is supported.

Dr. Prescott wrote that the system includes over 150 separate data bases dealing with medicine, chemistry, and other sciences, as well as grant funding, economics, and other subjects.

Specifically related to medicine are three Medline files covering 1966 to the present, three Excerpta Medica files covering 1974 to the present, and a Child Abuse and Neglect file sponsored by the National Center on Child Abuse and Neglect in Washington, D.C.

Although most of these files can be accessed by any Dialog user, some of the more specialized files are restricted. Using the Dialog search capability, a file can be searched by subject, title, author, key word, year, or journal. The search language permits the use of Boolean operators (AND, OR, NOT) to limit the search to the desired results.

Dialog users pay no initial or annual fees. However, a password might be purged from the system if it is not used for six months. Charges are based on the amount of time on-line for each data base and are calculated on an hourly basis plus Tymnet/Telenet charges. For off-line printouts of cited references, the charges will vary with each data base. It is possible to do on-line printing through your own printer, but with a large number of references, this becomes prohibitively expensive.

Access to any of the Medline files is $35 per hour, and Excerpta Medica costs $65 to $70 per hour. Although this sounds expensive, with an understanding of the search language and a well-planned search strategy, most searches can be completed in five to eight minutes, at an approximate cost of $4.70 to $9 (depending on the data base), plus connect charges of around $1.

He went on to say that although there is no initiation fee, essential guide books for Dialog are not free. The complete *Guide to Searching* costs $30. Additional, separate instruction chapters are available for each data base at $4 each and should be purchased.

According to Dr. Prescott new users are generally given $100 of free connect time to be used within one month of the initial access to the system. Complete information can be obtained from: Dialog Information Services Inc., 3460 Hillview Ave., Palo Alto, CA 94304, (415) 858-2700.

Differential Diagnosis

Differential diagnostic programs are on their way. Dr. Davis, the associate director of St. Francis-Mayo Family Practice Residency, has passed on helpful information about two differential diagnostic programs that should soon be available for the Model II. Hopefully we will be able to review one or two such programs in this column within a few months.

Journals

Several physicians have written requesting information on magazines devoted to computers and medicine. While several such journals have folded, one that is growing is the *Medical Computer Journal.* Originally catering to the Northstar computer, this journal is now directed to the more popular microcomputers such as the TRS-80 and the Apple. Published bi-monthly, it costs $25 per year. It has a circulation of 3,000 (including libraries). Although there has been a problem with this journal being published late, it is coming out close to schedule at the present time. For information or to subscribe write: *Medical Computer Journal*, 42 East High St., East Hampton, CT 06424, (203) 267-2934.

Orthopedic Review contains a regular column devoted to microcomputers in orthopedic medicine. The author owns an Apple, so it may be of less help to TRS-80 users.

New England Medical Computing Newsletter is a newsletter of the New England Medical Computing Society. At a cost of $10 per year, it would be of special interest to those in the Boston area. It can be obtained by writing: Dr. H. B. Messinger, 226 Mystic Valley Parkway, Winchester, MA 02890.

The American Medical Association puts out *Computers and Medicine*, which reviews large and small computing systems.

Medical User's Group

I am not aware of any TRS-80 medical user's group; however, there appears to be significant interest in such a group. If one does exist, please contact me. If you are interested in starting such a group, I will be happy to announce and support it in this column.

Organizing a Model I/III medical user's group will require the ability to produce Model I compatible, single-density disks. It would also be desirable to have CP/M capability and 8-inch disks. For a Model II medical user's group, you will need FASTBAK (from The small Computer Company Inc., 230 West 41st St., Suite 1203, New York, NY 10036), or its equivalent. You should also have CP/M capability. (Pickles and Trout's CP/M is one of the finest now available for the Model II. Cybernetics also has a good, reliable CP/M that has fewer bells and whistles than Pickles and Trout's, but is a completely standard CP/M and is not on a protected disk. Lifeboat's and FMG's CP/Ms are not recommended.)

Heading up such a program might involve much time and money, but if it is anything like this column, it will be rewarding in making numerous contacts with other physician computer users.

Public Domain Software

DataMed Research has public domain software for physicians. Volume 1 of *Softdoc* is taken mostly from the now-defunct *Physician's Microcomputer Report* and is available for $25. (Contributors of software programs can get this volume free.) It consists of an 8-inch disk in CP/M format, and has three programs for the Model I/III: CARDIOVS.BAS calculates cardiovascular data for the critically ill; ELECTROL.BAS corrects serum electrolytes and derives anion gap; and PRENATAL.BAS allows scheduling of prenatal clinic services by dates. For CP/M it has MUMPS as well as three health education programs. Information is available from: DataMed Research Inc., 1433 Roscomare Road, Los Angeles, CA 90024, (213) 472-8825.

Medical Spelling Dictionaries

Phil Mansfield, author of Electric Webster, (Cornucopia Software, P.O. Box 6111, Albany, CA 94706, (415) 524-8098) is attempting to develop public-domain dictionaries for various medical specialties and subspecialties. Any reader using this program (or its predecessor, Microproof) who has developed specialized medical spelling lists should contact Phil. He would like to make such lists available to all physicians.

Model II

Model II information is hard to come by and in short supply. A letter arrives weekly from some physician frustrated by the difficulty in discovering the "insides" of the Model II. Does someone have information on patching TRSDOS, Scripsit 2.0, and Profile Plus to make the keys auto repeat? I agree with one user, who asked not to be identified, who feels that it is clumsy to have to push the repeat key for repeated cursor movements.

Currently, the favorite Model II programs in medical offices appear to be VisiCalc, Profile Plus, and Scripsit. If you have found some unique or helpful way to use these (or any other program for that matter) in your clinic, please pass specific how-to information along. If I get enough suggestions I will devote a column to using these programs effectively in office practice.

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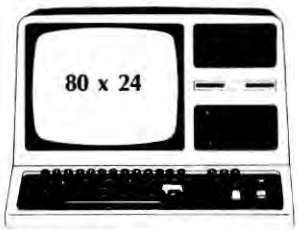

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Last year, our clinic decided to see if the computer could effectively assist us with this chore. Since all the Model II income-tax software seemed expensive, we purchased a Model I/III package: Tax/Saver (available from Micromatic Programming Co., P.O. Box 158, Georgetown, CT 06829, (203) 324-3009 or (203) 544-8777). It is a well-written Basic program that utilizes the capabilities of the Model I/III. It requires 32K. A printer is listed as being optional, but in my opinion it is essential. If using the Model I with lowercase, a software driver such as Radio Shack's or Apparat's will enhance the video appearance.

This program comes with three single-density disks or two double-density disks. Documentation comes in a cardboard, three-ring binder. The 1982 version was 54 pages long. Most of the documentation is devoted to the tax laws themselves, and consists of summaries of government documents. The glossary was helpful, but most users will need a good income-tax guide in addition to this manual. It is printed in small dot matrix, so far-sighted readers may need a magnifying glass.

Tax/Saver has a question-and-answer format. Since all responses are saved to disk, it is unnecessary to complete the tax computations in one marathon session. Unfortunately, it is not possible to change answers once they have been written to disk. The entire tax computation process must be repeated if you must alter responses.

Tax/Saver II completes the long form, itemized deductions, interest, dividends, income averaging, business income, and capital gains. It will compare the deductions claimed against the average deductions claimed for the income bracket, and will even print out the tax return, either as an overlay or on computer paper.

What Tax/Saver does, it does well; clinic staff who used it found it helpful. However, for a physician it is lacking—it does not compute investment credit, depreciation, or Keough, to name a few omissions.

All computer tax programs will have certain limitations. They will not handle your audit with the IRS, or be able to inform you which areas the IRS is investigating this year. Third, a computer will probably be unable to suggest ways to record deductions and expenses so as not to raise suspicions at the IRS office. Still, I learned of several deductions by going through the entire program, and gained a better understanding of the tax system, as well.

Computer entry was fun—at first. The fun soon wore off when I had to go through the entire process several times just to redo one figure. After a day at the computer, constantly redoing the tax forms, answering the same questions again and again, I gave up and returned to the old hand method.

A first-time user will pay $139.95, and a previous user can update for $83.97. Is it worth it? Not for a physician. If a clinic purchases it for multiple users (which is legal as long as only one machine is used), it can very well be a reasonable consideration.

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sive, and probably more helpful to physicians. Also from Micromatic, it requires a Model I/III with 32K (48K for the "professional" version). Once again, a printer is optional.

Primarily designed for self-employed persons, it uses a simple question-and-answer format to help estimate the taxes to be paid for the next year. Theoretically, it should estimate taxes over the next several years. Of course, no program can promise this since tax laws change frequently.

First, it asks for information to determine expected income. Questions on interest income, capital gains, stock dividends, professional income, and the like are included. This can require some guessing and tentative information. The program functions much like a thorough interviewer with a calculator.

Then it estimates deductions. In this portion of the program, questions are asked concerning deductible expenses. Again the computer functions much as an interviewer with a calculator.

Last, the program computes estimated taxes and gives suggestions for ways to decrease these taxes.

My copy contained no documentation, but only minimal documentation is necessary, since the instructions are relatively self-explanatory on the screen. An income-tax guide might be helpful in understanding some of the questions.

Error-trapping was fair, but not totally complete. For example, numbers entered with commas resulted in no warning messages, although calculation errors would be made.

Rounding errors of $0.01 sometimes occurred with amounts larger than $100,000. This is not significant since the Tax/Forecaster produces only a rough estimate of taxes, anyway.

My greatest complaint with this program is its inflexibility. Its greatest strength lies in its ability to answer the question, "But how will this investment (or expense) affect taxes?" Unfortunately, to make such comparisons you must go through the entire program.

This year a Professional Tax/Forecaster is available for $99 that will save answers on disk. Primarily designed for accountants with many clients, it probably would not be particularly useful to physicians. It still cannot simply change one answer without redoing the entire tax-figuring procedure. Although some physicians may find the package worth the new user price of $59.95, most will probably find it simpler, less time-consuming, and no more expensive to use their accountants.

Previous purchasers can update for substantial savings. An update of the Tax/Forecaster can be as little as $20.97 when purchased with the Tax/Saver program. I can recommend it for that price.

For my own use, the only type of tax program I would purchase is one that is part of a complete accounting package. Such a package would be used each month to enter expenses, income, deductions, contributions, and so on. Furthermore it would provide a checkbook balance and list the budget. At the end of the year such a program would automatically compute the taxes and print out all forms. At the present I know of no such package. ■

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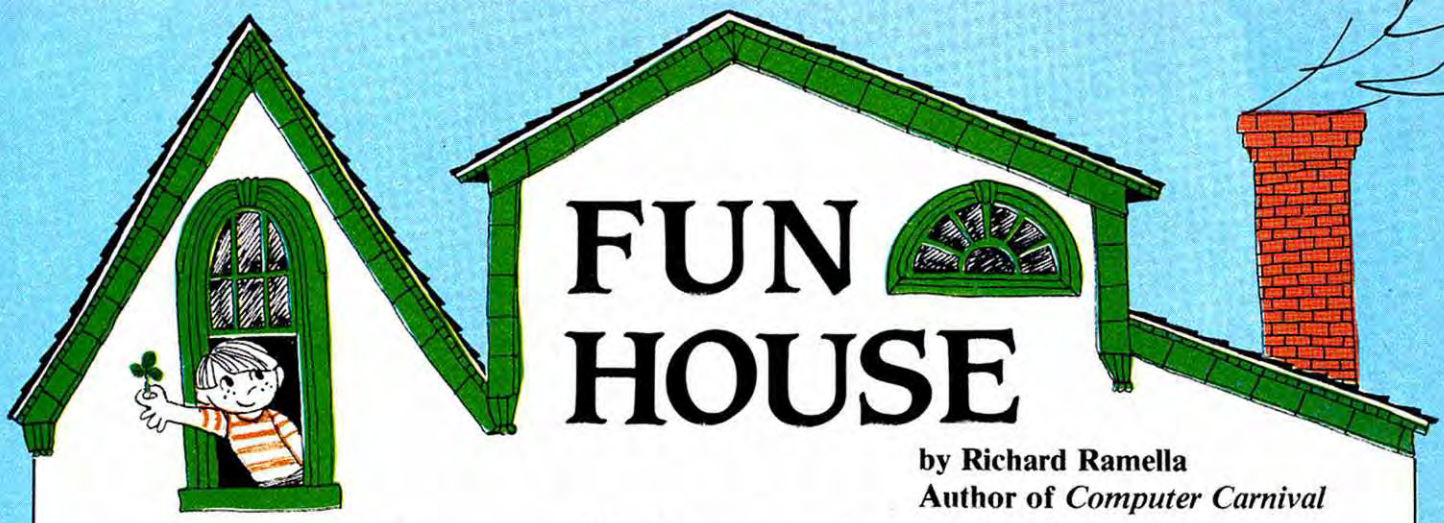

FUN HOUSE

by Richard Ramella
Author of *Computer Carnival*

Adventure Secrets

Put on your Seven League Boots and get your Magic Spectacles. We're going to learn a bit about adventure gaming during this visit to the Fun House.

If you program, you can find some tips on how to write adventures. If you don't program, then I still have three adventure games for you. All three listings will work on any TRS-80 Color Computer or Level II computer.

An adventure is an undertaking that carries risk, surprise, and sometimes danger with it. There is no danger in these games. I don't want anyone to get hurt. I dislike computer games in which a player must pretend to pay the death penalty just because of a wrong choice at the fork of a path.

The Gingerbread Caper is for people up to about seven years old. Treasure Trove is just what it says and is only a bit tricky. I will explain how these two work. However, Wonderland is a tough game and there is only room here to give the rules. I will also tell you how to change Wonderland into a game with characters and places you choose.

The Gingerbread Caper is the easiest way to program a story. It's called the **linear** method because you move through the story in a straight line—most of the time. In its simplest form, the linear program tells a situation and gives the player two or more choices of what to do. A right choice sends the player on to the next scene. A wrong choice can do anything from stopping the game to sending the player back to the start.

In Gingerbread you join Hansel and Gretel who, as always, are lost in the forest. Your decisions take the story to the end. There aren't too many tricks in this program. Most of

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The Gingerbread Caper

```
100 REM * THE GINGERBREAD CAPER * 4K COLOR BASIC OR LEVEL II BAS
IC *
110 CLS
120 A$=STRING$(10,"*")
130 INPUT "WHAT IS YOUR NAME";B$
140 PRINT B$;", YOU ARE IN THE WOODS WITH HANSEL AND GRETEL."
150 PRINT "HANSEL SAYS: LEAVE A BREADCRUMB TRAIL (1)"
160 PRINT "GRETEL SAYS: NO, EAT THE BREAD (2)."
170 INPUT "YOUR CHOICE";X
180 PRINT A$
190 IF X=1 THEN PRINT "BIRDS EAT THE CRUMBS. YOU'RE LOST."
200 IF X=2 THEN PRINT "YOU'RE LOST BUT NOT HUNGRY."
210 PRINT "YOU COME TO A FORK IN THE PATH."
220 PRINT "HANSEL SAYS GO LEFT (1), GRETEL RIGHT (2)"
230 INPUT "WHAT'S YOUR VOTE";X
240 PRINT A$
250 IF X=1 THEN PRINT "YOU'RE GOING IN CIRCLES. ONCE AGAIN,": GO
TO 140
260 IF X=2 THEN PRINT "THE TRAIL WINDS THROUGH A GLOOMY FOREST."
270 IF X<>1 AND X<>2 GOTO 250
280 PRINT "YOU COME TO A BOAT ON A LAKE."
290 PRINT "GRETEL: TAKE THE BOAT (1) -- HANSEL: STAY ON PATH (2)
"
300 INPUT "YOU DECIDE";X
310 PRINT A$
320 IF X<>1 AND X<>2 GOTO 300
330 IF X=1 THEN N=0: GOTO 420
340 IF X=2 THEN N=2: GOTO 350
350 PRINT "YOU MEET A WOLF WHO ASKS IF YOU'VE SEEN RED RIDING HO
OD."
360 INPUT "YES OR NO";C$
```

Listing continues

```
370 PRINT A$
380 IF C$<>"NO" AND C$<>"YES" GOTO 360
390 IF C$="YES" THEN PRINT "NO, YOU HAVEN'T.": GOTO 360
400 PRINT "THANKS, SAYS THE WOLF, AND RUNS AWAY."
410 PRINT "YOU MEET RED RIDING HOOD."
420 PRINT "SHE ASKS IF YOU HAVE SEEN A WOLF."
440 INPUT "YES OR NO";C$
450 PRINT A$
460 IF C$="NO" AND N=2 THEN PRINT "YES, YOU HAVE": GOTO 440
470 IF C$="YES" AND N=0 THEN PRINT "NO, YOU HAVEN'T": GOTO 440
480 IF C$<>"YES" AND C$<>"NO" GOTO 440
490 IF C$="YES" THEN Z=2: PRINT "SHE GOES WITH YOU."
500 IF C$="NO" THEN Z=0: PRINT "SHE GOES IN THE DIRECTION YOU PO
INT."
510 PRINT "YOU ARRIVE AT A GINGERBREAD HOUSE."
520 L=2
530 PRINT "HANSEL: LET'S NIBBLE IT (1)
540 PRINT "GRETEL: DON'T DO IT (2)"
550 IF Z=2 THEN PRINT "RED RIDING HOOD: WAIT A WHILE (3)": L=3
560 IF L=3 THEN V=3 ELSE V=2
570 INPUT "YOUR CHOICE";X
580 PRINT A$
590 IF X<1 OR X>L GOTO 570 ELSE X=INT(X)
600 IF X=1 THEN PRINT "AN ELDERLY WOMAN COMES OUT TO CHASE YOU.
AGAIN, ": GOTO 140
610 IF X=2 THEN PRINT "THE WOLF ARRIVES AND SHOWS YOU THE WAY HO
ME.": GOTO 660
620 PRINT "THE HOUSE BELONGS TO RED RIDING HOOD'S GRANDMA."
630 PRINT "GRANDMA INVITES YOU ALL TO VISIT."
640 PRINT "YOU CALL YOUR PARENTS ON GRANDMA'S PHONE."
650 PRINT "THEY SAY YOU MAY SPEND THE NIGHT."
660 PRINT "AND EVERYONE LIVES HAPPILY EVER AFTER."
670 END
```

all, it's meant to show how a story can be set up to make different choices result in different events.

