

THE  
MAGAZINE FOR  
TRS-80• USERS

80 Microcomputing

6/80

#6

# 80 microcomputing<sup>T.M.</sup>

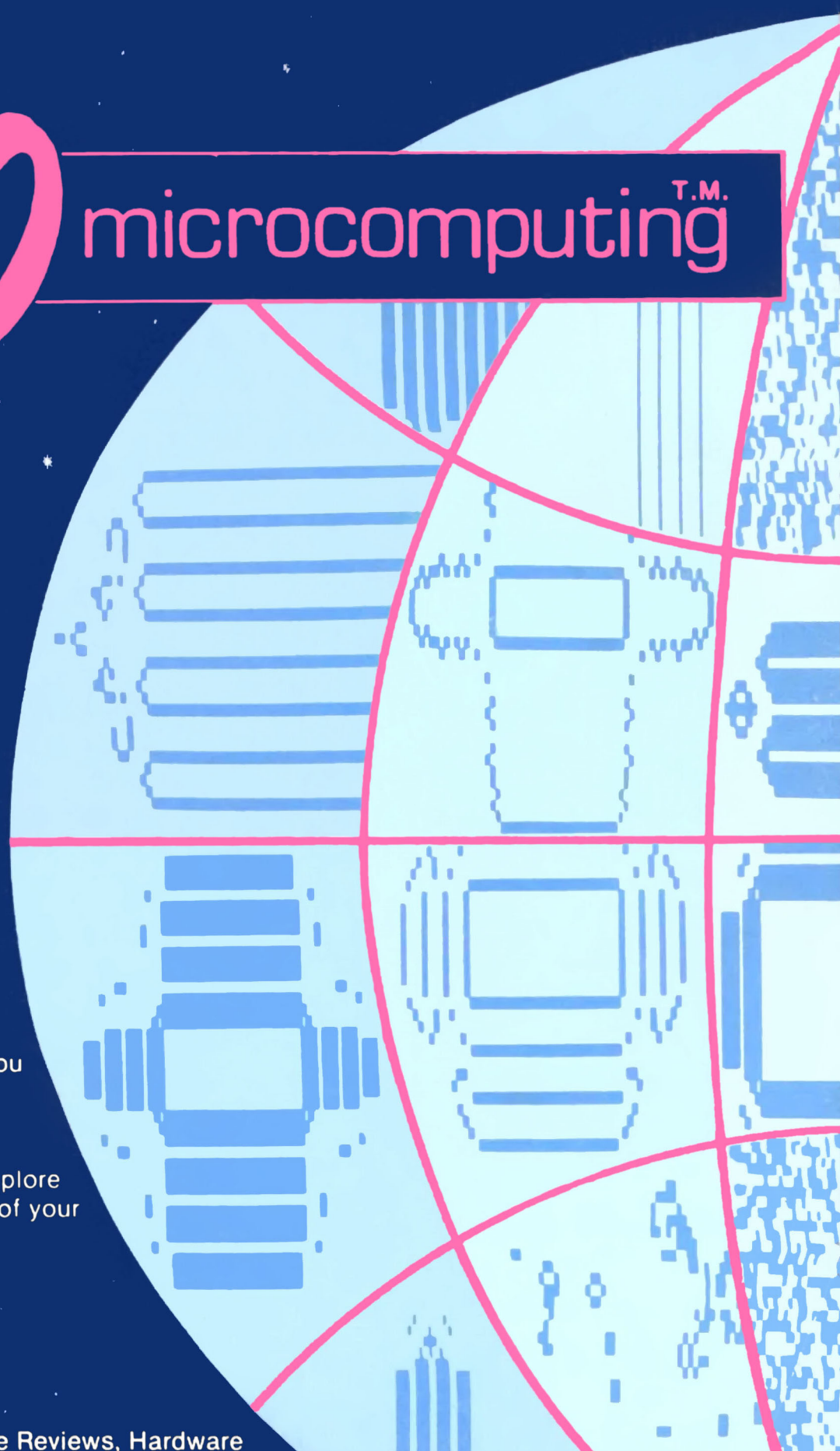
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Game  
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**Special Graphics Issue:** Explore the full graphics potential of your system. \*

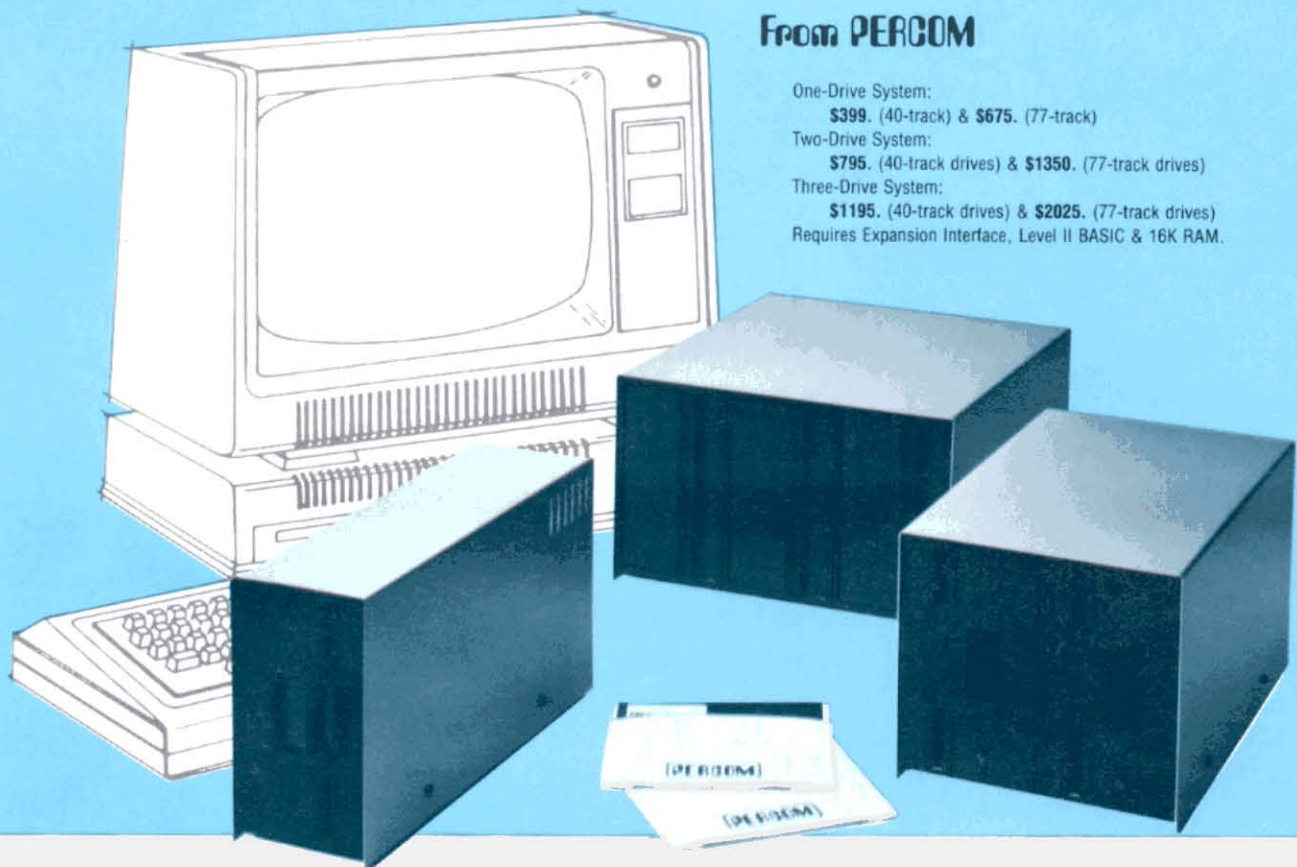


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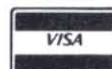
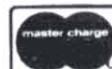
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# 80 REMARKS

by Wayne Green

*"As the size of the magazine increases, so does the postage involved in sending it to the subscribers."*

**M**y editorial on electronic mail brought quite a bit of response. To my knowledge there are at least three firms designing Electronic Mail Boxes (EMB), a unit that will plug into both your computer and your telephone.

Some questions have been raised about my proposal. First, I suggested EMB's use 1200 baud because I felt the currently used 300 baud was far too slow. It should be possible to connect and transfer a one page message all within one minute . . . and that requires at least 1200 baud.

#### **Suggests 9600**

A letter from Art Brothers, who runs a small phone company out in Utah, suggests we think in faster terms. He claims that it is possible to jam 9600 baud over a phone line using compression and expansion techniques. Undoubtedly a lot of you readers are far more experienced with this than I, so we need some articles on the subject. A 9600 baud system which would work over any conceivable phone connection over long distance lines with 100 percent transfer of a message would be wonderful. If this is even remotely possible, we should work for it right now and not be forced to change standards in a year or two.

We also need to establish protocols for signaling over the lines. Then, we need a handshake protocol to initiate the transfer of the message and a protocol to assure that the message has been received 100 percent error free. We can use error correcting codes for this to some advantage, but we will still need a system for checking the received copy . . . and acknowledging it's receipt.

One suggestion is that the EMB automatically forward a received message, if desired. Perhaps we could get a dump of waiting messages from any remote terminal. Even if the first systems do not have these features, I think they will be along soon enough.

Received messages will have to be stored on tape or disk automatically, so that the system will be ready for the next message. And the software must be flexible enough that you can be writing messages to be sent at the same time as the system is receiving one.

Would we want a duplex switch on the system for immediate two-way communications similar to a Telex? Why not? A special signal might indicate that the recipient of the message is on the line for immediate answer.

The software should include a word processor so we can write our messages on the tube and edit them. It does not have to have all of the sophistication of a full fledged word processor, complete with paragraph movers and key word

finders. If it does just a little better than a Teletype machine, it will be fine for this.

If there is enough interest in this, I will be glad to organize a symposium for individuals and firms interested in exchanging information so that we may standardize protocols. I think that between *80 Microcomputing* and *Kilobaud Microcomputing* I may have enough clout to make sure that the best system becomes a standard.

I believe that Radio Shack will be selling on the order of half a million computers this year and I will be disappointed if at least 75 percent of those buyers do not get an EMB to go with their system.

#### **Research Done**

In order to get this project moving, we first have to do the research and development. This means that the ball is in the air. Most of the technical development has been done and the results published in one or more magazines.

#### **Cover Photos**

Would you like the prestige of getting a photo on the *80 Microcomputing* cover?

Subject? Generally we like to have some photo which shows the TRS-80—either model—in use . . . hopefully with some interested people around.

Submissions will do best if they are larger than 35mm. We prefer the 6 x 7 cm or larger format, so we will have clear and sharp cover pictures.

Photographers should keep their eyes open for interesting applications of the Tandy computer system. Radio Shack stores are not exempt from the competition and a credit line on the photo will not hurt business one bit.

Oh, I almost forgot . . . we pay up to \$100 for cover photos.

#### **The Price Goes Up**

When a publisher starts a new magazine, it is always a gamble. Of course I try to keep the gamble to a minimum by knowing my trade better than most people. I've gotten rather good at starting new magazines and having them succeed, right from the first issue. In 1975 it was *Byte*, in 1977 it was *Kilobaud Microcomputing* and now, *80*.

As the size of the magazine increases, so does the postage involved in sending it to the subscribers or in shipping copies to the newsstands. That is why cover prices and subscription prices tend to go up. Of course inflation makes mat-

ters even worse. In order to be sure that *80* got a good start I set the cover price and subscription rate much lower than normal for a technical magazine of its quality. There are several higher priced magazines with a lot less interesting material on the market.

Starting with the July issue the cover price of *80* will be \$2.50 and the subscription rate within the U.S. will be \$18 per year. A three year subscription is currently only \$40. This will be going up to \$45 with the July issue.

If you follow the normal pattern of procrastination, you'll do me a big favor and pay the higher price. In order to "save money" you'll buy at the one year rate and we'll do even better. I expect the cover price to go up again, possibly by the end of this year, to \$2.95, with the subscription rate going to \$25 for one year and \$53 for three years. Why not wait and see for yourself?

#### **See You in Hong Kong**

You have always wanted to go to Asia, but you just haven't had the proper push to get you going. I'm pushing . . . so get out your checkbook and enjoy the ride.

Last fall I went on an IEEE sponsored tour of the Far East and had a fantastic time. The tour is running again and you'll want to come along and see Asia. It will be from October 2-22nd and the cost is just over \$2,000 each, a wonderful bargain. That includes all plane fares, buses, hotels, banquets and sightseeing trips.

Quite a few microcomputer addicts and industry people make this trip, so it will be much more fun than going with undertakers or pipefitters. The trip coincides with consumer electronic shows in Tokyo, Taipei, Seoul and Hong Kong. Unless you are made of sterner stuff, you will find yourself getting enthused over importing some of the electronic and computer equipment that smaller Asian firms are making.

Or you may want to take advantage of the low cost production facilities for some product you are making or would like to make.

We'll plan on getting together with the president of the Hong Kong TRS-80 club, which had over 300 members last year. We'll also visit Akihabara in Tokyo, a section of town with hundreds of electronic stores.

If you're interested, drop me a line and ask for further information. I think we'll try for two tables of computerists—that's about 24 of us—so don't procrastinate. The address is: Asia Tour, c/o *80 Microcomputing*, Peterborough, NH 03458 ■



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*"The hate is generated by virtually everything Tandy does, and . . . doesn't do."*

## Past Lives

I want you to know how much I appreciated "The Mind Works Much Like a Computer" (Feb. 80). I "flashed" on your suggestion that ". . . the human brain's storage medium is both infinite and permanent", with ". . . of course!" Somehow I just know that and don't know how.

An area which fascinates me is consciousness, although a computer could probably duplicate much of our decision, thought and analysis process, what would it take to make the computer conscious of its thoughts, decisions and analyses?

Thank you also for 80 Microcomputing—truly tremendous! I've already placed several orders and contemplate several more. Thank you for your contribution to my life.

Leo Horowitz  
San Diego CA

*My feeling is that computers will not attain consciousness, no matter their complexity. Of course, we really don't know what consciousness is. We can try to define it as an awareness . . . or, in the case of people, an awareness of awareness, but this really doesn't help us to understand what it is and how it happened.*

*With the concept of consciousness we are getting into country where scientists are ill at ease. When we observe the actions of individual cells in our body, there is activity which seems to indicate some sort of cellular consciousness. Each of these cells is made up of a large number of replicating molecules, and, yet, each cell has a life of its own and an apparent consciousness.*

*When we go to the next order of abstraction we find that just as the molecules which made up the cells took on a life and consciousness of the unit, so do the cells which make up our bodies take on a consciousness of the unit. Of course it is unlikely that the cells, though they exhibit consciousness, are aware of the consciousness of the whole body.*

*Now getting back to our unconscious computer system. I might draw a parallel with a person, who has consciousness, and a library of information, which does not. Adding memory to a computer is akin, as I see it, to adding volumes to a library. Adding more computational circuits would speed the access to the information, but somewhere that spark of life is missing. We don't have any good explanation from religion either—other than attributing the whole thing to God. I'll buy that . . . at least until we get a better understanding of the matter.—Wayne.*

## Tandy Love—Hate

*Since your observations are shared by others, I thought the readers of 80 Microcomputing might be interested in your letter to Mr. Kornfeld. One can hope that Radio Shack will embark on a project to take customer problems to heart and work toward eliminating them in the future. Shall we drink to that idyllic world?—Wayne.*

Mr. Lew Kornfeld, President  
Radio Shack  
Fort Worth, Texas

Dear Mr. Kornfeld:

Owning a TRS-80 projects one into a Love-Hate relationship with his machine and with Radio Shack, which is unaffected by my ownership of one share of Tandy stock obtained in the good old days when we shareholders received a ten percent discount.

The love is generated by the wondrous little machine you have placed on my desk.

The hate is generated by virtually everything Tandy does, and what is left over is generated by things which Tandy doesn't do.

I started out small and put my office on the Level I cassette payroll. It was fair, but it was a nuisance to have to calculate the New Jersey state tax by hand each week for each employee, with a computer staring me in the face and doing the much more difficult job of calculating the Federal tax. A plea to Fort Worth for help? Dumb or arrogant answers, and certainly no help. For example, "We can't be expected to provide fifty different programs!" (Why not, you sell the TRS-80 in fifty different states without warning the purchasers that the program won't run automatically?) Why not set up state taxes like the Federal, with data lines to be changed by the user each year as rates changed? No reason, just indifference. Why not make documentation available so that the user could easily modify the program to his needs?

Yesterday, ready to move into the world of disks and printers, I made an appointment for a word processor demonstration at the East Hanover, New Jersey Computer Center. The appointment was made two days in advance, and I asked for assurance that a skilled operator of the system would be available to demonstrate it (having been previously advised by this center to call first for this demonstration). So, I left my practice for the morning, drove forty-five minutes, arrived at the appointed hour, and was pleasantly seated at the machine

by a chain-smoking store manager, who was able to load the diskette, call up "SCRIP-SIT/LC" and list "HIPPO/LC", and then sat helplessly before the screen, manual in hand, unable to demonstrate even a single editing function. The demonstrator had gone out to install a system!

I have purchased a number of excellent programs, all from other sources; REMODEL, PROLOAD, T-SHORT, LEVEL I IN LEVEL II, Z-CHESS, DUNJONQUEST and a package of programs from TBS. All of these have been excellent, and have enhanced my use and enjoyment of the computer.

Radio Shack sells inferior programs, gives terrible software support, provides an 800 "hot-line" which is almost always busy, and which has never been able to answer my relatively simple and unsophisticated questions, has sales personnel who usually know less about the computer than anyone who has finished the second page of the excellent Level I manual (what on earth went wrong with the Level II manual?), and puts on media blitzes advertising products that will not be available for months (how many Daisy Wheel printers have made it to the stores yet?).

The TRS-80 has been made into a huge success in spite of Tandy, and due to the efforts of such as Wayne Green and his *Kilobaud* and *80 Microcomputing* publications, and by companies such as Racet, Microsoft, Apparat, Houston Micro-Computer Technologies, and others who have supported your system with good programs, good peripherals, good articles, good fixes for your problems, sympathy, understanding, a willingness and an ability to help their customers, and, in point of fact, provide what Radio Shack should, but can't or won't provide.

They deserve your encouragement and support. Three TRS-80's have been purchased by friends and associates of mine, seeing my enthusiasm. Had it not been for the availability of outside support, that enthusiasm would not have existed, and those three individuals would not have become customers. Multiply that by the number of units out, and you will perhaps become appreciative of the need for continuing support of those who support you.

Robert A. Goldstone, M.D., P.A.  
Paterson, NJ

## Disk Primer Update

Having just received the March issue and noticing Mr. Kenderdine's comments on my article, "A Disk Primer," I thought I should put a quick note in the mail.



In as much as I dislike letters that begin "In Response . . .," let me say that I agree with Jim a full 50 percent.

CMD" T and CMD" R work well on BASIC tapes, but system tapes, designed for the typical Level II, 16K configuration, as most are, load either over, under but almost always through DOS, forcing a reboot.

Perhaps I should have said ". . . Level II SYSTEM tapes are not compatible . . ."; it's just a quirk of mine that mentally blocks the fact that there are tapes in BASIC, since the bulk of them are games and I have a strong aversion to spending \$4000+ for a toy to play games on.

As for the deletion of DOS programs to free disk space, yes, again he is correct, but the article was meant to be a *Primer*. When I first got my drive, I could hardly wait to start using it, but my Expansion Interface kept crashing, I lost a few files and routinely ran the FORMAT/BACKUP pair. Later on, with DOS 2.3, I used the check-out procedures (TEST1/TEST2) just after booting. And BASIC is something I find difficult to live without.

The point is, with *one* drive, inserting, extracting, inserting, extracting, ad nauseam, is fatiguing, especially after a six or seven hour session at the machine. I can see deleting the TAPEDISK/CMD and the 3/BAS utilities, but I think that brings storage space up to about 48 or 49K. I have nothing against being creative, but a valid and viable disk-based TRS-80 *must*, in my opinion, have two drives. It took me 3 months to come to that conclusion, after which I had to scrape and spend a long time waiting for it.

I think my DOS-mate, Mr. Kenderdine, will find this out as he goes along the Disk route. I do thank him for the compliment, and for piping out some more information, since that is the essence of learning. Without personal interaction, CRT might still stand for Crummy Rock Tablet.

Bill O'Brien  
NYC, NY

## Illegal Victory

Soon after receiving the March issue of your magazine, I approached my machine's keyboard and entered in William Lopez's Hex-pawn game, making slight modifications so that it would run on my Level II machine. Then, after this long typing session, I started the program running. At first all went well—I first used the example given in the article, then strange things began to happen. I won the first round, as was expected, and also the second round, but from then on no matter what move I opened with, it conceded the game!

I listed out the program again, and found no error this time on my part. I thought maybe it was my machine, and so I checked its RAM with a memory tester, but found nothing. Once again I ran the program, only to have it cheat time and again (like putting captured men back on the board and moving diagonally to empty spaces).

I've gone over my work twice since then, and

can find no flaw. Was there maybe a misprint (or an omission) from the magazine text? I pray some hearty soul can find what is causing such unsportsmanship in my machine.

Joseph Teller  
Waltham, MA

## Squot's Travels

I enjoyed the article/program "Ball Box" by James D. Lewis in *80 Microcomputing*, April 1980. I modified the listing to enable me to run the simulation on my Level II system without any problem (POINT(X,Y) returns -1, if the point is set).

In the process of enhancing the mini-universe, I have discovered a heretofore unreported phenomenon which other Level II users might also want to investigate. I have designated this effect "Space Wrinkle" (SPRINKLE). It may be observed by inserting the following line in the Level II version of the program (sorry Level I users):

```
5125 IF INKEYS<>"" THEN IF RND(2) = 1 THEN A = - A  
      ELSE B = - B
```

Once the modified program is running and the Squot starts its travels, the SPRINKLE may be observed by depressing any keyboard key. The investigator will notice a certain degree of control which he now has over Squot's travels. This control may be invoked benevolently (i.e., to help the unfortunate creature to find the food) or merely as an experimental tool (i.e., "Will Squot ever find that neat slide, if I don't help?").

I also believe that line 5001 contains an error for both Level I and Level II versions. It should read:

```
5001 Y = RND(48 - 4) + 2
```

Jim Cardell  
Bethlehem, PA

## Problem Winker

In response to the Winking Cursor article on page 68 of the January 1980 issue, I submit the following observations:

I had been working on a program for some time and had a requirement for a "Winking Cursor". My approach was somewhat more lengthy than Mr. Lovy's. Needless to say I was impressed and decided to utilize his approach. After a few short tests, I discovered something was amiss.

The first problem was that on second and subsequent string entries FIS equals all characters that have been input. The solution for this is to null FIS upon each call to the subroutine. (Example 1 line 1002.)

The second problem occurred when I attempted to utilize the LEN(\$ statement to test string length upon return from the subroutine, after inputting a string including one or more backspaces. It seems that our friend FIS keeps track of not only wanted characters but also every backspace intended to delete unwanted characters. This means that LEN(\$ will return the number of characters wanted plus the number of backspaces. My solution to this problem was twofold.

First if FIS is null and a backspace is encountered we disregard and start over. (Example 1 line 1009.) Second if FIS is not null and a backspace is encountered, we must adjust FIS string length to the desired length by subtracting a character for each backspace. (Example 1 line 1010.)

T. D. Sylvester  
Atlantic Beach, FL

## Simple APPENDING

The article in the February 1980 issue by C. Gerald on APPENDING programs was interesting but I think it complicates a rather simple procedure. It is possible to APPEND programs using CLOAD and a few PEEKs and POKE as follows:

1. With your first program already entered in core PEEK at 16633, 16634. This is a pointer to the end of the BASIC program and start of variable storage.
2. Subtract two from the address you get in Step 1 as follows: If 16633 is greater than one just subtract two from it; if 16633 is less than or equal to one, add 254 to it and subtract one from the number in 16634.
3. POKE the resulting numbers into 16548 and 16549. Do not do anything to 16633 and 16634.
4. 16548, 16549 is a pointer to the beginning of a BASIC program, normally 17129. We have now altered it to point to the end of the present program, actually the two zero bytes where the next line pointer would normally be.
5. CLOAD your program to be APPENDED.
6. At READY, POKE 16548 with 233 and 16549 with 66. This sets the pointer back to 17129 and you're done. All the pointers for variables, etc. will be properly handled by CLOAD.

If you forgot Step 6, the system will only know about your APPENDED program and if you try a LIST, it will look like you lost your original program. Also RUN will only execute your APPENDED program. Try it!

I've used this method many times and it works like a charm.

The article also has a technical error in stating (see Table 1) that line numbers take 1 byte followed by a null byte. They actually take 2 bytes. His examples had line numbers less than 256 which leaves the 2nd byte zero.

M. Winnick  
Plano, TX

continued on next page



# 80 DEBUG

## Conflict of Interest

I have received many calls concerning my letter in the April issue about putting Sargon II on disk. It is not clear to people that the DOS "DUMP" command requires blanks: one after the word DUMP and one after the filespec SARGON2/CMD. Thus the correct syntax is:

```
DUMP SARGON2/CMD (START=X'8000',
END=X'AD19',TRA=X'ACFD')
```

where the blanks have been emphasized for clarity. While it is necessary to have one blank in each of the indicated positions, it is also important that the rest of the command (between the parentheses) not have any blanks.

Many of the owners of this expensive program were quite upset that they could not run it from disk. I am surprised that this important fact is not mentioned in the ads. Also, subscribers to other magazines may be interested to know that some have refused to publish my technique, citing conflict of interest with their advertisers.

*Roxton Baker  
Ellington, CT*

## Break Disable

In my article printed in April 80 *Microcomputing*, "Break Disable" (p. 128), an error appeared in line 10, the beginning of the FOR-NEXT loop.

The start of the loop is wrong, causing the program to be POKED into the wrong place in RAM. Line 10 should read:

```
10 CLS:FOR X = 32743 TO 32767
```

I trust this will help your readers make the "Break Disable" work.

*Jim Rastin  
London, ONT*

## KWICest Index

In my letter concerning the article I authored, KWICest Index, there are three errors in the published listing brought to my attention by Dr. Ronald Ribler. The errors are in lines 1110, 1160 and a missing line 1265.

The correct lines are:

```
1110 IF W(I)=TW THEN 1190
      (not IF W(I)=TTW THEN 1190)
1160 TC=TC+" "+TW
      (not TC=-TC+" "+TW)
1265 TC="":REM SET TC TO NULL STRING
```

When these changes are made the program runs as shown.

I am embarrassed over my failure to catch these errors and apologize for the inconvenience caused you and your readers.

*Leslie E. Sparks  
Durham, NC*

## BUGged Light Pen

There appears to be a BUG in program listing 7 on page 42 of the April article, "Build a Light Pen". The assembly language program does not work. (At least it didn't for me.)

According to the Radio Shack Level II and DOS manuals, a machine language program which is called by the USR function will not return a value if terminated by a RET instruction. In order to return the status of the light pen (light on or off) the value of the light pen must be loaded in the HL register and a JP 0A9AH will return this value to the USR function in the BASIC program.

I am by no means an assembly language programmer but I did change the program to reflect this requirement. A copy of the listing is attached.

I did construct the light pen and encountered no problems. The pen works very well using the BASIC programs and with the modification to the machine program that also ran. I have used the machine program on a Level II system and also a two disk system using the NEWDOS+ operating system with no problems. I substituted a Radio Shack photo transistor (part #276-130) for the one specified. In all, an excellent article, and I think a very useful piece of equipment.

Many thanks for such an excellent machine. The April issue is about three days old and already dog-eared and coffee-stained. Also very glad to see the start of an assembly language column.

*Thomas J. Bell  
Mickleton, NJ*

```
00090 ;CORRECTION TO ALLOW LIGHT PEN STATUS TO BE
00092 ;RETURNED IN HL REG. TO USR(ND / USR(ND) FOR DISK
00100 ;LIGHT PEN SUBRTH - 88 MICRO - APRIL 1980
00110 ;READS LIGHTPEN STATUS AND RETURNS
00120 ;HL = 0 IF NO LIGHT/ OR 128 IF LIGHT
00130 ;
00132                ORG      7FE5H    ;32741D
7FE5 21DC05 00150 LPEN   LD      HL,15000
7FE8 3E00   00160       LD      A,0
7FEA D3FF   00170       OUT     (<255>),A
7FEC 2B    00180 LOOP   DEC     HL
7FED 7C    00190       LD      A,H
7FEE B5    00200       OR      L
7FEF 20FB  00210       JR      NZ,LOOP
7FF1 DBFF  00220       IN      A,<255>
7FF3 E680  00230       AND    128
7FF5 6F    00240       LD      L,R    ;LOAD PEN STATUS IN HL
7FF6 2600  00242       LD      H,0    ;
7FF8 C39A0A 00250      JP      0A9AH ;FOR RET IN USR FUNCTION
7FE5      00260       END    LPEN
00000 TOTAL ERRORS
```

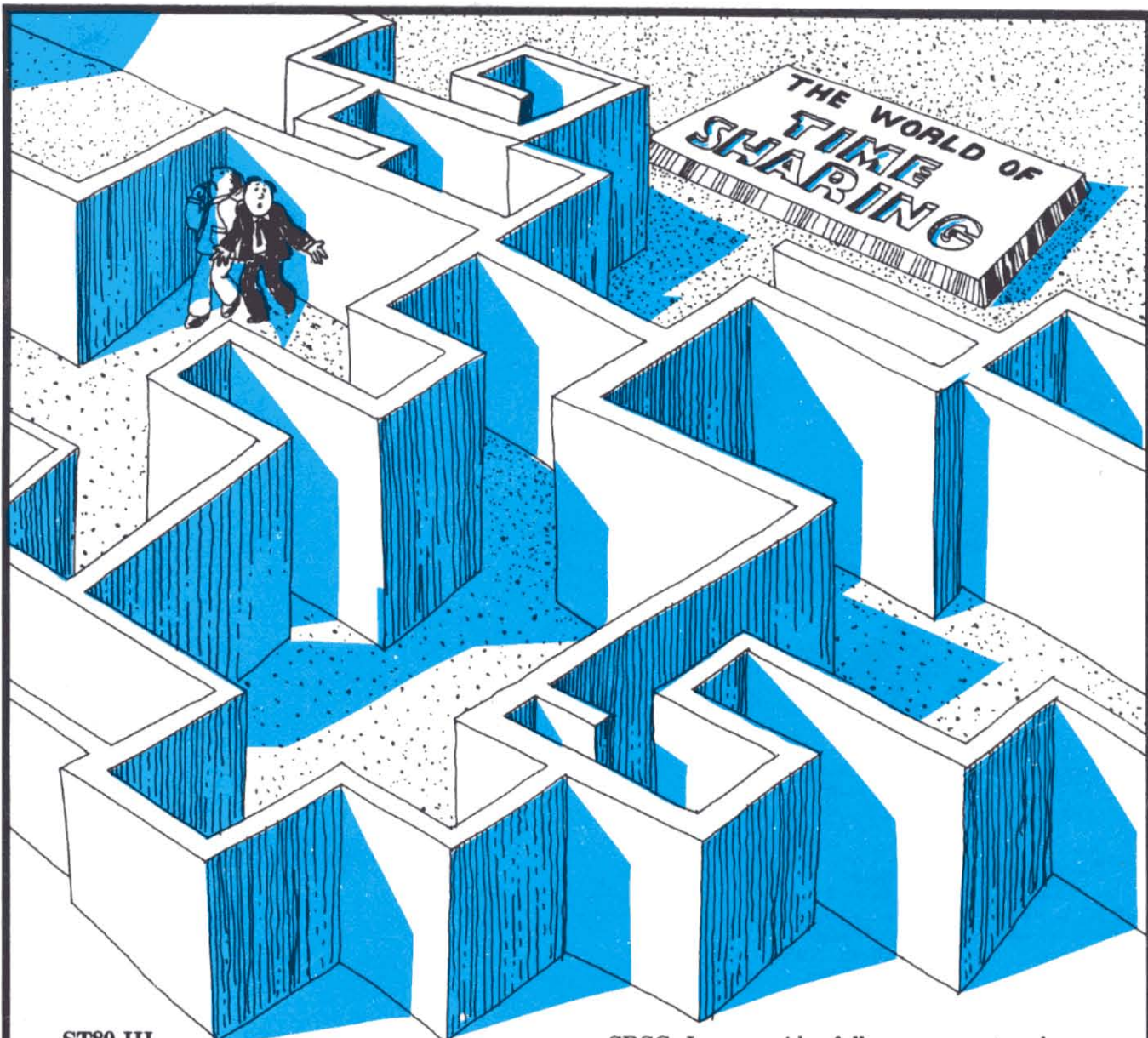
```
LOOP  7FEC 00180 00210
LPEN  7FE5 00150 00260
```

FOLLOWING IS DECIMAL EQUIVALENT OF ASSEMBLY PROGRAM WHICH CAN BE POKED IN MEMORY WITH A BASIC PROGRAM.

```
1 DATA33,220,5,62,0,211,255,43,124,181,32,251,219,255,230,128,111,38,0,195,154,1
0
2 FORX=32741TO32762:READP:POKEX,P:NEXTX
```

*Assembly Listing by Thomas Bell*





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SBSG, Inc., provides full user support and markets three other ST80 products. Any computer with communication capability can be accessed by ST80 III via your TRS80. Here are those computers SBSG has accessed:

- |               |               |               |
|---------------|---------------|---------------|
| Harris 7      | Apple         | Dartmouth TS  |
| Sigma 6 & 7   | Northstar     | Source        |
| DECsystems    | TRS-80* MOD I | Micronet      |
| HP2000        | TRS-80 MOD II | FORUM-80's    |
| CDC           | Superbrain    | Tymshare      |
| Honeywell     | Zenith/Heath  | Comshare      |
| IBM 370 & 360 | Altos         | Compugraphics |
| PDP-11        | GE            | Burroughs     |

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# 80 REVIEWS

*"We once received a tape with a program on one side and Barry Manilow's Greatest Hits on the other."*

**Acu-Data Tape Digitizer**  
Alphanetics Mfg.  
Forestville, CA  
\$54.95

by Chris Brown  
80 Staff

**A**h CLOAD, a much maligned mode. That the process works at all is testimony to the flexibility of the electronic devices involved. Cassette recorders were never really meant to handle data, even at slow rates, and microprocessors wince at the thought of their internal timing being upset by wildly gyrating cassette tape transport mechanisms.

Nevertheless, if you persevere, you can often actually load a program from tape into a computer via a cassette recorder. It may take some time, but it can be done. If your time (and patience) is at a premium however, you should consider acquiring an Acu-Data from Alphanetics.

### Data Pulses are Shaped

The Acu-Data is designed to facilitate CLOAD and tape duplication. In essence, it is a combination filter, rectifier and pulse shaping device. Placed at the recorder output, it conditions the tape data. Hum and other spurious noise is filtered out. Data pulses are then rectified and shaped to insure that proper pulse amplitude and timing is achieved before the computer ever sees the pulse train.

An Acu-Data has been in use at the *80 Microcomputing* editorial office for six months. Quite simply, it works.

Program tapes of questionable quality often accompany article submissions to the magazine, and loading these gems can be a real epic. We once received a tape with a program on one side and "Barry Manilow's Greatest Hits" on the other. The Acu-Data rarely encounters a tape it can't handle (including Barry Manilow's).

The unit runs on 110VAC so batteries are not necessary. Other features include an LED to indicate the presence and amplitude level of data, a polarity switch that allows the user to select either positive or negative going data pulses (to compensate for differences in the head and audio circuits or various cassette recorders) and a copying digital output jack that allows duping of processed program tapes.

The model we have has an optional switch that provides computer control of the recorder. This option, especially handy when sequentially loading data in long programs, costs an extra five bucks.

The most immediate benefit of an Acu-Data

is that it ends your worries about recorder volume settings. The unit produces the proper output level under widely varying input conditions: No more fooling with your kid's Dick Tracy Wrist Radio and the recorder volume control to get a good load.

The Acu-Data has proved to be a miracle worker when it comes to salvaging marginal tapes.

In addition, lousy originals can generate good copies when the copying digital output is used for duplicating.

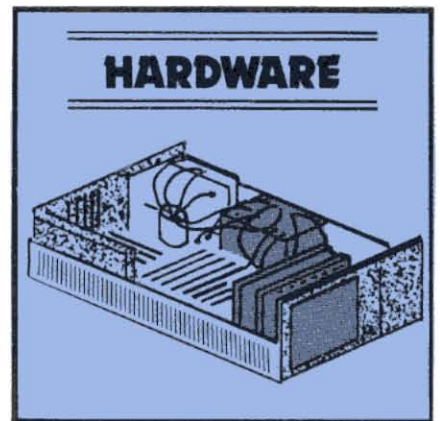
There are limits to the capabilities of the Acu-Data. Generally though, if you could not quite load a tape through the Acu-Data, you would not have gotten close without it.

The unit is ruggedly built, enclosed in a shielded metal case. The version we have shows signs of last minute fixes on the clad side of the PC board. The manufacturer assures us that they are not present on current production models.

### Always On Line

The Acu-Data is on line whenever it is plugged into a 110VAC outlet. No provision for removing AC from the primary of the line transformer is made and, consequently, the transformer is forced to dissipate a respectable amount of hysteresis generated heat. How this constant heat dissipation will effect its service life is a good question. So far, it has not affected the performance of our unit.

The comprehensive user's manual is clearly written and includes many hints on using tapes.



A schematic and parts list was not available, but we did see the warranty. It is impressive. Each Acu-Data comes with a ten-day, money back guarantee. In addition to a 90 day, unconditional warranty on parts and labor, a flat \$15 maximum repair fee is guaranteed on any problems encountered within the first 12 months.

Guarantees like this are rare in the microcomputer industry and certainly inspire confidence. Three cheers for Alphanetics.

Alphanetics has a winner in the Acu-Data. For tape oriented computerists who prefer to think in terms of black boxes and have no desire for breadboard projects, the Acu-Data is a worthwhile investment at \$54.95. ■

**TC-8 Cassette System**  
JPC Products  
Albuquerque, NM  
Kit: \$70  
Assembled: \$100

by Carl A. Kollar

**I** guess I don't have to tell any TRS-80 owners how frustrating the cassette system that comes with the computer can be. Even with the factory mod that's available, the annoyance of loading and checking programs becomes just barely tolerable.

If you're like me, after you've just plunked down a chunk of money for a Level II 16K machine, "you ain't got nuttin left" for even one disk drive at 500 bucks apiece. So you suffer.

A reasonable alternative is the Exatron Stringy Floppy (ESF). This will cost you about

250 bucks and totally eliminates your loading and saving problems, automatically and fast. I've had one of these for about six months and love it!

But, if the price is still too steep, have I got a device for you!

### The Device

The February 1980 issue of *Microcomputing* had an ad that intrigued the hell out of me. It was for a high-speed cassette system by JPC Products acclaimed as a "poor man's floppy." It made all sorts of seemingly ridiculous claims such as "loads five times faster," "stores 50,000 bytes on a 10-minute cassette," "less than one bad load in a million bytes with the volume control anywhere between one and eight."

All this for a measly 70 bucks? How could this be? A call to Albuquerque answered a few questions: Yes, it had its own power supply,

*Continue to page 16*



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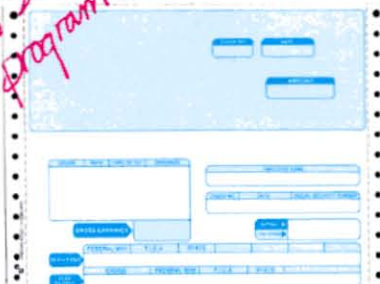
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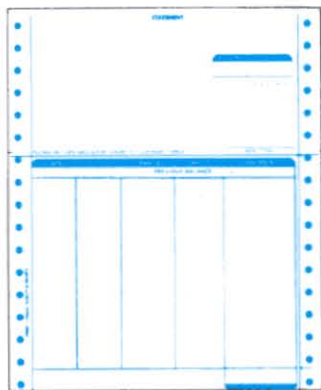


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TRS-80 FORMS





# 80 REVIEWS

From page 14

and, it stored programs five times faster because it utilized higher density data. The computer outputs the information at a higher rate out of the rear keyboard connector.

The ad had even claimed anyone could build it even if you have never soldered before. JPC would make it work, if you couldn't—for free. I was sold. I placed my order, and it arrived about two months later (parts shortage).

I work in electronics, so I found the unit exceptionally easy to build. It took about an hour. The manual is superb. (That's better than great.) It was clear, concise and exact with no ambiguities. Important parts placements are stressed (polarity markings on electrolytics, bands on diodes, etc.).

JPC was right! With these instructions, you couldn't go wrong. The board quality is excellent. It is double-sided and parts locations are clearly marked on the component side of the board. There are no jumper wires to install. JPC utilizes PC traces and plated-through holes for connections to traces on the other side of the board.

Also, there are absolutely no adjustments or settings to bother with.

The documentation is a sheaf of 8½ x 11 papers stapled together. It is written in the nicest format I've seen in a while. Each command and/or subject is covered on its own sheet in large type. All explanations are in easy to read English—not computerese.

## Commands and Features

**SAVE“filename”:** Saves your BASIC program on cassette.

**LOAD:** Reads the next BASIC program from the cassette.

**LOAD“filename”:** Searches for and loads the specified file from cassette.

**LOAD? and LOAD? “filename”:** Reads file from cassette, and compares contents to memory.

**LOADN:** Prints a list of all the programs on a cassette, until interrupted by the “break” key.

**LOADN“filename”:** Same as above except the tape will stop at the end of the program named.

**KILL:** Removes the file manager program from memory so that the extra memory can be used by large programs.

**RSET:** Allows the operator to rewind and position the tape on tape recorders that have these functions tied to the motor control jack.

**RUN“filename”:** TC-8 searches for a specified program and runs it immediately.

**PUT“filename”:** Same as SAVE“filename”, except it is for use with system tapes.

**GET:** Same as LOAD, except it is for use with system tapes.

**GET“filename”:** Same as LOAD“filename”, except it is for use with system tapes.

**GET? and GET? “filename”:** Same as LOAD? and LOAD?“filename”, except it is

for use with system tapes.

**GETN and GETN“filename”:** Same as LOADN and LOADN“filename”, except it is for use with system tapes.

**OPEN:** Required before cassette input or output of a data file can be attempted.

**CLOSE:** Required to end a cassette data file.

**PRINT#:** Allows numerical or string data to be output to a cassette file.

**INPUT#:** Allows numerical or string data to be input from a cassette file.

I haven't counted them, so I don't know about the “one load in a million bytes” claim,

but my son, Anthony (age 11), loaded about 30 of his programs from his Radio Shack format tape to a new TC-8 format tape. He's run them all and found no bad loads.

Unlike the standard tape system, you can position your tape anywhere before the program you want and not have to look for a blank spot between programs. The TC-8 patiently waits for the program you want and then starts loading without getting confused by the portion of the previous program you just fed it.

Try that on your regular cassette system; you'll wear out the reset button. ■

## MAYDAY + S Uninterruptible Power Supply Sun-Research, Inc. New Durham, NH \$325

by Chris Brown

Mayday, the international signal of distress, is not likely to be the first word uttered by a computerist when the power fails in the middle of a lengthy program. Personally, I can think of many more satisfying expletives, but Mayday may be more appropriate. It is the trade name for an uninterruptible power supply, designed to end power line problems.

### Emergency Power

Mayday is a fail-safe device which, in the event of a drop in line voltage, provides emergency power to a microcomputer system. Once on emergency power, you can terminate the system in an orderly fashion with no program crash or loss of data. Emergency operation time varies with the Mayday model and the size of your system, that is, how many disk drives you own. The Mayday + S can generate up to 30 minutes of emergency power.

Sun-Research, Inc. is a new manufacturing and marketing venture launched by Phase-R Corporation, a diversified New Durham electronics firm. Among its products are laser devices manufactured for the medical field and the government.

The original Mayday unit was created to meet Phase-R's need for a reliable, isolated power source for the office TRS-80. The company's rural location resulted in frequent power outages, and the TRS-80's close proximity to heavy machinery made it difficult for it to run without glitches. After a few monthly payroll records were lost, the Mayday was born.

Not only does the unit provide instant back-up power, it also isolates the computer from spikes and transient voltage surges on the AC line.

The Mayday uses a modified, 120 Hz, square wave generator as a DC to AC converter. When power fails, this generator supplies power from a 12-volt battery to the computer. A specially designed isolation transformer allows the Mayday to maintain, plus

or minus, five percent required computer power during switch-over to internal power. Plus or minus one-half percent is maintained thereafter. Switch-over time is on the order of five milliseconds, so no loss of memory occurs.

A 12-volt automotive battery (available separately) is used in conjunction with the Mayday and is enclosed in a high impact plastic case. A built-in trickle charger keeps the battery voltage within accepted limits.

The computer monitor, interface, keyboard and peripherals plug into a bank of outlets on Mayday's front panel. The entire system is controlled by one circuit breaker, while an idiot light indicates system status. A very convenient layout.

### Line Surge Protector

Most versions of the Mayday incorporate an MDS line surge protector. If your computer operates in an electrically noisy environment, this option is a must.

If its operation in our office is any indication, Sun-Research has met its design goals with the Mayday. The 80 editorial offices share building space with a printshop and darkroom, and the AC line that our computer runs on is subject to large voltage swings and noise. The constant shrinking of our video as presses came on line was a real source of worry.

Once the Mayday + S was installed, the shrinking video was eliminated. Now, the occasional excursions of the line below normal levels result in a smooth transition to emergency power rather than a catastrophic program crash.

One drawback of our Mayday + S is its inability to power the 60 Hz AC fan motors used in our disk unit and printer. This can be overcome by wiring these motors directly to an external AC source. To alleviate this problem, Sun-Research has developed a Mayday unit that supplies a 60 Hz sine wave source of voltage. This new Mayday is suitable for use with Model II machines.

As the air conditioning season approaches and brown-outs become more frequent in metropolitan areas, the computer chaos caused by erratic AC lines will increase. A Mayday unit can be your first line of defense against system glitches. Now, if you can only get your TRS-DOS squared away . . . ■



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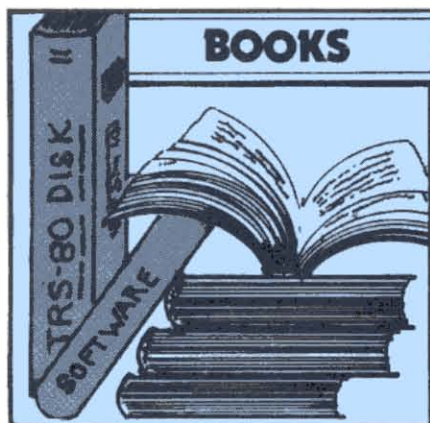
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**TRS-80 Disassembled Handbook**  
**Robert Richardson**  
 Richcraft Engineering Ltd.  
 Chautauqua, NY  
 \$10 Vol. 1, \$15 Vol. II

by Dennis Bathory Kitz

The programmer's afterworld is destined to offer three options: a heaven of powerful, high-level languages; a hell of detailed machine code; and a purgatory, where everyone uses Richcraft Engineering's *TRS-80 Disassembled Handbook*.

The handbook's premise is that once a user has struggled (resentfully, no doubt) through machine code, "it is ridiculous to 're-invent the wheel' . . . when these routines already exist in Level II ROM." Much of this premise is sound, and author Richardson, with more than a few questionable generalizations about the primacy of his book and the ease of his method, takes the reader step by step through the many useful subroutines available in Microsoft's BASIC.

#### Hurrah for the Evangelist

For once we may say, "Hurrah for the evangelist of the short-cut," for Richardson does insist that knowing machine language well is prerequisite to using these subroutines effectively. Indeed, a technique that dips into the netherworld of another person's code can be disastrous and misleading for a novice, but perfectly valid for an experienced machine language program author, who does not care to expend either the time or the memory necessary to write, for example, double-precision decimal arithmetic.

The available options for a user-programmer are, of course, inevitably slow BASIC; assembly language coding; compilers such as BASEX or FORTH; or a combinational method such as the handbook suggests. The compilers are generally straightforward, but cannot efficiently co-exist with resident programs. Where a TRS-80 must fill a variety of needs, machine language programs easily accessible through a SYSTEM or USR(X) command are most desirable.

Richardson's technique stands out as singularly effective, because most of the speed of original machine language software is main-

tained, and memory is conserved through generous use of calls to Level II ROM.

On the other hand, much of Richardson's proselytizing is overbearing and self-righteous, and often useful points are obscured by his tone. A bit overeager in self-appreciation, the author states that his work is the first revelation of the inner workings of the Level II ROM, when in fact, *TRS-80 Supermap*, published by Fuller Software, exposed and annotated the ROM's contents six months before the appearance of Richardson's book.

Even worse, the organization of the book is weak, and the continuous cross-pollution of hexadecimal and decimal references further blurs the operations of a code still based on the octal language of the 8080 archetype. Finally, one is forced to question the value of 16 pages of the 70-page handbook dedicated to a hex listing of Level II ROM. Since none of it is disassembled, the user cannot learn how registers and memory are employed.

#### Plenty of Oratory

In short, Richardson does not help us learn; he presents a technique, some examples of its use, and plenty of oratory. A sample: "Only a retarded 3rd grader would overlook them (the BASIC names) in memory locations 5712

through 6172."

And one more: "Let us be kind, though, and presume that Radio Shack had not the slightest idea what Level II ROM contained, and if they did, had not the slightest idea on how to find it and use it. If such is not the case, they surely stand guilty of gross negligence and malice aforethought . . ."

Fortunately, the handbook's techniques are significantly more space-efficient than the author's writing.

Now to the question: As microcomputer users, we have been overwhelmed with software and printed matter which seems priced far above its worth. By comparison with other fields, we pay an enormous amount for companion products for our machines. Is the *TRS-80 Disassembled Handbook* worth its cover price? Perhaps.

For less than \$20 the *TRS-80 Supermap* comes with a detailed annotation of the operation of Level II ROM subroutines. That and Richardson's book, plus Editor/Assembler, T-BUG and the Z-80 Technical Manual, return no change from a hundred-dollar bill. Together, they are a powerful resource. But on its own *TRS-80 Disassembled Handbook* provides only a modest return in exchange for your investment. ■

**Adventure**  
 by Gordon Letwin  
 Softwin Associates  
 Microsoft  
 Bellevue, CA  
 \$30.00

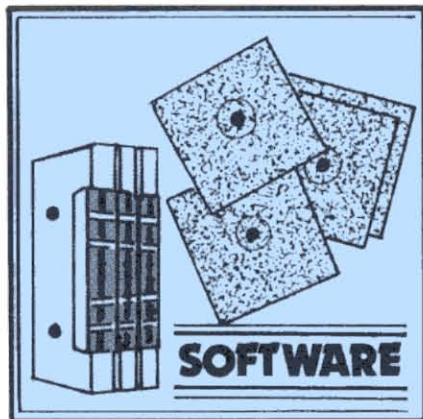
by John Warren

Having been introduced to Adventure on a Burroughs 6802, I just couldn't get excited about the many mini-adventures written for home computers. However, Gordon Letwin of Softwin Associates has produced a rip-snorter that is almost indistinguishable from the original.

A player explores a giant cave, finds treasures and battles knife-wielding dwarves. The computer is directed with one or two-word commands like "get axe" or "north" (go north). Part of the fun is finding out what commands the computer accepts and when it accepts them. Adventure is not a game that someone learns in a few minutes, plays in half an hour and forgets in a week.

In a mainframe environment, experienced adventurers assist (and tantalize) novices with hints. "So the dragon has got you stuck. He isn't any problem if you're tough. Come on now—what would Conan do in this situation?" To overcome the micro-user's isolation, Softwin has prepared a series of four hint books and is selling them for a buck apiece (4 for \$3).

The game runs on a 32K, single disk TRS-80. To say that it uses the disk is an understatement. Almost every move causes a quick search. However, the delay is insignificant—rarely over a second. Playing a mainframe over a 300 baud line is much more frustrating.



The specially designed DOS seems to occupy only one sector, leaving the rest free for program and data. Software filchers are going to be tearing their hair out on this one, since there is no "copy" utility and data is disguised by a sophisticated bit shifting routine. Unfortunately, this also means there is no way to make a backup. Microsoft recognizes this and offers a one-year replacement warranty.

Because of the lengthy playing time (several hours), a "save" feature allows players to suspend the game for later resumption.

The game is attractively packaged and comes with a clearly written instruction book. Clearly, both the \$30 price tag and the extensive hardware necessary are going to limit sales, but this is an exceptionally entertaining game, and if the fanaticism of the mainframe adventure addicts is any indication, it should enjoy a steady increase in popularity. ■



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By Gregory Berryhill

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# 80 ACCOUNTANT

by Michael Tannenbaum C.P.A.

*“ . . . even if these problems can be overcome, the mechanical construction of the Model I has limitations.”*

**D**uring the period in which I have been writing articles for this column, one of the most frequently asked questions has been how much disk storage is available for the Model I microcomputer.

By now, most users know that the Model I can handle up to four drives. Each drive accommodates just under 90,000 bytes (words) of information.

In some data processing systems a word equals one alphanumeric character, however, the 80 can pack several numeric characters into each word. Accordingly, it is difficult to calculate the numbers of words of disk storage available for mixed numeric and alphabetic data.

## How Many Bytes

The technical reasons for this are as follows:

- Integers—up to 64,000—require two bytes of storage.
- Single precision data require four bytes.
- Double precision data require eight bytes and each alphabetic character requires one byte.

An additional complicating factor is the way the 80 reads and writes disk records. All Model I operating systems, with the exception of VTOS 3.0, read and write 256 bytes at a time in the random mode. Thus, if you have a random access file with less than 256 bytes, you lose storage.

Data type and record length affect the ultimate size of the file. However, the real storage problem in the TRS-80 is the fact that a file cannot span more than one disk. For example, a file with 6,000 names requires multiple disks to contain the data. You must break the file into segments. Each segment can be entered on a separate disk, but the software must be written so that the directory of each disk is accessed before processing.

Of course, changing data on this file causes problems. As you add and delete data, gaps appear. The system would have to maintain a record of every gap and, periodically, rearrange the file to accommodate new data.

Since the data would have to be inserted randomly, access would require the extraction of key words and the development of a sorted index. To sort 6,000 keys into any kind of order is a time-consuming task on the Model I.

If the sort could not be performed in memory, then a disk sort and an index disk would be required. This separate disk might be required in any case to retain key words and pointers to locations on the main data file.

Using an index disk can also create problems. You might have to remove data disks to provide a drive for the index, if sufficient core

was not available for the index to be kept in memory.

But, even if these problems can be overcome, the mechanical construction of the Model I has limitations. The Model I can only detect if a disk drive is on or off line. The program has no way of knowing whether or not someone inadvertently took out a portion of the file. Because this increases the chance for error, most soft-

ware developers prefer not to write programs for accessing large files on the Model I.

Although the Model II disks contain more data than the Model I diskettes, you cannot escape the limitations of floppy storage. Even with its larger files, a Model II cannot control all items. Systems that use extremely large files require a hard disk.

*Continue to next page*

## CAPTAIN 80

by Bob Liddil

**H**ere's Captain Eighty, sitting in his reviewer's chair, assessing this month's mail. Response to the contest was lively. Entries ranged from high camp to very serious. Many readers were less than convinced that we really had a contest going at all.

Andy Anderson, from Larimore, ND, suggested an Elections game, where players receive a random dollar amount from Fat Cats, to be spent in media exposure, transportation, office support and insurance against ethnic jokes, slipping on buses, and stuff like that. A second program, appropriately entitled Headache, dealt with taxes, government agencies, the economy and all those pesky problems that interfere with a politician's partying, after his election.

The last of Andy's three paragraph program series would finance and manage World War III, a situation that came about as a result of our messing up in the second.

Thanks, Andy. I hope the programmers out there are paying attention.

## More Letters

Craig Griffin, from Bessemer, AL, would like to see language translation programs, particularly Portuguese, in which an English sentence entered would elicit the appropriate foreign phrase. Very useful. After all, a computer has more memory available than those little hand-held calculators.

Tom Mason, of Akron, OH, suggests programs that "shoot anything"—X-wing fighters airplanes, ducks, tanks, ships, world leaders—and with selectable skill levels. Impressive graphics is a must for the hit, says Tom, as well as a user selected description: boss' name, mother-in-law's name. You get the idea.

Al Mescha, of Chicago, IL, sent in a one liner (that contest hasn't started yet, Al). He says, "When I use the INPUT command, I use the following format: PRINT STRING\$(60)," ";CHR\$(28); :INPUT. This homes the cursor and clears the first line only. Thus, you only have to draw your graphs, pictures or whatever once." This is a handy little ditty, try it.

Rob Robinson, of Palo Alto, CA, sent in an educational program he wrote for his six year old. Called Scrambled Words, it features a blinking cursor and a reward display named Anthro. This program is excellent.

Rob, I suggest that you submit your program to *80 Microcomputing* along with a description. It would fill a void in 80's educational programming department.

NITS Software, Rialto, CA, also sent me an educational sampler. To my absolute surprise and delight, Wordmaster, a terrific reading and spelling program, loaded the first time out. A fresh, professional approach to the subject, Wordmaster gives the student (early third grade) plenty of work without overwhelming him. Wordmaster builds vocabulary and reading skills with style, grace and charisma.

This is not NITS' only offering. The company has a catalog full of educational material, which should be every bit as well written as the above. Drop these guys a line at 680 North Arrowhead Ave., Rialto, CA, 92376. I'm sure they'll pop a catalog to you in the mail.

Radio Shack has a new Adventure, Pyramid 2000. It's impressively packaged and reasonably priced. Hard core Adventure fans will no doubt mourn the omission of the Scott Adams split screen and blinking cursor. Radio Shack chose to ignore all Adams' genetic

*Continue to page 26*



However, the Model II can detect changes in a drive's directory. When a disk is removed and a new disk is put in place an initialization command must be used. The DOS then reads the directory to learn its contents.

The Model II has an additional advantage over the Model I—with the exception of those who use the VTOS 3.0 operating system—in that every byte on the disk is available. It is the disk operating system that fills the tracks and handles sector boundaries. This advantage means that not only can the Model II utilize disk space more efficiently, but the burden of managing data storage is removed from the programmer.

#### Recordkeeping from Osborne

During the past year, I have had the opportunity to review accounting software developed by the Osborne Company. This software, originally developed for a Wang Minicomputer, was designed for firms using job cost recordkeeping. Because this system has been published in book form, many software houses have copied the package and are distributing it under their name.

I have reviewed portions of the package from various vendors. The most recent was the Accounts Receivable, adapted from Wang BASIC by the Small Systems Business Group. Perspec-

tive purchasers of Osborne systems are advised to purchase the description books which are available at many computer stores: *Payroll and Cost Accounting in BASIC, Accounts Receivable, General Ledger.*

Since the system was designed to keep track of expense by job, the program handles large files. When the job is billed, the net profit on the job can be calculated.

The Small Systems Business Group has dropped much of the job-costing features of the original Osborne program. This is fortunate, because it reduces the size of key files. On the Model I, the Accounts Receivable program permits a maximum of 670 accounts and 650 transactions for a four-disk system. If these limitations do not dissuade you, it has its advantages:

- The documentation explains the system and permits modification.
- The user manual is relatively readable.
- Because of the program's wide publication, it has been accepted as somewhat of a business standard.

The receivable system is of the open item type. Open item receivable systems retain details of all active transactions (invoices, payments and credits) until updated. Once updated, completed transactions are purged, and only open items are retained.

There are two advantages to this type of file maintenance. One is that file agings indicate open transactions. This significantly aids follow-up and resolution of old balances due. If only a balance forward is kept, details of outstanding items must be researched or maintained manually.

#### A Second Advantage

The second advantage of an open item system is that aging reports can be prepared accurately, since the date of all transactions is present. In a balance forward system, cash application is particularly troublesome, if applied to the wrong category.

Under the Osborne system no payment or transaction can be recorded, unless an invoice is already on file. This is both a safeguard and an inconvenience. It is a safeguard in that transactions can be tracked back to a document. However, if you get cash on account before an invoice is prepared such a system will cause problems. In order to record the cash on the receivable system, a dummy invoice must be created. This is inconvenient to say the least.

Generally, you will find that the Osborne program creates excellent reports in a readable format. The receivable system can be purchased separately, or integrated with a payables system and the general ledger. ■

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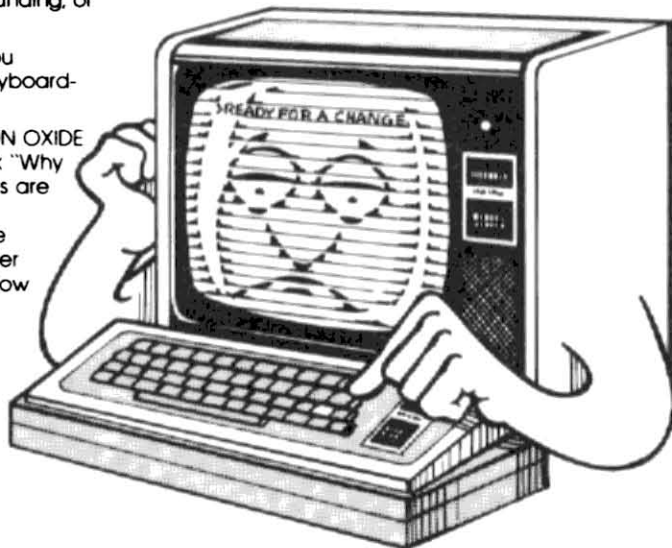
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# THE ASSEMBLY LINE

by William Barden, Jr.

*"This is the heartbreaking story of why it is so difficult to use TRS-80 graphics to their full potential."*

Six into eight don't go", said the Duchess, evenly.

I've always wanted to start a best selling novel with that line. The novel has never materialized, but at long last I can use it. This is the heartbreaking story of why it is so difficult to use TRS-80 graphics to their full potential.

Most of the readers know very well how graphics are used on the TRS-80. To refresh your memory: There are 16 lines of 64 character positions on the video display. Each character position occupies one byte of video display. The addresses of video display memory are from 3C00H through 3FFFH (15360 through 16383 decimal).

*"If you're hazy on this point use BASIC to POKE various values into video memory . . ."*

When any of those bytes in video display memory are loaded with a value from 20H through 7FH (32 through 127 decimal) an ASCII character is displayed on the screen. The ASCII character is generated by the video display electronics hardware on the CPU board, which contains a character generator chip that translates from ASCII into a pattern of 5 by 7 dots for the character.

When a byte in video display memory is loaded with a value from 80H through BFH (128 through 191 decimal), a graphics character is used in place of the ASCII character; the character generator is not used in this case, but the logic sets one or more of six pixels, dependent upon which bits are set in the value as shown in Fig. 1.

Note that for any graphics character, bit 7, the "high-order" bit, is set, bit 6 is ignored, and bits 5 through 0 determine whether the pixel is on or off.

If you're hazy on this point, use BASIC to POKE various values into video memory until you can predict which pixels will be set based on the value POKEed.

What we'd like to develop here is an assembly language routine to SET any one of those 6 by 1024 pixels. Although the 6144 pixels provide rather coarse resolution when the TRS-80 is compared to some other microcomputers,

the graphics mode is much better than working on a character position basis.

## Set the Pixel

Before we can develop the assembly language code, we need to know the algorithms involved. (Algorithm is simply a synonym for plan or formalized procedure.) Let's see what's involved in setting a pixel on or off.

Fig. 2 shows a generalized character position on the screen that contains a pixel to SET or RESET. If we start with any X,Y position, what can be said about the position of that pixel in the 1024 bytes of video display memory?

First of all, the line number of the character position containing the pixel is given by the quotient of  $Y/3$ . For example, Ys of 0-2 are in line 0; Ys of 3-5 are in line 1; and so forth, up to Ys of 45-47, which are in line 15. What happened to the remainder of  $Y/3$ ? Ask me again later.

The character position along the line is given by the quotient of  $X/2$ . There are 64 character positions along the line, numbered 0 through 63. Xs of 0 and 1 are in character position 0; Xs of 2 and 3 are in character position 1; and so forth, up to Xs of 126 and 127, which are in character position 63. What happened to the remainder of  $X/2$ ? Ask me again later.

Knowing the line number and character position, it is easy to find the actual location of the video display byte that contains the pixel in question. If the line number is the quotient of  $Y/3$ , and the character position is the quotient of  $X/2$ , then the byte displacement, or position from the start of video display memory is:  $\text{Byte Displacement} = (\text{Line \#}) * 64 + \text{Char Pos}$ . The actual memory location is the  $\text{Byte Displacement} + 3C00H$ , or  $\text{Byte Location} = (\text{Line \#}) * 64 + \text{Char Pos} + 3C00H$ .

Now that we know how to find the byte con-

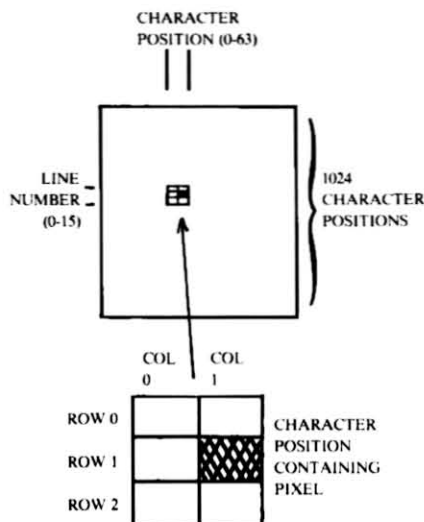


Fig. 2. Line Number, character position along line, row, and column of Pixel

taining the pixel, how do we know which of the six bits controls the pixel? Would you hand me those remainders, please?

If we separate each graphics byte into two columns and three rows, we can use the remainders of  $Y/3$  and  $X/2$  to find the right bit.

The remainder of  $X/2$  defines the column number of the pixel. For example, Xs of 0,2,4,6, etc., define a pixel in column number 0; Xs of 1,2,5,7, etc., define the row number of the pixel. Ys of 0,3,6,9, etc., are in row 0, Ys of 1,4,7,10, etc., are in row one, and Ys of 2,5,8,11, etc., are in row two.

Knowing the row and column, we can also

*Continue to 24*

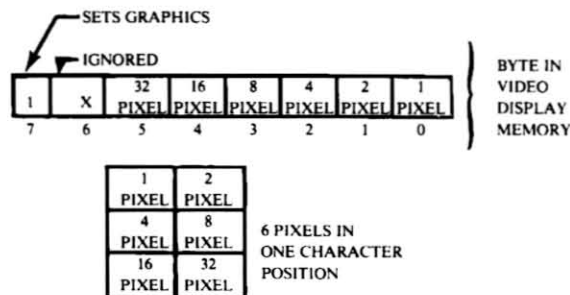


Fig. 1. Graphics Mode Pixel Mapping



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find the bit position in the byte by Bit Pos = (Row #)\*2 + Col #. For example, row one, column number one, is defined by bit 3 of the byte.

## Seven Incomprehensible Formulas

We now have seven incomprehensible formulas that we can use to develop the code for SETing or RESETing any pixel. They are shown in Fig. 3.

Now that we've got the formulas, let's develop the assembly language routine. Hummm . . . dividing by two is easy—a simple shift right will divide by two and even save the remainder of 0 or 1 in the carry. Multiplying by 64 is also quite easy—an ADD HL,HL multiplies by two and six of them will multiply by 64. It look like the hardest part is the division by three. Three is not a "convenient" divisor as it is not a power of two. The code for this task is shown in Listing 1.

The code from SET to SET10 finds the character position (CP) by dividing the X value in the E register by two. The SRL shifts the contents of the E register one bit right to do this, and the remainder of zero or one is shifted to the carry flag after the shift. The state of the carry is used to put either a 0 or 1 into the D register for the column number (CN).

The code from SET10 to SET25 finds the line number (LN) and row number (RN) by dividing the Y value by three. The divide is done by successive subtraction of three from the Y value in the A register. The count of the number of times three is subtracted is held in the B register. As long as A remains positive, the subtraction is continued. When A goes negative, the ADD A,3 restores the remainder to A while the quotient remains in the B register.

At this point we have the four basic values of line number (B), character position (E), row number (A), and column number (D).

Now we can use these values to find the actual byte containing the pixel, and then find the bit within the pixel. SET25 to SET27 finds the bit position in the byte by multiplying the row number by two (RLCA) and adding the column number. This bit position is saved in the C register.

The code from SET27 through SET32 multiplies the line number by 64 by shifting it 6 bit positions left. This multiplication is done by 6 ADD HL,HL instructions. This must be a double (16-bit) add because the product may be as great as 15\*64 (960). At SET32, the line number\*64 is in the HL register pair.