An example of the way this program works starts on line 220, where the choice is a left or right fork in the path. Choosing right takes you to a boat on a lake. Choosing left sends you in a circle back to the beginning of the story.

To trace this game, CLOAD the program, type TRON, hit enter, and then run the program.

The linear game takes up a lot of room for the few decisions and small amount of action it provides. However, it is a very good style to use if you are just starting to program adventures.

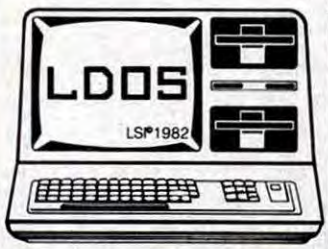
Treasure Trove is shorter than Gingerbread, but it does a lot more. You are put into a scene, told your location, given a tool, and told its use. To answer the prompt DIRECTION?, type in compass points and tap enter. The legal travel directions are N for north, W for west, S for south, E for east, NW for northwest, SE for southeast, SW for southwest, and NE for northeast. If you try

```
100 REM * TREASURE TROVE * 4K COLOR BASIC OR LEVEL II BASIC *
110 CLS
120 DATA BOX,TREE,DRAGON,BEACH,KEY,LADDER,FEATHER
125 DATA SHOVEL,UNLOCK,CLIMB,TICKLE,DIG,LADDER,SHOVEL
130 DATA KEY,TREASURE,CLIMB,DIG,UNLOCK,ENJOY!
140 DIM A$(20)
150 FOR A=1 TO 20
160 READ A$(A)
170 NEXT A
175 B$="FEATHER"
180 PRINT "FIRST TOOL: ";A$(7);". USE: ";A$(11)
200 A=1
205 GOSUB 4000
220 GOSUB 3000
230 IF C$="N" GOTO 500
240 IF C$="E" GOTO 900
250 IF C$="NE" GOTO 700
260 GOSUB 2000
270 GOTO 220
500 A=2
505 GOSUB 4000
510 GOSUB 3000
520 IF C$="E" GOTO 700
530 IF C$="S" GOTO 200
540 IF C$="SE" GOTO 900
550 GOSUB 2000
560 GOTO 510
700 A=3
705 GOSUB 4000
710 GOSUB 3000
720 IF C$="W" GOTO 500
730 IF C$="SW" GOTO 200
740 IF C$="S" GOTO 900
750 GOSUB 2000
760 GOTO 710
900 A=4
905 GOSUB 4000
910 GOSUB 3000
920 IF C$="N" GOTO 700
930 IF C$="W" GOTO 200
940 IF C$="NW" GOTO 500
950 GOSUB 2000
960 GOTO 910
2000 PRINT
2010 PRINT "B-O-N-K !"
2015 PRINT
2020 RETURN
2046 PRINT "RIGHT"
3000 INPUT "DIRECTION";C$
3005 CLS
3010 RETURN
4000 PRINT "LOCATION: ";A$(A)
4010 PRINT "TOOL: ";B$
4020 E$=""
4030 INPUT "ACTION";E$
4032 IF E$="" THEN RETURN
4035 CLS
4040 IF B$<>A$(A+4) OR E$<>A$(A+8) GOSUB 5000: RETURN
4045 PRINT "GOOD MOVE."
4050 PRINT "THE ";A$(A);" PRODUCES A ";A$(A+12)
4060 PRINT "THIS IS YOUR NEW TOOL."
4065 PRINT "ITS PURPOSE: ";A$(A+16)
4066 B$=A$(A+12)
4067 IF B$=A$(16) THEN PRINT "YOU WIN.": END
4070 RETURN
5000 PRINT "WHAT, ";E$;" A ";A$(A);" WITH A ";B$;"?"
5010 PRINT "IMPOSSIBLE !!!"
5020 RETURN
5030 END
```

Treasure Trove

LDOS MICRO REVIEW

Volume 1 No. 1 ★ SPECIAL EDITION ★★★ March 1, 1983



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The BASIC Answer is a BASIC text processing utility. It is designed to allow the BASIC programmer to build code in a structured manner. "Source" code is written with a word processor or text editor which allows the user to exploit the powerful editing and movement features characteristic to those types of editors. Source code can even be created by your own BASIC interpreter. **The BASIC Answer** is then used to process these files into normal interpretive BASIC code.

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The BASIC Answer allows substitution of labels for **line numbers!** This means that your BASIC code now can read like a novel. Instead of the typically undescriptive "GOSUB 1000", a label such as "GOSUB @Search.Name" is used. Imagine yourself reading code filled with such descriptive branches and understanding it at a glance, even years later. This feature even allows totally relocatable BASIC routines without the renumbering problems.

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*Certain features of LDOS require specific hardware.

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The BASIC Answer allows variable names to be as long as 14 characters and ALL 14 are significant. Imagine reading:

"IF ACCNT.OVERDUE #> 0 THEN GOSUB @PRINT.DUN"

rather than

"IFAO#>0THEN GOSUB52130"

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a direction that isn't open, the computer will print B-O-N-K! and let you try again.

When the computer prompts ACTION?, you can type in the use of your tool to see if it works at that location. To take no action, just tap enter. Here's an example: Your location is Tree. Your tool is Feather. Its use is Tickle. To try this tool, type Tickle when the prompt Action appears. The computer tells you if you're right.

You must travel from place to place, trying out tools. Each time a tool works, you are given a new tool that will work in another location. In time you find the treasure.

Treasure Trove is very simple, but it includes several things that make a good adventure game. One is a **closed system**, which means that you can travel from place to place in the "world" that has been created for the game. And there are tools that help you.

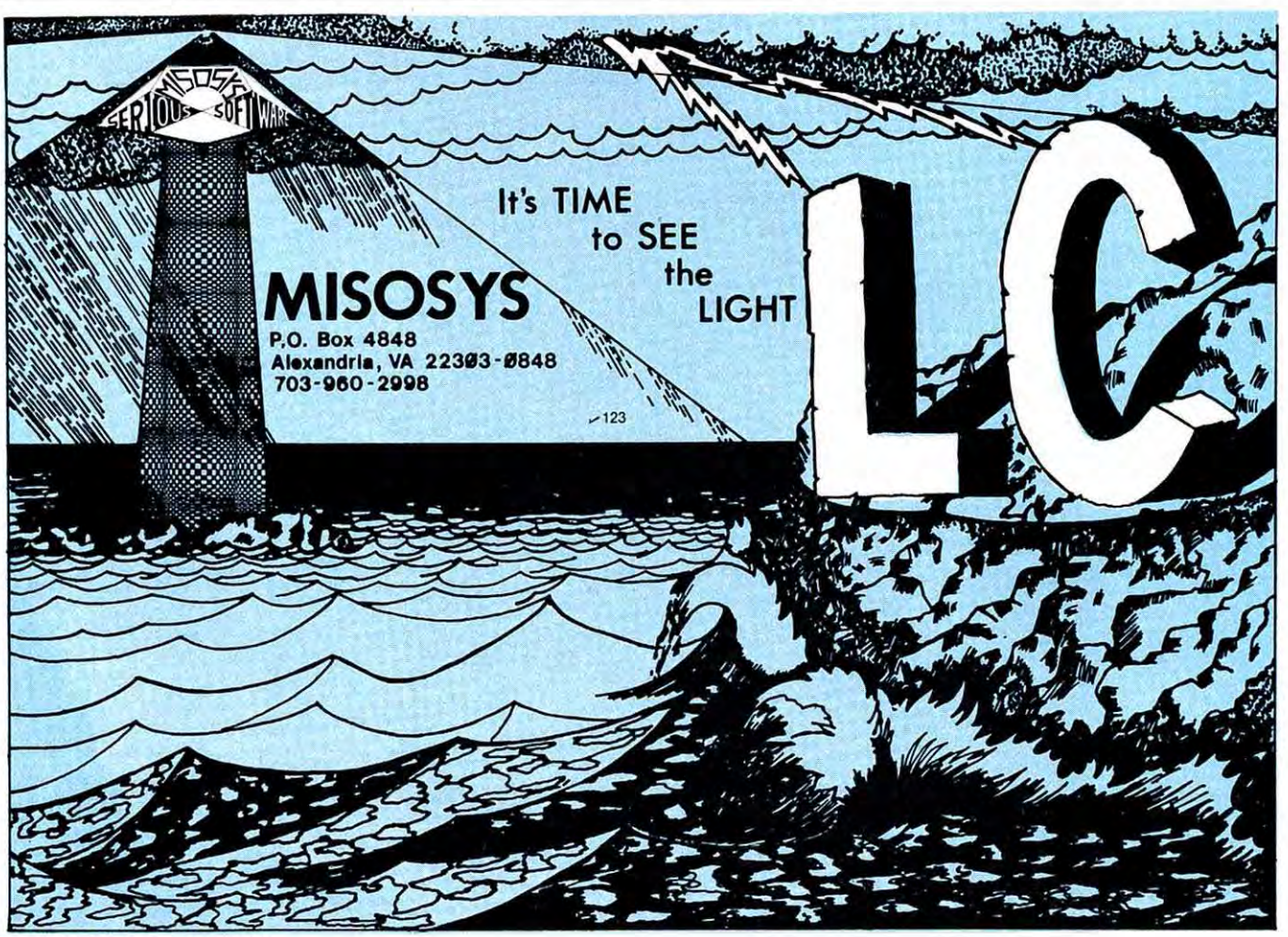
Actually, Treasure Trove is a very small world. Picture a square with a box, a tree, a dragon, and a beach at the four corners. You can travel between any two locations. For examples, lines 230–250 send you either north, east, or northeast to discover what is there. In reality, the program sends you to other lines where the other situations are made possible.

Again, you can use TRON to trace your way through the program and begin to understand how it works.

I will make no attempt to explain how Wonderland was programmed; I'll just give the rules. If anyone wants a fairly technical explanation of Wonderland, that's this month's Nickel Bargain Bin offer. Don't bother if you're just starting to program. Otherwise, send a nickel and a stamped envelope with your name and address to Richard Ramella, 1493 Mountain View Ave., Chico, CA 95926. Include a note with the word "WONDER" on it.

Note that Wonderland isn't much longer than the other two program listings. However, it is more complex and much harder to win. That's the way an adventure game should be.

This program borrows 10 characters and 10 items or scenes from the Lewis Carroll stories *Alice in Wonderland* and *Through the Looking-Glass*. Each is assigned a different



place on a 5-by-5 grid. You don't see the grid, but you do travel around it logically. The grid also has five clue areas.

At the start, one of the characters is secretly made the mystery character. Your goal is to identify that character and then find its location. You travel in compass directions by tapping N, W, E, and S. Nothing happens if you try to travel off the imaginary grid.

There are three categories of locations:

- If the location is an item or place, you keep moving and simply use it to remember where you are.
- If the location is a character, you are invited to guess the mystery character by the prompt MYSTERY GUESS Y/N? Type

Wonderland

```
100 REM * WONDERLAND * 4K COLOR BASIC OR LEVEL II BASIC *
110 CLS
120 PRINT "W O N D E R L A N D"
130 CLEAR 250
140 DATA WALRUS,MAD HATTER,WHITE RABBIT,CHESHIRE CAT,RED QUEEN
150 DATA JABBERWOCKY,TWEEDLEDUM,TWEEDLEDEE,WHITE KNIGHT,ALICE
160 DATA RABBIT HOLE,TEA PARTY,POOL OF TEARS,OYSTER BED
170 DATA QUEEN'S THRONE,THE WABE,EIGHTH SQUARE
180 DATA GLASS TABLE,LONG HALL,CROQUET GROUND
190 G$="WRONG. EXIT WONDERLAND"
200 DIM D$(25),E$(5,5)
210 FOR C=1 TO 25
220 IF C>20 THEN D$(C)="CLUE": GOTO 250
230 READ D$(C)
240 IF C<11 THEN D$(C)=" "+D$(C)
250 NEXT C
260 S=RND(10)
270 K$=RIGHT$(D$(S),LEN(D$(S))-1)
280 A=1
290 B=1
300 FOR C=1 TO 25
310 D=RND(25)
320 IF D$(D)="" GOTO 310ELSE E$(A,B)=D$(D): D$(D)=""
330 IF B<6 THEN B=B+1
340 IF B=6 THEN B=1: A=A+1
350 IF A=6 THEN A=1
360 NEXT C
370 A=RND(5)
380 B=RND(5)
390 PRINT STRING$(20,"*")
400 X$=E$(A,B)
410 PRINT "LOCATION: ";X$
420 IF L$=X$ THEN PRINT K$;" FOUND. YOU WIN": END
430 IF LEFT$(X$,1)=" " AND Z$<>K$ GOSUB 510
```

Listing continues

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Listing continued

```
440 IF X$="CLUE" GOSUB 590
450 INPUT "DIRECTION";D$
460 IF D$="N" AND B>1 THEN B=B-1
470 IF D$="S" AND B<5 THEN B=B+1
480 IF D$="W" AND A>1 THEN A=A-1
490 IF D$="E" AND A<5 THEN A=A+1
500 GOTO 390
510 INPUT "MYSTERY GUESS Y/N";T$
520 IF T$<>"Y" AND T$<>"N" GOTO 510
530 IF T$="N" RETURN
540 PRINT "CLUE LETTERS: ";M$
550 INPUT "GUESS";Z$
560 IF Z$=K$ GOTO 870
570 IF Z$<>K$ THEN PRINT G$: END
580 RETURN
590 PRINT
600 FOR T=1 TO RND(500)+500
610 NEXT T
620 CLS
630 FOR T=1 TO RND(500)+500
640 NEXT T
650 G=RND(20)
660 H=RND(20)
670 PRINT H"+"G
680 FOR T=1 TO 60
690 NEXT T
700 CLS
710 PRINT @ 0,"ANSWER";
720 INPUT S
730 IF S=H+G THEN PRINT "RIGHT": PRINT "NEW LETTER IS ";
740 IF S<>H+G THEN PRINT "WRONG": RETURN
750 Q$=MID$(K$,RND(LEN(K$)),1)
760 PRINT Q$
770 M$=M$+Q$
780 PRINT "IF YOU HAVE 13 CLUE LETTERS, YOU LOSE."
```

Listing continues

N and no guess is made; type Y, tap enter, and make your guess.

● If the location is a clue, keep a sharp eye out. In a moment after the word Clue comes on, the screen goes blank. Then an addition problem is flashed on and off at top screen left, followed by the prompt ANSWER?

If you answer the addition problem quickly and correctly, you're rewarded with one letter from the mystery character's name. This is added to a list of clue letters, some of which may be repeated. That's how you get clues to help identify the mystery character.

Every time you finish in a clue area, the clue travels to some other place on the grid and its place is taken by the character or item it bumped out of the way

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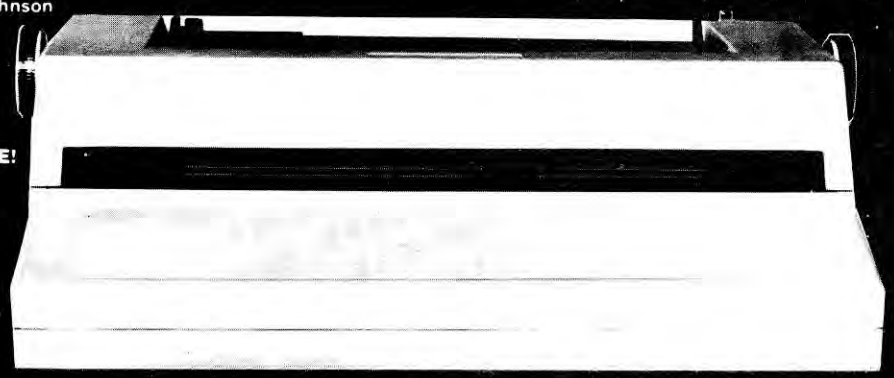

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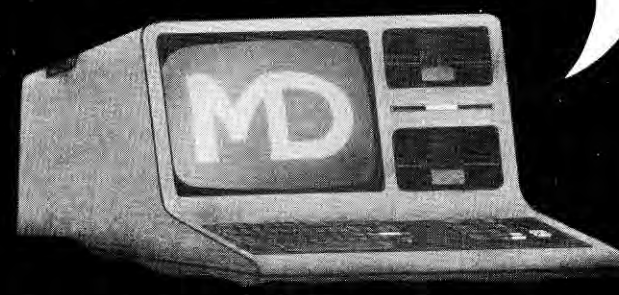

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Listing continued

```
790 Y=LEN(M$)
800 PRINT "CLUE LETTERS: ";M$;" NUMBER:";LEN(M$)
810 IF Y=13 THEN PRINT G$: END
820 F=RND(5)
830 I=RND(5)
840 E$(A,B)=E$(F,I)
850 E$(F,I)="CLUE"
860 RETURN
870 PRINT "RIGHT."
880 PRINT "NOW FIND ";K$
890 L$=" "+K$
900 GOTO 390
```

when it moved. So things can change.

Now, let's have an example: You enter the area of the Walrus. It's a character, so the game asks: "MYSTERY GUESS Y/N?" You answer by tapping Y for yes. The string of clue letters is printed; we'll say these letters are CEELIA. The prompt GUESS? appears. You type in ALICE. The computer comes back: "RIGHT. NOW FIND ALICE." At this point all you have to do is travel around until you find the Alice location, and you win.

You can lose this game in two ways: when your mystery character guess is wrong or spelled incorrectly, and when your string of clue letters is 13 characters long. In both cases you're told to exit Wonderland and the game ends.

This game is different each time it's played. Characters and items are put in different areas, and the mystery character can be any of the characters in program lines 140 and 150.

You can put your own characters in this game by replacing the names in lines 140 and 150 with 10 names—your friends or the characters in your favorite movie or TV series. Lines 160, 170, and 180 can be street names, towns, planets, or imaginary things. You can rename the game by replacing the Wonderland in line 120 with the new name.

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- The search for a key that will open the castle, where the princess tells the riddle that charms the dragon that leads you to...
- Finding the right two characters whose combined talents get you out of Captain Silly's House of Confusion.

Take them. They're yours.

And last, I just realized next month is April. I haven't decided yet whether to explain how a simple household computer can be used to fly to the moon, or to offer a few April Fool programs. ■

The December 1982 Fun House column ran two listings for Peglegs—one for Color Basic and one for Level II. There are errors in the last several lines of these listings. See Debug, p. 27 for the corrections.—Eds.

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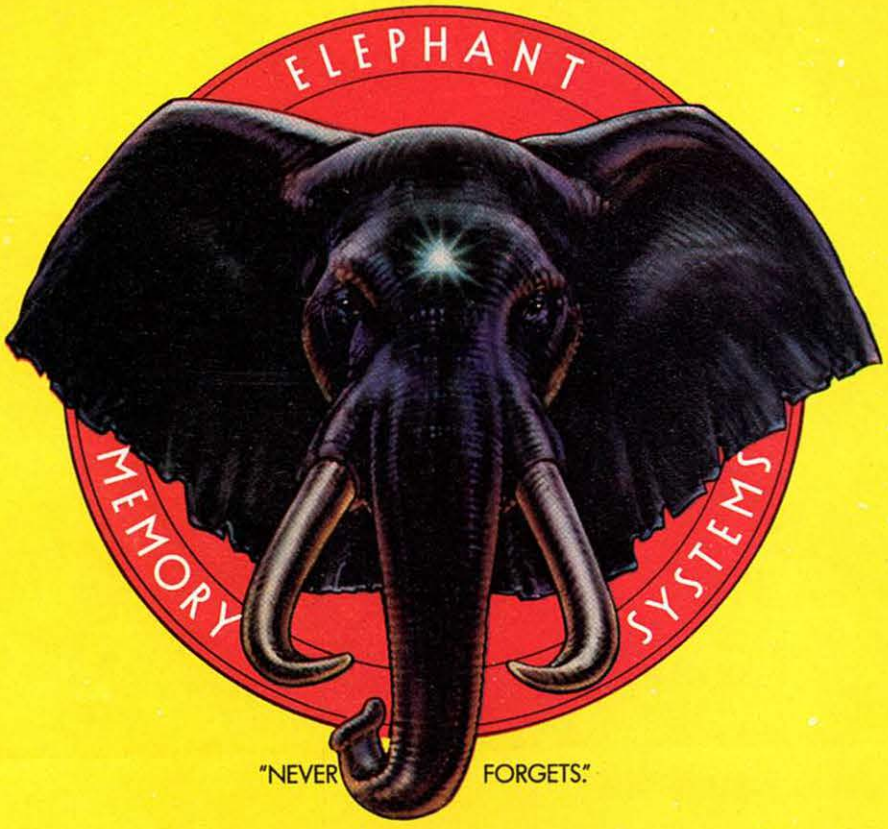

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___1. Printers
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___4. Hard disk drives
___5. Modems
___6. PMC/LNW micros

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3. $501-$750
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5. $1,001-$1,500
6. $1,501-$2,000
7. $2,001-$2,500
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F. If you were planning to purchase an additional microcomputer, would you buy another TRS-80?
1. Yes
2. No

G. What is your major application for your TRS-80?
1. Word processing
2. Business
3. Freelance clerical
4. Education
5. Games
6. Hobby
7. Other home use
8. Other_____

H. If you use a Model III, what types of software would you like to see more of?
1. Word processing
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4. Education
5. Games
6. Hobby
7. Other home use
8. Other_____

I. Do you use your micro at home as a source of revenue?
1. Yes
2. No

J. Where do your children use a microcomputer?
1. At home
2. At school
3. Both of the above
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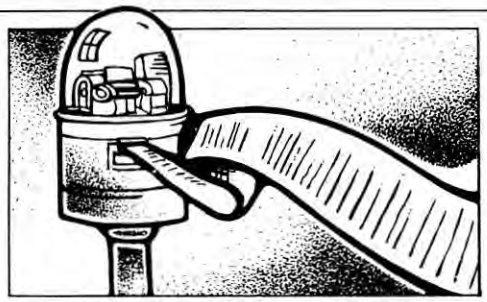
MONEY DOS

by J. M. Keynes



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The way to protect your principal while having a chance for large gains is to invest only interest/dividends earned. To do this you set up two pools of money within one account. The funds are invested in some investment-quality bonds (A rated or better), maturing in 10–20 years at 15 percent, which you will hold to maturity. This *investment pool* (IP) will generate $1,500 per year with which you can speculate. Even if you lose it all, your capital is intact. The interest generated is placed in a money-market fund currently yielding 10 percent. This will give you a solid base that can support entry into the more speculative and, you hope, more profitable investments. In other words, the investment pool will generate income to continually fund a speculative and aggressive program for another pool, which I call the *speculative pool* (SP).

The selection of investments to be made by the SP must be oriented toward high leverage. The rationale for the IP is to continually generate capital for the SP. Now you can use the SP ultra-aggressively, in high-risk vehicles to achieve capital gains.

Once positions in the SP are closed out, profits revert to and are reinvested in the IP. As long as the IP is funded with the profits from the SP, the capital resources invested will continue to grow and will thus continually provide more funding for the SP. Such a strategy assures one that speculative gains from the SP are not immediately frittered away but rather compounded, by recycling the aggressive speculative profits back to the conservative IP. Many SP investments will be unprofitable, but when a windfall comes along, one is sure that the capital base of the IP will be enhanced (see Fig. 1). Losses are much easier to deal with as you are secure in the knowledge that your capital is intact.

The best investments for the SP are low- and ultra-low-priced stocks and options. These offer the investor potential for large speculative gains and risks. While the market has done well these last months (predicted here when the Dow was at 800), the low-priced stocks, generally speaking, are still languishing near their lows. There has been little public sponsorship of these securities. In fact, many are selling substantially below their historic levels, and in many cases below net asset value.

These securities will only move if the public gets excited about the market, as they carry no appeal for the institutional investors who usually must restrict their purchases to higher-quality issues. Furthermore, many of the low-priced stocks have only a few million shares outstanding and it is impossible to take a large position without materially affecting the price. The fact that the behemoths of Wall Street can't participate is an advantage to the small investor. (It wasn't that many years ago that Tandy was selling for $1 per share.)

I think there will be explosive moves in low-priced stocks in this decade. The reason this may happen is that many low-priced companies are in solid positions to leverage their capital through the technological advances they are making. In addition, they are capable of increasing their sales dramatically because of their relatively small size. It is much easier for a company with sales of five million per year to double them than for a General Motors to achieve the same growth rate.

The new-issue market is attracting attention. The MONEY DOS BBS recommended only three of them in November. Those who accessed were advised to sell at the first opportunity. Those mentioned were: Systems & Computer at 16, sold at 20 1/8; Altos at 21, sold at 30½; and Lee Data at 19, sold at 30½. . . all within 15 minutes of their opening. The new-issue market is not for the uninformed. Many of them wind up in Chapter 11. This is one of the areas where the large full-service (and full-commission) brokerage firms are to your advantage. The "bare-bones boys" (discount firms) have little chance of getting any of the new issues that are in demand.

These lesser companies offer high leverage and great potential for exponential gains in the years to come. There is little doubt that some of these emerg-

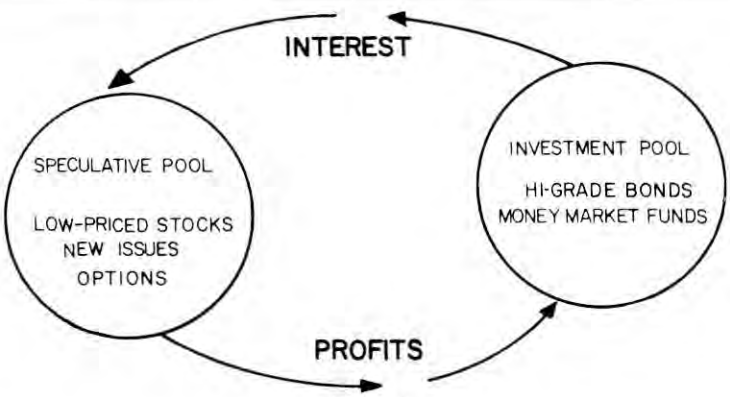

Figure 1

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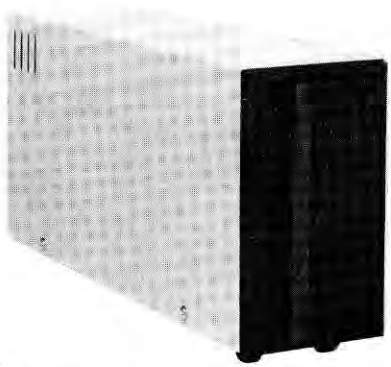

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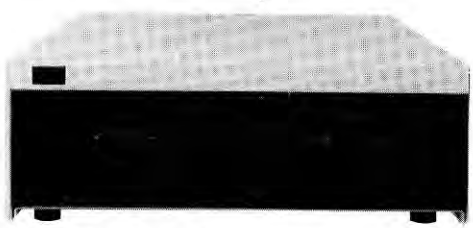

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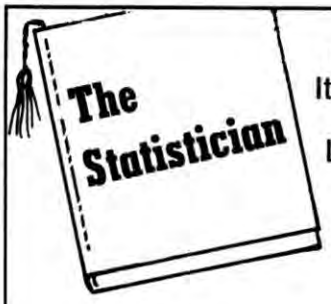