The code from SET32 to SET34 adds the character position in DE to HL to find the byte displacement, and then adds the displacement to 3C00H to find the actual location of the byte. At SET34, the location of the byte containing the pixel is in the HL register pair.

Now the only thing left to do is to SET the pixel of the byte. The code from SET34 on uses the bit position in C to "index into" a table of masks, using the IX register. The A register is loaded with the byte containing the pixel (LD A,(HL)), followed by an OR (IX) to set the proper pixel, followed by a store of the altered value (LD (HL),A). Note that bit 7 is always set by the mask value to ensure that graphics mode will be used.

We now have a general subroutine to set any pixel at will.

## Reflections on the SET Subroutine

What you're seeing in SET is the result of a great deal of work. I could say here that I sat down and wrote this code in five minutes. Tain't so. I have seen programmers who could generate such code in fifteen minutes, but they are few and far between. It would not be unusual for many programmers to spend a day on the algorithms and a day on the code for this subroutine.

How fast can assembly language code be generated? This depends on a number of fac-

tors, such as access to the computer, interaction with the system, complexity of the code, definition of the problem and others. As assembly language programmers on the TRS-80, we have probably the best of all environments—a highly interactive system with a single user and excellent assembly and debugging tools.

Typical industrial standards used for assembly language code are on the order of 10 to 30 lines of assembly-language code per day! That's right, per day! Of course, those figures are based upon the complete program design, coding, debugging and documentation task,

*Continue to 26*

```

FF00      00100      ORG      0000H      ;CHANGE ORIGIN FOR YOUR SYSTEM
00110      ;*****
00120      ;* SUBROUTINE TO SET A PIXEL GIVEN X (0-127) IN H *
00130      ;* REGISTER AND Y (0-47) IN L REGISTER *
00140      ;*****
00150      ;
FF00 5C      00160 SET   LD      E,H      ;X
FF01 7D      00170 LD      A,L      ;Y
FF02 C83B    00180 SRL     E      ;GET CHAR POSITION (0-63) IN E
FF04 1600    00190 LD      D,0     ;SET COL# TO 0
FF06 3001    00200 JR      NC,SET10 ;GO IF COL# = 0
FF08 14      00210 INC     D      ;COL# = 1
FF09 06FF    00220 SET10 LD     B,0FFH ;-1 TO B
FF0B 0A      00230 SET20 INC     B      ;BUMP QUOTIENT IN B = LINE#
FF0C D603    00240 SUB     3      ;SUCCESSIVE SUBT FOR /3
FF0E F20BF  00250 JP      P,SET20 ;GO IF NOT NEGATIVE
FF11 C603    00260 SET25 ADD     A,3     ;ADD BACK FOR REMAINDER = ROW#
FF13 07      00270 RLCA    ;(ROW#)*2
FF14 82      00280 ADD     A,D     ;(ROW#)*2 + COL# = BIT POS
FF15 4F      00290 SET27 LD     C,A     ;SAVE BIT POS IN C
FF16 68      00300 LD     L,B     ;LINE #
FF17 2600    00310 LD     H,0     ;NOW IN HL
FF19 0606    00320 LD     B,6     ;SHIFT COUNT
FF1B 29      00330 SET30 ADD     HL,HL   ;MULTIPLY LINE#*64
FF1C 10FD    00340 DJNZ   SET30 ;LOOP TIL DONE
FF1E 1600    00350 SET32 LD     D,0     ;DE NOW HAS CHAR POS
FF20 19      00360 ADD     HL,DE   ;(LINE#)*64 + CHAR POS IN HL
FF21 1100C3  00370 LD     DE,3C00H ;START OF VIDEO
FF24 19      00380 SET34 ADD     HL,DE   ;(LINE#)*64 + CHAR POS + 3C00H
FF25 0600    00390 LD     B,0     ;BC NOW HAS BIT POS
FF27 DD2133FF 00400 LD     IX,MASK ;START OF MASK TABLE
FF2B DD09    00410 ADD     IX,BC   ;POINT TO MASK
FF2D 7E      00420 LD     A,(HL)  ;LOAD PIXEL
FF2E DDB600  00430 OR     (IX)   ;SET PIXEL
FF31 77      00440 LD     (HL),A  ;STORE IN VIDEO
FF32 C9      00450 RET     ;RETURN
FF33 B1      00460 MASK  DEFB   B1H   ;MASK TABLE
FF34 B2      00470 DEFB   B2H
FF35 B4      00480 DEFB   B4H
FF36 BB      00490 DEFB   BBH
FF37 90      00500 DEFB   90H
FF38 A0      00510 DEFB   0A0H
0000      00520 END
00000 TOTAL ERRORS
    
```

*Program Listing 1. SET Pixel Subroutine*

```

8000      00100      ORG      8000H
00110      ; 8-BIT SQUARE RT SUBROUTINE BY CLIFF DEJONG
00120      ; A CONTAINS NUMBER ON ENTRY, B CONTAINS RESULT ON EXIT
00130      ;
8000 010100  00140 Sqrt  LD      BC,1     ;B=0 C=1
8003 91      00150 LOOP  SUB     C      ;A=A-C
8004 08      00160 RET     C      ;DONE IF A<0
8005 0C      00170 INC     C      ;
8006 0C      00180 INC     C      ;C=C+2 NEXT ODD #
8007 04      00190 INC     B      ;B=B+1 BUMP COUNT
8008 1BF9    00200 JR      LOOP
00210      ;
00220      ; 16-BIT SQUARE RT SUBROUTINE BY JAMES BRAUD
00230      ; HL CONTAINS NUMBER ON ENTRY, A CONTAINS RESULT ON EXIT
00240      ;
800A AF      00250 BEGIN  XOR     A,A     ;INITIALLY TRY 0 AS SQ RT
800B 01FFFF  00260 LD     BC,0FFFFH ;BC = -1
800E 09      00270 LOOP1  ADD     HL,BC   ;IF NUMBER IN HL BECOMES NEG
800F D0      00280 RET     NC   ;YES-RETURN
8010 3C      00290 INC     A      ;NO - TRY NEXT RT
8011 08      00300 DEC     BC
8012 08      00310 DEC     BC
8013 1BF9    00320 JR      LOOP1 ;UPDATE SUBTRACTOR
0000      00330 END
00000 TOTAL ERRORS
    
```

*Program Listing 2. Square Root Subroutine*





**S-80**

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and also are based upon larger programs than ten or twelve instruction subroutines.

On a positive note, though, standards for higher level language code, such as BASIC, also show that not many lines of code can be generated rapidly when the entire design, coding, debugging and documentation tasks are considered.

The point of this monologue is that you should not be dismayed if some of the assembly language code takes longer than you expected; you have plenty of company!

The SET routine is a "medium hard" piece of code, and it encompasses a lot of techniques. If you can follow it, you've gone a long way into learning assembly language methods.

By the way, it's entirely possible that there is a more efficient way to accomplish this problem. I would be most interested in any better subroutines.

Why is it so difficult to SET a pixel? The "mapping" of X and Y into the corresponding byte and bit values is not straightforward, as we have seen. Could it have been made easier? Yes, but at the expense of increased hardware costs. For the moment, we have to "program around" the fact that six into eight don't go—evenly.

## Assembly Line Programming Contest

Back in the first Assembly Line column I offered a challenge to the readers in the form of a programming problem: "Given a number, find the integer portion of its square root in a short assembly language routine. For example, given 137, find the 11 portion of 11.7047 in a short piece of code."

Since that time I've received a number of replies, many with interesting comments about assembly language topics. I appreciate them all. There were three winners for this problem, and they will each receive an autographed copy of my new Howard W. Sams book *Z-80 Microcomputer Design Projects*, \$12.95 (\$11.95 autographed).

Some of the readers tried brute force for finding the square root, but there is a trick. The "nth" perfect square is the sum of the first n odd integers. A perfect square is 1<sup>2</sup>, 2<sup>2</sup>, 3<sup>2</sup>, 4<sup>2</sup>, and so forth. If n is six, for example, its square is 36, which is the sum of the first six odd integers, 1 + 3 + 5 + 7 + 9 + 11. All we must do to find the integer portion of the square root of any number is to successively subtract 1, 3, 5, . . . until the residue goes negative. The number of subtractions, minus one, is the integer portion of the square root. If we have 137, for example, we have:

137 - 1 = 136 - 3 = 133 - 5 = 128 - 7 = 121 - 9 = 112 - 11 = 101 - 13 = 88 - 15 = 73 - 17 = 56 - 19 = 37 - 21 = 16 - 23 = -7. We had 12 subtractions, and 12 minus one is 11, the integer portion of the square root.

The shortest 8-bit routines were submitted by Gary E. Clark of Bethesda, MD and Cliff De-Jong of Colorado Springs, CO. As several readers pointed out, I had not specified whether 8 or 16-bit arithmetic was to have been used. The shortest 16-bit routine was written by James Braud of Bay St. Louis, MS. Cliff's 8-bit routine and James' 16-bit routine are shown in

$$1. LN = \text{LINE \#} = \left( \frac{Y}{3} \right) \text{ QUOTIENT}$$

$$2. CP = \text{CHARACTER POSITION} = \left( \frac{X}{2} \right) \text{ QUOTIENT}$$

$$3. \text{BYTE DISPLACEMENT} = (LN) \cdot 64 + CP$$

$$4. \text{ACTUAL LOCATION} = (LN) \cdot 64 + CP + 3C00H$$

$$5. RN = \text{ROW NUMBER} = \left( \frac{Y}{3} \right) \text{ REMAINDER}$$

$$6. CN = \text{COLUMN NUMBER} = \left( \frac{X}{2} \right) \text{ REMAINDER}$$

$$7. \text{BIT POSITION} = (RN) \cdot 2 + CN$$

Fig. 3. Pixel Formulas

## Program Listing 2.

The eight-bit routine uses 10 bytes. The BC register pair is loaded with one. In fact, this load really loads the C register with one and the B register with 0, saving one byte over two separate "load immediates" of B and C. The remainder of the routine is a loop. Each time through the loop, the count in B is bumped by one, and the odd number in C is incremented by two. A SUB of the odd number in B is performed before the increments. If the result has gone negative, a return from the subroutine is made.

The 16-bit subroutine uses 11 bytes. The A register is first zeroed to hold the count minus one, which may be a max of 255. The BC register is then loaded with -1. This will be changed by decrementing twice to -3, -5, -7, and so forth. The loop portion of the subroutine adds the current negative odd number to the residue in HL. If HL goes negative the carry flag is reset, and a return is made. The remainder of the loop bumps the count in A, decrements the odd number to the next value, and then loops back for the next iteration.

Although the subroutines contrived here are short in terms of memory requirements, they

are not necessarily the fastest code that can be implemented to find the integer portion of the square root. If we assume that the average 16-bit square is 32768, then it will take 181 iterations to find the integer portion of the square root.

Each iteration takes about six instructions, and the average time for each instruction is perhaps six microseconds. Roughly, then, the average processing time for square root computation will be:

181 \* 6 \* 6 microseconds, or about 6.5 milliseconds. Putting it another way, about 150 roots can be extracted per second, on the average.

This would be quite efficient for a DDS, but is quite inefficient for assembly language code. The routines presented here are interesting because of the "trick" involved and are not presented as the best method of finding square roots.

The trade-offs between memory space and speed are just two factors to consider in writing any program. Other factors are program development time (Does the code take a long time to produce because it is too "tricky"?), debugging (Has the code been adequately debugged, with test cases that represent typical and limiting parameters?) and program maintenance (Will you pick up the code at a later time when a bug is discovered and be completely at a loss to explain the tricks you employed?).

## A New Challenge

Since the last puzzle was moderately successful, here's a second challenge to the readers of The Assembly Line. All results should be sent to me at the address at the end of this column. We'll announce the winners in a later column, and there'll be a token prize to make it interesting.

Problem: Write the fastest subroutine possible to multiply two eight-bit unsigned (0-255) numbers in the A register and B register. The result should appear in the HL register pair, and the two operands in A and B should be unchanged.

That's it for this month; next month we'll continue the topic of high-speed graphics, and have other topics geared to the assembly language beginner. ■

## CAPTAIN 80

From page 20

niceties and go their own way. But whatever Pyramid 2000 lacks in familiarities, it makes up in descriptions and plot.

## Name That State

Last on the review list is a game-educational offering from Synergistic Solar, Inc., Miami, FL. Name That State Quiz is the title, and it comes with sound. The program draws the shapes of different states on the screen and presents a user selected format of questions about that state.

Identifying a state by its shape can be a bit difficult, but I managed to get the first four or

five right. T'pring, resident tabby cat in the Captain 80 headquarters, came over to investigate the pleasant sounds. Then I got one wrong. The computer emitted this unearthly combination buzz and gargling noise. T'pring, thinking I had killed it and she was next, leaped from the side of the desk, bowled over a cardboard box, lost traction, bounced off a door-jam and took up residence under a bed.

I liked Name That State Quiz for its educational value but a combination of its slow drawing speed and chalk-on-the-blackboard sound could hinder it in the classroom.

Next month, the winner of the Program in a Paragraph Contest will be announced. Until then, here's Captain 80 in Software Secret Headquarters signing off. ■



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without disturbing the resident program.

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NEWDOS/80 with all of the NEWDOS + utility programs, many of which have been enhanced, is priced at just \$149.00 and is available at most TRS-80 dealers. Previous NEWDOS owners may receive full trade in allowance toward the purchase of NEWDOS/80 by including with their order the *serial number* of their NEWDOS 2.1 diskette, the *price paid* and *where purchased*. In most cases that purchase price will be subtracted from the price of NEWDOS/80. As with NEWDOS 2.1, NEWDOS/80 relies on the TRSDOS and Disk Basic Reference Manual published by Radio Shack. NEWDOS/80 documentation supports its enhancements and upgrades only.



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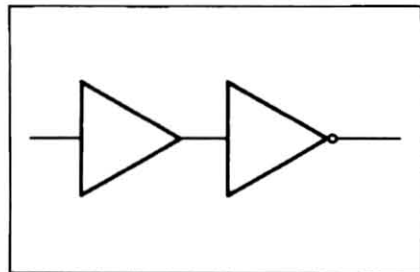
# 80 APPLICATIONS

by Dennis Kitz

*"A gate electronically evaluates its input to determine the pattern of similarity and difference."*

**B**etween last month and this, I hope you were successful in building the input port for the TRS-80. This month we will finish with some theory and an application.

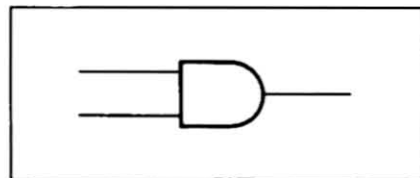
Fear not; basic digital electronics is tediously logical, but seldom very difficult. Let's return to the locked door analogy we used in April and see how the door can be opened. Here is one of the eight "tumblers" of the output port:



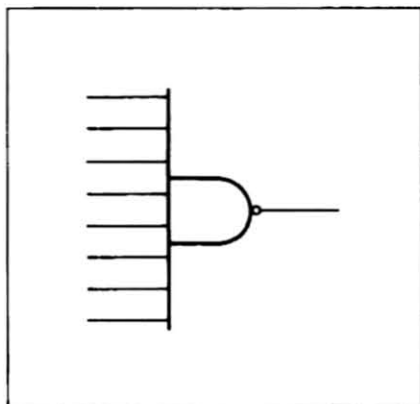
The triangle is a buffer—it leaves the signal unchanged, but protects the TRS-80's electronics from being overburdened with attachments. The second triangle is an inverter, having a small circle at its output meaning NOT. If the signal (bit) entering is one, its output is NOT one; if the input is zero, the output is NOT zero. The 81LS95 integrated circuit contains eight buffers, and the 81LS96 package contains eight inverting buffers.

### The Gate's Job

A gate electronically evaluates its input to determine the pattern of similarity and difference and produces a specific output. The design below represents one sort of simple gate:

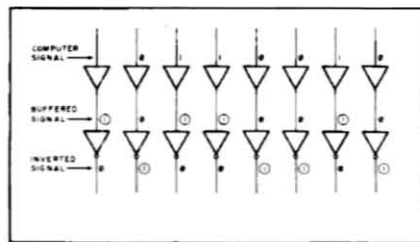


This gate's job is to determine if the first *and* second inputs are both one (high). Only then will its output swing high. We are using eight address signals to open the port's lock, so our "lock cylinder" must evaluate eight input. It looks like this:



Notice the NOT circle at the output. It means that if all input is high, and only then, the result will be NOT high. This cylinder is an 8-input NAND (NOT AND) gate.

How do we use this lock? In April's column, our key was cut to binary 1011 0010, which translates to hexadecimal B2 or decimal 178. The NAND gate, the lock's cylinder, has to see all one's to operate, so we set up the tumblers to produce this result:



The signals shown by the circled numbers are all ones—precisely what the "cylinder" circuit needs in order to respond. The tumblers are set, the NAND gate responds by trying to open the latch. Now refer to the complete circuit diagram: Z1 and Z2 are the tumblers, Z7 is the cylinder. Z5 and Z6 form the latch. The job of this latch is to allow signals to pass through its door when it is unlocked (enabled) and at no other time. This latch operates on a high (one) signal.

Look for a moment at Z8; it is a NOR (NOT OR) gate. If the first OR second (or both) input is high, the output is NOT high. Only if each input is low, will this gate swing high. Let's follow this through. The address of our output

device has been found by the "tumblers" and the "cylinder" turns, but the Z5-Z6 latch will only snap open if a low signal called OUT is being sent by the computer at the same time. Data from the computer can now flow through buffer Z3, into the latch, and is locked in place for our use.

Before looking at the rest of the circuit, notice that the OUT signal from the TRS-80 also enables Z3. If we have so carefully designed our lock and latch, why isn't Z3 just left on? Isn't this extra signal redundant? One truly critical aspect of the eight lines handling data on the TRS-80—in fact, on virtually all microcomputers—is the dual use of these lines.

An address is a set of signals always commanded by the Central Processing Unit (CPU) in the computer; on the other hand, data must flow both to and from the microprocessor. This data, whether in or out, is sent on the very same set of signal lines, the "data bus." The computer has to tell us which way the data is expected to flow, and we must respect that. The CPU gives us this information on separate signal lines, some of which READ data from memory or WRITE data to memory, and two similar signal lines which indicate INput to and OUTput from ports.

Now, turn back to the diagram, and notice, in addition to the OUT line going to Z3, there is also an IN line to Z4. If we have any intention of relating reasonably to the outside world, the "data" door had better swing both ways!

### A Short Circuit?

But if the output of Z4 is connected to the input of Z3, doesn't this form a short circuit? Or does Z3 get confused as to what input it is receiving? The answer could be a devastating yes. However, if we respect the computer signals, the doors can appear to be invisible—a special condition, a third state, neither on nor off, but rather one appearing electronically disconnected. A signal comes from Z7 to tell Z3 and Z4 (each an 81LS95 buffer) that their address has been selected; but the computer must send an IN or OUT signal to decide which one will be used—which way the information door will swing.

If the door swings in, the computer wants information from the outside world (for more details, see "A Simple Interface" in *80 Microcomputing*, February 1980). When the door swings out, the signals are latched by Z5 and Z6 for our use.

Finally, take note of the small circles at four of the outputs of each latch (Z5-Z6). Even at



this final stage, we have our choice of data either in the form the computer sent it, or in its inversion. Some peripherals may turn on with a high signal, others with a low signal. It allows us programming simplicity, as we can always think of "on" as "one," no matter what control signal the peripheral device expects.

Why, then, do we not have the option of inverted signals on the input? It is possible, but because the TRS-80 is a computer, it can with simple elegance invert the input signal in a *program*—the software equivalent of an output latch!

I want to encourage you to understand that this device is versatile and can be a real alternative to searching for the special, expensive hardware that fills your need. I have spent considerable time with this device because from time to time, future columns will describe simple devices to "control your environment": generating sound, operating lights, motors and displays, checking temperature, and so forth. All will need a form of latched and buffered input/output device similar to this one.

#### Fair Game

Finally, let's put together a simple, but very useful attachment, a "fair" input for playing games on your computer. Since the TRS-80's keyboard is scanned a row at a time, Player A always has the advantage of being first in action games that use INKEY\$.

Attach a 1000-ohm resistor between each input of Z4 and the 5-volt supply. This ensures that the input "sees" a high signal, and that the



Photo by Dennis Kitz

Before and after versions of the I/O latch project.

millions of changing signals all around it don't accidentally trigger it into producing a zero. Next, obtain a small keyboard, or better for remote use, eight momentary-on pushbuttons. You can make a terrific set for youngsters or any folks who have difficulty with small objects (I built some for a nursing home) by attaching a long strip of aluminum to a large, flat board, so:

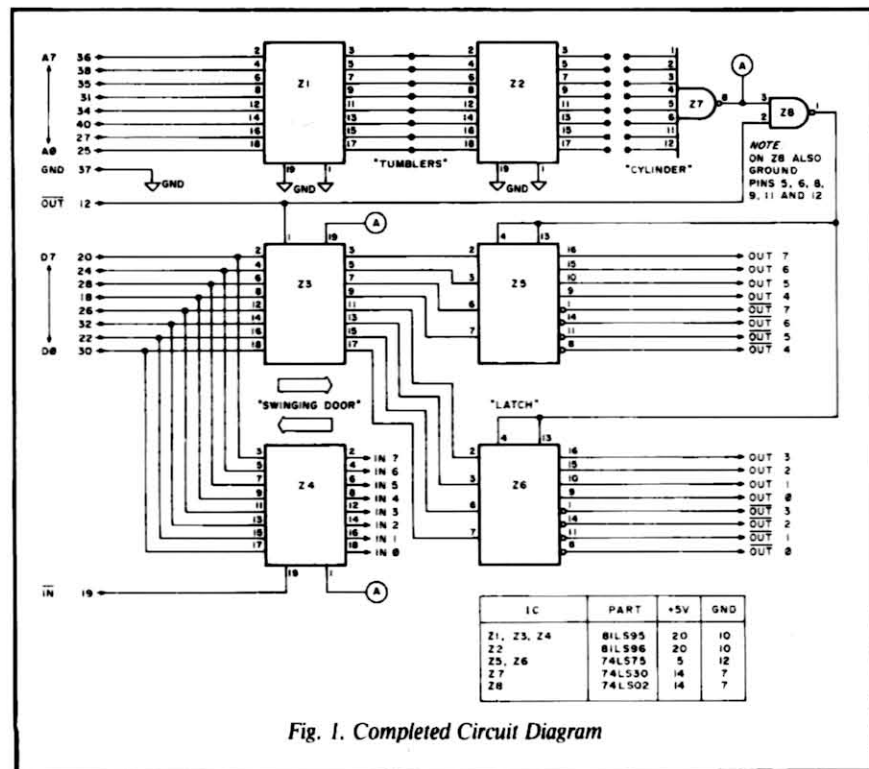
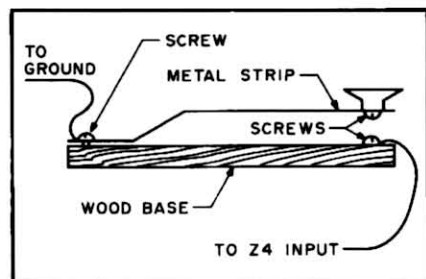


Fig. 1. Completed Circuit Diagram

Connect a wire between one side of each pushbutton and ground; connect the other contact to its respective input at Z4. This input floats high; pressing the button brings the signal low.

Here's a subroutine to use it; players in this example are holding buttons 1, 3 and 4 (connected to inputs IN0, IN2 and IN3):

```

1000 A = INP (178)
1010 A = NOT A
1020 A = A AND 13
1030 X = (A AND 1) + 12
1040 Y = (A AND 4) + 9
1050 Z = (A AND 8) + 5
1060 IF X = 13 PRINT "X",
1070 IF Y = 13 PRINT "Y",
1080 IF Z = 13 PRINT "Z",
1090 PRINT : GOTO 1000
REM * NUMBER OF PORT IN USE
REM * COMPLEMENT OF INPUT VALUE
REM * MASK FOR BUTTONS IN USE
REM * PLAYER 1 (IN0)
REM * PLAYER 2 (IN2)
REM * PLAYER 3 (IN3)
REM * RESULTS OF INPUT
REM * RESULTS OF INPUT
REM * RESULTS OF INPUT

```

Both space and devilishness prevent me from explaining this program; I leave it to you. Clues? 1. Think it in binary. 2. Write it in binary. 3. Aha!

Next month: software. (phew!) ■

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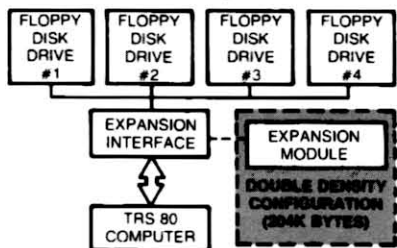
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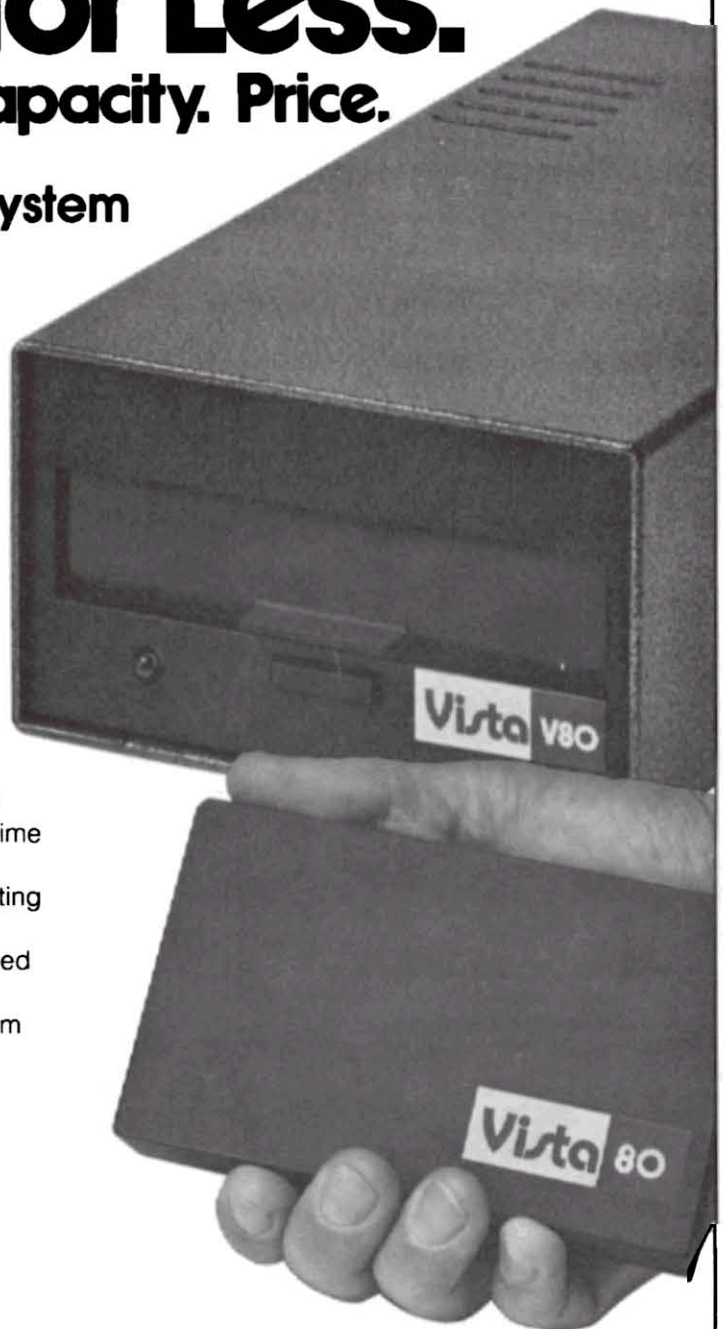
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*"Someone recently estimated that there was a backlog of \$200 billion . . . in software projects."*

**A** new Pascal special interest group is being formed this month. The coordinator is Richard J. Bonneau, PhD (6 Tanglewood Dr., Shrewsbury, MA 01545). Richard is a computer software consultant and feels more people should be made aware of the potential benefits of higher-order languages. If you have an interest in Pascal pass your thoughts and ideas along to Richard.

Do the FORTRAN, FORTH, COBOL and LISP users out there desire a special interest group for their language? All it takes is one person to take the lead and serve as the coordinator.

#### Business Special Interest Group

A local business group is forming in the central coast area of California. The local coordinator is John J. Duemler (128 S. Elm St., Arroyo Grande, CA 93420). John works for H&R Block and has written and is using data processing and payroll programs in three H&R Block offices. He is currently planning to write a program to check tax returns (a natural). If you use a TRS-80 for business and desire to meet fellow users, you can call John at (805) 489-1414.

#### Education Special Interest Group

George Christoph is forming a special interest group for the exchange of information on computers in education. George teaches computer programming in a Cincinnati Junior High School (using seven TRS-80's) and BASIC programming in the local community education program. The first Information Processing Tournament, held in Ohio in 1974, was sponsored by George. To contact George Christoph write to him at Finneytown Junior High School, 8916 Fontainebleau Terrace, Cincinnati, OH 45231.

And don't forget about the High School Science Special Interest Group (Richard A. Marble, c/o Casady School, Box 20390, Oklahoma City, OK 73156).

#### Amateur Radio Operators' Group

If you are a ham, interested in the TRS-80 this new group may be just for you. For information contact Sam Martinez N3SM, 625 Kingston Road, Middle River, MD 21220.

#### Getting Behind?

Someone recently estimated that there was a backlog of \$200 billion (that's right, billion) in software projects. Are you among all the others waiting for the "right" program to be developed? If you do not have the expertise to develop the software yourself and do not want to pay the full price for a custom program, there is still hope. Offer a free-lance programmer the mar-

keting rights to the programs he writes for you. I often do this for clients and it benefits everyone. The programmer gets a little something right away and the possibility of a later profit, if he does a good job. You, the customer, get a program to your specifications. The public also gets another program to choose from.

#### Programming Hint

To disable the BREAK key in NEWDOS use the following BASIC statement in your program:

POKE 23461,0

To reactivate the BREAK, you should PEEK the contents of 23461 into a temporary variable before POKEing 0, and then use another POKE to replace the original value when you want the BREAK enabled.

I am always happy to hear from you. Please send your comments to me at 15906 E. 96 St. N., Owasso, OK 74055. Please include a self-addressed stamped envelope for personal replies. ■

## UNLIMITED 80's

by Sherry Smythe

**R**ecently, I was given the red carpet treatment by Radio Shack while visiting the Tandy Towers in beautiful downtown Fort Worth, Texas, where the West begins.

It's hard not to be impressed by one of the world's nicest private subway systems, a Tandy Center free service given to the residents of Fort Worth. The end of the line takes you to a mall whose center attraction is a large ice skating rink with all the trimmings—beautifully costumed skaters and their pupils.

Upstairs, about seventeen floors higher, are Tandy's corporate offices paneled with oak, offering breathtaking panoramic views of the city.

#### Tight Security

About ten minutes away, amid tight security, in what used to be a J. C. Penney's store and later a Motorola factory, is now a Tandy manufacturing plant, assembling TRS-80 Model I's and II's. Inside, in the austere waiting room, visitors sign in, receive passes and wait for a tour escort. Mr. Nishikawa conducted our tour.

Everywhere you look Model II's are in all stages of completion. Much of the sub assembly work is done in the orient, and many of the raw materials for this assembly come from other Tandy enterprises. The assembly line in Fort Worth is a narrow track that winds its way through the room. Each computer rests on a flat car that rolls along until the Model II is fully assembled and packed. Quality is controlled by a machine that can pinpoint any short on a board and reject it, if it is not perfect. Every

Model II has two burn-in periods. One is under normal conditions for 24 hours and the other under extremes of heat and projected user abuse.

In a smaller area of the same building, Model I's are constructed. Only the keyboard-CPU unit is assembled in Fort Worth. But quality is controlled in every step of the production.

Mr. Nishikawa keeps his employees competitive within the organization by recording the progress of various construction stages on a series of five or six TRS-80's mounted in the wall. Each displays the performance records of the departments and the daily percentage completed of their assigned goals.

The number of rejected units is shown and teams of employees endeavor to keep their reject scores low and their daily output high.

#### Upgrading

One part of the Model I assembly area is dedicated to upgrading the machines. Everything from new chips to new keyboards are installed.

Repairs are performed in another area with special diagnostic equipment that tells the operator just what's wrong and in most cases how to fix it. Spooky! Computers fixing computers.

John Roach assured me that Radio Shack is planning to maintain support on all existing computers, even though new and more exotic equipment is now being developed to hit the marketplace in late summer or early fall. And witnessing the thousands of computers being cranked along the assembly line, I believe it. ■



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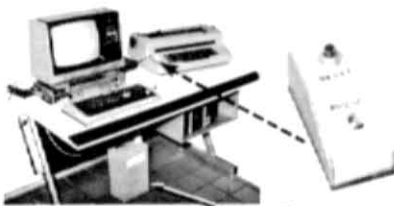
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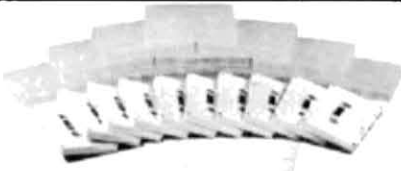
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## Radio Shack Support Of Computer Products

According to statements made by company President Lewis Kornfeld in a recent press release, Radio Shack is offering wider support of their computer products. Computer leasing has been available since January. Computer centers have been opened in the 50 major markets and on-site service is an option to carry-in service.

Kornfeld states that the computer centers each incorporate "a full servicing facility, as well as a classroom, stockroom, sales room and display area."

Charlie Philips, company vice president, explains that, theoretically, each computer center has an instructor and a technician on the payroll. Courses are offered in the basics of computing. Customers are offered advice on devising a system of hardware and peripherals that is best for their specific needs.

The on-site service contract will bring a repairman to your door. To maintain and repair the equipment after the warranty lapses, contracts may be purchased for limited or unlimited on-site service for the Model II. This option is generally available for Model II service only. If you own a bevy of TRS-80 Model I's, it may also be possible to contract for the service.

Contracts and costs for on-site repairs vary



TRS-80 Model II

from system to system. According to Philips, the most common form of the limited service agreement provides an installation visit, one preventative maintenance call and two remedial calls for \$500 within a 50 mile zone of the service center.

Further information on leasing and on-site service contracts is available from computer centers and from company owned RS stores. Check with dealers as well. Computer centers may be located through the yellow pages or directory assistance in large urban areas. Local Radio Shack owned stores can direct rural residents to the center nearest them. ■

## Three Software Utilities

There is another editing tool on the market. This one, Packer, is sold by Cottage Software, 614 N. Harding, Wichita, KS 67208. Using five options, Packer helps save memory and time. It is one of three new releases from Cottage Software.

Packer is written in machine language, and is supplied on two tape cassettes in three versions, one each for 16K, 32K and 48K for Level II or Disk BASIC. Packer is sold with an instruction manual for \$29.95. It works with the following commands:

UNPACK unpacks multiple statement BASIC lines into single statement lines while maintaining program logic. It also inserts spaces for easy reading and editing. You select the starting and ending line numbers, or unpack the entire program.

SHORT removes unnecessary words (eg. LET, GOTO after THEN or ELSE), spaces, and remark statements to shorten program

length. Again, you can specify starting and ending line numbers.

PACK performs UNPACK then SHORT. Next it packs lines into multiple statements up to the maximum length you specify. It maintains complete program logic, including IF/THEN/ELSE statements, branches, etc. You can PACK the entire program or just sections of it.

RENUM renames your BASIC program lines including all branch references, such as GOTO, GOSUB, etc. You may input the first line number to be changed, the new line number and the increment for all subsequent lines to the end of the program.

MOVE moves any number of program lines to any new location in your program, and changes all branch references to the new line number.

Cottage Software's Disassembler disassembles Z-80 object code into Zilog mnemonics and shows ASCII Strings during disassembly.

With the MEMORY DISPLAY/MODIFY routine you can see the contents of 256 bytes of

memory at one time in either hex or ASCII. You can modify the contents of RAM from the keyboard. STRING SEARCH searches through memory for a string of object codes to find subroutine calls, compares, register loads, etc. With READ/WRITE OBJECT TAPE you can read an object tape into memory for disassembly or modification, and then make a copy on tape of any part of ROM or RAM.

A program written in BASIC that edits Disassembler for use on a line printer and a program that allows loading and inspection of any TRS-80 500 baud tape are included in the package which costs \$19.95.

System Tape Duplicator, another Cottage Software product, duplicates machine language tapes. Programs recorded on your own equipment normally load more easily, as the folks at Cottage Software point out. This item sells for \$12.95.

Reader Service ✓ 170.

## Machine Code Disassembler

Datagraphics, P.O. Box 566 Union Station, Endicott, NY 13760, is selling Disassembler-80. This software disassembles ROM or RAM, and has selectable output to either video display or a printer. It prints standard Z-80 mnemonics, with decoded data and addresses, in an easily readable format. Disassembler-80 handles all legal code combinations and traps illegal codes.

It provides an aid to assembly language programmers and is an educational tool for anyone interested in learning the workings of the Z-80 microprocessor. The package is supplied on tape for 16K Level II with optional line printer and is disk compatible. It costs \$9.95 for the Model I. It has just become available for Model II, as well.

Reader Service ✓ 169.

## Products Stretch Memory of Models I & II

For the Model I TRS-80, Vista Computer Co., 1401 Borchard St., Santa Ana, CA 92705, offers the V-80 Disk Drive System. Available in one-, two-, and four-drive configurations, the V-80 is a 40-track system which provides 102K bytes per drive. Track-to-track access time for the V-80 is 12ms compared to 40ms for the TRS-80.

A program patch, supplied at no charge by Vista, will adapt your TRSDOS disk operating



system to accommodate the 40-track drives and faster access times. Patches are available for all existing versions of TRSDOS. Cables are available for two and four drives.

Another Vista product, the VXM-80 Expansion Module, operates with the TRS-80 expansion interface to provide double density storage. In other words, total storage on a 40-track diskette can be increased from 102K to 204K bytes. VXM is priced at \$239, including all hardware and software.

**Beware:** The VXM-80 is designed for use with Vista's V-80 Disk Drives, and Vista does not guarantee its operation in double-density format with TRS-80 drives.

Vista also offers Model II Disk Expansion System, which is available with up to three eight-inch, 77-track disk drives. A three-drive system can add 1.5 Mbytes of storage to your Model II TRS-80, giving the system a total of up to 2 Mbytes of on-line disk storage. Vista's Model II is fully compatible with the TRS-80 Model II, and plugs directly into one of the expansion connectors on the TRS-80.

The single-drive expansion system lists for \$1000, the two-drive for \$1550, the three-drive for \$2100 and additional drives for \$525. Vista products carry a 120-day warranty which covers both parts and labor.

Reader Service ✓ 180.

## Level II Data Management

A data management utility for the TRS-80 Level II 32K, TRSDOS or NEWDOS, is available from Standard Systems Corp., Marketing Department, 2421 Tanglewood Road, Decatur, GA 30033.

The program, which is written in Disk BASIC, is called Customized Record Inquiry/Edit System (CRIES). It is menu managed for key-indexed records.

Naturally, the program will EDIT, ADD and DELETE records. It will allow listing of record keys, searching by examples and merging of disk selected portions.

The disk package contains CRIES, DOS command file, documentation and sample data files for \$45.

Reader Service ✓ 164.

## Create and Compile Graphics and Animation

Electra Sketch is an animation and graphics compiler which is available from Macrotronics, 1125 N. Golden State Blvd., Suite G, Turlock, CA 95380.

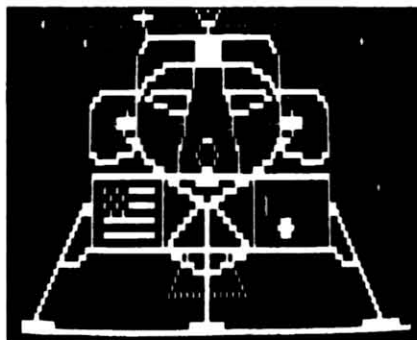
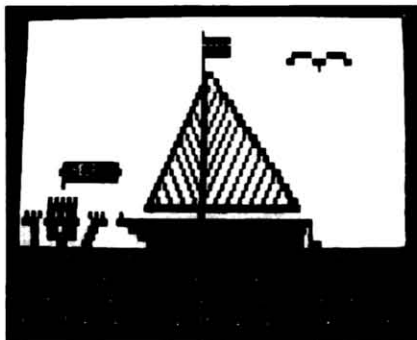
Macrotronics explains Electra Sketch will let you create your own movie sequence or combine graphics and plain text to create animation.

Electra Sketch works with one-key commands to control cursor direction, erase, draw vectors, fill in backgrounds, or create titles. Frames are saved on disk, can be recalled, edited and printed on a line printer.

Saved frames are animated by displaying them in either forward or reverse sequence. The speed of the animation can be changed in 10 increments from slow motion to rapid play.

Macrotronics is charging \$14.95 for Electra Sketch. A catalog of 30 Macrotronics products is available without charge.

Reader Service ✓ 163.



Examples of Electra Sketch graphics

## Series 8000 Medical & Dental Management Systems

The Series 8000 Medical and Dental Management Systems for the TRS-80 Model II (and most other 32K CP/M disk based microcomputers) upgrades Univair, Inc.'s early version of the package.

Among other things, the new features include automatic display and computation of normal office charges, improved patient scheduling routines, alphanumeric patient sorting and archiving, provisions to link special user-developed programs into the main menu, and detailed operators manuals.

Series 8000 Medical/Dental Systems are on sale from Univair, Inc., 10327 Lambert Int. Airport, St. Louis, MO 63145 for \$495 each. The price includes telephone consultations on initial set-up. Series 2000 owners may upgrade their systems at a cost of \$100 and will receive a new six-month warranty. Operators manuals may be bought separately for \$15.

Reader Service ✓ 177.

## Accounts Receivable/Invoicing for Model II

Accounts Receivable/Invoicing System for the TRS-80 Model II is available from Taranto & Ass., Inc. The package design is the result of users' experience with Taranto's Model I conversion of the Osborne/McGraw-Hill Accounts Receivable book, and has also been expanded to include an invoice program.

Customer and invoice files are key controlled for quick access. Up to 51 items may be billed on a single invoice. Both invoices and statements are printed. Package users define sales tax rates as they apply to each customer. Customer service charge rates are also defined by users. These functions are then computed as they apply.

The package generates reports which list invoices that have not been billed, open items, closed items, and an analysis of age and open items.

Osborne/McGraw-Hill's *Accounts Payable/Accounts Receivable Wang Book* documents much of the package and must be used in conjunction with it. Both the book and the package are available from Taranto & Ass., Inc., Box 6073, 4136 Redwood Hwy., San Rafael, CA 94903. The book costs \$20. Accounts Receivable/Invoicing System costs \$249.95.

Reader Service ✓ 162.

## Data Base Management

IDM-M2, an interactive data manager for the TRS-80 Model II, provides a general purpose approach to data base management. Micro Architect, who produces IDM-M2, suggests that it allows many applications for users without the technical knowledge required by most data base programs.

The package is a conversion of IDM-IV for the Model I with additions. It includes two levels of security, up to 40 fields, search command, statistics and error trapping. The report generator has optional column justification, dating and automatic paging and a record selection range. The report writer includes field addition and subtraction, and operators for filter criteria, field updates, record deletion and a display format for records.

IDM-M2 is written in BASIC. It requires 64K memory. The package is priced at \$199 and is sold by Micro Architect, 96 Dothan St., Arlington, MA 02174. Demonstrations can be arranged.

Reader Service ✓ 176.

## 32K Expansion Interface

An expansion interface for the TRS-80 called Model LX80 is available from Lobo Drives Int. It expands memory capacity up to 40 million bytes, or 32K of RAM.

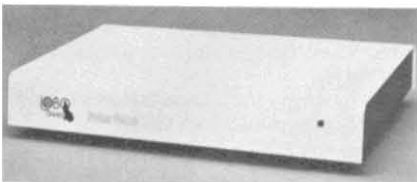
A switch permits overriding the keyboard ROM for booting in diagnostics and custom-

ized operating systems. Connectors for the 5.25 and eight-inch floppy disk drives and other peripheral devices are located on the side and rear panels.

Other features include a parallel Centronics printer port; a port for the Lobo Drives Model 7710T Winchester hard disk drives, a screen printer port, two microprocessor-controlled bidirectional serial ports and a crystal controlled real time clock.

The interface is sold by Lobo Drives Int., 5082 Shirley Drive, LaPalma, CA 90623 for \$525. Dealer discounts are available.

Reader Service ✓ 178.



Lobo Drives' Expansion Interface.

## Nevada COBOL for TRS-80s

Business Microproducts, Livermore Financial Center, 1838 Catalina Ct., Livermore, CA 94550, has the Nevada COBOL compiler available for the TRS-80 Model I and II. The compiler has been running for one year under PTDOS and was converted to CP/M in 1979. It has been relocated to 4200H for the Model I, while the Model II works with the standard CP/M.

Nevada COBOL by Ellis Computing was designed specifically for small businesses using microprocessors. It quickly translates source language programs into machine language programs and is simple to use.

The compiler is a subset of ANSI-74 and includes random access file support, both fixed and variable length sequential files, debugging capability, copy statement, character string, 16-bit binary and packed decimal (COMP-3) data types, 18-digit accuracy, hexadecimal non-numeric literals, English language error messages and interactive ACCEPT/DISPLAY.

Nevada COBOL requires 16K RAM, two five-inch single density drives, or one eight-inch single density drive.

Including a run time package, sample COBOL program and terminal configuration program, the compiler is supplied on a CP/M data diskette. The cost, including a manual, is \$99. Documentation is available separately for \$25.

Reader Service ✓ 166.

## Software for Dentists

Dentalware, a package combining patient treatment plans with patient billing, is being sold by Caldata Systems, P.O. Box 178446, San Diego, CA 92117. Caldata explains that

"complete word processing capability" is thrown into the bargain.

Besides keeping track of past and planned treatment for each patient, the package can take care of all patient accounts. Fees are set by the package user, then the package will issue itemized statements and tally balances. Dentalware can also be used to fill and file insurance forms.

Designed for the Model II, the complete package costs \$2600. (From what Caldata says, you get the impression that pulling teeth will be just about the only thing left for the dental staff to do.) The instruction manual may be purchased separately for \$35. The word processor, Word Magic II, costs \$100 when purchased separately.

Reader Service ✓ 181.

## Electric Pencil Products

Several new Electric Pencil products are available from Michael Shryer Software, Inc., 1198 Los Robles Drive, Palm Springs, CA 92262.

The Electric Pencil II is being shipped for TRS-80 Model II users who have CP/M. It is available with three print packages:

Standard Print Package runs with serial or parallel interfaced printers. It costs \$275.

Diablo/Qume Print Package works with serial versions of the Diablo and Qume Micro Sprint 5 printers. It is priced at \$300.

NEC Print Package works with serial interface NECs only. The price is \$300.

All these packages contain fractional character spacing (pseudo proportional), bidirectional printing, boldface and automatic negative line-feeds.

The TRS-80 Model II TRSDOS version of the Electric Pencil II for non CP/M users is also available. Additional features in this version are word left, word right, word delete and page numbering at the bottom.

Standard Printer Package retails for \$325 and the Diablo/Qume/NEC Printer Packages retail for \$350. The company makes no upgrades or exchanges between CP/M Model II and TRSDOS versions.

Convert is a conversion utility program which converts files created by the Electric Pencil II to CP/M. Files may be created in assembly language, BASIC, Fortran, etc., using the Electric Pencil and then converted into CP/M files for further processing. Convert is available for \$35.

Reader Service ✓ 167.

## Personal Finance Package

Investment Portfolio System, a data base management program with a broad range of applications, is available from Personal Finance Systems, 1446 Durham Rd., Madison CT 06443.

The program will store and report data on as many as 72 securities and review items in the portfolio by price, yield, percent gain or loss. It

provides four special reports: complete summary data on the portfolio; current value and return; long and short term gain and a security analysis report. This latter report provides information about return on investment, annualized yield and earnings and yield gain compared to market index.

Personal Finance Systems is developing other data base management programs, which will record sales as well as purchases, issue tax reports and Security Exchange Commission reports and update the data base via a telephone modem.

Investment Portfolio System is available in a disk version for TRS-80 32K LII single drive computers, and in a tape version for 16K LII. Both programs are supplied on a single tape. The package, including documentation, costs \$39.95. Documentation is available separately for \$7.50.

Reader Service ✓ 165.

PERSONAL FINANCE SYSTEMS A		SAMPLE PORTFOLIO 4/2/80	
PORTFOLIO VALUE REPORT			
SYMBOL	SHARES	PURCH VALUE	NET VALUE
ATL/99	1000	60,275.00	110,290.01
TSM	2000	40,100.00	101,250.01
IBM	1000	60,219.00	65,000.00
NEC	1000	40,200.00	60,125.00
NEC	1000	31,375.00	50,200.00
TTL/98	1000	52,125.00	52,000.00
TSM	500	30,125.00	30,250.00
NEC	300	27,250.00	44,250.00
T	1000	19,125.00	4,125.00
TOTALS		307,485.00	953,750.02

PRESS ENTER TO CONTINUE

PERSONAL FINANCE SYSTEMS A		SAMPLE PORTFOLIO 4/2/80	
PORTFOLIO GAIN REPORT			
SYMBOL	PUR DATE	L/T GAIN	S/T GAIN
TSM	12/30/77	52,000.00	110.12
NEC	12/30/77	23,125.00	73.72
ATL/99	03/01/79	47,015.00	70.02
TSM	12/30/77	14,125.00	39.12
IBM	12/30/77	15,075.00	23.92
NEC	02/22/80	0.00	0.02
TTL/98	02/22/80	-125.00	-0.22
IBM	12/30/77	-1,219.00	-1.02
T	12/30/77	-13,000.00	-70.02
TOTALS		89,967.00	47,750.00

PRESS ENTER TO CONTINUE

Sample gain on value reports

## Mediamix Typesetter

Mediamix, PO Box 8775, Universal City, CA 91608, is selling PSRJ + 2.0 for use with their IBM Model 50 Typewriter/TRS-80 Interface. This machine language program prints out an Electric Pencil text file (or any ASCII file) using the IBM 50's proportional spacing type elements, with full right justification.

The user can imbed codes in the text for centering of titles, indenting paragraphs, underlining, typing special characters and pauses during printing to allow changing type fonts for titles, italics, etc.

Reader Service ✓ 174.



# TBS-80 DATA PROCESSING SYSTEMS. ONE STEP BEYOND.

If you thought the TRS-80™ microcomputer was just a toy, think again. These **TBS-80** software systems will turn that computer into a **powerful data processor**.

**INFORMATION SYSTEM** by Dale Kubler is simply the best in-memory, data base manager on the market. It allows you to create files with up to ten fields per record, up to 40 characters per field and 200 characters total per record. Data from the keyboard is entered directly onto a screen display of one entire file.

Once entered, you can sort or search your entire data base by any category and have the information desired displayed on the screen. **INFORMATION SYSTEM** provides a thorough editing mode allowing changes by line without rewriting an entire file.

This program allows you to program your own printouts to almost any form you desire for line or serial printers. Screen prints from anywhere in the program are also available **INFORMATION**

**SYSTEM** creates either disk or cassette files depending upon the version you use. From mail lists to recipes, this program is the ideal small system information manager. The price for this program, 32K up disk is \$34.50. For systems 16K up tape it's \$24.50.

**DATA MANAGER** by Dale Kubler starts out where **INFORMATION SYSTEM** leaves off. Requiring 32K and one disk, it accepts up to ten user-defined fields with up to forty characters per field and 255 characters per record. As with all TBS software, data entry and editing is professional and simple to use. What makes this program stand apart from "in-mem" data managers is that it uses up to four disks on line as memory, or as much as 320K of memory storage. Because disk sorts take more time than in-mem sorts,

**DATA MANAGER** enables the user to create and maintain up to 5 "key" sort files for quick access of data. A utility program is provided to calculate the number of records possible since the amount of records you can maintain is dependent on a number of variables. This program also supports the upper/lower case modification, and printouts can be programmed to almost any format and sent to line or serial printer.

Background printing is provided enabling the computer to search and print at the same time. If you already have **INFORMATION SYSTEM**, **DATA MANAGER** will accept those files. A necessity for organized people, this program sells for \$49.50.

**BUSINESS MAIL SYSTEM** by Dale Kubler is designed for large-scale business users. Requiring 32K, two disks and printer, this program will store up to 150,000 names in a single file spread out over multiple disks. Each data disk holds 500 names.

After data entry, BMS automatically sorts the data by zip code and alphabetical order within the zip code. The program tells you when and which data disk to insert, expanding your files automatically until you've reached 300 disks. Data is input directly onto formatted screen display with the option to use Company Name/Attention instead of Last Name/First Name. Three numeric and one alpha code fields are provided to help you use the search and printout mode. **BUSINESS MAIL SYSTEM** allows you to



program the number and spacing of your labels.

With more features than can be described here, this high-powered program sells for \$125.00.

**TEXT MERGE** is the program that puts it all together. If you have the **ELECTRIC PENCIL** from Michael Shroyer, 32K and one disk drive, then this program is a must. It will merge your data base from any of the above programs with an Electric Pencil file. For example, when you write a letter that is going to several hundred people, you can "code" it by entering a field name from the above programs in place of the actual information. Then, when **TEXT MERGE** is run, it will print out your Pencil file and substitute the "code" with the actual data. In other words, you can print out 1,000 personalized letters without stopping the computer. This program will also enable you to selectively search out only the records from your data base that you wish to use. Also included is the ability to set left, right, top and bottom margins, set page numbers anywhere on the page, and print out right justified if you so choose. **TEXT MERGE** will turn your computer into a powerful data processor and it sells on disk for \$49.50.

TBS has other incredible software for Tandy's microcomputer. Intent on making it a powerful tool, we have **large scale business accounting systems, general accounting systems, system utilities** and the **Library 100**. We have the only **DISK HEAD CLEANER** (for APPLE too!) and **GRAN MASTER DISKETTES**, the best on the market.

TBS is **YOUR COMPANY**, and we build systems, not just software. The above products are available now, nationwide. Visit your local Computer Dealer or Associate Radio Shack Store and demand the best, demand TBS. For more information, contact us through the numbers below.

™ TRS-80 is a trademark of the Tandy Corporation.

Reader Service — see page 162

**TBS**™ ✓6  
**THE BOTTOM SHELF, INC.**  
(404)939-6031 • P.O. Box 49014 • Atlanta, GA 30359



# The Game Of Life

Dennis Bathory Kitz  
Roxbury, VT

**C**lassic among challenges in computer programming is the Game of Life, conceived and developed in the early 1970's by British mathematician John Conway. Life is not exactly a game, it is more than a pastime, and most of all, it is a stunning display of video graphics for the TRS-80.

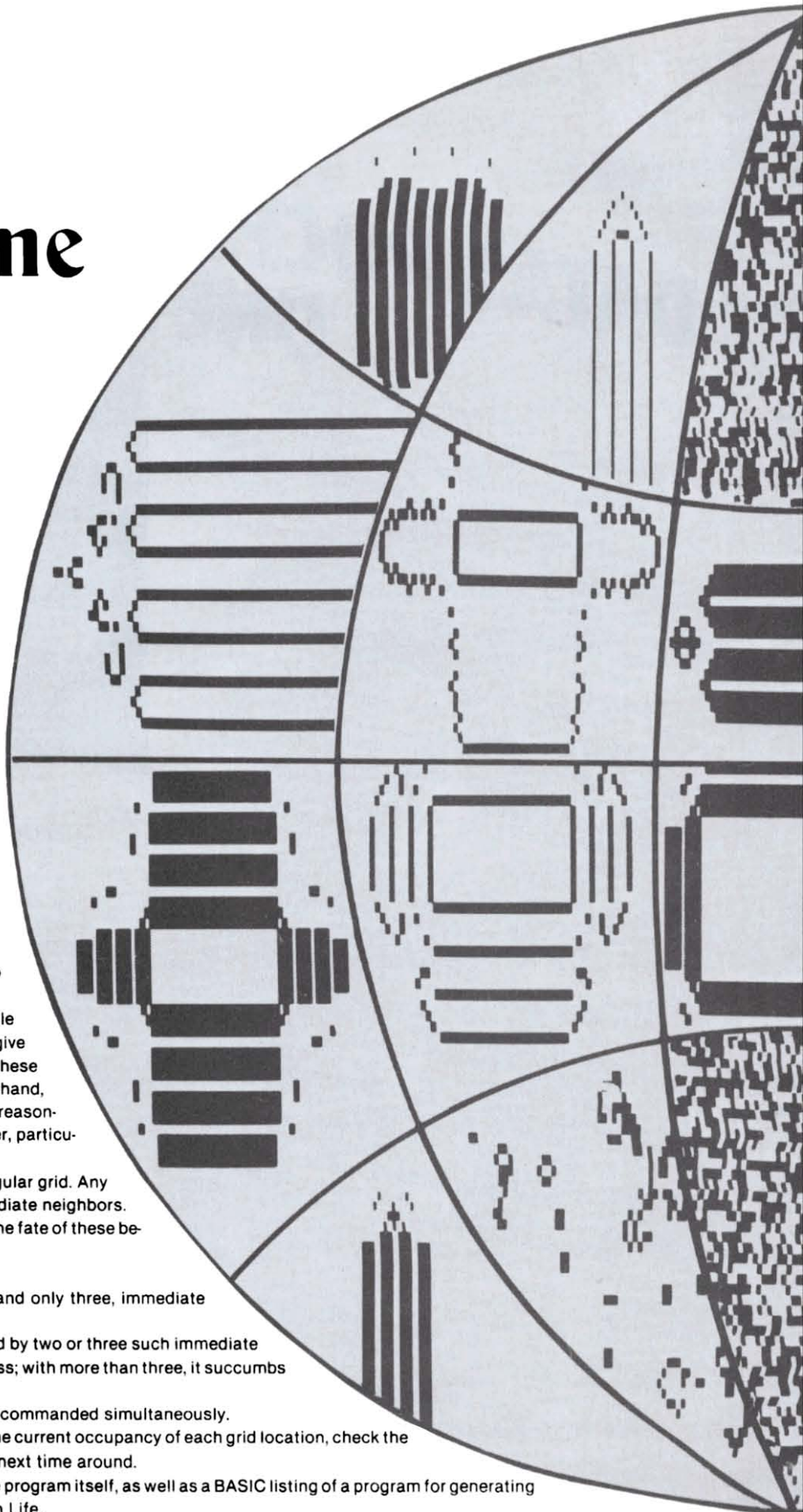
The Game of Life is based on a few very simple rules. A universe of beings is created to live, give birth, and die. An infinite, random universe of these beings would be most interesting. On the other hand, a limited, regularly-ordered universe is the only reasonable way Life can be programmed on a computer, particularly on a computer of the TRS-80's size.

Conway's original universe consisted of a regular grid. Any being on this grid is surrounded by eight immediate neighbors. Conway provided only three rules to determine the fate of these beings.

1. A potential being, surrounded by three, and only three, immediate neighbors, is given birth.
2. A being, once born, stays alive if bordered by two or three such immediate neighbors. With less than two, it dies of loneliness; with more than three, it succumbs to overpopulation.
3. Every generation of births and deaths is commanded simultaneously.

This is an ideal computer problem: Examine the current occupancy of each grid location, check the number of its neighbors, and readjust the grid next time around.

What follows is an assembly listing of the Life program itself, as well as a BASIC listing of a program for generating "seed" populations. I call it Playing "God" with Life.





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## Complete Assembly Code Listing Begins on Page 54

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### About this Version

This version of Life was created with certain of the frustrating aspects of real life in mind. In the beginning, when the screen clears and the introductory text is presented, a long delay ensues. Each letter appears separately, and the text builds on the screen. The machine is taken from the hands of the user until the text is complete, and, even then, will accept only the requested input, with no help from the ENTER or BREAK keys.

Take a look at the actions of the program a step at a time. The assembly program, Listing 7, gives a loading message to the user starting at line 240. The following statement is displayed:

```
** LOADING LIFE9 *** WAIT FOR "GOOD LOAD" *** THEN ENTER "/" **
```

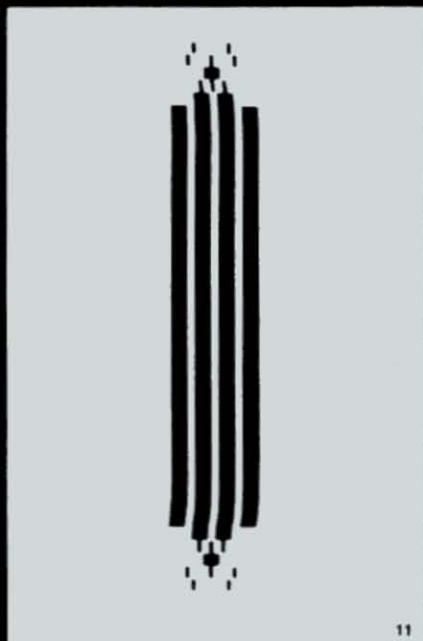
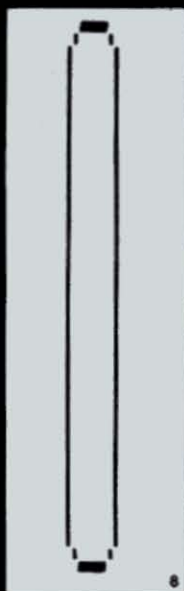
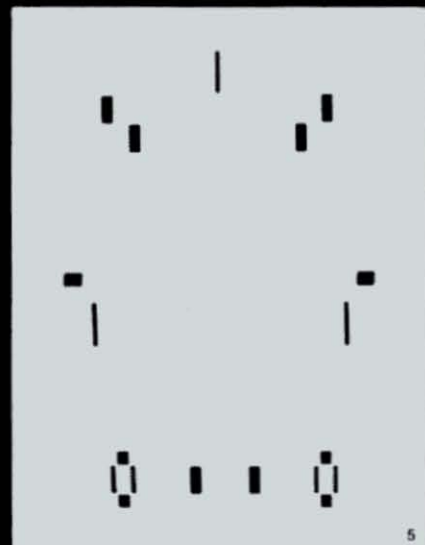
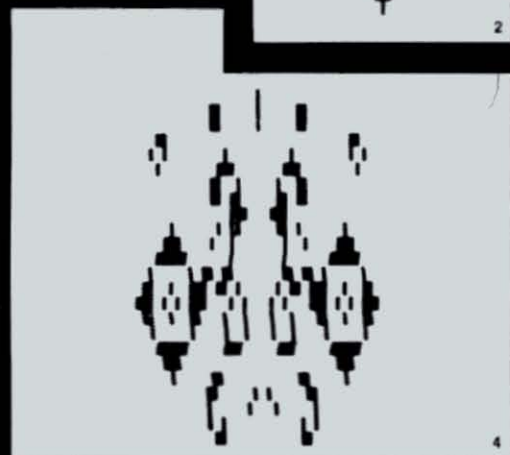
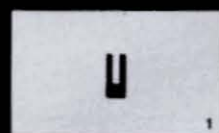
Notice, also, that a \*\*\*\*\* GOOD LOAD \*\*\*\*\* message concludes the process (line 6740), in order to offer a measure of assurance that the program made it.

The first action of the Life machine program is at line 5190. These instructions transfer the opening monologue to the screen a character at a time. A call to a screen-clearing subroutine is made, which is held for a few seconds. At that point, the first two lines of text are displayed, followed by the introductory sentences.

During this time (approximately 15 seconds), the keyboard is disabled, and the user is forced to summon patience. A final delay holds the message on the screen, followed by another clearing of the monitor. The starting address of BASIC's "USR" call is put in place (line 5860), and the user is presented with a message that asks whether a count of the passing generations is desired; the keyboard is scanned for a 0 or a 1.

Another delay is ended by a "return to BASIC" message. When the user enters a zero (the program responds only to this character), the machine is returned to Level II BASIC control. The main Life pro-

*continued to page 44*



In the Game of Life, the pattern of growth should be fluid — although for theoretical purposes, this fluidity is not important — the beauty of the changes is often the most important reason for programming Life. But the larger the grid of beings, the slower these changes can be calculated by the computer.

A small (and certainly uninteresting) total universe of four cells by four cells demands 16 checks on each cell and its eight neighbors, or 144 examinations in all. A 20 by 20 grid is still small, hardly two square inches on the video monitor, but demands about 3,600 distinct cell checks.

The TRS-80 video graphics system offers an irresistible arrangement of 48 cells deep by 128 cells wide — 6,144 in all. For that large a grid, over 55,000 cell examinations have to be made to complete each

generation.

After that introduction, the game may sound like a dry process, but the screen patterns produced are beautiful designs that are often referred to by names such as gliders, ponds, space ships, flashers, traffic lights, and by more poetic terms such as civilizations, gypsy troupes, marauding bands, hermits, and so forth. Take a look at the first series of photographs, 1-6.

A simple group of seven beings formed in the shape of an arch (sometimes called pi) develops over the course of 173 generations, producing fascinating symmetrical patterns. Through its life, this civilization grows larger.

One interesting pattern, dubbed a glider in Conway's original description, is among the group of pentominoes, or pat-

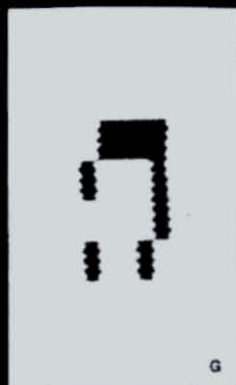
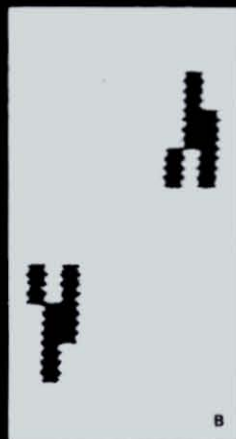
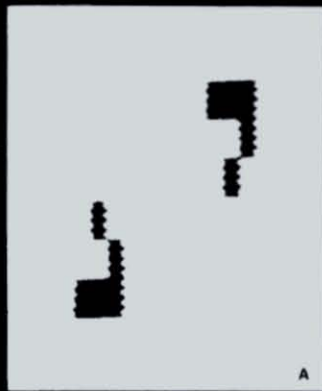
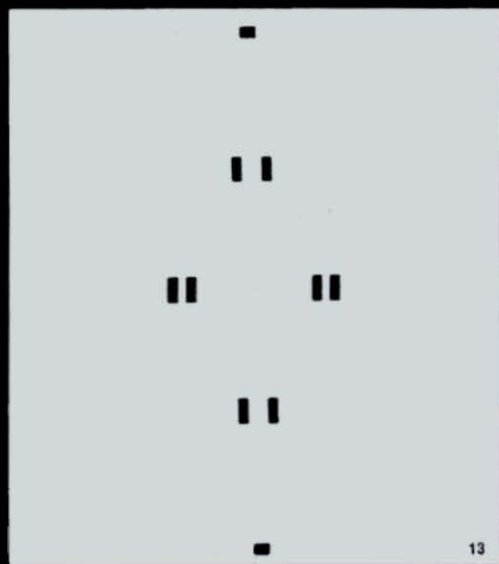
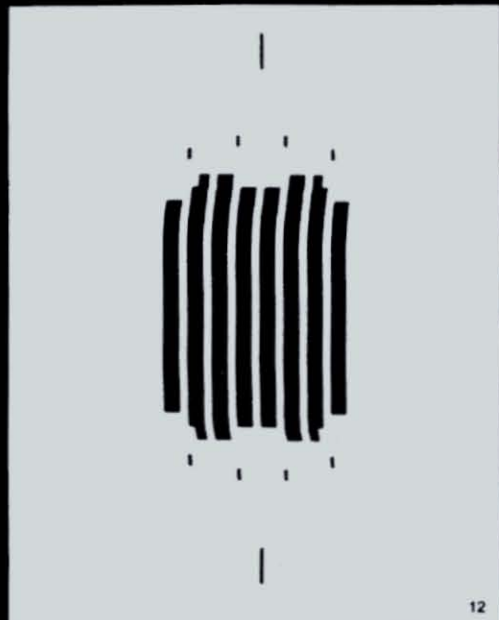
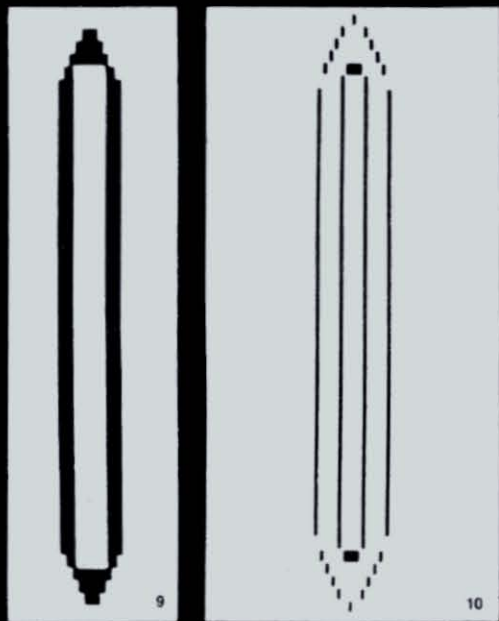
terns built from five characters. The glider goes through a few permutations, eventually cloning itself after four generations, but moves in an angular path with each self-duplication. See photos A-D.

Another of the familiar Life patterns is the spaceship, photos E-H, which replicates itself in four generations as well, but appears in mirror image every two generations.

The tall bar presented in photos 7-13 reaches stability much earlier, but during that time offers dozens of designs reminiscent of art deco, or, at the very least, like an old Wurlitzer juke box!

The third series of photos, 14-6, shows three points in the long life of a random initial population, which reaches stability only after hundreds of generations. Some random patterns will continue for thou-





Photos 1-6: The Life of the arch pentomino, at birth; generations 18, 90, 113, 159, and stability at generation 173.

Photos 7-13: A tall bar created of several hundred cells, at birth; generations 1, 2, 3, 4, 12, and stability at generation 31.

Photos A-D: Life cycle of two "gliders". The glider returns to its original configuration at a new position in four generations.

Photos E-H: Life cycle of the "spaceship". Like the glider, this figure returns to its original configuration in four generations.

Photos by Dennis Kitz

sands of generations, as a small group of beings might develop in one corner, eventually traveling and overtaking another portion of the screen in what could be called a battle or perhaps imperialistic exploration or merely the mixing of great cultures.

Life aficionados will talk about Garden of Eden patterns. These are groups which must be created to exist; that is, they cannot be given birth by any other known combination of cells. But the greater enjoyment for me is becoming an observer in an ageless master plan—a sort of limited deity with control over a Garden of Eden, possessing the power to commit the universe to oblivion or make it grow full.

You can create and destroy at will, but to change the master plan is beyond your power. We can only observe as the generations march by, suspending time to save a few friends.

It is a programming challenge to develop a Game of Life that makes metaphors like these possible. To understand this challenge, it is worthwhile to attempt to produce a single generation from a seed pattern by hand. Let's take a look at three ways of programming Life on the TRS-80.

The first method of programming is to use an entire memory location for each cell. This means, unfortunately, that a grid of only 64 characters across by 16 characters deep can be used. Nevertheless,

this is the easiest choice, and can be programmed in BASIC (Listing 1). Each generation of blocks takes two minutes and 10 seconds to produce.

The second method of programming Life is to use all the graphics cells that make up the TRS-80 video system. Each character location has been broken up into six graphics points, which are accessible through the SET and RESET functions in Level II BASIC. However, the SET and RESET commands are very slow. In order to demonstrate quickly the speed at which the built-in graphics of the TRS-80 function, enter the three short BASIC programs presented in Listings 2, 3 and 4.

The first of these executes in 60 seconds; the second, in 10 seconds; and the third, fastest of the BASIC options, in two seconds. Now, enter the program in Listing 5, which POKES into place a program to perform the identical function executed by the previous BASIC programs; it returns to BASIC after a short delay.

The speed of machine language changes is considerably faster, because once we have put a cycle of instructions to the machine's central processing unit, we can avoid making the dozens of comparisons and calculations necessary to use the Level II BASIC interpreter in ROM.

This Game of Life has been written in machine or assembly language. ■

by Dennis Kitsz

```

10 CLS
20 DEFINT X,N,Q,A,B,C,D,F,G,H,I,J,K,L,M
30 DIM L(1024) : Q = 191 : K = 15359
40 GOSUB 300
50 FOR M = 15360 TO 16320 STEP 64 : POKE M,32 : NEXT M
60 FOR X = 15360 TO 16383 : N = 0
70 A = PEEK (X-65) : B = PEEK (X-64) : C = PEEK (X-63) : D = PEEK (X-1)
80 F = PEEK (X+1) : G = PEEK (X+63) : H = PEEK (X+64) : I = PEEK (X+65)
90 IF A = Q THEN N = N + 1
100 IF B = Q THEN N = N + 1
110 IF C = Q THEN N = N + 1
120 IF D = Q THEN N = N + 1
130 IF F = Q THEN N = N + 1
140 IF G = Q THEN N = N + 1
150 IF H = Q THEN N = N + 1
160 IF I = Q THEN N = N + 1
170 L(X-K) = N
180 NEXT X
200 FOR X = 15360 TO 16383
210 IF L(X-K) = 2 THEN 240
220 IF L(X-K) = 3 THEN POKE X,191 : GOTO 240
230 POKE X,32
240 NEXT X
250 GOTO 50
300 FOR X = 15360 TO 16383
310 J = RND(2) : IF J = 1 THEN POKE X,191
320 NEXT X
330 RETURN

```

Program Listing 1. Simplified Life in BASIC.

```

10 CLS
20 FOR X = 0 TO 47
30 FOR Y = 0 TO 127
40 SET (Y,X)
50 NEXT Y,X
60 GOTO 60

```

Program Listing 2. Screen white-out using SET and RESET functions

```

10 CLS
20 FOR X = 15360 TO 16383
30 POKE X,191
40 NEXT X
50 GOTO 50

```

Program Listing 3. Screen white-out using POKE commands.

```

10 CLS
20 CLEAR 100
30 FOR X = 1 TO 15
40 PRINT STRING$(64,191)
50 NEXT X
60 GOTO 60

```

Program Listing 4. Screen white-out using PRINT STRING\$ function

```

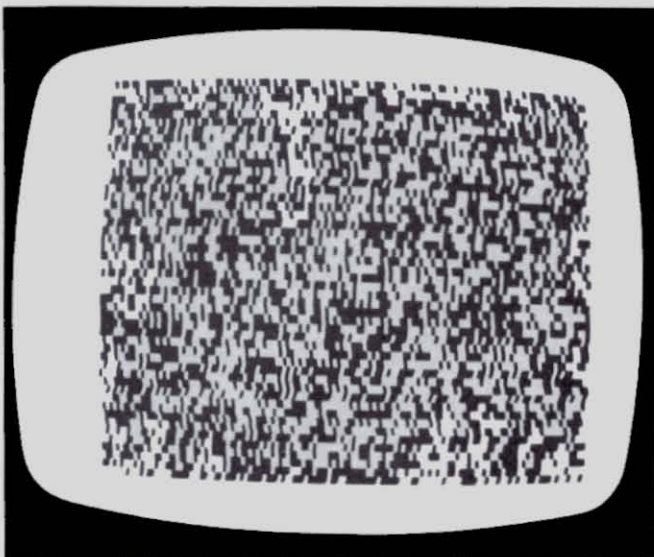
10 CLS
20 DIM A(30)
30 FOR X = 1 TO 27
40 READ A(X)
50 NEXT X
60 DATA 33,0,60,17,1,60,1,255,3,54,191,237,
176,6,5
70 DATA 33,255,255,43,124,181,194,18,127,
16,245,201
80 FOR X = 32512 TO 32538
90 POKE X,A(X-32511)
100 NEXT X
110 POKE 16526,0 : POKE 16527,127
120 M% = USR(0)
130 CLS

```

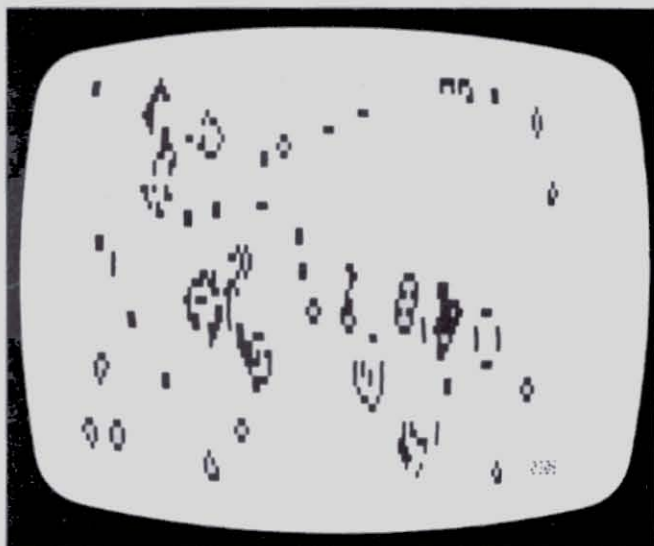
Program Listing 5. Screen white-out in machine language jumping from BASIC.

Photos 14-16: A large random universe, at birth; at generation 306; and finding stability at generation 696.

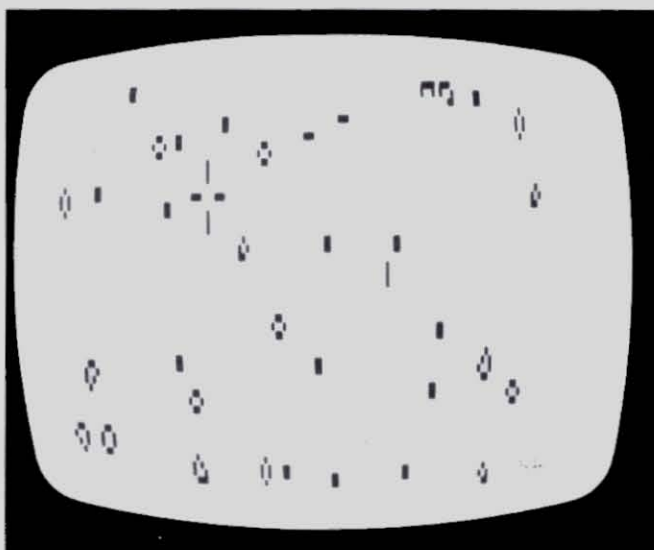




14



15

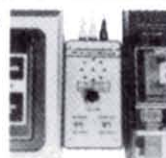


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## for the TRS-80 from Micro-Mega

### CASSETTE CONTROL UNIT

• Speed up your cassette tape handling • Pinpoint program locations on tape with an audible monitor • Get protection from recording and playback glitches resulting from ground loops • Eliminate the tedious plugging and unplugging of recorder cables. The Micro-Mega Cassette Control Unit does all this and more. You get instant manual control of the recorder at the flick of a switch. Want to find the beginning or end of a program? Flick another switch and you'll hear it. All cables remain plugged in all the time. The Micro-Mega Cassette Control Unit does a lot to improve the appearance of your TRS-80 system, too. As shown, it's in a 2 1/2" x 5" box which snuggles between the keyboard and your recorder. There is no need to move the recorder, and all cables come neatly into the unit. The Cassette Control Unit is tailored to the CTR-41 recorder, but may be used with most other recorders as well.



CASSETTE CONTROL UNIT.....\$37.95  
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Ever find yourself with a blank screen wondering what your computer is up to? The Micro-Mega CPU Monitor can tell you, for example • If your CPU is in a loop with no exit • When a long sort is nearing completion, or • If a key bounces during keyboard input. The CPU Monitor lets you listen to all CSAVEs and CLOADs and will help you quickly find the correct recorder volume setting. If you have an expansion interface, you will always know whether the real time clock is on or off because you can hear it. The Micro-Mega CPU Monitor gives a voice to the 2-80 microprocessor in your TRS-80 by using AM radio circuitry to pick up the computational rhythms of the CPU, which are amplified and played through a loudspeaker. The pickup unit of the CPU Monitor, shown at left in the photo, goes under your TRS-80 keyboard. It is connected by a 36" cable to the speaker and control unit, which includes an on/off volume control and an LED "power-on" indicator. The Monitor is powered by an AC adapter, shown at right in the photo. No batteries are needed and no electrical connections to your TRS-80 are required.



By listening to the CPU Monitor, you will soon become familiar with the "personalities" of the programs you run and whether they are executing in a normal way. A dramatic use of the CPU Monitor is in the great enhancement which it provides for computer games. (See "Gaming Environment" below.)

CPU MONITOR.....\$47.95  
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### THE GREEN-SCREEN

The eye-pleasing Green-Screen fits over the CRT of your TRS-80 Video Display and gives you improved contrast with reduced glare. You get bright, luminous green characters and graphics like those featured by very expensive CRT units.

The Green-Screen is closely matched to the color and texture of the TRS-80 Video Display and improves the overall appearance of your system. It is attached with adhesive strips, which do not mar your display unit in any way. The Micro-Mega Green-Screen gives improved video display visibility for all applications and is especially effective in creating dramatic, high-impact displays for computer games. (See "Gaming Environment" below.)



THE GREEN-SCREEN.....\$13.95  
Add \$1.00 for postage and handling

### THE ULTIMATE STAR TREK PACKAGE

Tired of trivial computer games? This complete Star Trek package will provide you with endless fascination and challenge. In addition to the program cassette, it includes comprehensive instructions, a pad of "Voyage Log" record sheets, and a free-standing "Torpedo and Maneuvering Chart."

The package is built around the latest version of Lance Micklus' incomparable Star Trek III, a 13,000 byte program with a host of subtle and imaginative features, which include numerous dynamic and spectacular graphic displays. Star Trek III puts you in command of the Enterprise cruising in a galaxy of 192 quadrants filled with uncharted hazards, including hostile Klingons, pulsars, and black holes. You have at your disposal scanners, various weapons and defense systems, on-board computers, and a loyal crew. (You will need them all to survive the Klingons.) Your mission is to rid the region of Klingons and to locate five inhabitable planets, all within 300 stardays, before returning to Star Fleet Headquarters where your overall effectiveness as a starship commander will be scored. High scores are possible only with careful planning and effective battle tactics. The "Voyage Log" sheets will guide your strategy, and the "Torpedo and Maneuvering Chart" will give you a vital edge in combat. (When you engage three Klingon ships you can't afford to miss.)



STAR TREK PACKAGE (for Level II, 16K only).....\$22.95  
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### CREATE YOUR OWN SPECTACULAR GAMING ENVIRONMENT (and save \$5.00)

The Enterprise is in battle trim with deflector shields at full power. As her captain, you are taking her into combat. The battle-stations siren rings in your ears and "CONDITION RED" flashes on your monitor screen. You call for warp drive and key in the coordinates of the quadrant where your scanners have detected Klingon ships. As you select the warp factor, you hear the reassuring clicking of your navigational gear as it activates the warp drive.

Suddenly, you break out of hyperspace and your monitor displays the chilling sight of three Klingon Battle Cruisers floating on your screen! Their evil shapes glow in luminous green against the black void of space. Moments later, you hear the characteristic rasping sound of Klingon laser weapons, and, as you watch, high-energy beams come knifing toward the Enterprise in succession from each of the Klingon ships.

You have been hit! You hear the dismal sound of the damage control alarm as "DAMAGE TO WARP DRIVE" and "DAMAGE TO PHASERS" flash on your screen. The Klingons have stopped firing! The Enterprise is crippled, but your best weapon is still intact, and it's your turn now! You key in the command for photon torpedoes. As your screen again displays the position of the Klingon ships, you select a firing vector from your torpedo chart and key it in. Now you hear the buzz of your photon torpedo as you see it speeding toward a Klingon ship. It strikes him dead-center! As you watch, the Klingon Battle Cruiser disintegrates, accompanied by a satisfying crackling sound.

Does the above scenario sound far-fetched? Not at all! It's a small sample of what you will experience with Micro-Mega's Gaming Environment, which consists of • The STAR TREK PACKAGE • The GREEN-SCREEN and • The CPU MONITOR. The fast-paced and dynamic action reflects the superb Star Trek III program together with the "Voyage Log" and "Torpedo Chart" of the Star Trek Package. All of the unique graphic displays are greatly enhanced by the Green-Screen. Finally, the uncanny sound effects are produced by the CPU Monitor, which faithfully picks up the FOR, NEXT loops and other CPU patterns, which create the distinctive siren sounds that accompany the ALERT and DAMAGE messages along with the harsher notes of the weapons salvos. Once you've tried it, you won't any longer be satisfied with silent computer games.

Remember that with the Gaming Environment you also get all of the other excellent features of the CPU Monitor and the Green-Screen for non-gaming applications. You also save \$5.00 off the combined cost of the individual items.

GAMING ENVIRONMENT.....\$79.85  
Add \$3.50 for postage and handling

Terms: Check or money order, no CODs or credit cards, please. Add amount shown for postage and handling to price of the item. All items shipped within 48 hours by first class or priority mail. Virginia residents, add 4% sales tax.

✓ 29

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gram has not yet been activated.

At this point, a set of "seed" civilizations can be created. This article includes a BASIC listing that will create 20 seed populations. (See Listing 6.)

TRS-80's video system has two kinds of blanks, represented by decimal values 32 (a character space) and 128 (a graphics blank). Both these characters appear the same to the eye, but have entirely different results in the Life program. When clearing the screen for use with Life, it is essential that character 128 (hexadecimal 80) be used. The following subroutine will produce the desired effect:

```
10 CLS
20 FOR X = 15360 TO 16383
30 POKE X,128
40 NEXT X
```

#### Program Listing 8. Clears the screen before jumping to Life.

Now a seed population can be created on this blank field. Here is a section of Listing 6:

```
2300 GOSUB 9999: REM * CLEARS SCREEN WITH CHAR 128
2310 FOR X = 15817 TO 15860
2320 POKE X,191
2330 NEXT X
2340 M% =USR(0)
```

Following the screen-clearing, these lines will POKE a graphics pattern into place that looks like this:



It is created from a dense bar of graphics cells, and will eventually follow the pattern shown in photos 18-21. Through the USR(0) command, the program now jumps to the machine language Game of Life routines.

#### The Action of the Program

The first action of the program is to save the BASIC stack pointer (line 280). The reason for this is that the program as a whole (the seed program and the Life program) will be using two stacks — one for the video display work area, and the other for the BASIC seed programs.

Next, the generation count is set to zero, and the upper and lower borders of the video workspace are blanked. This blanking is necessary because unwanted neighbors to cells in our real population may intrude upon the territory of our universe and produce mutant births.

Now the pattern on the screen is transferred to a scratchpad, or workspace, elsewhere in memory. Have you ever noticed the black streaks that detract from the continuity of the screen display when graphics are being drawn? There is a very short period of time when the video memory circuits must be taken over by the rest of the computer system in order to place information on the video screen, or,

less often, to read information that is there.

The memory is taken out of the video scanning circuit for a very brief moment, so the display blanks out. The more times we need to dip into the video, the more black streaks there will be. In order to prevent our Life display from becoming a jittery mess, you can remove the information displayed as a block and place it elsewhere, where you can plunder it at will. The screen then remains passive until the altered block is transferred back to the monitor.

Two very important instructions appear in lines 610 and 760. These commands, which appear early in the program, load values into each of the two index registers available in the Z-80 microprocessor chip. In fact, without these two registers, you could not attain the speed of this game.

#### Program Listing 6. BASIC Seed Populations

```
10 CLS
15 - SPACESHIP
20 PRINT@460,"PLAYING GOD WITH LIFE:
*STARTS*"
30 FORX=1TO2000:NEXT
40 PRINT"ENTER 1 FOR INSTRUCTIONS
ENTER 2 FOR GRAPHICS CHARACTER LIST
ENTER 3 FOR LIST OF SEED CHARACTER PROGRAMS"
50 PRINT:INPUT"ENTER 1, 2 OR 3";A
60 IFA=1GOTO1000
70 IFA=2GOTO1000
80 IFA=3GOTO2000
100 CLS
110 PRINT"PLAYING GOD WITH LIFE MUST START WITH A BASE
CIVILIZATION CREATED BY A SEED PROGRAM. THIS PROGRAM
USES TRS-80'S GRAPHICS CHARACTERS SET, WHICH IS
PRESENTED A BIT LATER IN THIS PROGRAM."
120 PRINT:PRINT"ASCII CHARACTER 128 -- CHR$(128) -- IS A
GRAPHICS BLANK.ALL THE SEED PROGRAMS FIRST CLEAR THE
SCREEN WITH THESE BLANKS,THEN PRODUCE A STARTING
CIVILIZATION USING THE TRS-80 GRAPHICS ";
121 PRINT"CHARACTERS. FINALLY, THE SEED PROGRAMS JUMP INTO
THE MACHINE LANGUAGE *LIFE* PROGRAM."
130 PRINT:PRINT"REMEMBER, YOU MUST HAVE ALREADY ENTERED THE
*LIFE9* SYSTEMTAPE THAT PRECEDES THIS ";CHR$(34);
"STARTS";CHR$(34);" SECTION, OR A FC ERROR?WILL BE
GENERATED."
140 FORX=1TO10000:NEXT:CLS:GOTO40
1000 CLS
1010 FORX=128TO155STEP4
1020 PRINTX;CHR$(X),X+1;CHR$(X+1),X+2;CHR$(X+2),X+3;CHR$(X+3)
1025 PRINT
1030 NEXTX
1040 INPUT"PRESS ENTER TO CONTINUE";X
1045 CLS
1050 FORX=156TO183STEP4
1060 PRINTX;CHR$(X),X+1;CHR$(X+1),X+2;CHR$(X+2),X+3;
CHR$(X+3):PRINT
1070 NEXTX
1080 INPUT"PRESS ENTER TO CONTINUE";X
1090 FORX=184TO191
1100 PRINTX;CHR$(X):PRINT
1110 NEXTX
1120 INPUT"ENTER 1 TO REVIEW, 2 TO RETURN";B
1130 IFB=1GOTO1000
1140 IFB=2GOTO40
2000 CLS:PRINT"ENTER THE NUMBER OF THE SEED PATTERN DESIRED:"
2010 PRINT" 1 - RANDOM 11 - ARCH (PI)
2 - BOX 12 - LONG BARGE
3 - LONG BAR 13 - LARGE BLOCK
4 - SMALL RANDOM GROUP 14 - GLIDERS
5 - TALL BAR
2020 PRINT" 6 - MIXED SEEDS 16 - TALL RANDOM
7 - 4 RANDOM GROUPS 17 - TWO ARCHES 90 DEG.
8 - FLASHERS & GLIDERS 18 - 2 DIAGONAL RANDOMS
9 - THIN SQUARES 19 - THICK SQUARES
2030 PRINT" 10 - SPARSE RANDOM 20 - SURPRISE"
2040 PRINT:INPUT"ENTER 1 THROUGH 20";C
2050 ONCGOTO2100,2200,2300,2400,2500,2600,2700,2800,2900,3000,
3100,3200,3300,3400,3500,3600,3700,3800,3900,4000
2100 GOSUB9999
2110 FORX=15360TO16383
2120 Y=127+RND(64)
2130 POKE X,Y
2140 NEXTX
2190 M%=USR(0):GOTO2000
2200 GOSUB9999
2210 POKE15829,183:POKE15830,149
2290 M%=USR(0):GOTO2000
2300 GOSUB9999
2310 FORX=15817TO15860
2320 POKE X,191
2330 NEXTX
2390 M%=USR(0):GOTO2000
2400 GOSUB9999
2410 FORX=15700TO15716:Y=127+RND(64):POKE X,Y:NEXTX
2420 FORX=15764TO15780:Y=127+RND(64):POKE X,Y:NEXTX
2430 FORX=15828TO15844:Y=127+RND(64):POKE X,Y:NEXTX
2440 FORX=15892TO15908:Y=127+RND(64):POKE X,Y:NEXTX
2490 M%=USR(0):GOTO2000
2500 GOSUB9999
2510 FORX=61TO67
2520 FORY=3TO42
```



Load the first index register (IX) with the first memory cell in the workspace. Index register IY is crucial; its value is the same as that of the new stack pointer. Initialize the stack at 7AEF (recall line 320), and now push six fresh zero bytes onto it (lines 710 to 740). In this way you can manipulate individual bytes near the top of the stack at will. These bytes are left on the stack, and the stack grows as the program progresses, but you still retain control over the contents without digging through the stack and piling heaps of bytes all about.

This extensive manipulation of data is necessary because of the crude but serviceable graphics in the TRS-80. A byte of data is eight bits wide; bits 0 through 5 normally define ASCII characters and control codes (carriage returns, etc.), and bits 6 and 7 are ignored. But in

the TRS-80, these most significant bits cause the video circuit to switch from ASCII mode to graphics mode.

A zero in both bits 6 and 7 will produce the expected letters and numbers; but if either or both of these bits goes high, the computer triggers a group of circuits which switch out of ASCII mode, and produce a small graphics block for each of bits 0 through 5 which is also high. It is a simple, functional video system, certainly not high-resolution, but assuredly better than an entire block per character.

A diagram of a video memory cell and the bits responsible for each "hexant" is given in Fig. 1.



Fig. 1.

Recall that the Game of Life rule requires that we look at each neighbor of a cell. If each block were a single byte-sized entity, we could evaluate its neighbors quickly and easily: The one above, the one below, left and right, and the four corners. But this TRS-80 bit system makes things quite nasty. If we label a cell X, and it lives in memory location A, what are its eight immediate neighbors? Well, there's more to know. What bit position does this upstart X occupy in a byte? Okay, let's arbitrarily say X resides comfortably in bit position zero, thus:

	A
x	1
	2 3
	4 5

Okay, seems easy. First neighbor, to the right, is bit 1; clockwise, the next is bit 3; then clockwise again it is bit 2. Pretty safe so far. Next neighbor clockwise is ... hmmm ... memory location A minus one, uh ... bit 3. Better draw that:

A-1	A
0 1	x 1
2 3	2 3
4 5	4 5

Yes, fine. Next neighbor further clockwise is memory location A minus 1, bit 1. Still safe. But then, what about the next neighbor clockwise? It's a line above on the screen, and back a space. Since our screen is 64 characters wide, this is back 64 and back one more. Now we've got to look at bits in A minus 65 and probably, if intuition serves, in location A minus 64 too. We'd better draw it.

A - 65	A - 64
0 1	0 1
2 3	2 3
4 5	4 5
	0 1 x 1
	2 3 2 3
	4 5 4 5
A-1	A

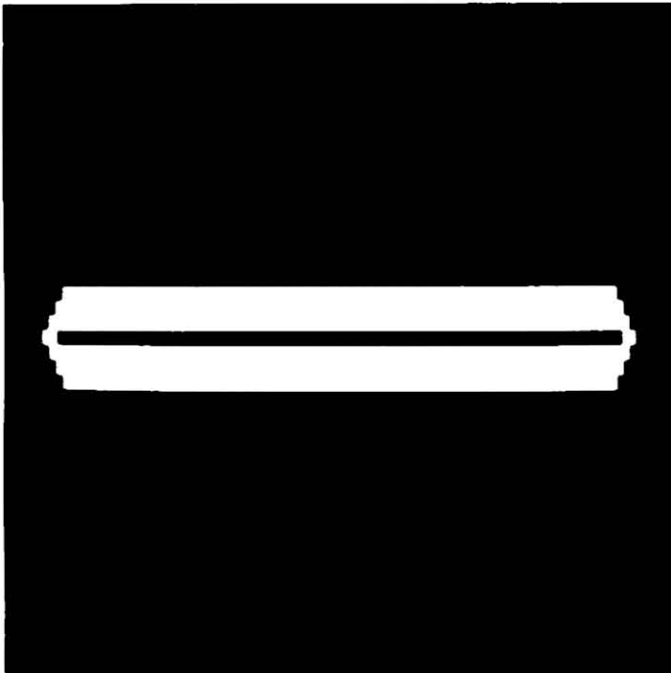
Yes, intuition is correct. We've got to check A minus 65, bit 5, and

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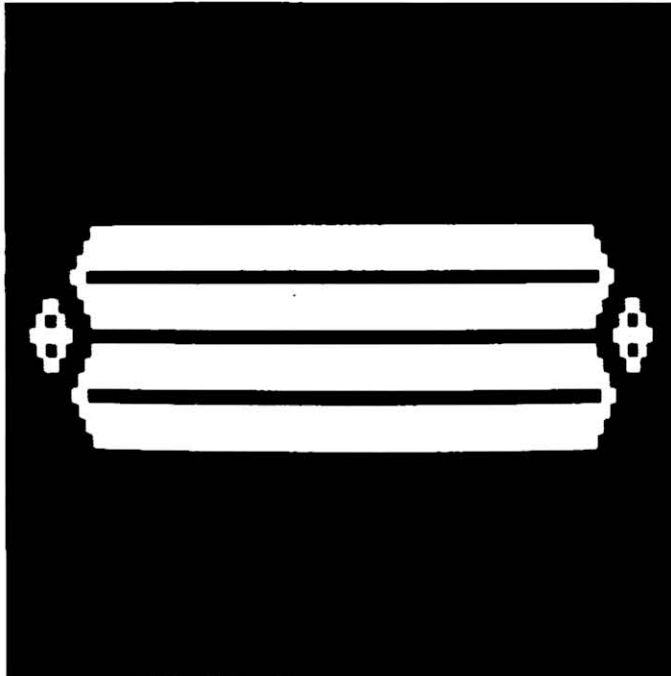
```

2530 SET(X,Y)
2540 NEXTX,X
2590 M%=USR(0):GOTO2000
2600 GOSUB9999
2610 FORX=15400TO15408:Y=127+RND(64):POKEX,Y:NEXTX
2620 FORX=15464TO15472:Y=127+RND(64):POKEX,Y:NEXTX
2630 FORX=16300TO16311:Y=127+RND(64):POKEX,Y:NEXTX
2640 FORX=16364TO16370:Y=127+RND(64):POKEX,Y:NEXTX
2650 FORX=15820TO15845:Y=127+RND(64):POKEX,Y:NEXTX
2690 M%=USR(0):GOTO2000
2700 GOSUB9999
2710 FORX=15360TO15370:Y=127+RND(64):POKEX,Y:NEXTX
2720 FORX=15424TO15434:Y=127+RND(64):POKEX,Y:NEXTX
2730 FORX=15413TO15423:Y=127+RND(64):POKEX,Y:NEXTX
2740 FORX=15477TO15487:Y=127+RND(64):POKEX,Y:NEXTX
2750 FORX=16373TO16383:Y=127+RND(64):POKEX,Y:NEXTX
2760 FORX=16309TO16319:Y=127+RND(64):POKEX,Y:NEXTX
2770 FORX=16320TO16330:Y=127+RND(64):POKEX,Y:NEXTX
2780 FORX=16256TO16266:Y=127+RND(64):POKEX,Y:NEXTX
2790 M%=USR(0):GOTO2000
2800 GOSUB9999
2810 POKE15993,130:POKE15994,155:POKE15857,182:POKE15858,144:
POKE16309,167:POKE16310,129
2820 POKE15570,183:POKE15571,149:POKE16060,183:POKE16061,149:
POKE15364,183:POKE15365,149
2830 POKE16160,183:POKE16161,149
2890 M%=USR(0):GOTO2000
2900 GOSUB9999
2910 FORX=20TO40:SET(X,5):SET(X,17):NEXTX
2920 FORY=5TO17:SET(20,Y):SET(40,Y):NEXTY
2930 FORX=77TO95:SET(X,28):SET(X,41):NEXTX
2940 FORY=28TO41:SET(77,Y):SET(95,Y):NEXTY
2990 M%=USR(0):GOTO2000
3000 GOSUB9999
3010 FORX=15360TO16383STEP3
3020 Y=127+RND(25)
3030 POKEX,Y
3040 NEXTX
3090 M%=USR(0):GOTO2000
3110 POKE15839,151:POKE15840,149
3120 M%=USR(0):GOTO2000
3200 GOSUB9999
3210 POKE15830,150:POKE15831,148:POKE15894,137:POKE15895,129
3290 M%=USR(0):GOTO2000
3300 GOSUB9999
3310 FORX=45TO85:FORY=9TO29:SET(X,Y):NEXTX,Y
3390 M%=USR(0):GOTO2000
3400 GOSUB9999
3410 POKE15498,160:POKE15499,185:POKE15950,167:POKE15951,129
3490 M%=USR(0):GOTO2000
3500 GOSUB9999
3510 POKE15746,144:POKE15747,160:POKE15810,164:POKE15811,176:
POKE15812,149
3590 M%=USR(0):GOTO2000
3600 GOSUB9999
3610 FORX=15392TO16383STEP64
3620 Y=127+RND(64):POKEX,Y:NEXTX
3630 FORX=15393TO16383STEP64
3640 Y=127+RND(64):POKEX,Y:NEXTX
3690 M%=USR(0):GOTO2000
3700 GOSUB9999
3710 POKE15820,151:POKE15821,149:POKE15859,183:POKE15860,145
3790 M%=USR(0):GOTO2000
3800 GOSUB9999
3810 FORX=15360TO16383STEP69:Y=127+RND(64):POKEX,Y:NEXTX
3820 FORX=15424TO16319STEP59:Y=127+RND(64):POKEX,Y:NEXTX
3890 M%=USR(0):GOTO2000
3900 GOSUB9999
3910 FORX=16TO36:FORY=2TO5:SET(X,Y):NEXTX,Y
3920 FORX=16TO20:FORY=6TO9:SET(X,Y):NEXTX,Y
3930 FORX=32TO36:FORY=6TO9:SET(X,Y):NEXTX,Y
3940 FORX=16TO36:FORY=10TO13:SET(X,Y):NEXTX,Y
3950 FORX=48TO57:FORY=24TO38:SET(X,Y):NEXTX,Y
3960 FORX=50TO55:FORY=28TO34:RESET(X,Y):NEXTX,Y
3990 M%=USR(0):GOTO2000
4000 GOSUB9999
4010 FORX=15360TO16383:Y=RND(255):POKEX,Y:NEXTX
4090 M%=USR(0):GOTO2000
9998 GOTO9998
9999 FORX=15360TO16383:POKEX,128:NEXTX:RETURN
READY
>_

```



18



19

A minus 64, bits 4 and 5. That's quite a lot of manipulation there, and there are six different bit possibilities for every memory location! And to make matters worse in terms of speed, a machine operation to check the presence of a bit is itself four bytes long.

#### Get a Cup of Coffee

If this were in my living room and not a magazine article, I would invite you to have a cup of coffee, sit back, and clear your mind. It took me three months and eight versions of the program to discover the key to speedy operation.

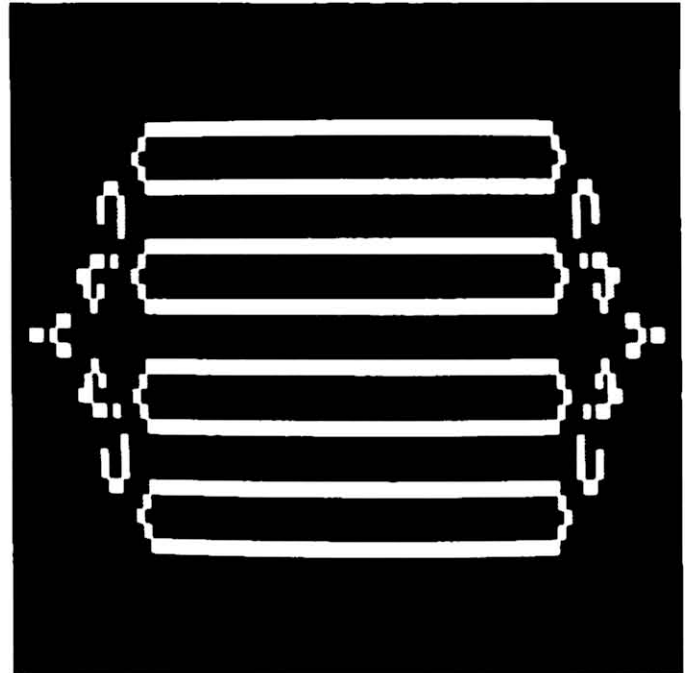
My solution to the fast Game of Life algorithm would not have been possible if the designers of the TRS-80 had chosen another of the popular microprocessor chips. The two index registers—16-bits wide—are needed, so also are relative jump instructions, bit test and manipulation, and an extensive stack movable anywhere in memory. The index register, you may recall, allows you to store and

adjust data within a certain geography of the register's base value. You may, for example, change the contents of memory location IX, IX-32, IX + 17 and so forth. The relative jump instruction is one byte shorter than an absolute jump, saving considerable time in this program requiring thousands of jumps.

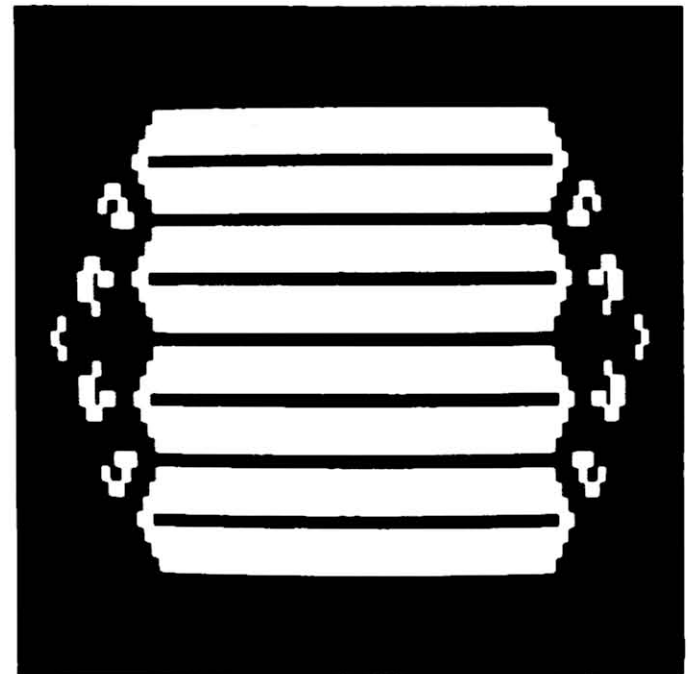
Finally, we need to preserve not only the BASIC stack (which is fairly large) for use with the seed programs, but also maintain an extensive stack of values analogous to the video pattern we are adjusting.

We know further that a check of all the cells in a given memory location must be made; thus, our algorithm for cell checking should probably be done within the context of one memory address at a time. If there are six cells in a video memory location with eight

*Continue to page 48*



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*Photos 18-21: A long bar universe created from several hundred cells, at birth; generations 2, 6, 13, and 14.*



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neighbors each, that comes to a total of 48 evaluations.

Before your cup of coffee, we were attempting to test a cell and all of its neighbors. If we test cell X in bit 0 of memory location A, then bit 1 is among its neighbors. Later, we will need to know, for example, the neighbors of bit 2 in memory location A. Or the neighbors of bit 3. Or the neighbors of bit 5 in memory location A minus 64. If we make our cell checks independent of each other, we will be engaging in enormous redundancy. If cell X has eight neighbors, then doesn't it follow that cell X is itself the neighbor of eight other cells, including the ones just mentioned? Aha!

Examine the diagram below.

```
5 4 5 4
1 0 1 0
3 2 3 2
5 4 5 4
1 0 1 0
```

Here we have a video memory address together with all the individual cells that can be considered its immediate neighbors. In all, only 20 cells need to be examined to determine the fate of all six beings in that memory address. Let us now assign this memory address to register IX; all the needed addresses are well within the relative addressing range of IX: IX - 65, IX - 64, IX - 63, IX - 1, IX, IX + 1, IX + 63, IX + 64 and IX + 65.

Return again to the assembly listing, beginning at line 800. This is the test for bit 5 in address IX - 41 (the listing uses hexadecimal notation since the screen is numbered in even blocks of 40 hex). Twenty bit tests are made, identical to the pattern described above.

What is done with the result of each bit test? You could store the result, using standard instructions, elsewhere in memory, incrementing to the next or decrementing to the previous address as necessary. But this process consumes considerable time, and requires that flag registers be saved, addition or subtraction be performed and so forth.

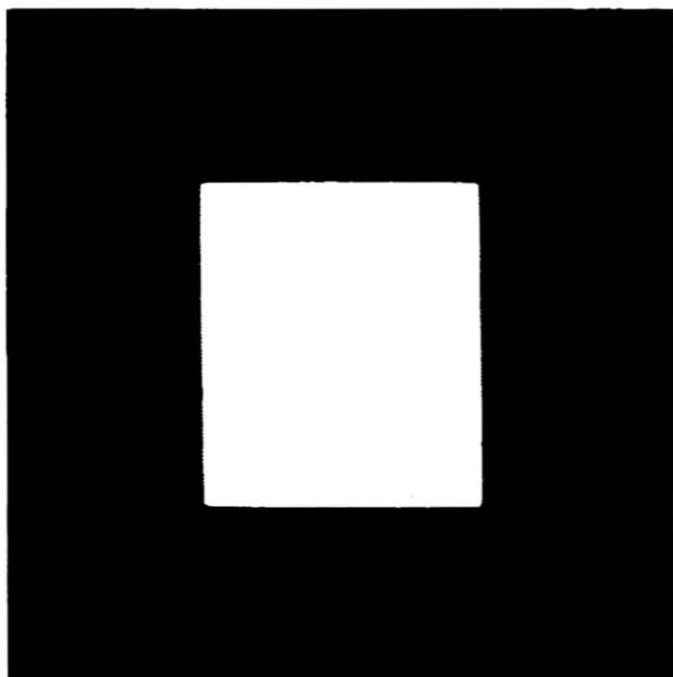
Instead, look at lines 710 through 760. Here, you may recall, six empty bytes were pushed onto the stack, and the IY register was given to the top (actually, to the bottom, as the Z-80 stack moves downward in memory) stack value. If each byte in the stack represents one bit or being, then IY can sum the neighbors of being (bit) 5, IY + 1 can hold the total neighbors for bit 4, and so on. This is a terrible waste of memory, you may insist; I agree. It is, however, the fastest way of completing the Game of Life computations using the 80's complex graphic bit system.

### Is Your Neighbor Alive?

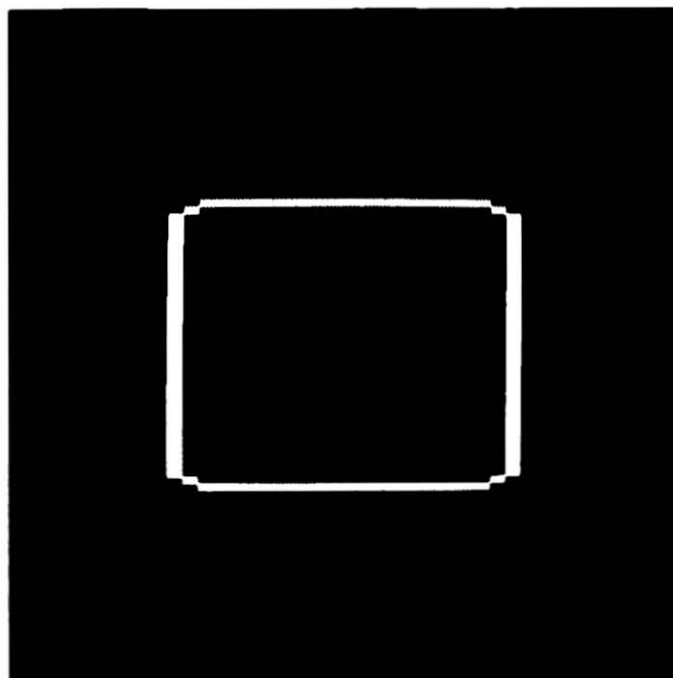
Let's follow this process through. Bit 5 of IX - 41 is tested. If the neighbor is alive (result of the bit test equals one), increment the value stored in IY + 5. If not, skip it, going on to test bit 4 of IY - 40. If this neighbor is alive, increment the value stored in IY + 5 and IY + 4. Why in two locations? Because bit 4 of IY - 40 is neighbor to two cells in our memory location, cell 0 and cell 1. If this neighbor is not alive, skip to the next test.

Time for more coffee. Just to be sure, follow each bit test in lines 800 through 1670 of the assembly listing. Test a bit. Is it alive? If so, add one to the stack byte representing the memory cells to which it is a neighbor. If not, go on. Make 20 tests. When all the checks are complete, the six-byte stack will contain the total number of neighbors for each bit in the memory address under observation. Finally (line 1680), the memory address under test is advanced. The jump to HOLD shown in line 1700 is one of the special features of Playing "God" with Life, so for the moment, ignore this command.

At line 1740, the BC register is decremented and tested; if all 1,024



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bytes (400 hex) video memory locations have been checked, the process ends. If not, we go back to line 670 and PUSH six more zero bytes onto the stack, each representing a bit in our next universe location. Earlier I mentioned that an extensive movable stack is important to the operation of this Life algorithm; with six bytes assigned to each universe location, and 1,024 locations to examine, this results in a fairly monumental stack more than 6K bytes deep!

When the examination process is complete, how do we make our changes? First, let's see where we are. You have the initial generation on the screen, a duplicate of it in a workspace, and 6,144 bytes of stack. Your object is to evaluate the stack values, a byte at a time, and alter their corresponding cells according to the result.

At the top of the stack is the last cell evaluated. We begin the generation change process at the last memory address in workspace, STORE + 3FF (line 1830). POP a register off the stack, and compare the first byte to 2. If it is 2, remembering Conway's rule,

*Continue to page 50*



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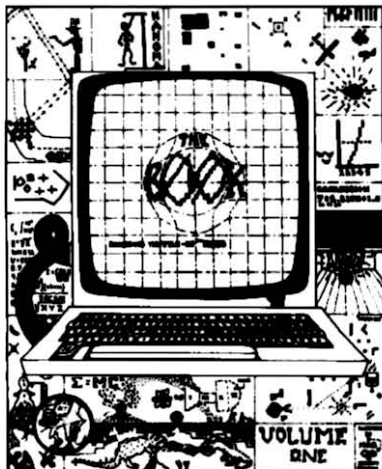
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BACK  
TO BASIC

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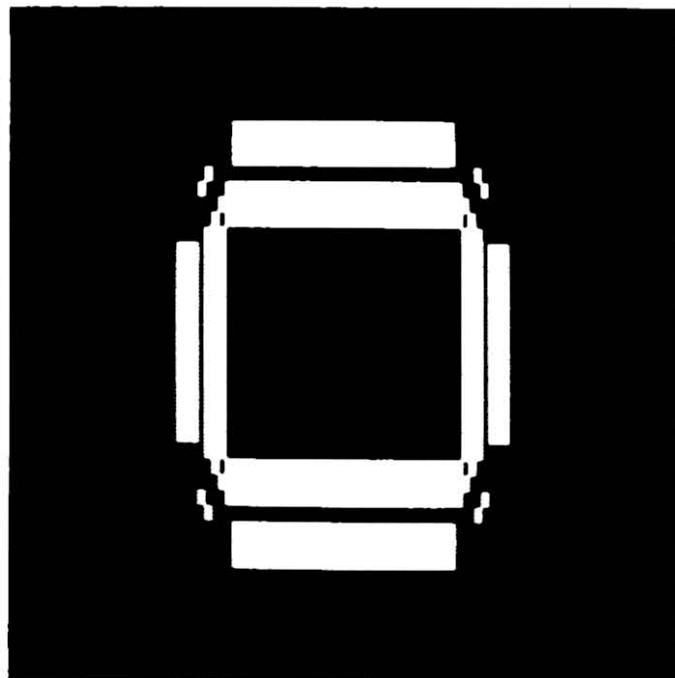
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the current contents of a cell remain unaltered—no birth, no death. If it is not 2, compare it to a 3. If it is a three, then a cell must be given birth, as in line 1920. (If a live cell is already in place, this action has no effect, but still satisfies the Life rule.) A more exhaustive test is only redundant.

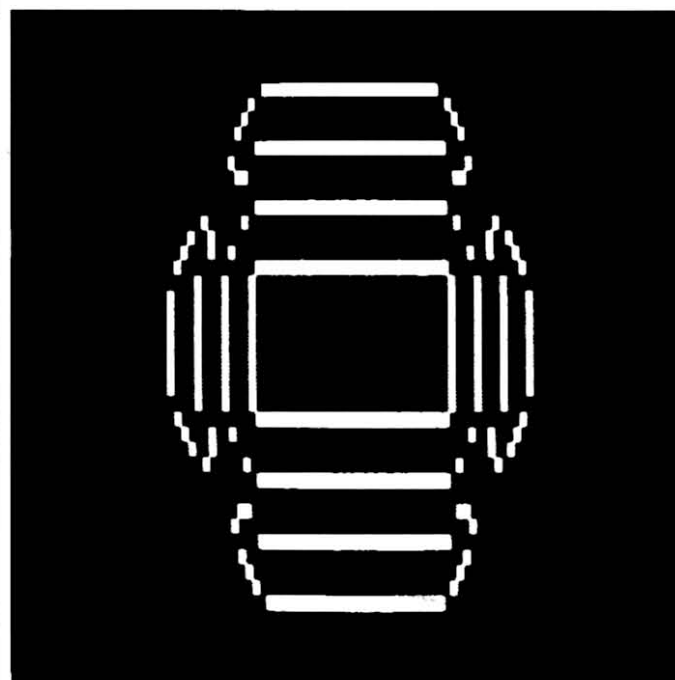
Finally, if our byte is neither 2 nor 3 (the number of neighbors), then of course it must be less than 2 (lonely) or greater than 3 (overpopulated) and Conway's rule stipulates that in such a circumstance, the cell cannot live. Line 1900 resets (turns off, or kills) this bit.

Line 1930 examines the next byte in the same terms. Although the POP-and-test pattern is identical for all three byte pairs, a CALL to subroutine is not used in the interest of speed. In fact, in the entire Playing "God" with Life program, memory is almost always sacrificed in the interest of speed. This program uses six times the

Continue to page 52



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memory that a slower program would. But for advanced games, the Level II 16K TRS-80 is fairly standard. Were this program a utility, the space would be crucial, but for Life, it's whatever makes the game most effective.

When six byte evaluations are completed, you have altered one memory address in your workspace. At line 2350, decrement the workspace value, and decrement the loop counter. When this process is complete (1,024 evaluations), it is just about time to restore the newly derived generation to the screen.

This is a flat world, this video screen, yet the memory itself is not set up that way. The display wraps around contiguous memory locations: 3C3F (the last location in the first row) is neighbor to 3C40 (the first location in the second row). Lines 2480 through 2550 reset a thin line of memory cells on one side of the screen (actually, at this point, in the workspace). This action provides the remainder of the "border of pestilence" set up earlier for the top and bottom rows of the display. Finally, at lines 2590 to 2620, the workspace is restored to the video monitor, and the new generation comes into view.

The balance of this program is taken up with the special features, including display hold, a generation count, return to the BASIC program, and the "god" control, in actuality only a cursor, flashing on and off over the top of the current contents of four contiguous video positions.

A check of the generation status flag is made beginning at line 2660. If the user selects a generation count display when the question is posed in the original instructions, the generation counter is incremented, converted to decimal, and finally to ASCII characters (lines 2710 through 3020). Since the numerals themselves can influence future generations, it is necessary to sweep clear a path around them. This is done in lines 3070 to 3180, where the bordering bits are reset.

Earlier, we ignored a command to jump to the HOLD routine before re-evaluating the generation. You can depress letter H on the keyboard to freeze the current display on the screen (lines 3220 through 3250); or you can return to BASIC by depressing letter X, after first restoring its original stack pointer (lines 3260 through 3300). Finally, you can "play god" by pressing the G, and the program is diverted to a series of routines beginning at line 3430.

This controlling cursor is initiated at the top left of the screen (lines 3430 through 3520). A short delay allows a comfortable flashing rate. The keyboard is then scanned for three groups of commands: motion commands (the four keyboard arrows); activity commands (bear or kill, letters B or K); and the cancel command (return to mortality, letter M).

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This machine language program makes duplicate copies of ANY tape written for Level II. They may be SYSTEM tapes (continuous or not) or data lists. It is not necessary to know the file name or where it loads in memory, and there is no chance of system co-residency. The file name, entry point, and every byte (in ASCII format) are displayed on the video screen. Data may be modified before copy is produced. CLONE.....\$16.95

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#### RAM TEST FOR LEVEL II

This machine language program tests memory chips for open or shorted address or data lines as well as intermittents. It tests each BIT for validity and each BYTE in the execution of an actual instruction as in real program execution. Bad addresses are displayed along with the bad data and proper data. One complete test of 48K takes just 14 seconds. Also includes a test for errors induced by power line glitches from external equipment. RAMTEST.....\$9.95

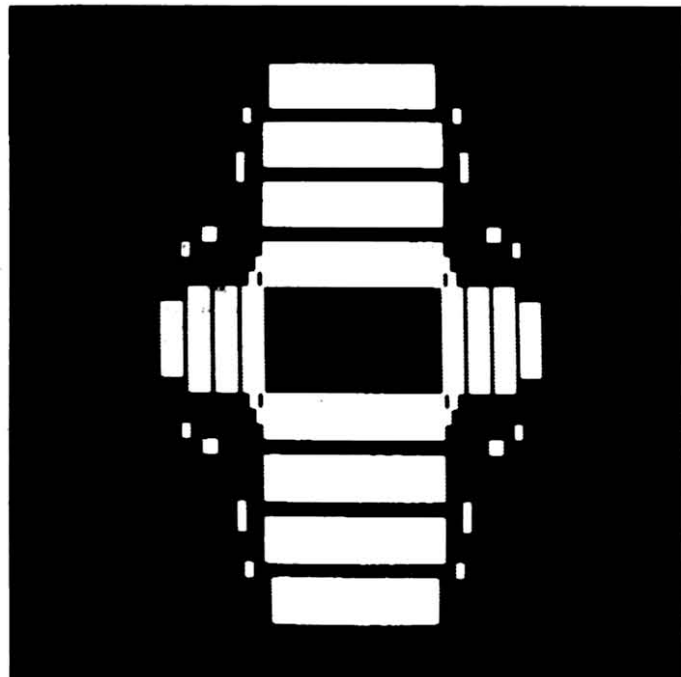
#### INSIDE LEVEL II

Inside Level II is a comprehensive reference guide to the Level II ROMs which allows the machine language programmer to easily utilize the sophisticated routines they contain. Concisely explains set-ups, calling sequences, variable passage, and I/O routines. Special consideration is given to disk systems. Part II presents an entirely new composite program structure which loads under the SYSTEM command and executes in both Basic and machine code with the speed and efficiency of a compiler. In addition, the 18 chapters include a large body of other information useful to the programmer. INSIDE LEVEL II.....\$15.95

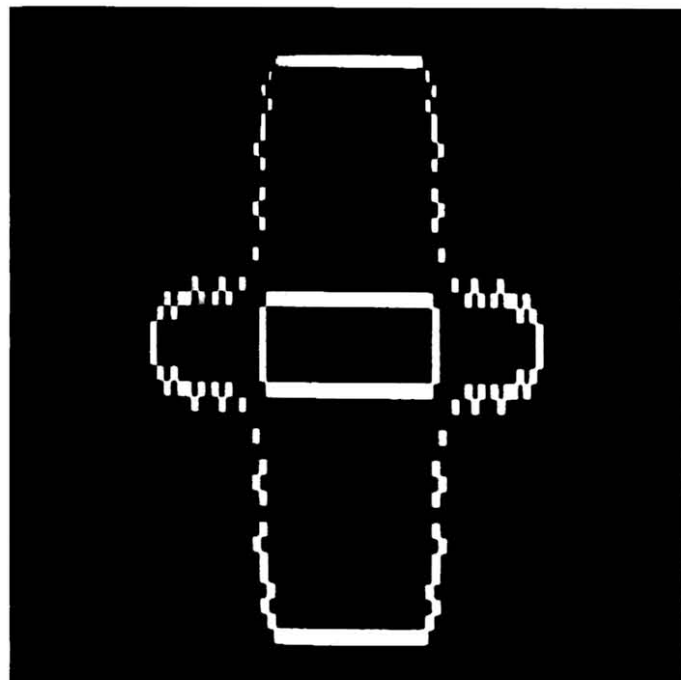
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27

Photos 22 - 27: A symmetrical block (the 4:3 ratio of graphics blocks in the TRS-80 accounts for the vertical elongation), at birth; generation 1, 4, 7, 8, and 9.



Upon the choice of bear or kill, an asterisk appears, isolating the six points in one memory location. Pressing the appropriate number (0 through 5) will set or reset that bit (lines 4090 through 4770), changing one cell on the screen. Pressing M (mortality) returns to the start of the generation checks, so that any change wrought by the cursor will be incorporated into the next generation of beings.

#### Flaws, Frustrations and Bedevilment

The individual graphics block visible on the screen is actually a matrix of three dots by four dots. Because of this, symmetrical images will appear vertically elongated. Also, the universe is nearly twice as wide as it is high. Both these flaws are inherent to the TRS-80's video graphics system.

One additional game variable is that the controlling cursor can march omnipotently through any part of memory. Holding the down arrow causes the cursor to disappear off the bottom of the video screen. This little bedevilment will allow "god" to be marched through any part of memory, and the bear or kill commands can be used in any part of RAM (or even on the memory-addressed ports). This invisible action can crash a program or wreak any kind of havoc — something I consider a nice touch.

If your preference is speed over size, it is easy to revise this program to use the 32-character mode. Remember, of course, that alternate, even-numbered memory locations are addressed in this video format, and that the location of the large-character flag is port 255, bit 3 (1 = on, 0 = off). Normal video is always restored whenever the Life program returns to BASIC. With these alternatives, the program's speed will be doubled to nearly 150 generations per minute.

Another modification, not to the software, but to the hardware, yields something I have found very pleasant to watch: Surplus monitors with the slow green phosphor are available in the \$40 range, and although it is nearly impossible to read normal (64 character per line) text with them, the Life displays appear with high resolution, and the slow phosphor imparts an eerie, organic appearance.

#### Acknowledgments and Conclusion

Thanks are due to Philip K. Hooper, a programmer and mathematician, for his inspiring version of Life and Serpent for the KIM; and to Claire Manfredonia, who suggested that a deity could visit this electronic universe of beings to intervene with fate.

I have received a few comments regarding my use of the "god" cursor. No offense was intended; rather, I feel that control even when playing a game, should be approached with caution and even fear. It is surprising to consider the amount of violence embedded and assumed a part of computer games. ■

#### Bibliography

The subject of Conway's Game of Life has been covered well in other sources over the past decade. The following articles are selected from among the dozens published since the game's introduction:

"Mathematical Games: The Fantastic Combinations of John Conway's New Solitaire Game, 'Life'", Martin Gardner, *Scientific American*, October 1970, pp. 120ff.

"Mathematical Games: On Cellular Automata, Self-Reproduction, the Garden of Eden and the Game 'Life'", Martin Gardner, *Scientific American*, February 1971, pp. 112ff.

The following references are from *Byte*, December 1978:  
 "Life with Your Computer", Justin Millium, pp. 45-50; "Some Facts of Life", David J. Buckingham, pp. 54-67; "Programming Quickies: Life", William Englander, pp. 76-82; "One-Dimensional Life", Jonathan K. Millen, pp. 68-74.  
 "Life Algorithms", Mark D. Niemiec, *Byte*, January 1979, pp. 90-97.

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# COMPLETE ASSEM Playing "God"

```

00100 ;
00110 ; PLAYING GOD WITH LIFE
00120 ; BY DENNIS BATHORY KITSZ
00130 ; VERSION 1.9.3, 5 DECEMBER 1979
00140 ;
00150 ; SPECIAL THANKS TO
00160 ; PHILIP K. HOOPER
00170 ; CLAIRE MANFREDONIA
00180 ;
3C00 00190 VIDEO EQU 3C00H
5D00 00200 STORE EQU 5D00H
00210 ;
00220 ; PRINT LOAD MESSAGE ON SCREEN
00230 ;
3C00 00240 ORG VIDEO
00245 *LIST OFF
00265 *LIST ON
00270 ;
00280 ; SAVE STACK, SET UP NEW STACK
00290 ;
7B00 00300 ORG 7B00H
7B00 ED73FE7F 00310 LD (7FFEH),SP
7B04 31EF7A 00320 LD SP,7AEFH
00330 ;
00340 ; SET GENERATION COUNT TO 0
00350 ;
7B07 21F27A 00360 LD HL,7AF2H
7B0A 3600 00370 LD (HL),0
7B0C 23 00380 INC HL
7B0D 3600 00390 LD (HL),0
00400 ;
00410 ; BLANK UPPER AND LOWER BORDERS
00420 ;
00430 ;
7B0F 21C05C 00430 LD HL,STORE-40H
7B12 0640 00440 LD B,40H
7B14 3600 00450 BLANK LD (HL),00H
7B16 23 00460 INC HL
7B17 10FB 00470 DJNZ BLANK
7B19 210061 00480 LD HL,STORE+400H
7B1C 0640 00490 LD B,40H
7B1E 3600 00500 BLINK LD (HL),00H
7B20 23 00510 INC HL
7B21 10FB 00520 DJNZ BLINK
00530 ;
00540 ; TRANSFER VIDEO TO WORKSPACE
00550 ; THIS ACTION PREVENTS SCREEN "HASH"
00560 ;
7B23 21003C 00570 PHIL LD HL,VIDEO
7B26 11005D 00580 LD DE,STORE
7B29 010004 00590 LD RC,400H
7B2C EDB0 00600 LDIR
7B2E DD21005D 00610 LD IX,STORE
00620 ;
00630 ; SET UP SCREEN POSITIONS TO CHECK
00640 ;
7B32 D9 00650 LIFE EXX
7B33 010004 00660 LD RC,400H
7B36 D9 00670 START EXX
00680 ;
00690 ; START WITH FRESH BYTE FIELD
00700 ;
7B37 110000 00710 LD DE,0
7B3A D5 00720 PUSH DE
7B3B D5 00730 PUSH DE
7B3C D5 00740 PUSH DE
7B3D ED73FC7F 00750 LD (7FFCH),SP
7B41 FD2AFC7F 00760 LD IX,(7FFCH)
00770 ;
00780 ; START CHECK OF 20 CELL POSITIONS
00790 ;
7B45 DDCBFF6E 00800 BIT 5,(IX-41H)
7B49 280F 00810 JR 2,CL01
7B4B FD3405 00820 INC (IX+5)
7B4E DDCB066 00830 CL01 BIT 4,(IX-40H)
7B52 2806 00840 JR 2,CL02
7B54 FD3405 00850 INC (IX+5)
7B57 FD3404 00860 INC (IX+4)
7B5A DDCB06E 00870 CL02 BIT 5,(IX-40H)
7B5E 2806 00880 JR 2,CL03
7B60 FD3405 00890 INC (IX+5)
7B63 FD3404 00900 INC (IX+4)
7B66 DDCB166 00910 CL03 BIT 4,(IX-39H)
7B6A 280F 00920 JR 2,CL04
7B6C FD3404 00930 INC (IX+4)
7B6F DDCBFF4E 00940 CL04 BIT 1,(IX-1)
7B73 2806 00950 JR 2,CL05
7B75 FD3405 00960 INC (IX+5)
7B78 FD3403 00970 INC (IX+3)
7B7B DDCBFF5E 00980 CL05 BIT 3,(IX-1)
7B7F 2809 00990 JR 2,CL06
7B81 FD3405 01000 INC (IX+5)
7B84 FD3403 01010 INC (IX+3)
7B87 FD3401 01020 INC (IX+1)
7B8A DDCBFF6E 01030 CL06 BIT 5,(IX-1)
7B8E 2806 01040 JR 2,CL07
7B90 FD3403 01050 INC (IX+3)
7B93 FD3401 01060 INC (IX+1)
7B96 DDCB0046 01070 CL07 BIT 0,(IX)
7B9A 2809 01080 JR 2,CL08
7B9C FD3404 01090 INC (IX+4)
7B9F FD3403 01100 INC (IX+3)
7BA2 FD3402 01110 INC (IX+2)
7BA5 DDCB004E 01120 CL08 BIT 1,(IX)
7BA9 2809 01130 JR 2,CL09
7BAB FD3405 01140 INC (IX+5)
7BAE FD3403 01150 INC (IX+3)
7BB1 FD3402 01160 INC (IX+2)
7BB4 DDCB0056 01170 CL09 BIT 2,(IX)
7BB8 280F 01180 JR 2,CL10
7BBA FD3405 01190 INC (IX+5)
7BBD FD3404 01200 INC (IX+4)
7BC0 FD3402 01210 INC (IX+2)
7BC3 FD3401 01220 INC (IX+1)
7BC6 FD3400 01230 INC (IX)
7BC9 DDCB005E 01240 CL10 BIT 3,(IX)
7BCD 280F 01250 JR 2,CL11
7BCF FD3405 01260 INC (IX+5)
7BD2 FD3404 01270 INC (IX+4)
7BD5 FD3403 01280 INC (IX+3)
7BD8 FD3401 01290 INC (IX+1)
7BDB FD3400 01300 INC (IX)
7BDE DDCB0066 01310 CL11 BIT 4,(IX)
7BE2 2809 01320 JR 2,CL12

```

```

7BE4 FD3403 01330 INC (IX+3)
7BE7 FD3402 01340 INC (IX+2)
7BEA FD3400 01350 INC (IX)
7BED DDCB006E 01360 CL12 BIT 5,(IX)
7BF1 2809 01370 JR 2,CL13
7BF3 FD3403 01380 INC (IX+3)
7BF6 FD3402 01390 INC (IX+2)
7BF9 FD3401 01400 INC (IX+1)
7BFC DDCB0146 01410 CL13 BIT 0,(IX+1)
7C00 2806 01420 JR 2,CL14
7C02 FD3404 01430 INC (IX+4)
7C05 FD3402 01440 INC (IX+2)
7C08 DDCB0156 01450 CL14 BIT 2,(IX+1)
7C0C 2809 01460 JR 2,CL15
7C0E FD3404 01470 INC (IX+4)
7C11 FD3402 01480 INC (IX+2)
7C14 FD3400 01490 INC (IX)
7C17 DDCB0166 01500 CL15 BIT 4,(IX+1)
7C1B 2806 01510 JR 2,CL16
7C1D FD3402 01520 INC (IX+2)

```

## Instructions for Play

### Instructions for Playing "God" with Life

This listing may be entered using the Radio Shack Editor/Assembler in order to produce the Life object code. A machine with 16K memory is sufficient to hold this source listing.

After entry of this listing is complete, an object code may be produced; owners of EDTASM 1.1 will get seven FIELD OVERFLOW error messages on lines 800, 830, 870, 910, 940, 980 and 1030 indicating a negative offset for IX. However, the line will assemble correctly, and this error message may be ignored; later versions of EDTASM have corrected this flaw.

After the object code has been produced, be sure to save several copies of both it and the source code for future reference or modifications.

In order to load and run Playing "God" with Life:

1. Power-up the TRS-80, or type SYSTEM [ENTER] /0 [ENTER].
2. Respond to MEMORY SIZE? with 23700 [ENTER].
3. Insert the object tape, type SYSTEM [ENTER], and respond to the "? prompt with the name you used to assemble the object code. (I use "LIFE9").
4. If all is well, the screen will read:

```
** LOADING LIFE9 *** WAIT FOR "GOOD LOAD" *** THEN ENTER "F" **
```

5. When the tape has finished loading, the screen will display:

```
***** GOOD LOAD *****
```

6. Type a slash (/) and [ENTER].

The screen will clear, followed by the introductory text. When you have finished reading the text, you have the opportunity to call for an on-screen generation count:

```
GENERATION COUNT? ENTER 1 FOR ON-SCREEN COUNT, 0 FOR NO COUNT
```

Press 1 or 0 (ENTER not necessary), then:

```
ENTER 0 TO RETURN TO BASIC, THEN LOAD OR PROGRAM CIVILIZATIONS.
```

Press 0 [ENTER]

Now you may either:



# BLY LISTING FOR with Life

```

7C20 FD3400 01530      INC      (IY)
7C23 DDCB3F4E 01540 CL16 BIT      1,(IX+3FH)
7C27 2803 01550      JR      2,CL17
7C29 FD3401 01560      INC      (IY+1)
7C2C DDCB4046 01570 CL17 BIT      0,(IX+40H)
7C30 2806 01580      JR      2,CL18
7C32 FD3401 01590      INC      (IY+1)
7C35 FD3400 01600      INC      (IY)
7C38 DDCB404E 01610 CL18 BIT      1,(IX+40H)
7C3C 2806 01620      JR      2,CL19
7C3E FD3401 01630      INC      (IY+1)
7C41 FD3400 01640      INC      (IY)
7C44 DDCB4146 01650 CL19 BIT      0,(IX+41H)
7C48 2803 01660      JR      2,CL20
7C4A FD3400 01670      INC      (IY)
7C4D DD23 01680 CL20 INC      IX
7C4F D9 01690      EXX
7C50 C33C7D 01700      JP      HOLD
01710 ;
01720 ; SEE IF ALL POSITIONS CHECKED
01730 ;

```

- 1) Enter your own program in BASIC, or
- 2) Enter the STARTS program (Listing 6).

### Notes on Writing Your Own Program:

1. Use POKE statements for graphics, never PRINT or PRINT@. You may POKE graphics on the video display from locations 15360 to 16383. For example, POKE 15392,191, will give a graphics block (191) a seat halfway into the top line. SET and RESET may also be used.