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```
10  CLS: INPUT"BEGINNING KITTY";K
20  INPUT"YEARLY RETURN (15% ENTERED AS 15)";R:Q=R/100+1
30  PRINT"VALUE OF KITTY COMPOUNDED AT ";R;"%
40  FORI=1TO20
50  K=K*Q
60  PRINT"YEAR #";I,"VALUE $";INT(K),
70  NEXT
```

Program Listing

ing companies will gain 500–1000 percent in value if the speculative fever of the public returns to the market. I especially favor the field of computers and data transmission, as I see the computer industry in a similar position to the auto industry in 1920—some had cars—others scoffed, but in the end everyone had a car.

Now, most investors are asleep as we are just emerging from a period of pervasive gloom. Such time is ideal to build a portfolio of low-priced stocks. "A camera that develops its own pictures. . . nonsense Mr. Land, it won't sell." Wait and see; when the Dow hits 1200 (it may have done so when you read this), the public will start buying stocks with both hands. The result may well be a head-long scramble to buy low-priced stocks. Once this speculative fever begins, it may run rampant for many years. The free 24-hour MONEY DOS BBS 305-744-0190 (see last month's column) will now begin to track some low-priced issues. You must have a modem to access the BBS.

The SP can invest in options where one has enormous leverage with risk limited to what you invest, and, unlike stocks, one can profit in a falling market through the use of Puts. (I suggest you read the December 1982 MONEY DOS column for a brief explanation of option strategies.) Failing that, I will say only that outright option purchases are potentially the most profitable, albeit the most risky. I much prefer the option spread that requires less capital and yet may have a leverage factor of 10 or more to one. The MONEY DOS BBS has daily updates on various option strategies.

If the IP only grows at the 15-percent rate compounded (this will happen if the SP only breaks even each year), a beginning IP of $10,000 will, in 10 years, be worth $40,455! If you want to do some fantasizing, run the listing.

Remember, profits from the SP are placed in the IP. Even in a disastrous year, the IP remains intact. The IP can increase in size, but never decrease. Now all you must do is implement the strategy. You won't get rich quick, but then you won't have to read by streetlight either. The above strategy is suitable only for those who can afford to risk losing all or part of the interest earned from the IP. ■

(J.M. Keynes is a pen name for a Sr. V.P. of a member firm of the New York Stock Exchange.)

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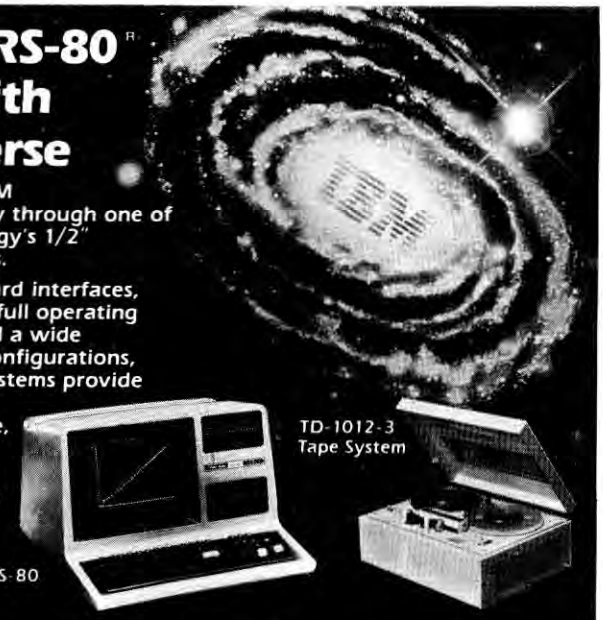

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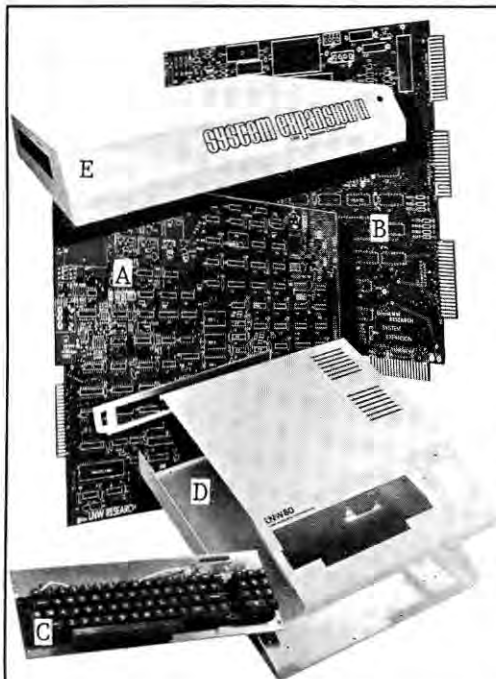

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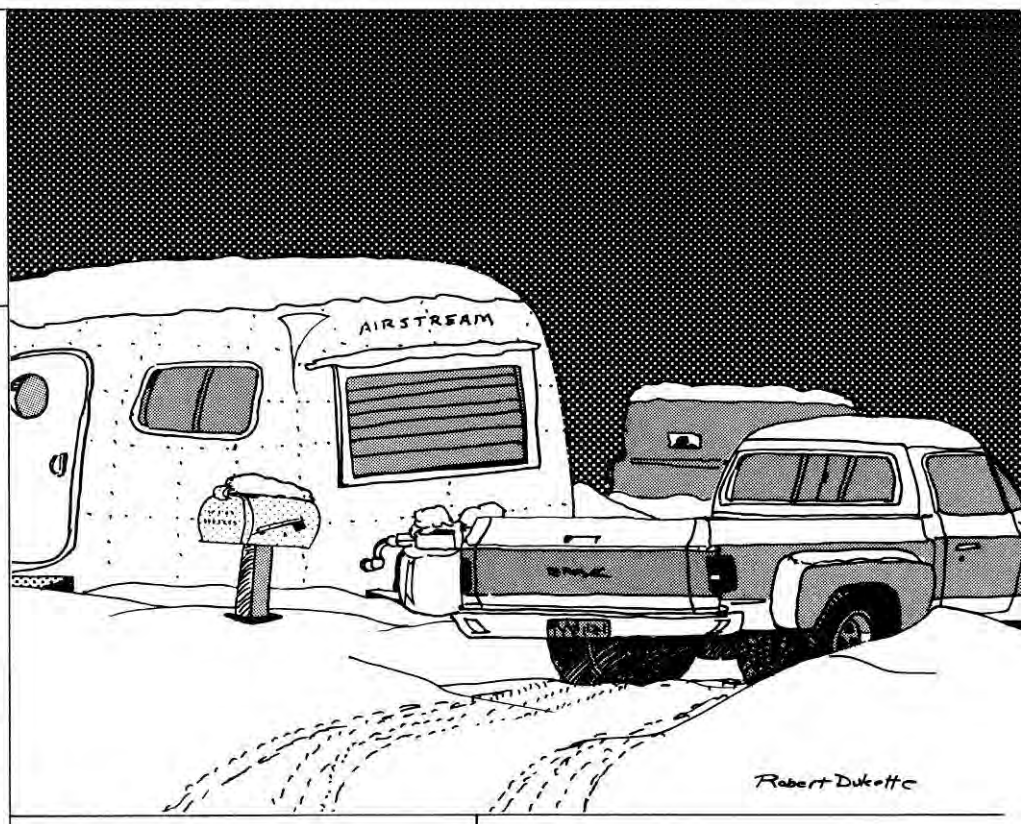

Hi. My name is Stella. I live in a 1964 Airstream trailer at the KOA just outside Provo, UT.

I'm not sure just exactly who I'm writing to, but I found this envelope addressed to *80 Micro*, and figured I should at least let you know that your friends are OK.

They're all passed out right now. Doesn't look like they've slept much in recent weeks. That fellow named Rodney keeps mumbling "panic, panic" in his sleep. Maybe somebody's after them. I don't care—they seem like decent sorts, even if the scruffy guy named Max said some nasty things about my Tammy Wynette tapes.

I'll tell you right now, these folks are lucky they didn't freeze their buns off. You probably read about the big blizzard we had. Well, that beat-up old van of theirs was in a ditch on Route 36, just south of Faust. Lord only knows what they were doing on Route 36. Maybe they were going to visit the Bingham Canyon Copper Mine.

Anyway, I picked up their SOS on my scanner, and got my boyfriend Luke to go out in his pick-up (one of those big things with four wheels in the back that makes my heart beat faster) and bring them in.

What a pitiful lot! Particularly that little girl Mercedes Silver, wearing nothing but lederhosen and a sequined bowling shirt. So I fed them some Campbell's Chicken Noodle Soup and a box of Ring Dings, and then watched them all fall asleep right there at the table.

* * * * *

It's a couple of hours later now. I had to do the dishes, and then Barney called to ask me out to the movies. He's Luke's best friend, and has a crush on me. I told him no thanks on account of the weather.

I found some papers on the floor next to Rodney that look kind of important. I don't understand much of what's written here, but maybe you can figure it out. The first sheet's got "Update from the Gamer's Cafe box score department" written across the top. It says that some fellow named Karl Boule, who lives in Kirkland, Quebec (I'll bet it's awfully cold up there!), got 68,000 on Eliminator (whatever that is), beating the 59,600 listed in the December issue. But then, it says, a guy named Nick Fazio from Norristown, PA (I used to have a second cousin in Pittsburgh), got 117,300. Well, that sure is a lot more than 68,000, isn't it?

There's this note here that reads, "see attached letter." The letter has got "Taylor Public Schools" across the top of it, and it's from Taylor, AK, and is signed by Taylor High School senior-class president Marvajean Lane and student-body president Staci Dalrymple. They say that Joe Garcie got 104,400 points on Cosmic Fighter.

I know it isn't any of my business, but I once went out with a fellow from Taylor, and he was all right by me. And this letter looks pretty official, so it seems to me that these kids are being straight with you. Of course, as I say, it's none of my business.

Let's see here. There's another letter stuck to the back. It's from Budd Mager, of Lac du Bonnet, Manitoba. (You folks sure know lots of Canadians.) He says that when you master level 15 of Ghost Gobbler, you "try a POKE 65495,0 after loading just before typing EXEC. This should heighten your action to double the level shown; i.e., level 1 becomes level 16 and level 15 becomes level 30. If you want a different color for the background, try a POKE 65314,8."

I sure don't know what any of *that* means, but it sounds awfully technical. It must have something to do with all of those funny-looking TV sets in the back of the van. I hope your friends aren't doing anything illegal. Luke wouldn't be too happy about that.

* * * * *

The most peculiar thing just happened. I was sitting here reading the last letter in this batch, from a guy named David Miller in Lynnfield, MA, when I got a phone call. And it was...

I guess I should tell you about the letter first. It says, "HELP! I am stuck in Aardvark-80's Color Computer Pyramid. I am in many twisting corridors that lead into a crypt with a sarcophagus. When I open the sarcophagus, I can enter a dusty cellar. I searched

everywhere! I can't do anything! HELP PLEASE! I am going I-N-S-A-N-E. . . "

Well, I nearly fell off my chair when I read that. Here was this poor fellow locked up in a tomb somewhere scared out of his wits, and I didn't know what to do. I was just about ready to call Luke (he's the one with the pick-up) when the phone rang.

"Hi Stella, this is Rodger Olsen," said the man on the other end of the line. "I wrote Pyramid. Tell David not to feel too bad—the record time for solving Pyramid is about 40 hours by a team of four people. Usually it takes about 80."

I was so shocked I didn't know what to say, and I sure didn't understand what *he* was saying. Something about the dusty cellar being a dead end, and then later blowing a lock by opening a pistol and some bullets to get gunpowder and lighting the powder with a match. He said to look at everything in every direction, including up and down (which is what Luke says about life). And that another blind alley will prove to be the way out, if you can decode a line of graffiti to find what to do there.

"There's a hint or a clue or something for every game we do," Mr. Olsen said. "I hate adventures that don't have clues. Every 16-year-old kid who knows Basic writes an adventure and puts it on the market, and they're really weird. They all have a robot you have to feed a hamburger."

I told him I agreed 100 percent.

Mr. Olsen said he is proud that all his adventures can be figured out logically, and I said he certainly had every right to be. He said something about the original Adventure in which you ran into Cyclops (it's joggers that make me nervous), and could only defeat him by whispering his old enemy's name, Odysseus. I told Mr. Olsen that was something that wouldn't come to me right off the bat, and he said that was the point.

Anyway, he gave me Aardvark's phone number, so I suppose it's OK to tell you—it's (313) 669-3110.

"We're allowed to laugh at you a little if you call for help," he said. I told him that if anybody laughed at me, Luke would break his fingers with a tire iron.

* * * * *

It's a day later now, and they're all still asleep. I wish they hadn't conked out on the table; I'm not exactly comfortable eating in my bedroom, which is about the size of a phone booth.

At least, the snow's let up. And Barney won't be bothering me any more, 'cause Luke shot him last night.

Luke's coming over for supper. I think I'd better have your friends out of here by then. ■

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* Method I. Winthrop racked up 281,000 points using Method II.

** Winthrop still had six ships left, but he got bored.

+ Novice mode. Max got 69,480 in the expert mode.

+ + Winthrop got through all nine swamps, too.

The Gamer's Cafe Greatest Hits

Gamer's Cafe readers are invited to submit their high scores, for these and other TRS-80 games. We'll print unvalidated scores, but validated scores (a photo of the screen) will, of course, rank higher in prestige.

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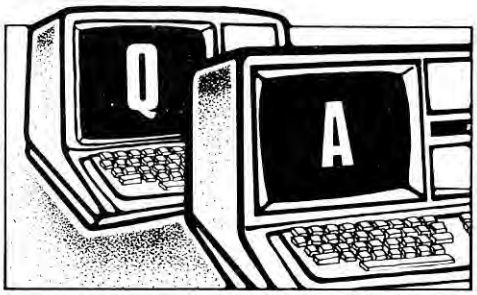

Send any questions or problems dealing with any area of TRS-80 microcomputing to Feedback Loop, 80 Micro, *80 Pine Street, Peterborough, NH 03458.*

I've upgraded my Color Computer to 16K and Extended Color Basic by following articles in 80 Micro. *I see that Radio Shack is selling a 32K upgrade, and I suspect that installation would be easy. Have you ever run an article on this or do you expect to in the future?*

Also, will the Color Computer run an Epson MX-80 or Smith-Corona TP-1 Daisy Wheel printer?

R.J.
Phoenix, AZ

Yes, on all three counts!

"Smarten Up, Color Computer!" by Richard Esposito and Bertram Thiel (March 1982, p. 126) shows how you can expand your Color Computer's memory by 16K of RAM in the comfort of your home.

As for your other question, the Color Computer can drive an Epson printer, but you have to get a serial board to interface between the computer and the Centronics parallel port normally used on the Epson. Order either part number 8145 or 8155 when you order your printer. Part 8145 is a serial board that plugs into a socket inside the Epson and supplies a 2K RAM printer buffer. It retails for $115. Part 8155 is the same as part 8145 except that it has a 4K RAM buffer and costs $152. Part 8145 is being phased out, so you may not be able to get it.

You'll have to modify the Radio Shack Color Computer in order to connect it to the Epson printer. Take pin 2 from the Color Computer and connect it to pin 20 on the Epson, connect pin 3 to pin 7, and pin 4 to pin 3. (See Table 1.)

Color Computer Cable	Epson Cable	Use
Pin 2	Pin 20	Handshaking
Pin 3	Pin 7	Signal ground
Pin 4	Pin 3	Data Line

Table 1

You also need to determine if your Color Computer is the new version that sends 8 bits out the RS-232, or the old version that sends only 7 bits, and set the RS-232 interface in the Epson to the appropriate word size. The 1.1 ROM uses 8-bit words, version 1.0 uses 7-bit words.

The Color Computer can drive the Smith-Corona TP-1, but you have to make sure that you order the serial version and match up the Color Computer RS-232 pins with the proper pins of the TP-1. (By the way, the TP-2 is now available for the same price as the TP-1. The TP-2 will correct many of the TP-1's faults.)

I own a 48K Model III single-disk system, which I often take to the office since I discovered VisiCalc. I want to implement Advanced VisiCalc (which requires 128K of memory) on a networking basis with access to a large VisiCalc data base on a hard disk.

The Models II and 16 are too bulky for my use, and there seems to be no practical way of expanding my Model III beyond 48K. Does this mean I have to go to an Apple III or IBM PC?

I don't want to be unfaithful to my Tandy, which has given me a full year of trouble-free service and an expanding VisiCalc data base on 5¼-inch disks.

E.L.J.
Antwerp, Belgium

I'm afraid that there's no way you can use more than 64K of RAM in a Model III for VisiCalc. Your only choice in the Tandy line are the Models II and 16.

If your only objection to the Model IIs and 16s is their bulk, consider that when you include the monitor, an Apple III or IBM-PC takes up almost as much room as the Tandy machines do.

Another consideration is that you can always use your Model III as a remote terminal to access the Advanced VisiCalc on the Model II or 16 at either your home or the office. You can also leave your Model III at home and use the Model II or 16 at the office and reserve the Model II for remote terminal work at home and eliminate the need to transport the microcomputers entirely.

Could you send me the name and address of T.B. in Hartford, CT (September 1982)? I currently attend a computer club in New Canaan, CT, which is an hour-and-15-minute drive each way. A club in Hartford would be convenient, since it's only 45 minutes away.

J.H.
Litchfield, CT

I don't have a complete address for T.B., so I can't help you there. But I can give a list of the five computer clubs I know of in Connecticut (courtesy of the User Group Listing in the Special Anniversary Issue of *80 Micro*). They are:

North Eastern Basic Four User Group, 22 Tobey Road, Bloomfield, 06002.

Fairfield County TRS-80 Users Group, 10 Richlee Road, Norwalk, 06851.

Southern New England Computer Society, 267 Willow St., New Haven, 06511.

Connecticut Microists, 8802 Wendy Lane, Westport, 06881.

Connecticut Computer Club, 18 Ridge Court West, West Haven, 06516.

I hope one or more of these are close to where you live.

I have a 48K Model III with disk drives, and several questions:

- *What would it take to convert my computer to CP/M, and what would be the approximate cost?*
- *Is there any simple way to upgrade the real-time clock to a higher interrupt level? Disk/tape accesses slow the clock down to the point where it's unreliable for operating a modem, external lighting, heating, and A/C systems.*
- *Has anyone reported any difficulties*

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using the Radio Shack Fortan IV package? I found several discrepancies in using the format statements depending on whether the data is input from keyboard or disk, and output to CRT or printer.

● *Are there any TRS-80 user groups near me?*

A.K.
New Carrollton, MD

You have several choices on converting your Model III to CP/M. In this issue there is an article on converting your computer to CP/M operation for only $5! The CP/M operating system is not included in that cost. Most of the CP/M boards available for the Model III cost at least several hundred dollars. Fortunately for Model III users, these CP/M boards usually just plug into the Model III and require little or no soldering.

You can't move the clock to a higher interrupt level without sacrificing the use of both the tape and disk I/O. The timing constraints required for tape and disk I/O are very stringent, and the clock interrupt signal, if it were to be set at a higher priority level, would make tape and disk I/O totally unreliable. As a simple test, CSAVE and then try to CLOAD a tape without first giving the CMD"T" command. Disk I/O, with a data exchange rate about 180,000 bits per second, would be simply impossible since the 40-millisec clock pulse would block approximately 7,000 bits of information from reaching the CPU each time the pulse appeared.

Yes, other people have complained about the same faults you mention. From all appearances, the current version of Fortran isn't going to be updated anytime soon, so you'll just have to live with the problems (unless someone knows of a patch to the Fortran package that would fix the data format problem).

There's only one that I know of in Maryland: TRS-80 Baltimore User's Group, 3505 N. Charles St., Baltimore, 21218.

I have the Alpha-Products joystick for my Model III. It works fine in Basic and it will work with all the games that have the Model I program on one side and the Model III program on the other, but it won't work with programs that have only one program version for both Model I and III computers.

I believe that the problem is that you need the OUT 236,16 statement to turn on the printer port on the Model III, but not on the Model I. Hence, the programmers left the statement out on the Model I/III programs. Since the System command on the Model III automatically turns off the printer port (which the joystick needs to work properly), these games won't work with my joystick.

I have very little knowledge of machine language, and I would like to know if there's any way to modify these programs to use my joystick.

W.W.
Kingsport, TN

I'm sorry, but there isn't much you can do except call the manufacturers of the programs, explain the problem, and hope they'll fix the program for you. To add the statement you want requires some knowledge of machine language, a disassembler (or a machine-language debugging program that has a disassembler), and an editor/assembler program.

What you would do is load the disassembler, load the erring program, find the starting point of the program (not necessarily the beginning), find the ASCII messages to the program user (so they won't be treated as instructions to the Z80 CPU), and save the program to tape. Then load the editor/assembler, load the disassembled program, add the necessary code to reenable the printer port, and save the new machine-language program to tape. This is complicated by the protection procedures some programmers put into their programs, which might make it impossible for you to make the changes you need.

In either case, good luck.

I've spent the last three days entering and trying to debug the program "Acrostic Generator" by Jonathan Falk (August 1982, p. 240). Everything works fine except printing the puzzle diagram and definitions. I have a Model I Level II with 32K of RAM and a RS Line Printer IV.

I changed lines 670 and 950 to LPRINT STRING$(5,"X") as suggested by Mr. Falk, as well as changing LPRINT TO LPRINT " " (which solved some, but not all, of my problems).

B.S.
Swarthmore, PA

Your problem isn't with your printer, nor is it the program. The difficulty lies with a bug in the Level II Basic of your Model I. Due to a miscalculation, the ROM won't tab past column position 63 on your printer. Any tab greater than 63 is tabbed to 63. If the print head is already at or beyond 63, the tab is ignored. The Model III has this problem corrected, while most DOSes for the Model I intercept the printer-driver routine and make the necessary correction.

Your solution, since you don't have disk drives, is to calculate the difference between the last print position and the tab, and send that many spaces to the printer. Memory position 409BH (16539 decimal) should contain the current position of the print head.