2. Use ASCII character 128 for a space, not CLS. (Listing 8).

3. The last program statement before Life must be M% =USR(0), although any variable may be used in place of M%. The correct starting address for Life has been put in place by the Life system program (see text).

Summary of using the god cursor control:

1. Press G: Mortal time is suspended and GOD → flashes on the screen.
2. Move GOD → up, down, left or right by using the four keyboard arrows; be careful if you go off the screen (see text).
3. When GOD → is pointed at a block of cells: Press B to enter the BIRTH mode, or Press K to enter the KILL mode. An asterisk (\*) will appear as a prompt.
4. Press 0, 1, 2, 3, 4, or 5 to BEAR or KILL a cell. (Fig. 2.)
5. You may:

Press B or K plus 0 through 5 again  
 Move GOD→ with the 4 arrows, or  
 Press M to return to mortal time; Life continues

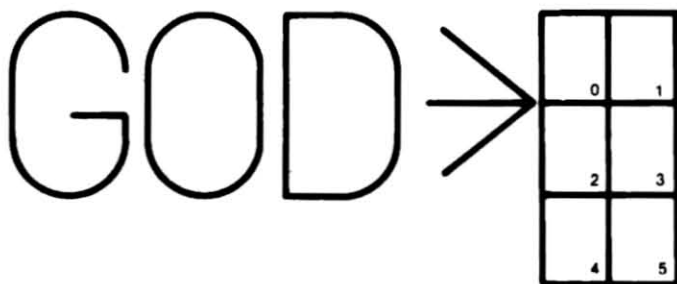


Fig.2. Note that cells 4 and 5 are below the baseline of the word.

```

7C53 0B 01740 FATS0 DEC      BC
7C54 78 01750      LD      A,B
7C55 B1 01760      OR      C
7C56 C2367B 01770      JP      NZ,START
7C59 010004 01780      LD      BC,400H
7C5C D9 01790      EXX
01800 ;
01810 ; MAKE GENERATIONAL CHANGES
01820 ;
7C5D 21FF60 01830      LD      HL,STORE+3FFH
7C60 D1 01840      SCREN  POP      DE
7C61 7A 01850      LD      A,D
7C62 FE02 01860      CP      2
7C64 280A 01870      JR      2,NXT1
7C66 FE03 01880      CP      3
7C68 2804 01890      JR      2,S+6
7C6A CBA6 01900      RES      4,(HL)
7C6C 1802 01910      JR      S+4
7C6E CBE6 01920      SET      4,(HL)
7C70 7B 01930      LD      A,E
7C71 FE02 01940      CP      2
7C73 280A 01950      JR      2,NXT2
7C75 FE03 01960      CP      3
7C77 2804 01970      JR      2,S+6
7C79 CBAE 01980      RES      5,(HL)
7C7B 1802 01990      JR      S+4
7C7D CBE6 02000      SET      5,(HL)
7C7F D1 02010      LD      A,E
7C80 7A 02020      LD      A,D
7C81 FE02 02030      CP      2
7C83 280A 02040      JR      2,NXT3
7C85 FE03 02050      CP      3
7C87 2804 02060      JR      2,S+6
7C89 CB96 02070      RES      2,(HL)
7C8B 1802 02080      JR      S+4
7C8D CBD6 02090      SET      2,(HL)
7C8F 7B 02100      LD      A,E
7C90 FE02 02110      CP      2
7C92 280A 02120      JR      2,NXT4
7C94 FE03 02130      CP      3
7C96 2804 02140      JR      2,S+6
7C98 CB9E 02150      RES      1,(HL)
7C9A 1802 02160      JR      S+4
7C9C CBDE 02170      SET      3,(HL)
7C9E D1 02180      LD      A,E
7C9F 7A 02190      LD      A,D
7CA0 FE02 02200      CP      2
7CA2 280A 02210      JR      2,NXT5
7CA4 FE03 02220      CP      3
7CA6 2804 02230      JR      2,S+6
7CA8 CB86 02240      RES      0,(HL)
7CAA 1802 02250      JR      S+4
7CAC CB86 02260      SET      0,(HL)
7CAE 7B 02270      LD      A,E
7CAF FE02 02280      CP      2
7CB1 280A 02290      JR      2,NXT6
7CB3 FE03 02300      CP      3
7CB5 2804 02310      JR      2,S+6
7CB7 CB8E 02320      RES      1,(HL)
7CB9 1802 02330      JR      S+4
7CBB CB8E 02340      SET      1,(HL)
7CBD 2B 02350      LD      HL
7CBE D9 02360      EXX
7CBF 0B 02370      DEC      BC
7CC0 78 02380      LD      A,B
7CC1 B1 02390      OR      C
7CC2 2802 02400      JR      NZ,S+4
7CC4 1804 02410      JR      MILB
7CC6 D9 02420      EXX
7CC7 C3607C 02430      JP      SCREN
02440 ;
02450 ; BLANK ONE BORDER OF BITS
02460 ; THIS PREVENTS WRAPAROUND EFFECT
02470 ;
7CCA 060F 02480      LD      B,0FH
7CCC 114000 02490      LD      DE,40FH
7CCF DD21FF5C 02500      LD      IX,5CFFH
7CD3 DDCB008E 02510      ZAAZ  RES      1,(IX)
7CD7 DDCB009E 02520      ZAAZ  RES      3,(IX)
7CDB DDCB00AE 02530      RES      5,(IX)
7CDF DD19 02540      ADD     IX,DE
7CE1 18F0 02550      DJNZ   ZAAZ
02560 ;
02570 ; RESTORE VIDEO FROM WORKSPACE
02580 ;
7CE3 21005D 02590      LD      HL,STORE
7CE6 11003C 02600      LD      DE,VIDEO
7CE9 010004 02610      LD      BC,400H
7CEC EDB0 02620      LDIR
02630 ;
02640 ; CHECK GENERATION COUNT STATUS FLAG
02650 ;
7CEE 21F47A 02660      LD      HL,7AF4H
7CF1 7E 02670      LD      A,(HL)
7CF2 FE01 02680      CP      1
7CF4 C2387D 02690      JP      NZ,NOCNT
02700 ;
02710 ; COUNT AND CONVERT TO ASCII
02720 ;
7CF7 0602 02730      LD      B,2
7CF9 11F3F 02740      LD      DE,3FFFH
7CFC 21F27A 02750      LD      HL,7AF2H
7CF7 7E 02760      LD      A,(HL)
7D00 3C 02770      INC     A
7D01 27 02780      DAA
7D02 77 02790      LD      HL,(HL),A
7D03 3807 02800      JR      NC,S+9
7D05 3F 02810      CCF
7D06 23 02820      INC     HL
7D07 7E 02830      LD      A,(HL)
7D08 3C 02840      INC     A
7D09 27 02850      DAA
7D0A 77 02860      LD      HL,(HL),A
7D0B 2B 02870      DEC     HL
7D0C AF 02880      XOR     A
7D0D ED67 02890      RRD
7D0F C630 02900      ADD     A,30H
7D11 12 02910      LD      (DE),A
7D12 D630 02920      SUB     30H
7D14 ED67 02930      RRD
7D16 C630 02940      ADD     A,30H
7D18 1B 02950      DEC     DE
7D19 12 02960      LD      (DE),A

```

```

7D1A D638 02978 SUB 38H
7D1C ED67 02988 RRD
7D1E 1B 02998 DEC DE
7D1F 23 03008 INC HL
7D28 85 03018 DEC B
7D21 28E9 03028 JR NZ,S-15H
03038 ;
03048 ; CLEAR BLANKS AROUND NUMERALS TO AVOID
03058 ; INTERACTION WITH GRAPHICS BITS
03068 ;
7D23 21F83F 03078 LD HL,VIDEO+3FBH
7D26 CB8E 03088 RES 1,(HL)
7D28 CB9E 03098 RES 3,(HL)
7D2A CBAA 03108 RES 5,(HL)
7D2C 0604 03118 LD B,4
7D2E 21B3F 03128 LD HL,VIDEO+3FBH
7D31 CBAA 03138 BLUNK RES 4,(HL)
7D33 CBAA 03148 RES 5,(HL)
7D35 2B 03158 DEC HL
7D36 18F9 03168 DJNZ BLUNK
7D38 D9 03178 NOCMT EXJ
7D39 C3237B 03188 JF PHIL
03198 ;
03208 ; KEYBOARD SCAN FOR HOLD, GOD, BASIC
03218 ;
7D3C 210238 03228 HOLD LD HL,3802H
7D3F 3E81 03238 CP (HL)
7D41 BE 03248 CP (HL)
7D42 28F8 03258 JR Z,S-6
7D44 210838 03268 LD HL,3808H
7D47 BE 03278 CP (HL)
7D48 2085 03288 JR NZ,S+7
7D4A ED7BFE7F 03298 LD SP,(7FFEH)
7D4E C9 03308 RET
7D4F 210138 03318 LD HL,3801H
7D52 3E80 03328 LD A,80H
7D54 BE 03338 CP (HL)
7D55 2087 03348 JR Z,S+9
7D57 C3537C 03358 JF PATSO
7D5A 23 03368 CARRY INC HL
7D5B 34 03378 INC (HL)
7D5C 2B 03388 DEC HL
7D5D C9 03398 RET
03408 ;
03418 ; FLASHING "GOD" SEQUENCE STARTS
03428 ;
7D5E DD21083C 03438 LD IX,VIDEO
7D62 DD85 03448 GODB PUSH IX
7D64 E1 03458 POP HL
7D65 11F87A 03468 LD DE,7AF8H
7D68 018400 03478 LD BC,4
7D6B EDB8 03488 LDIR
7D6D DD360847 03498 LD [IX],47H
7D71 DD36014F 03508 LD [IX+1],4FH
7D75 DD360244 03518 LD [IX+2],44H
7D79 DD36035E 03528 LD [IX+3],5EH
7D7D CD827D 03538 CALL DELAY
7D80 1889 03548 JR SCANA
03558 ;
03568 ; DELAY ROUTINE PLACED BEFORE ACTION
03578 ; PRODUCES DELIBERATE FRUSTRATION
03588 ;
7D82 21081A 03598 DELAY LD HL,1A80H
7D85 2B 03608 DEC HL
7D86 7C 03618 LD A,H
7D87 85 03628 OR L
7D88 28F8 03638 JR NZ,S-3
7D8A C9 03648 RET
03658 ;
03668 ; SCAN FOR MOTION OF "GOD" CONTROL
03678 ;
7D8B 214038 03688 SCANA LD HL,3840H
7D8E 3E80 03698 LD A,8
7D98 BE 03708 CP (HL)
7D91 CA827E 03718 JF Z,UPAR
7D94 87 03728 RLCA
7D95 BE 03738 CP (HL)
7D96 CA917E 03748 JF Z,DNAR
7D99 87 03758 RLCA
7D9A BE 03768 CP (HL)
7D9B CA807E 03778 JF Z,BCKAR
7D9E 87 03788 RLCA
7D9F BE 03798 CP (HL)
7DA0 CA777E 03808 JF Z,FRTAR
03818 ;
03828 ; SCAN KEYBOARD FOR KILL, BEAR, MORTALITY
03838 ;
7DA3 210238 03848 EDIT LD HL,3802H
7DA6 3E80 03858 LD A,8
7DA8 BE 03868 CP (HL)
7DA9 2814 03878 JR Z,S+16H
7DAB 2D 03888 DEC L
7DAC 8F 03898 RRCA
7DAD BE 03908 CP (HL)
7DAE 2813 03918 JR Z,S+15H
7DB0 23 03928 INC HL
7DB1 3E20 03938 LD A,20H
7DB3 BE 03948 CP (HL)
7DB4 CAAB7E 03958 JF Z,HELD
7DB7 CD627E 03968 CALL ONCE
7DBA CD027D 03978 CALL DELAY
7DBD 18A3 03988 JR GODB
7DBF 8680 03998 LD B,0
7DC1 1802 04008 JR S+4
7DC3 8681 04018 LD B,1
7DC5 21F87A 04028 LD HL,7AF8H
7DC8 DD7E85 04038 LD A,(IX+5)
7DCB 77 04048 LD (HL),A
7DCC DD36052A 04058 LD (IX+5),2AH
04068 ;
04078 ; SCAN FOR BIT TO KILL OR BEAR
04088 ;
7DD8 211038 04098 POOD LD HL,3818H
7DD3 3E81 04108 LD A,1
7DD5 BE 04118 CP (HL)
7DD6 2823 04128 JR Z,BIT8
7DD8 87 04138 RLCA
7DD9 BE 04148 CP (HL)
7DDA 282F 04158 JR Z,BIT1
7DDC 87 04168 RLCA
7DDD BE 04178 CP (HL)
7DDE 283B 04188 JR Z,BIT2
7DE0 87 04198 RLCA
7DE1 BE 04208 CP (HL)
7DE2 2847 04218 JR Z,BIT3
7DE4 87 04228 RLCA
7DE5 BE 04238 CP (HL)
7DE6 2853 04248 JR Z,BIT4
7DE8 87 04258 RLCA
7DE9 BE 04268 CP (HL)
7DEA 285F 04278 JR Z,BIT5
7DEC 210238 04288 LD HL,3802H
7DEF BE 04298 CP (HL)
7DF0 28DE 04308 JR NZ,POOD
7DF2 2AF87A 04318 LD HL,(7AF8H)
7DF5 DD7585 04328 LD (IX+5),L
7DF8 C3AB7E 04338 JF HELD
04348 ;
04358 ; START ROUTINES TO KILL OR BEAR BITS
04368 ;
7DFB AF 04378 BIT8 XOR A
7DFC 88 04388 OR B
7DFD 2806 04398 JR NZ,S+8
7DFE DDCB8486 04408 RES 8,(IX+4)
7E03 1854 04418 JR STAR
7E05 DDCB84C6 04428 SET 8,(IX+4)
7E09 184E 04438 JR STAR
7E0B AF 04448 BIT1 XOR A
7E0C 88 04458 OR B
7E0D 2806 04468 JR NZ,S+8
7E0E DDCB848E 04478 RES 1,(IX+4)
7E13 1844 04488 JR STAR
7E15 DDCB84CE 04498 SET 1,(IX+4)
7E19 183E 04508 JR STAR
7E1B AF 04518 BIT2 XOR A
7E1C 88 04528 OR B
7E1D 2806 04538 JR NZ,S+8
7E1F DDCB8496 04548 RES 2,(IX+4)
7E23 1834 04558 JR STAR
7E25 DDCB84D6 04568 SET 2,(IX+4)
7E29 182E 04578 JR STAR
7E2B AF 04588 BIT3 XOR A
7E2C 88 04598 OR B
7E2D 2806 04608 JR NZ,S+8
7E2F DDCB849E 04618 RES 3,(IX+4)
7E33 1824 04628 JR STAR
7E35 DDCB84DE 04638 SET 3,(IX+4)
7E39 181E 04648 JR STAR
7E3B AF 04658 BIT4 XOR A
7E3C 88 04668 OR B
7E3D 2806 04678 JR NZ,S+8
7E3F DDCB84A6 04688 RES 4,(IX+4)
7E43 1814 04698 JR STAR
7E45 DDCB84E6 04708 SET 4,(IX+4)
7E49 180E 04718 JR STAR
7E4B AF 04728 BIT5 XOR A
7E4C 88 04738 OR B
7E4D 2806 04748 JR NZ,S+8
7E4F DDCB84AE 04758 RES 5,(IX+4)
7E53 1804 04768 JR STAR
7E55 DDCB84EE 04778 SET 5,(IX+4)
04788 ;
04798 ; ROUTINES TO DELETE STAR AND
04808 ; RESTORE ORIGINAL IMAGE HIDDEN BY "GOD"
04818 ;
7E59 2AF87A 04828 STAR LD HL,(7AF8H)
7E5C DD7585 04838 LD (IX+5),L
7E5F C3A37D 04848 JF EDIT
7E62 ED4BF87A 04858 ONCE LD BC,(7AF8H)
7E66 DD7188 04868 LD (IX),C
7E69 DD7081 04878 LD (IX+1),B
7E6C ED4BF87A 04888 LD BC,(7AF8H)
7E78 DD7182 04898 LD (IX+2),C
7E73 DD7083 04908 LD (IX+3),B
7E76 C9 04918 RET
04928 ;
04938 ; ROUTINES TO PRODUCE MOTION OF "GOD"
04948 ;
7E77 CD627E 04958 FRTAR CALL ONCE
7E7A DD23 04968 INC IX
7E7C CD827D 04978 CALL DELAY
7E7F C3627D 04988 JF GODB
7E82 CD627E 04998 UPAR CALL ONCE
7E85 8640 05008 LD B,48H
7E87 DD2B 05018 DEC IX
7E89 18FC 05028 DJNZ S-2
7E8B CD827D 05038 CALL DELAY
7E8E C3627D 05048 JF GODB
7E91 CD627E 05058 DNAR CALL ONCE
7E94 8640 05068 LD B,48H
7E96 DD23 05078 INC IX
7E98 18FC 05088 DJNZ S-2
7E9A CD827D 05098 CALL DELAY
7E9D C3627D 05108 JF GODB
7E9F CD627E 05118 BCKAR CALL ONCE
7EA3 DD2B 05128 DEC IX
7EA5 CD827D 05138 CALL DELAY
7EA8 C3627D 05148 JF GODB
7EAB CD627E 05158 HELD CALL ONCE
7EAE 11EF7A 05168 LD SP,7AF8H
7EB1 C3237B 05178 JF PHIL
05188 ;
05198 ; ROUTINES TO DISPLAY SCREEN TEXT
05208 ; AT BEGINNING OF PROGRAM, INCLUDING
05218 ; DELAYS, GENERATION COUNT CHOICE,
05228 ; AND RETURN TO BASIC CONTROL
05238 ;
6288 05248 ORG 6288H
05258 ;
05268 ; CLEAR SCREEN AND HOLD CLEAR
05278 ;
6288 CD5C62 05288 CALL PLOP
6283 8618 05298 LD B,18H
6285 CD827D 05308 STAY1 CALL DELAY
6288 18FB 05318 DJNZ STAY1
05328 ;
05338 ; DISPLAY FIRST TWO LINES OF TEXT
05348 ;
628A 21F762 05358 LD HL,PLAY
628D 1153C 05368 LD DE,VIDEO+15H
6218 811500 05378 LD BC,15H
6213 EDB8 05388 LDIR
6215 21523C 05398 LD HL,VIDEO+52H
6218 861B 05408 LD B,18H
621A 363D 05418 OLSE LD (HL),3DH
621C 23 05428 INC HL

```



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SORT	32K	49	SORT	680K	2569
SORT	85K	173	SORT and MERGE	85K SORT + 1275K Merge	1757
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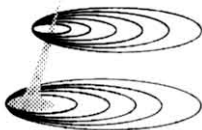
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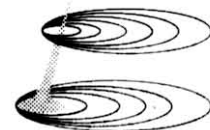
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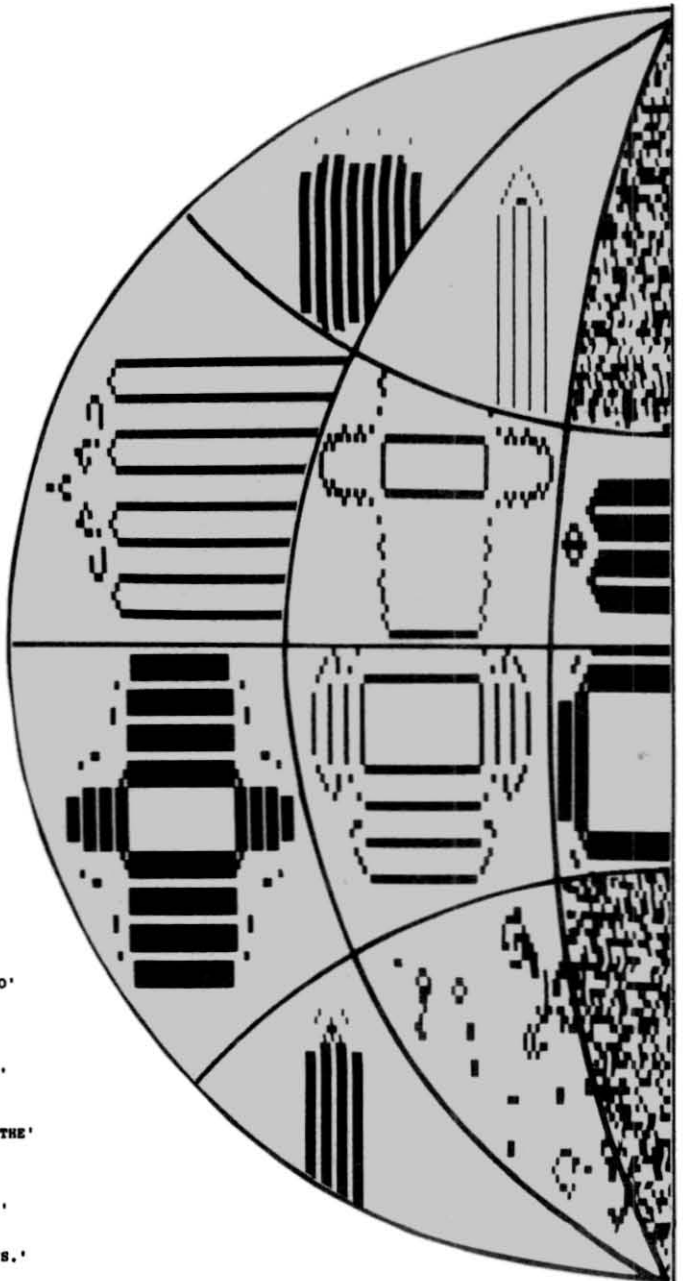
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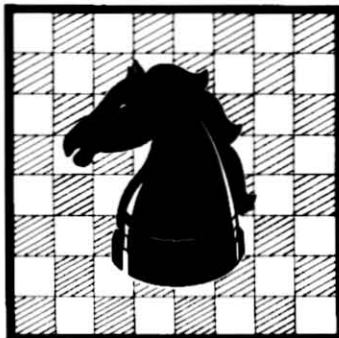
621D 10FB 05438 DJNZ QLSE 06688 DEFM 'THEN LOAD OR PROGRAM CIVILIZATIONS.'
621F 210C63 05440 LD HL,COPY 06690 ;
6222 11C83C 05450 LD DE,VIDEO+8C0H 06700 ; DISPLAY "GOOD LOAD" AT END OF LOAD
6225 01A000 05460 LD BC,40H 06710 ; TO ASSURE USER OF GOOD LOAD (WHAT ELSE?)
6228 EDB0 05470 LDIR 06720 ;
05480 ;
05490 ; DISPLAY NEXT GROUP OF LINES WITH
05500 ; DELAY FROM LETTER TO LETTER
05510 ;
622A 214C63 05520 LD HL,INSTR
622D 11483D 05530 LD DE,VIDEO+148H DOLC 62AF HELD 7EAB CL18 7C38
6230 06FF 05540 LD B,8FFH BASC 65CB EDIT 7DA3 CL17 7C2C
6232 CD3C62 05550 CALL WRDS CLID 629C FRTR 7E77 CL16 7C23
6235 06C1 05560 LD B,0C1H CLOD 629A BCKAR 7EAB CL15 7C17
6237 CD3C62 05570 CALL WRDS GEN 62BA DNAR 7E91 CL14 7C08
623A 180C 05580 JR HERE POKE 626A UPAR 7E82 CL13 7BFC
623C 7E 05590 WRDS LD A,(HL) STAY2 6255 SCANA 7DB8 CL12 7BDB
623D 12 05600 LD (DE),A PLUS 658C DELAY 7D82 CL11 7BDE
623E 05 05610 PUSH HL HERE 6248 GODB 7D62 CL10 7BC9
623F CD027D 05620 CALL DELAY WRDS 623C CARRY 7D5A CL09 7B84
6242 E1 05630 POP HL INSTR 634C BLUNK 7D31 CL08 7B5A
6243 23 05640 INC HL COPY 638C NOCMT 7D38 CL07 7B96
6244 13 05650 INC DE QLSE 621A ZAAZ 7CD3 CL06 7B8A
6245 10F5 05660 DJNZ WRDS PLAY 62F7 WILB 7CCA CL05 7B7B
6247 C9 05670 RET STAY1 6285 NKT6 7CBD CL04 7B6F
6248 210C65 05680 HERE LD HL,PLUS PLOP 625C NKT5 7CAE CL03 7B66
624B 11483F 05690 LD DE,VIDEO+348H STAR 7E59 NKT4 7C9E CL02 7B5A
624E 06BF 05700 LD B,8BFH BITS 7E4B NKT3 7C8F CL01 7B4E
6250 CD3C62 05710 CALL WRDS BIT4 7E3B NKT2 7C7F START 7B36
6253 0650 05720 LD B,50H BIT3 7E2B NKT1 7C70 LIFE 7B32
6255 CD027D 05730 STAY2 CALL DELAY BIT2 7E1B SCREN 7C60 PHIL 7B23
6258 10FB 05740 DJNZ STAY2 BIT1 7E0B FATSO 7C53 BLINK 7B1E
625A 180E 05750 JR POKE BIT0 7DFB HOLD 7D3C BLANK 7B14
05760 ; POOD 7DD0 CL28 7C4D STORE 5D00
05770 ; CLEAR SCREEN SUBROUTINE ONCE 7E62 CL19 7C44 VIDEO 3C00
05780 ;
625C 01FF03 05790 PLOP LD BC,3FFH
625F 21003C 05800 LD HL,VIDEO
6262 11013C 05810 LD DE,VIDEO+1
6265 3680 05820 LD (HL),80H
6267 EDB0 05830 LDIR
6269 C9 05840 RET
05850 ;
05860 ; PUT "USR(0)" ADDRESS IN PLACE
05870 ;
626A 218E48 05880 POKE LD HL,488EH
626D 3680 05890 LD (HL),0
626F 23 05900 INC HL
6270 367B 05910 LD (HL),7BH
6272 CD5C62 05920 CALL PLOP
05930 ;
05940 ; DISPLAY GENERATION COUNT PROMPT
05950 ;
6275 21BA62 05960 LD HL,GEN
6278 11003D 05970 LD DE,VIDEO+100H
627B 013D00 05980 LD BC,3DH
627E EDB0 05990 LDIR
06000 ;
06010 ; SCAN KEYBOARD FOR RESPONSE
06020 ;
6280 211038 06030 LD HL,3810H
6283 3E01 06040 LD A,1
6285 BE 06050 CP (HL)
6286 2806 06060 JR Z,9+00H
6288 3C 06070 INC A
6289 BE 06080 CP (HL)
628A 2809 06090 JR 1,9+00H
628C 18F2 06100 JR S-8CH
06110 ;
06120 ; SET UP GENERATION COUNT STATUS FLAG
06130 ;
628E 21F47A 06140 LD HL,7AF4H
6291 3600 06150 LD (HL),0
6293 1805 06160 JR CLOD
6295 21F47A 06170 LD HL,7AF4H
6298 3601 06180 LD (HL),1
06190 ;
06200 ; DELAY FOLLOWED BY RETURN TO BASIC
06210 ; PROMPT AND KEYBOARD SCAN
06220 ;
629A 0618 06230 CLOD LD B,10H
629C CD027D 06240 CALL DELAY
629F 10FB 06250 DJNZ CLID
62A1 CD5C62 06260 CALL PLOP
62A4 21C865 06270 LD HL,BASC
62A7 11003D 06280 LD DE,VIDEO+100H
62AA 013F00 06290 LD BC,03FH
62AD EDB0 06300 LDIR
62AF 211038 06310 DOLC LD HL,3810H
62B2 3E01 06320 LD A,1
62B4 BE 06330 CP (HL)
62B5 28F8 06340 JR NZ,DOLC
06350 ;
06360 ; RETURN TO BASIC CONTROL
06370 ;
62B7 C3191A 06380 JP 1A19H
06390 ;
06400 ; THE LINES OF TEXT FOLLOW AS A BLOCK
06410 ;
06420 GEN DEFM 'GENERATION COUNT? ENTER 1 FOR '
06430 DEFM 'ON-SCREEN COUNT, 0 FOR NO COUNT'
06440 PLAY DEFM 'PLAYING GOD WITH LIFE'
06470 INSTR DEFM '"PLAYING GOD WITH LIFE" IS A '
06480 DEFM 'MATHEMATICAL PASTIME. THERE ARE NO '
06490 DEFM 'WINNERS OR LOSERS. YOU BECOME '
06500 DEFM 'THE OBSERVER IN AN AGELESS MASTER '
06510 DEFM 'PLAN -- A SORT OF LIMITED DEITY '
06520 DEFM 'WITH CONTROL OVER YOUR GARDEN OF '
06530 DEFM 'EDEN, POSSESSING THE POWER TO '
06540 DEFM 'COMMIT THE UNIVERSE TO OBLIVION OR '
06550 DEFM 'TO CREATE OR DESTROY INDIVIDUALS '
06560 DEFM 'AT WILL. BUT FOR YOU TO CHANGE '
06570 DEFM 'THE MASTER PLAN IS OUTSIDE '
06580 DEFM 'YOUR POWER. YOU ONLY OBSERVE AS THE '
06590 DEFM 'GENERATIONS MARCH BY, SUSPENDING '
06600 DEFM 'TIME TO SAVE A FEW FRIENDS.... '
06610 PLUS DEFM 'CONTROL WILL BE RETURNED TO YOU '
06620 DEFM 'AND BASIC IN TWENTY SECONDS, AND '
06630 DEFM 'IF YOU REFER TO YOUR "PLAYING GOD '
06640 DEFM 'WITH LIFE" INSTRUCTION SHEETS, '
06650 DEFM 'YOU WILL BE ABLE TO CREATE '
06660 DEFM 'YOUR UNIVERSE AND ITS CIVILIZATIONS.'
06670 BASC DEFM 'ENTER 0 TO RETURN TO BASIC, '

```





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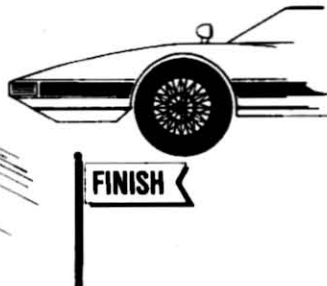
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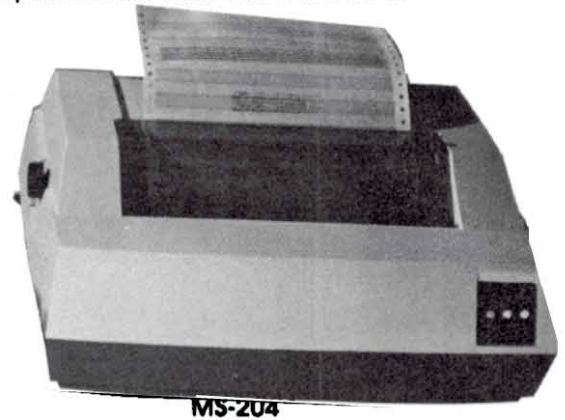
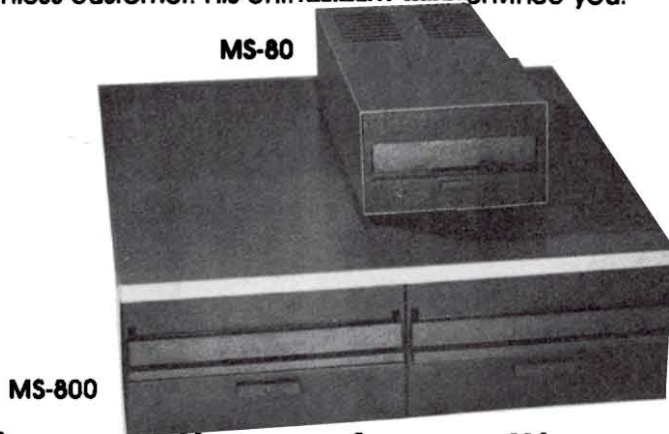
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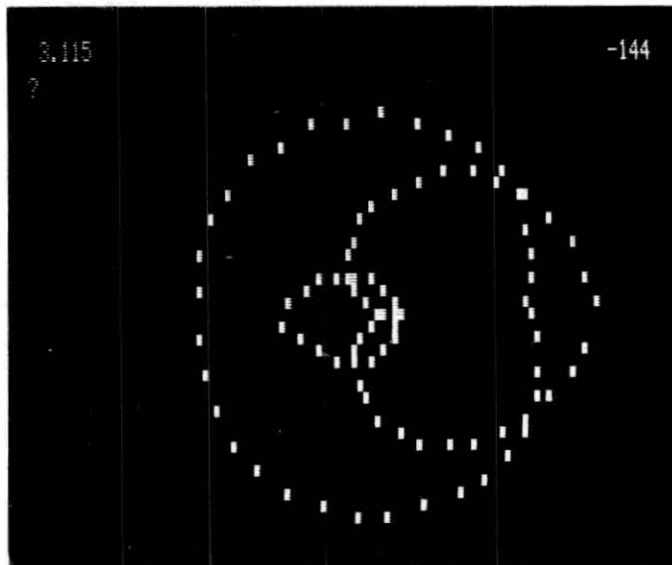
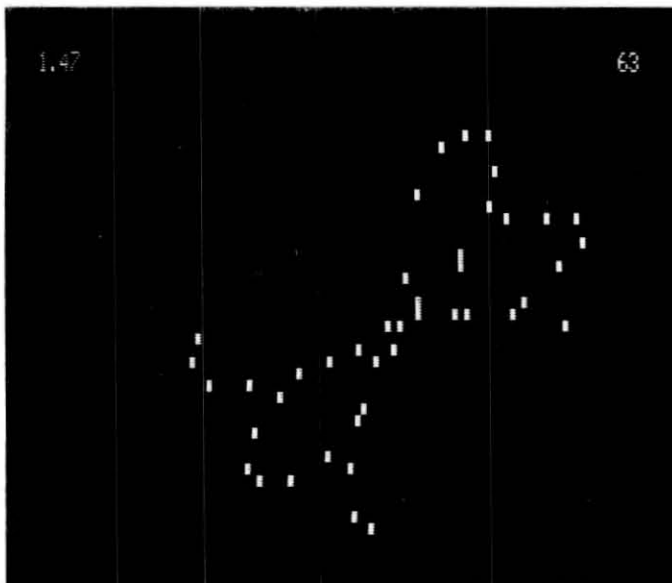
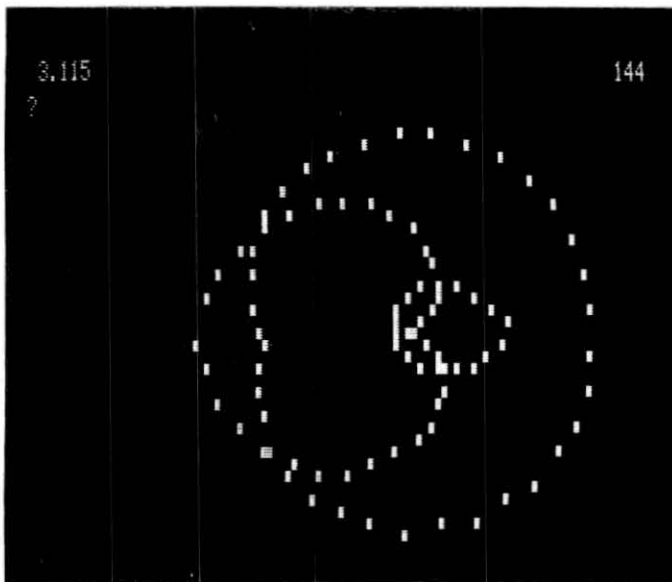
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# Adventures In Roseland



*Adventures in Roseland*

Allan S. Joffe W3KBM  
1005 Twining Road  
Dresher, PA 19025

This general equation  $J = a \sin X$ , if properly translated into a program that your TRS-80 can digest, paints a three leafed rose onto your monitor screen.

Program Listing 1 gives a programming possibility. After you have run the program and examined the scenery, the question "Why bother?" may come up.

### Pattern After Pattern

For a partial answer, make the following changes and additions to Listing 1.

```
5 G=0
15 G=G+1: PRINT [a] 50,G
30 R=35*SIN(G*J)
80 INPUT Z$
90 GOTO 10
```

You now have a program that produces pattern after pattern, because of the changing value of G, each time the program runs. Line 80 is merely a way to put in a controlled pause.

When one pattern has been generated, you may examine it for as long as you wish, hitting ENTER to get the next one.

The print statement in line 15 is an index that will help you make a record of any pattern

that happens to strike your fancy.

Running the revised listing, you will see that when G is an even number, the rose has petals equal to  $2 \cdot G$ , and when G is odd, the petal count equals G. Note also that when G is odd, the figure is first traced and then retraced by the program.

If you are going to run any number of these patterns, I suggest you alter the STEP in line 20 to read .035. This cuts the print time in half without too much damage to the image.

After you have played with the program for a bit, jump past the rose petal section by changing line 5 to read  $G = 29$ . Remember that as the patterns form, you can stop them as desired using SHIFT [A].

You will notice that some of the patterns are predominantly circular, while others are spirals. Some are cluttered looking and others quite sharply defined.

You can expand them by setting the value in line 5 to such constants as 99, 199 or 299 to find new patterns. For more visual fun with your TRS-80, set

```
10 CLS
20 FOR J=0 TO 6.28 STEP .0175
30 R=35*SIN(3*J)
40 X=(R-COS(J))^64
50 Y=(R-SIN(J))^47
60 SET(X,47*(Y/2))
70 NEXT J
```

*Program Listing 1.*



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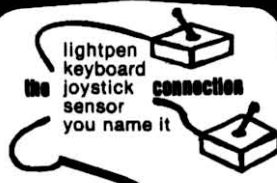


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the value of G in line 5 to 29. Line 20 should read:

20 FOR J=0 TO 3.14 STEP .035

This line eliminates some of the clutter you may have noticed in the patterns and also speeds up the printing of the image.

When G = 35 you see an image of five tangent circles. If G = 44 you have a gaggle of four circles. When G = 36 you see a stylized eagle inside a spiral segment.

We already have index G as a guide. Add another index so you can see what I see in the following examples.

Change line 30 to read:

30 R=35-SIN(G+J); PRINT@0,J

Start the program running again by setting G in Line 5 to equal 28. The first time you run the program G will equal 29. If you stop the pattern when J = 1.12, you should see what might be interpreted as a barbell weight.

If G = 33 and J = 1.575, you may see a dinosaur.

If G = 63 and J = 1.47, you will hopefully see Snoopy the dog.

If G = 116 and J = 1.435, you will see a running dog.

Here are some other fantasies available by altering G.

G = 143, is a stylized Darth Vader, and G = 144 gives you a close approximation of the human eye as shown in a cross section of an anatomy book.

### Negative Values

You can also use negative values for G. In this last image, let G = -144. The pattern is identical except it has been rotated so that it is now the mirror image of the positive G input.

Since we are dealing with circular functions, this displacement can be left to right as in this example, or top to bottom (G = and G = -1).

You can also get a combination of shifts, such as both right

to left and top to bottom, as when G = 36 or G = -36. There are times when altering the symmetry makes the image more realistic. For example, if G = 33 and J = 1.115, you see what looks like a running horse. If you alter line 30 to read,

30 R = 45-SIN(G+J)

the running horse becomes more realistic.

This program is a nice way to introduce some imaginative people to the TRS-80. It is one sure way to get rid of the comment, "Shucks, I can do that with my calculator". ■

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# Randomness

Todd L. Carpenter  
6660 Washington  
St Louis, MO 63130

chance, the RANDOM statement. Having the ability to look at the shape of the RANDOM distribution, can give you the power of shaping the distribution to suit your purposes.

Graphics displays on the TRS-80 certainly have their

limitations, but there is one type of display the TRS-80 handles rather nicely—the bar graph. If you are interested in the statement  $Y = \text{RND}(X)$ , it is important for you to understand the distribution characteristics of  $Y$  over its range (1 to  $X$ ). A bar

graph can display this with a touch of elegance.

### Is RANDOM Really Random

I had written a custom Star Trek program (hasn't everyone?) for my Level I, 16K machine. After playing with it for several

**A**t the heart of most game programs is a statement of

#### Program Listing.

```

100 REM ** RANDOM DISTRIBUTION GRAPHICS PROGRAM **
110 REM **
120 REM ** TODD L. CARPENTER **
130 REM ** 10/01/79 **
140 REM **
150 :
300 CLS
310 P.: P."INPUT X          FOR THE RND(X) STATEME
    NT. IT"
320 P. "                    MUST BE A POSITIVE NUM
    BER:"
330 P.: P. "
340 P.A.74,"";: INPUT X    0 <= RND(X) <= X"
400 CLS
410 P.: P."# OF TRIALS     INPUT THE DESIRED NUMB
    ER OF TRIALS."        THE GREATER THE NUMBER
420 P. "                    OF TRIALS,"
430 P. "                    THE SMOOTHER THE GRAPH
440 P.A.77,"";: INPUT C
450 CLS
460 :
470 :
500 P.A.348,"THINKING";
510 K=0: P=50
520 FOR I=0 TO 50
530 A(I)=0
540 NEXT I
550 X=INT(X)
560 IF X<=0 THEN 300
570 :
580 :
710 REM ** CALCULATE RND(X) VALUES **
720 REM ** MAX VALUE STATEMENT **
725 REM *****
730 M=2*X
740 REM *****
760 L=M
770 IF M<50 THEN M=50
775 IF M>50 THEN M=(INT((M-1)/50)+1)*50
780 N=M/50
790 FOR I=1 TO C
800 REM ** RND(X) STATEMENT **
805 REM *****
810 Y=RND(X)+RND(X)
820 REM *****
830 B=INT(Y*50/M)
840 IF B<0 THEN 870
850 A(B)=A(B)+1
860 IF K<A(B) THEN K=A(B)

870 NEXT I
880 :
890 :
1000 REM ** PLOT X-AXIS **
1010 CLS
1020 J=INT(K/32)+1
1030 FOR I=16 TO 123
1040 SET (I,38)
1050 IF INT(I/10)=I/10 THEN SET (I,39)
1060 NEXT I
1070 :
1080 :
1100 REM ** LABEL X-AXIS **
1110 FOR I=0 TO 10
1120 P.A.905+5*I,5*I*N;
1130 NEXT I
1140 :
1150 :
1200 REM ** LABEL Y-AXIS **
1210 FOR I=0 TO 5
1220 P.A.770-I*128,J+J*6*I;
1230 NEXT I
1240 :
1250 :
1300 REM ** PLOT Y-AXIS **
1310 FOR I=6 TO 38
1320 IF INT((I-2)/6)=(I-2)/6 THEN SET (15,I-1)
1330 SET (16,I): SET (17,I)
1340 NEXT I
1350 :
1360 :
1400 REM ** HEADING AND LABELS **
1410 P.A.29,"RANDOM DISTRIBUTION";
1420 P.A.83,"X=";X;" ";C;"TRIALS MAX VALUE=";L;
1430 P.A.64,"# OF TRIALS";
1440 P.A.976,"EACH BAR IS A";N;"VALUE RND(X) BIN";
1450 :
1460 :
2000 REM ** PLOT GRAPH **
2010 FOR I=0 TO 50
2020 IF A(I)<J THEN 2060
2030 FOR H=1 TO INT(A(I)/J)
2040 SET (20+2*I,38-H)
2050 NEXT H
2060 NEXT I
2070 :
5000 P.A.960,"";
6000 INPUT I
7000 GOTO 300
9999 REM ** END **

```

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Acorn produces several games for the TRS-80\*. These include: *Codebreaker*, *Star Warp & Lunar Lander*, *Word Challenge*, *Bandito*, *Block'em*, and *Ting-Tong* priced at \$9.95. *Pigskin*, *Quad* and *Star Trek Two* are available for \$14.95. Ask for these and other quality Acorn programs at your local computer store.

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weeks, I noticed that the majority of the Klingons were always located near the center of the galaxy. Rarely did I ever find a Klingon in any of the perimeter quadrants. I thought I had used a simple  $Y = \text{RND}(X)$  statement in distributing the Klingons; but it seemed that either my RANDOM statement was not truly random or the Klingons had succeeded in outsmarting Captain Carpenter. I chose to pursue the former suspicion because, after all, the Klingons are the bad guys and they could not outsmart me—could they?

I set out to write a simple program that would show me once and for all whether or not the

ment over 4,000 times in distributing the elements of the galaxy. As you will see, it was Captain Carpenter who had goofed, not Radio Shack.

### Random Shaping

After a closer examination of my Star Trek Program I discovered that I had inadvertently used a combination of RANDOM statements. How could I test the distribution of this combination? After a few generalizations in my program I was ready to run an analysis on any combination of RANDOM statements that could start with "Y=". I proceeded to test my Klingon distribution. Sure

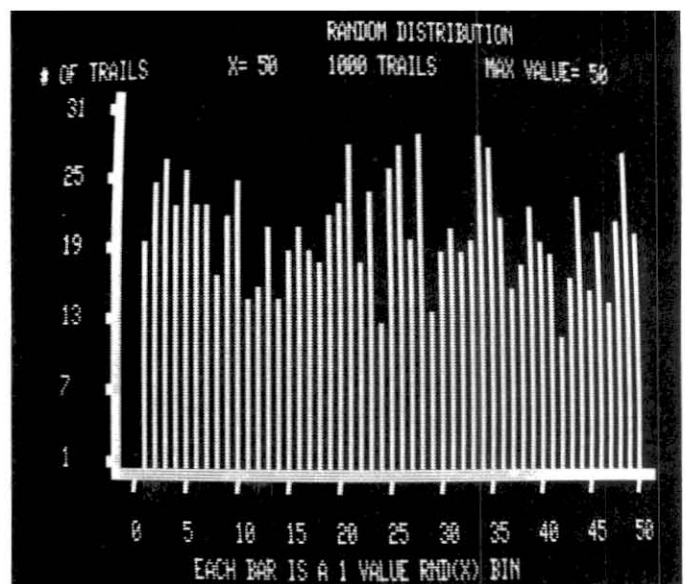


Photo 1

Photos by Yuan Chang Lo

RANDOM statement really gave me a uniform random distribution. The purpose of the program was to display in a single picture the distribution of the  $\text{RND}(X)$  statement. The ability to see the RANDOM distribution would enable me to determine immediately the actual randomness of the statement.

I was prepared to make a shattering discovery that Radio Shack had goofed in their design of the  $\text{RND}(X)$  statement. But why had no one else discovered this biased RANDOM statement? Perhaps, I thought, the bias was slight, and I had discovered it only because my program used the RANDOM state-

ment, they were doing just what I had been telling them to do, concentrating in the middle. In separate parts of the program, I had mistakenly used what amounted to the sum of two RANDOM statements and gotten a dice-like distribution. See Fig. 1.

As all craps players should know, when rolling two dice, more sevens turn up than twos or twelves. In fact, six times as many sevens turn up.

The advantage of seeing any RANDOM distribution before ENTERING it, is that the shape of a distribution can be selected to fit an application. Once you know how to generate some



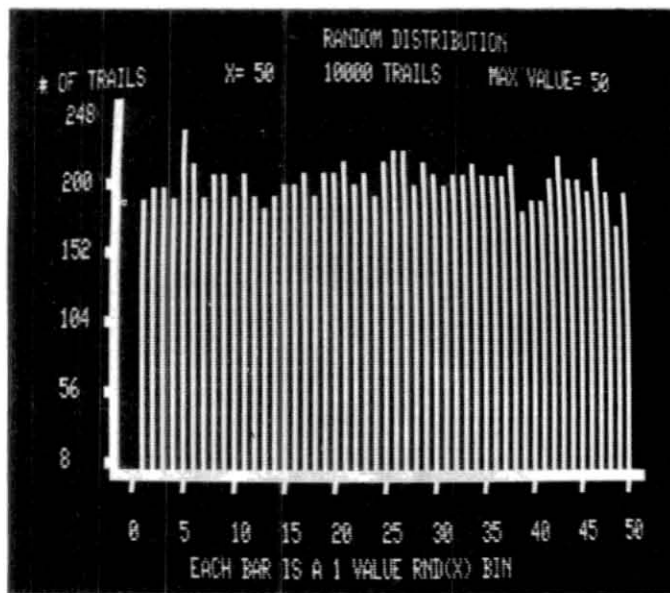


Photo 2

simple shapes, the next steps seem easier.

#### Program Inputs

The program (See Program Listing) starts by asking for the value of X in the RND(X) statement. It can be any number greater than zero and preferably an integer (although the machine will accept a decimal value and find the integer value itself). For the case of the simplest RANDOM statement,  $Y = \text{RND}(X)$ , the function Y is uniformly distributed from 1 to X. This means that for a single trial, the probability is the same

for getting any integer value from 1 to X. For example,  $X = 6$  is analogous to the case of rolling one die. With six faces, the probability that any particular face comes up is  $1/6$ . See Fig. 2.

Next, input the number of trials to be made. For our example this would be the number of rolls of the single die.

The greater the number of trials performed the more the graph will be delineated. The number of trials made must be large compared to the entered value of X. As a rule of thumb I make the number of trials at least 20 times the maximum

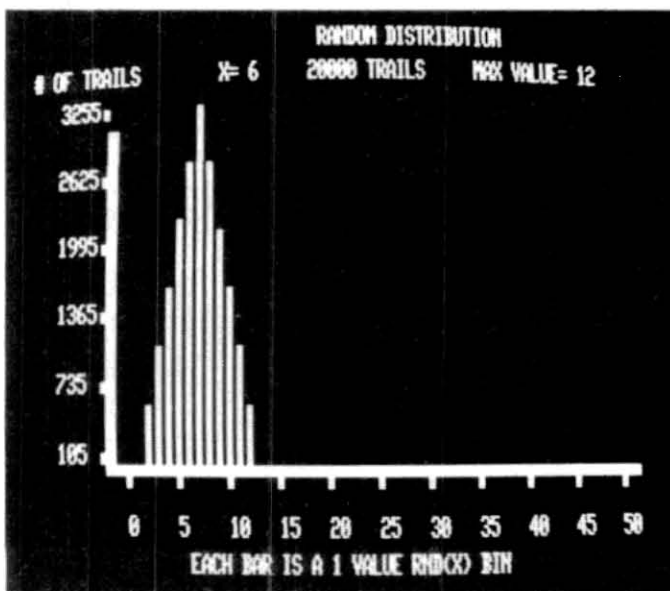


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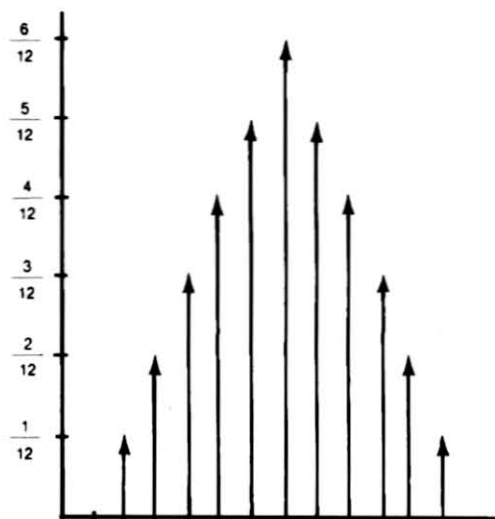
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PROBABILITY



POSSIBLE ROLLS OF TWO DICE

value that Y can be. In this case, make Y equal to X or 6.

You are now ready to take a peek at Photo 1 which shows a graph of the function,  $Y = \text{RND}(50)$ . There were 1,000 trials, the minimum rule of thumb value, used to determine this graph. (Fifty values times 20 trial outcomes per value, equals 1,000 total trials.) As you can see it yields quite an uneven distribution.

I chose to use the number of trial outcomes for the vertical axis rather than probability in this case. But, either way the shape of the graph is the same.

Now consider Photo 2. I ran the same distribution, but this

time with 10,000 trials. As you would expect, the average number of values per "bin" is now 10 times what it was in the previous example, or 200. I have coined the word bin to refer to each bar of the graph. A bar getting larger can be thought of as a bin being filled.

## Changing the Distribution

There are two important statements in the program. They are the RANDOM statement and the MAX VALUE statement. The RANDOM statement is at line 810 and contains the expression which determines the shape of the distribution. This statement must be edited manually when-

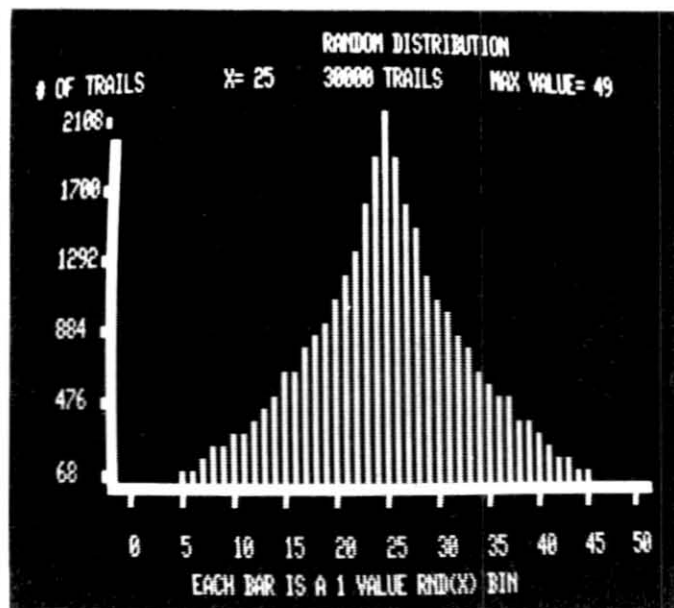


Photo 4



ever a new expression is desired. The MAX VALUE statement is at line 730, and defines the variable M which must be set equal to the largest possible value Y can be in the RANDOM statement. In the listing shown,  $Y = RND(X) + RND(X)$ , so  $M = X + X$ . For instance, if line 810 reads  $Y = X - RND(X)$ , line 730 would read  $M = X - 1$ . (When a term is subtracted, use its minimum value.)

Photo 3 shows the distribution of the equation in the program listing. I chose to enter  $X=6$ , so I would be able to extend the dice rolling analogy. This time I rolled two dice and

approximated by using a large sum of simple  $RND(X)$  statements. I used six terms here.

As more and more sophisticated functions are used, a definite limitation crops up. A simple statement like  $Y = RND(X)$  takes about six times as long to execute as a FOR-NEXT loop pair, and the statement  $Y = RND(RND(X))$  takes about 10 times as long. In other words, this program can take quite a long time to run through 30,000 trials. With that in mind, it's wise to start testing a new function with the minimum rule of thumb number of trials. If  $Y = RND(RND(X)*2)$ ,

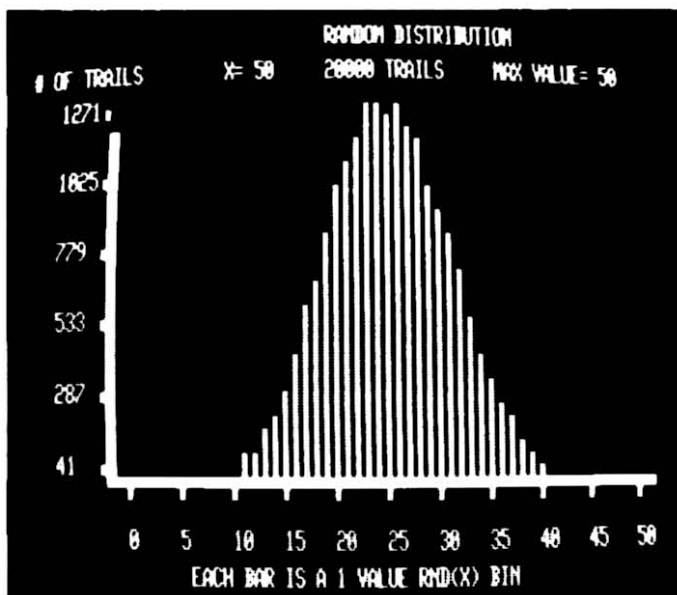


Photo 5

got a distribution such that the most likely number to come up, seven, was in the center. This is essentially how my Klingons were distributing themselves.

Now, we move on to some more complicated distributions. Photo 4 shows a graph of the distribution,  $Y = X + RND(RND(X)) - RND(RND(X))$ , where  $M = X + X - 1$ . This was run with 30,000 trials and quite a smooth graph was obtained. On my Level I, 16K machine, the largest number of passes allowable through a FOR-NEXT loop is 32767, so this is the largest number of trials I can enter.

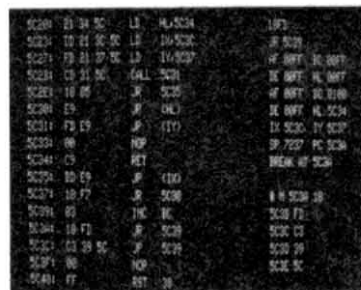
Photo 5 shows a normal distribution, for those of you interested in statistics. It can be

$M = X*2$ , and you enter  $X=50$ , then you should enter the number of trials as 2,000 (20 times M). This will not produce a very smooth graph, but will take only about 1/15th as much time to run. Usually this is about two to three minutes.

#### Auto Scaling

This brings up one last significant feature of the program. You have seen how the vertical axis scales itself depending on the maximum number of trial outcomes per bin. The same thing applies to the horizontal axis. You are not limited to a maximum value of 50. It can be 51 or 135 or 1,000 or whatever you like.

## DEBUG-S/S FOR YOUR TRS-80\*



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With DEBUG-S/S you may run your program in slow motion or single step and observe your Z-80\* registers dynamically and/or observe your message printing on the screen one-character-at-a-time!

#### SPLIT/SCREEN DISPLAY

DEBUG-S/S uses a convenient split screen display system. The upper right section of the screen automatically displays upon entry to DEBUG-S/S from the user's program. This section shows the user's next instruction in hexadecimal and disassembled symbolic form, and also shows the user's major Z-80\* registers. The left portion of the screen is for the user's display or a scratch pad area for memory dumps. The lower right section of the screen is where DEBUG-S/S commands are entered and echoed for the user's inputs.

#### TRANSPARENT MODE

DEBUG-S/S may be operated in a transparent mode which leaves the entire screen showing all of the user's display data upon entry to DEBUG-S/S, except for the letter D displayed on the upper right corner of the screen indicating that DEBUG-S/S has been entered. If the user now wishes to examine his Z-80\* registers, he simply types D (Display).

#### "NO CRASH" BREAKPOINTS

DEBUG-S/S uses a single byte breakpoint which means you may put a breakpoint in the first byte of any instruction in your program and not cause your program to crash because of the breakpoint insertion. Your breakpoint will stay active until you reset it or redefine it. This allows you to run through loops in your program repeatedly without having to redefine your breakpoint each time. You may enter any number of one byte pseudo breakpoints simultaneously in your program manually with the Memory command.

#### POWERFUL COMMANDS

Examples of DEBUG-S/S commands are: Jump - Go - Breakpoint - Memory examine/modify - Hex Dump - ASCII Dump - Symbolic Instruction Dump - Single Step - Automatic Step start/stop - Increase/Decrease Auto Step rate - Clear Screen and save cursor position - Clear Screen and home cursor position, plus other commands.

#### YOU WILL RECEIVE

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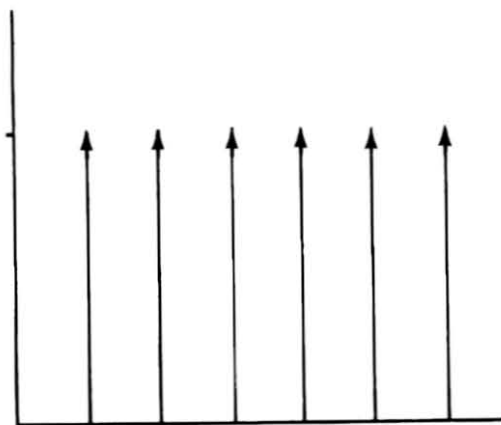
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POSSIBLE ROLLS OF ONE DIE

If the graph shape is all that is desired, this can generally be accomplished with 50 as a maximum value.

If you decide that some larger number is more convenient, then the axis will be automatically scaled. There will never be more than 50 bins in which to accumulate trial points, but if the maximum value is 64, for example, the axis will be scaled down

by a factor of two. This makes each bin a two-value, rather than single-value bin.

Now you have an elegantly simple program that lets you see what the RANDOM statement can do. Thanks to this program, my Klingons have been controlled, the galaxy has been saved, and Starfleet Command will not have to give me a desk job. ■

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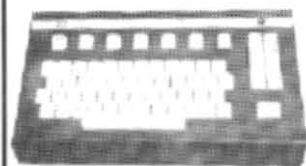
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*Forget pen and paper, use your 80 for doodling—interesting results can be saved on cassette or disk.*

# Doodle Bug

R. Daniel Bishop  
Department of Chemistry  
The School of the Ozarks  
Point Lookout MO 65726

Some people are habitual doodlers. Give them a pen or pencil and, without being aware of their actions, they begin sketching or scribbling on anything that might be handy. Their addiction seems to be uncontrollable in certain locations, such as near telephones, and at specific times, such as during long business meetings or conferences. Some even doodle on napkins in restaurants! I know these things because I, too, am a compulsive doodler. Long ago I gave up all hope of ever reforming myself.

It thus should come as no surprise that one of the programs I just had to complete for my TRS-80 was Doodle, a program designed to promote uninhibited doodling using the graphics capability of the microcom-

puter. Furthermore, in the event that a productive sketch were to take birth during the doodle process, I derived two subroutines to permit saving the video display, either on disk or on cassette tape, and two corresponding subroutines to permit recalling the stored data and recast the video display in its entirety. Thus, a building floor plan, a circuit diagram or stylized drawings of equipment or building architecture can be stored for future redesign or viewing.

Once a design has been completed and stored, some simple program statements that employ the PRINT @ XXX, feature can be written temporarily into the redisplay subroutine. Then, when this subroutine is run, not only does the original sketch reappear on the screen, but also the alphanumeric information shows up. This new display can then be saved using the save subroutine, thus allowing complex graphics displays with accompanying labels and captions to be stored.

## The Program

Two sets of keys are used to provide direct keyboard control of the sketch and of the program. Fig. 1 shows the eight direction keys that are used for directing the movement of the graphics display points. With your middle finger on the G key, it is then quite natural for you to tap the T for upward movement, the H for movement to the right, the C for diagonal movement to

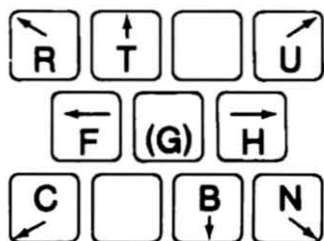


Fig. 1. Eight direction keys used to control development of the sketch via keyboard input.

P Pause. Halts the program until a new keyboard entry is made.

S SAVE video sketch on disk.

Z CSAVE video sketch on cassette.

G Move cursor without leaving permanent display.

L Erase current cursor position and proceed to next position (as determined by last direction key pressed).

Table 1. Five program control keys used to provide program control from the keyboard without interrupting the video display.

the P causes the program to pause, thus halting the movement of the display point and stopping the line being generated by it.

The S and Z keys function only when the program is in the pause mode. Thus the P key must first be pressed, followed by either S or Z. The S directs the program to the save subroutine, which saves the video display on disk. Similarly, the Z key directs the program to the save subroutine, which saves the video display on cassette. To avoid a possible mix-up between these two, which would result in an error message and destruction of the sketch on display, it is advisable to incorporate only one of these options into your program, depending on the particular storage method you wish to use.

The G and L keys function only after a direction key has been depressed. The G key will cause the pointer to move in the direction determined by the last direction key to be pressed, but it will not leave a permanent display of the points. This allows for moving the cursor to any part of the screen without leaving a trace of its passage. Several unconnected figures can be sketched using the G key to move the cursor from one figure to the next.

The L key is used to erase points that have previously been set. Erasing is accomplished as follows:

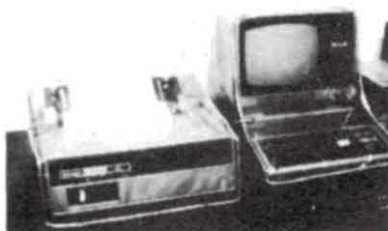
1. Use an appropriate direction key and the G control key to

the lower left, etc.

The program was initially designed to produce only one point each time a key was tapped. I soon decided to let the computer handle any repetitive functions, so that now each of the eight direction keys initiates a line drawn in the direction chosen. Tapping any of the other direction keys once redirects the line.

In addition to the eight direction keys, five control keys were chosen to allow program control to be initiated from the keyboard. These five control keys are listed in Table 1. Pressing





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position the cursor exactly where erasing is to begin.

2. Depress the appropriate direction key that would be needed to trace over the line to be erased.

3. Immediately press the L key. Each tap of the L key moves the cursor one point along the line to be erased and erases one point on that line. Note that the direction key is pressed only once at the start of the erasing sequence.

## Saving Video Displays on Disk or Cassette

The video display may be stored on disk using the subroutine containing statements numbered 300-385. This subroutine is accessed from the main program by first pressing the P pause command key, then pressing the S command key. Both alphanumeric and graphics characters are stored as eight, 255 byte strings. Thus two lines are fielded and stored at a time. Since two complete lines require 256 bytes, the last character of every other line is deleted. This, however, is a small price to pay for the simplicity of the SAVE and PRINT subroutines and the more efficient use of storage.

Storing the video display on cassette can be accomplished using the subroutine containing statements numbered 500-585. This subroutine is accessed from the main program by first pressing the P pause command key, then pressing the Z com-

mand key. Be sure that the recorder is in the Record mode *before* pressing the Z key.

As for the disk, both alphanumeric and graphics characters may be stored, although here each character code must be converted into a 4-byte string, which requires each row to be entered as a separate data string. Thus, the cassette subroutine stores 16 strings. Care must be taken to ensure that each character code fills four bytes (which includes the integer's sign); this is accomplished by adding 100 to each code. Again, for the sake of efficiency, the last two characters of each row are deleted from this routine. This is more critical than the case with the disk subroutine, and should be kept in mind when the sketch is drawn.

In order to reload your sketch from disk storage, load the program and then use the command RUN 400. Be sure that line 400 contains the appropriate file name for the particular sketch you wish to retrieve. Also before running the program, you should modify line 300, providing the name under which the new sketch will be filed. The subroutine fills in the video screen with the appropriate sketch and then transfers control to the main program, with the cursor's beginning location being the bottom right-hand corner of the screen.

Reloading the sketch from cassette storage requires the command RUN 600. The cas-

### Doodlebug program.