I recently had a drive belt replaced on my RS Line Printer I by Radio Shack, and was shocked to be charged $110! (The belt cost $58.80, labor was $45, and tax came to $6.23.) The cost, I was told, is based on the price they had to pay to Centronics to get it!

I intend to protest this to higher authorities, as I understand that the repair groups operate independently of the Computer Center.

W.K.
Huntingdon Valley, PA

WOW! I called my local RS technician and asked about this. He verified your information. Radio Shack charges $58.80 for the belt because Centronics doesn't make the printer or the belt any more and because there's little call for the belt.

Stocking items that aren't used much costs money; i.e., you invest several thousand dollars buying belts for your printer at $25 each. Since you have to borrow money (and pay interest) to stock *all* the parts you need, the longer it takes to sell these parts, the more you lose. If you borrowed at 10 percent and it takes you 10 years to sell all the belts, the last belts sold end up costing you $50 (the original money spent plus the money spent on the interest each year). Since the Line Printer I hasn't been made for several years, the cost for replacement parts is beginning to climb as the cost of interest mounts up.

This isn't a defense of the price charged by Radio Shack, just an explanation of the reasons behind the high cost. The labor charge is probably close to accurate because the print-head

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mechanism has to be disassembled, reassembled, and aligned when the belt is replaced, a procedure that should take about one and a half hours. If you want to complain about the parts cost, address your correspondence to National Parts, 900 East Northside Drive, Fort Worth, TX 76102.

Thanks for the attention you gave to my questions (December 1982). One problem remains, though: the little ripple that travels up my screen. There are no light dimmers or neon lights in the house. I called one Radio Shack store and the owner seemed to be familiar with the problem and the solution which was some kind of keyboard modification. Unfortunately, he died before I could get it in for service.

Can you help me eliminate this problem? This problem only occurs one-half to two-thirds of the time.

H.L.
South Bend, IN

Rather cheeky of him to desert you in your hour of need, but I'll see what I can come up with. I find it hard to believe that you have absolutely no neon lights in your home, since they appear in everything from ovens (burner-on lights) and TVs (mine has one to indicate when my auto-fine tune is engaged), to night-lights and digital clocks. I have the same difficulty with my video ripple, sometimes it's there and sometimes it isn't. I've given up trying to figure it out.

If anyone has a solution, send it to me and I'll send it on to H.L., as well as inform the other readers of this column.

I have a Model I, Level II, with an LNW expansion interface and two disk drives. My system hasn't operated properly since connecting it to the interface.

When I first turn on the system, the logo comes up properly, but the memory available is only 15570. By experimenting I've found that turning the system on and off quickly will eventually get me the TRSDOS logo. After this, the computer operates correctly.

One last note: When I upgraded to Level II, I received the new ROMs that power up with MEM SIZE? instead of MEMORY SIZE.

Are the ROMs the source of my problem? Or the keyboard? Or the LNW expansion interface?

V.C.
Torrance, CA

The ROMs shouldn't be the source of your troubles. The first step in tracking down the culprit is to disconnect your disk drives from the LNW, and then turn on the computer. You should receive the correct memory size of 48368 in answer to the PRINTMEM command. If you still get 15570, then your keyboard and the LNW aren't talking together. (Have you tried formally introducing them?)

The next step requires the assistance of a friend who has a Model I computer with an expansion interface. Take your computer to your friend's house and try it on his interface. Then try your interface with his computer. If your computer works fine with his interface and his computer has the same problems yours does when connected to the LNW, then the problem is with the LNW interface. Call LNW Research at (714) 544-5744 and ask for the LNW expansion interface service technician. Explain your problem to him and if he doesn't have any suggestions for you to try, make arrangements to return the LNW unit for repair.

I own a 16K Color Computer and have several commercial machine-language programs and games on cassettes. The programs are recorded at different volume levels, with several copies on each tape. I usually spend 5 to 15 minutes trying to get a successful load.

I would like to record a copy of each program at the same volume level to avoid wasting so much time. I've tried CSAVE"PROGRAM" and CSAVEM "PROGRAM" without success. Help!

D.R.
Memphis, TN

The solution to your problem is a bit more complex than simply typing CSAVEM"PROGRAM". To save a machine-language program to tape you have to specify the starting and ending points of the program in memory, as well as the location at which the program starts execution. To determine this information, you need a machine-language monitor program such as The Micro Works Software Development System.

Another method, much simpler and easier, is to use Color Tape Copy (Computer Shack, 1691 Eason, Pontiac, MI 48054, (313) 673-2224, $15.95), or Copy Cat (DSL Computer Products, P.O. Box 1113, Dearborn, MI 48121, (313) 582-3406, $19.95). Simply load the program and follow its instructions to save a copy of your target program on a new tape.

I've discovered the problem with my Scripsit program crashing when I ask for a file not on the disk. I've fixed all my Scripsit disks so that they auto-run the Scripsit program when I press reset. This is apparently a no-no! The Auto command interferes with Scripsit in such a way as to cause it to crash if an attempt is made to load a nonexistent file.

I think Radio Shack should've known about this and notified their customer service representatives, and put it in their newsletter.

R.T.
Denver, NC

Strange!

My system consists of a Model I, The Patch (Hacks, P.O. Box 12963, Houston, TX 77017, (713) 455-3276), the Mapper One (Omikron Systems Inc., 1127 Hearst St., Berkeley, CA 94702, (415) 845-8013), and the Doubler Two by Percom. The Patch is a special lowercase hardware fix for the Model I, and the Mapper One lets me use both CP/M and TRSDOS on my Model I and also has its own keyboard debounce routine and lowercase driver.

The Patch works flawlessly while I'm in TRSDOS, but doesn't seem to work when I'm in CP/M mode. Omikron says that there's no way to disable the debounce routine of the Mapper One.

My questions are: Could these problems be due to a conflict between Mapper One and The Patch? Is there any way to disable the debounce routine in the CP/M mode? Do I have to remove The Patch to fix the problem?

J.H.P.
Richardson, TX

Yes, your problem is because of a conflict between the two hardware modifications. Because the Mapper One uses a PROM (programmable read-only memory), there's no way to

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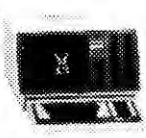

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selectively disable its debounce routine. You don't have to remove The Patch, just install a switch on the power lines to it that will let you turn it off when you don't want it activated.

The firmware debounce/lowercase driver routine in Mapper One does the job when you're in CP/M mode, and The Patch can be enabled when you're in TRSDOS. If you don't have the installation instructions for The Patch, send Hacks a letter asking how to install an on/off switch for their modification.

Thanks for the advanced copy of your answer to my question. (I send my responses directly to the people with the problems, instead of making them wait until their letter is published in the magazine—T.K.) *Considering the review of* The Custom TRS-80 *in the October* 80 Micro, *page 66, by Charles Edwards, which said the book was riddled with errors and mislabelings, I don't see how you can recommend it.*

I'd still like reliable information on how to perform the lowercase modification. I still have my 2101 RAM chip and mini SPST switch (or have your technical experts checked out Mr. Kitsz's procedure and found it to be correct?).

H.S.
Cincinnati, OH

I don't know if you noticed, but the October issue contained two reviews of Dennis Kitsz's book *The Custom TRS-80 and Other Mysteries.* The other review, by Fred Blechman, is on page 64. Blechman was able to locate Appendix VII and the parts list for the graphics board. Blechman mentioned that the first edition of the book contained problems with captioning and text references, which have been corrected with the printing of the second edition.

Edwards was also unable to find the details about replacing the Basic ROMs. I checked my copy of the book and found the information on page 152. Half the page is a schematic showing you how to connect PROMs to your system's expansion port to replace the ROMs you removed, and the other half is a discussion of the topic. In fact, Kitsz even shows how to fix the computer to turn on to a machine-language monitor instead of the memory-size prompt, letting you decide if you want a normal Basic start, or if you want to do something else with the monitor (such as machine language).

I asked Kitsz about the mistakes mentioned by Edwards. He said the only mistakes he knows of were jumbled captions and minor errors with several drawings, all of which have been fixed in the second printing. He suggested that perhaps Edwards was a victim of a "lost signature." The last signature of the book, about 16 pages, is the section containing the parts lists and printed-circuit-board schematics. It sometimes happens that a signature isn't bound into an individual book when it's printed. This can happen to any book and to blame an entire print run for an error in one book out of thousands is unfair.

I stand by my recommendation that you use the lowercase modification detailed in *The Custom TRS-80.*

This is my second letter to 80 Micro. *The September 1982 issue contains an advertisement, featuring an* 80 Micro *issue with a robot on the cover, for subscriptions to* 80 Micro. *I want to get it, but my first letter was never answered.*

If it's available, can you send it to me COD, and if it isn't can you suggest how I can see or get one.

R.B.
Des Plaines, IL

You don't say where you sent your first letter, but I suppose you sent it to the Farmingdale address shown on the page with the advertisement. That address is good only for subscribing to *80 Micro*, and is actually the address of a large fulfillment service used by dozens of magazines. They don't have the wherewithal to handle anything other than questions relating to subscriptions. If you want a back issue, address your request to *80 Micro* Back Issues, Attn. Pauline Johnstone, 80 Pine Street, Peterborough, NH 03458. Issues dated July 1980 and after are $3.50 each; issues dated February 1980 to June 1980 are $3; and January 1980 is $5. Not all issues are still in stock.

Unfortunately, the issue you requested, September 1981, is sold out. If you want one, I suggest you check your local library, computer club, and computer store. If that fails, put a classified advertisement in a computer publication asking for a copy of that issue. If anyone has an extra copy of that issue, contact me and I'll send your name to R.B.

I often have problems booting up my Model I 32K, two-disk system when I turn it on. If I press the reset button while holding the break key, I frequently get 15572 in response to PRINT MEM instead of 31956. It takes several tries to get the proper response. Using the disk drives is just as difficult, with a screenful of garbage and a locked-up system. When I finally get into Disk Basic and begin writing and running programs, the frustration mounts; after typing in 999 steps of a 1,000-step program, the system resets or locks up.

TRSDOS TEST1A gives differing results each time it runs, sometimes saying "Bad RAM in expansion interface," amd other times, "Test complete, no errors." I also have trouble loading Basic programs from disk, sometimes getting them hopelessly jumbled and sometimes only having one character wrong.

I suspect the problem lies with the cable connecting the CPU and the EI. The connector appears scored from numerous cable removals and replacements. What do you think?

R.Z.
Henrietta, NY

BINGO! You picked the only reasonable source of your problem given your system's errors. Anytime you have difficulty with PRINT MEM stopping at 15572, and Basic programs that lose their top half, you can suspect the CPU-to-EI cable. Often you can use isopropyl alcohol and Q-Tips to clean dirt and oxide from the contacts, and substantially improve your system's performance, but that's only a temporary solution.

There are several possible permanent solutions: Silver-plate the connectors; gold-plate the connectors; or replace the tin/lead edge connectors with gold-plug edge connectors. Silver-It (Fuller Products, Grand Prairie, TX) is a solution that coats the edge connectors of the CPU and EI with a corrosion-resistant layer of silver that never needs cleaning. Gold-plating is a more difficult, and poisonous, process that leaves your connectors corrosion-proof. For details refer to "A Gold-Plated 80" by G. W. Martin in the December 1981 issue of *80 Micro.*

The last solution is the one I prefer—replacing the connectors with Gold-Plug 80s (EAP Company, Box 14, Keller, TX 76248, 817-498-4242. $18.95 for the CPU-EI set). The new plugs fit over

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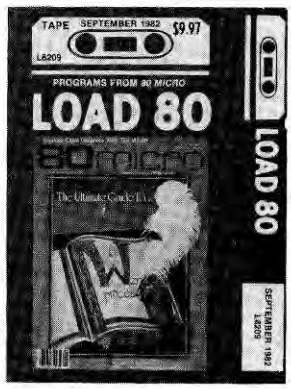

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the old connectors and you solder them in position, making sure you don't create any solder bridges between the CPU circuit board traces. The new plugs stick out from the CPU and EI cases by about half an inch, which is a small price to pay for system reliability. (Since installing mine eight months ago, I haven't had any CPU-EI cable problems at all.)

I bought my computer shortly after they came out, and have added every fix and upgrade Radio Shack has put out. My system has grown from 4K Level I to 32K Level II with three disk drives, a cassette recorder, Centronics 703 printer, and a line filter.

I'm having, and have had, the following problems: serious keybounce, three burnt-out power supplies, an entire 16K block of RAM fried, reboots at random intervals, keyboard lockout requiring system reset to recover, and reset button not working all the time.

The system was just returned from the shop and now has these problems: TEST1/CMD alternately passes and fails large sections of RAM, editing line 200 causes lines 845–885 to list after line 10000, and the program is no longer sequentially numbered; 10 disks crashed.

I've had the following experiences with Radio Shack service and technicians: The system has been in the shop 27 times (one to two weeks each time, total time about eight months); my Percom data separator was removed (blamed for the problems), then later a technician suggested that I install one to help solve my problems; a buffered cable was installed at their suggestion, but it caused even more problems, so I removed it and went back to the previous cable.

What can I do?

R.F.
Little Rock, AR

You must have the patience of Job to have put up with so many problems for such a length of time without shooting either the computer or the repair technician. First, see the previous letter of this column for Gold-Plug 80 connectors (a full set of six plugs, one for each port, costs $54.95). You might want to get Gold-Plug 80s for your disk drives if they also have tin/lead connectors instead of copper. These will help eliminate the spurious reboots, system lock ups, and program disintegration your system suffers through (the last three of your old complaints, and all your new ones).

If keybounce is a serious problem, consider getting either a disk operating system (DOS) with a better key-debounce routine (such as MULTIDOS, DOSPLUS, LDOS, or others), or getting the ALPS bounceless keyboard from Radio Shack. It costs $105 ($75 for the keyboard, $30 for installation) without the numeric pad, or $120 with it.

Your problems with power supplies and burnt RAM chips are probably related to your buffered cable. The original design of the Expansion Interface contained a few layout flaws (such as putting the RAM beside the power supplies where heat and interference are big problems). The buffered cable was developed by Radio Shack to control these problems. When the buffered cable is added to one of these older Expansion Interfaces (the newer, redesigned EIs don't need the buffered cable), six cuts are made to the Expansion Interface circuit board.

Three pairs of twisted wires are then wired from the CAS, RAS, and MUX lines, directly to the edge-card connector. These cuts bypass the circuit traces normally used by these IC lines, removing several possible sources of data corruption. If you should go back to your previous unbuffered cable, you'll put a power short across your Expansion Interface power supply, which will eventually burn it out. If the buffer modification isn't correctly performed, you'll probably still end up with a shorted power supply (and possibly other things too, such as RAM).

For computers that still had a data interference problem, even with the buffered cable, the MUX modification was added. This modification removed the three wire pairs (CAS, RAS, MUX) from the buffered cable entirely, using a second cable (which looks very similar to a cassette cable) to directly connect these lines to the CPU. Once this modification has been made, you can't use an unbuffered cable on the system. The system just won't work. If it does, the MUX modification was improperly installed.

My Model I is a 48K three-disk system with the MUX modification and buffered cable. I also have Percom's data separator and EAP Gold Plug 80s on the edge connectors. Other modifications include the Electric Pencil lowercase modification, switch-selectable Level II or Level I (but no Expansion Interface or drives when in Level I mode), an AM radio (amplifier only) wired to the cassette port for sound generation (driven by the computer's 5-volt line), and the Holmes Engineering Sprinter II (which lets me operate at 5.5 MHz instead of only 1.7 MHz).

In spite of these modifications, my system hardly ever causes problems, except when I try to add more modifications and accidentally break things, like the keyboard-to-CPU cable, power transistors, diodes...

I was wondering if programs that normally run under TRSDOS will work on LDOS, NEWDOS80, and DOSPLUS.

T.R.
Carlisle, MA

As a general rule of thumb, almost any Basic program that runs under TRSDOS will run under any of the other DOSes (LDOS, DOSPLUS, ULTRADOS, MULTIDOS, VTOS, NEWDOS, NEWDOS80 V.1, NEWDOS 80 V.2, and DBLDOS, Model I or Model III). Not all of these DOSes can read each others' disks, but if it's a Basic program you can CSAVE it to tape and then CLOAD it into the DOS Basic you want to use. (Be sure the program doesn't contain any special Basic commands that might not be available in the foreign DOS; e.g., TIME$ is a Model III, Level II Basic command that doesn't exist in Model I Level II Basic. Most Basic TRSDOS commands are duplicated in the foreign DOSes).