```

1 :REM LISTING FOR * DOODLEBUG *
2 :REM
3 :REM ALL PROGRAM LINES INCREMENT
4 :REM CONTINUOUSLY BY 5 STARTING
5 :REM AT LINE 10, ALLOWING USE OF
6 :REM "AUTO 10,5" MODE.
7 :REM
10 CLS: CLEAR1000
15 PRINT@460, "**** DOODLE ****"
20 PRINT@832, "BY R.D.BISHOP"
25 PRINT: PRINT"CUSTOM COMP"
30 PRINT"BOX 125, BRANSON, mo 65616"
35 FOR I=1TO999:NEXTI:CLS
36 :REM
37 :REM INITIALIZE CURSOR POSITION
38 :REM
40 PRINT"ENTER STARTING X POSITION."
45 INPUT"(0 TO 127):";X:IFX>127ORX<0THEN45
50 PRINT"ENTER STARTING Y POSITION."
55 INPUT"(0 TO 47):";Y:IFY>47ORY<0THEN55
60 CLS:SET(X,Y)
61 :REM
62 :REM TEST FOR KEYBOARD INPUT.
63 :REM XI & YI DEFINE INCREMENTS FOR X AND Y.
64 :REM
65 AS=INKEYS:IF LEN(AS)=0 THEN 65
70 XI=0:YI=0

```



```

71 :REM
72 :REM TEST FOR "PAUSE" COMMAND AND
73 :REM "DIRECTION" COMMANDS.
74 :REM
75 IF A$="P" THEN 125
80 IF A$="H" THEN XI=+1:GOTO145
85 IF A$="F" THEN XI=-1:GOTO145
90 IF A$="T" THEN YI=-1:GOTO145
95 IF A$="B" THEN YI=+1:GOTO145
100 IF A$="R" THEN XI=-1:YI=-1:GOTO145
105 IF A$="U" THEN XI=+1:YI=-1:GOTO145
110 IF A$="N" THEN XI=+1:YI=+1:GOTO145
115 IF A$="C" THEN XI=-1:YI=+1:GOTO145
120 GOTO 65
121 :REM
122 :REM "PAUSE" SEQUENCE TESTS FOR DISK
123 :REM OR CASSETTE SAVE COMMANDS.
124 :REM
125 A$=INKEY$:IF LEN(A$)=0 THEN 125
130 IF A$="S" THEN 265
135 IF A$="Z" THEN 410
140 GOTO 70
141 :REM
142 :REM INCREMENT CURSOR POSITION.
143 :REM VERIFY THAT POSITION FITS ON SCREEN.
144 :REM
145 X=X+XI:Y=Y+YI
150 IF (X<0 OR X>127) THEN X=X-XI
155 IF (Y<0 OR Y>47) THEN Y=Y-YI
160 P=POINT(X,Y):SET(X,Y)
165 GOSUB595
166 :REM
167 :REM TEST FOR "G" OR "L" COMMANDS AND
168 :REM DIRECT PROGRAM TO THE CORRECT MODULE.
169 :REM
170 A$=INKEY$
175 IF LEN(A$)=0 THEN GOTO145
180 IFA$="G" THEN RESET(X-XI,Y-YI):GOTO195
185 IFA$="L" THEN RESET(X-XI,Y-YI):GOTO235
190 GOTO70
191 :REM
192 :REM "G" MODULE. CURSOR CONTINUES MOVING, BUT LE
AVES NO
193 :REM PERMANENT MARK, UNTIL ANOTHER KEY IS PRESSE
D.
194 :REM
195 IF P<0 THEN 200 ELSE RESET(X,Y)
200 X=X+XI:Y=Y+YI
205 IF (X<0 OR X>127) THEN X=X-XI
210 IF (Y<0 OR Y>47) THEN Y=Y-YI
215 P=POINT(X,Y)
220 SET(X,Y):GOSUB595
225 A$=INKEY$:IF LEN(A$)=0 THEN 195
230 GOTO 70
231 :REM
232 :REM "L" MODULE. PREVIOUS AND CURRENT CURSOR PO
SITION
233 :REM ERASED. IF <L> IS TAPPED, CURSOR INCREMENTS
ONE
234 :REM STEP AND ERASES NEW POSITION.
235 IF (X<0 OR X>127) THEN X=X-XI
240 IF (Y<0 OR Y>47) THEN Y=Y-YI
245 RESET(X,Y)
250 A$=INKEY$:IF LEN(A$)LOC*ASTOP@r50
255 IF A$="L" THEN X=X+XI:Y=Y+YI:GOTO235
260 GOTO 70
261 :REM SUBROUTINE THAT SAVES DISPLAY ON DISK, 2 LI
NES AT A TIME. J INCREMENTS ONE FOR EACH CHARACTE
R POSITION.
262 :REM Z% RECORDS THE CHARACTER CODE WHICH IS CONV
ERTED TO STRING DATA AND ADDED TO ZP$.
263 :REM ZP$ ENDS UP WITH 2*(64+63)=254 BYTES. PR IS
THE PHYSICAL RECORD NUMBER. ZP$ IS FIELDLED AS Z$
.
264 :REM
265 CLEAR1000:OPEN "R",1,"SKETCH01"
270 FOR I=0TO15 STEP2
275 ZP$=""
280 FOR K=0TO1
285 FOR J=0 TO 63-K
290 Z%=PEEK(15360+J+64*I+64*K)
295 ZZ$=MKIS(Z%)
300 ZP$=ZP$+ZZ$
305 NEXT J
310 NEXT K
315 FIELD 1,254 AS Z$:PR=INT(I/2+.5)+1
320 GET1,PR
325 LSETZ$=ZP$
330 PUT1,PR
335 NEXTI
340 CLS:PRINT"SKETCH IS SAVED ON DISK."
345 CLOSE
350 END
351 :REM SUBROUTINE THAT LOADS DISPLAY FROM DISK. EA
CH OF THE 8 PHYSICAL RECORDS IS BROUGHT OUT AND DI
SPLAYED.
352 :REM THE LAST 3 CHARACTERS ARE DELETED TO PREVEN
T ROLL-OVER.
353 :REM STARTING VALUES FOR X AND Y ARE ASSIGNED. T
HE PROGRAM IS RETURNED TO THE MAIN PROGRAM FOR KEY
BOARD INPUT, ALLOWING ADDITIONS TO THE SKETCH.
354 :REM
355 CLEAR1000:CLS:PRINT@515,"** INSERT DISK THAT CONTAI
NS SKETCH AND PRESS <ENTER>. **";INPUTZM$:CLS:OP
EN "R",1,"SKETCH01"

```

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```

360 FOR I=1TO8
365 FIELD 1, 254 AS Z$
370 GET 1,I
375 IF I=8 THEN Z$=LEFT$(Z$,252)
380 PRINT Z$; " ";
385 NEXT I
390 X=127:Y=47
395 CLOSE
400 SET(X,Y)
405 GOTO 65
406 :REM SUBROUTINE TO CSAVE DISPLAY ON CASSETTE. O
MIT THE CMD"T" AND CMD"R" COMMANDS IF A DISK-DRIVE
IS NOT ON-LINE.
407 :REM EACH ROW IS SAVED SEPARATELY AS A STRING OF
CHR$ CODES. TO INSURE UNIFORM RECORD SIZE OF 4 BY
TES, 100 IS ADDED IF THE CODE IS LESS THAN 100.
408 :REM THE CODE IS CONVERTED TO STRING DATA AND ADDE
D ONTO ZP$. EACH ROW IS THEN RECORDED ON CASSETTE
.
409 :REM
410 CLEAR 1000:CMD"T"
420 FOR I=0 TO 15
425 ZP$=""
430 FOR J=0TO62
435 Z%=PEEK(15360+J+64*I)
440 Z%=Z%+100
445 ZZ$=STR$(Z%)
450 ZP$=ZP$+ZZ$
455 NEXT J
460 PRINT#-1,ZP$
465 NEXTI
470 CLS:PRINT"YOUR SKETCH IS SAVED"
475 PRINT"ON CASSETTE AS 16 DATA ITEMS."
480 CMD"R"
485 END
490 CLEAR1000
491 :REM SUBROUTINE THAT LOADS VIDEO DISPLAY INFO F
ROM CASSETTE. OMIT CMD"T" AND CMD"R" INSTRUCTIONS
IF A DISK SYSTEM IS NOT ON-LINE.
492 :REM EACH LINE IS READ IN AS ZP$. ZP$ IS THEN S
LICED INTO 4 BYTE SECTIONS, EACH BYTE CORRESPONDIN
G TO A CHR$ CODE, Z%. 100 IS SUBTRACTED FROM EACH
CODE AND THE RESULT IS POKED INTO THE DISPLAY.
493 :REM THE LAST TWO COLUMNS OF THE DISPLAY DO NOT
TRANSFER, SO THESE ARE FILLED WITH BLANKS TO ERASE
UNWANTED CHARACTERS. X AND Y ARE ASSIGNED STARTI
NG VALUES AND PROGRAM RETURNS TO AWAIT INPUT.
494 :REM
495 PRINT#515,"INSERT TAPE TO LOAD DOODLE; PLAY MODE; P
RESS <ENTER>.";INPUTZM$
500 CMD"T"
505 CLS
510 FOR I=0TO15
515 INPUT#-1,ZP$
520 ZP$="+"+ZP$
525 FOR J=0TO61
530 ZZ$=MID$(ZP$,4*J+1,4)
535 Z%=VAL(ZZ$)
540 Z%=Z%-100
545 POKE 15360+J+64*I,Z%
550 NEXTJ
555 POKE 15423+64*I,032
560 POKE 15422+64*I,032
565 NEXTI
570 POKE 15422,032:POKE 15423,032
575 X=127:Y=47
580 SET(X,Y)
585 CMD"R"
590 GOTO 65
591 :REM
592 :REM TIME DELAY SUBROUTINE. LENGTHEN OR SHORTEN
AS
593 :REM DESIRED.
594 :REM
595 FOR I=1TO40:NEXTI:RETURN

```

sette recorder must be in Play mode. Again, the subroutine transfers control to the main program, with the cursor located at the bottom right-hand corner of the screen.

It should be noted that these sets of subroutines are entirely general in nature and can be used with any type of program that generates a graphics display that you might wish to preserve for future use. The following comments relating to the program listing need to be emphasized:

1. Only one Clear 1000 instruction needs to be used for the entire program.
2. For a system that does not have a disk drive, it is not necessary to include a CMD"T" or CMD"R" instruction.
3. For applications other than *Doodle*, where it is not necessary to set new data points or change the sketch, lines 435, 445, 660 and 665 are unnecessary.

#### Program Modifications

You may desire to slow down the program so the lines do not develop so fast. This may be especially true if children are to be using the program. (And, believe me, are kids ever fascinated by the sketches they can generate!) Just change the timing loop in line 999, using a number larger than 40.

On the other hand, you may wish to stop the line generation function altogether, so that only one point is made each time a direction key is depressed. This is most easily accomplished by deleting line 110, changing the

GOTO statements in lines 116 and 220 to GOTO 115 and GOTO 220 and changing line 215 to SET(X,Y), deleting the GOSUB999 instruction.

The direction keys chosen are those conveniently reached using the left hand. If you prefer to exercise directional control using your right hand, you may wish to change the U key to Y (line number 65). The P and L keys may be moved to the left side of the keyboard, perhaps using 1 in place of P in line 35 and 3 in place of L in lines 125 and 260.

Finally, in order to insert captions, titles, labels, etc., first complete your sketch and then determine just where each of these labels should be placed on the screen using the PRINT @ XXX, statement. Next, save the sketch on disk or cassette. Now insert your PRINT @ XXX, statements into the program between lines 430 and 450 (disk) or between lines 657 and 680 (cassette), taking care not to erase any other program lines. Now a RUN 400 or RUN 600 will display the sketch complete with titles and labels. This new sketch can be saved right over the disk or cassette recordings of the old sketch, but this time all of the alphanumeric information will be included with the sketch.

With this article, I anticipate a whole new approach to the advertising campaigns of micro-computer manufacturers: "Be the first in your neighborhood with the most elaborate, expensive and versatile doodle-pad ever invented!" ■

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Not only permits use of the printer as a typewriter but will allow you to retain any display already on the video, make notes from it, or actually copy it on the printer automatically. This program will run concurrently with another program you may be using and you can go from one to the other at will. Also contains a calculator. So useful it is hard to describe here.

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You've probably seen a kaleidoscope program running on a computer, and you've undoubtedly wished that you could create some of those patterns yourself. Why should the computer have all the fun? Well now you can jump right in there and explore your creative potential.

### How It Works

Before you begin drawing, you need to understand how the program works. As you can see from Fig. 1, your video screen is split into four quadrants. As you draw in the upper left-hand quadrant, the computer creates mirror images of your design in the other three.

Points in quadrant I are defined as (X,Y) and are printed by using the SET command. Remember that your screen is 128 (0 to 127) by 48 (0 to 47). Therefore, points in quadrant II must be defined as (127-X,Y) in order to produce a mirror image to the right.

Similarly, quadrant III uses

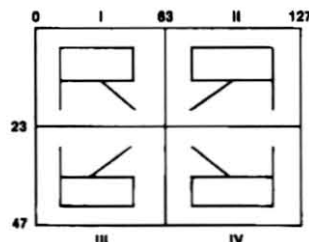


Fig. 1.

(X,47-Y) to produce a mirror image looking down. And in quadrant IV, (127-X,47-Y) creates a mirror image looking down and to the right. The total effect is of a kaleidoscopic pattern centered on the screen.

Running Kaleidopen you are asked to specify the starting coordinate for your design. Enter the X (0 to 63) and Y (0 to 23) coordinate as a pair separated by a comma. For example, try 20,10. This is the only time you will use the ENTER key while drawing. For the rest of the commands, simply press the key you desire.

Fig. 2 shows the eight directions used in the program. Just press any key (one-eight) and when the line has reached the location you want, press the S key to stop it. Then press the number of the next direction you want. Continue until your design is finished.

Notice that you are only drawing in quadrant I, but that the computer is simultaneously drawing the appropriate mirror

images in the other three quadrants. Always remember that your directions refer to quadrant I only!

### Suppose You Make a Mistake

Now we all make mistakes once in awhile. If you make an error, just press B to clear the board and begin a new pattern from scratch. If, on the other hand, it is just a case of having drawn a line too long, use the E key to erase.

Suppose I drew a line in direction four, but failed to stop in time. I simply press E to erase, followed by eight. I erase in direction eight because, as you can see from Fig. 2, eight is the direction opposite four. If I drew in direction one, I would have to erase in direction five.

You can also use the E key to skip to a new position on the screen without leaving a trace. For instance, pressing E-three moves the point up without drawing a line. Pressing S stops at a new position.

The only problem is that you may pass over a line you wanted. The result is an erasure at that point. The trick is to move up to the line in the E mode, stop, draw one point and then go back into the E mode again to keep moving without leaving a trace. It takes a little practice, but really isn't that difficult.

If you are feeling ambitious, you can build a move command

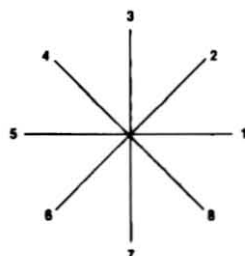


Fig. 2.

(M) that moves without leaving a trace and does not erase anything already on the screen. (Hint: Use the POINT (X,Y) command.)

So what do you do with your masterpiece once you've completed it? Why save it on tape of course! That way you can recall your best creations for use in projects or for putting on your own one man art show.

Put a blank tape into your recorder, position it, note its location, be sure your cables are all connected and depress both the play and record buttons. Now press the P key to save your design on tape.

The entire process takes about 80 seconds. The screen clears when the process is completed and you will be told that the picture has been saved.

If you wish to recall a picture from tape, respond yes when you are asked. Rewind the tape to the correct position, plug in the cables, depress the play button and hit ENTER. Your picture prints on the screen in 45 seconds.

And that's all there is to it! The program includes a brief summary of the drawing commands to refresh your memory. So limber up your fingers and begin creating with KALEID-

```
420 INPUT "ENTER STARTING COORDINATES X (0-127) , Y (0-47) " ; X , Y
440 IF (X<0 OR X>127) OR (Y<0 OR Y>47) THEN 420
1100 IF X+R<0 OR X+R>127 OR Y+U<0 OR Y+U>47 THEN 460
```

Example 1.

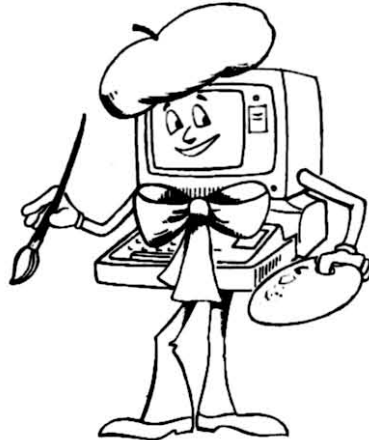


# FROM PROGRAMMA

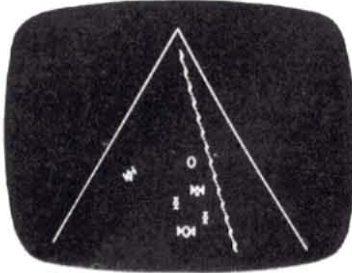
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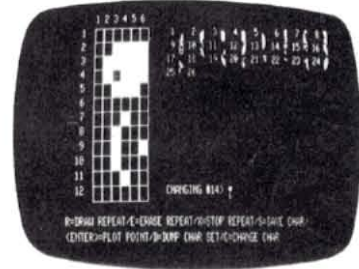
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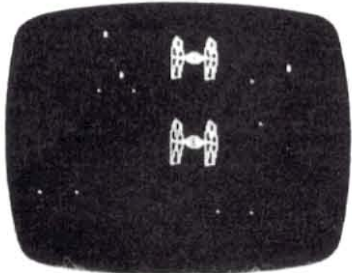
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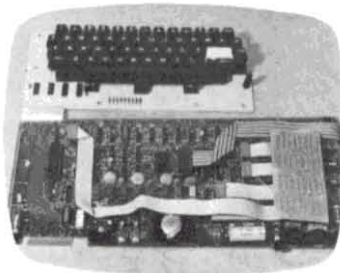
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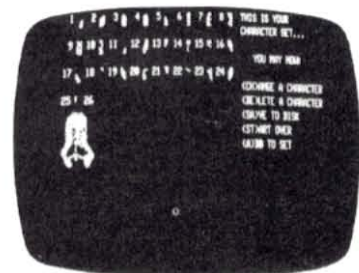
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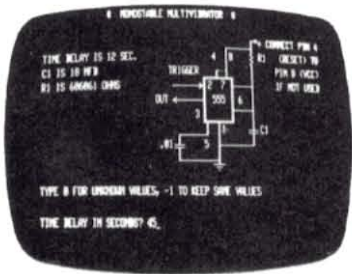
**REAL-TIME GRAPHIC GAMES**  
With the 80-GRAFIX board you can write exciting real-time games using BASIC.



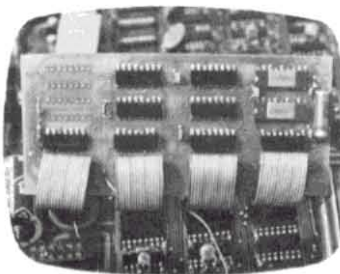
**EASY INSTALLATION**  
The 80-GRAFIX board is simple to install and fits inside the TRS-80 case.



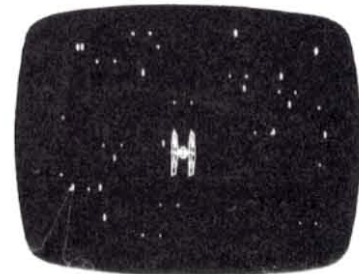
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OPEN.

440 and 1100 as indicated in Example 1.

### Modifications

You can modify the program to produce only one mirror image (bilateral symmetry?) by deleting lines 1200, 1210, 1260 and 1270. Also change lines 420,

To create one large drawing board (the entire screen), delete lines 1190, 1200, 1210, 1250, 1260 and 1270 and change lines 420, 440 and 1100 as indicated in Example 2. ■

```

420 INPUT "ENTER STARTING COORDINATES X (0-63),Y (0-47)";X,Y
440 IF (X<0 OR X>63) OR (Y<0 OR Y>47) THEN 420
1100 IF X+R<0 OR X+R>63 OR Y+U<0 OR Y+U>47 THEN 460

```

### Example 2.

### Program Listing

```

10 ' K A L E I D O P E N
20 ' ROBERT F. NICHOLAS
30 CLS
40 DEFINT A-Z
50 CLEAR 2000
60 PRINT@456,CHR$(23)"K A L E I D O P E N";
70 FOR TI=1 TO 1500
80 NEXT TI
90 CLS
100 DIM PS(5)
110 PRINT"THIS IS A KALEIDOPEN.
120 PRINT" PRESS A # FROM 1 TO 8 FOR DIRECTION OF
    YOUR MOVE.
130 PRINT" PRESS 'S' TO STOP A LINE.
140 PRINT" PRESS 'E' TO ERASE (FOLLOWED BY THE DIR
    ECTION #).
150 PRINT" ALSO USE 'E' TO SKIP TO A NEW P
    OSITION WITHOUT
160 PRINT" LEAVING A TRACE.
170 PRINT" PRESS 'B' TO CLEAR SCREEN AND GET A NEW
    DRAWING BOARD.
180 PRINT
190 PRINT" THE DIRECTIONS ARE AS FOLLOWS:
1224 PRINT@728,"+";
210 PRINT@736,"1";
220 PRINT@668,"2";
230 PRINT@600,"3";
240 PRINT@660,"4";
250 PRINT@721,"5";
260 PRINT@788,"6";
270 PRINT@856,"7";
280 PRINT@796,"8";
290 PRINT@960," ";
300 INPUT"HIT ENTER TO CONTINUE DIRECTIONS";X
310 CLS
320 PRINT" NOTE THAT YOU DO NOT HIT THE ENTER KEY WHI
    LE YOU ARE
330 PRINT"DRAWING A PICTURE. JUST PRESS THE KEY YOU DE
    SIRE.
340 PRINT
350 PRINT" IF YOU WISH TO SAVE ONE OF YOUR PICTURES,
    DEPRESS BOTH
360 PRINT"PLAY AND RECORD KEYS ON RECORDER AND THEN PRE
    SS 'P'.
370 PRINT
380 INPUT"DO YOU WANT TO RECALL A PICTURE PREVIOUSLY SA
    VED (Y/N)";Z$
390 CLS
400 Z$=LEFT$(Z$,1)
410 IF Z$="Y" THEN 1470
420 INPUT"ENTER STARTING COORDINATES X (0-63),Y (0-23)"
    ;X,Y
430 CLS
440 IF (X<0 OR X>63) OR (Y<0 OR Y>23) THEN 420
450 GOSUB 1170
460 E=0
470 A$=""
480 B$=""
490 U=0
500 R=0
510 REM INKEY$ ROUTINE TO ENTER DRAWING COMMANDS
520 B$=INKEY$
530 REM STOP DRAWING
540 IF B$<>"S" THEN 580
550 GOSUB 1170
560 GOTO 460
570 REM GO INTO ERASE MODE
580 IF B$<>"E" THEN 640
590 E=1
600 B$=""
610 GOSUB 1230
620 GOTO 520

```

```

630 REM CLEAR THE BOARD AND BEGIN A NEW DESIGN
640 IF B$<>"B" THEN 680
650 CLS
660 GOTO 420
670 REM GO SAVE THE DESIGN ON TAPE
680 IF B$="P" THEN 1300
690 A$=A$+B$
700 REM DRAW WEST
710 IF A$<>"5" THEN 760
720 R=-1
730 U=0
740 GOTO 1100
750 REM DRAW NORTHWEST
760 IF A$<>"4" THEN 810
770 R=-1
780 U=-1
790 GOTO 1100
800 REM DRAW EAST
810 IF A$<>"1" THEN 860
820 R=1
830 U=0
840 GOTO 1100
850 DRAW SOUTHWEST
860 IF A$<>"6" THEN 910
870 R=-1
880 U=1
890 GOTO 1100
900 REM DRAW NORTH
910 IF A$<>"3" THEN 960
920 R=0
930 U=-1
940 GOTO 1100
950 REM DRAW SOUTHEAST
960 IF A$<>"8" THEN 1010
970 R=1
980 U=1
990 GOTO 1100
1000 REM DRAW SOUTH
1010 IF A$<>"7" THEN 1060
1020 R=0
1030 U=1
1040 GOTO 1100
1050 REM DRAW NORTHEAST
1060 IF A$<>"2" THEN 520
1070 R=1
1080 U=-1
1090 REM CHECK NEW POSITION IS WITHIN SCREEN BOUNDARIES
1100 IF X+R<0 OR X+R>63 OR Y+U<0 OR Y+U>23 THEN 460
1110 X=X+R
1120 Y=Y+U
1130 GOSUB 1170
1140 IF E=1 THEN GOSUB 1230
1150 B$=""
1160 GOTO 520
1170 REM SET POINTS IN ALL FOUR QUADRANTS
1180 SET(X,Y)
1190 SET(127-X,Y)
1200 SET(X,47-Y)
1210 SET(127-X,47-Y)
1220 RETURN
1230 REM RESET POINTS IN ALL FOUR QUADRANTS
1240 RESET(X,Y)
1250 RESET(127-X,Y)
1260 RESET(X,47-Y)
1270 RESET(127-X,47-Y)
1280 RETURN
1290 REM SAVE DESIGN ON TAPE
1300 P$=""
1310 N=1
1320 FOR X=15360 TO 16380
1330 P=PEEK(X)
1340 IF P=32 THEN P$=P$+CHR$(128) ELSE P$=P$+CHR$(P)
1350 N=N+1
1360 IF N<250 THEN 1400
1370 N=1
1380 PRINT@-1,P$
1390 P$=""
1400 NEXT X
1410 P=PEEK(16383)
1420 PRINT@-1,P$,P
1430 CLS
1440 PRINT"PICTURE HAS BEEN SAVED.
1450 GOTO 380
1460 REM RECALL DESIGN FROM TAPE
1470 PRINT" DEPRESS PLAY BUTTON ON RECORDER. AFTER P
    ICTURE HAS BEEN
1480 PRINT"PRINTED, HIT 'ENTER' TO ERASE SCREEN AND BEG
    IN ANOTHER DESIGN.
1490 PRINT"WHEN TAPE RECORDER IS READY, HIT 'ENTER'.
1500 INPUTX
1510 CLS
1520 FOR J=1 TO 4
1530 INPUT@-1,P$(J)
1540 NEXT J
1550 INPUT@-1,P$(5),P
1560 PRINT@0,"";
1570 FOR J=1 TO 5
1580 PRINT P$(J);
1590 NEXT J
1600 POKE 16383,P
1610 IF INKEY$="" THEN 1610 ELSE CLS
1620 GOTO 380

```



# the electric pencil II™

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## for the TRS-80 Model II\* Computer



The Electric Pencil is a Character Oriented Word Processing System. This means that text is entered as a continuous string of characters and is manipulated as such. This allows the user enormous freedom and ease in the movement and handling of text. Since lines are not delineated, any number of characters, words, lines or paragraphs may be inserted or deleted anywhere in the text. The entirety of the text shifts and opens up or closes as needed in full view of the user. Carriage returns as well as word hyphenation are not required since each line of text is formatted automatically.

As text is typed and the end of a screen line is reached, a partially completed word is shifted to the beginning of the following line. Whenever text is inserted or deleted, existing text is pushed down or pulled up in a wrap around fashion. Everything appears on the video display screen as it occurs thereby eliminating any guesswork. Text may be reviewed at will by variable speed or page-at-a-time scrolling both in the forward and reverse directions. By using the search or the search and replace function, any string of characters may be located and/or replaced with any other string of characters as desired. Specific sets of characters within encoded strings may also be located.

When text is printed, The Electric Pencil automatically inserts carriage returns where they are needed. Numerous combinations of Line Length, Page Length, Character Spacing, Line Spacing and Page Spacing allow for any form to be handled. Right justification gives right-hand margins that are even. Pages may be numbered as well as titled.

### the electric pencil

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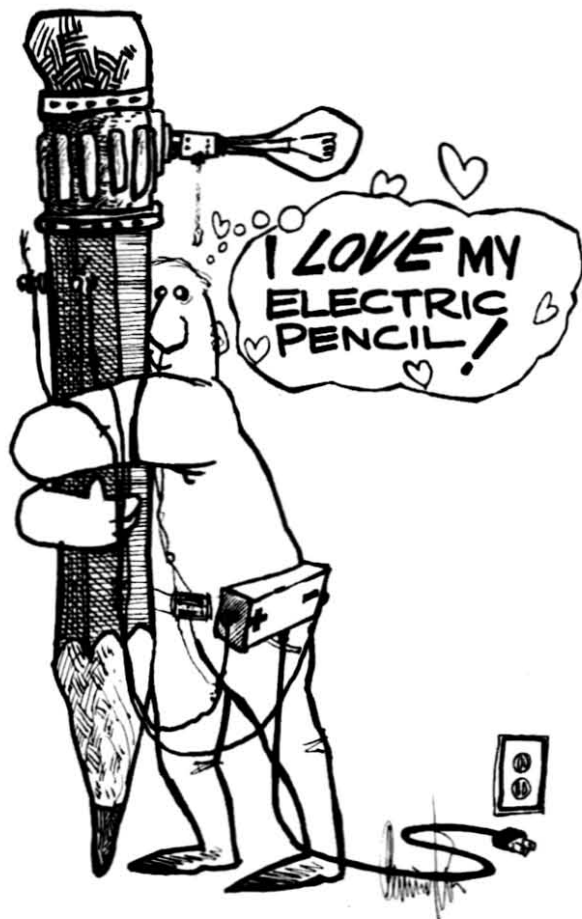
Our CP/M versions are the same as we have been distributing for several years and allow the CP/M user to edit CP/M files with the addition of our CONVERT utility for an additional \$35.00. CONVERT is not required if only quick and easy word processing is required. A keyboard buffer permits fast typing without character loss.

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Serial Diablo, NEC, Gume	\$ 300.00	\$ 350.00
All other printers . . . . .	\$ 275.00	\$ 325.00

The Electric Pencil I is still available for TRS-80 Model I users. Although not as sophisticated as Electric Pencil II, it is still an extremely easy to use and powerful word processing system. The software has been designed to be used with both Level I (16K system) and Level II models of the TRS-80. Two versions, one for use with cassette, and one for use with disk, are available on cassette. The TRS-80 disk version is easily transferred to disk and is fully interactive with the READ, WRITE, DIR, and KILL routines of TRSDOS.

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# Have fun with PEEK & POKE making your game simulations realistic

## Real-time Graphics

Richard A. Zidonis  
4500 Ardmore Ave.  
Cleveland OH 44144

If your friends were like mine, the first thing they asked about your computer was, "What can it do?" Most likely, you responded by loading a game program. As time went on, you became less impressed with the standard Wumpus or lander game and struck out on your own to develop the ultimate game program. And that's where we begin!

### PEEKing

I have a Radio Shack TRS-80,

16K, Level II system.

The TRS-80 has an available command called INKEY\$. The INKEY\$ function returns a one-character string equal to a strobed keyboard depression. This allows you to interact with the system during real time. Visions of real-time video games came to my mind at once. But as often happens, problems came into play. For instance, if you had a dot on the screen that you wished to move to the left, a single keystroke could start it moving, but another keystroke would be needed to stop it. This problem was quite troublesome for awhile, but the solution finally materialized.

We will develop a method of moving and stopping a game paddle with a single keystroke, and at computer real time. Not only that, but we're also going to move it at a speed rivaling a true analog-input video game.

To do this we first need to develop a method of determining the presence of a single depressed key. The TRS-80 system is memory mapped. Upon looking at the memory map, we find that the keyboard is located between memory locations decimal 14336 and decimal 15359. Knowing that, let's PEEK some keyboard locations.

The PEEK command in Level

II requires that a variable be assigned to what is found at the PEEK location. As in the statement X = PEEK (14337), the decimal value of memory location 14337 is assigned to the variable X. Still with me? Since we can only assign variables to alpha (A) or alphanumeric (A1) characters, we are only interested in PEEKing the letters of the alphabet. Refer to Table 1. Note the first 16 keyboard memory locations (for the alphabet) and the PEEK value for each letter of the alphabet. If you are saying to yourself that it looks repetitive and long, don't despair; it's not.

If we tell the system X = PEEK

	14336	14337	14338	14339	14340	14341	14342	14343	14344	14345	14346	14347	14348	14349	14350	14351
A	0	2	0	2	0	2	0	2	0	2	0	2	0	2	0	2
B		4		4		4		4		4		4		4		4
C		8		8		8		8		8		8		8		8
D		16		16		16		16		16		16		16		16
E		32		32		32		32		32		32		32		32
F		64		64		64		64		64		64		64		64
G		128		128		128		128		128		128		128		128
H	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
I			2	2			2	2			2	2			2	2
J			4	4			4	4			4	4			4	4
K			8	8			8	8			8	8			8	8
L			16	16			16	16			16	16			16	16
M			32	32			32	32			32	32			32	32
N			64	64			64	64			64	64			64	64
O			128	128			128	128			128	128			128	128
P	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
Q					2	2	2	2					2	2	2	2
R					4	4	4	4					4	4	4	4
S					8	8	8	8					8	8	8	8
T					16	16	16	16					16	16	16	16
U					32	32	32	32					32	32	32	32
V					64	64	64	64					64	64	64	64
W					128	128	128	128					128	128	128	128
X	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
Y									2	2	2	2	2	2	2	2
Z									4	4	4	4	4	4	4	4

Table 1. PEEK chart.





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15360	PLUS 63 =	15423
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15488		15551
15552		15615
15616		15679
15680		15743
15744		15807
15808		15871
15872		15935
15936		15999
16000		16063
16064		16127
16128		16191
16192		16255
16256		16319
16320		16383

Position 15360 is the same as print location zero.

Position 15551 is the last print position in the third row, etc.

Table 2. POKE chart.

(14337) and then depress an "A" key, the variable X will have a value of 2. If the above PEEK statement is locked in a loop, the variable X will take on the PEEK value *only during the key depression*. With the A key depressed, X returns a decimal value of 2; with the key *not* depressed, X returns a decimal value of zero. Now if that doesn't forward-bias the LED above your head, keep reading. Keep reading anyway; we're not done.

### POKE

First let's change the subject for a moment. The TRS-80 graphics character consists of a block two bits wide by three bits deep. Each of these bits can be accessed and turned on by the set (X,Y) command and turned off by the reset (X,Y) command. This method is effective but terribly slow. Fortunately, we have an alternative. We can POKE the graphics positions. Refer to Table 2, which shows you the POKE locations of all the print locations. POKE location 15360 is the same as print location zero.

As you can see, the chart is self-explanatory. If you know the print position you can find the POKE position. OK? So now we have established places to POKE, but what do we POKE? Time to move on again.

### Available Graphics

Via the TRS-80, we have available a number of ASCII codes (129-191). If you examine

these codes, you will see that they are different configurations of the 2 x 3 graphics block. To do the examining, the command is PRINT CHR\$(X). If X equals one of the available graphics codes, you will see a graphics configuration displayed.

To see what is available, refer to Table 3, which shows the ASCII number and the corresponding display. An X refers to a bit turned on, and an O refers to a bit *not* on. For instance, a PRINT CHR\$(191) results in all six bits turning on. A PRINT CHR\$(149) results in the bits on the left side of the block being turned on. As you can see, we have lots of different configurations available for our use.

### Doing It

Now that all the preliminaries are out of the way, let's get it working. Refer to the short program in Listing 1. While referring to this program, let's decipher each line and see what we have.

Line 10 is easy; it's a standard clear screen command. Line 20 sets the initial value of X to be used when we start POKEing. Table 2 shows that the location of the POKE is on the left side of the display about halfway down.

In line 30 we are assigning the value of PEEK(14337) to the variable named Y. In line 40 we set the stage for moving our paddle. The line starts with IF Y=2 THEN POKE X,128. The only time Y can equal 2 is during the depression of the A key on the keyboard.



If Y does equal two then we POKE X, 128. The format for POKE (in my system) is POKE LOCATION, INFORMATION. The ASCII character code for a space is 128. After POKEing the space we increment the value of X by 64 (puts us one line down). The last portion of line 40 keeps the value of X within our video POKE positions; otherwise, we POKE into places we do not need to be, such as the program, the stack, etc. This causes all kinds of nasty crashes. Line 50 decreases the value of X during a key depression, which produces a Y value of 4, which happens to be the B key. Line 60 POKEs at our new X value the ASCII graphics code 149. Looking at Table 3, we find 149 to be all the bits on the left side of the

graphics block. Line 70 loops us back to our PEEK statement at line 30.

In a nutshell, what we are doing is quickly lighting a graphics position, erasing it and relighting it at the new location as is appropriate. If you have the program in your system, you will notice that when you depress the A or B key the paddle moves, and when you release the key the paddle stops. What we have is real-time interaction with our program with a single key depression. Use the keyboard table to pick where you want to PEEK. In the case of the UP, DOWN, LEFT and RIGHT commands, you may use several PEEK locations assigned different variables—for instance, U = PEEK (14340). When the U

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129	130	131	132	133	134
XO	OX	XX	OO	XO	OX
OO	OO	OO	XO	XO	XO
OO	OO	OO	OO	OO	OO
135	136	137	138	139	140
XX	OO	XO	OX	XX	OO
XO	OX	OX	OX	OX	XX
OO	OO	OO	OO	OO	OO
141	142	143	144	145	146
XO	OX	XX	OO	XO	OX
XX	XX	XX	OO	OO	OO
OO	OO	OO	XO	XO	XO
147	148	149	150	151	152
XX	OO	XO	OX	XX	OO
OO	XO	XO	XO	XO	OX
XO	XO	XO	XO	XO	XO
153	154	155	156	157	158
XO	OX	XX	OO	XO	OX
OX	OX	OX	XX	XX	XX
XO	XO	XO	XO	XO	XO
159	160	161	162	163	164
XX	OO	XO	OX	XX	OO
XX	OO	OO	OO	OO	XO
XO	OX	OX	OX	OX	OX
165	166	167	168	169	170
XO	OX	XX	OO	XO	OX
XO	XO	XO	OX	OX	OX
OX	OX	OX	OX	OX	OX
171	172	173	174	175	176
XX	OO	XO	OX	XX	OO
OX	XX	XX	XX	XX	OO
OX	OX	OX	OX	OX	XX
177	178	179	180	181	182
XO	OX	XX	OO	XO	OX
OO	OO	OO	XO	XO	XO
XX	XX	XX	XX	XX	XX
183	184	185	186	187	188
XX	OO	XO	OX	XX	OO
XO	OX	OX	OX	OX	XX
XX	XX	XX	XX	XX	XX
189	190	191			
XO	OX	XX			
XX	XX	XX			
XX	XX	XX			

Table 3. Graphics chart.

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key is depressed on the keyboard, your variable U returns a decimal 32. When the U is not depressed, you have a zero returned to your variable.

In the case of an actual video display, use Table 2 to find the screen location and Table 3 to find your particular graphics character. Also—hadn't mentioned it before—you can POKE any character, number, symbol or control code that you may desire by referring to the appropriate chart in your user's manual.

### New Thoughts

Now that we have all that accomplished, you can start writing your ultimate game pro-

```

10 CLS
20 X=15808
30 Y=PEEK(14337)
40 IF Y=2 THEN POKE X,128 : X=X+64 :
   IF X > 16320 THEN X=16320
50 IF Y=4 THEN POKE X,128 : X=X-64 :
   IF X < 15360 THEN X=15360
60 POKE X,149
70 GOTO 30
80 REM "A" FOR UP AND "B" FOR DOWN
  
```

Listing 1.

gram, either a video game as above or the ever-popular lander-type program. Use the above idea to enter fuel and direction during real time. The trouble with a lot of present lander games is that the program stops and allows you to

think. With real-time entries you become a busy pilot. It will also be almost impossible to come up with a set routine to land your lander. How about running a dot through a maze? You could have an incrementing counter in your control loop that gives a relative

time readout upon negotiating the maze.

I put this article together to demonstrate a function that I find convenient. If you find it interesting, then I have accomplished my goal. If you have also picked up some general PEEK, POKE and graphics information, then I have doubly succeeded.

### Conclusions

Just remember to put your PEEK statement in a loop where it will be strobed. You can branch out when your statement is qualified and then return. When POKEing the video section, always put in an upper and lower POKE limit to keep from crashing through. ■

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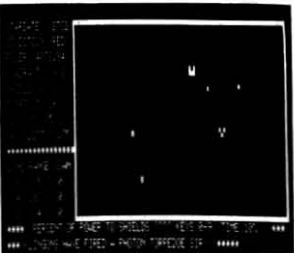
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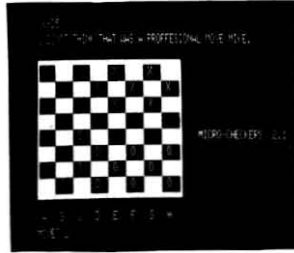


# SOFTWARE → TRS-80 ← SOFTWARE



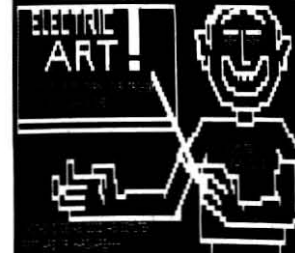
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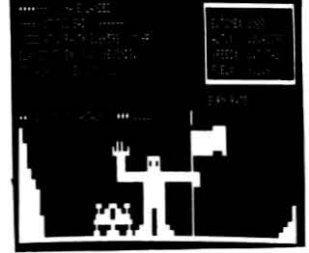
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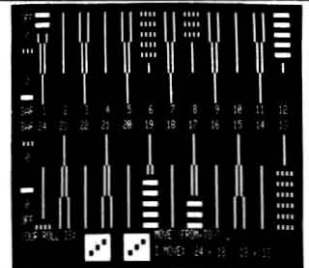
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# Hex Display

```

100 GOSUB370
110 A=0 B=0 C=1 D=10 H=48
120 FOR I=1 TO 10: IFB=AND(B<10)OR(B<15)AND(B<20)OR(B<25)AND(B<30)PRINTA:B: IFB<31AND(B<40)PRINTA:B:
130 IFB<27AND(B<35)OR(B<40)AND(B<45)PRINTA:B: ",CHR$(B),
140 A=A+1: B=B+1: NEXT
150 FOR I=1 TO 6: H1=CHR$(H): H2=CHR$(64+C): IFB=AND(B<10)OR(B<20)OR(B<30)AND(B<40)PRINT" ",H1$,H2$: " ",D: ",CHR$(D):
160 IFB<27AND(B<35)OR(B<40)AND(B<45)PRINT" ",H1$,H2$: " ",D: " ",CHR$(D),
170 C=C+1: D=D+1: NEXT
180 B=B+6: C=1: H=H+1: D=D+10
190 IFH1="2"ANDH2="F"GOSUB360
200 IFH1="5"ANDH2="F"GOSUB360
210 IFH1="8"ANDH2="F"GOSUB360
220 IFH1="9"ANDH2="F"GOSUB360
230 GOTO120
240 D=10: E=1: H=48: K=170: J=65
250 IFD>191GOSUB360: GOTO290
260 FOR I=1 TO 10: H1=CHR$(J): H2=CHR$(H): PRINT" ",H1$,H2$: " ",D: " ",CHR$(D),
D=D+1: H=H+1: NEXT
270 FOR I=1 TO 6: H1=CHR$(J): H2=CHR$(64+E): PRINT" ",H1$,H2$: " ",K: " ",CHR$(K),
E=E+1: K=K+1: NEXT
280 J=J+1: H=H+10: D=D+6: E=1: K=K+10
290 GOTO290
290 FOR I=1 TO 10: H1=CHR$(J): H2=CHR$(H): PRINT" ",H1$,H2$: " ",D: D=D+1: H=H+1: NEXT
300 FOR I=1 TO 6: H1=CHR$(J): H2=CHR$(64+E): PRINT" ",H1$,H2$: " ",K: E=E+1: K=K+1: NEXT
310 J=J+1: H=H+10: D=D+6: E=1: K=K+10
320 IFH1="B"ANDH2="F"GOSUB360
330 IFH1="E"ANDH2="F"GOSUB360
340 IFH1="F"ANDH2="F"GOSUB360
350 GOTO290
360 PRINT:PRINTTAB(20)"WAIT FOR MORE":FOR I=1 TO 1000: NEXT
370 CLS:PRINT" ",H," ",",",D," ",",",ASCII":TAB(17)"H": " ",D," ",",",ASCII":
TAB(33)"H": " ",D," ",",",ASCII":TAB(49)"H": " ",
D," ",",",ASCII":RETURN
380 PRINTTAB(20)"END OF DISPLAY":END

```

H	D	ASCII	H	D	ASCII	H	D	ASCII	H	D	ASCII
1	1		2	2		3	3		4	4	
5	5		6	6		7	7		8	8	
9	9	0A	10	0A	11	0C	12		0C	12	
00	13	0E	14	0F	15	10	16		10	16	
11	17	12	18	13	19	14	20		14	20	
15	21	16	22	17	23	18	24		18	24	
19	25	1A	26	1B	27	1C	28		1C	28	
1D	29	1E	30	1F	31	20	32		20	32	
21	33	!	22	34	"	23	35	#	24	36	\$
25	37	%	26	38	&	27	39	'	28	40	(
29	41	)	2A	42	*	2B	43	+	2C	44	,
2D	45	-	2E	46	.	2F	47	/			

WAIT FOR MORE

H	D	ASCII	H	D	ASCII	H	D	ASCII	H	D	ASCII
30	48	0	31	49	1	32	50	2	33	51	3
34	52	4	35	53	5	36	54	6	37	55	7
38	56	8	39	57	9	3A	58	:	3B	59	;
3C	60	<	3D	61	=	3E	62	>	3F	63	?
40	64	@	41	65	A	42	66	B	43	67	C
44	68	D	45	69	E	46	70	F	47	71	G
48	72	H	49	73	I	4A	74	J	4B	75	K
4C	76	L	4D	77	M	4E	78	N	4F	79	O
50	80	P	51	81	Q	52	82	R	53	83	S
54	84	T	55	85	U	56	86	V	57	87	W
58	88	X	59	89	Y	5A	90	Z	5B	91	[
5C	92	\	5D	93	]	5E	94	^	5F	95	_

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The speed of many micro applications could be improved by rapid and accurate hexadecimal conversions of decimals 0-255.

Assembly language programming is tedious without this facility and modifying byte data in main memory or disk sectors can be highly dangerous.

Although converting numbers in this range with a pencil and paper is not difficult when done as an exercise, it is a source of distraction and prone to error when carried out while programming or doing surgery on data registers. Yet there appears to be no software available specifically designed for this purpose.

## Display ASCII as Well

The program Hexadecimal Display, written here in Level II BASIC, displays not only hex conversions but also the ASCII characters and the TRS-80 graphics characters. The latter, of course, appear only as periods in the printed RUN.

Hexadecimals composed only of numbers can be displayed by using the simple variables A and B. Since variables consisting of a combination of letters and numbers cannot be assigned or called directly, it is necessary to introduce two modifications to the simple A-B scheme.

Firstly, the calls for all number hexadecimal must be made to leapfrog over the alphanumeric ones. This is done with the Boolean logic of line 120, having initialized the variables in line 110.

Secondly, to call the alphanumeric hexadecimal the variables are first assigned to strings and these are then equated with appropriate CHR\$ functions. This can be seen in lines 50, 260, 270, 290 and 300.

The logic in line 150 ensures correct spacing in the display. Here, as in all the PRINT lines, meticulous care must be taken with punctuation. Throughout, CHR\$(H) provides the hexadecimal number byte and CHR\$(64+C) or CHR\$(64+E) establishes the appropriate letter byte.

Calling the ASCII and graphics characters cannot be done as a continuous series because many of them are control codes, which execute following a PRINT statement. For example, a simple request such as

```
FOR I=0 TO 255:PRINT CHR$(I):NEXT
```

will founder in several places. The worst, perhaps, is when CHR\$(23) is reached. This immediately converts all subsequent display to 32-character format.

Higher codes will do other unacceptable things such as clearing the screen and compressing in tabular fashion. Still, this problem is easily overcome by



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SEND FOR CATALOG

incorporating leapfrogging logic into the lines that display the CHR\$ equivalent of the decimal variable, viz. lines 130, 160, 250, 260 and 270.

#### Hexadecimal Categories

This set of hexadecimals comprises several groups that fall into two categories. One category is the groups in which the first byte runs from A to F; the other category has the numbers 0-9 as the first byte. Each of these categories requires a distinct FORNEXT loop, 1 to 6 and 1 to 10 respectively (see lines 150, 270, 300 for the first category; 120, 260, 290 for the second category).

The values of the variables *within* each loop are changed by the accumulator assignments in lines 140, 170, 260, 270, 290 and 300.

Since each FORNEXT loop assigns its own set of values to the variables, these must be reset correctly for the looping that follows the GOTO statements in lines 230 and 250. Resetting is done in lines 180, 280 and 310.

When the first hexadecimal byte is a letter (decimal 160) and when both bytes are letters (decimal 170) variable values must be reassigned. Line 240 accomplishes this. The pointer is sent here when 9FH is reached (line 220).

As listed, the program scrolls page-size displays with pauses

between each page. Interim pages carry the message WAIT FOR MORE and the last page contains the information END OF DISPLAY. These break points cannot, of course, occur within FORNEXT loops, so lines 190-210 and 320-330 call the delay subroutine in line 360 (which may be user-modified to alter the length of the delay period).

When FFH is reached, line 340 sends the pointer to the final message and END of the program in line 380.

Headings for the columns are provided by the subroutine in line 370, which is called at the beginning (line 100) and which follows the various GOSUB, to line 360.

The program responds to BREAK at any time and the RUN may be printed in whole or in part by using the JKL screen printer of NEWDOS+. In the absence of this facility or if hard copy is desired, obviously the PRINT statements should be changed to LPRINTS.

Deliberate compression of the program by avoiding spaces and REMs produces a memory requirement of only 1.1K. Thus the program can usually be SAVED on most disks where surgery is to be carried out, providing an *in situ* source of hexadecimals which, unlike printouts, cannot become buried under other papers. ■

WAIT FOR MORE

H	D	ASCII	H	D	ASCII	H	D	ASCII	H	D	ASCII
60	96		61	97		62	98		63	99	
64	100		65	101		66	102		67	103	
68	104		69	105		6A	106		6B	107	
6C	108		6D	109		6E	110		6F	111	
70	112		71	113		72	114		73	115	
74	116		75	117		76	118		77	119	
78	120		79	121		7A	122		7B	123	
7C	124		7D	125		7E	126		7F	127	
80	128		81	129		82	130		83	131	
84	132		85	133		86	134		87	135	
88	136		89	137		8A	138		8B	139	
8C	140		8D	141		8E	142		8F	143	

WAIT FOR MORE

H	D	ASCII	H	D	ASCII	H	D	ASCII	H	D	ASCII
90	144		91	145		92	146		93	147	
94	148		95	149		96	150		97	151	
98	152		99	153		9A	154		9B	155	
9C	156		9D	157		9E	158		9F	159	
AA	160		AB	161		AC	162		AD	163	
AE	164		AF	165		AG	166		AH	167	
AA	168		AB	169		AC	170		AD	171	
AE	172		AF	173		AG	174		AH	175	
BA	176		BB	177		BC	178		BD	179	
BE	180		BF	181		CG	182		CH	183	
BA	184		BB	185		CA	186		CB	187	
BC	188		BD	189		CE	190		CF	191	

WAIT FOR MORE

H	D	ASCII	H	D	ASCII	H	D	ASCII	H	D	ASCII
C0	192		C1	193		C2	194		C3	195	
C4	196		C5	197		C6	198		C7	199	
C8	200		C9	201		CA	202		CB	203	
CC	204		CD	205		CE	206		CF	207	
D0	208		D1	209		D2	210		D3	211	
D4	212		D5	213		D6	214		D7	215	
D8	216		D9	217		DA	218		DB	219	
DC	220		DD	221		DE	222		DF	223	
E0	224		E1	225		E2	226		E3	227	
E4	228		E5	229		E6	230		E7	231	
E8	232		E9	233		EA	234		EB	235	
EC	236		ED	237		EE	238		EF	239	

WAIT FOR MORE

H	D	ASCII	H	D	ASCII	H	D	ASCII	H	D	ASCII
F0	240		F1	241		F2	242		F3	243	
F4	244		F5	245		F6	246		F7	247	
F8	248		F9	249		FA	250		FB	251	
FC	252		FD	253		FE	254		FF	255	

END OF DISPLAY

READY

>

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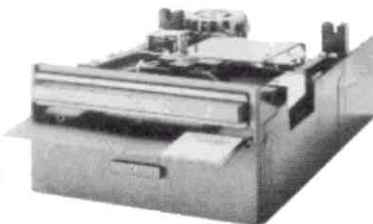
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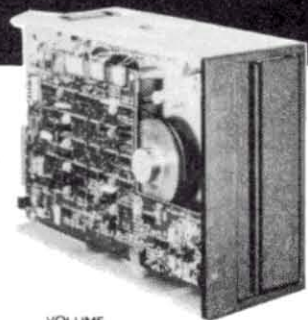
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**B**y looking at documentation, ease of loading, difficulty of use and suitability, I will attempt to help the potential buyer decide whether the programs discussed will be useful to him. At the same time, please keep in mind that your requirements and desires may be different than mine and that what appeals to me may turn you off and vice versa.

## The Software

**Vendor:** Micro Architect, 96 Dothan Street, Arlington MA 02174

**Name:** WORD-1

**Purpose:** General-purpose word-processing system

**Documentation:** Four pages—well-written

**Loading:** OK—Level 7

**Implementation:** Requires a printer to be of any practical value. Also, the TRS-80 should be modified for lowercase. User should have some BASIC pro-

gramming background since text is entered into the system as data statements. This is more difficult than the method used in most word processing systems, but they cost at least four times as much as WORD-1. Also, since this is written in BASIC rather than machine language, it is quite slow.

**Suitability:** This is not for the author or others with high-volume requirements. It is, however, quite suitable for the letter writer or for someone who needs many copies of the same letter with a different name and address on each one. I like word processors because they allow me to correct all of my mistakes without being committed to paper.

**Vendor:** Micro Architect

**Name:** BANK-1

**Purpose:** Personal checkbook accounting system

**Documentation:** One page—sufficient, mostly self-documenting

**Loading:** OK—Level 7

**Implementation:** No hardware requirements except the standard cassette recorder. This program will process and store 100 checks in a 4K machine and 1600 checks if you have 16K. Data is input from the keyboard and includes check number,

amount and transaction code. Each check is put into one of a number of categories depending upon the transaction code. All checks can be recalled, changed or deleted, and a summary report can be displayed at any time. The summary breaks expenses down into categories with totals for each one. All check data is stored on cassette for future use.

**Suitability:** A simple but effective personal accounting system. Should be all that most households will need. Since it is written in BASIC, the names of categories can easily be changed to suit your situation. I have already entered all of last year's checks into its data base.

**Vendor:** Micro Architect

**Name:** STOCK-1

**Purpose:** To keep track of the value of your stock portfolio

**Documentation:** One page—sufficient, self-documenting

**Loading:** OK—Level 7

**Implementation:** Program comes loaded with sample stocks so that the user can get an idea of what to expect. For your own stocks, you enter the date, original price, number of shares and current dividend. The program then computes your current worth by asking for the latest price for each of your

stocks. It also figures in the present value of your house. As in WORD-1, all data is input as data statements rather than as a response to an input statement. It is also awkward to use if you have blocks of the same stock that were purchased at different times or for different prices. Each block must be input as a separate stock entry. Data is stored on cassette as part of the program which is resaved anytime that changes are made.

**Suitability:** The speculator will want something more sophisticated than this. For the user who buys and holds his stocks for a reasonable period of time, this program will compute his net worth and gain or loss position. It will not analyze future stock possibilities.

Other software available from Micro Architect: Cassette Data Base Manager, Inventory Management, Mailing List System, Sorting Utility, Key-access Utility, Statistics Package, Sales Analysis and many more.

**Vendor:** M, M and S Computer Software, 16 Marylyn Lane, Westbury NY 11590

**Name:** Statistical Package

**Purpose:** Designed to compute and display mean, variance and standard deviation, linear correlation coefficient, T-test, anal-



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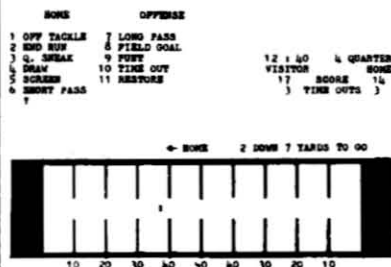
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ysis of variation and analysis of covariance from user input.

**Documentation:** Five pages—excellent

**Loading:** OK—Level 6

**Implementation:** If I lost you reading the purpose of these (five) programs, then we're still together. Quite frankly, I'm not a math major (or math minor either!) and this is way over my head.

**Suitability:** Math students, scientists and anyone else who understands the terms used above can probably put this package to good use.

Other programs available from M and S Computer Software: A Dissassembler.

**Vendor:** Contract Services Associates, 1846 W. Broadway, Anaheim CA 92804

**Name:** Form 1040A Tax Program

**Purpose:** To help the user fill out the IRS 1040A income tax form  
**Documentation:** Two pages—complete

**Loading:** OK—Level 7

**Implementation:** You are asked to enter from the keyboard the information that will be used to fill out the 1040A. If you qualify for earned income credit (income under \$8000), this is computed. You are directed to the tax tables and asked to enter your tax. The information required on the form is then displayed on the screen.

**Suitability:** Since the form

1040A is so simple to fill out, it would be hard to justify the purchase of this program for a one-time use. There is no guarantee that the form will be the same next year or that you will qualify for it.

Other software from Contract Services Associates: All income tax forms and schedules (home and professional), Monitor, Calculator, Loan Payment Computation, Hex-Dec-Oct Conversions, Cash Flow Prediction and many more.

**Vendor:** Circle Enterprises, Inc., PO Box 546, Groton CT 06340

**Name:** File Handling

**Purpose:** To keep a file of names, addresses, telephone numbers and birthdays

**Documentation:** Self-documenting

**Loading:** OK—Level 7

**Implementation:** Program is self-documented and easy to use. Names (last name first) can be entered in any sequence and will be arranged in alphabetical order. Any listing can be recalled, changed or deleted, and the entire block—name, address, telephone number and birthday—will be displayed while it is being modified. You can step your way through the file or cause a list of all of the names and telephone numbers in the file to be displayed. No direct provision for hard copy is made, but this could easily be added.

**Suitability:** This is another one that I've put into family service. It will handle up to 100 names and should be usable by most households. It ought to make our Christmas card list much simpler to generate this year.

Other software available from Circle Enterprises, Inc.: Moving Signboard, Loan Payment, Prime Numbers, Amway Distributer System and more.

### Conclusion

Note that most programs were loaded with the CTR-41 volume control set between 6 and 7. In order to get a good CLOAD for the first time, I used the following procedure:

```
10 Set the volume control to 4.
20 CLOAD.
30 If CLOAD fails THEN advance volume slightly;GOTO 20
40 RUN
```

Radio Shack has a modification out for the TRS-80 that uses the data on the tape instead of the computer clock for clocking the CLOAD. This should allow a much greater volume control setting range. I have another computer that uses that method, and I can set the volume anywhere from 1 to 10 and still get a good load.

When I CSAVE my own programs, they CLOAD best with the volume set at 4½. I don't like to have tapes that play back at different levels because I

usually forget to reset the volume control correctly. Therefore, once I get a good CLOAD. I CSAVE the program back to a second tape. This means that from now on it will CLOAD from this tape with my standard volume setting. Also note that most programs only take up a portion of the tape that they are sold on, so I put many programs on this second tape, which reduces the number of active tapes in my library.

Most of the tapes that I received came without boxes. Since dust and error free digital tape recording are not compatible, I do not like to see cassette tapes lying around loose gathering dust. A box for each tape would be a small part of the vendor's program production expense and would certainly be a beneficial service to the customer.

I have barely scratched the surface of this field. While I was disappointed in some of the above software for the reasons given, I think that we have made a start in the right direction. However, I still think that there is a need for more sophisticated applications-type programming. Personal computing is growing up very rapidly. More and more people who are not interested in computers as a hobby are getting involved. They are going to demand and be willing to pay for good applications software. ■

## WHY LOWERCASE?

Unfortunately,



Wouldn't you like access to YOUR entire typeset? Level II Basic converts lowercase command words into UPPERCASE. All characters contained between quotes remain as typed, but the software in an unconverted TRS-80 allows UPPERCASE display only! This software shortcut allowed Tandy to omit one video memory chip. This chip must be added and the video software repaired before the display of dualcase is possible.

converting your TRS-80 requires installing the video memory chip plus wiring changes. There is only one modification on the market which eliminates most of the wiring. To get the dualcase mod installed you have three choices: 1) Send your computer to a company or individual who will do the wiring, 2) do it yourself, or 3) "THE PATCH" (trade mark).

To make choices 1 & 2 operate requires using software overhead in the form of a "driver". This takes 30 bytes, unless you want a "normal" shift to UPPERCASE keyboard. That takes upwards of 60 more bytes. Software oriented mods have three more disadvantages: 1) They reside in program memory, eating program space which you could be using, 2) other machine language programs are unusable if they are loaded against the top of memory, or 3) the "driver" software MUST be loaded every time you power-up, or the "MEMORY SIZE?" appears due to program bomb. Choice number three suffers from NONE of the software overhead problems. We call it "THE PATCH" and it's new for the 80's!

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*If you bought your 80  
to learn about computers, why upgrade to Level II?*

---

# Inside Level I

Robert V. Meushaw  
4188 Brittany Dr.  
Ellicott City, MD 21043

Once I had worked my way through the *TRS-80 Level I BASIC User's Manual* and had run most of the examples, I grew itchy to move on to Level II BASIC. My friends who already had Level II machines constantly reminded me of how primitive my system was. The pressure to move up kept growing.

I would have succumbed to the pressure, if I had not already gone through a similar experience in my younger days when I had been bitten by the stereo bug. I had spent thousands of dollars on speakers, amplifiers, tuners, turntables, etc., in an attempt to own the ultimate system. Clearly, it was an impossible task.

Looking back, I realized that my pretention overcame my better judgement. After all, the purpose of owning a stereo was to

listen to music, not to claim the lowest distortion figures of any of your friends' systems.

My ears could have been satisfied with a much less expensive system.

I had to reevaluate my true motives for owning a computer. After several days of mulling it over, I realized I wanted to understand the underlying concepts of the machine. My true desire was to know the details of the Z-80 microprocessor, how the various software routines worked and how the Level I BASIC interpreter worked. There was so much more to learn on the system I already had. I had only scratched the surface of understanding the TRS-80.

## Level I BASIC

What I needed was a more well-defined objective than just to "learn more about Level I." I decided to begin my investigation with Level I BASIC and attempt to learn any technique that allowed me to use the language more efficiently.

A simple timing experiment (Listing 1) opened my eyes. This is a very simple timing loop which increments the variable I

from 1 to 15,000 and then prints "DONE".

There is nothing amazing about this program, but I was dumbfounded to find that it took 302 seconds to execute. In fact, I was so amazed that on the first several runs of the program, I terminated the execution prematurely because I thought the computer was broken.

Why on earth, considering the speed of modern day computers, should it take 302 seconds to count to 15,000? This was extremely puzzling, so for my second investigation I ran an equivalent program, shown in Listing 2. It took only 33 seconds.

Here was a problem worth investigating: Why should two equivalent programs differ in execution time by a factor of almost ten? More importantly: What can be done to obtain the fastest program execution time?

Out of curiosity, I tried to improve on the results of the program in Listing 2. Listing 3 shows a third program that executed in 28 seconds. This improvement was not as dramatic, but it still amounted to about a 15% increase in speed.

```
10 I = 1
20 I = I + 1
30 IF I = 15000 THEN 50
40 GOTO 20
50 PRINT "DONE"
60 END
```

*Listing 1: Timing loop using incremented variable (302 seconds).*

```
10 FOR I = 1 TO 15000
20 NEXT I
30 PRINT "DONE"
40 END
```

*Listing 2: Timing loop using FOR-NEXT statement (33 seconds).*

```
10 FOR I = 1 TO 15000: NEXT I
20 PRINT "DONE"
30 END
```

*Listing 3: Single line version of timing loop in Listing 2 (28 seconds).*

```
10 FOR I = 1 TO 5000
20 **** BASIC STATEMENT ****
30 NEXT I
40 PRINT "DONE"
50 END
```

*Listing 4: Program used to investigate timing behavior of various Level I BASIC statements.*



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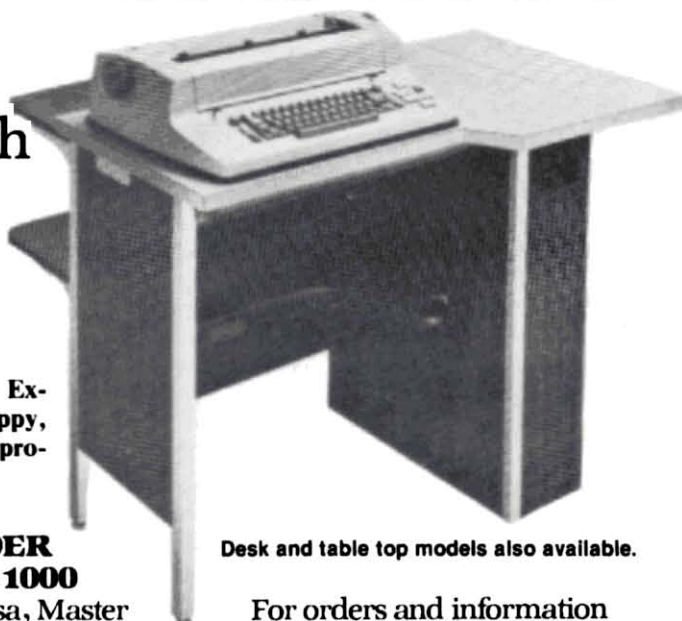
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Clearly, for a given program, there could exist a large number of equivalent programs whose execution times might differ substantially. Unless each equivalent program was coded and tested, it might not be possible to determine *a priori* which would be fastest.

I had defined my project: Determine a set of guidelines which could be applied to an arbitrary program to improve its execution time.

### The Approach

Since I had already obtained execution times for the FOR-NEXT loop shown in Listing 2, it was a simple matter to add statements in the loop as shown in Listing 4 and measure the total time of execution. The extra time for execution beyond that required by the FOR-NEXT loop would be directly attributable to the extra statement in the loop.

For example, if the timing loop of Listing 2 required 48 seconds to execute its 15,000 iterations after a statement was added, then the additional time required because of that statement would be 48 minus 33 = 15 seconds. If the time per execution of that statement was computed, it would be 15/15,000 = .001 seconds.

In practice, the delay loop which I used performed 5000 iterations because it did not result in excessive execution times.

Firstly, I attempted to categorize the kinds of Level I BASIC statements including:

Assignment Statements;

- Arithmetical Statements;
- Logical Assignment Statements;
- Single Parameter Statements;
- Two Parameter Statements;
- Transfer of Control Statements;
- Conditional Statements;
- I/O Statements.

Within each statement category, I included various forms of each statement in order to test the effect of the variations. While the list is not exhaustive, it's sufficient to gain an understanding of the overall operation of Level I BASIC.

### The Assignment Statement

Table 1 shows the execution times of the assignment statement variations. The various forms included the assignment of constants, variables, array elements and strings to real variables, string variables and array element variables.

For example, the first two results show that it requires more time to assign a constant to the variable K than to assign the value of X to K.

The next two lines show that it requires less time to assign K the value of a variable array element, i.e. A(X), than to assign it the value of a particular array element, i.e. A(7).

Comparing these results with the previous results shows that it requires more time to assign W the value of an array element than a non-array element. For instance, in going from K = A(8) to K = X, we can cut the execution time by 41%.

The next three lines show the

considerable savings that result from using the optional assignment statement LET. Going from K = A(8) to LET K = X we can cut execution time by over 65%.

The next series of statements shows the results of assigning values to array elements. As you see, the fastest executing statement uses only variables and the LET statement (i.e., LET A(I) = X), and the slowest uses constant parameters without the LET statement (i.e., A(8) = 7).

Finally, the limited string assignment capabilities of Level I are evaluated in the last two statements. As expected, the use of the LET statement results in a considerable savings in time.

Aside from comparing relative speeds it is interesting to examine the absolute times required to execute assignment statements.

It takes approximately 10 ms. to execute these assignment statements. If you approximate the machine instruction execution time of the microprocessor as 6 microseconds, it would appear that as many as 1500 machine instructions are executed in carrying out one BASIC assignment statement.

These crude approximations can give some insight into the relative inefficiency of an interpreted language as compared to a machine code implementation of the same operation.

### Arithmetical Statements

Since so many programs involve arithmetic functions, the results of Table 2 are particularly interesting. The left column of the table shows the expressions

### Logical Assignment Statements

A = (B = C)	.011
A = B = C	.0086
LET A = B = C	.0062
A = B > C	.0085
A = B < C	.0085

Table 3: Logical Assignment Statement Execution Times.

evaluated in the timing loop described previously.

Each expression is written in a general form using ? to stand for one of the functions +, -, /, or \*, shown at the top of the table. All the functions have relatively close execution times. Addition and subtraction, for example, have nearly identical execution times. The next fastest function is multiplication, and division is the slowest function.

Comparing execution times in each column, we get similar results to those previously obtained. For a given expression, approximately 24 percent more time is required if parentheses are used, and approximately 26 percent less time is required if the LET statement is used. Additionally, substitution of variables for constants improves execution speed. For instance, A = I + J is 24 percent faster than using A = 5 + 5.

### Logical Assignment Statements

Often programs require the use of Boolean variables, or variables which take only two values, usually 0 and 1.

Table 3 shows some examples of statements which compute the value of a Boolean variable. The first statement assigns A the value of 1 if (B = C) and 0 otherwise. The second

Assignment Statements		Execution Time (Sec.)
BASIC Statement	K = 5	.007
	K = X	.0058
	K = A(5)	.0098
	K = A(X)	.0086
LET	K = 5	.0046
LET	K = X	.0034
LET	K = A(X)	.0062
	A(5) = 5	.0108
	A(I) = 5	.0096
	A(5) = X	.0096
	A(I) = X	.0084
LET	A(I) = X	.006
	A\$ = "ABCD"	.0042
LET	A\$ = "ABCD"	.0018

Table 1: Execution times for Level I BASIC Assignment Statements.

Arithmetical Statements				
	+	-	*	/
A = 5?5	.01	.01	.011	.0118
A = I?5	.009	.009	.01	.0104
A = I?J	.0076	.008	.0088	.0092
A = (5?5)	.0124	.0124	.0134	.0142
A = (I?5)	.0114	.0114	.0124	.0128
A = (I?J)	.01	.0104	.0112	.0116
LET A = 5?5	.0074	.0074	.0084	.0092
LET A = I?5	.0066	.0066	.0074	.0078
LET A = I?J	.005	.0054	.0062	.0068

Table 2: Arithmetical Statement Execution Times for Level I BASIC.



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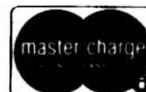
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#### Single Parameter Statements

K = RND(66)	.0134	
K = RND(X)	.012	
LET K = RND(X)	.0096	
K = RND(30000)	.014	
K = RND(0)	.0098	
K = RND(J)	.0088	where J = 0
LET K = RND(0)	.0072	
K = INT(5)	.0096	
K = INT(X)	.0084	
LET K = INT(X)	.006	
K = ABS(5)	.0086	
K = ABS(X)	.0074	
LET K = ABS(X)	.005	

Table 4: Single parameter statement execution times.

#### Two Parameter Statements

SET(30,47)	.0112
SET(X,Y)	.008
REST(30,47)	.0098
RESET(X,Y)	.0066
K = POINT(30,47)	.0146
K = POINT(X,Y)	.0114
LET K = POINT(X,Y)	.009

Table 5. Two-parameter statement execution times.

statement may look somewhat strange, but it is equivalent to the first and it executes 22 percent faster.

This is another example of the execution time penalty incurred when unnecessary parentheses are used. As expected, the use of the LET statement provides a significant decrease in execution time over the first statement. In this case the decrease amounts to 44 percent.

The last two statements show that there is no substantial difference in execution time when using logical tests such as "greater than," "less than or equal," etc.

On the average, the logical assignment statements are noticeably slower than the addition/subtraction statements, which surprised me. This may indicate that arithmetical statements can be used in place of

logical statements in cases where execution time is critical.

#### Single Parameter Statements

Level I BASIC includes the single parameter functions RND, INT, and ABS, which are shown in various forms in Table 4. The examples given for all of these functions show a modest increase in speed when using a variable rather than a constant parameter.

The speed increase ranges from 10.5 percent for the RND function to 14 percent for the ABS function. A LET statement increases the speed more dramatically. This increase ranges from 28 percent for the RND function to 42 percent for the ABS function.

In Level I BASIC when RND(0) is used, a random number between 0 and 1 is generated. This particular function executes considerably faster than when the RND function is used with a non-zero constant parameter or even a non-zero variable parameter.

The fastest execution of RND results when a variable whose value is 0 is used as a parameter. It is interesting to note that the execution times of the ABS and INT functions are on a par with the addition/subtraction assignment statements shown in Table 2. However, the RND function appears considerably slower than even the division statements shown in that table.

#### Two Parameter Statements

There are three statements in Level I BASIC which require two parameters. These statements, summarized in Table 5, are all associated with the TRS-80 graphics.

The SET statement is used to turn on a particular point in the 128 by 48 point display, while RESET is used to turn off a particular point. POINT is a Boolean function used to determine whether or not a particular point is turned on.

As expected, each of these statements executes faster when using variable parameters rather than constants or other expressions. Oddly enough, it requires considerably more time to turn on a point than to turn it off, despite the fact that the instruction set of the Z-80 microprocessor allows a particular bit in memory to be set to 1 as quickly as it can be set to 0.

The POINT statement is the slowest of the graphics instructions, even when it employs a LET statement. Unfortunately, the LET statement cannot be used to increase the speed of the SET or RESET statements.

It is possible to determine the approximate time required to turn on or off every point in the display, using the figures in Table 5 and the fact that there are  $128 \times 48 = 6144$  individual points in the display. The time required to turn on 6144 points is approximately 49 seconds, while the time required to turn them off is 41 seconds. But this does not include the time required by the necessary FOR-

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```
10 FOR I = 1 TO 5000
20 GOTO 30
30 NEXT I
```

Listing 5a: Program used to test GOTO statement.

```
10 FOR I = 1 TO 1000
20 GOSUB 100
30 NEXT I
100 RETURN
```

Listing 5b: Program used to test GOSUB/RETURN statements.

```
10 FOR I = 1 TO 5000
20 GOTO 100
30 NEXT I
100 GOTO 30
```

Listing 5c: Program used to compare GOTO statement with GOSUB/RETURN statements.



NEXT loops. Using the results of Table 1 to approximate the loop time necessary for 6144 iterations adds about 14 seconds to the total, giving us 63 seconds to turn on all the points and 55 seconds to turn them all off.

#### Transfer of Control Statements

Measuring the execution speed of a transfer of control statement required a slightly different approach.

The GOTO statement required a number to which control could be passed. The GOSUB statement required not only a control number, but a RETURN of control to the statement after the GOSUB.

The particular routines which I used to test these statements are shown in Listings 5a, 5b and 5c. Listing 5a allows the GOTO statement to transfer control to the NEXT statement of the timing loop. Listing 5b was used to test the GOSUB/RETURN statements. Listing 5c was used to compare the transfer of control to a routine using only GOTO statements with that required by the GOSUB/RETURN statements.

The results are given in Table 6. Interpreting them is not as clear cut as in the previous cases. To execute a given routine using only GOTO statements is faster, but this routine is not as flexible as one that uses GOSUB/RETURN statements, especially in the return of control to the calling routine.

There may be occasions when you can use the increased speed of the GOTO to your advantage. In comparison, the

transfer of control using only GOTO statements is approximately 14 percent faster than using GOSUB/RETURN.

A similar savings should be gained by using the ON N GOTO rather than the ON N GOSUB statement. Of course, the entire overhead associated with the transfer of control can be avoided, at the expense of a longer program, by including the sub-routine as in-line code.

Unfortunately, in Level I BASIC you cannot use a variable name in place of a line number in the transfer of control statements (e.g. GOTO K), so this trick does not reduce execution time.

#### Conditional Statements

Level I BASIC includes only the IF-THEN conditional statement. At first glance, it does not appear that there is much you can do to improve its operating characteristics.

I found, however, that in some cases the THEN portion of the statement is unnecessary. In an expression such as IF X=1 THEN 100, where control is passed to line number 100, THEN is required, but for conditional assignment statements, etc., it's simply not.

The execution times in Table 7 indicate that there is no penalty in speed for omitting the THEN statement, so this is a four byte savings which is always worth taking.

The execution speed of the conditional statement depends heavily upon whether or not the condition tested is true or false. By comparing the third and

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Transfer of Control Statements		
GOSUB -	GOSUB 100	.0072
	100 RETURN	
GOTO -	GOTO 30	.0026
	30 NEXT I	
	GOTO 100	.0062
	30 NEXT I	
	100 GOTO 30	
ON N GOSUB	ON N GOSUB 100	.0092
	100 RETURN	
ON N GOTO	ON N GOTO 30	.0052
	30 NEXT I	

Table 6. Execution times for the transfer of control statements.

#### Conditional Statements

(The following execution times are measured with J = 1)

IF J = 1 THEN X = 1	.0142
IF J = 1 X = 1	.0142
IF J = 1 LET X = 1	.0114
IF J = 2 THEN X = 1	.007
IF J = 2 X = 1	.007

Table 7: Execution times for conditional statements.

fourth statements in Table 7, you can see that when the test fails, its execution speed is increased by a minimum of about 40 percent.

This means that, where feasible, conditional statements should be constructed to allow for failure of the condition tested. It is probably safest to time your program with conditionals that usually test true, and again with conditionals that usually test false, in order to determine which approach is fastest.

#### I/O Statements

Because of the limitless number of ways in which strings, variables, TABs, ATs, constants, etc., can be combined in an I/O statement, it is a large field to test. I limited my survey to a few combinations which provide insight into possible areas of saving. These are shown in Table 8.

The first eleven statements

are examples of PRINT statements. The results seem inconclusive, except to say that using a variable parameter in an AT statement is faster than using a constant. It also appears that suppressing the carriage return in a PRINT statement, ending it with a ";", saves time.

After further consideration, it seems to me that the execution speed of the PRINT statement is not really significant because it makes no sense to print huge amounts of data—the display screen only holds 1024 characters. Execution speed is important only in the internal computation that occurs before a print statement.

The data entry statements available in Level I BASIC are the INPUT and READ statements. The INPUT statement, of course, requires manual intervention to supply the data. But the READ statement, since it can execute continuously in a timing loop, is measurable.

It was necessary for me to include a RESTORE statement with the READ statement in the timing loop, since I didn't want to type a DATA statement with 5000 entries, even if I did have sufficient memory to hold it. I determined the execution time for a single READ operation by independently finding the execution time of the RESTORE statement and subtracting this

from the combined READ/RESTORE execution time. These results are also displayed in Table 8.

Some interesting tradeoffs are available when using READ/RESTORE statements. For example, if a sequence of numbers is referenced frequently in a program loop, the numbers can be referenced either as array elements or by READ/RESTORE statements.

The DATA statement is not normally considered executable, but it does require time to determine that it isn't an executable statement. When placed in the FOR-NEXT timing loop, I measured an "execution" time of .003 seconds. This time did not vary appreciably with the number of items in the statement.

I arbitrarily included the CLS, or clear screen, statement in Table 8. This is the slowest executing statement in all of Level I BASIC. I didn't know why, so I explored it in more detail.

By consulting a Z-80 microprocessor reference card, I developed an assembly language routine which cleared the screen (Listing 6). It first loads the HL register with the start address of the display memory (i.e., 3C00 hex) and then stores a blank at that location (i.e., 20 hex).

Next, the DE register is loaded with the address of the second display location address (i.e., 3C01 hex). Then the BC register is loaded with the number of bytes to be moved in the following "block move" instruction. The effect of the "block move" is to clear the

#### Compound Statements

K = INT(A(X))	.0074
K = ABS(X + Y)	.0094
K = ABS(A(X))	.0114
K = INT(X)	.0084
K = INT(X + Y)	.0104
K = INT(A(X))	.0114

Table 9: Execution times for various compound statements.

screen.

Each instruction in Listing 6 is accompanied by the number of "T cycles" it requires, where a "T cycle" corresponds to the machine clock period. The total time required by this routine is shown beneath the listing.

The number 1023 in the calculations is the number of bytes moved in the block move, and the number  $1.8 \times 10^{-6}$  is the approximate clock speed of the TRS-80. The total time required by the assembly language program is approximately .012 seconds, just under one-half of the time required by the CLS statement.

#### Compound Statements

After determining the execution times of various Level I statements, I decided to examine their behavior when they were combined. Table 9 shows the execution times of the ABS and INT statements used with different parameters. In both cases, the fastest execution time results when a simple variable is used as a parameter, which is not surprising.

It occurred to me that by decomposing them into several simpler statements, I might

	Input/Output Statements	
PRINT	PRINT	.0172
	PRINT " "	.0184
	PRINT " ;"	.0042
	PRINT " (64 spaces) "	.0278
	PRINT " (64 spaces) ;"	.027
	PRINT AT 0, " "	.0098
	PRINT AT 0, " ;"	.0086
	PRINT AT N, " ;"	.0072
	PRINT AT 0, " (64 spaces) "	.0178
	PRINT AT 0, " (64 spaces) ;"	.0178
	PRINT TAB(10); " ;"	.0088
INPUT	Not measured	
READ/RESTORE	READ X	.012
	RESTORE	.0022
(from above we can compute)	READ X	.0098
DATA	DATA (. 20 ITEMS ..)	.003
CLS	CLS	.0262

Table 8: Execution times for various I/O statements.

Instruction	Number of T cycles
LD HL,3C00H	10
LD (HL),20H	10
LD DE,3C01H	10
LD BC,3FFH	10
LDIR	21
Total T cycles =	$10 + 10 + 10 + 10 + 1023 \cdot 21$
	$= 40 + 21483$
	$= 21523$

One T cycle =  $1/(1.8 \cdot 10^{-6})$  sec.  
Total time =  $21523/(1.8 \cdot 10^{-6})$   
= .0119  
= .012 sec.

Listing 6: Assembly language program to perform CLS (clear screen).



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K = ABS(X + Y) .0094	K = X + Y .0076	L = ABS(K) .0074	015 total
K = ABS((A(X) ) .0114	K = A(X) .0086	L = ABS(K) .0074	016 total
LET K = ABS(X + Y) .007	LET K = X + Y .005	LET L = ABS(K) .005	01 total

Table 10: Execution time comparison of compound and decomposed statements.

reduce their execution time. Table 10 gives three examples. In each of the cases, a single compound statement is replaced by two simpler statements that produce the same result. As the execution times clearly show, using a single compound statement is considerably faster than using two simpler statements.

While it is not fair to say that this will always be the case, it is certainly something that you should investigate when developing your programs.

#### BASIC Variations

As a final project in my investigation of Level I BASIC, I decided to examine the behavior of the language when used in ways not documented in the *Level I User's Manual*. It often turns out that there are quirks in a language, which you can use to your advantage if you can find them.

The first statement I looked at was the FOR statement. A typical form of this statement is:

```
FOR I = 1 TO 100 STEP 2
```

In this example, the start index, end index and step size are all numbers. I wanted to know what would happen if I used something other than a number, and I was pleased to discover that I could replace any or all of these numbers with either variables or expressions.

For example, the following statements will execute properly:

```
FOR I = A TO B STEP C
```

```
FOR I = A + 3 TO ABS(K/4) STEP RND(5)
```

This is very useful in programming situations. One example is a general purpose subroutine

that can be called and supplied with the particular parameters to be used in its loop calculation. The use of variables or logical expressions can be extended considerably beyond what is described in the manual. It is possible to use logical expressions to define Boolean variables such as:

```
X = (A > 5) * (B <= 7)
```

It is also possible to use "mixed mode" expressions, or expressions in which logical tests are used with other variables. For instance:

```
SET( (X>Y)*32 + 2, 42)
```

is a valid expression.

In the expressions ON K GOTO and ON K GOSUB, I found that if K is a negative integer the expression will not work. However, if K is zero, or if K is a positive integer greater than the number of parameters in the expression, the first parameter will be selected. For example, in the expression:

```
ON K GOTO 100,200,300
```

if K is zero or if K is greater than three, the statement will transfer control to line number 100. I tried a sample program which includes multiple statements on the same line as a conditional test. The program line I selected was:

```
IF X = ' THEN A=0: B=1: C=2
```

In running the program with several values for X, I found that if the test evaluations were true, all the remaining statements on the line were executed; while if the test evaluations were false, all the remaining statements on the line were skipped.

This might be very bothersome, but it can be useful in programs that require multiple actions after some decision. Many interesting variations of program statements are possible as a result of this feature. For example:

```
IF X = 1 THEN A = 1: B = 2: IF Y = 1 THEN A = A + 1: B = B - 1
```

will set A = 2 and B = 1, if X = 1 and Y = 1 or A = 1 and B = 2, if X = 1 and Y <> 1. A, B are unchanged if X <> 1.

One final interesting result that I found was that in a program line which includes a PRINT statement, if the final character on the line is a quote the mark can be eliminated, thereby saving one byte of storage.

This means that the following program lines will produce the same result:

```
PRINT "NO FINAL QUOTE NEEDED"  
PRINT "NO FINAL QUOTE NEEDED"
```

#### Level I Guidelines

Some of the above results have shown you how to conserve memory space, while others have shown you how to increase speed, usually at the expense of program size. You should make the tradeoffs you feel are necessary in your own applications. It should be possible to obtain the benefits of both reduced program size and increased speed if the "80/20" rule

of programs applies in your case (i.e., 80 percent of the execution time is spent in 20 percent of the code).

Following is a summary of some general guidelines you can use to increase the performance of your programs.

- 1) Avoid unnecessary use of parentheses.
- 2) Use the LET statement in assignment statements.
- 3) Use FOR-NEXT loops as much as possible without tests for exiting the loop.
- 4) Use FOR-NEXT loops on a single line.
- 5) Avoid unnecessary statements within loops.
- 6) Use variables in frequently evaluated expressions rather than constants or array elements.
- 7) Use compound statements rather than sequences of simpler statements.
- 8) Use the random function with a zero parameter where feasible.
- 9) Where possible, use conditional statements which evaluate false most of the time.
- 10) In arithmetical expressions use multiplication operations rather than division operations.

As I have noted, these items are strictly guidelines: Consider them along with the various timing results I have presented.

I have applied some of these guidelines in Listing 7a which was recoded in Listing 7b. The execution time for the first program was 47 seconds. Using the recoded version, the execution time was reduced to 17 seconds, a reduction of almost 64 percent!

While results such as this may not be possible in every case, I believe that the savings you can attain are well worth the effort. ■

```
10 A(0) = 1  
20 FOR I = 1 TO 500  
30 X = (16.28) * A(0) * I  
40 IF ((X - A(0)/100) > .0001) THEN X = 6.28 * X  
50 A(I) = X  
60 NEXT I
```

Listing 7a: Sample program for use in applying Level I BASIC programming guidelines.

```
10 P = 6.28  
20 K = A(0)/P  
30 L = A(0) + 5  
40 M = 1/100  
50 N = .0001  
60 FOR I = 1 TO 500  
70 LET X = K * I  
80 IF (X - L) * M > N LET X = P * X  
90 LET A(I) = X  
100 NEXT I
```

Listing 7b: Recoded version of program shown in Listing 7a.

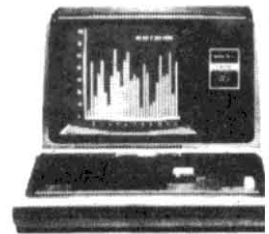




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# Double Size Graphics

Bertram Thiel  
159 West Main St.  
Frostburg, MD 21532

It's funny how one thing leads to another in computing. I start adapting a hangman program and end by PEEKing, POKEing and performing some fancy logic that has nothing to do with spelling.

While transcribing a hangman program into my TRS-80 Level II machine, I decided that the meager graphics in the original needed some embellishment, like sketching the figure and gallows, followed by a rope dropping down and the head moving to one side with the word "snap" appearing next to it.

## Simple Garbage

That's simple enough, but I am using the double-sized character width for greater legibility on my 9-inch monitor with the command:

```
PRINT CHR$(23)
```

That's where the trouble begins. I have written the graphics part using SET(X,Y) and a PRINT@ for the word to appear near the head, but in normal 64 character mode. When I

insert the CHR\$(23) at the beginning and run it, all I get is garbage, and the PRINT@ line fails to appear.

Extensive debugging fails to show anything of importance, except when I eliminate the CHR\$(23), everything works fine. It is also apparent that once you are in the double-width mode, the only way to get out of it is to clear the screen with the CLS command, erasing anything on the screen. Radio Shack gives no information on how to restore single width graphics and letters without erasing the screen.

The article, "Hidden Codes and Missing Chips", by Patrick and Leah O'Connor (*80-Microcomputing*, January, 1980) starts me on the way to a solution when they describe how double mode works in hardware. I try OUT255,0 and OUT255,8 to go back and forth between the two modes, but it is too quick. The OUT command does not latch, so when it is finished the double mode reverts back to what it was before.

Putting the OUT command in a delay loop helps, but this is impractical. Somewhere there has to be a bit that is flipped and used as a reference to change the bit No. 3 on the output port when it is finished.

To find it, I have to get my feet wet in the swamp of PEEK and POKE to examine the several hundred addresses of reserved RAM that Radio Shack does not

explain.

Since some byte has to change when going from CLS to CHR\$(23), I try writing a short program to test RAM within range of addresses, compare the contents before and after the conversion and store any positive results for display at the end of the run.

Listing 1 does just that, storing the contents of memory in B and C, then comparing them and storing those that changed. I dimension the arrays to 12 places which, as it turns out, are more than enough. Try the program and specify memory locations starting at 16384 and ending at 17128, which is the zero at the beginning of Program Text (see the T-BUG manual for more detailed information).

The results show that there has been a change in the cursor

location, and six other locations in reserved RAM. The one that stands out and says, "BINGO!" is location 16445, which shows a zero in normal mode and an eight (or binary 00001000) for data pin No. 3 in the CHR\$(23) mode.

Now all I have to do is POKE 16445,0 to convert back to normal graphics and character size. As far as I can tell, POKE 16445,8 is equivalent to PRINT-CHR\$(23).

Switching back and forth between normal and double mode, it is soon apparent how the thing works.

## Even Numbering

First, the PRINT@, in double mode, only works for a word starting at an even-numbered position. If you are in double-width mode and type:

```
10 REM ADDRESS COMPARE FOR TRS-80
20 REM B THIEL 1/05/80
30 DIM D1(12),D2(12), D3(12)
40 INPUT "STARTING ADDRESS":A1
50 INPUT "ENDING ADDRESS":A2
60 LET A=A1
70 CLS
80 B=PEEK(A)
90 PRINT CHR$(23)
100 C=PEEK(A)
110 IF B<>C THEN GOSUB 200
120 LET A=A+1
130 IF A<A2 THEN 70
140 CLS
150 PRINT "ADDRESS", "NORMAL", "DOUBLE"
160 FOR D=1 TO 12
170 PRINT D1(D),D2(D),D3(D)
180 NEXT
190 STOP
200 J=J+1
210 D1(J)=A:D2(J)=B:D3(J)=C
220 RETURN
```

Program Listing 1.



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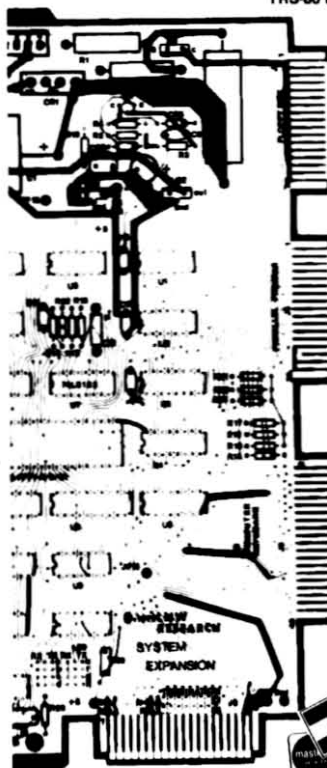


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Character	Division	Remainder	Division	Remainder	Action
0	x/2	no	x/2/2	no	x = x
1	(x + 1)/2	no	(x + 1)/2/2	yes	x = x - 1
2	x/2	no	x/2/2	yes	x = x - 1
3	(x + 1)/2	no	(x + 1)/2/2	no	x = x - 2

Table 1. Logic chart.

PRINT@100,"HELLO 1";PRINT@165,  
"HELLO 2"

you see only the first line printed. Now enter:

POKE16445,0

and the other line will appear. Note they are both double spaced. Double-width mode inputs characters every other position in memory, and if they don't start in an even position, you'll never see them. This can be surprising when loading the screen memory with a message or graphic in double-width, and you have it suddenly appear by reverting back to the normal mode.

If you have printing on the screen in normal mode and you POKE 16445,8 or PRINT CHR\$(23), you see only one half of what was there before. Also, the whole screen is shifted right one double-character width, which is the clue to understanding how double mode characters and graphics work.

Remember that you can SET any X position between 0 and

127, but in double mode all you have available is every other pair of X memories. If we look at the first four numbers, 0,1,2 and 3, you'll see what I mean.

Type in SET(0,30) and you get a block in positions zero and one (in double width mode), SET(1,31) occupies screen positions two and three on line 31. SET(2,32) and SET(3,33) though they do reside in video memory, are not displayed on the screen. POKE 16445,0 and you see them; POKE 16445,8 and they disappear again. To draw in double mode graphics, you have to take this into account.

The only thing left to explain is how to do it easily, especially if you are graphing. Studying the characteristics of the numbers, it becomes apparent that each had a couple of characteristics unique to its own group (multiples of four). Each time you divide by two you have a result that either does or does not have a remainder, with a one added to compensate for odd numbers.

Table 1 shows how a position can be evaluated and, when

true, what action will be taken to set the proper memory bit to give a continuous line.

#### Subroutine

The subroutine starting at line 1000 in Listing 2 uses these characteristics from the table with the integer function and the logical AND to determine if there is a remainder after division.

Note that a fourth decision line does not exist since, if the first three are not satisfied, then the X must be of character three type which requires a displacement two positions to the left. Special consideration is given to zero in line 1020 and an over-value check in line 1010.

If you enter the program as shown and run it, you get a nor-

mal graphics line from 0,0 to 47,47. Insert:

15 PRINTCHR\$(23)

and note the discontinuous line on a new run. To activate the subroutine, put in the line:

35 GOSUB 1000

and you correct this problem. Study how the subroutine is used and insert it whenever you decide to use double mode in graphics.

With the knowledge of the PRINT@ idiosyncracies and the unusual use of graphics memory storage, many unusual and useful effects can be accomplished. ■

```

1 REM DEMONSTRATION PROGRAM WITH GRAPHICS
2 REM SUBROUTINE TO CORRECT FOR CHR$(23)
3 REM B THIEL 1/05/80
10 CLS
20 FOR Y=0 TO 47
30 X=Y
40 SET(X,Y)
50 NEXT Y
60 GOTO 60
999 END
1000 REM SUBROUTINE TO EVALUATE X POSITION IN SET COMMAND
1010 IF X>127 PRINT "X IS OVERVALUED": STOP
1020 IF X=0 RETURN
1030 A=X/2
1040 B=A/2
1050 C=(X+1)/2
1060 D=C/2
1070 IF ((A-INT(A))=0) AND ((B-INT(B))=0) THEN RETURN
1080 IF ((C-INT(C))=0) AND ((D-INT(D))>0) THEN X=X-1:RETURN
1090 IF ((A-INT(A))=0) AND ((B-INT(B))>0) THEN X=X-1:RETURN
1100 X=X-2: RETURN
1110 STOP

```

Program Listing 2.

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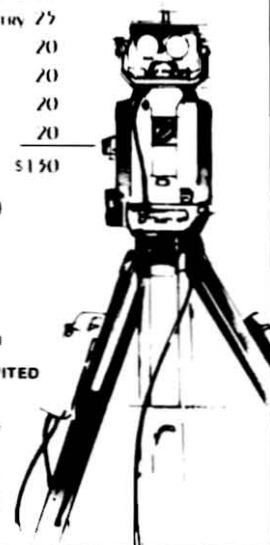
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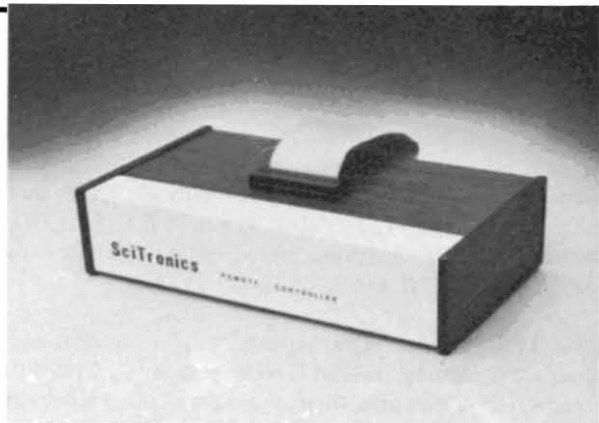
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## A real I/O Driver for the DEC LA-34 turns it into a fully working terminal.

# DECwriter Driver

James D. Beauchamp, Jr.  
6214 Silverleaf  
League City, TX 77573

**W**hat is better for a micro-computer's output blues than a line printer, but costs about the same? A printing terminal!

After considering various line printers I decided the best thing that I could buy for my TRS-80 was the DECwriter LA-34. Here was a table top printer, for about the same price as a Centronics line printer, yet was a professional terminal as well. The only thing missing was the software driver enabling the LA-34 to be used as a terminal.

Though the RS-232 port from Radio Shack has a DECwriter Driver listed in the instruction manual, it is only an output driver to be used with the LPRINT command. I wanted a real I/O driver for my DECWRITER.

### The Control Codes

So I sat down, chained myself to the computer and wrote the Term program that Radio Shack had announced but not yet released. The DECwriter I/O driver is broken down into several sections which I have separated with comment lines. The first section of the listing is the control codes.

Control A is used as a BREAK.

The key labeled BREAK on the LA-34 transmits a .233 ms pulse which is ignored by the TRS-80. The computer decodes its own break as 01H. This is the control character SOH in ASCII and is transmitted by the CTRL A on the LA-34.

The second control character, S, was added because the TRS-80 has a habit of speeding off during the DOS PRINT command. Every time I tried to list a program from disk, the TRS-80 would outrun the LA-34 and I would lose valuable data.

Since the DECwriter can automatically transmit an X-OFF character whenever its character buffer contains over 100 characters and an X-ON when it contains less than 10, I decided to take advantage of this feature.

During the print cycle, whenever an X-OFF is received, the print routine enters a tight loop (at label X-OFF). When any character other than X-OFF is in the RS-232 data register, the loop is terminated.

During normal operation, when the register does not contain the X-OFF character, the loop is ignored. The loop can also be entered by pressing the Control S during printing and exited by pressing the carriage return.

Another control character I added, to prevent printing on the perforations of my fanfold paper, is CTRL L or form feed. I added a line counter (actually Radio Shack added it in the line

printer device control block, it just seems that they did not make very good use of it) and a routine (FORMFD) to generate enough line feeds to send the printer to the top of the page whenever the FF character is transmitted.

I also inserted a check for the CTRL L in the keyboard routine to allow the form feed routine to be invoked manually.

The Controls 8 and I were recognized by the TRS-80 and required no special programming. So that I could have the option of using typing paper I added a loop (PLOOP for pause loop) in the form feed routine. This caused the computer to pause at the end of each page. This loop responds to a flag (PFLAG) that is set with Control P (for PAUSE) and reset with Control R (for RESET PAUSE).

### Input and Output

The next sections of the program are the Equate Table and the DCB initialization. Here I set the values in all of the DCBs except the keyboard. The keyboard is initialized by going to BASIC and using the SYSTEM command to jump to KBINIT-6 (here I have used 65001—see ORG in line 600).

This is the technique used by KBFIX and is the only way I could get the keyboard to initialize. If anyone else can get the keyboard to initialize from DOS, I would be grateful to hear how you do it.

The next section performs the actual input from the DECwriter keyboard. It first checks the UART to see if it has been initialized and, if so, inputs the character. If FORM FEED and PAUSE commands are present they are acted upon; otherwise, the character is returned. The UART is then initialized—a standard routine suggested by Radio Shack in their RS-232 manual.

FFTEST begins the output routine by checking the line counter to see if the printer is within five lines of the perforation. If it is, the current character is stored and a form feed is output.

The computer next checks the status register to see if the LA-34 is ready to receive another character, then checks the data register to see if a control character has been received from the LA-34. The possible characters are X-OFF, X-ON, CTRL P and CTRL R. If one of these is detected, it is acted upon immediately, otherwise the next character is output.

After the character is output the computer checks for a line feed and a carriage return. If a line feed has been sent, the line counter is decremented and if a carriage return has been sent, a line feed is also output.

The next section contains the subroutines for decrementing the line counter, generating a form feed, setting and resetting the PLOOP flag and a loop for PLOOP to wait in.

Program Listing

A /MO

```

00100 :*****
00110 :          BECRITER I/O DRIVER
00120 :          AUGUST 26, 1978          JAMES BEAUCHAMP
00130 :          2318 KENT ST
00140 :          BRYAN, TEXAS
00150 :*****
00160 : THIS IO DRIVER ALLOWS BY DEC LA-34 TO ACT AS A FULL
00170 : TERMINAL TO MY TRS-80. IT ALSO TAKES CARE OF THE END OF PAGE
00180 : FORM FEED AND THE LINE COUNTER.
00190 :
00200 : THESE CONTROL CODES HAVE THE FOLLOWING FUNCTIONS:
00210 : CTRL A === BREAK
00220 : CTRL S === PAUSE - THIS IS A TIGHT LOOP
00230 : CTRL L === FORM FEED
00240 : CTRL B === CANCEL THE LINE
00250 : CTRL I === TAB
00260 : CTRL P === PAUSE AT END OF PAGE ON
00270 : CTRL R === PAUSE AT END OF PAGE OFF
00280 :
00290 :
00300 :*****
00310 :== EQUATE TABLE
00320 :*****
00330 :
00340 LINECT EBU 4020H          :ADDRESS OF THE LINE COUNTER
00350 PGLNTH EBU 4020H          :ADDRESS OF THE PAGE LENGTH
00360
00370 RESURT EBU 0EBH           :THIS IS FROM TRS80S
00380
00390
00400 SWTCH EBU 0EBH           :AN OUT TO THIS LOCATION RESETS
00410
00420
00430 CMTREG EBU 0E4H           :THE UART, AN IN READS THE RS-232
00440
00450
00460 DTAREG EBU 0EBH           :CONTROL BITS
00470
00480
00490
00500
00510
00520
00530
00540 : DEVICE CONTROL BLOCK INITIALIZATION
00550 :*****
00560
00570
00580
00590
00600
00610
00620
00630
00640
00650
00660
00670
00680
00690
00700
00710 :*****
00720 : THIS SECTION INPUTS THE CHARACTER FROM THE BECRITER.
00730 : IT THEN CHECKS THE CHARACTER FOR CONTROL CODES AND IF PRESENT
00740 : IT GOES TO THE CORRECT ROUTINE. FOR INSTANCE, IF A FORM FEED
00750 : IS RECEIVED, WE CALL FORMFD. IF CTRL P IS RECEIVED WE CALL
00760 : THE SETP ROUTINE. WE THEN RETURN TO THE CALLING CODE.
00770 :*****
00780
00790
00800
00810
00820
00830
00840
00850
00860
00870
00880
00890
00900
00910
00920
00930 :*****
00940 : THIS ROUTINE IS USED TO INITIALIZE THE RS-232 PORT. IT IS USED
00950 : ONLY WHEN THE FLAG IS NOT SET.
00960 :*****
00970
00980
00990
01000
01010

```

```

01020 CP 01H
01030 JR Z,RESTOR          :RESTORE REG AND OUT CHR IF SO
01040 LD A,01H
01050 LD (FLAG),A          :SET FLAG TO INDICATE UNIT
01060 OUT (RESURT),A       :READ 370CH TO RESET UART
01070 IN A,(SWTCH)        :READ SENSE SWITCHES
01080 AND OFBH             :LOOP OFF LOWER 3 BITS
01090 OR 04H               :RSTS RTS, RSTS BTR, SETS BRK
01100
01110 LD (SWTNG),A         :IN HANDSHAKE LATCH
01120
01130
01140
01150
01160
01170
01180
01190
01200
01210
01220
01230
01240
01250
01260 :*****
01270 : CHECK IF AT LAST OF PAGE. IF SO THEN SAVE CHARACTER AND OUTPUT
01280 : A FORM FEED, ELSE OUTPUT THE CHARACTER.
01290 : THIS ROUTINE IS USED BY BOTH THE LPRINT COMMAND AND THE VIDEO
01300 : DRIVER ROUTINE. IT WILL BE CALLED BY (LPRINT) AND (VIDEO)
01310 :*****
01320
01330
01340
01350
01360
01370
01380
01390
01400
01410
01420
01430 :*****
01440 : TEST FOR CONTROL CHARACTERS ENTERED WHILE IN PRINT LOOP
01450 : IF YOU DON'T TEST HERE, YOU MAY BE STUCK IN A PRINTING LOOP
01460 : FOR A LONG TIME.
01470 :*****
01480
01490
01500
01510
01520
01530
01540
01550
01560
01570 :*****
01580 : OTHERWISE OUTPUT THE CHARACTER
01590 :*****
01600
01610
01620
01630
01640
01650
01660
01670
01680
01690
01700 :*****
01710 : SUBROUTINES:*****
01720 : FORMFD === GENERATES ENOUGH LINE FEEDS TO CREATE A FORM FEED
01730 : SETP === SETS THE PAUSE FLAG
01740 : RSETP === RESETS THE PAUSE FLAG
01750 : LFCTR === DECREMENTS THE LINE COUNTER EVERY LINE FEED
01760 :*****
01770
01780
01790
01800
01810
01820
01830
01840
01850
01860
01870
01880
01890
01900
01910
01920
01930
01940

```

Program continued



# PRINT MONEY WITH YOUR TRS-80!

If you have a TRS-80 disk system, you already own "Money Machine". It can "print money" for you and your family... and do it legally.

Virtually every business in your community has customer and prospect lists... people and companies that they should send mailings to on a regular basis. But, they seldom do. In a typical business, these names and addresses are totally disorganized and seldom used...even though they represent a valuable sales tool.

## PUT YOUR TRS-80 TO WORK

Your TRS-80 has the ability to totally organize mailing lists for these companies. It also has the ability to supply them with tabular listings and mailing labels upon request. All it takes is a little bit of your time. Any progressive business would be happy to pay you a nominal fee to keep their lists organized and up to date. What's a nominal fee? You can charge 10 cents a name to enter, store and maintain each record in your computer. It's also worth 3 cents to supply this name on a gummed mailing label. Think of it. The label costs three-tenths of a cent going into the printer and, with the value you add, is worth 3 cents when it comes out the other end. That's 1000% profit. That's a "Money Machine".

## HOW DO I GET STARTED?

As a minimum, you'll need a 32K TRS-80 with at least one disk drive and a good line printer. You'll also need a copy of "LABELMAKER", available on diskette from The Peripheral People. This program will allow you to input names and addresses, plus optional data such as company, phone number and so on. "LABELMAKER" also features a unique method of coding each record. You can selectively print labels by using these codes and bypass all others. The records can be sorted by zip code or alphabetically by company or name. In other words, you can provide mailing labels or tabular listings any way your customers want them.

## ANY FRINGE BENEFITS?

You bet! Providing this service is a great way to get the family involved with your TRS-80. Teenagers can easily input and output records during the day. Most women are latent business persons and your wife can easily sell the service... particularly if it means some new clothes, furniture or other "fringe benefits" for her. You can probably promote discounts or trade services with your customers. Once you've established a business in your home you can legally write off a portion of the

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The baud rate and variable table are explained in the Radio Shack RS-232 users manual. The last section is the house-keeping routine to return to the video driver.

If you have added lowercase to your TRS-80, remove lines 2400 thru 2420 and all of the proper conversions will be made.

### Conclusion

The only problem I have encountered is that the editor assembler uses upper memory to store its symbol reference table and a large table will wipe out the driver. It will also wipe out

any other routines that you have in upper memory — so beware!

I invoke this routine with SYSTEM /65001 on my computer, but if you have smaller memory, change the ORG in line 600. This is the address you will use to enable the keyboard.

One last word about this program and assembly language programming on the TRS-80. If you have a disk, but have not bought the Apparat Editor/Assembler patches, you are not realizing the full potential of your TRS-80. The only problem is the lack of a memory size command at assembly to protect the drivers. ■

```

0220 :*****
02200 :> THIS IS THE VIDEO DRIVER. DON'T FORGET TO DO THE DEC OUT. *
02240 :*****
FE04 F5 02250 VIDEO PUSH AF
FE05 C5 02260 PUSH BC
FE06 E5 02270 PUSH HL ;SAVE REGISTERS
FE07 C02FE 02280 CALL DECINT ;OUTPUT CHARACTER TO DECDRIVER
FE08 E1 02290 POP HL
FE09 C1 02300 POP BC
FE0A F1 02310 POP AF ;RESTORE REGISTERS
FE0B D0603 02320 LD L,(IX+3)
FE0C D0604 02330 LD H,(IX+4)
FE0D D0A04 02340 JP C,049BH
FE0E D07E5 02350 LD A,(IX+5)
FE0F 87 02360 OR A
FE10 2001 02370 JR Z,VID1
FE11 77 02380 LD (HL),A
FE12 79 02390 VIDI LD A,C
FE13 FE0 02400 CP 00H ;CONVERT LOWER TO UPPER CASE
FE14 FAF3FE 02410 JP N,VID2 ;REMOVE THESE THREE LINES
FE15 E03F 02420 AND 5FH ;IF YOU HAVE THE LOWER CASE HD
FE16 FE2 02430 VIDI CP Z0H
FE17 D0A05 02440 JP C,0506H
FE18 FE0 02450 CP 00H
FE19 D2A04 02460 JP NC,04A6H
FE1A C37004 02470 JP 0470H
002D 02480 END 4020H
00000 TOTAL ERRORS
BAUDST FE3E 01140
BOTABL FE3 02110 01170
CNTREG 00EA 00430 00800 01130 01400
CTRL 000C 00520 00800
CTRLP 0010 00500 00840 01530
CTRLR 0012 00510 00860 01550
DECINT FE22 00970 00990 00790 02280
DTAREG 00EB 00460 00830 01480 01610 02040
FFUIT FE0 01800 01850
FFTEST FE4F 01320
FLAG FE32 02200 00770 01000 01050
F0RNF0 FE31 01810 00800 01370 01870
MBFX FE0 00770
MBINIT FBEF 00630
LFCTR FE3A 01760 01630
LINECT 402B 00340 00620 01320 01770 01830 01890
PFLAG FE33 02210 01900 01960 02010
POLNTH 402B 00350 00610 01880
PLOOP FE0 02040 01920 02060
RESTOR FE4C 01230 01030
RESURT 00EB 00370 01050
RETRN FE3 01680 01850 01530 02070
RSETP FE3B 01990 00870 01580
RSX FE2 00810 00820
SETP FE3D 01940 00850 01540
STATIN FE3E 01400 01340 01420 01670 01860
SWTCH 00EB 00400 01070 01140 01220
SWTNG FE31 02190 01110
VID1 FEED 02380 02370
VID2 FEFS 02430 02410
VIDEO FE04 02250 00570
XOFF FE3A 01480 01500

```

### Continued Program

```

FE01 3EFF 01950 LD A,OFFH ;PUT FF IN A
FE02 3203FE 01960 LD (PFLAG),A ;PUT IT IN PAUSE FLAG
FE03 F1 01970 POP AF
FE04 C3 01980 RET ;RETURN TO CALLING CODE
FE05 F3 01990 RSETP PUSH AF ;ROUTINE TO RESET PAUSE FLAG
FE06 3E00 02000 LD A,0 ;GET 0 IN A REG
FE07 3203FE 02010 LD (PFLAG),A ;STORE 0 IN PAUSE FLAG
FE08 F1 02020 POP AF
FE09 C3 02030 RET ;RETURN TO CALLING CODE
FE0A D0EB 02040 PLOOP IN A,(DTAREG) ;PAUSE LOOP, GET LAST KEY HIT
FE0B FE0B 02050 CP 00H ;WAS IT A (CR)
FE0C 20FA 02060 JR NZ,PLOOP ;IF NOT LOOP
FE0D C383FE 02070 JP RETRN ;WHEN (CR) HIT, THEN RETURN
02080 :*****
02090 :> BAUD RATE AND VARIABLE TABLE *
02100 :*****
FE09 22 02110 BOTABL DEFB 22h ;110 BAUD
FE0A 44 02120 DEFB 44h ;150 BAUD
FE0B 55 02130 DEFB 55h ;300 BAUD
FE0C 66 02140 DEFB 66h ;600 BAUD
FE0D 77 02150 DEFB 77h ;1200 BAUD
FE0E AA 02160 DEFB 0AAh ;2400 BAUD
FE0F CC 02170 DEFB 0CCh ;4800 BAUD
FE10 EE 02180 DEFB 0Eeh ;9600 BAUD
FE11 00 02190 SWTNG DEFB 00h ;IMAGE OF HANDSHAKE LATCH
FE12 00 02200 FLAG DEFB 00h ;FLAG TO INDICATE INITIALIZATION
FE13 00 02210 PFLAG DEFB 00 ;PAUSE FLAG

```

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## A guessing game, where the computers recognize patterns!

# True or False?

John Krutch  
P.O. Box 9284  
Fort Worth, TX 76107

The subject of artificial intelligence seems to fascinate everyone, computer scientists and the general public alike. Public interest in AI is amply demonstrated by the popularity of such movies as *The Forbin Project* and *The Demon Seed*. (Both of them are shallow and unimaginative; for a much more thoughtful presentation, see the computer-psychiatrist in science fiction writer Frederik Pohl's fine novel, *Gateway*.)

Computer scientists, like

Terry Winograd and Peter Woods, are hard at work developing programs that someday, perhaps, will make these fictional portraits a reality.

Most of the programs are written for big computers with 32-bit processors and elephant-like main memories. Smaller, but interesting AI programs can be written for 8-bit processors with modest amounts of memory. The TF program I describe in this article is one of them.

### How the Game Works

TF is a sort of prediction game. The program tries to predict what the player is going to do next, based on its observation of his past behavior.

The player types in the letter T or the letter F at random. The

program must figure out which letter the player plans to type next. The program assumes that a person's behavior is never *truly* random. No matter how many times the player tries to arbitrarily respond, certain patterns, of which he himself may be unaware, surface in his actions. The program carefully stores each response, whether T or F, and searches for patterns in the player's behavior. If it finds a particular pattern that occurs again later, the program finds itself in a position to make a prediction.

TF is written in Radio Shack Level II BASIC. It requires 16K RAM in its present version, but it can be converted to a 4K machine without too much effort. The program stores the first four

characters the player types in order to make its prediction. The character that the player types is known as the "current event." (This terminology is adopted from AI researcher John H. Andreae of New Zealand, although the program itself is not derived from Andreae's work.)

Starting with the fifth current event, TF makes its first prediction by displaying the character it has established the player will choose. The player must wait a second or two for the command READY to appear before typing another character.

The keys you strike do not appear on the display. The letter that shows on the screen after you press a key is the computer's prediction. The program keeps a running score of

Program Listing 1.

```

10 '      INITIALIZATION
20 RANDOM
30 DEFINT C,E,F,I,Q,R,T
40 DEFSTR A
50 DIM Q(1111,2)
60 CNTXTLNTH = 4
70 CLS

100 '      MAIN PROGRAM
110 FOR I = 1 TO CNTXTLNTH
120 GOSUB 500 ' INPUT SUBROUTINE
130 CRNTCNTEXT(I) = EVENTCODE
140 NEXT I
150 GOSUB 500 ' INPUT SUBROUTINE
160 GOSUB 800 ' PRINTING AND SCOREKEEPING SUBROUTINE
170 GOSUB 600 ' LOCATION-CALCULATING SUBROUTINE
180 IF EVENTCODE = 1 THEN Q(L0,1) = Q(L0,1) + 1 ELSE
    Q(L0,2) = Q(L0,2) + 1
190 GOSUB 700 ' CURRENT CONTEXT UPDATING SUBROUTINE
200 GOSUB 600 ' LOCATION-CALCULATING SUBROUTINE
210 GOTO 150

500 '      INPUT SUBROUTINE
510 PRINT@ 412, "READY"
520 CURRENTEVENT$ = INKEY$: IF CURRENTEVENT$ = "T" OR
    CURRENTEVENT$ = "F" THEN 530 ELSE 520
530 IF CURRENTEVENT$ = "T" THEN EVENTCODE = 1: GOTO 550
540 IF CURRENTEVENT$ = "F" THEN EVENTCODE = 0: GOTO 550
550 CLS
560 RETURN

600 '      LOCATION-CALCULATING SUBROUTINE
610 A = ""
620 FOR I = 1 TO CNTXTLNTH
630 A = A + MID$(STR$(CRNTCNTEXT(I)),2)
640 NEXT I
650 LQ = VAL(A)
660 RETURN

700 '      CURRENT CONTEXT UPDATING SUBROUTINE
710 FOR I = 1 TO 3
720 CRNTCNTEXT(I) = CRNTCNTEXT(I + 1)
730 NEXT I
740 CRNTCNTEXT(4) = EVENTCODE
750 RETURN

800 '      PRINTING AND SCOREKEEPING SUBROUTINE
810 IF Q(L0,1) > Q(L0,2) THEN TF$ = "T": T = T + 1:
    PRINT@ 350, TF$: GOTO 860
820 IF Q(L0,2) > Q(L0,1) THEN TF$ = "F": F = F + 1:
    PRINT@ 350, TF$: GOTO 860
830 RAN = RND(2)
840 IF RAN = 1 THEN TF$ = "T": T = T + 1: PRINT@ 350, TF$
850 IF RAN = 2 THEN TF$ = "F": F = F + 1: PRINT@ 350, TF$
860 IF TF$ = CURRENTEVENT$ THEN RIGHT = RIGHT + 1
870 PRINT@ 512, "TOTAL NUMBER OF ENTRIES: "; T + F
880 PRINT@ 576, "NUMBER OF CORRECT PRE-"
890 PRINT@ 641, "DICTIONS BY THE COMPUTER: "; RIGHT
900 PRINT@ 704, "PERCENT OF CORRECT PRE-"
910 PRINT@ 769, "DICTIONS BY THE COMPUTER: ";
    INT((RIGHT / (T + F)) * 100) * 10 + .5) / 10; "%"
920 RETURN

```



how well it's doing.

How does TF make its predictions? Each time the player types in a letter, TF examines the "current context"—the last four letters you've typed, including the one you just entered. The length of this context is four. That is the value assigned in line 60, but you can experiment with other values.

Suppose you type the letter T. Assume that the three previous characters were T, F and F. The program consults array Q to see what you did in the past when the combination TFFT came up.

For example, if you typed T six times and F twice after the pattern TFFT first appeared, the program predicts that the next character you will type is T. If you have typed T and F an equal number of times after a particular pattern, the program generates a random T or F as its new prediction.

Each time you type in a new letter, TF eagerly codes it (T = 1, F = 0) and stores it as data. The storage structure set up in line

50 is a 1111 X 2 array. The vast majority of the elements in this array go unused. It's done this way only for convenience.

The program consists of six modules, shown in Listing 1. An initialization routine takes care of some housekeeping, followed by the main program and four subroutines.

The REMark statements are intended to help you understand TF, but they can be omitted when typing the program. The long variable names can be abbreviated to the first two letters of the name without damage to the program. However, if the variable name contains the \$ character, this must be included in the abbreviation. For instance, CURRENTEVENTS\$ must be typed in either as CU\$ or in its entirety.

Incidentally, variable A in line 610 is set to the empty string, not to a blank. The confusion sometimes produced when double quotation marks are printed is one of the few defects of Radio Shack's Line Printer III. ■

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There is a review of Radio Shack's new text editor and a user tells how to (or how not to) handle a "RELIGIOUS ERROR"! Plus, there are the regular features: A tutorial on the Editor/Assembler for beginners; New Products; Reviews and the Business Section. It isn't called the "TRS-80 Users Journal" for nothing! It is published regularly every two months, and costs just \$16.00 per year in the U.S. Get a sample current issue (first class mail) for just \$3.00. Use your VISA or Mastercharge and call (206) 475-2219 today! Or, send check or Money Order to: 80-U.S. Journal 3838 South Warner Street Tacoma, Washington 98409

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*Learn about assembly language by "looking" into the Z-80.*

# Assembly Language Trainer

William L. Colsher  
4328 Nutmeg Lane, Apt. 111  
Lisle, IL 60532

Sooner or later, most hobbyists get the urge to learn assembly language. Unfortunately, many never get any further. They've heard that assembler is hard to learn, that only advanced programmers use it, and that it is only good for bit twiddling.

Actually, assembly language is no more difficult than any other programming language—it just takes a slightly different mind set. One must think not only about solving the problem at hand, but also about what is physically going on inside the computer.

Because nothing stands between your program and your computer's CPU, assembler programs can be very fast. Real-

time games with animated graphics come to mind as a case where fast execution is critical. If you have any devices like coffee pots or furnaces you plan to use as peripherals, chances are you'll want to use assembler programs to control them.

I can't teach you assembler in a single article. I can give you a tool—the TRS-80 Trainer—to make learning assembler a little easier. It is an assembler program that will run with changes to the I/O on any Z-80 computer, not just the TRS-80. The program instantly shows the result of nearly all the machine instructions which you're likely to find troublesome.

## Getting the Program to Run

Obviously, you'll need an assembler. This is a not-so-subtle technique to get you into using assembly language quick-

ly. This particular program is written for the Radio Shack Editor/Assembler, so you'll need to run out and buy one.

If you already have another assembler, you may have to make some changes in the code. They shouldn't be major, though. You'll also need a Level II TRS-80 with at least 16K.

All the information on getting the Editor/Assembler running is included in the Radio Shack manual. Since it is a system format tape you may have some trouble loading it. Be patient and keep turning the volume down. Some of the information about using the assembler won't make too much sense at first, but things should seem more clear after you've started to type in the program.

While you're typing the program, you'll be glad to know that the spaces in the code listing are actually tabs—the right-

row on the keyboard. Naturally, spaces that are inside quotes are actually spaces. Just as in BASIC, comments can be deleted, but really shouldn't be.

Because this program uses many symbols, assemble it with the "/NS" option. This suppresses the symbol table, and you can see how many typos you make. When the symbol table is displayed on the screen, it scrolls the error count off.

Once the program is error free, follow the instructions in the Editor/Assembler manual for creating a tape. Make sure you save the source with the "W" command as well.

## Using the TRS-80 Trainer

You're now ready to run the TRS-80 Trainer. Your system format tape should have the TRS-80 Trainer on it. Fig. 1 shows how to load the tape and start up the program.

Displayed on Monitor	Comments
MEMORY SIZE? (cr)	
RADIO SHACK LEVEL II BASIC	
READY	
>SYSTEM (cr)	Puts the computer into system mode and allows it to read machine language tapes put out by the Assembler.
*? TRAIN (cr)	"TRAIN" is the name I used for the program when I assembled it.
*? /17152 (cr)	17152 is the decimal address of the first instruction in the Trainer. When you press ENTER the Trainer display comes on. (See Fig. 2.)

Fig. 1. How to load the TRS-80 Trainer.

A - 00000000 00	F - 00000000 00	A1 - 00000000 00	F1 - 00000000 00
B - 00000000 00	C - 00000000 00	B1 - 00000000 00	C1 - 00000000 00
D - 00000000 00	E - 00000000 00	D1 - 00000000 00	E1 - 00000000 00
H - 00000000 00	L - 00000000 00	H1 - 00000000 00	L1 - 00000000 00
		I - 00000000 00	R - 00000000 00
		IX - 0000000000000000 0000	
		IY - 0000000000000000 0000	
		INSTRUCTION:	
		Display format: Register name	
		Binary representation of register contents	
		Hexadecimal representation of register contents.	

Fig. 2. TRS-80 Trainer Display.



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Your display (Fig. 2) shows all the Z-80's registers, except the stack pointer and program counter. They are all initialized to zero to make it easy to see the effects of the instructions you type.

At this point, I caution you: It is quite simple to blow up the Trainer. Entering jump instructions will do it, as will messing with the stack pointer. Storing things in RAM, where the program is (4300<sub>h</sub> through 4760<sub>h</sub>), can foul things up, too.

To use the Trainer, you have to know what kinds of input it accepts. There are exactly three. The hexadecimal digits zero through nine and letters A through F form allowable ma-

chine instructions. Secondly, the ENTER key tells the computer you want something EXECUTED. The third is the exclamation mark. If you make a typing error, press the "!", and your input will be erased. If you enter less than five bytes of machine instruction, you have to press ENTER to make the program execute them. Table 1 reviews these commands.

You've already seen that the Trainer sets all the registers to zero when you start out. With this in mind, type 3E01. Now press ENTER. You'll notice that the A register in the upper left hand corner of the display now contains a one. In this example, 3E is the machine code for "load

the next byte into the A register". Of course, the byte this time is 01.

Now type in 0601 and press ENTER. A one appears in the B register. Type 80 and press ENTER. 80 is the machine instruction for "ADD the contents of register B to register A." If all is well, there should be two in

register A.

With the TRS-80 Trainer you can enter up to five bytes of machine code at once. This example loads register A with five, register B with six and then adds the two. Note that as soon as you type the final zero, the computer displays the results. Try this by typing: 3E05060680. ■

Input	Function/Use
!	Erases current instruction. Use it when you make a typing mistake.
ENTER	Signals the computer to execute the current instruction. If the instruction you have typed uses five bytes, the enter is not needed.
0-9, A-F	The hexadecimal digits used to input instructions to the TRS-80 Trainer.

*Table 1. TRS-80 Trainer Input.*

### Program Listing

```

4300      00140      ORG      4300H
4300 210050      00150      LD      HL,SCRBUF
4303 110150      00160      LD      DE,SCRBUF+1
4306 010004      00170      LD      BC,400H
4309 3620      00180      LD      (HL),20H
430B EDB0      00190      LDIR
430D 215546      00200      LD      HL,TEXT
4310 111950      00210      LD      DE,SCRBUF+25
4313 010E00      00220      LD      BC,0EH
4316 EDB0      00230      LDIR
4318 115353      00240      LD      DE,SCRBUF+851
431B 010C00      00250      LD      BC,0CH
431E EDB0      00260      LDIR
4320 216P46      00270      LD      HL,L1
4323 110500      00280      LD      DE,SCRBUF+128
4326 013400      00290      LD      BC,52
4329 EDB0      00300      LDIR
432B 11C050      00310      LD      DE,SCRBUF+192
432E 013400      00320      LD      BC,52
4331 EDB0      00330      LDIR
4333 110051      00340      LD      DE,SCRBUF+256
4336 013400      00350      LD      BC,52
4339 EDB0      00360      LDIR
433B 114051      00370      LD      DE,SCRBUF+320
433E 013400      00380      LD      BC,52
4341 EDB0      00390      LDIR
4343 11D351      00400      LD      DE,SCRBUF+467
4346 011100      00410      LD      BC,17
4349 EDB0      00420      LDIR
434B 115452      00430      LD      DE,SCRBUF+596
434E 010300      00440      LD      BC,03H
4351 EDB0      00450      LDIR
4353 119452      00460      LD      DE,SCRBUF+660
4356 010300      00470      LD      BC,03H
4359 EDB0      00480      LDIR
00490 ;THIS CODE PUTS USER REG VALUES IN THE DISPLAY
435B CD4145      00500 SHOW CALL HEXR ;DISPLAY HEX VALUES
00510 ;REST OF CODE DOES BINARY VALUES
435E 210350      00520 LD      HL,SCRBUF+131
4361 3A3E46      00530 LD      A,(SA)
4364 CD2346      00540 CALL DISPR
4367 219350      00550 LD      HL,SCRBUF+147
436A 3A3046      00560 LD      A,(SF)
436D CD2346      00570 CALL DISPR
4370 21C350      00580 LD      HL,SCRBUF+195
4373 3A4846      00590 LD      A,(SB)
4376 CD2346      00600 CALL DISPR
4379 21D350      00610 LD      HL,SCRBUF+211
437C 3A3F46      00620 LD      A,(SC)
437F CD2346      00630 CALL DISPR
4382 210351      00640 LD      HL,SCRBUF+259
4385 3A4246      00650 LD      A,(SD)
4388 CD2346      00660 CALL DISPR
438B 211351      00670 LD      HL,SCRBUF+275
438E 3A4146      00680 LD      A,(SE)
4391 CD2346      00690 CALL DISPR
4394 214351      00700 LD      HL,SCRBUF+323
4397 3A4446      00710 LD      A,(SH)
439A CD2346      00720 CALL DISPR
439D 215351      00730 LD      HL,SCRBUF+339
43A0 3A4346      00740 LD      A,(SL)
43A3 CD2346      00750 CALL DISPR
43A6 21A450      00760 LD      HL,SCRBUF+164
43A9 3A4546      00770 LD      A,(SAL)
43AC CD2346      00780 CALL DISPR
43AF 21B450      00790 LD      HL,SCRBUF+188
43B2 3A4546      00800 LD      A,(SFL)
43B5 CD2346      00810 CALL DISPR
43B8 21E450      00820 LD      HL,SCRBUF+228
43BB 3A4846      00830 LD      A,(SBL)
43BE CD2346      00840 CALL DISPR
43C1 21F450      00850 LD      HL,SCRBUF+244
43C4 3A4746      00860 LD      A,(SCL)
43C7 CD2346      00870 CALL DISPR
43CA 212451      00880 LD      HL,SCRBUF+292
43CD 3A4446      00890 LD      A,(SDL)
43D0 CD2346      00900 CALL DISPR

```

```

43D3 213451      00910 LD      HL,SCRBUF+308
43D6 3A4946      00920 LD      A,(SBL)
43D9 CD2346      00930 CALL DISPR
43DC 216451      00940 LD      HL,SCRBUF+356
43DF 3A4C46      00950 LD      A,(SBL)
43E2 CD2346      00960 CALL DISPR
43E5 217451      00970 LD      HL,SCRBUF+372
43E8 3A4846      00980 LD      A,(SBL)
43EB CD2346      00990 CALL DISPR
43EE 21D551      01000 LD      HL,SCRBUF+469
43F1 3A5346      01010 LD      A,(SI)
43F4 CD2346      01020 CALL DISPR
43F7 21E451      01030 LD      HL,SCRBUF+484
43FA 3A5446      01040 LD      A,(SR)
43FD CD2346      01050 CALL DISPR
4400 215752      01060 LD      HL,SCRBUF+599
4403 3A4846      01070 LD      A,(SIX+1)
4406 CD2346      01080 CALL DISPR
4409 215F52      01090 LD      HL,SCRBUF+607
440C 3A4D46      01100 LD      A,(SIX)
440F CD2346      01110 CALL DISPR
4412 219752      01120 LD      HL,SCRBUF+663
4415 3A5046      01130 LD      A,(SIY+1)
4418 CD2346      01140 CALL DISPR
441B 219F52      01150 LD      HL,SCRBUF+671
441E 3A4F46      01160 LD      A,(SIY)
4421 CD2346      01170 CALL DISPR
4424 CD0046      01180 CALL MOVE ;MOVE DISPLAY TO SCREEN
;THIS SETS UP FOR ACCEPTING AN INSTRUCTION
;HL -> DISPLAY AREA, DE -> EXECUTE B IS MAX BYTES
4427 21603F      01210 LD      HL,SCRTOP+864
442A 115947      01220 LD      DE,INSTR
442D 0605      01230 LD      B,5
442F C5      01240 READ PUSH BC
4430 CD9A44      01250 CALL HXIN ;READ ONE HEX BYTE
4433 C1      01260 POP BC
4434 DA3B44      01270 JP C,FINIS
4437 12      01280 LD      (DE),A
4438 13      01290 LD      (DE),A
4439 1BF4      01300 INC DE
DJNZ READ
01310 ;NEXT CODE GETS USER REGS SET UP
443B ED735146      01320 FINIS LD      (SSP),SP
443F 313D46      01330 LD      SP,SP
4442 3A5346      01340 LD      A,(SI)
4445 ED47      01350 LD      I,A
4447 3A5446      01360 LD      A,(SR)
444A ED4F      01370 LD      R,A
444C F1      01380 POP AF
444D C1      01390 POP BC
444E D1      01400 POP DE
444F E1      01410 POP HL
4450 08      01420 EX AF,AF'
4451 D9      01430 EXX
4452 F1      01440 POP AF
4453 C1      01450 POP BC
4454 D1      01460 POP DE
4455 E1      01470 POP HL
4456 08      01480 EX AF,AF'
4457 D9      01490 EXX
4458 DBE1      01500 POP IX
445A FDE1      01510 POP IY
445C ED7B5146      01520 LD      SP,(SSP)
4460 CD5947      01530 CALL INSTR ;EXECUTE USER INSTRUCTION
;NEXT CODE SAVES USER REGS
4463 ED735146      01550 LD      (SSP),SP
4467 315146      01560 LD      SP,SIY+2
446A FDE5      01570 PUSH IY
446C DDE5      01580 PUSH IX
446E 08      01590 EX AF,AF'
446F D9      01600 EXX
4470 E5      01610 PUSH DE
4471 D5      01620 PUSH BC
4472 C5      01630 PUSH AF
4473 F5      01640 PUSH AF,AF'
4474 08      01650 EX
4475 D9      01660 EXX
4476 E5      01670 PUSH HL
4477 D5      01680 PUSH DE
4478 C5      01690 PUSH BC

```

Program continues



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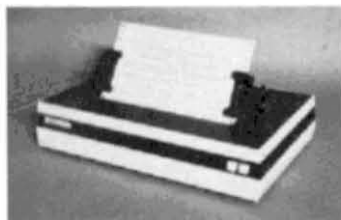
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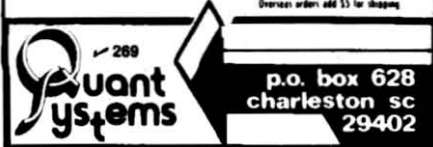
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Program continued

```

4479 P5 01700 PUSH AF
447A ED57 01710 LD A,I
447C 325346 01720 LD (SI),A
447F ED5F 01730 LD A,R
4481 325446 01740 LD (SR),A
4484 ED7B5146 01750 LD SP,(SSP)
4488 3E00 01760 CLEAR LD A,0 ;CLEAR USER INSTRUCTION AREA
448A 215947 01770 HL,INSTR
448D 115A47 01780 LD DE,INSTR+1
4489 018400 01790 LD BC,A
4493 3600 01800 LD (HL),0
4495 EDB0 01810 LDIR
4497 C35B43 01820 JP SHOW ;CONTINUE
01830 ;THIS CODE ACCEPTS ONE HEXADECIMAL BYTE
01840 ;A CARRIAGE RETURN ENDS CURRENT INSTRUCTION
449A CDD544 01850 HXIN CALL CHAR
449D F8D 01860 CP 0DH
449F CACE44 01870 JP Z,SETLST
44A2 32D344 01880 LD (C1),A
44A5 CDD544 01890 CALL CHAR
44A8 F8D 01900 CP 0DH
44AA CACE44 01910 JP Z,SETLST
44AD 32D444 01920 LD (C2),A
44B0 3AD344 01930 LD A,(C1)
44B3 CD0545 01940 CALL HEXIT
44B6 CB27 01950 SLA A
44B8 CB27 01960 SLA A
44BA CB27 01970 SLA A
44BC CB27 01980 SLA A
44BE F5 01990 PUSH AP
44BF 3AD444 02000 LD A,(C2)
44C2 CD0545 02010 CALL HEXIT
44C5 C1 02020 POP BC
44C6 80 02030 ADD A,B
44C7 47 02040 LD B,A
44C8 3E00 02050 LD A,0
44CA CB27 02060 SLA A
44CC 78 02070 LD A,B
44CD C9 02080 RET
44CE 3E00 02090 SETLST LD A,0FFH
44D0 CB27 02100 SLA A
44D2 C9 02110 RET
44D3 00 02120 C1 DEFB 0
44D4 00 02130 C2 DEFB 0
02140 ;THIS CODE CALLS R.S. KEYBOARD ROUTINE
44D5 D5 02150 CHAR PUSH DE
44D6 FDE5 02160 PUSH IH
44D8 CD2000 02170 AGN CALL 2B
44DB B7 02180 OR A
44DC 2BFA 02190 JK Z,AGN
02200 ;IF NONZERO MAKE SURE IT'S HEX OR CR
44DE FDE1 02210 POP IY
44E0 D1 02220 POP DE
44E1 F8D 02230 CP 0DH
44E3 CA8445 02240 JP Z,RET2
44E6 FE21 02250 CP 21H
44E8 CA8F45 02260 JP Z,KILLIT
44EB FE30 02270 CP 30H
44ED FAD544 02280 JP M,CHAR
44EF FE3A 02290 CP 3AH
44F2 F2F844 02300 JP P,TRY41
44F5 FA8245 02310 JP M,RET1
44F8 FE41 02320 TRY41 CP 41H
44FA FAD544 02330 JP M,CHAR
44FD FE47 02340 CP 47H
44FF F2D544 02350 JP P,CHAR
4502 77 02360 RET1 LD (HL),A
4503 23 02370 INC HL
4504 C9 02380 RET2 RET
4505 F840 02390 HEXIT CP 0DH
4507 FABC45 02400 JP M,ZAPHI
450A C609 02410 ADD A,9
450C E60F 02420 ZAPHI AND 0FH
450E C9 02430 RET
450F F1 02440 KILLIT POP AF
4510 F1 02450 POP AF
4511 C38844 02460 JP CLEAR
4514 7E 02470 HEXOUT LD A,(HL)
4515 F5 02480 PUSH AF
4516 CB3F 02490 SRL A
4518 CB3F 02500 SRL A
451A CB3F 02510 SRL A
451C CB3F 02520 SRL A
451E FE0A 02530 CP 0AH
4520 F22045 02540 JP P,A1
4523 EE30 02550 XOR 30H
4525 C32C45 02560 JP ST1
4528 D609 02570 A1 SUB 9
452A EE40 02580 XOR 40H
452C 12 02590 ST1 LD (DE),A
452D 13 02600 INC DE
452E F1 02610 POP AF
452F E60F 02620 AND 0FH
4531 FE0A 02630 CP 10
4533 F23B45 02640 JP P,A2
4536 EE30 02650 XOR 30H
4538 C33F45 02660 JP ST2
453B D609 02670 A2 SUB 9
453D EE40 02680 XOR 40H
453F 12 02690 ST2 LD (DE),A
4540 C9 02700 RET
02710 ;NEXT CODE DOES HEX REGISTER DISPLAY
4541 213E46 02720 HEXR LD HL,SA
4544 118C51 02730 LD DE,SCRBUF+140
4547 CD1445 02740 CALL HEXOUT
454A 213D46 02750 LD HL,SP
454D 119C50 02760 LD DE,SCRBUF+156
4550 CD1445 02770 CALL HEXOUT
4553 214646 02780 LD HL,SA1
4556 11AD50 02790 LD DE,SCRBUF+173
4559 CD1445 02800 CALL HEXOUT
455C 214546 02810 LD HL,SP1
455F 11BD50 02820 LD DE,SCRBUF+189
4562 CD1445 02830 CALL HEXOUT
4565 214046 02840 LD HL,SB
4568 11CC50 02850 LD DE,SCRBUF+204
456B CD1445 02860 CALL HEXOUT
456E 213F46 02870 LD HL,SC
4571 11DC50 02880 LD DE,SCRBUF+220
4574 CD1445 02890 CALL HEXOUT
4577 214846 02900 LD HL,SB1
457A 11ED50 02910 LD DE,SCRBUF+237
457D CD1445 02920 CALL HEXOUT
4580 214746 02930 LD HL,SC1
4583 11FD50 02940 LD DE,SCRBUF+253