The only difficulties you'll have will be with Basic programs that use machine-language subroutines. Depending on what the machine-language routine does and where in memory it sits, you might not be able to get the program to work. Whether you can use a Basic and machine-language program with any given DOS can't be predicted; you can only try it and see.

Machine-language programs are another story. Most machine-language programs that operate under TRSDOS will also operate in the foreign DOSes, but will require patches to work right. The manufacturers of the DOSes usually supply patches for the more popular programs so that you can use them without problems.

A Florida storm put a power surge through our Model III and blew out our RS-232 board. We replaced it with a new board, but after a few days the computer malfunctioned again. A trip to the repair center revealed that the board had died. It was replaced. A few days after we brought the unit home it malfunctioned again. This time a ROM chip was replaced. Twice more the computer malfunctioned. Finally someone told us that a power surge weakens resistors, so that when a new board is put in, it places an overload on the system and blows boards. We finally bought a new computer and left the first in the repair center to be thoroughly checked out.

Have you ever heard of this happening before, and do you think we'll have problems when we get it back?

P. Y.
Seminole, FL

Power surges come in many sizes. The smaller ones aren't noticed most of the time, and, as you discovered, it's the big ones that cause the havoc. A power surge drives more power into the computer than it's capable of handling. Like a chain that is subjected to more pull than it was designed to take, the weakest component breaks first. Unfortunately, all the components are overstrained, but they don't have time to self-destruct because the component weaker than they blew out first. This means it's merely a matter of time before these weakened components (ICs, resistors, transistors) begin blowing out.

In this situation the best thing to do is to buy a new computer, as you did. If the service technician does his job right, you shouldn't experience any problems with the repaired equipment, but to be certain, buy a memory test program and let it run nonstop in the computer for an entire week. If anything is going to go wrong, it should go in that week. This doesn't mean that you won't have problems, but it does give you a chance to flush out any marginal components that the technician may have missed.

To prevent this from happening again, buy a power-line protector for your computer. Then, if a power surge comes along, the computer will be safe from harm.

Superscript can now be used normally with only minor glitches: The print codes will not operate as indicated in the manual, but this doesn't matter since they can be entered as user print codes; and the program doesn't feed the paper or forms correctly. For some reason Superscripsit adds six lines per page. The solution is simple: Lie to the computer! When the "Print Text Options" are requested, tell the computer that there are six lines less than there really are. In other words, if your paper is 66 lines in length, tell Superscripsit that it's only 60 lines long. There are other problems, but none render the program unusable.

All tabs, line spacing, searches, edit print, user keys, and so on work normally, and all Epson features work and can be mixed on one line.

G.O.
Phoenix, AZ

Thanks for the progress report.

What, in your opinion, is the best chess game available for a TRS-80 Model III 16K with two disks?

O.C.
Charlotte, NC

The SFINKS 3.0 program is the best I know of, with Mychess a close second (its graphics aren't as well done as SFINKS 3.0), followed by Sargon II. SFINKS 3.0 retails for $39.95 (disk or tape) and is available from William Fink (Suite 24B, 1105 N. Main Street, Gainesville, FL 32601, (904) 377-4847). Mychess was sold by the now-defunct Programma International. Sargon II is published by Hayden Software for $34.95, but Computer House (P.O. Box 538, Mammoth Lakes, CA 93546, (714) 934-6538) sells it for $27.95. ■

Terry Kepner is a freelance writer and programmer, and the vice-president of Interpro. He's been writing about microcomputers since 1979.

Update

In the December 1982 issue I mentioned two programs for determining the rotational speed of your disk drives. Well, there's a third one available. It's called RPM and is sold by Prosoft (Box 560, North Hollywood, CA 91603, (213) 764-3131, $24.95).

RPM and DDT (DiscoTech) are Basic programs, while Floppy Doctor (The Micro Clinic) is a machine-language program. RPM and DDT use graphic displays to show you the variations in speed of your drive; Floppy Doctor doesn't. But Floppy Doctor performs six other disk-drive diagnostics that the other two don't.

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↙See List of Advertisers on Page 403

RELOAD 80

by Art Huston

Loading your tapes, part II

Last month we discussed the single most important factor in loading cassettes—the cassette recorder's alignment. Here at *80 Micro*, we must custom-align our recorder to load 75 percent of the tapes we receive from authors.

If your recorder has a pitch adjustment, make sure it is set to high.

Load 80 tapes are designed to load at a volume of 5½, but this varies. To load a difficult tape, start at the low end of the volume scale and work your way up. Write down the correct volume when you've found it.

Different Systems

As the Radio Shack line grows, it becomes harder to remember which command loads what. Here's a quick guideline.

Load 80 Model I and III tapes are recorded at 500 baud, the standard for the Model I. Model III users must respond "L" to the CASS? prompt at power-up or POKE 16913,0 from the Basic Ready prompt. These tapes will not load into the Color Computer. Conversely, Color Load 80 tapes will not load into the Model I or III.

Model I disk users must type CMD"T" when loading tapes under Disk Basic. This disables the real-time clock, which would otherwise interfere with the loading routine.

Finally, before loading a file, check the Load 80 documentation to see if the program is in Basic or Assembly language. Basic programs load with the command CLOAD or CLOAD"file name". Assembly-language files require an editor/assembler (available from advertisers in this magazine or from Radio Shack). If you buy a disk-based editor/assembler, be sure it will load cassette source code.

Garbled Listings

On the Model I, always list a Basic program immediately after loading it. Files can seem to load correctly but have undefined-line or syntax errors. If so, align your recorder and try a different volume setting.

Sometimes a program will become garbled after a run. This can happen on the Model I or III if you're using a Level II program in a machine running Disk Basic.

A Hardware Trouble-Spot

The cassette-jack wires can pull apart after heavy use. Radio Shack sells these jacks for the Model I, III, or Color Computer ($5.95, part 26-1207).

Problems on Our End

Fewer than 1 percent of our Load 80 tapes are returned as defective. If you have any questions about your tape copy, write to Art Huston, *80 Micro*, 80 Pine St., Peterborough, NH 03458, or call 603-924-9471, ext. 251. To return or exchange your tape, write to Lori Eaton at the same address, or call 603-924-9471, ext. 309. ■

Program	Title	Page	Comments
1	COPYRGHT/BAS	—	None
2	PASSCARD/SRC	74	Needs EDTASM
3	TIMEDLAY/SRC	74	Needs EDTASM
4	CPMBOOT/SRC	112	Needs EDTASM
5	AIDS3/BAS	134	None
6	PRINTAT/BAS	164	None
7	LISP/BAS	176	None
8	DLOAD/SRC	190	Needs EDTASM
9	TIMEWARP/BAS	218	None
10	SEEKER/BAS	272	None
11	COMPAC/SRC	280	Needs EDTASM

March Load 80 Directory

Month	Page	Article	Program	Type
Jan.	126	Mailing List Compiler	MAILLIST/BAS	Application
	192	Dogfight	DOGFIGHT/BAS	Game
	227	Denominational Computation	CHURCH/BAS	Application
	252	CC Monitor	MINIMON/BAS	Utility
	292	Repairing a Disk Crash	QUIKBACK/DR2	Utility
	292	Repairing a Disk Crash	QUIKBACK/DR1	Utility
	298	Discipline for the DIR Cmd	DIRUTIL/BAS	Utility
	348	When OK Isn't	NOTOKAY/BAS	Utility
Feb.	166	States and Capitals	STATES/K32	Education
	166	States and Capitals	STATES/K16	Education
	104	Music Composer	COMPOSE/BAS	Application
	124	The Lair of Kraken	KRAKEN/BAS	Game
	132	Byte Cycles	CYCLES/BAS	Game
	224	Cassette Index	CASSINDX/BAS	Utility
	256	Convergem	CONVERGE/BAS	Utility
	282	Drop your Color Computer into Disk Drive	COLORZAP/BAS	Utility
	282	Drop your Color Computer into Disk Drive	COLORMNU/BAS	Utility
	282	Drop your Color Computer into Disk Drive	PAGER/BAS	Utility
	282	Drop your Color Computer into Disk Drive	ZERORAM/BAS	Utility
	282	Drop your Color Computer into Disk Drive	VIDPTCH/BAS	Patch
	314	Color Life	COLRLIFE/BAS	Education
	332	Color Computer Merge	MERGE/BAS	Utility
March	150	Testing Your New RAM	MEMTEST/K32	Utility
	328	Scholastic Bowl	GAMESHOW/BAS	Application
	328	Scholastic Bowl	GAMESHOW/EXT	Application

Color Load 80 Directory

CALENDAR

March

1-3 IEEE Computer Society, Silver Spring, MD. **COMPCON Spring '83** San Francisco, CA.

8 IEEE Computer Society, Silver Spring, MD. **MICRODELCON** Newark, DE.

8-9 Hewlett-Packard, Palo Alto, CA. **Productivity '83** Phoenix Civic Plaza, Phoenix, AZ.

8-9 **ACM SIGCOMM '83** University of Texas, Austin, TX.

10-12 The Council for Exceptional Children, Reston, VA. **Use of Microcomputers in Special Education** Hartford, CT.

14-15 Michigan Association for Computer Users in Learning, Wayne, MI. **MACUL '83** Dearborn, MI.

16-17 Hewlett-Packard, Palo Alto, CA. **Productivity '83** Greenway Plaza Hotel, Houston, TX.

16-18 IEEE Computer Society, Silver Spring, MD. **16th Annual Simulation Symposium** Tampa, FL.

17-19 Arizona State University, Tempe, AZ. **Microcomputers in Education** ASU campus.

17-19 Kengore Corp., Franklin Park, NJ. **New Jersey Business Computer Show** Holiday Inn (North), NJ Turnpike Exit 14.

18-19 Pacific Northwest Associates for Computers in Education/Seattle Pacific University, Seattle, WA. **Sixth Annual Computers in Education Conference** SPU campus.

18-20 **West Coast Computer Faire** Brooks Hall, San Francisco, CA Civic Auditorium.

24-27 The Interface Group, Framingham, MA. **Computer Showcase Expo** Atlanta, GA.

25-26 **1983 Small College Computing Symposium** St. Olaf College, Northfield, MN.

27 **Greater Baltimore Hamboree and Computerfest** State Fairgrounds Exhibition Complex, Timonium, MD.

28-30 **Florida Instructional Computing Conference** Hyatt Regency Hotel, Tampa, FL.

29-30 Hewlett-Packard, Palo Alto, CA. **Productivity '83** World Congress Center, Atlanta, GA.

29-31 IEEE Computer Society, Silver Spring, MD. **Workshop on Computer System Organization** New Orleans, LA.

April

4-8 IEEE Computer Society, Silver Spring, MD. **Tutorial Week East '83** Orlando, FL.

4-8 National Computer Graphics Association, Washington, DC. **Computers/Graphics in the Building Process '83** Convention Center, Washington, DC.

6-7 Hewlett-Packard, Palo Alto, CA. **Productivity '83** Adam's Mark, Philadelphia, PA.

6-8 IEEE Computer Society, Silver Spring, MD. **1983 International Optical Computing Conference** Cambridge, MA.

10-13 Association for Computing Machinery (ACM)/SIGAPL, Washington, DC. **APL83** Sheraton Washington Hotel.

17-22 **Infocom '83** Town & Country, San Diego, CA.

18-20 American Production and Inventory Control Society, Falls Church, VA. **APICS Spring Seminar** Hilton Riviera Hotel, Palm Springs, CA.

19-21 Hewlett-Packard, Palo Alto, CA. **Productivity '83** Michigan Inn, Detroit, MI.

21-23 The Interface Group, Framingham, MA **Computer Showcase Expo** St. Louis, MO.

25-27 IEEE Computer Society, Silver Spring, MD. **1983 Symposium on Security and Privacy** Claremont Hotel, Oakland/Berkeley, CA.

26-29 **Comdex/Spring '83** World Congress Center, Atlanta, GA.

May

3-5 Hewlett-Packard, Palo Alto, CA. **Productivity '83** Sheraton O'Hare, Chicago, IL.

10-12 **Northcon/83** and **Mini/Micro-NorthWest/83** Portland, OR.

16-19 American Federation of Information Processing Societies, Arlington, VA. **1983 National Computer Conference** Anaheim and Disneyland Hotel Convention Centers, Anaheim, CA.

18-19 Hewlett-Packard, Palo Alto, CA. **Productivity '83** Breckenridge Concourse Hotel, St. Louis, MO.

23-26 **ATE East Conference** Hynes Auditorium and Sheraton-Boston Hotel, Boston, MA.

24-25 Hewlett-Packard, Palo Alto, CA. **Productivity '83** Radisson South Hotel, Minneapolis, MN.

Coming Next Month

In April, we'll have a special treat. *80 Micro's* technical editors, G. Michael Vose and Art Huston, will review three hard disk drive systems: BT Enterprises' 4×5, Computech's Model 326, and MTI's Model III Plus. All three are modified Model IIIs. Vose and Huston will compare the three machines and discuss their cost-effectiveness. It's a review you won't want to miss.

The issue will also focus on sports. We'll have a soccer game for the Color Computer, a bowling league statistics program, and a golf scorecard program, among others.

Beginning in April, we'll have a new feature—monthly buyer's guides. Each month we'll look at a different area of microcomputing. The first buyer's guide covers language software, ranging from Basic enhancements to advanced and obscure dialects.

Our Lisp interpreter series continues, and we'll have the last installment of Margaret Grothman's APL series. Also, look for a program that discusses graphics on the Line Printer VII.

Color Computerists no longer have to alternate the plugs for their modem and printer, since we'll have a black box into which two RS-232 devices can be plugged. And, Model II owners can learn to use Profile as an analytical tool. ■

MODEL III HARD DRIVE

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Model III Drive Kits

We refuse to sell a low quality kit,because you don't need any problems. All of the Compukit drive kits contain Tandon disk drives, Astec switching power supply, factory brackets, 32K of memory, a drive controller that works with all Model III disk operating systems, a manual that is easy and simple to use, and all the hardware required. All that you supply is 2 screw drivers, 2 hours average time, and software. The Compukit drive kit will also allow upgrades of hard drives, 8" drives, and will read single, double, or quad density. Support? We have full time techs available for your questions.

No Drive Drive Drive Kit $279.
Drive Kit With one 40trk Single Sided Drive $479.
Drive Kit With two 40trk Single Sided Drives $699.
Drive Kit With two 40trk Double Sided Drives $899.

FREE OFFER
we will install your Compukit drive kit in your Model III FREE exclusive of shipping charges

COMPLETE MODEL III SYSTEMS

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system options RS232C $69. green phosphor CRT $89.

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MODEL III RS232C KIT $69.95

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System diagnostic for disk based Model III's
This fast menu driven program checks ROM, RAM, keyboard, and disk drives. Worth twice the price .

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See List of Advertisers on Page 403

NEW PRODUCTS

edited by Eric Grevstad

Microcom PCS

Professional Communications System

Microcom's PCS (Professional Communications System) includes a Bell 103- or 212A-compatible modem and up to 64K RAM of message buffer, providing unattended, scheduled message reception and transmission even while your computer is off or being used for other applications. It is designed primarily for use by businesses or by individuals who want access to centralized data bases or public-information utilities.

With a single ASCII command, the unit can be readied to retrieve a stored number, access a file from the message buffer, establish a connection with a remote site at a predetermined time, and send the message. Users can queue messages for transmission during hours when phone rates are lowest.

Incoming messages can be directed to memory or directly to an attached printer. The message buffer is allocated dynamically between messages waiting to be sent and those already received; all or part of the memory can be configured as a printer buffer. A second RS-232 serial port allows the computer to handle both the modem and a third device, such as a printer, for simultaneous printing and display of received information.

The PCS/300 costs $595 (16K RAM) or $695 (64K RAM); the PCS/1200 sells for $995 (16K) or $1,095 (64K). Either model is available from Microcom Inc., 1400A Providence Highway, Norwood, MA 02062, 617-762-9310.

Reader Service ✓577

CoCo-Cooler

Color Computer owners who've noticed the micro's case growing uncomfortably hot after long use will be interested in the CoCo-Cooler, a specially designed fan that adheres to the side of the unit. The Cooler has its own rubber support feet, putting no stress on the computer housing; its fan holds computer temperature rise in worst-case situations to no more than 15 degrees.

Its price is $39.95 from Rem Industries Inc., 9420 "B" Lurline Ave., Chatsworth, CA 91311, 213-341-3719.

Reader Service ✓554

Executive Calculator

The Executive Calculator, a multi-program software package, gives the Model III owner over 150 common business utilities on a single disk for $29.95.

The main menu has 12 major sections, such as graphs and charts, personal loans, real-estate analysis, financial decision making, and so on. Each topic has multiple submenu selections. The programs almost fill a double-density disk, but leave enough room for most operating systems.

Sound and graphics enhance the programs' usability; an index lists the complete set. Examples of each subroutine are supplied in the user's guide.

The package is available from MCS Software, 809 Parkway, Conway, AR 72032, 501-327-4443.

Reader Service ✓575

Checkbook Secretary

Checkit is an easy-to-use checkbook record keeper and statement-verification system designed to maintain error-free personal checking accounts with minimal effort. It can support several checkbooks used simultaneously, as in a family where the parents and one or more children have checkbooks drawing on a common account.

All input is clearly prompted and mistakes easily corrected. If a major error is made during statement verification, the whole job can be canceled without losing any checks or deposits on file. Bad data entries are spotted and rejected, and options are provided for skipping entry or canceling processing.

The program requires a disk operating system; if you have only one disk drive, order Checkit on cassette ($20) to transfer to your TRSDOS disk. It is available on a disk without DOS for $20, or on a TRSDOS disk for $35.

For more information, contact Bluebird's Computer Software, 2267 23rd St., Wyandotte, MI 48192, 313-285-4455.

Reader Service ✓573

Olivetti Interface

The OP-140S interface kit lets you use an Olivetti Praxis electronic portable typewriter as a letter-quality printer connected to the RS-232 serial port. The interface is mounted inside the typewriter and does not affect normal operation; under computer control, it gives a printing speed of 10–12 characters per second.

The $195 kit includes a step-by-step instruction manual, plus application notes with connection points, configuration notes, and operating tips for many popular microcomputers. (A similar kit, the OP-150P, is compatible with Centronics parallel ports.)

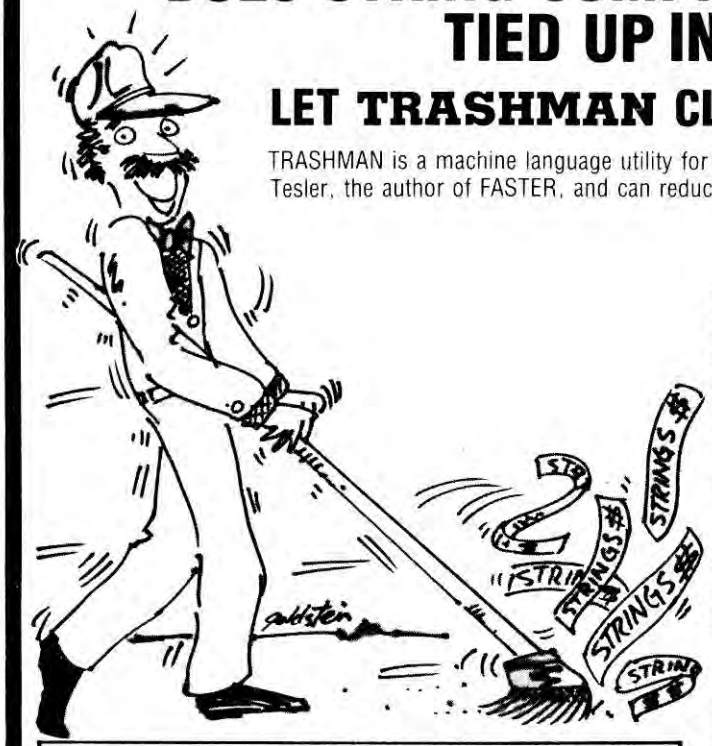
For those who prefer to leave hardware work to others, the Micro-Typer 30

Olivetti Praxis and OP-140S

DOES STRING COMPRESSION HAVE YOU TIED UP IN KNOTS?

LET TRASHMAN CLEAN UP THE MESS!

TRASHMAN is a machine language utility for the TRS-80 Models I and III. It was written by Glenn Tesler, the author of FASTER, and can reduce BASIC's string compression time by 95% (see table below).



# STRINGS	SECONDS DELAY NORMAL	TRASHMAN	PERCENT IMPROVEMENT
250	11.8	0.7	94
500	45.8	1.6	96.5
1000	179.6	3.5	98
2000	713.2	7.8	98.9

WHAT'S STRING COMPRESSION?

When a BASIC program changes a string (words, names, descriptions), it moves it to a new place in memory, and leaves a hole in the old place. Eventually, all available memory gets used up and BASIC has to push the strings together to free up some space. This takes time. Lots of time. The computer stops running for seconds or minutes, and you may even think it's "crashed". The keyboard won't work, and until all the strings have been collected, you just have to sit and wait. Then things run for a while, until string compression is needed again. And again.

If you're using your computer for business, that wastes your money. If you're using it personally, it wastes your time.

WHAT'S THE SOLUTION?

As soon as you start using TRASHMAN, those delays almost disappear. It uses less than 600 bytes of memory, plus 2 bytes for each active string. It works with other machine language programs and with all major operating systems. It's easy to use, comes with complete instructions, and can be copied to your own disks.

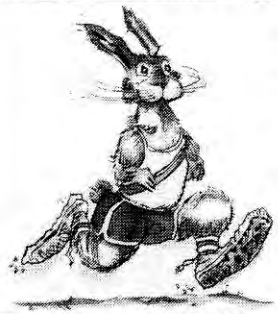
WHAT'S THE CATCH?

If a BASIC program uses only a few strings, very little time is wasted in string compression, and TRASHMAN won't be helpful. But, if hundreds of strings, including large string arrays, are used, TRASHMAN is just what you need.

TRASHMAN is available on disk for just **$39.95.**

(All timings done on TRS-80 Model I. Model III 15% faster, but pct. improvements identical. Listing of timing program available on request.)

SAVE TIME WITH FASTER



"FASTER" speeds up most TRS-80 BASIC programs by 20-50%. It's helped hundreds of satisfied people and it can help you. Detailed instructions make it easy to use. FASTER analyses your BASIC programs *while they run*, then displays a simple change, usually one line, that sequences program variables so the ROM will find them faster.

You can use FASTER to speed up programs you've bought, as well as programs of your own. Since it isn't a compiler, your BASIC programs can be read and changed afterwards. FASTER works on business programs, models, and games. The more complex your program, the better the results.

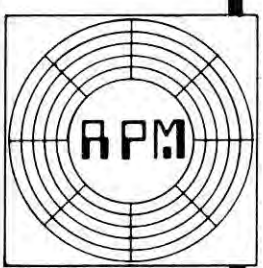
Does FASTER really work? Yes! Just check the reviews in *Personal Computing*, May, 1981, p. 116: **"FASTER is effective and easy to use"**; *80 U.S. Journal*, April, 1982, p. 106: **"I recommend FASTER to everyone"**; and *80 MICRO* (April, 1982, p. 40): **"If you...would like a significant increase in the run-time speed, then buy FASTER."**

FASTER runs on the TRS-80 Models I and III, 16-48K tape or disk, and all major operating systems. **$29.95**

"QUICK COMPRESS" takes only 276 bytes of memory, and removes the blanks and remarks from even the largest BASIC program in less than 3 seconds. It produces smaller, faster programs without altering their logic. **$19.95**

SPECIAL: FASTER and QUICK COMPRESS: **$39.95**

ERRATIC DISK DRIVES?



You can avoid unnecessary disk errors and repair bills by using **RPM.** This easy-to-use program measures the rotational speed and fluctuations of your disk drives, and warns you if they are running **too fast, too slow, or unevenly.**

Incorrect or erratic speed is a common cause of unexplained disk errors and loss of data. RPM's documentation explains how to **detect** *and* **correct** these problems quickly and easily. As *80 MICRO* (April, 1982, page 41) said: **"If your drives have problems I recommend RPM before paying to get it repaired."**

RPM is supplied on diskette for the TRS-80 Models I and III. We suggest you order a copy *before* you need it.

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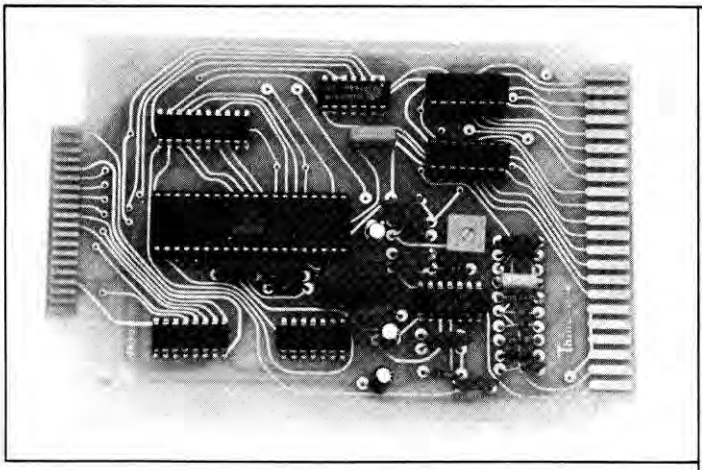

CCAD Analog Interface

($695) is an Olivetti Praxis 30 with the serial or parallel interface installed, and the Micro-Typer 35 ($795) is an interface-equipped Praxis 35.

The kits and typewriter/printers are sold by Selectone Corp., Computer Products Division, 28301 Industrial Blvd., Hayward, CA 94545, 800-227-0376.

Reader Service ✓567

Analog Converter for Color Computer

The CCAD Analog Interface is a data-acquisition system based on a 16-channel analog-to-digital converter for the Color Computer. The converter board features bipolar 12-bit resolution and three digital output lines, and plugs directly into the user port. Its dual-slope integration technique provides excellent noise rejection characteristics, and automatically zeroes itself before each analysis.

A cassette software package is included; the main data-acquisition program is interrupt-driven, so you can use the computer for other tasks while data is being collected. The program includes a real-time clock that can be adjusted to within 0.1 second per month, as well as printer formatting, different printout modes, and analysis time and channel selection.

The CCAD board, cassette, and instructions sell for $169.50 from Technical Hardware Inc., P.O. Box 3609, Fullerton, CA 92634, 714-870-1882.

Reader Service ✓558

Premium-Quality Disks

Verbatim Corporation (323 Soquel Way, Sunnyvale, CA 94086, 408-245-4400) has introduced its Optima Series, a new line of high-performance flexible disks with an average life expectancy of 70 million revolutions and a warranty of 17 years.

Each Optima disk is tested at 150 percent above ANSI, ECMA, and ISO standards before shipment, including tests of track location and searches between tracks to ensure error-free performance. The disks' coating-lamination procedure gives durability 20 times the industry standard; an advanced burnishing technique provides a 20 percent smoother surface and 30 percent more lubricant than other high-quality disks.

Packaging is also premium: Stronger jacket materials give more protection and resist thermal distortion up to 160 degrees Fahrenheit, and 10 disks are supplied in a plastic storage/filing box with an interlocking design to create dust-free disk libraries.

The Optima Series includes 8-inch single- and double-sided disks in single or double density, and 5¼-inch disks in single- and double-sided double density with 40, 70, or 80 tracks per side. Price depends on configuration and number purchased; the price structure is 45 percent higher than that of Verbatim's Datalife brand.

Reader Service ✓566

Better VisiCalc Reports

VisiCalc users can enhance their report-printing capabilities with VisiBridge/RPT, a new software enhancement for the Models I/III and II/16.

VisiBridge provides for variable-width columns, column suppression, and decimal-point alignment. Paper size is variable at your option; reports too wide or too long for a single sheet are automatically segmented over multiple pages with automatic repetition of identifying rows and columns.

It allows optional printing of report titles, page numbers, date, and time of each report, and can create print files on disk for transmission or later printing.

The program costs $79 on either 5¼- or 8-inch disk (it runs in 8-bit mode on the Model 16). It is available from Solutions Inc., Box 989, Montpelier, VT 05602, 802-229-0368.

Reader Service ✓559

Model II Hard-Disk Storage

Graymatter, a hard-disk mass-storage system for the Model II, allows users to get the full benefit of Pickles & Trout's version of CP/M. The system gives faster access, an enlarged data base, and complete file-to-file analysis and reporting. It can be installed in under an hour.

Three expandable versions are available: 5-megabyte ($1,895), 10-megabyte ($2,495), and 20-megabyte ($3,695). For more information, write IQ Systems, 2931 La Jolla St., Anaheim, CA 92806.

Reader Service ✓550

Verbatim Optima Disks

TRS-80* APTITUDE TEST STUDY GUIDE

Reading and Comprehension Sample Question

READ the short piece below and ANSWER the question that follows.

WHY I SUBSCRIBE TO 80 MICRO

Before I read my first issue of 80 MICRO I thought, "What's all the fuss about? It's just another microcomputing magazine, isn't it?" Sure I knew that 80 MICRO had published an awful lot of pages of TRS-80 information (10,000 in its first three years), but I had assumed most of it was filler, just like those other computer magazines.

Boy, was I wrong! One day, while at a friend's house, I happened to see a copy of 80 MICRO lying on his coffee table, I picked it up and began to read. I immediately realized that 80 MICRO was no ordinary micro magazine. That one issue provided me with more useful information on my TRS-80 than any other single source I had ever read. It was just packed with features like honest reviews of hardware and software, dozens of programs for business or pleasure, and page after page of money-saving ads. (I saved hundreds of dollars on computer-related purchases in the first year of my subscription ALONE.) I went out and bought my own copy of the magazine that very day. And I've been a regular subscriber ever since.

QUESTION 1: Why does this TRS-80 user subscribe to 80 MICRO? (More than one answer may be correct. Circle the answer which is *most* correct.)

a) 80 MICRO provides him with more useful information than any other single source—over 10,000 pages in the first three years.

b) He finds dozens of practical and enjoyable programs in each and every issue of 80 MICRO.

c) 80 MICRO's hardware and software reviews give him the truth, the whole truth, and nothing but the truth.

d) The ads in 80 MICRO save him literally hundreds of dollars on computer-related purchases every year.

e) All of the above.

The correct answer is: e) All of the above.

You may now ***PROCEED*** *to the questions on the order form. Remember to darken the squares completely. When you have answered all the questions. . . STOP! Do not turn the page. Do not go back to any previous section. Lay your pencil on the table, cut out the coupon, and send it in. If you are not sure of the answers, you may call toll free*

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Does every one have a pencil?. . .
Are there any questions about this section?. . .
Ready?. . .
Begin.

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YES! The correct answer is:

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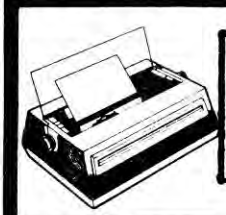

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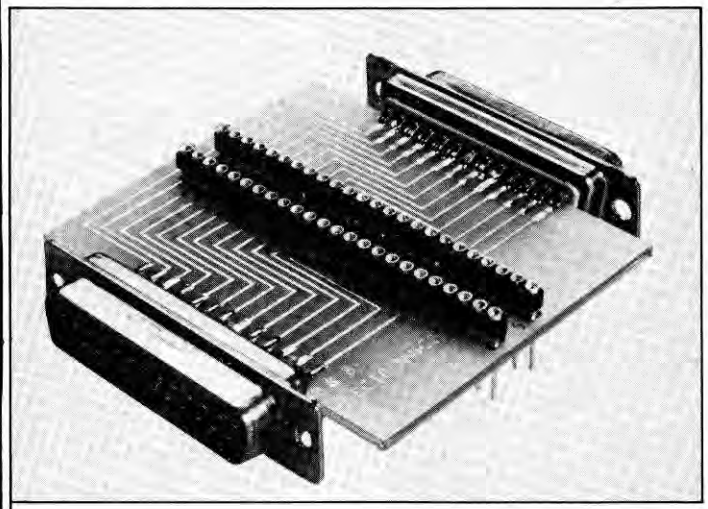
TELEPHONE ORDER LINE (313) 525-3040

NEW PRODUCTS



Wiring Adapter

Wiring Adapter

A versatile wiring adapter that connects any two RS-232 devices in any pattern is now offered by B & B Electronics, Box 475, Mendota, IL 61342, 815-539-5827. The $24.95 unit includes 10 plug-in jumper wires, and can be installed temporarily or permanently.

Reader Service ✓557

A Printer for All Computers

The Qume Sprint 11/40 Plus is a 40-cps daisy-wheel printer that connects to virtually any computer by means of an interchangeable plug-in communications module. Since modules are available separately, a business or owner with more than one type of computer can use the 11/40 Plus with any standard word-processing software on all machines.

The printer features Intel 8085 8-bit microprocessor-controlled, single-board electronics. A quick-loading cartridge ribbon yields 375,000 characters between replacements, and Qume sells over 100 different 96-character print wheels. Print line is 132, 158, or 197 characters at 10, 12, and 15 characters per inch respectively, with proportional spacing.

Reliability is achieved by a carriage mechanism using a wide, toothed belt reinforced with a substance having twice the strength of steel and one-fifth the weight. The belt eliminates the need for complicated cables and adjustment pulleys, giving a tested mean time between failures of 5,500 hours, or almost three years' service-free operation.

With your choice of serial (RS-232C), parallel, or IEEE-488 interfaces, the 11/40 Plus sells for $1,776. A 55-cps model is also available, as are bidirectional forms tractors and single-sheet feeders.

For dealer or other information, contact Qume Corp., 2350 Qume Drive, San Jose, CA 95131, 408-942-4000.

Reader Service ✓564

A Universal Language

The Universal Operating System, PCD's version of the University of California's UCSD p-System, allows a user to develop a program on the Model II, III, or 16 and run it on a different micro without change or special hardware. In addition to the three Tandy machines, Universal Operating System software will run on the Apple II, IBM PC, Osborne, Commodore Business Machine and

64, Xerox 820, and Hewlett-Packard computers, as well as the IBM Displaywriter and DEC Professional Series.

Complete with Pascal compiler, screen editor, file manager, run-time system, and documentation, the Model II or III Universal Operating System is $650. A Model 16 (Z80) version is also $650; a 68000-mode system is scheduled for release soon. Utilities to transfer existing TRSDOS or CP/M files to p-System format are $100 each. Additional software and information is available from PCD Systems Inc., P.O. Box 143, 163 Main St., Penn Yan, NY 14527, 315-536-7428.

Reader Service ↙583

From I/III to PC

Personal Computer Products (1400 Coleman Ave., Suite C-18, Santa Clara, CA 95050, 408-988-0164) has released a product that allows the transfer of programs, text, spreadsheet data, or any other file from a Model I or III to an IBM PC.

Communication programs for both systems are included, as is a connecting adapter and a test communication file. Files of any length can be sent; file concatenation is provided. Supported baud rates are 110, 150, 300, 600, 1,200, 2,400, 4,800, and 9,600.

The package sells for $39.95. Program conversion tips are included in the user's manual.

Reader Service ↙572

Law Office Software

Timelog is a set of programs designed to handle the billing and timekeeping functions of a one- to five-attorney legal office. It is menu-driven and uses English instead of codes for easy operation.

Information stored in Timelog can be accessed for billing or for other uses such as client, attorney, or category totals between dates. The set generates printed bills, lists of clients (names, addresses, and previous balances), and printouts of the day's entries. Totals can be printed or not at the user's discretion, and up to 800 entries can be handled per disk.

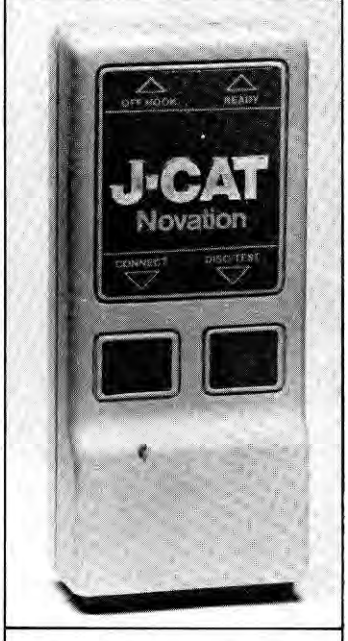
The system requires a 48K Model III or Model I with DOSPLUS. It supports the Daisy Wheel II and Epson MX-80 F/T, and sells for $750 from Gavel Computing Systems Inc., Route 2 Box 466, Alachua, FL 32615, 904-462-4564.

Reader Service ↙571

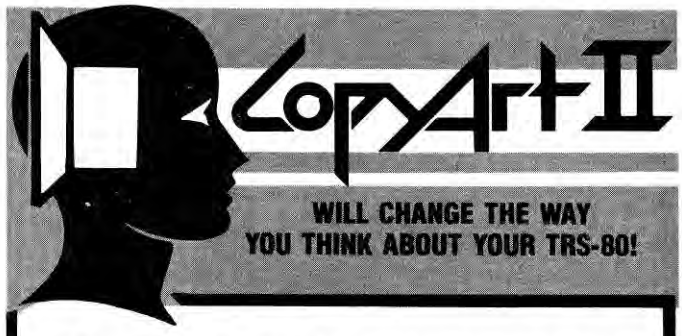
Pocket-Sized Modem

The J-Cat, a 300-baud, direct-connect modem that measures only 5 by 1.9 by 1.3 inches, is RS-232C compatible and plugs into any modular RJ11C phone jack.

The $149 modem automatically switches into the right mode (answer or originate). LEDs show you status; audio tones tell you when you reach a busy signal, detect a carrier, or get a dial tone. Other features include disconnect/test



Novation Compact Modem



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5. Screen widths from 32-255 characters wide. Screen widths can be changed to allow formatting your text as you want.
6. MATH. Built in MATH function for doing calculations on columns or rows. Used with the SORT command, CopyArt II can do a small inventory of 200-300 items, or keep track of small receivables or payables, general ledgers or home financial reports. Super floating point precision up to 32 digits!
7. *GRAPHICS. CopyArt has a built in graphics program that allows inserting graphics within your text. Drawings, graphs, illustrations, cartoons etc. may be used within newsletters or company reports. Graphics commands include: Plot between points, Circles, Squares, Fill, Erase, Draw, Move, Pixel cursor controls and more.
8. *GRAPHIC CHARACTERS. CopyArt has a built in graphics character generator. Used for typesetting large letters from 3 to 25 times normal size! Yes, you can even print characters down the page as well as across. Black on white or white on black.
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10. *SUPER or SUB-SCRIPT.
11. UNDERLINING.
12. BOLDFACTING.
13. *CHANGE CHARACTER SIZE or PITCH within your document. Character size changes for dot matrix printers with capability. Pitch change for daisy wheel printers with capability.
14. HELP. Help is available for all the commands at the touch of a key while using the word processor. Super for training inexperienced secretaries. Great reminder for experienced people as well. MENU DRIVEN Help for over 45 commands.

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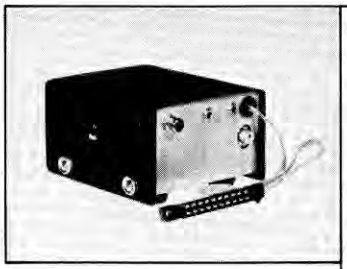

Video Mod

and connect/break keys.

It is available from Novation Inc., 18664 Oxnard St., Tarzana, CA 91356, 800-423-5419.

Reader Service ✓555

Video Mod

Video Mod is a plug-in module that allows the connection of extra monitors or TVs to a Model III. Besides providing an external display, the module permits programs with sound to be heard over the TV speaker, and gives a switch-selectable reverse video mode.

It sells for $149.95 from EJB Electronic Systems, 2902 Eggert Road, Tonawanda, NY 14150, 716-837-9411.

Reader Service ✓580

Gods of Mt. Olympus

In Gods of Mt. Olympus, an illustrated adventure game for the 16K Model I or III, you attempt to rise as far as possible in the hierarchy of power, wealth, and prestige. In ancient times, that meant becoming a god—a quest that takes all your intelligence and originality, facing many Herculean tasks and the magic and mischief of the established gods.

The price of ambition is $14.95 from Software Magic, P.O. Box 2184, Bramalea, Ontario, Canada L6T 3S4.

Reader Service ✓563

The Basics, Plus Pascal

Fundamentals of Microcomputer Programming, Including Pascal is not a Pascal programming manual, but an introduction to programming and computer languages in general, emphasizing the increasingly popular Pascal.

Assuming no previous background in programming or computer science, author Daniel McGlynn offers important and understandable coverage of program design, microcomputer operating systems, software protection, and more sophisticated topics such as computer linguistics. Within this context, the fundamentals of Pascal are presented for both novice and experienced users, ranging from basic specifications to simple programs and implementations.

The 332-page paperback is published by John Wiley & Sons Inc., 605 Third Ave., New York, NY 10158, 212-850-6000. It sells for $14.95.

Reader Service ✓562

One-Switch Communication

The Words+ Living Center is a system that allows severely handicapped persons to operate a Model III by use of a single switch. It is designed for victims of cerebral palsy, muscular dystrophy, amyotrophic lateral sclerosis or other diseases—those who are mentally alert but unable to communicate through speech or writing.