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4586 CD1445 02950 CALL HEXOUT
4589 214246 02960 LD HL,SD
458C 118C51 02970 LD DE,SCRBUF+268
458F CD1445 02980 CALL HEXOUT
4592 214146 02990 LD HL,SE
4595 111C51 03000 LD DE,SCRBUF+284
4598 CD1445 03010 CALL HEXOUT
459B 214A46 03020 LD HL,SD1
459E 112D51 03030 LD DE,SCRBUF+301
45A1 CD1445 03040 CALL HEXOUT
45A4 214946 03050 LD HL,SE1
45A7 113D51 03060 LD DE,SCRBUF+317
45AA CD1445 03070 CALL HEXOUT
45AD 214446 03080 LD HL,SH
45B0 114C51 03090 LD DE,SCRBUF+332
45B3 CD1445 03100 CALL HEXOUT
45B6 214346 03110 LD HL,SL
45B9 115C51 03120 LD DE,SCRBUF+348
45BC CD1445 03130 CALL HEXOUT
45BF 214C46 03140 LD HL,SH1
45C2 116D51 03150 LD DE,SCRBUF+365
45C5 CD1445 03160 CALL HEXOUT
45C8 214846 03170 LD HL,SL1
45CB 117D51 03180 LD DE,SCRBUF+381
45CE CD1445 03190 CALL HEXOUT
45D1 215346 03200 LD HL,SI
45D4 11DE51 03210 LD DE,SCRBUF+478
45D7 CD1445 03220 CALL HEXOUT
45DA 215446 03230 LD HL,SR
45DD 11ED51 03240 LD DE,SCRBUF+493
45E0 CD1445 03250 CALL HEXOUT
45E3 214E46 03260 LD HL,SIX+1
45E6 116E52 03270 LD DE,SCRBUF+616
45E9 CD1445 03280 CALL HEXOUT
45EC 214D46 03290 LD HL,SIX
45EF 116A52 03300 LD DE,SCRBUF+618
45F2 CD1445 03310 CALL HEXOUT
45F5 215046 03320 LD HL,SIY+1
45F8 11A052 03330 LD DE,SCRBUF+600
45FB CD1445 03340 CALL HEXOUT
45FE 214F46 03350 LD HL,SIY
4601 11A552 03360 LD DE,SCRBUF+602
4604 CD1445 03370 CALL HEXOUT
4607 C9 03380 RET
03390 ;THIS CODE MOVES SCREEN BUFFER TO R.S. SCREEN AREA
4608 210050 03400 MOVE LD HL,SCRBUF
460B 11003C 03410 LD DE,3C00H
460E 010004 03420 LD BC,400H
4611 EDB0 03430 LDIR
4613 C5 03440 RET
4614 215947 03450 LD HL,INSTR
4617 115A47 03460 LD DE,INSTR+1
461A 018400 03470 LD BC,A
461D 3E00 03480 LD A,0
461F 77 03490 LD (HL),A
4620 EDB0 03500 LDIR
4622 C9 03510 RET
03520 ;THIS CODE DOES BINARY REGISTER DISPLAY
4623 0600 03530 DISPR LD B,00H
4625 CB27 03540 SHIFT SLA A
4627 D43146 03550 CALL NC,ZERO
462A DC3746 03560 CALL C,ONE
462D 23 03570 INC HL
462E 10F5 03580 DJNZ SHIFT
4630 C9 03590 RET
4631 F5 03600 ZERO PUSH AF
4632 3E30 03610 LD A,30H
4634 77 03620 LD (HL),A
4635 F1 03630 POP AF
4636 C9 03640 RET
4637 F5 03650 ONE PUSH AF
4638 3E31 03660 LD A,31H
463A 77 03670 LD (HL),A
463B F1 03680 POP AF
463C C9 03690 RET
03700 ;NEXT ARE USER REG STORAGE AREAS
463D 00 03710 SF DEFB 0
463E 00 03720 SA DEFB 0
463F 00 03730 SC DEFB 0
4640 00 03740 SB DEFB 0
4641 00 03750 SE DEFB 0
4642 00 03760 SD DEFB 0
4643 00 03770 SL DEFB 0
4644 00 03780 SH DEFB 0
4645 00 03790 SF1 DEFB 0
4646 00 03800 SA1 DEFB 0
4647 00 03810 SC1 DEFB 0
4648 00 03820 SB1 DEFB 0
4649 00 03830 SE1 DEFB 0
464A 00 03840 SD1 DEFB 0
464B 00 03850 SL1 DEFB 0
464C 00 03860 SH1 DEFB 0
464D 0000 03870 SH DEFB 0
464E 0000 03880 SIY DEFB 0
464F 0000 03890 SSP DEFB 0
4650 00 03900 SI DEFB 0
4651 00 03910 SR DEFB 0
4652 00 03920 ;FOLLOWING DEFINES SCREEN DISPLAY
4653 54 03930 TEXT DEFM 'TRG-00 TRAINERINSTRUCTION:'
5000 03940 SCRBUF EQU 5000H
466F 41 03950 L1 DEFM 'A - F - A1-'
46A3 42 03960 DEFM 'B - C - B1-'
46D7 44 03970 DEFM 'D - E - D1-'
47B8 48 03980 DEFM 'H - I - H1-'
473F 49 03990 DEFM 'J - K - J1-'
4750 49 04000 DEFM 'IX-IY-SP-' R-'
4759 0000 04010 INSTR DEFW 0
475B 0000 04020 DEFW 0
475D 00 04030 DEFB 0
475E C9 04040 DEFB 0C9H
3C00 04050 SCRTP EQU 3C00H
0000 04060 END
00000 TOTAL ERRORS

```

```

A1 4528 02570 02540
A2 453B 02670 02640
AGN 44D8 02170 02190
C1 44D3 02120 01800 01930
C2 44D4 02130 01920 02000
CHAR 44D5 02150 01850 01890 02280 02330 02350
CLEAR 4488 01760 02460
DISPR 4623 03530 00540 00570 00600 00630 00660 00690 00720
00750 00780 00810 00840 00870 00900 00930
00960 00990 01020 01050 01080 01110 01140
01170

```

Program continues





## An additional index for Radio Shack's Editor/Assembler manual—cross-referenced for easy use.

# EDTASM Index

Terry Kepner  
P.O. Box 481  
Peterborough, NH 03458

Learning to program in assembly code is like trying to learn a foreign language; how long it takes will depend upon how good a reference book you have.

If the book is well written with a good cross-reference listing the new words, their English equivalents and the pages where you can find their descriptions, you will learn the language more easily. If the book doesn't have these features, you have a hard trip ahead.

Unfortunately, the Radio Shack Editor/Assembler Manual falls into the latter category. While it does provide an alphabetic and a numeric opcode-mnemonic cross-reference list at the back, these two lists do not tell the user where their descriptions can be found.

It took only a few frustrating hours before I decided to rectify the situation and produce a good cross-referenced index. However, this proved more difficult than I had thought.

The numeric cross-reference in the Radio Shack Editor/Assembler is actually organized into three separate numeric lists. This meant, in addition to an alphabetic index, I also had to make a new numeric index, properly sorted.

Creating the index, I discovered some errors in the Radio Shack manual, which are detailed as follows:

1. The LD A,R (pg. 22) and LD R,A (pg. 23) mnemonics are not in the Radio Shack numeric and alphabetic indices.

2. OUT (D),R (pg. 103) should be OUT (C),R.

3. LD B,H,NN (pg. 121) should be LD B,H.

I hope these indices are as useful to you as they have been for me. Since I am a beginner at assembly language programming, the time it took to prepare them has been more than repaid by the time saved finding information. ■

OBJECT CODE	MNEMONICS	PAGE #
8E	ADC R,(HL)	46
DD8E85	ADC R,(IX+IND)	46
FD8E85	ADC R,(IV+IND)	46
8F	ADC R,A	46
88	ADC R,B	46
89	ADC R,C	46
8A	ADC R,D	46
8B	ADC R,E	46
8C	ADC R,H	46
8D	ADC R,L	46
CE28	ADC R,N	46
ED4A	ADC HL,BC	63
ED5A	ADC HL,DE	63
ED6A	ADC HL,HL	63
ED7A	ADC HL,SP	63
86	ADD R,(HL)	44
DD8685	ADD R,(IX+IND)	44
FD8685	ADD R,(IV+IND)	45
87	ADD R,A	43
88	ADD R,B	43
81	ADD R,C	43
82	ADD R,D	43
83	ADD R,E	43
84	ADD R,H	43
85	ADD R,L	43
C628	ADD R,N	43
89	ADD HL,BC	62
19	ADD HL,DE	63
29	ADD HL,HL	63
39	ADD HL,SP	63
DD89	ADD IX,BC	64
DD19	ADD IX,DE	64
DD29	ADD IX,IX	64
DD39	ADD IX,SP	64
FD89	ADD IV,BC	65

OBJECT CODE	MNEMONICS	PAGE #	OBJECT CODE	MNEMONICS	PAGE #
FD19	ADD IV,DE	65	CB78	BIT 6,B	81
FD29	ADD IV,IV	65	CB7A	BIT 6,C	81
FD39	ADD IV,SP	65	CB72	BIT 6,D	81
86	AND (HL)	49	CB73	BIT 6,E	81
DD8685	AND (IX+IND)	49	CB74	BIT 6,H	81
FD8685	AND (IV+IND)	49	CB75	BIT 6,L	81
A7	AND R	49	CB7E	BIT 7,(HL)	81
88	AND B	49	DDCB857E	BIT 7,(IX+IND)	82
A1	AND C	49	FD857E	BIT 7,(IV+IND)	82
A2	AND D	49	CB7F	BIT 7,A	81
A3	AND E	49	CB78	BIT 7,B	81
A4	AND H	49	CB79	BIT 7,C	81
A5	AND L	49	CB7A	BIT 7,D	81
E628	AND N	49	CB7B	BIT 7,E	81
CB46	BIT 0,(HL)	81	CB7C	BIT 7,H	81
DDCB8546	BIT 0,(IX+IND)	82	CB7D	BIT 7,L	81
FD8546	BIT 0,(IV+IND)	82	DC8485	CALL C,NN	93
CB47	BIT 0,A	81	FC8485	CALL M,NN	93
CB48	BIT 0,B	81	D48485	CALL N,NN	93
CB41	BIT 0,C	81	CD8485	CALL NN	93
CB42	BIT 0,D	81	E48485	CALL N2,NN	93
CB43	BIT 0,E	81	F48485	CALL P,NN	93
CB44	BIT 0,H	81	EC8485	CALL PE,NN	93
CB45	BIT 0,L	81	E48485	CALL PO,NN	93
CB4E	BIT 1,(HL)	81	CC8485	CALL Z,NN	93
DDCB854E	BIT 1,(IX+IND)	82	CF	CCF	58
FD854E	BIT 1,(IV+IND)	82	BE	CP (HL)	52
CB4F	BIT 1,A	81	DD8E85	CP (IX+IND)	52
CB48	BIT 1,B	81	FD8E85	CP (IV+IND)	52
CB49	BIT 1,C	81	BF	CP A	52
CB4A	BIT 1,D	81	B8	CP B	52
CB4B	BIT 1,E	81	B9	CP C	52
CB4C	BIT 1,H	81	BA	CP D	52
CB4D	BIT 1,L	81	BB	CP E	52
CB56	BIT 2,(HL)	81	BC	CP H	52
DDCB8556	BIT 2,(IX+IND)	82	BD	CP L	52
FD8556	BIT 2,(IV+IND)	82	FE28	CP N	52
CB57	BIT 2,A	81	ED89	CPD	42
CB58	BIT 2,B	81	ED89	CPDR	42
CB51	BIT 2,C	81	ED91	CP1	41
CB52	BIT 2,D	81	ED81	CP1R	41
CB53	BIT 2,E	81	2F	CPL	57
CB54	BIT 2,H	81	27	DAA	56
CB55	BIT 2,L	81	35	DEC (HL)	55
CB5E	BIT 3,(HL)	81	DD3585	DEC (IX+IND)	55
DDCB855E	BIT 3,(IX+IND)	82	FD3585	DEC (IV+IND)	55
FD855E	BIT 3,(IV+IND)	82	05	DEC A	55
CB5F	BIT 3,A	81	06	DEC B	55
CB58	BIT 3,B	81	08	DEC BC	67
CB59	BIT 3,C	81	0D	DEC C	55
CB5A	BIT 3,D	81	15	DEC D	55
CB5B	BIT 3,E	81	1B	DEC DE	67
CB5C	BIT 3,H	81	1D	DEC E	55
CB5D	BIT 3,L	81	25	DEC H	55
CB66	BIT 4,(HL)	81	2B	DEC HL	67
DDCB8566	BIT 4,(IX+IND)	82	DD2B	DEC IX	67
FD8566	BIT 4,(IV+IND)	82	FD2B	DEC IV	68
CB67	BIT 4,A	81	2D	DEC L	55
CB68	BIT 4,B	81	3B	DEC SP	67
CB61	BIT 4,C	81	F3	D1	68
CB62	BIT 4,D	81	182E	D1NZ D15	91
CB63	BIT 4,E	81	FB	E1	68
CB64	BIT 4,H	81	E3	EX (SP),HL	35
CB65	BIT 4,L	81	DD63	EX (SP),IX	36
CB6E	BIT 5,(HL)	81	FD63	EX (SP),IV	36
DDCB856E	BIT 5,(IX+IND)	82	88	EX AF,AF	34
FD856E	BIT 5,(IV+IND)	82	EB	EX DE,HL	34
CB6F	BIT 5,A	81	D9	EXX	35
CB68	BIT 5,B	81	76	HALT	59
CB69	BIT 5,C	81	ED46	IM 0	61
CB6A	BIT 5,D	81	ED56	IM 1	61
CB6B	BIT 5,E	81	ED5E	IM 2	62
CB6C	BIT 5,H	81	ED78	IN A,(C)	98
CB6D	BIT 5,L	81	DD28	IN A,(N)	98
CB76	BIT 6,(HL)	81	ED48	IN B,(C)	98
DDCB8576	BIT 6,(IX+IND)	82	ED48	IN C,(C)	98
FD8576	BIT 6,(IV+IND)	82	ED58	IN D,(C)	98
CB77	BIT 6,A	81	ED58	IN E,(C)	98



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OBJECT CODE	MNEMONICS	PAGE #	OBJECT CODE	MNEMONICS	PAGE #	OBJECT CODE	MNEMONICS	PAGE #	OBJECT CODE	MNEMONICS	PAGE #
ED68	IN H.(C)	98	1628	LD D.N	13	FDCB859E	RES 3.(IV+IND)	85	90	SBC R.L	48
ED69	IN L.(C)	98	ED5B8485	LD DE.(NN)	26	CB9F	RES 3.A	85	DE28	SBC R.N	48
34	INC (HL)	53	118485	LD DE.NN	24	CB98	RES 3.B	85	ED42	SBC HL.BC	64
D03485	INC (IX+IND)	54	5E	LD E.(HL)	14	CB99	RES 3.C	85	ED52	SBC HL.DE	64
FD3485	INC (IV+IND)	54	D05E85	LD E.(IX+IND)	14	CB9A	RES 3.D	85	ED62	SBC HL.HL	64
3C	INC A	53	FD5E85	LD E.(IV+IND)	15	CB98	RES 3.E	85	ED72	SBC HL.SP	64
84	INC B	53	5F	LD E.A	13	CB9C	RES 3.H	85	37	SCF	58
83	INC BC	65	58	LD E.B	13	CB90	RES 3.L	85	CB6	SET B.(HL)	83
8C	INC C	53	59	LD E.C	13	CB96	RES 4.(HL)	85	D0CB85C6	SET B.(IX+IND)	84
14	INC D	53	5A	LD E.D	13	D0CB85A6	RES 4.(IX+IND)	85	FDCB85C6	SET B.(IV+IND)	84
13	INC DE	65	5B	LD E.E	13	FDCB85A6	RES 4.(IV+IND)	85	CB7	SET B.A	83
1C	INC E	53	5C	LD E.H	13	CB97	RES 4.A	85	CB8	SET B.B	83
24	INC H	53	5D	LD E.L	13	CB98	RES 4.B	85	CB1	SET B.C	83
D023	INC HL	65	1E28	LD E.N	13	CB91	RES 4.C	85	CB2	SET B.D	83
FD23	INC IX	66	66	LD H.(HL)	14	CB92	RES 4.D	85	CB3	SET B.E	83
2C	INC L	53	D06685	LD H.(IX+IND)	14	CB93	RES 4.E	85	CB4	SET B.H	83
33	INC SP	65	FD6685	LD H.(IV+IND)	15	CB94	RES 4.H	85	CB5	SET B.L	83
ED9A	IND 101	101	67	LD H.A	13	CB95	RES 4.L	85	CB2E	SET 1.(HL)	83
ED9B	INDR 102	102	68	LD H.B	13	CB9E	RES 5.(HL)	85	D0CB85CE	SET 1.(IX+IND)	84
ED92	INT 99	99	61	LD H.C	13	D0CB859E	RES 5.(IX+IND)	85	FDCB85CE	SET 1.(IV+IND)	84
ED92	INTR 100	100	62	LD H.D	13	CB9F	RES 5.(IV+IND)	85	CB2F	SET 1.A	83
E9	JP (HL)	89	63	LD H.E	13	CB9F	RES 5.A	85	CB3	SET 1.B	83
D0E9	JP (IX)	90	64	LD H.H	13	CB98	RES 5.B	85	CB9	SET 1.C	83
FD E9	JP (IV)	90	65	LD H.L	13	CB99	RES 5.C	85	CB9A	SET 1.D	83
D9A85	JP C.NN	86	2628	LD H.N	13	CB99	RES 5.D	85	CB9B	SET 1.E	83
FR8485	JP M.NN	86	29A85	LD HL.(NN)	25, 26	CB98	RES 5.E	85	CBCC	SET 1.H	83
D28485	JP NC.NN	86	21A85	LD HL.NN	24	CB9C	RES 5.H	85	CB20	SET 1.L	83
C38485	JP NN.NN	86	ED47	LD I.A	22	CB90	RES 5.L	85	CB26	SET 2.(HL)	84
C28485	JP NZ.NN	86	D029A85	LD IX.(NN)	26	D0CB85B6	RES 6.(IX+IND)	85	D0CB85D6	SET 2.(IX+IND)	84
F28485	JP P.NN	86	D021A85	LD IX.NN	24	FDCB85B6	RES 6.(IV+IND)	85	FDCB85D6	SET 2.(IV+IND)	84
EA8485	JP PE.NN	86	FD29A85	LD IV.(NN)	27	CB97	RES 6.A	85	CB07	SET 2.A	83
E28485	JP PD.NN	86	FD21A85	LD IV.NN	25	CB98	RES 6.B	85	CB08	SET 2.B	83
CB8485	JP Z.NN	86	6E	LD L.(HL)	14	CB98	RES 6.C	85	CB01	SET 2.C	83
382E	JR C.DIS	87	D06E85	LD L.(IX+IND)	14	CB81	RES 6.D	85	CB02	SET 2.D	83
182E	JR DIS	87	FD6E85	LD L.(IV+IND)	15	CB82	RES 6.E	85	CB03	SET 2.E	83
382E	JR NC.DIS	88	6F	LD L.A	13	CB83	RES 6.E	85	CB04	SET 2.H	83
282E	JR NZ.DIS	89	68	LD L.B	13	CB84	RES 6.H	85	CB05	SET 2.L	83
282E	JR Z.DIS	88	69	LD L.C	13	CB85	RES 6.L	85	CB06	SET 3.B	83
82	LD (BC).A	28	6A	LD L.D	13	CB8E	RES 7.(HL)	85	CB0E	SET 3.(HL)	83
12	LD (DE).A	28	6B	LD L.E	13	D0CB859E	RES 7.(IX+IND)	85	D0CB850E	SET 3.(IX+IND)	84
77	LD (HL).A	15	6C	LD L.H	13	FDCB859E	RES 7.(IV+IND)	85	FDCB850E	SET 3.(IV+IND)	84
78	LD (HL).B	15	6D	LD L.L	13	CB8F	RES 7.A	85	CB0F	SET 3.A	83
71	LD (HL).C	15	2E28	LD L.N	13	CB88	RES 7.B	85	CB09	SET 3.C	83
72	LD (HL).D	15	ED4F	LD R.A	23	CB89	RES 7.C	85	CB0A	SET 3.D	83
73	LD (HL).E	15	ED78A85	LD SP.(NN)	26	CB89	RES 7.D	85	CB0B	SET 3.E	83
74	LD (HL).H	15	F9	LD SP.HL	29	CB88	RES 7.E	85	CB0C	SET 3.H	83
75	LD (HL).L	15	D0F9	LD SP.IX	38	CB8C	RES 7.H	85	CB00	SET 3.L	83
3628	LD (HL).N	17	FD F9	LD SP.IV	38	CB80	RES 7.L	85	CB6	SET 4.(HL)	83
D07785	LD (IX+IND).A	16	318485	LD SP.NN	24	C9	RET	94	D0CB85E6	SET 4.(IX+IND)	84
D07885	LD (IX+IND).B	16	ED98	LDD	39	D8	RET C	95	FDCB85E6	SET 4.(IV+IND)	84
D07185	LD (IX+IND).C	16	ED98	LDDR	48	F8	RET N	95	CB7	SET 4.A	82
D07285	LD (IX+IND).D	16	ED98	LDI	37	D8	RET NC	95	CB8	SET 4.B	83
D07385	LD (IX+IND).E	16	ED44	LDIR	38	C8	RET NZ	95	CB2	SET 4.C	83
D07485	LD (IX+IND).H	16	8B	NEG	57	F8	RET P	95	CB2	SET 4.D	83
D07585	LD (IX+IND).L	16	86	NOP	59	E8	RET PE	95	CB4	SET 4.H	83
D0368520	LD (IX+IND).N	16	D08685	OR (HL)	58	C8	RET PZ	95	CB5	SET 4.L	83
FD7785	LD (IV+IND).A	16	D08685	OR (IX+IND)	58	CB	RET Z	95	CBEE	SET 5.(HL)	83
FD7885	LD (IV+IND).B	16	D08685	OR (IV+IND)	58	ED40	RETI	96	D0CB85EE	SET 5.(IX+IND)	84
FD7185	LD (IV+IND).C	16	87	OR A	58	ED455	RETN	96	FDCB85EE	SET 5.(IV+IND)	84
FD7285	LD (IV+IND).D	16	88	OR B	58	CB16	RL (HL)	73	CBF	SET 5.A	83
FD7385	LD (IV+IND).E	16	81	OR C	58	D0CB8516	RL (IX+IND)	73	CB8	SET 5.B	83
FD7485	LD (IV+IND).H	16	82	OR D	58	FDCB8516	RL (IV+IND)	73	CB9	SET 5.C	83
FD7585	LD (IV+IND).L	16	83	OR E	58	CB17	RL A	73	CB9A	SET 5.D	83
FD368520	LD (IV+IND).N	18	84	OR H	58	CB18	RL B	73	CB9B	SET 5.E	83
328485	LD (NN).A	21	85	OR L	58	CB11	RL C	73	CB9C	SET 5.H	83
ED438485	LD (NN).BC	28	FC28	OR N	58	CB12	RL D	73	CB9C	SET 5.L	83
ED538485	LD (NN).DE	28	ED88	OTDR	187	CB13	RL E	73	CB0D	SET 5.L	83
228485	LD (NN).HL	27, 28	ED83	OTIR	185	CB14	RL H	73	CB6	SET 6.(HL)	82
D0228485	LD (NN).IX	28	ED79	OUT (C).A	183	CB15	RL L	73	D0CB85F6	SET 6.(IX+IND)	84
FD228485	LD (NN).IV	29	ED41	OUT (C).B	183	CB17	RLA	69	FDCB85F6	SET 6.(IV+IND)	84
ED738485	LD (NN).SP	28	ED49	OUT (C).C	183	CB96	RLC (HL)	71	CB7	SET 6.A	83
8A	LD R.(BC)	18	ED51	OUT (C).D	183	D0CB8596	RLC (IX+IND)	72	CB9F	SET 6.B	83
1A	LD R.(DE)	19	ED59	OUT (C).E	183	FDCB8596	RLC (IV+IND)	72	CB1	SET 6.C	83
7E	LD R.HL	14	ED61	OUT (C).H	183	CB97	RLC A	71	CB2	SET 6.D	83
D07E85	LD R.(IX+IND)	14	ED69	OUT (C).L	183	CB98	RLC B	71	CB3	SET 6.E	83
FD7E85	LD R.(IV+IND)	15	D328	OUT (ND).A	183	CB91	RLC C	71	CB4	SET 6.H	83
398485	LD R.(NN)	19	ED98	OUTD	186	CB92	RLC D	71	CB5	SET 6.L	83
7F	LD R.A	13	ED93	OUTI	184	CB93	RLC E	71	CBFE	SET 7.(HL)	83
78	LD R.B	13	F1	POP AF	32	CB94	RLC H	71	D0CB85FE	SET 7.(IX+IND)	84
79	LD R.C	13	C1	POP BC	32	CB95	RLC L	71	FDCB85FE	SET 7.(IV+IND)	84
7A	LD R.D	13	D1	POP DE	32	87	RLCR	69	CBFF	SET 7.A	82
7B	LD R.E	13	E1	POP HL	32	ED6F	RLD	79	CB8	SET 7.B	82
7C	LD R.H	13	D0E1	POP IX	33	CB1E	RR (HL)	75	CB9	SET 7.C	83
ED57	LD R.L	21	FD E1	POP IV	33	D0CB851E	RR (IX+IND)	75	CB9A	SET 7.D	83
7D	LD R.L	13	F5	PUSH AF	31	FDCB851E	RR (IV+IND)	75	CB9B	SET 7.E	83
3E28	LD R.N	13	C5	PUSH BC	31	CB1F	RR A	75	CBFC	SET 7.H	83
ED5F	LD R.R	13	D5	PUSH DE	31	CB18	RR B	75	CBFD	SET 7.L	83
46	LD B.(HL)	14	E5	PUSH HL	31	CB19	RR C	75	CB26	SLR (HL)	76
D04685	LD B.(IX+IND)	14	D0E5	PUSH IX	31	CB1A	RR D	75	D0CB8526	SLR (IX+IND)	76
FD4685	LD B.(IV+IND)	15	FD E5	PUSH IV	32	CB1B	RR E	75	FDCB8526	SLR (IV+IND)	76
47	LD B.A	13	CB86	RES B.(HL)	85	CB1C	RR H	75	CB27	SLR A	76
48	LD B.B	13	D0CB8586	RES B.(IX+IND)	85	CB1D	RR L	75	CB28	SLR B	76
41	LD B.C	13	FDCB8586	RES B.(IV+IND)	85	1F	RRR	78	CB21	SLR C	76
42	LD B.D	13	CB87	RES B.A	85	CB9E	ARC (HL)	74	CB22	SLR D	76
43	LD B.E	13	CB88	RES B.B	85	D0CB858E	ARC (IX+IND)	74	CB23	SLR E	76
44	LD B.H	13	CB81	RES B.C	85	FDCB858E	ARC (IV+IND)	74	CB24	SLR H	76
45	LD B.L	13	CB82	RES B.D	85	CB9F	ARC A	74	CB25	SLR L	76
8628	LD B.N	13	CB83	RES B.E	85	CB98	ARC B	74	CB2E	SRR (HL)	77
ED488485	LD BC.(NN)	26	CB84	RES B.H	85	CB99	ARC C	74	D0CB852E	SRR (IX+IND)	77
818485	LD BC.NN	24	CB85	RES B.L	85	CB9A	ARC D	74	FDCB852E	SRR (IV+IND)	77
4E	LD C.(HL)	14	CB8E	RES 1.(HL)	85	CB98	ARC E	74	CB2F	SRR A	77
D04E85	LD C.(IX+IND)	14	D0CB858E	RES 1.(IX+IND)	85	CB9C	ARC H	74	CB28	SRR B	77
FD4E85	LD C.(IV+IND)	15	FDCB858E	RES 1.(IV+IND)	85	CB9D	ARC L	74	CB29	SRR C	77
4F	LD C.A	13	CB9F	RES 1.A	85	8F	ARRR	78	CB2A	SRR D	77
48	LD C.B	13	CB98	RES 1.B	85	ED67	RDD	88	CB2B	SRR E	77
49	LD C.C	13	CB99	RES 1.C	85	C7	RST B	90	CB2C	SRR H	77
4A	LD C.D	13	CB9A	RES 1.D	85	D7	RST 18H	97	CB2D	SRR L	77
4B	LD C.E	13	CB9B	RES 1.E	85	D7	RST 19H	97	CB2E	SRR (HL)	77
4C	LD C.H	13	CB9C	RES 1.H	85	E7	RST 28H	97	D0CB853E	SRR (IX+IND)	78
4D	LD C.L	13	CB9D	RES 1.L	85	E7	RST 29H	97	FDCB853E	SRR (IV+IND)	78
8E28	LD C.N	13	D0CB8596	RES 2.(HL)	85	F7	RST 38H	97	CB3	SRR A	78
56	LD C.(HL)	14	FDCB8596	RES 2.(IX+IND)	85	FF	RST 39H	97	CB9	SRR B	78
D05685	LD C.(IV+IND)	14	CB97	RES 2.(IV+IND)	85	CF	RST B	97	CB39	SRR C	78
FD5685	LD C.(IX+IND)	15	CB98	RES 2.A	85	9E	SBC R.(HL)	48	CB3A	SRR D	78
57	LD D.A	13	CB98	RES 2.B	85	D09E85	SBC R.(IX+IND)	48	CB3B	SRR E	78
58	LD D.B	13	CB91	RES 2.C	85	FD9E85	SBC R.(IV+IND)	48	CB3C	SRR H	78
51	LD D.C	13	CB92	RES 2.D	85	9F	SBC R.A	48	CB3D	SRR L	78
52	LD D.D	13	CB93	RES 2.E	85	98	SBC R.B	48	96	SUB (HL)	47
53	LD D.H	13	CB94	RES 2.H	85	99	SBC R.C	48	D09685	SUB (IX+IND)	47
54	LD D.L	13	CB95	RES 2.L	85	9A	SBC R.D	48	FD9685	SUB (IV+IND)	47
55	LD D.L	13	CB9E	RES 3.(HL)							



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 FOR TRS-80 16K LEVEL II

LOADS IN SECONDS FROM CASSETTE INTO LESS THAN 1/2K BYTES OF PROTECTED MEMORY AND TIES INTO ROM KEY SCAN.

Customize Your Cursor!

SELECT ANY CHARACTER OR GRAPHICS BLOCK AND WATCH IT BLINK!  
 CHANGE AS OFTEN AS YOU LIKE.

### FEATURES:

- FAST REPEATING ← KEY AND SPACE BAR
- INSTANT SWAP WITH RESIDENT CURSOR
- UNAFFECTED BY NEW OR RESET
- WORKS IN COMMAND- EDIT-EXECUTE MODES
- KEY DEBOUNCE

\* T.M. TANDY CORP.

**'KGS-80'**



**KOGYOSHA**

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A TRS-80 WORD PROCESSING SYSTEM FOR LESS THAN \$600

(If you own IBM Selectric or equivalent)

Turn your typewriter and TRS-80 into a new word processing system with a new device, the "KGS-80".

- Plug in compatible with TRS-80.
- No mechanical modification to the typewriter.
- Can be installed in 5 seconds.
- Software, a versatile Simple Letterwriter, included.

OBJECT CODE	MNEMONICS	PAGE #	OBJECT CODE	MNEMONICS	PAGE #	OBJECT CODE	MNEMONICS	PAGE #	OBJECT CODE	MNEMONICS	PAGE #
91	SUB C	47	6A	LD L,D	13	CB18	RR B	75	CB9A	RES 3,D	85
92	SUB D	47	6B	LD L,E	13	CB19	RR C	75	CB9B	RES 3,E	85
93	SUB E	47	6C	LD L,H	13	CB1A	RR D	75	CB9C	RES 3,H	85
94	SUB H	47	6D	LD L,L	13	CB1B	RR E	75	CB9D	RES 3,L	85
95	SUB L	47	6E	LD L,(HL)	14	CB1C	RR H	75	CB9E	RES 3,(HL)	85
0620	SUB N	47	6F	LD L,A	13	CB1D	RR L	75	CB9F	RES 3,A	85
AE	NDR (HL)	51	70	LD (HL),B	15	CB1E	RR (HL)	75	CB9A	RES 4,B	85
00985	NDR (IX+IND)	51	71	LD (HL),C	15	CB1F	RR A	75	CB9B	RES 4,C	85
FD985	NDR (IV+IND)	51	72	LD (HL),D	15	CB20	SLA B	76	CB9C	RES 4,D	85
AF	NDR A	51	73	LD (HL),E	15	CB21	SLA C	76	CB9D	RES 4,E	85
AB	NDR B	51	74	LD (HL),H	15	CB22	SLA D	76	CB9E	RES 4,H	85
AD	NDR C	51	75	LD (HL),L	15	CB23	SLA E	76	CB9F	RES 4,L	85
AE	NDR D	51	76	MULT	59	CB24	SLA H	76	CB9A	RES 4,(HL)	85
AF	NDR E	51	77	LD (HL),A	15	CB25	SLA L	76	CB9B	RES 4,A	85
AG	NDR H	51	78	LD A,B	13	CB26	SLA (HL)	76	CB9C	RES 5,B	85
AH	NDR L	51	79	LD A,C	13	CB27	SLA A	76	CB9D	RES 5,C	85
AI	NDR N	51	7A	LD A,D	13	CB28	SRA B	77	CB9E	RES 5,D	85
00	NOP	59	7B	LD A,E	13	CB29	SRA C	77	CB9F	RES 5,E	85
01845	LD BC,NN	24	7C	LD A,H	13	CB2A	SRA D	77	CB9A	RES 5,H	85
02	LD (BC),A	29	7D	LD A,L	13	CB2B	SRA E	77	CB9B	RES 5,L	85
03	INC BC	65	7E	LD A,HL	14	CB2C	SRA H	77	CB9C	RES 5,(HL)	85
04	INC B	53	7F	LD A,A	13	CB2D	SRA L	77	CB9D	RES 5,A	85
05	DEC B	55	80	RDD A,B	43	CB2E	SRA (HL)	77	CB9E	RES 5,(HL)	85
0620	LD B,N	13	81	RDD A,C	43	CB2F	SRA A	77	CB9F	RES 6,B	85
07	RLCA	69	82	RDD A,D	43	CB30	SRL B	78	CB9A	RES 6,C	85
08	EX AF,AF'	34	83	RDD A,E	43	CB31	SRL C	78	CB9B	RES 6,D	85
09	RDD HL,BC	63	84	RDD A,H	43	CB32	SRL D	78	CB9C	RES 6,E	85
0A	LD A,(BC)	18	85	RDD A,L	43	CB33	SRL E	78	CB9D	RES 6,H	85
0B	DEC BC	67	86	RDD A,(HL)	44	CB34	SRL H	78	CB9E	RES 6,(HL)	85
0C	INC C	53	87	RDD A,A	43	CB35	SRL L	78	CB9F	RES 6,A	85
0D	DEC C	55	88	RDD A,B	46	CB36	SRL (HL)	78	CB9A	RES 7,B	85
0E20	LD C,N	13	89	RDD A,C	46	CB37	SRL A	79	CB9B	RES 7,C	85
0F	RRCA	70	8A	RDD A,D	46	CB38	BIT B,B	81	CB9C	RES 7,D	85
182E	DJNZ DS	31	8B	RDD A,E	46	CB39	BIT C,C	81	CB9D	RES 7,E	85
18485	LD DE,NN	24	8C	RDD A,H	46	CB40	BIT D,D	81	CB9E	RES 7,H	85
12	LD (DE),A	28	8D	RDD A,L	46	CB41	BIT D,E	81	CB9F	RES 7,L	85
13	INC DE	65	8E	RDD A,(HL)	46	CB42	BIT B,H	81	CB9A	RES 7,(HL)	85
14	INC D	53	8F	RDD A,A	46	CB43	BIT B,L	81	CB9B	RES 7,A	85
15	DEC D	55	90	SUB B	47	CB44	BIT B,(HL)	81	CB9C	SET B,B	83
1620	LD D,N	13	91	SUB C	47	CB45	BIT B,A	81	CB9D	SET B,L	83
17	RLA	69	92	SUB D	47	CB46	BIT 1,B	81	CB9E	SET B,D	83
182E	JR DIS	87	93	SUB E	47	CB47	BIT 1,C	81	CB9F	SET B,E	83
19	RDD HL,DE	63	94	SUB H	47	CB48	BIT 1,D	81	CB9A	SET B,H	83
1A	LD A,(DE)	19	95	SUB L	47	CB49	BIT 1,E	81	CB9B	SET B,L	83
1B	DEC DE	67	96	SUB (HL)	47	CB4A	BIT 1,H	81	CB9C	SET B,(HL)	83
1C	INC E	53	97	SUB A	47	CB4B	BIT 1,L	81	CB9D	SET B,A	83
1D	DEC E	55	98	SBC A,B	48	CB4C	BIT 1,(HL)	81	CB9E	SET B,L	83
1E20	LD E,N	13	99	SBC A,C	48	CB4D	BIT 1,A	81	CB9F	SET 1,D	83
1F	RRR	78	9A	SBC A,D	48	CB4E	BIT 2,B	81	CB9A	SET 1,E	83
282E	JR NZ,DIS	89	9B	SBC A,E	48	CB4F	BIT 2,C	81	CB9B	SET 1,H	83
21845	LD HL,NN	24	9C	SBC A,H	48	CB50	BIT 2,D	81	CB9C	SET 1,L	83
22845	LD (NN),HL	27,28	9D	SBC A,L	48	CB51	BIT 2,E	81	CB9D	SET 1,L	83
23	INC HL	65	9E	SBC A,(HL)	48	CB52	BIT 2,H	81	CB9E	SET 1,(HL)	83
24	INC H	53	9F	SBC A,A	48	CB53	BIT 2,A	81	CB9F	SET 1,A	83
25	DEC H	55	AA	AND B	49	CB54	BIT 2,(HL)	81	CB9A	SET 2,B	83
2620	LD H,N	13	AB	AND C	49	CB55	BIT 2,A	81	CB9B	SET 2,C	83
27	DRA	56	AC	AND D	49	CB56	BIT 2,B	81	CB9C	SET 2,D	83
282E	JR Z,DIS	88	AD	AND E	49	CB57	BIT 2,C	81	CB9D	SET 2,E	83
29	RDD HL,HL	63	AE	AND H	49	CB58	BIT 2,D	81	CB9E	SET 2,H	83
2B845	LD HL,(NN)	25,26	AF	AND L	49	CB59	BIT 2,A	81	CB9F	SET 2,L	83
2B	DEC HL	67	90	AND (HL)	49	CB5A	BIT 3,H	81	CB9A	SET 2,(HL)	83
2C	INC L	53	91	AND A	49	CB5B	BIT 3,L	81	CB9B	SET 2,A	83
2D	DEC L	55	92	XOR B	51	CB5C	BIT 3,L	81	CB9C	SET 3,B	83
2E20	LD L,N	13	93	XOR C	51	CB5D	BIT 3,(HL)	81	CB9D	SET 3,C	83
2F	CPL	57	94	XOR D	51	CB5E	BIT 3,A	81	CB9E	SET 3,D	83
382E	JR NC,DIS	88	95	XOR E	51	CB5F	BIT 4,B	81	CB9F	SET 3,E	83
31845	LD SP,NN	24	96	XOR H	51	CB60	BIT 4,C	81	CB9A	SET 3,H	83
32845	LD (NN),A	21	97	XOR L	51	CB61	BIT 4,D	81	CB9B	SET 3,L	83
33	INC SP	65	98	XOR A	51	CB62	BIT 4,E	81	CB9C	SET 3,(HL)	83
34	INC (HL)	53	99	XOR B	51	CB63	BIT 4,H	81	CB9D	SET 3,A	83
35	DEC (HL)	55	AA	XOR C	51	CB64	BIT 4,L	81	CB9E	SET 3,L	83
3620	LD (HL),N	17	AB	OR B	50	CB65	BIT 4,(HL)	81	CB9F	SET 4,B	83
37	SCF	58	AC	OR C	50	CB66	BIT 4,A	81	CB9A	SET 4,C	83
382E	JR C,DIS	89	AD	OR D	50	CB67	BIT 4,B	81	CB9B	SET 4,D	83
39	RDD HL,SP	63	AE	OR E	50	CB68	BIT 5,C	81	CB9C	SET 4,E	83
3B845	LD A,(NN)	19	AF	OR H	50	CB69	BIT 5,D	81	CB9D	SET 4,H	83
3B	DEC SP	67	90	OR L	50	CB6A	BIT 5,E	81	CB9E	SET 4,L	83
3C	INC A	53	91	OR (HL)	50	CB6B	BIT 5,H	81	CB9F	SET 4,(HL)	83
3D	DEC A	55	92	OR A	50	CB6C	BIT 5,A	81	CB9A	SET 4,A	83
3E20	LD A,N	13	93	OR B	52	CB6D	BIT 5,L	81	CB9B	SET 5,B	83
3F	CCF	58	94	OR C	52	CB6E	BIT 5,(HL)	81	CB9C	SET 5,C	83
40	LD B,B	13	95	OR D	52	CB6F	BIT 5,A	81	CB9D	SET 5,D	83
41	LD B,C	13	96	OR E	52	CB70	BIT 6,B	81	CB9E	SET 5,E	83
42	LD B,D	13	97	OR H	52	CB71	BIT 6,C	81	CB9F	SET 5,H	83
43	LD B,E	13	98	OR L	52	CB72	BIT 6,D	81	CB9A	SET 5,L	83
44	LD B,H	13	99	OR (HL)	52	CB73	BIT 6,E	81	CB9B	SET 5,(HL)	83
45	LD B,L	13	AA	OR A	52	CB74	BIT 6,H	81	CB9C	SET 5,A	83
46	LD B,(HL)	14	AB	OR B	52	CB75	BIT 6,L	81	CB9D	SET 5,L	83
47	LD B,A	13	AC	OR C	52	CB76	BIT 6,(HL)	81	CB9E	SET 6,B	83
48	LD B,B	13	AD	OR D	52	CB77	BIT 6,A	81	CB9F	SET 6,C	83
49	LD B,C	13	AE	OR E	52	CB78	BIT 6,B	81	CB9A	SET 6,D	83
4A	LD B,D	13	00	POP BC	32	CB79	BIT 7,C	81	CB9B	SET 6,E	83
4B	LD B,E	13	01	JP NN	86	CB7A	BIT 7,D	81	CB9C	SET 6,H	83
4C	LD B,H	13	02	CALL NZ,NN	93	CB7B	BIT 7,E	81	CB9D	SET 6,L	83
4D	LD B,L	13	03	PUSH BC	31	CB7C	BIT 7,H	81	CB9E	SET 6,(HL)	83
4E	LD C,L	13	04	RDD A,N	43	CB7D	BIT 7,A	81	CB9F	SET 6,A	83
4F	LD C,(HL)	14	05	RST 9	97	CB7E	BIT 7,(HL)	81	CB9A	SET 7,B	83
50	LD D,B	13	06	RET 2	98	CB7F	BIT 7,A	81	CB9B	SET 7,C	83
51	LD D,C	13	07	RET	94	CB80	RES 7,B	85	CB9C	SET 7,D	83
52	LD D,D	13	08	RET	94	CB81	RES 8,C	85	CB9D	SET 7,E	83
53	LD D,E	13	09	JP Z,NN	86	CB82	RES 8,D	85	CB9E	SET 7,H	83
54	LD D,H	13	0A	RLC B	71	CB83	RES 8,E	85	CB9F	SET 7,L	83
55	LD D,L	13	0B	RLC C	71	CB84	RES 8,H	85	CB9A	SET 7,(HL)	83
56	LD D,(HL)	14	0C	RLC D	71	CB85	RES 8,L	85	CB9B	SET 7,A	83
57	LD D,A	13	0D	RLC E	71	CB86	RES 8,(HL)	85	CB9C	CALLZ,NN	93
58	LD E,B	13	0E	RLC H	71	CB87	RES 9,A	85	CD945	CALL NN	92
59	LD E,C	13	0F	RLC (HL)	71	CB88	RES 1,B	85	CE20	RDC A,N	46
5A	LD E,D	13	10	RLC A	71	CB89	RES 1,C	85	CF	RST 8	97
5B	LD E,E	13	11	RRC B	74	CB8A	RES 1,D	85	08	RET NC	90
5C	LD E,H	13	12	RRC C	74	CB8B	RES 1,E	85	01	POP DE	32
5D	LD E,L	13	13	RRC D	74	CB8C	RES 1,H	85	02845	JP NN,NN	86
5E	LD E,(HL)	14	14	RRC E	74	CB8D	RES 1,L	85	0320	OUT (N),A	103
5F	LD E,A	13	15	RRC H	74	CB8E	RES 1,(HL)	85	04845	CALL NN,NN	93
60	LD H,B	13	16	RRC L	74	CB8F	RES 1,A	85	05	PUSHDE	31
61	LD H,C	13	17	RRC (HL)	74	CB90	RES 2,B	85	0620	SUR H	47
62	LD H,D	13	18	RRR	74	CB91	RES 2,C	85	07	RST 18H	97
63	LD H,E	13	19	RL B	73	CB92	RES 2,D	85	08	RET C	95
64	LD H,H	13	1A	RL C	73	CB93	RES 2,E	85	09	EXX	35
65	LD H,L	13	1B	RL D	73	CB94	RES 2,H	85	0B845	JP C,NN	86
66	LD H,(HL)	14	1C	RL E	73	CB95	RES 2,L	85	0B20	IN A,(N)	98
67	LD H,A	13	1D	RL H	73	CB96	RES 2,(HL)	85	0C845	CALL NN	97
68	LD L,B	13	1E	RL L	73	CB97	RES 2,A	85	0C89	RDD IX,BC	64
69	LD L,C	13	1F	RL (HL)	73	CB98	RES 2,H	85	0D19	RDD IX,DE	64
						CB99	RES 2,B	85	0D21845	LD IX,NN	24
							RES 2,C	85	0D22845	LD (NN),IX	28



OBJECT CODE	PHONONICS	PAGE #	OBJECT CODE	PHONONICS	PAGE #	OBJECT CODE	PHONONICS	PAGE #	OBJECT CODE	PHONONICS	PAGE #
DD23	INC IX	66	DDC850E	SET 3. (IX+IND)	84	ED69	OUT (C),L	103	FD6685	LD H. (IV+IND)	15
DD29	ADD IX,IX	64	DDC850E	SET 4. (IX+IND)	84	ED6A	ADC HL,HL	63	FD6685	LD L. (IV+IND)	15
DD2B485	LD IX. (IND)	26	DDC850E	SET 5. (IX+IND)	84	ED6F	RLD	79	FD7085	LD (IV+IND). B	16
DD2B	DEC IX	67	DDC850E	SET 6. (IX+IND)	84	ED72	SBC HL,SP	64	FD7185	LD (IV+IND). C	16
DD3485	INC (IX+IND)	54	DDC850E	SET 7. (IX+IND)	84	ED738485	LD (IND). SP	28	FD7285	LD (IV+IND). D	16
DD3585	DEC (IX+IND)	55	DD1	POP IX	33	ED78	IN R. (C)	98	FD7385	LD (IV+IND). E	16
DD368528	LD (IX+IND). N	17	DD3	EX (SP),IX	36	ED79	OUT (C),R	103	FD7485	LD (IV+IND). H	16
DD39	ADD IX,SP	64	DD5	PUSHIX	31	ED7A	ADC HL,SP	63	FD7585	LD (IV+IND). L	16
DD4685	LD B. (IX+IND)	14	DD69	JP (IX)	38	ED7B8485	LD SP. (IND)	26	FD7785	LD (IV+IND). R	16
DD485	LD C. (IX+IND)	14	DD9	LD SP,IX	38	ED8A	LDI	37	FD885	LD R. (IV+IND)	15
DD585	LD D. (IX+IND)	14	DD20	SBC R,N	48	ED91	CFI	41	FD885	ADD R. (IV+IND)	45
DD585	LD E. (IX+IND)	14	DDF	RST 38H	97	ED92	INI	99	FD885	ADC R. (IV+IND)	46
DD685	LD H. (IX+IND)	14	ED	RET PD	95	ED93	OUTI	104	FD985	SUB (IV+IND)	47
DD685	LD L. (IX+IND)	14	E1	POP HL	32	ED96	LDI	39	FD985	SEC R. (IV+IND)	48
DD785	LD (IX+IND). B	16	ED8485	JP PO,NV	86	ED99	CFD	42	FD985	RND (IV+IND)	49
DD785	LD (IX+IND). C	16	E3	EX (SP),HL	35	ED9A	IND	101	FD985	XOR (IV+IND)	51
DD785	LD (IX+IND). D	16	E48485	CALL PD,NN	92	ED9B	OUTD	106	FD985	OR (IV+IND)	50
DD785	LD (IX+IND). E	16	E5	PUSHHL	31	ED9B	LDIR	38	FD985	CP (IV+IND)	52
DD785	LD (IX+IND). H	16	E628	RND N	49	ED91	CFIR	41	FD985	RLC (IV+IND)	72
DD785	LD (IX+IND). L	16	E7	RST 20H	97	ED92	INIR	100	FD985	RRC (IV+IND)	74
DD785	LD (IX+IND). R	16	E8	RET PE	95	ED93	OTIR	105	FD985	RL (IV+IND)	75
DD785	LD R. (IX+IND)	14	E9	JP (HL)	89	ED98	LDOR	40	FD985	RR (IV+IND)	75
DD885	ADD R. (IX+IND)	44	ED8485	JP PE,NN	86	ED99	CFOR	42	FD985	SLR (IV+IND)	76
DD885	ADC R. (IX+IND)	46	EB	EX DE,HL	34	ED9A	INDR	102	FD985	SRR (IV+IND)	77
DD985	SUB (IX+IND)	47	ED8485	CALL PE,NN	93	ED9B	OTDR	107	FD985	SRL (IV+IND)	78
DD985	SBC R. (IX+IND)	48	ED48	IN B. (C)	98	EE28	XOR N	51	FD985	CP R. (IV+IND)	82
DD985	RND (IX+IND)	49	ED41	OUT (C),B	103	EF	RST 20H	97	FD985	BIT 1. (IV+IND)	82
DD985	XOR (IX+IND)	51	ED42	SBC HL,BC	64	F8	RET P	95	FD985	BIT 2. (IV+IND)	82
DD985	OR (IX+IND)	58	ED438485	LD (IND). BC	28	F1	POP AF	32	FD985	BIT 3. (IV+IND)	82
DD985	CP (IX+IND)	52	ED44	NEG	57	F28485	JP P,NN	86	FD985	BIT 4. (IV+IND)	82
DD985	RLC (IX+IND)	72	ED4455	RETN	96	F3	DI	60	FD985	BIT 5. (IV+IND)	82
DD985	RRC (IX+IND)	74	ED46	IM 0	61	F48485	CALL P,NN	93	FD985	BIT 6. (IV+IND)	82
DD985	RL (IX+IND)	73	ED47	LD L,R	22	F5	PUSH AF	31	FD985	BIT 7. (IV+IND)	82
DD985	RR (IX+IND)	75	ED48	IN C. (C)	98	F628	OR N	50	FD985	RES 8. (IV+IND)	85
DD985	SLR (IX+IND)	76	ED49	OUT (C),C	103	F7	RST 30H	97	FD985	RES 1. (IV+IND)	85
DD985	SRR (IX+IND)	77	ED4A	ADC HL,BC	63	F8	RET M	95	FD985	RES 2. (IV+IND)	85
DD985	SRL (IX+IND)	78	ED4B8485	LD BC. (IND)	26	F9	LD SP,HL	29	FD985	RES 3. (IV+IND)	85
DD985	BIT 8. (IX+IND)	82	ED4D	RETI	96	F8485	JP M,NN	86	FD985	RES 4. (IV+IND)	85
DD985	BIT 1. (IX+IND)	82	ED4F	LD R,R	23	FB	EI	60	FD985	RES 5. (IV+IND)	85
DD985	BIT 2. (IX+IND)	82	ED50	IN D. (C)	98	FC8485	CALL M,NN	93	FD985	RES 6. (IV+IND)	85
DD985	BIT 3. (IX+IND)	82	ED51	OUT (C),D	103	FD89	ADD IV,BC	65	FD985	RES 7. (IV+IND)	85
DD985	BIT 4. (IX+IND)	82	ED52	SBC HL,DE	64	FD19	ADD IV,DE	65	FD985	SET 8. (IV+IND)	84
DD985	BIT 5. (IX+IND)	82	ED538485	LD (IND). DE	28	FD218485	LD IV,NN	25	FD985	SET 1. (IV+IND)	84
DD985	BIT 6. (IX+IND)	82	ED56	IM 1	61	FD228485	LD (IND). IV	29	FD985	SET 2. (IV+IND)	84
DD985	BIT 7. (IX+IND)	82	ED57	LD R,I	21	FD23	INC IV	66	FD985	SET 3. (IV+IND)	84
DD985	RES 8. (IX+IND)	85	ED58	IN E. (C)	98	FD29	ADD IV,IV	65	FD985	SET 4. (IV+IND)	84
DD985	RES 1. (IX+IND)	85	ED59	OUT (C),E	103	FD28485	LD IV. (IND)	27	FD985	SET 5. (IV+IND)	84
DD985	RES 2. (IX+IND)	85	ED5A	ADC HL,DE	63	FD385	DEC IV	68	FD985	SET 6. (IV+IND)	84
DD985	RES 3. (IX+IND)	85	ED5B8485	LD DE. (IND)	26	FD3485	INC (IV+IND)	54	FD985	SET 7. (IV+IND)	84
DD985	RES 4. (IX+IND)	85	ED5E	IM 2	62	FD385	DEC (IV+IND)	55	FD985	POP IV	33
DD985	RES 5. (IX+IND)	85	ED5F	LD R,R	22	FD38528	LD (IV+IND). N	18	FD985	EX (SP),IV	36
DD985	RES 6. (IX+IND)	85	ED60	IN H. (C)	98	FD39	ADD IV,SP	65	FD985	PUSH IV	32
DD985	RES 7. (IX+IND)	85	ED61	OUT (C),H	103	FD4685	LD B. (IV+IND)	15	FD985	JP (IV)	38
DD985	SET 8. (IX+IND)	84	ED62	SBC HL,HL	64	FD485	LD C. (IV+IND)	15	FD985	LD SP,IV	38
DD985	SET 1. (IX+IND)	84	ED67	RND	80	FD585	LD D. (IV+IND)	15	FD985	CP N	52
DD985	SET 2. (IX+IND)	84	ED68	IN L. (C)	98	FD585	LD E. (IV+IND)	15	FD985	RST 30H	97

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*Use this program to replace your  
columnar work sheets when doing the books.*

# Accountants Aid

James H. Sheats  
2036 Headland Drive  
East Point, GA 30344

From time to time accountants, bookkeepers, ana-

lysts and the rest of the number-scribbling fraternity (by whatever name called) pick up a sheet of columnar work paper, print a report title and date at the top, print columnar head-

ings across the page, and start filling in lines and columns of figures.

Usually these sheets have both line and column totals, which should be equal when cross-footed. After considerable work with an adding machine and an eraser they usually are. Finally.

The Accountant's Writeup Aid is designed to eliminate some of the pain associated with this process. The program can be adapted to a number of purposes in its present state and can be customized to your own needs.

This program is written for a TRS-80, Level II, with a 132 column line printer (in the author's case, an IDS Paper Tiger). 4K of memory is plenty, since the program is very short, about 874 bytes.

## The Program

The program uses both screen and printer output, but users without printers can eliminate all LPRINT statements and still have a useful program.

The command on Line 55,

LPRINT CHR\$(31), is a Paper Tiger control command that adjusts the line length to 132 characters. It may not be necessary with other printers. Lines 65 and 68 allow you to input a Report Name and Date. Both of these lines are unnecessary without a printer.

Line 70 is the reference name. This can be Date, Check Number, Invoice Number or other suitable reference. This entry is not used for any computations.

In Line 75, input the number of columns that you want for a particular task. This version of the program is written with 10 characters per column and will print the reference column, 11 data columns and a line total column. (See Fig. 1.) You may customize your LPRINT USING statements for more or fewer columns.

Lines 80-125 form a routine to input heading names for the columns.

In Lines 130-190, numerical data is input. Each entry may be positive, negative or zero. After accepting an entry for each column, the program prints a line

```

10 REM "SPREAD SHEET"
20 REM PROGRAMMED BY JAMES H. SHEATS
30 REM                2036 HEADLAND DRIVE
40 REM                EAST POINT, GEORGIA 30344
50 REM                404-766-0857
52 CLEAR2000
53 DEFDBL C,T
55 CLS:LPRINT CHR$(31);LPRINT:LPRINT
60 PRINT"SPREAD SHEET PROGRAM"
65 INPUT"REPORT NAME";R$:LPRINT TAB(30)R$:LPRINT:LPRINT
68 INPUT"DATE";D$:LPRINT TAB(35)D$:LPRINT:LPRINT
70 INPUT"INPUT LINE NAME";L$
75 INPUT"NUMBER OF COLUMNS WANTED ";N
76 DIM CS(N),C(N),CT(N)
77 LPRINT USING"%          %";L$;
80 FOR X=1 TO N
90 INPUT"COLUMN NAME";C$(X)
100 LPRINT USING"%          %";C$(X);
120 NEXT
125 LPRINT"TOTAL"
130 PRINTL$:INPUT L
140 IF L=999 THEN 200
144 LPRINT USING"#####.##";L;
145 T=0
150 FOR X=1 TO N
155 C(X)=0
160 PRINT C$(X);:INPUT C(X):T=T+C(X)
165 LPRINT USING"#####.##";C(X);
170 CT(X)=CT(X)+C(X)
180 NEXT X
185 PRINT "TOTAL";T:LPRINT USING"#####.##";T
190 GOTO 130
200 CLS:LPRINT:PRINT "TOTALS":LPRINT"TOTALS      ":FOR X=1 TO N
204 PRINT C$(X),CT(X),
205 TT=TT+CT(X)
208 LPRINT USING"#####.##";CT(X);
210 NEXT X
220 PRINT "GRAND TOTAL ";TT
230 LPRINT USING"#####.##";TT
240 END

```

Program Listing

total, and the routine is repeated for the next line. If an input error is made, the same reference number can be re-entered, zero quantities entered for the unchanged columns, and corrections made in the erroneous columns. This procedure is demonstrated in Fig. 1 for day 4.

This program loop is exited by inputting a reference number of 999, but you may establish your own loop exit. Upon exit from the loop, the program prints column totals and a grand total. At that point, the program terminates. This routine is in Lines 200-240.

### One Disadvantage

One disadvantage to this program is that an entry must be made in each column, each time. However, a zero or an ENTER will do. No heading routines for second and subsequent pages are provided, either.

Still, for the computer owner/businessman, this simple program has a great deal of flexibility and should be in his library along with the amortization, checkbook balancing, depreciation and all the rest of the so-called "business" programs. ■

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NOVEMBER 1977												
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3	2.50	2.00	18.75	5.00	0.00	0.40	1.20	3.50	4.75	0.00	45.00	86.40
4	200.00	2.25	3.25	1.50	4.75	0.40	1.20	3.50	2.75	250.00	0.00	571.80
4	-200.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-200.00
4	7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00
5	0.00	0.00	4.15	1.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.40
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Fig. 1.



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## Display your buffer contents in hex, ASCII or decimal.

# Buffer Analysis

Robert M. Chambers  
74 Stinson Ave.  
Nepean, Ontario  
Canada K2H 6N4

In my efforts to discover the various TRS-80 tape formats, I found that I had to write several assembler and BASIC programs to do little bits and pieces of the work.

To overcome the awkward-

ness of frequently loading the different programs, I decided to write one program which would do all the jobs.

Buffer Analyser is a program which displays the TRS-80's I/O buffer in ASCII, decimal or hexadecimal format.

The whole idea of this program is to read a record into the I/O buffer and display it on the screen in hex, decimal or ASCII. Using the I/O buffer overcomes the problem of truncated data which often occurs when a

string variable is used.

According to the memory map provided in the Level II BASIC Reference Manual, the address of the I/O buffer begins at 16870 and ends at 17127. Using the PEEK instruction within FOR-NEXT loops and referencing this area, one byte at a time is accessed and processed for the chosen display format.

When the command menu is displayed, you press A for ASCII, H for hexadecimal, D for decimal, N to read the next tape record, C to clear the buffer and X to stop the run.

Hexadecimal display is most useful for my purposes and I have, therefore, supplied the list of compression codes in that (Table 1) form. This list is useful in analyzing BASIC program tapes and useful information to use for writing programs to renumber or change BASIC programs. These codes are used in memory and on tapes to reduce

the amount of storage needed for BASIC programs.

The Level II manual also mentions that each line of BASIC code contains a carriage return, a two-byte line pointer and a two-byte line number. The TRS-80 Microcomputer Technical Reference Handbook says that a CSAVE will generate 128 zero bits, an A5 hex byte for synchronizing a read, a two-byte start address, a two-byte end address, the data and, finally, a one-byte check sum. The check sum is the sum of all the data.

When you examine the buffer you will not see a lot of this. A BASIC program in hex will start 00 2C D3 D3 D3. Presumably, this portion follows the sync byte A5, which is not shown. Using the code compression table below, you can find the start of the program statements and proceed to decipher the program. ■

ABS	D9	GET	A4	PUT	A5
AND	D2	GOSUB	91	RANDOM	86
ASC	F6	GOTO	8D	READ	8B
ATN	E4	IF	8F	REM	93
AUTO	B7	INKEY\$	C9	RESET	82
CDBL	F1	INP	DB	RESUME	9F
CHR\$	F7	INPUT	89	RESTORE	90
CINT	EF	INSTR	C5	RETURN	92
CLEAR	B8	INT	D8	RIGHT\$	F9
CLOAD	B9	KILL	AA	RND	DE
CLOSE	A6	LEFT\$	F8	RSET	AC
CLS	84	LEN	F3	RUN	8E
CMD	85	LET	8C	SAVE	AD
CONT	B3	LINE	9C	SET	83
COS	E1	LIST	B4	SGN	D7
CSAVE	BA	LLIST	B5	SIN	E2
CSNG	F0	LOAD	A7	SQR	DD
CVD	E8	LOC	EA	STEP	CC
CVI	E6	LOF	EB	STOP	94
CVS	E7	LOG	DF	STR\$	F4
DATA	88	LPRINT	AF	STRING\$	C4
DEF	B0	LSET	AB	TAB(	BC
DEFDBL	9B	MEM	C8	TAN	E3
DEFINT	99	MERGE	A8	THEN	CA
DEFSGN	9A	MID\$	FA	TIMES	C7
DEFSTR	98	MKD\$	EE	TO	BD
DELETE	B6	MKIS	EC	TROFF	97
DIM	8A	MKS\$	ED	TRON	96
EDIT	9D	NAME	A9	USING	BF
ELSE	95	NEW	BB	USR	C1
END	80	NEXT	87	VAL	F5
EOF	E9	NOT	CB	VARPTR	C0
ERL	C2	ON	A1	+	CD
ERR	C3	OPEN	A2	-	CE
ERROR	9E	OR	D3	*	CF
EXP	E0	OUT	A0	/	DO
FIELD	A3	PEEK	E5	↑	D1
FIX	F2	POINT	C6	>	D4
FN	BE	POKE	B1	=	D5
FOR	81	POS	DC	<	D6
FRE	DA	PRINT	B2		

Table 1. Level II BASIC Compression Codes.

### Program Listing.