A stored vocabulary of over 1,000 words is supplemented by stored sentences and phrases and a mode that allows new words to be spelled one letter at a time, and words or phrases to be added to the vocabulary.

The primary display in the communication mode shows a matrix of letters, numbers, and other commands; the user presses the switch when the pointer is in front of the row that contains the desired letter, and again when the pointer indicates the letter.

Words that begin with that letter are then shown in blocks of 50, and the desired word is selected in the same fashion. All rows end with an exit command in case the row was selected by mistake.

Communication is accomplished by building sentences on the video screen. The same switch can turn a printer on and off; a voice synthesizer can be added for speech.

In addition to writing or using a synthesizer, the operator can draw pictures and copy them, play games or use educational programs, and control appliances and other devices. Normal operation of the Model III is not affected.

The Words+ systems include computers; different packages are available, from a $1,099 cassette-based system that uses Morse-code input to a $2,799 model with voice synthesizer, 80-column printer, and control of four appliances. For more information, contact Words+ Inc., 622 So. Fair Oaks, Sunnyvale, CA 94086, 408-730-9588.

Reader Service ✓561

5K Basic Data Base

The Electric Notebook is a short but versatile data-management program written in only 5K of Basic. It allows creation of up to a 10-field record, has a built-in label maker and two different search routines, and can sort within a sort, operating on already-sorted data in any field.

Files are handled sequentially, and capacity is adequate for most small-business and personal record keeping. The program can easily be modified; for example, while it will total any numeric field, it can be adapted to calculate and display multi-field values, and keep and sort financial records such as checkbooks.

The $49.95 program is available in Model I or III TRSDOS or NEWDOS80 versions from Wizard Software through Caltec Marketing, 9520 Chesapeake Drive, San Diego, CA 92123, 619-286-0720.

Reader Service ✓560

PEEK

PEEK, the Journal of Micro Abstracts, is a monthly publication furnishing abbreviated abstracts of feature articles, hardware, software, and book reviews, and instructional material appearing in the current microcomputer literature. The journal addresses subjects ranging from business and education to utilities and equipment innovations.

The combination of categorized abstracts and a simple search system allows convenient reference to the sources and helps you target your reading and organize your reference library. A 12-month subscription costs $30 from Herbert Skovronek, Editor, *PEEK*, 88 Moraine Road, Morris Plains, NJ 07950.

Improve Your LNW

Hires 1 is a machine-language driver that adds several commands to Basic to let the LNW user get the most out of his or her machine. Taking less than 2,500 bytes of high memory, the driver allows access to the 480-by-192 B&W graphics mode with easy commands to create lines, circles, tones, and 80-by-24 or 80-by-16 text formats. Formats can be mixed if the user elects.

Hires 1 comes on a 35-track, single-density disk with five demonstration programs. A special version is available for TRS-80 Model I users who have ERAM.

It sells for $20 plus $1 shipping and handling from E & H Software, 11814 Coursey Blvd., Suite 249, Baton Rouge, LA 70816, 504-293-3400.

Reader Service ✓574

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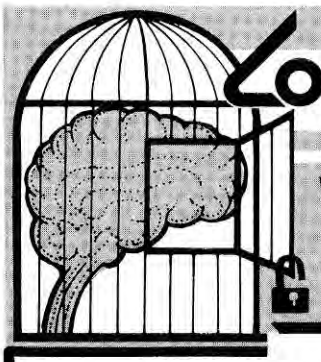

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22. DOS COMMANDS from within the editor. Kill files, check free space or get directories easily.
23. CUSTOMIZED PRINTER driver. Since your printer has features that other printers don't, CopyArt II will be supplied with the printer driver of your choice below. Each printer driver is custom made to provide you with commands for each of your printer's fine capabilities. If you have more than one printer, order other printer drivers for only $19.95 each. Printer drivers are available for:

- •Radio Shack LP IV, V, VI, VII, VIII and Daisy Wheel II
- Epson MX-80, MX-80/FT, MX-100 with or without graftrax.
- Okidata Microline 80, 82a, 83a and 84
- NEC 8023
- Smith Corona Daisy Wheel TP-1
- Brother Daisy Wheel
- C-itoh Starwriters and Prowriters all, 85 10A, 1550
- PMC Printer
- Centronics 737, 739
- Diablo 620

OTHERS COMING SOON. Call if you don't see your printer!

24. Unprotected diskette. Unlimited backups can be made.
25. MAILIST/MAILMERGE INCLUDED. CopyArt II comes with a mailist program that stores over 2,000 names on a MOD III diskette. These names can be sorted by any field and have a special field for your code. You can make PERSONALIZED FORM LETTERS that will take the following codes from the mailist and insert them in your text. FIELDS INCLUDE: Mr. or Ms., Last name, First name, Business name, City, State, up to 9 digit ZIP code and your own special 2 character code. ANY OF THESE fields can be inserted within your form letter wherever you want. You can print form letters or mailing labels to all the people on your list or to specific codes only. CopyArt makes it easy.

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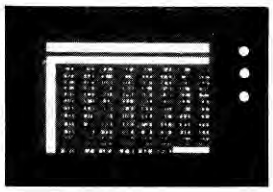

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Microfazer

Microfazer

Microfazer is a printer buffer that lets printing take place while the computer is being used for other work. It can double the output of word-processing applications, and triple that of graphics production.

A copy feature allows additional copies of the buffered material—from one to as many as needed—with the touch of a button. Front panel LEDs give copy, ready, and error status information; a reset switch sets the Microfazer and clears its memory. Data rates and handshake signals are user-selectable.

Serial-to-serial models, including the required power supply, are $229 (8K), $249 (16K), $279 (32K), and $330 (64K). Serial-to-parallel models with cable are $199 (8K), $220 (16K), $260 (32K), and $330 (64K).

For more information, contact Quadram Corp., 4357 Park Drive, Norcross, GA 30093, 404-923-6666.

Reader Service ✓569

Exbidite

Salesmen can quickly and efficiently create itemized cost estimates or contract bids with Exbidite, a software package that handles an unlimited number of inventory items and reviews them according to services required by a customer.

The estimate lists items or services, quantities, prices, and totals, as well as information identifying the company, customer, annotations, terms, and type of project.

Once created, the estimate can be printed for the customer and stored on disk for later reference or recalculating. Prices can be easily updated, and the margin of profit for each estimate can be adjusted according to individual items or across the entire estimate.

The Basic program requires a 48K Model I or III with one disk drive and a printer. A program is supplied that creates inventory tables, simplifying the initial creation of an inventory data base.

Exbidite is available for $39.95 from Grout & Associates, 26324 Edgewater Blvd. N.W., Poulsbo, WA 98370, 206-779-5149.

Reader Service ✓565

Pocket Computer Business Programs

CATSb-CALC is a set of three planning and budgeting programs for the Pocket Computer PC-1 or Sharp PC-1211.

A spreadsheet program calculates sheets of up to 30 rows and an infinite number of columns. Rows are devel-

oped as combinations of constant values, as regularly increasing or decreasing values by mathematical operations upon other rows, or as accumulations of another row.

There is a function for net present value. Results are calculated and printed sequentially (rows within a column); input parameters can be saved and read from cassette.

A second program calculates internal rate of return and present value for any evenly spaced cash flows. The third program is a purchase-versus-lease analyzer; it allows for inflation, various tax rates and methods of depreciation, and different rates of gain or loss, and permits inclusion of investment tax credit.

The set sells for $25 from Computer Assistants to Small Business, P.O. Box 1687, Wayne, NJ 07470.

Reader Service ✓553

Gas Attack

You are the mad inventor of a gas to destroy all living things. You roam a vertically scrolling field, annihilating plants, dogs, and people; dodging impassable blocks; and blasting your way out should you fall into a pit. Gas canisters scattered around the field refill your supply. However, your evil plan has backfired slightly—the gas turned some beetles into giant mutants. They're now immune to the poison, and hot on your trail.

Gas Attack is a game that lets you be the bad guy. Both cassette and disk versions for the Models I and III are supplied on cassette for $15.95 from Comp-U-Gamer Software, P.O. Box 802, Nevada, MO 64772.

Reader Service ✓576

Control System Manual

Russell Genet's *Real-Time Control with the TRS-80* gives step-by-step instructions for planning and developing a real-time data-logging or control system.

A detailed case example helps the reader see how theoretical elements are applied to making a reliable, sophisticated system. Practical details given include how to communicate with the TRS-80 by remote keypad and video monitor; the use of counters as timers, delay devices, and dividers; automatic signal averaging; and how to eliminate the need to read strip charts, write down data, or key it in. Using interpretive Basic for its simplicity, the control system also avoids the use of interrupts.

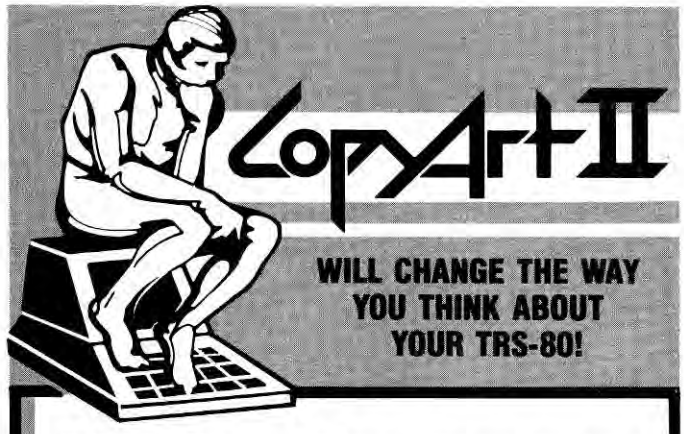
The 116-page paperback is available for $14.95 plus $1 shipping and handling (Virginia residents add 4 percent tax) from Group Technology Ltd., P.O. Box 87, Check, VA 24072, 703-651-3153.

Reader Service ✓570

Market Trend Analysis

The Trend Analysis program offers the Model I- or III-owning investor the ability to create and maintain files of historical data on stock and commodity prices, market averages, trading volume, interest rates, put and call activity, stock index futures, or any other data of interest. It can make calculations to help the user determine the major trend of the series, as well as calculate the deviation from the trend of the data itself or any moving average.

The program lets you create and update files from the keyboard, read data from and write to disk for storage, combine two or more files or parts of them, or examine any part of the file on screen. You can calculate up to two moving averages with periods of your choice, determining the percent deviation of one from the other, or a time-weighted moving average in



26. SIMPLE CURSOR commands. Simply use the arrow keys to move your cursor around the text. The screen will scroll both vertically and horizontally. Shift arrows take you to the beginning or end instantly.
27. Hi-Resolution graphics supported.
28. COMPLETE MARGINS CONTROL. You tell CopyArt II what margins you desire. You can even change margins within the same text. You may also have parts of your text with 2 columns, some with one etc. It's super easy to use.
29. BASIC PROGRAMS can be edited easily. CopyArt is really useful for inserting graphics within quoted strings to give your programs super animation without the hastle of calculating the CHR$ of the graphics!
30. VISICALC files can be loaded into CopyArt II to be manipulated easily. Great when you want to accompany your Visicalc reports with written reports, GRAPHS and BOLDFACING etc. Visicalc reports up to 255 wide can be loaded.
31. SPECIAL SCRIPSIT FILE LOADER. Allows you to load your old Scripsit files without having to save them in ASCII. Copyart will also load Pencil files and other normal ASCII files.
32. Similar to Scripsit. If you have used Scripsit, you can use Copy Art in minutes.
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Copyart II requires a TRS-80 Model I or III, (or PMC-80 or LNW), 48k and 2 disk drives with Newdos-80, Ldos, Multidos, Dosplus or TRSDOS. Double density disk drives recommended for the Model I.

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CLR

which the most recent data has the greatest weight. Data and the various averages can be printed; six different options let you use your printer to draw graphs.

Four and a half years of NYSE Composite Index daily closing prices, from early 1978 to late 1982, are supplied, as is a user's manual (available separately for $12). Full operation requires 48K, two disk drives, and a printer; the program will run with some modification in 32K.

Price is $37.50 from Harley D. Wilbur, 9709 Elrod Road, Kensington, MD 20895.

Reader Service ✓579

Anti-Static Cleaner

CLR, a new CRT screen cleaner and conditioner, provides quick cleaning combined with protection against static electricity.

An anti-static chemical originally designed for the Apollo space program slows the buildup of static-charged particles, which mix with dirt and grime to form a film on the CRT screen.

A four-ounce spray bottle of CLR costs $5.95 from Adamark Inc., P.O. Box 234, Ada, MI 49301, 616-791-2124.

Reader Service ✓556

Disk Conversion Service

Port-A-Soft, a firm that converts CP/M disks between various formats for different machines, now provides transfer of TRSDOS Model II 8-inch single-density disks to or from any other CP/M or non-CP/M format.

Conversion costs range from $5 to $15 per disk, with additional copies $2.50 each after conversion. Port-A-Soft requires assurance that customers have the legal right to make conversions or copies.

More information about the firm's services is available from Port-A-Soft, 423 E. 800 N., Orem, UT 84057, 801-224-2852.

Reader Service ✓552

Economical Word Processor

The Pel-Tek Word Machine is a machine-language, line-oriented word processor on disk for 32K and 48K Models I and III.

It features a full range of line editing and search functions, saving and loading of disk files, variable print formats for margins or special printer codes imbedded in text, lowercase support for unmodified Model Is, a help file, full access to DOS functions with the ability to warm-start the program, and a simplified command structure. Documentation is included; Pel-Tek will mail the documentation free to those sending a stamped, self-addressed envelope.

The program sells for $16.95 from Pel-Tek, P.O. Box 1026, Southampton, PA 18966, 215-947-2334.

Reader Service ✓582

Space Ambush

Space Ambush is a high-resolution skill and strategy game for the Color Computer.

A pack of marauding terrorist ships has ambushed your Galaxian Protector Fleet station. The attack has left you with no vertical boosters, limiting you to surface maneuvers; you have only short-range phasers to attack ships that descend close enough to drop bombs. The enemy gang has a varied collection of hijacked transports, blinkers, bombers, flippers, and flagships; their speed and maneuverability will test your reflexes as well as your joystick.

The game is available on cassette ($21.95) or disk ($26.95) from Computerware, Box 668, 4403 Manchester Ave., Encinitas, CA 92024, 619-436-3512.

Reader Service ✓568

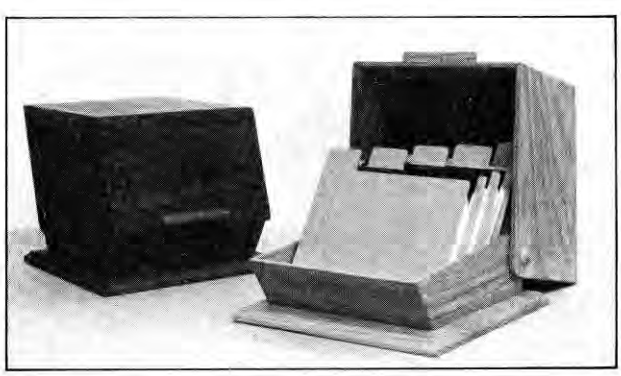
DIFFERENT TRACK

Review Editor Janet Fiderio rejected the 10-page manuscript of the New Products disk-box comparison test, but this month's extraordinary-items section presents the winner: the Disk Niche, a storage bin made of solid walnut, oak, or cherry with a hand-rubbed, oiled finish.

This nonplastic, not-too-portable accessory provides a dust-proof, static-free home for up to 50 5¼-inch disks. Five movable, tabbed dividers keep things organized.

The stylish container costs $49.95 plus $3 postage and handling in any of the three hardwoods. It can be ordered from Systems Integration, 1519 N. Nevada Ave., Colorado Springs, CO 80907, 303-635-4477.

Reader Service ✓551



Disk Niche

New Products listings are based on information supplied in manufacturers' press releases. 80 Micro *has not tested or reviewed these products and cannot guarantee any claims.*

ARE YOU STILL LETTING YOUR PRINTER TIE UP YOUR COMPUTER?

While your printer is running, your computer is tied up. You can't use it for processing, computing, data entry. Nothing. All you *can* do is twiddle your thumbs until the program is finished.

Pretty ridiculous.

MICROBUFFER ALLOWS YOU TO PRINT AND PROCESS SIMULTANEOUSLY.

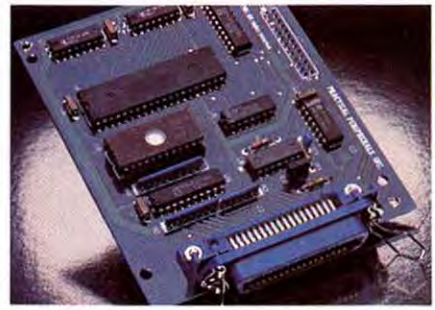
You just dump your printing data directly to Microbuffer, whoosh!, and continue processing. No waiting.

Microbuffer accepts data as fast as your computer can send it. It stores the data in its own memory buffer then takes control of your printer.

It's that easy.

THERE IS A MICROBUFFER ESPECIALLY FOR YOUR EPSON.

Microbuffer/E (just one in the full line of Microbuffers) is designed to be specifically compatible with an Epson



printer. An intelligent interface card with on-board RAM for data buffering, Microbuffer/E supports all standard Epson commands, including GRAFTRAX-80 and GRAFTRAX-80+. The serial version comes with 8K or 16K (upgradable to 32K) and features both hardware handshaking and XON-XOFF software handshaking at baud rates up to 19,200. The Berg jumper allows selectable UART settings. The parallel version has 16K or 32K (upgradable to 64K) and features a very high data transfer rate — over 4,000 characters per second. All models have a power-efficient low-consumption design. Prices range from $159 to $279.

Microbuffer/E is simple to install — it easily mounts in the exisiting auxiliary slot directly inside the Epson.

Other Microbuffer models include Microbuffer II for Apple II computers and a stand-alone, in-line Microbuffer to untie virtually any computer/printer combination.

MICROBUFFER FROM PRACTICAL PERIPHERALS.

So what are you waiting for? Write to us for more information or ask your dealer for a demonstration.

When you see how much freedom Microbuffer will allow, you'll understand why it's so silly to be without one.

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Data Base Management
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TRSDOS*

CP/M**

Open your doors to a world of SOFTWARE with LNW computers. You'll get **MORE PERFORMANCE**[1] than with the IBM PC[2] the Apple II[3] TRS80 MODEL II or TRS80 MODEL III[4] along with software support of TRSDOS or CP/M, the TWO MOST WIDELY USED OPERATING SYSTEMS. This means you, the user, can select from the largest base of business or personal software.

Standard Features: A serial RS232 communication port, parallel printer port, Hi-Resolution (480x192) B/W and COLOR graphics, an 80 character-per-line screen display along with Quad-density interface for 5" or 8" floppy disk storage offering immediate access to 3.5 million characters, or optional Hard disk interface to 5 or 10 million characters.

Standard Software: LNWBASIC and DOS PLUS operating system packages, commanding all the above features, are included.

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**CP/M is a trademark of Digital Research Corp.
1. Performance is based on bench mark test in the JAN 1982 issue of BYTE magazine, pg. 54, with LNW80 II as the comparison.
2. IBM PC is a trademark of IBM CORP.
3. APPLE II is a trademark of APPLE COMPUTERS.
4. TRS80 is a trademark of Tandy Corp.

International orders please inquire for pricing/shipping cost.