```

1 CLEAR1000
5 A$="0123456789ABCDEF"
10 CLS:PRINTCHR$(23):PRINT@528,"BUFFER ANALYZER";:FORZ=
  1TO1200:NEXTZ
15 GOTO30 REM >>>>>> TO MAIN LINE START <<<<<<<<
20 CLS:AF$=CHR$(0):PRINT@530,"PRESS A KEY TO READ THE N
  EXT RECORD";
25 AF$=INKEY$:IFAF$<CHR$(1)THEN25ELSECLS:PRINT@534,"TAP
  E RECORD BEING READ";:INPUT#-1,B$
30 AF$=CHR$(0):CLS:PRINT@412,"PRESS";:PRINT@515,"A FOR
  ASCII, H FOR HEX, D FOR DECIMAL N FOR NEXT OR X TO
  END";:PRINT@658,"PRESS C TO CLEAR THE BUFFER";
35 AF$=INKEY$:IFAF$<CHR$(1)THEN35
40 IFAF$="A"THENGOSUB176:GOTO500
45 IFAF$="H"THENGOSUB95:GOTO500
50 IFAF$="D"THENGOSUB200:GOTO500
55 IFAF$="N"THEN GOTO20
60 IFAF$="X"THENCLS:GOTO999
65 IFAF$="C"THENGOSUB700:GOTO30
90 GOTO30
94 '*****
  *****
95 '***** THE CONVERT BUFFER AND DISPAY IN HEX ROUTINE
  *****
96 '*****
  *****
100 CLS
150 FORX=16870TO17127:A=PEEK(X)
    
```

```

155 B=FIX(A/16):C=B*16:D=A-C
160 PRINTMID$(A$,B+1,1);MID$(A$,D+1,1);" ";
165 NEXTX
170 RETURN
175 *****
176 ***** THE READ BUFFER AND DISPLAY IN ASCII ROUTINE
177 *****
180 CLS
185 FORX=16870TO17127:PRINTCHR$(PEEK(X));" ";NEXTX
190 RETURN
199 *****
200 ***** THE READ BUFFER AND DISPLAY IN DECIMAL ROUTINE
201 *****
205 CLS
210 FORX=16870TO17127:PRINTPEEK(X);:NEXTX
234 RETURN
235 *****
500 ***** THE DELAY AT END OF DISPLAY ROUTINE *****
501 *****
505 AFS=CHR$(0)
510 AFS=INKEY$:IFAFS<CHR$(1)THEN510
515 GOTO30:REM BACK TO MAIN LINE
599 *****
700 ***** CLEAR BUFFER ROUTINE *****
701 *****
702 CLS:PRINT@540,"CLEARING";
705 FORX=16870TO17127:POKEX,0:NEXTX
706 CLS:PRINT@540,"CLEARED!";:FORZ=1TO333:NEXTZ
710 RETURN
997 ***** THE END ROUTINE *****
998 *****
999 END
1000 *****

```

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*Lots of data to display?  
Try these techniques for a tidier screen.*

# Display Formatting

Allan S. Joffe W3KBM  
1005 Twining Road  
Dresher PA 19025

The time will soon arrive when you wish to display large numbers of data bits on your monitor. You have been aware of the formatting aids, such as the four printing zones and the TAB function, built into the TRS-80. As a start, enter Listing 1 and Listing 2 and run first one and then the other for comparison.

You may have to carefully examine Listing 2 to fathom how

you got the same 40 numbers that Listing 1 gave you. The item of concern is really the difference in format. In Listing 1 the consecutive numbering is basically horizontal, while in Listing 2 the consecutive numbering pattern is basically vertical. While it is a matter of choice, I prefer the Listing 1 approach when formatting data on the video screen.

## Modifications

Now consider this slightly revised version of Listing 1. If you are working with this article at your computer (which is the way to fly), just make the appropriate changes in the listing on your screen (see Example 1). In line 7 there are three spaces between each X, X<sup>13</sup> couplet.

When you run this program, you will see we have added some data to illustrate the formatting look. Beside each value of X (1 to 40) we now show the cube of each X value. If your TRS-80 has the same firmware quirk that my machine has, it will show a value of 8000.01 as the cube of 20. Now look at Example 2.

Line 70 may be a momentary headscratcher, but if you worked out how line 70 in Listing 2 functioned, the new line 70 in Example 2 will fall into place. Once again the difference in formats is a matter of taste and what you are used to. I personally opt for Listing 2.

Another formatting aid is shown in Listing 3. The equation in line 20 is a centigrade (Cel-

sius) to Fahrenheit conversion based on the fact that -40 degrees is a point of numerical equality for both systems. Line 10 prints out Celsius temperatures from 0 to 102 degrees in steps of 2 degrees (in conjunction with line 30), and with the further aid of line 30, prints the corresponding Fahrenheit temperature beside the Celsius temperature.

The real value you get from this effort will only come if you enter the programs into your computer. Once you have a feel for and an understanding of the methods outlined here, then comes the fun. You can experiment and improvise, and in so doing you are in great danger of becoming a better programmer. Don't say I didn't warn you! ■

```
5 CLS
10 FOR X = 1 TO 40
20 PRINT X,
30 NEXT X
40 END
```

*Listing 1.*

```
50 CLS
60 FOR X = 1 TO 10
70 PRINT X,X + 10,X + 20,X + 30
80 NEXT X
90 END
```

*Listing 2.*

```
5 CLS
7 PRINT @0,"X X13","X X13","X X13","X X13"
10 FOR X = 1 TO 40
20 PRINT X; X13.
30 NEXT X
40 END
```

*Example 1.*

```
50 CLS
55 PRINT @0,"X X13","X X13","X X13","X X13"
60 FOR X = 1 TO 10
70 PRINT X;X13,X + 10;(X + 10)13,X + 20;(X + 20)13, X + 30;(X + 30)13
80 NEXT X
90 END
```

*Example 2.*

```
5 CLS
10 FOR C = 0 TO 24 STEP 2
20 F = ((C + 40) * 1.8) - 40
30 PRINT C;F,C + 26;F + 46.8,C + 52;F + 93.6,C + 78;F + 140.4
40 NEXT C
```

*Listing 3.*



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ZDQINKFSNAGTHLGFJSEYWTVNPFFJVZVC  
BVLFGULMNSNEKOTTSCYMBGCGWBQOFMPO  
UOVZKBFIOEPUYASEXMOLERZJXACHYRU  
PKBMYUCWOCGLDMRXSEWMCZTIONGULYK  
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The thought of my computer functioning as a data logging tool was enticing, but the thought of having to manually

key in the data was not. There had to be a better way!

### Parallel Ports

Fortunately there is a better way. I am referring to the parallel port, that neglected feature commonly used for little more than reading keyboards or driving printers.

You can create both the hardware and software necessary to link your computer to outside measuring instruments without having to learn assembly language, since everything can be done under BASIC.

Although most of what is presented is oriented toward the TRS-80, it is by no means limited to it. The S-100 bus computers

are equally usable. Let's look at some of the requirements for linking test equipment to a computer.

First, the data must be in a computer recognizable format and at TTL compatible levels. However, this does not mean that we are restricted to using only binary numbers. Binary code makes the most efficient use in space of a given number of bits but it is not always the easiest code to use.

By redefining the meaning of each bit position in an eight-bit word, we can make the code easier to work with in terms of the outside world. This is called binary coded decimal, or BCD for short.

### BCD Data

A single eight-bit-word can express any binary value from 00000000 to 11111111, or from 0 to 255 decimal. In a single-decimal-digit, it takes four bits to specify any of the possible values from 0 to 9. The remaining binary combinations from 11 to 15 are discarded.

Since the computer operates on eight-bit-data, it is only logical to use the remaining four bit positions to represent another digit. Thus an eight-bit-word can be used to represent any number between 0 and 99 in BCD format. Unlike a straight binary format, we now have some bit patterns that are illegal. Example 1 shows how this process works.

Why go to BCD? A quick look through an IC catalog will give part of the answer. Many common components such as counters, A/D converters, and clock chips have BCD outputs already available. Many commercially available measuring instruments have auxiliary outputs that are BCD coded.

In addition, it is easier to tailor your computer to the number of digits you wish to resolve by using BCD.

BCD also has some disadvantages. First is the need for a method of converting between BCD and binary.

Second, to have a large number of BCD interfaces you must also have a large number of interconnections. Remember that each digit requires four bits, therefore four leads will be needed. For a six-digit frequen-

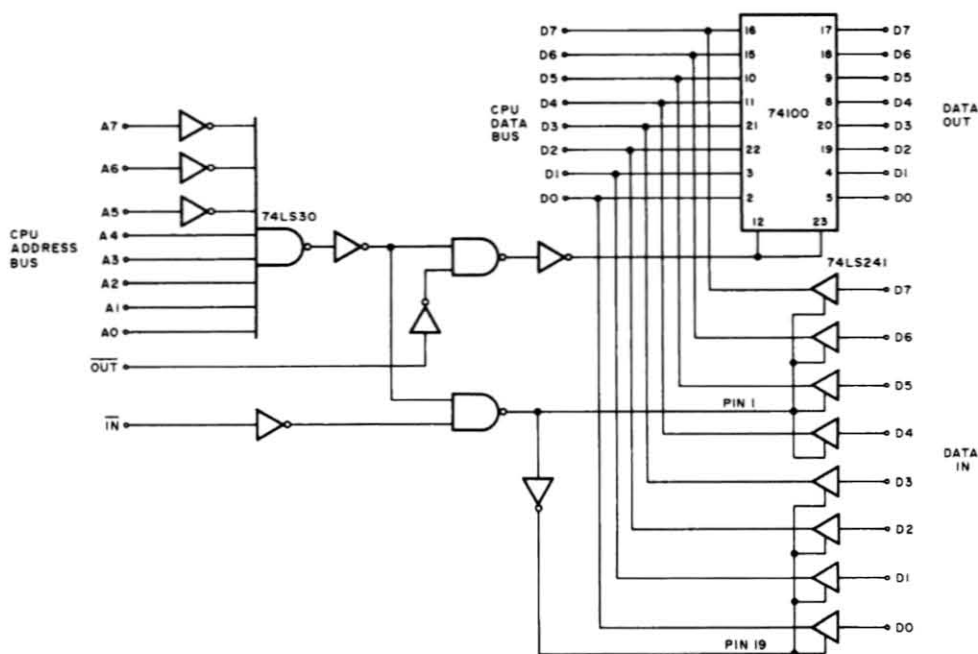


Fig. 1. One Parallel I/O Port. This example shows address 31 decoded.

cy counter this means 24 bulky connections. (Multiplexing can cut this down but that gets more complicated.)

## Hardware

Let's look at what it takes to get parallel data in and out of our computer. The TRS-80 has an edge connector on the back left that provides access to the CPU bus inside.

An explanation of the pinout can be found in the back of the Level I manual. Oddly enough, this diagram was omitted from the Level II manual in the system I worked on. You will need Level II BASIC to make both the hardware and software function properly.

The parts of the bus that interest us are the address lines, the data lines and the two control lines labelled  $\overline{IN}$  and  $\overline{OUT}$ . The Z-80 CPU can address up to 256 I/O ports. When this is done in the TRS-80, the CPU places the port address (0-255) on the lower eight address lines and issues the appropriate  $\overline{IN}$  or  $\overline{OUT}$  control command at the rear connector.

If a word is being written to the port, the data bus will contain the byte being output and the  $\overline{OUT}$  line will be strobed low. If an input byte is requested, the data bus is tri-stated to allow the input port hardware to place its byte on the bus and the  $\overline{IN}$  line is strobed low.

Whether a specific port number is used for input or output depends upon the design of the external hardware. It can be both.

The first requirement in setting up a parallel port is for the computer to recognize its port address. This means we must decode a particular address. At the same time we must check to see if either the  $\overline{IN}$  or  $\overline{OUT}$  line is valid. These control lines tell us that the address is a port and not a memory.

Fig. 1 shows an example of how this works. First we must pick an address that is not already in use. Let's use 31 as an example.

The address bus has the appropriate lines inverted to make the inputs to the eight input

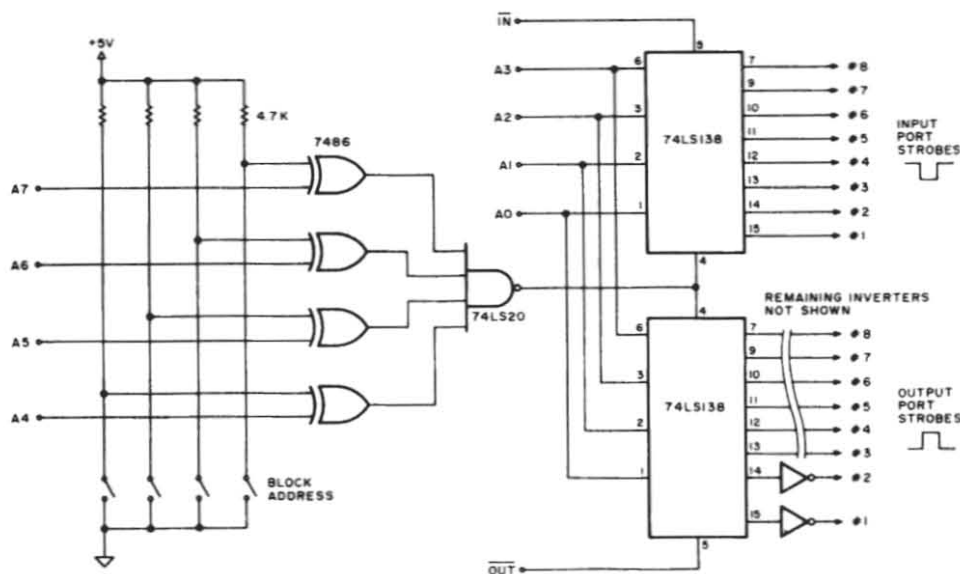


Fig. 2. Decoding 8 Parallel I/O Ports. Input & output circuits are the same as Fig. 2.

NAND gate high when address 31 is given. This signal is inverted and gated with the inverted  $\overline{OUT}$  command to form a strobe pulse for the latch.

For an input port we decode the address in the same way except we use the  $\overline{IN}$  line. Instead of a latch, we must now use a tri-state buffer to place the input byte on the data bus. Note that it is possible for an input and an output port to have the same numerical address. The control lines tell which of the two is to be active.

## Multiple Ports

Obviously, a single I/O port will not suffice for all measurement applications. In order to address at least four, and preferably eight ports, the address is decoded differently.

First, we will say that all port addresses will be contiguous, or numerically sequential. The lowest address will be the boundary of the block. Since

eight ports will require three bits for the address within the block, this leaves five bits to define the block boundary.

Addressing a specific port now requires three events to be true: The proper boundary as defined by A3-A7; the proper three-bit address as defined by A0-A2; and the  $\overline{IN}$  or  $\overline{OUT}$  command as appropriate. Fig. 2 illustrates this. (There are other ways of implementing parallel I/O ports. This method is shown because of its simplicity and the low cost of the parts.)

If a full eight ports are placed on the bus, it should be buffered. If not, there is the possibility of overloading the bus with all the additional decoding and latching circuitry.

Also, if you locate your interface at the end of several feet of cable, you can introduce error causing reflections onto the bus. As a final thought, consider the consequences if something goes haywire externally; you end up damaging some ICs and your connections are straight

onto the bus. Need I say more?

I built my buffer using tri-state gates on a small card that plugged straight into the edge connector. The buffer in turn had its own edge connector where the cable from the expansion interface was attached. I retained full use of the extra memory and the disk drive.

Circuit speed posed no problem. The  $\overline{IN}$  and  $\overline{OUT}$  signals are 1.4 microseconds wide, more than adequate settling time.

Incidentally, the manual showed one of the pins on the edge connector providing +5 volts. Check before you use it as mine turned out to be a ground. Because of the power draw of an eight port interface, plan on building a separate power supply.

(If you are working with an S-100 computer, see the article on building parallel port interfaces in the Oct. '77 issue of *Microcomputing*, pp. 102-108. Although the mechanics of decoding differ slightly, all other

BINARY	BCD	DECIMAL
01010010	10000010	82
01001101	01111001	79
00000011	00000011	3
10000000	ILLEGAL	128

01010110 BCD = 56 DECIMAL

Example 1. Binary, BCD and Decimal Equivalents. One byte can represent any two digit number.

```

1000 REM BCD SUBROUTINE
1010 N = INP(8)           N = 10010101 = 95 BCD
1020 N1 = N AND 15       N1 = 00000101 = 5
1030 N2 = N AND 240     N2 = 10010000 = 9
1040 N2 = N2/16         N = 10 * 9 + 5 = 95
1050 N = 10 * N2 + N1
1060 RETURN
  
```

Example 2. Subroutine to read and decode two BCD digits. Bit masking and shifting are employed.



principles remain the same.)

Check your work by instructing the processor to write a specific byte to a port. Verify this with any instruments, from an LED to an oscilloscope.

At the same time make sure that none of the other output ports are affected.

To check an input port, selectively ground each bit and verify that the binary number returned changes by the appropriate power of two.

### Software

Now that the hardware has been resolved, let's look at the necessary software. Under Level II BASIC we will make use of some special commands. The first are INP(X) and OUT(X,Y).

The statement  $A = \text{INP}(8)$  instructs the computer to read input port #8 and equate the value there to the variable A. (Note that at this time A can be from 0 to 255 decimal.)

To write to a port, tell the computer to  $\text{OUT } 8, Y$  and the value of Y in binary (not BCD) will appear on port #8. In the examples I am describing we cannot handle floating point numbers.

Now we need the ability to selectively examine specific bits for deciphering the incoming BCD data. Earlier I said that one byte, and therefore one port,

can represent two BCD digits. Since the computer uses binary and we are using BCD, some translating will be necessary.

Assume we are using port #8 and that it contains the BCD representation of the number 95. Our program must read the port and return the number 95 in binary to the processor.

The first step reads the port and places the number in the variable N. Next we mask off, or zero, the four most significant bits, leaving only the units digit. This is directly equated to the variable N1 for temporary storage.

Then the four least significant bits of N are masked and the remaining bits are shifted right four places. This number is directly equated to N2 for storage. An artificial binary number is now created from each half of the BCD byte. Since the four least significant bits equate directly to 0-9 (not counting the illegals), the interpreted digit must lie in the four least significant bit positions. Anything else will give an erroneous result.

The final step is to multiply N2 by 10, add it to N1 and return the number as N. If this process is made into a subroutine, any portion of the program can get a two-digit number from port #8.

Example 2 shows the me-

```

1000 REM 6 DIGIT BCD READ
1010 N1 = INP(8)
1020 N2 = INP(9)
1030 N3 = INP(10)
1040 N1 = N1 AND 15 + (N1 AND 240)/16 * 10
1050 N2 = N2 AND 15 + (N2 AND 240)/16 * 10
1060 N3 = N3 AND 15 + (N3 AND 240)/16 * 10
1070 N = N1 + 100*N2 + 10000*N3
1080 RETURN

```

*Example 3. 6 digit BCD read subroutine.*

chanics and the coding in more detail. Try it longhand to convince yourself that it works.

### Masking

The masking process is the key step in the conversion. Using the AND command makes it possible to selectively turn off any combination of bits in a word and leave the remainder unchanged.

Think of each bit in the input byte as one input to an AND gate and the other gate input as being the corresponding bit position in the mask word. If the mask bit is high, the gate output equals the second input bit.

If the mask bit is a zero, then the gate output is a zero, regardless of the state of the other bit. This command will act on all eight bits at once.

To determine the numerical value of the mask word, add the binary weight of the bit posi-

tions you want left unchanged.

Following the masking process (which leaves the tens digit), the shift right by four is accomplished through dividing by 16. Since dividing by two is the same as shifting every bit position right by one, it follows that a division by 16 will produce four shifts to the right. The code in Example 2 is shown one step at a time for clarity.

To obtain more than two digits of resolution (one part in a hundred is inadequate in many cases) use some of the additional ports to give whatever amount is necessary.

Each port is treated as in Example 2 except that the decoded numbers are scaled by the appropriate power of ten before being added. Remember when I said how easy it was to scale the system for any number of digits? All you have to do is to allocate sufficient ports and do the appropriate decimal scaling on the numbers. Example 3 shows a subroutine for reading a six-digit frequency counter connected to three input ports.

Output ports can be used to control relays, triacs, D/A converters, etc. One port can be used to control eight separate circuits by means of TTL compatible reed relays or optical isolators. The OR command controls any specific bit without affecting the others.

To establish how fast I could transfer values in and out I tried a couple of benchmark programs. In each case the program transferred 1000 values to a single port in a FOR NEXT loop while doing nothing else. The output was finished in 6.4 seconds while the input took 7.3 seconds. Using the subroutine in Example 3 took 115 seconds.

Obviously the calculations

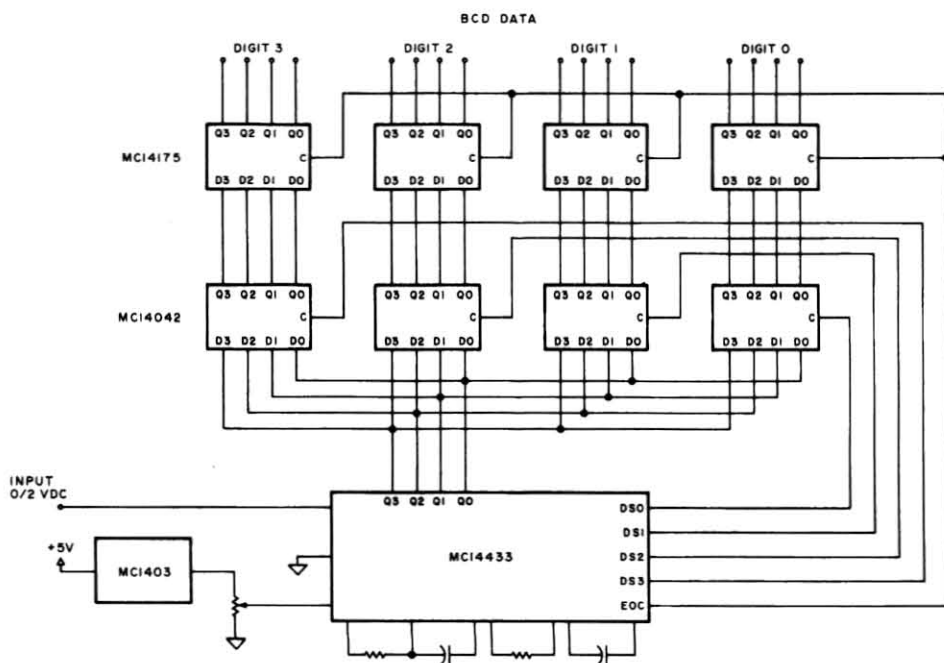


Fig. 3. Interfacing a DVM chip. Multiplexed data is in latched parallel format.

take their toll in speed. Consider however, the application you will be involved with, and if your experience echoes mine, the comparatively low speed is of little matter.

What is important is that the computer is now doing more work and the programmer less! Also, it is almost always necessary for the computer to wait idly while the external instrument makes its measurement.

A do nothing FOR NEXT loop can be used as a timer for such occasions. I have found that 340 iterations take one second.

### Examples

Let's look at a circuit that

uses the methods I have described. Fig. 3 shows an analog to a digital converter using the Motorola MC14433 IC. This chip is the basic building block for a 3½ digit DVM.

Note that most of the parts are used to convert the multiplexed BCD output to parallel latched BCD, which is compatible with the software described. This is a typical requirement for most instruments. In this application the multiplexing works against us. It is possible to directly read a multiplexed output, but it requires an intimate knowledge of the timing of both the instrument and the computer.

To do this, the computer must test the digit position it needs to read. When that digit is enabled, it must be read before the scan continues. All digits must be read in one scan so that an erroneous reading will not be returned. This would occur if the measuring instrument updated its reading to a new value while the computer was still trying to read the remainder of the original one.

Taking two readings and comparing them before returning to the calling program is a worthwhile check, if BASIC reads the data.

The circuit shown in Fig. 3 illustrates a typical requirement

for latching multiplexed data. If you intend to build it, or need more information on this particular device, consult the Motorola CMOS manual.

You can also call a machine-language program from BASIC to demultiplex the data in software and POKE the digit pairs into successive memory locations. This eliminates the demultiplexing hardware.

The subroutine in BASIC would then be modified to PEEK the memory locations as a source of data. Since the final program will depend on the specific instrument being interfaced I will leave the rest to you. ■

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600 Process up arrow and  
GOTO 100  
700 Process down arrow and  
GOTO 100  
800 Process both arrows and  
GOTO 100

Two or more keys pressed that are not in the same group must be checked separately. For example, if you are looking for the A and L keys pressed at the same time you can check it as follows:

X = PEEK(14337)  
Y = PEEK(14338)  
IF X = 2 AND Y = 16 GOTO \_\_\_\_\_

### Keyboard Interrogation

Program Listing 2 is a demonstration of keyboard memory interrogation. The following is a brief description of each routine in Program 2:

1000-2400	Set up screen
2500-2700	Saves next rocket position Restores old position Moves rocket to next position
2800	Call keyboard scan
2900-3400	Make sure rocket doesn't go off top or bottom
3500	Continue looping
....	KEYBOARD SCAN
3600	Get data value
3700	Checks for up arrow
3800	Checks for down arrow
3900	Checks for left arrow
4000	Checks for right arrow
4100	Checks for up and left arrows
4200	Checks for up and right arrows
4300	Checks for down and left arrows
4400	Checks for down and right arrows
4500	Checks for no input—branches if true

### ADDRESS

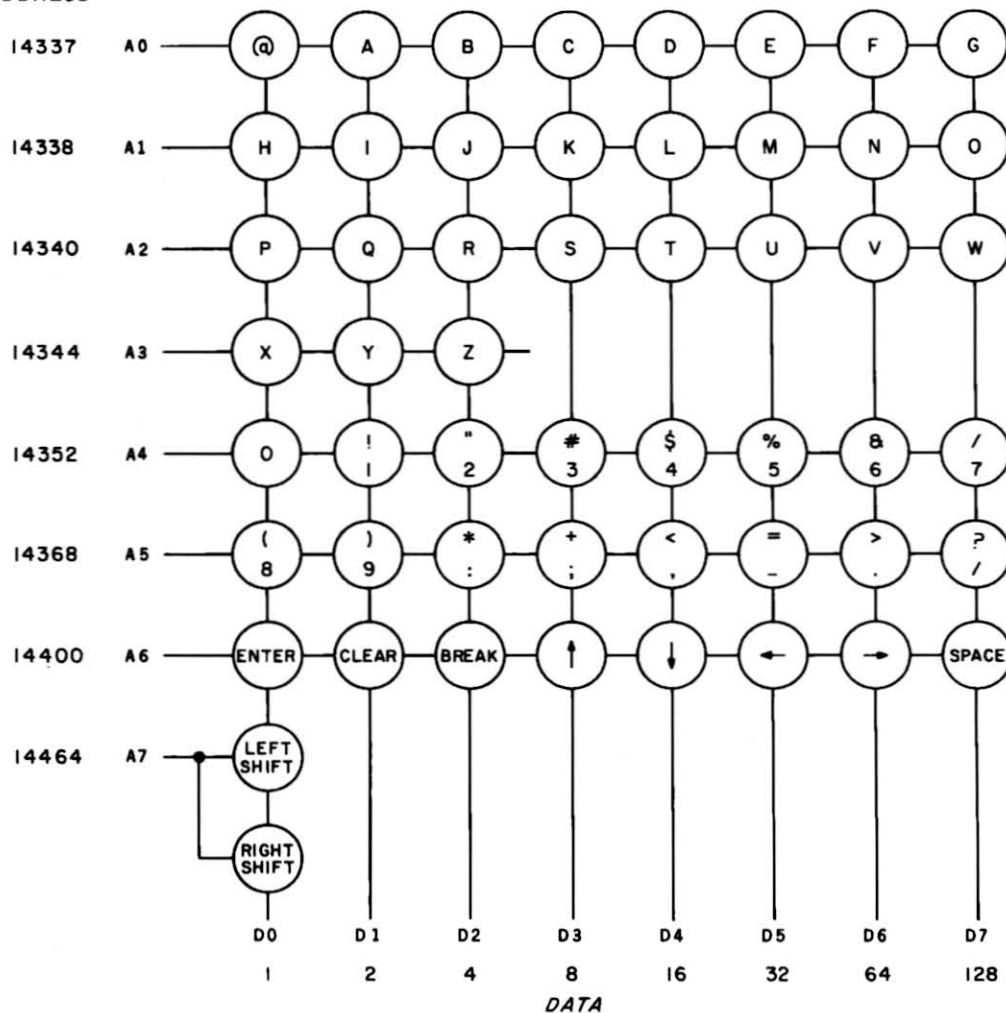


Fig. 1.

4600 Return to main program

**Conclusion**

In order to receive a response using the PEEK function, the key must be held down at the time the PEEK statement is executed.

You will receive the same response as long as you hold down the key.

You can access all the keys using PEEK, except for BREAK and CLEAR. The reason being the Level II ROM Interpreter is constantly checking these keys and has priority over them.

INKEY remains a powerful function that allows input of an ASCII character (string) that can be used without further processing. Using a combination of INKEY and directly accessing the keyboard memory, PEEK, you will be able to meet most of your programming needs. ■

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Use a Model 33 with your TRS-80,  
with no hardware modifications to your CPU.

# Teletype Interface

Peter E. Noeth  
6906 Lenwood Way  
San Jose CA 95120

Perhaps, like myself, you don't have a line printer to obtain hard copy from your TRS-80 but do have access to a Model 33 Teletype. The following circuit and assembly language program provides the necessary interface to the TRS-80 CPU (keyboard) through a 40-pin ribbon cable without making any modifications to the unit. It requires the Level II ROM modification.

Whenever you power up your TRS-80, this program must be entered and started. If a program you are running crashes and you get "memory size" displayed on your screen, the program must be restarted because the normal initialization routine within the ROM will place the regular line printer pointer (058DH) in location 4026H and 4027H. If this happens, the teletype will still print but will not provide a line feed for each carriage return.

## The Circuit

The address decoder section, made up of the 74LS30, 74LS139, 74LS155 and one gate of the 74LS04, decodes the address 37E8H. This is the memory mapped address for the line printer. When it is available on the address bus and RD line is pulsed low, pin-5 of the 74LS155 goes low enabling the Tri-State Buffer 74LS367. This places the binary bits 0011 or 3H on data

lines D4-D7. The printer status routine within the ROM is looking for this combination to determine that the printer is ready for a character. The four bits are associated to the logic within the TRS-80 line printer. This interface only requires the use of one bit to indicate the printer is busy with an output.

If the WR is pulsed low when the address is decoded, pin-11 of the 74LS155 goes low taking pin-25 (TBRL) low on the UART. This loads the character on the data lines into the UART's internal buffer. Then, it is transferred to the transmit register for output as serial data on pin-25 (TRO).

The Intersil IM6402 UART that I used has two signals which indicate this activity.

Pin-22 (TRBE) goes low when the buffer is being loaded. Pin-24 (TRE) goes low for the duration of the output of the character on Pin-25 (TRO).

These two signals are ANDed together by the 74LS03. Its output is used to indicate "busy" status to the TRS-80. See Fig. 1 for the timing diagram.

The UART's reset is tied to the TRS-80 system reset line so that when you hit the reset button on your TRS-80, the UART will also be reset and will clear its internal registers.

The NE555 timer chip is used to provide the necessary clock input to the UART. The clock rate is 16 x, therefore, an input frequency of 1.76 KHz will provide serial output of 110 Baud. The adjustment can be made with a frequency meter on pin-3 of the timer, if you have one, or can be adjusted using the tele-

type itself as follows: input the following basic program and enter run.

```
10 LPRINT "This is a test"
20 GOTO 10
```

This provides a continuous output to the teletype. Adjust the 50K potentiometer until the teletype begins to type the line correctly. Continue to turn the potentiometer until the teletype stops printing the message correctly. Noting the number of turns between these two points, readjust the potentiometer to a point midway. This should then provide the proper Baud rate.

The output at Pin-25 (TRO) is input to a gate of the 74LS04 which is used as a buffer for the 20MA current loop circuit. The two points marked + and - should be tied to the printer

magnets in your Model 33 teletype using its instruction manual for the proper connections.

## Hardware

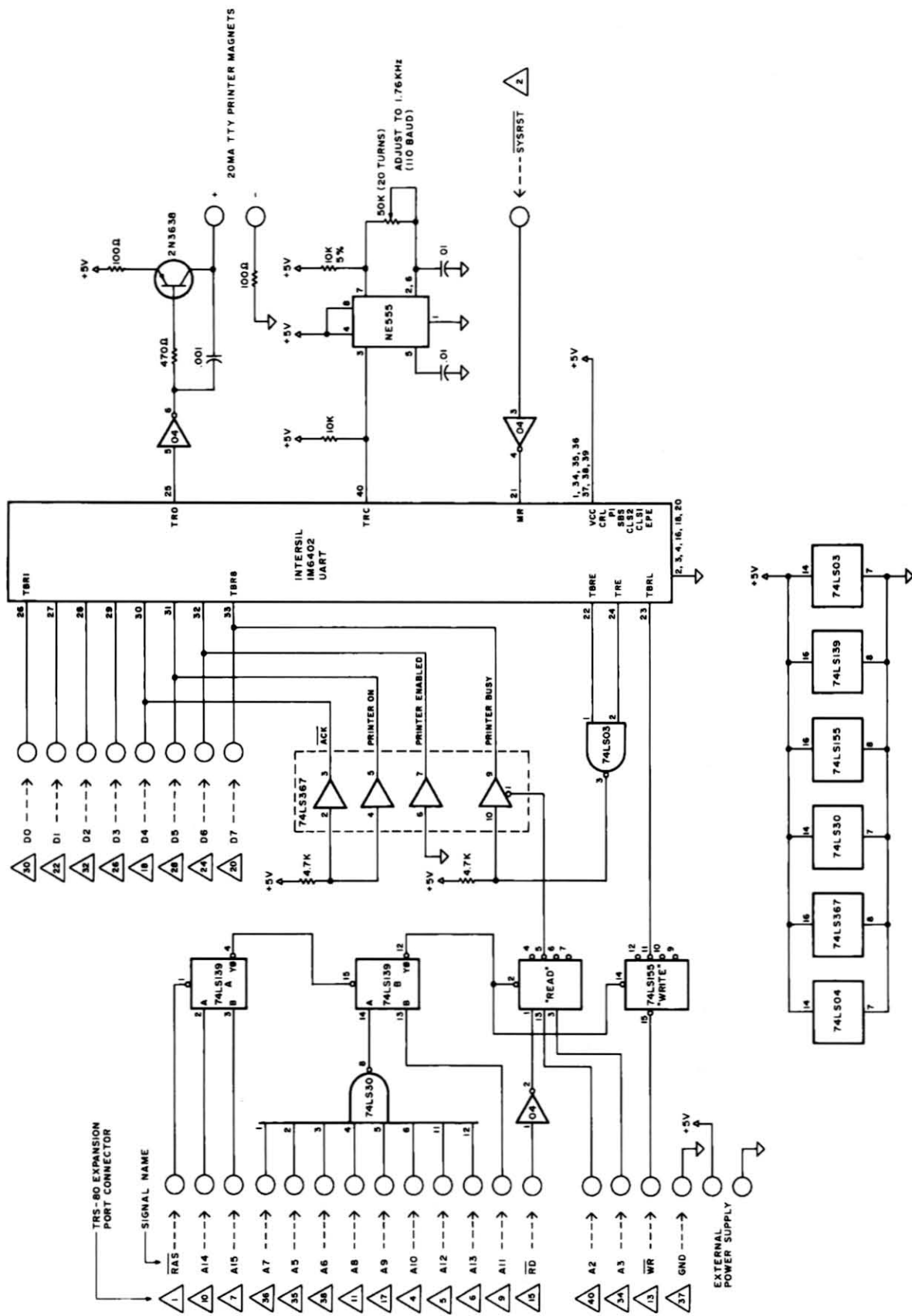
I built my interface on a general purpose wirewrap card with a 44-pin card edge connector using sockets for all ICs. The ribbon cable was soldered to a 44-pin card edge connector as were the connections for the teletype and external +5V power supply.

The only caution with this interface is the IM6402 UART which is a CMOS device and requires the normal grounding for static when handling. Also, remember not to insert or remove this device with the power turned on.

The parts can be purchased

Quantity	Description
1	UART—Intersil IM6402
1	74LS139 2-line to 4-line decoder
1	74LS155 2-line to 4-line decoder
1	74LS04 Hex Inverter
1	74LS03 2-input nand-open col.
1	74LS30 8-input nand gate
1	74LS367 Tri-state buffer
1	NE555 Timer
1	2N3638 PNP transistor
2	4.7K 1/4W Carb. Comp. Resistor
2	100 ohm 1/4W Carb. Comp. Resistor
1	470 ohm 1/4W Carb. Comp. Resistor
1	10K 1/4W Carb. Comp. Resistor
1	10K 5% 1/4 Carb. Comp. Resistor
1	50K 20-turn P.C. Board Pot
2	.01 uF Mylar caps
1	.001 uF Mylar caps
	<b>Misc.</b>
1	40-Pin IC socket
3	16-Pin IC socket
3	14-Pin IC socket
1	8-Pin IC socket
1	General purpose 4.5 in. P.C. Board w/44-Pin card edge connector
1	44-Pin card edge connector
A/R	.1 uF Bypass caps (for I.C.s)
1	40-Pin ribbon cable w/connector
1	+5V 1 amp Power Supply

Parts list.



TRS-80 Teletype Interface.



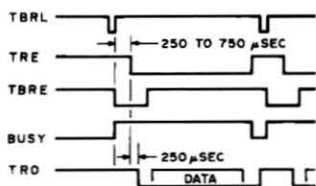


Fig. 1. UART timing diagram.

from most of the suppliers who advertise in *80-Microcomputing*. All parts, except the UART and the ribbon cable can also be purchased from any Radio Shack store. A three-foot ribbon cable with 40-Pin card edge connector can be purchased from Electronic Systems, San Jose CA, part number 3CAB40 and the IM6402 UART from Advanced Computer Products, Irvine CA.

Any +5V DC power source can be used or a small one can be built. Don't attempt to borrow +5V from your computer because with the Level II modification and 16K RAM the power output is running close to maximum.

#### Software

The assembly language program is shown in Fig. 2. The initialization routine loads the new line printer pointer into location 4026H and 4027H as well as

```

7F62 267F    LD    7F62H    ;32610 DECIMAL
7F64 2E6F    LD    H,7FH
7F66 222640  LD    (4026H),HL ;NEW LINE PRINTER POINTER ADDRESS
7F69 3E39    LD    A,39H    ;56 LINES/PAGE
7F6B 322840  LD    (4028H),A ;REENTER BASIC WITH "SYNTAX ERROR"
7F6E CA0040  JP    4000H    ;DISPLAYED ON SCREEN

7F6F 79      LD    A,C
7F70 B7      OR    A
7F71 CAD105  JP    05D1H    ;PRINTER STATUS ROUTINE IN ROM
7F74 F5      PUSH AF
7F75 CDD105  CALL 05D1H
7F78 20FB   JR    NZ,S-3  ;LOOP UNTIL PRINTER IS READY
7F7A F1      POP  AF
7F7B 32E837 LD    (37E8H),A ;OUTPUT THE CHARACTER
7F7E FE0D   CP    0DH     ;IS IT A "CR"?
7F80 C0      RET  NZ
7F81 CDD105  CALL 05D1H    ;YES, WAIT UNTIL PRINTER IS READY
7F84 20FB   JR    NZ,S-3
7F86 3E8A   LD    A,0AH   ;ASCII LINE FEED
7F88 32E837 LD    (37E8H),A ;OUTPUT A "LF"
7F8B DD3404  INC  (IX+04)  ;INCREMENT LINE COUNTER
7F8E DD7E04  LD    A,(IX+04H)
7F91 DDBE03  CP    (IX+03H) ;COMPARE TO LINES/PAGE (56)
7F94 79      LD    A,C
7F95 C0      RET  NZ
7F96 DD360400 LD (IX+04H),00H ;IF NOT 56 LINES CONTINUE
7F9A 0609   LD    B,09H   ;ZERO THE LINE COUNTER
7F9C CDD105  CALL 05D1H    ;LOOP COUNT FOR 9 LINE FEEDS
7F9F 20FB   JR    NZ,S-3
7FA1 3E8A   LD    A,0AH   ;OUTPUT "LF"
7FA3 32E837 LD    (37E8H),A ;LOOP UNTIL (9) LF'S ARE OUTPUT
7FA6 10F4   DJNZ 7F9CH
7FA8 C9      RET

```

Fig. 2. Assembly language program to interface a teletype to a TRS-80 16K, Level II.

changes the lines per page to 56. The routine checks for printer status (call 05D1H) and outputs the character when ready. It checks each character for a

carriage return (0DH) and if it is found, outputs a line feed (0AH). It then increments the lines/page counter, compares it to the line/page number (39H) and if 56

lines have been printed, zeros the line counter and outputs nine line feeds. This extra line feed activity creates a typed page consisting of a top margin of nine spaces, and 56 lines of type for a sheet length of 11.0 inches. I have also included the routine in BASIC for those who do not have either "TBUG" or the "EDITOR/ASSEMBLER" to enter this program. See Fig. 3.

After turning on the CPU answer the memory size question with "/32610." This protects the interface program from any BASIC program you enter. Enter the interface program, using either BASIC or assembly language. Enter the "System" command and answer the prompt with "/32610". The display will return a "SN ERROR" and a READY> prompt.

This is because of the JP 4000H in the initialization routine. (I have not as yet found the entry point in ROM which returns a "ready" without re-initializing the various pointers in RAM.) The program is now ready and use of LPRINT and LLIST provides a line feed after each carriage return. ■

```

10 REM * Teletype Interface - 16K TRS-80 Level II*
20 REM * P.E. Noeth, San Jose, CA. May, 1979*
30 REM * Answer Memory Size? -- 32610*
40 REM * Run this Program - Enter System Command*
50 REM * Answer Prompt with /32610*
70 For I = 32610 to 32680
80 Read D
90 Poke I, D
100 Next I
110 End
120 Data 38, 127, 46, 111, 34, 38, 64, 62, 57, 50, 40, 118, 121, 183
130 Data 202, 209, 05, 245, 205, 209, 05, 32, 251, 241, 50, 232, 55
140 Data 254, 13, 192, 205, 209, 05, 32, 251, 62, 10, 50, 232, 55
150 Data 221, 52, 04, 221, 126, 04, 221, 190, 03, 121, 192, 221
160 Data 54, 04, 0, 06, 09, 205, 209, 05, 32, 251, 62, 10
170 Data 50, 232, 55, 16, 244, 201

```

Fig. 3. BASIC program to interface a teletype to a TRS-80.

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## Treat assembly language tapes like BASIC with this interesting technique.

# CLOAD Assembly Language

Alfred S. Baker, II  
2327 S. Westminster St.  
Wheaton, IL 60187

Have you used the Radio Shack T-BUG program, In Memory Information program or Editor/Assembler? If you have, then you are probably wondering how these programs steal the computer away from Level I BASIC. You type CLOAD, load the tape, and then the unexpected happens. Instead of getting the READY message, you are suddenly running the program on the tape. What happened to BASIC? Where did it go? How did Radio Shack do that?

I had to find out. Beyond simple curiosity, I needed to do it myself. In this article you will see the detection process I used to discover how Radio Shack uses the CLOAD command to load assembly language programs. I also provide a section of program code that will help you do the same thing with your assembly language programs.

### Why Bother?

There are two ways to load an assembly language tape on a Level I TRS-80. The way Radio Shack tells you to do it is crazy. First, set the tape volume for Level I tapes and CLOAD the Editor/Assembler System tape. Next, change the volume to handle Level II tapes, type in the name of the assembly program's object file, and load that tape. And now comes the good part. The program should now

be in the machine, but you still have to run it. To do this, type a slash (/) followed by the memory address of the program... in decimal, no less!

I had written a simple assembly language game for my two-year-old to play. My wife knows nothing about computers. Can you imagine me explaining this to her? Can you imagine the look she'd give me if I tried? You can also imagine how often she would do it. I'll pass her most likely comment on to Radio Shack: "You've got to be kidding!"

Fortunately, there is another way of doing it. The Editor/Assembler System tape, as well as the other programs I mentioned above, are all written in assembly language. They are all loaded with the CLOAD command. Unfortunately, how this is done is not documented. If my son was to enjoy the "benefits" of a computer-assisted education, then I had to figure it out.

The first step was to go to my friendly Radio Shack store and buy the T-BUG program. This useful little product lets the user look around in memory and, in general, find out what is going on. If you plan to write very many assembly programs, I recommend that you get it.

If I was going to figure out how to successfully abuse the CLOAD command, I needed an hypothesis.

The one I developed was based on the way I write large programs for Z-80-type computers. I assumed that the CLOAD routine gets control from the statement-reading routine via

standard Z-80 CALL-RET Logic.

The statement routine reads the word CLOAD from the keyboard and does a CALL to the CLOAD routine. The CALL instruction in the Z-80 places the address of the next instruction in the statement-reading routine on the stack.

When the CLOAD routine has finished reading in a tape file, it issues a RET instruction. This instruction takes the top address off the stack and branches to it. This takes the computer back to the statement-reading routine.

Suppose the program being CLOADed replaces the address on the stack with its own address? Once the CLOAD routine is done it will pick up this new address and return to it. Voila! The CLOADed program has taken control of the computer away from BASIC!

There were two problems

though. I didn't know where BASIC kept its stack, and even if I did, I still didn't know where on the stack the CALL instruction would place the return address from the CLOAD routine. If I was going to replace it, I had to know where it was.

First I had to find the stack. This turned out to be simple. At the back of the Editor/Assembler manual is a list of the addresses for important routines. One of the addresses, 01C9H, is the entry point for Level I BASIC. I loaded T-BUG and, using its MEMORY command, looked at the routine beginning at 01C9H. One of the first things BASIC would have to do would be to set up the location of its stack. The first three bytes at this location were 310042. Paydirt!

If you know your Z-80 machine language (or have a reference book), you'll recognize these three bytes as the in-

```

; REPLACE THE CORRECT STACK LOCATION.
41FE 00100  ORG 41FEH
41FE 0042  00200  TESTAD DEFV TEST
; SET UP THE LOOP VALUES:
; HL->TV SCREEN
; A= THE LOWEST CHARACTER VALUE
0000 00300  TEST DEFS 0
4200 21003C 00400  LD HL,3000H ; TV
4203 97 00500  SUB A
; NOW FOR THE LOOP. EACH SUCCESSIVE
; CHARACTER IS PLACED IN EACH
; SUCCESSIVE SCREEN POSITION UNTIL WE
; ARE BACK TO CHARACTER 00.
0000 00600  LOOP1 DEFS 0
4204 77 00700  LD (HL),A
4205 23 00800  INC HL
4206 3C 00900  INC A
4207 20FB 01000  JR NZ,LOOP1
; THE PROGRAM IS DONE. PROVE IT BY
; LOOPING FOREVER.
0000 01100  LOOP2 DEFS 0
4209 18FE 01200  JR LOOP2
0000 01300  END

```

Fig. 1. Testing the CLOAD hypothesis.



```

; DEFINE THE PROGRAM START AND OTHER
; IMPORTANT SYSTEM ADDRESSES.
4400 00100 00000 4400H
0000 00200 BEGIN DEFS 0
0F09 00300 CASON EQU 0F09H
0F4B 00400 CASOUT EQU 0F4BH
0EF4 00500 CASIN EQU 0EF4H
01C9 00600 BASIC EQU 01C9H
4200 00700 BSTACK EQU 4200H
; SET UP THE TWO ENTRY POINTS. THE
; FIRST IS USED TO RUN THE PROGRAM FROM
; TBUG. THE SECOND IS USED TO CREATE A
; CLOADABLE TAPE.
4400 C35044 00600 JP RUN
4403 C31144 00900 JP CREATE
; THE LOAD ROUTINE IS READ IN BY THE
; CLOAD COMMAND BEGINNING WITH THE
; INSTRUCTION LABELED LOADAD. ONCE
; LOADED, IT GETS CONTROL AND LOADS IN
; THE REST OF THE PROGRAM AND EXECUTES
; IT.
4406 0042 01000 LOADAD DEFW BSTACK
0006 01100 LOAD DEFS 0
4408 CDE90F 01200 CALL CASON
440E CDF40E 01300 CALL CASIN
440E C35044 01400 JP RUN
0006 01500 LOAD100 EQU $-LOADAD
; THE CREATE ROUTINE DOES ALL THE SETUP
; WORK. IT MOVES THE LOAD ROUTINE DOWN
; TO LOCATION 41FEH AND THEN CREATES
; THE CLOADABLE TAPE FOUR TIMES FOR
; SAFETY. EACH OF THE FOUR SETS CON-
; SISTS OF TWO FILES: THE LOAD ROUTINE
; AT 41FEH AND THE ENTIRE PROGRAM AT
; 4400H
;
; FIRST, THE LOAD ROUTINE IS MOVED:
0000 01600 CREATE DEFS 0
4411 318444 01700 LD SP,ENDIT+32
4414 210644 01800 LD HL,LOADAD
4417 11FE41 01900 LD DE,BSTACK-2
441A 010B00 02000 LD BC,LOAD100
441D ED00 02100 LD1R
; NOW SET UP FOR FOUR COPIES.
441F 0604 02200 LD B,4
0006 02300 CRE100 DEFS 0
4421 C5 02400 PUSH BC
; WRITE THE FIRST FILE: THE LOADER.
4422 CDE90F 02500 CALL CASON
4425 21FE41 02600 LD HL,BSTACK-2
4428 210942 02700 LD DE,BSTACK-2+
; LOAD100
442B C0480F 02800 CALL CASOUT
; NOW WAIT A BIT
442E 210000 02900 LD HL,0
0006 03000 CRE150 DEFS 0
4431 23 03100 INC HL
4432 7C 03200 LD A,H
4433 85 03300 OR L
4434 20FB 03400 JR NZ,CRE150
; OUTPUT THE REAL THING: THE PROGRAM
4436 CDE90F 03500 CALL CASON
4439 210944 03600 LD HL,BEGIN
443C 115044 03700 LD DE,ENDIT
443F C0480F 03800 CALL CASOUT
; WAIT A BIT AGAIN
4442 210000 03900 LD HL,0
0006 04000 CRE200 DEFS 0
4445 23 04100 INC HL
4446 7C 04200 LD A,H
4447 85 04300 OR L
4448 20FB 04400 JR NZ,CRE200
; THE BOTTOM SIDE OF THE 4 TIMES LOOP
444A C1 04500 POP BC
444B 1804 04600 DJNZ CRE100
444D C3C901 04700 JP BASIC
; THIS IS THE PROGRAM START LOCATION:
0006 04800 RUN DEFS 0
;
; PLACE THE PROGRAM TO BE
; CLOAD HERE.
;
;
0006 04900 ENDIT DEFS 0
0006 05000 END

```

Listing 1. The instructions needed to prepare an assembly language program for loading with the CLOAD command.

struction "LD SP,4200H." SP is the stack register and 4200H is where the BASIC stack is located. One down and one to go.

Now I had to find out which address on the stack I had to replace. Again, a little thought presented me with an easy answer. I had just loaded T-BUG, hadn't I? T-BUG is one of those enigmatic programs that already was doing what I was trying to do. If it didn't use the same stack and if it didn't cover its trail, then somewhere on the BASIC stack should be the starting address for T-BUG, 40B1H.

This address is provided in the Editor/Assembler documentation. I took a look at the addresses on the BASIC stack using the T-BUG memory command. Again success! The T-BUG starting address was sitting at location 41FEH, the first position on the BASIC stack.

#### Into the Lab

So far, I only thought I knew what was going on. Now I had to run an experiment. The test I decided on was quick, but it presented a slight gamble. I assumed that T-BUG didn't use the 13 bytes between memory locations 41FEH and 420AH. Using the memory command, I hand loaded the machine language code for the program in Fig. 1. I then used the T-BUG

tape Punch command to put it on tape. I had a tape that *should* CLOAD on a Level I TRS-80.

Studying the program in Fig. 1 will tell you that it prints out the entire set of characters on the TV screen and then loops forever. I turned off the computer and then turned it back on. I wanted to make sure that the test wouldn't be fouled by anything left in memory.

Next, I CLOADed my test tape. It suddenly became difficult to read the screen. It was filled up with a large collection of characters. Not only that, but the keyboard wouldn't respond. The computer had gone into a loop. I had successfully CLOADed a home grown assembly language program.

#### Doing It Right

So much for the prototype. I needed a "production" version of this code. I needed a program or routine that could be used to create a CLOAD-able version of any assembly language program. Listing 1 contains the result. I place this piece code at the beginning of each of my assembly language programs. It divides the program into three logical components: CREATE, LOAD and RUN.

The easiest way to describe this program addition is to take

the three parts in reverse order. The RUN component is the original assembly language program unchanged. The only difference is that the line ENDIT DEFS 0 is added just before the END line.

The LOAD routine contains three statements. It turns on the cassette tape, reads in a file and then jumps to the RUN program. Which file does it read in? Oddly enough, it is reading in everything: the CREATE, LOAD and RUN programs. How can a program read itself in? This is handled by the first component of the program.

The CREATE routine performs the actual magic of this act. First, it copies the LOAD routine down to locations 41FEH to 4208H. The condition for CLOADING an assembly program has been met. The location on the stack that must be replaced, 41FEH, now points to 4200H. Location 4200H now contains a routine that will load a tape file containing the RUN routine and jump to it.

Now that the conditions have been set up, a tape must be prepared. The tape is written out four times. I never trust data on tape just once. The repeated section of code generates two tape files separated by a time delay loop. The first file is the LOAD routine beginning at location 41FEH. The

second file is the complete program. We now have a tape of an assembly language program that can be loaded with the CLOAD command.

Why didn't I let the entire program begin at location 41FEH instead of moving a load routine down to that location? I had two reasons. I use T-BUG, which sits in locations 4000H to 43FFH. Also, when I flip between my program and BASIC, BASIC destroys the contents of 41FEH. That is where its stack is, remember?

#### Conclusion

What have we learned? First, even with a computer with poor or missing system documentation, such as the TRS-80, it is still possible to learn a lot about the behind-the-scenes software. All that is needed is a little careful thought and some diligent experimentation. You must also have at least a few simple tools to work with, but without the former, they are nearly useless.

Finally, we now have a simple method for loading TRS-80 assembly language programs. A process that Radio Shack made too complicated can now be done by my six-year-old daughter. As for two-year-old Nathan, his mother is having a ball teaching him on "her" computer. ■

Use your disks to store questions and answers.

# Quiz Master

Richard R. Eckert  
Colegio De Ciencias  
Universidad Catolica  
de Puerto Rico  
Ponce, PR 00731

Because of the microcomputer revolution presently occurring, it is feasible for individual departments of universities or colleges to purchase sophisticated computing equipment that can be used in a myriad of different applications.

One such application creates question and answer files for exams and quizzes. Such a technique is used by the Physics and Chemistry Departments of the

Catholic University of Puerto Rico in multi-section introductory courses.

The university recently purchased a Radio Shack TRS-80 microcomputer with expansion interface, dual mini-floppies and a friction feed line printer. The total cost was slightly more than \$3000.

Two computer programs written in TRS-80 Disk BASIC form the heart of our exam-creation technique. The first program (Listing 1) permits a professor or secretary to add questions to a file on a mini-diskette. The second program (Listing 2) is used to prepare a quiz with questions selected from a given file either at random or by the professor.

Once the questions have

been selected, they are printed out on a ditto master on the line printer. The professor can then run off as many copies of his quiz as he desires.

## File Creation

The first program reserves string space for all of the string variables used in the program, including 255 bytes for the characters used in a question. This number was determined by our decision to use just one physical record (255 bytes) for each question.

In practice our courses are divided into chapter-size units with common objectives. We create one file for each unit, which usually means some 50 to 100 questions. Since the capaci-

ty of a Radio Shack formatted data diskette is 85,760 bytes, we can place up to 335 questions on one disk. This means some three to six course units per disk, and, depending on the course, some four to eight diskettes for all of the questions in a course. (Since our project has just begun, we have actually created only four question files on one diskette.)

After clearing string space, the first program gives the user instructions. First, he is told to place the correct diskette in position and then asked the name of the file (course unit) to which he is going to add questions. The variable used for this name is Y\$. The program requests the number of the last

Program Listing 1.

```
10 REM <THIS PROGRAM WAS WRITTEN BY RICHARD R. ECKERT>
20 REM <BOX 145, STATION 6, PONCE, PUERTO RICO 00731>
30 REM <ITS PURPOSE IS TO STORE QUIZ QUESTIONS IN A DISKETTE FILE>
40 CLS
50 CLEAR1000
60 PRINT
70 PRINT"PUT THE CORRECT DISKETTE IN DISK DRIVE # 1"
80 PRINT"TELL ME THE NAME OF THE QUESTION FILE YOU WISH TO USE"
90 INPUT$
95 Y$=Y$+" :1"
100 PRINT"WHAT IS THE NUMBER OF THE LAST QUESTION FILED"
110 INPUT
120 PRINT"HOW MANY QUESTIONS DO YOU WANT TO FILE NOW";
130 INPUT
140 PRINT
150 PRINT"WHEN YOU ARE ENTERING A QUESTION, DO NOT USE THE <ENTER>"
160 PRINT"KEY UNTIL YOU HAVE FINISHED IT. IF YOU COME TO THE END"
170 PRINT"OF A LINE BEFORE THE END OF THE QUESTION, USE THE DOWN ARROW"
180 PRINT"IN ORDER TO CONTINUE ON THE NEXT LINE. WHEN YOU HAVE FIN-"
190 PRINT"A QUESTION, HIT <ENTER>, AND THE COMPUTER WILL ECHO BACK EX-"
200 PRINT"ACTLY WHAT IT HAS RECEIVED. YOU WILL THEN HAVE THE CHANCE"
```

```
210 PRINT"TO ENTER THE QUESTION AGAIN IF THERE ARE ERRORS."
220 PRINT
230 PRINT"WHEN YOU SEE THE SIGN ==>, BEGIN TO ENTER A QUESTION."
240 PRINT"HERE WE GO."
250 PRINT
260 FORI=1TOM
270 PRINT"QUESTION #";I+N
280 PRINT"==>";
290 LINEINPUTA$
300 CLS
310 PRINTA$
320 PRINT
330 PRINT"ARE THERE ANY ERRORS (YES OR NO)";
340 INPUTC$
350 IF C$="YES" THEN 270
360 PRINT
370 PRINT"NOW WE'LL FILE THE QUESTION"
379 REM <OPEN THE FILE AS A RANDOM ACCESS FILE USING BUFFER # 1>
380 OPEN"R",1,Y$
389 REM <FIELD THE BUFFER---HERE WE MAKE ALL 255 BYTES AVAILABLE FOR THE QUESTION>
390 FIELD1,255 AS D$
399 REM <PLACE THE QUESTION IN THE BUFFER>
400 LSETD$=A$
409 REM <PUT THE CONTENTS OF THE BUFFER INTO RECORD NUMBER I+N OF THE FILE>
410 PUT1,I+N
420 CLOSE
430 NEXT
```

question filed (N); if it is a new unit he should answer with a zero. The next few print statements describe the way in which the user should enter questions.

The important point here is that when the user comes to the end of a line, but not the end of the question, he should use the down arrow instead of the ENTER key. This is necessary since the LINEINPUT instruction (used later in the program) terminates the input of a string when it receives an ENTER (ASCII code 10 or 13). The down arrow (ASCII code 26) causes the computer to jump to the next line without terminating the input of the string.

After the program finishes giving the user instructions, the loop beginning at line 260 asks for a question, receives it in the variable A\$ through the LINEINPUT instruction (line 290), prints the question as received and asks if there are errors or not (lines 300 to 330). If so, the user must enter the question again. If not, lines 370 to 420 file the question A\$ in the appropriate record (I + N) of the appropriate file Y\$. The file is then closed, and the loop repeats.

### Selecting Questions

The second program selects questions from a file and prints them on a ditto master in the line printer. The user must insert the correct diskette, give the computer the name of the question file desired (Y\$), the total number of questions in the file (N), the number of questions to

be selected for the quiz (M), and whether they are to be chosen at random or by the user.

If they are to be selected at random, the computer will make the selection without duplications (lines 260 to 320), print out the numbers chosen, and ask whether they are satisfactory (lines 330 to 370). If not, it will choose another random group. If the user wishes to choose his own questions, the computer will request the numbers desired (lines 210 to 240).

The program finally instructs the user to place a blank ditto master in the line printer, and, when everything is ready, proceeds to get the selected questions from the file and prints out the quiz (lines 410 to 520).

### General Comments

Although we are just starting to use the exam-creation technique it seems especially helpful to those instructors who have many sections of the same course and wish to give frequent quizzes without duplicating questions.

Also in small departments which do not have a full-time secretary (such as in our Physics Department), the technique can be of enormous value, as countless hours of typing time are saved.

In the near future we hope to modify the technique so that the question files can be created on cassette tape using a simple TRS-80 Level II BASIC system. Entering these questions is really time-consuming! ■

### Program Listing 2.

```

10 REM <THIS PROGRAM WAS WRITTEN BY RICHARD R. ECKERT>
20 REM <ITS PURPOSE IS TO SELECT QUESTIONS FROM A DISK
   ETTE FILE AND>
30 REM <TO PRINT THEM ON A DITTO MASTER IN THE LINE PR
   INTER.>
40 PRINT
50 DIM Z(20)
60 CLS
70 CLEAR1000
80 PRINT"PLACE THE CORRECT DISKETTE IN DISK DRIVE # 1."
90 PRINT"TELL ME THE NAME OF THE QUESTION FILE YOU WISH
   TO USE."
100 INPUT Y$
110 PRINT"WHAT IS THE NUMBER OF QUESTIONS IN THE FILE";
120 INPUT N
130 PRINT"HOW MANY QUESTIONS DO YOU WANT IN YOUR QUIZ";
140 INPUT M
150 PRINT
160 PRINT"NOW WE'LL SELECT THE QUESTIONS---IF YOU WANT
   THEM AT RANDOM,"
170 PRINT"ANSWER WITH AN 'R'"
180 PRINT"IF YOU WANT TO SELECT THEM YOURSELF, USE ANY
   OTHER KEY."
190 INPUT C$
200 IF C$="R" THEN 260

```

```

210 PRINT"ENTER THE NUMBERS OF THE QUESTIONS YOU DESIRE
   ---ONE BY ONE"
220 FOR J=1 TO M
230 INPUT Z(J)
240 NEXT J
250 GOTO 400
259 REM <THE FOLLOWING ROUTINE SELECTS THE QUESTIONS A
   T RANDOM>
260 FOR J=1 TO M
270 Z(J)=RND(N)
280 IF Z(J)=0 THEN 320
290 FOR L=1 TO J-1
300 IF Z(L)=Z(J) THEN 270
310 NEXT L
320 NEXT J
330 PRINT"THE QUESTIONS CHOSEN WERE:"
340 FOR J=1 TO M
350 PRINT Z(J)
360 NEXT J
370 PRINT"IS THE SELECTION SATISFACTORY (YES OR NO)";
380 INPUT S$
390 IF S$="NO" THEN PRINT"WE'LL TRY AGAIN":GOTO 260
400 PRINT
410 PRINT"NOW WE'LL GET THE QUESTIONS FROM THE FILE AND
   PRINT THEM"
420 PRINT"ON A DITTO MASTER IN THE LINE PRINTER."
430 PRINT"PUT THE DITTO MASTER IN THE PRINTER AND TURN
   IT ON."
440 PRINT"WHEN YOU'RE READY HIT ANY KEY."
450 INPUT S$
459 REM <OPEN THE FILE AS A RANDOM ACCESS FILE USING B
   UFFER # 1>
460 OPEN "R",1,Y$
469 REM <FIELD THE BUFFER---ALL 255 BYTES FOR A QUESTI
   ON, AS IN THE FILING PROGRAM>
470 FIELD 1, 255 AS D$
479 REM <BEGIN LOOP TO GET AND PRINT THE QUESTIONS CHO
   SEN>
480 FOR J=1 TO M
489 REM <GET RECORD # Z(J) FROM THE FILE AND PLACE IT
   IN THE BUFFER>
490 GET 1,Z(J)
499 REM <PRINT OUT ON THE LINE PRINTER THE QUESTION SE
   LECTED>
500 LPRINT D$
510 NEXT J
520 CLOSE

```

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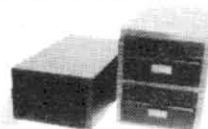
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  - file maintenance, pay data entry and verification
  - computation of pay and deduction amounts
  - printing of reports and checks
- ★ can handle salaried and hourly employees
- ★ employees can receive:
  - hourly or salary wage
  - vacation pay
  - holiday pay
  - piecework pay
  - overtime pay

(Continued on next page)

### CAPABILITIES

- ★ menu driven; easy to use; full screen prompting and cursor control
- ★ invoice oriented; everything revolves around the invoice; handles new invoice or credit memo or debit memo
- ★ invoice information recorded; invoice #, description, buyer, check register #, invoice date, age date, amount of invoice, discount (in %), freight, tax (\$), total payable
- ★ transaction print and file maintenance procedures insure accuracy
- ★ flexible check calculation procedure; allows checks to be calculated for a set of vendors - or - for specific vendors
- ★ program prints your checks; contiguous computer checks with your company letterhead can be purchased from SBSG
- ★ reports include (samples on back):
  - open item listing/closed item listing - both detail and summary
  - debit memo listing/credit memo listing
  - aging
  - check register report (to give an audit trail of checks printed)
  - vendor listing and vendor activity (activity of the whole year)
- ★ fully linked to GENERAL LEDGER; each invoice can be distributed to as many as five (5) different GL accounts; system automatically posts to cash and A/P accounts

### CAPABILITIES

- ★ menu driven; easy to use; full screen prompting and cursor control
- ★ invoice oriented; invoices can be entered before ready for billing, when ready for billing, after billing or after paid
- ★ allows entry of new invoice, credit memo, debit memo, or change/delete invoice
- ★ allows for progress payment
- ★ transaction information includes:
  - type of A/R transaction
  - customer P.O. #
  - description of P.O.
  - billing date
  - general ledger account number
  - invoice amount
  - shipping/transportation charges
  - tax charges
  - payment
  - progress payment information
  - transaction print and file maintenance procedures insure accuracy
- ★ customer statements printed; computer statements with your company letterhead can be purchased from SBSG
- ★ reports include; (samples on back)
  - listing of invoices not yet billed
  - open items (unpaid invoices)
  - closed items (paid invoices)
  - aging
- ★ fully linked to General Ledger; will post to applicable accounts: debits A/R, credits account you specify



**(PAYROLL CAPABILITIES CONTINUED)**

- ★ employees can be paid using any combination of pay types (except, hourly cannot receive salary & salary cannot receive hourly)
- ★ special non-taxable or taxable lump sums can be paid regularly or one time (bonus, reimbursements, etc)
- ★ health & welfare deductions can be automatically calculated for each employee
- ★ earnings-to-date are accumulated and added to permanent records; taxes are computed and deducted: US income tax, Social Security tax, state income tax, other deductions (regular or one time)
- ★ paychecks are printed; computer checks with your company letterhead can be purchased from SBSG
- ★ calculations are accumulated for: employee pay history, 941A report, W-2 report, insurance report, absentee report
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**CAPABILITIES**

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- ★ data is maintained and reported by:
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  - quarter
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  - previous three quarters
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## Fit an external fuse to your power supply.

# Fuse Fix

William P. Winter Jr.  
O'Higgins 3168  
1429 Buenos Aires  
Argentina

Having just purchased a TRS-80 keyboard/CPU, adding a TV monitor and cassette recorder, I had the system up and running, when—poof!—a fuse blew.

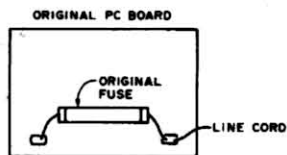


Fig. 1. Original PC Board.

Off went the TRS-80.

To get to the fuse I cut open the plastic power supply case (badly designed by Radio Shack). The fuse, soldered to the printed circuit board, has pigtailed. I soldered leads to a similar fuse and then turned on the TRS-80 again. (Radio Shack had incorrectly installed fast blow fuses, instead of the required slow blow, in a production run.)

Everything worked fine for a half hour or so and then off it went.

During the next few days the story repeated itself, and each time the fuse went, so did whatever program I was working on.

### Change Your Fuse

I knew the fuse was there to protect the expensive chips and that the TRS-80 designers prob-

ably wanted to keep inexperienced users from installing too heavy a fuse. However, it was also impractical to send the unit to a service center every half hour from Argentina.

If you have similar trouble you can remedy the situation by following these steps:

1. Remove the fuse and solder a jumper wire in its place.
2. Remove the line cord lead from the printed circuit board and insert an in-line fuse holder

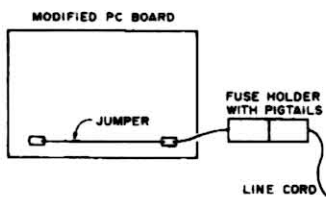


Fig. 2. Modified PC Board.

in series with the line cord lead just removed. Cut one lead of the fuse holder long enough to pass through the opening at the base of the supply and solder this lead to the hole previously occupied by the line cord lead.

You can now solder the other fuse holder lead to the line cord, or do as I did and solder the line cord directly to the contact inside the fuse holder. This requires more work but makes for a much neater job.

3. Replace the fuse with a slow blow fuse of the same current rating.

4. You can now glue the case back together. Use the special plastic cement available at toy and hobby shops.

Since performing this minor surgery, I haven't blown a single fuse. ■

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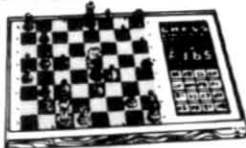
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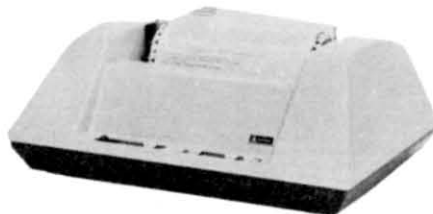


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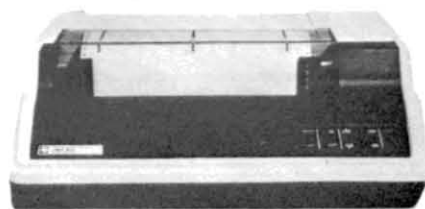
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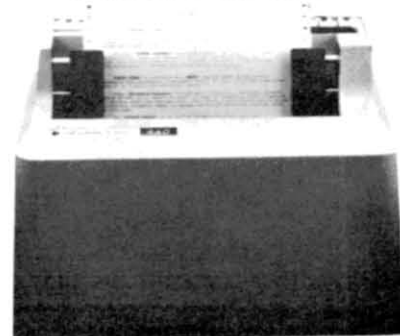


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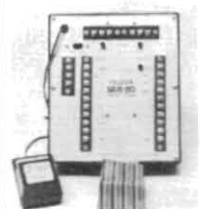
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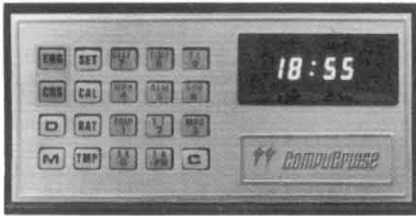
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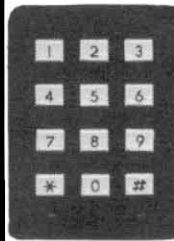
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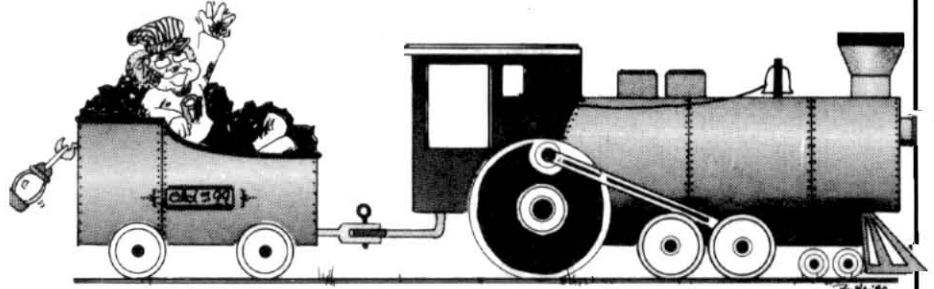
## DATA FILE MANAGEMENT

### THE BASIC SWITCHYARD

Your TRS-80, given the same set of instructions and data, will always arrive at the same conclusion. A railroad train, given the same track and switch settings, will always arrive at the same destination. Using this as an analogy, we investigate the way BASIC works and follow the interpreter through some programs. All aboard for BASIC, next month in 80.

If you're involved in one of the many home distributorships, or vending is your business, then this article is a must. With it you can save time and make money! The programs given are designed for use by Amway product distributors, but could be adapted for use by many other businesses.

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If you have any questions about the product, about Exatron, or ESFOA, please call the Hot Line. Address letters to ESFOA, 3559 Ryder St., Santa Clara, CA 95051.

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